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VOLUME III

MINERAL REVIEWS

INDIAN BUREAU OF MINES

Government of India
Ministry of Mines
Indian Bureau of Mines

INDIAN MINERALS YEARBOOK 2021

VOLUME - III
MINERAL REVIEWS

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ON WITH THE JOB

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PREFACE

Indian Minerals Yearbook–2021 (IMYB–2021) is the 60th Edition in its Series and comprises three Volumes. This book titled 'Mineral Reviews' is the third Volume and it contains 30 Reviews of important minerals produced in the country which are arranged in an alphabetical sequence. Each Review provides valuable insights on resource/reserve positions; production, stock & prices, mining, marketing & transport; usage & specifications; trade policy; world review; foreign trade; and future outlook of the minerals. The data coverage of this Edition, i.e., IMYB–2021 pertains to the year 2020-21.

This Edition of IMYB, i.e., IMYB–2021, in departure from the earlier editions and in consequence of the notifications of the Government of India declaring 31 major minerals as minor minerals, has a single consolidated chapter dedicated to Minor Minerals which includes 22 sub-chapters on various minor minerals produced in the country. Many minerals which hitherto were covered as individual Mineral Review after the realignment of chapters have been consolidated into a single Review on Minor Minerals.

Be that as it may, attempts nevertheless have been made to comprehensively cover the various minerals explored and extracted in India at the micro-level with inclusions of all recent updates. It has been our continuous endeavour to improve upon the coverage of the Yearbook and to present a complete perspective of all domains that have relevance to minerals and metals to the fullest extent possible.

This Yearbook is the outcome of the joint efforts of the Bureau's Mineral Economics Division and Mining & Mineral Statistics Division. While preparing this Volume, relevant inputs have been drawn from the reports of various Divisions of IBM. Various survey reports/annual reports, technical journals, periodicals of various organisations, including the affirmative responses received from the Mineral Industry on statutory and nonstatutory basis, have also been referred and information from related websites too were resourced and incorporated wherever necessary, during the compilation & formulation of this Volume.

The Bureau is indebted to Central and State Government Departments, Public Sector Undertakings, Public and Private Companies and Research Organisations, Mineral-Based Industries & Associations concerned with mines, minerals and mineral-based industries for their support & cooperation in lending and sharing information. It is firmly believed that this Edition of Indian Minerals Yearbook, i.e., IMYB–2021 is in the lines of its predecessors and will serve the interest of all its referring/reading clientele who in the past have reposed such unshakable faith in the authenticity of the data/information published in the Series.

Nagpur
December, 2023

(Sanjay Lohiya)
IAS
Additional Secretary &
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Indian Bureau of Mines

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MINERAL REVIEWS

EXPLANATORY NOTES AND SOURCES

The statistics presented in this publication are in metric units and the prices quoted are in the Indian currency unless otherwise stated.

The stage of measurement of quantity is normally the mine output which refers to the form in which the minerals are extracted. It also includes the usual processing operations done at the mine site to render the ore marketable. Exceptions to the above definition are gold and silver for which the metal output is considered, and for copper, lead & zinc, the concentrates.

The value of the mineral is reckoned in terms of the Ex-Mine Price which represents the sale value of the mineral at the mine site. The value of production of minerals is calculated by multiplying in each case the quantity of production and pit's mouth value per unit as furnished by the mine owners in the returns under MCDR 1988 in all cases except captive mines where the value is calculated on the basis of the cost of production. In case of fuel minerals, the production value figures in respect of coal & lignite are supplied by the Office of the Coal

Controller, Kolkata, on annual basis. Regarding petroleum and natural gas (utilised), value published by the National Accounts Division, Central Statistical Office, is used. Value of sulphur produced as by-product from fertilizer plants and oil refineries is not included in the value of mineral production. The value of non-ferrous metals is furnished by the respective units. The export valuation is on the basis of free on board (f.o.b.) inclusive of export duty, wherever such duty is levied. The basis of valuation of imports is the cost, insurance and freight (c.i.f.) value.

Break-ups may not add to total in some tables due to rounding-off.

Sources

The statistical data presented in this publication have been taken from a large number of sources as listed below:

Minerals other than fuels,

atomic minerals and

'minor minerals'

The basic data relating to major minerals except coal, petroleum and natural gas are collected by IBM under Rule 45 of the MCDR, 1988 framed under the Mines and Minerals (Development and Regulation) Act, 1957. These Rules cover all the States and Union Territories of the Indian Union and apply to all minerals except i) petroleum and natural gas, ii) coal, lignite and sand for stowing, iii) minor minerals, and iv) any mineral declared as prescribed substance by Atomic Energy Act, 1962. Data on sulphur are collected from fertilizer plants and oil refineries.

Ilmenite, rutile, monazite, rare earths and zircon

Indian Rare Earths Ltd; Kerala Minerals and Metals Ltd; Department of Atomic Energy, Mumbai, and Private Sector producers and processors.

Fossil fuel

a) Coal and lignite

b) Crude oil and natural gas

Coal Controller, Kolkata and the Coal Directory of India.

i) Economics and Statistics Division of the Ministry of Petroleum & Natural Gas, Government of India, New Delhi, and

ii) Indian Petroleum & Natural Gas Statistics, Ministry of Petroleum & Natural Gas, Government of India.

iii) Basic Statistics on Petroleum & Natural Gas, Ministry of Petroleum & Natural Gas, Government of India.

iv) National Accounts Division, Central Statistical Office, Ministry of Statistics and Programme Implementation, Government of India.

Minor minerals

Respective State Governments. 'Minor minerals' are defined in Clause (e) of Section 3 of the Mines and Minerals (Development and Regulation) Act, 1957. The current list of 'minor minerals' includes minerals, such as, building stones, gravel, ordinary earth, ordinary clay, ordinary sand other than sand used for prescribed purposes (i.e. used for other than refractory, ceramics, metallurgical, stowing in coal mines and optical purposes, and in manufacture of silvicrete cement, sodium silicate, pottery and glass), boulder, shingle, chalcedony or impure quartz pebbles (used for ball mill purposes or filling for boreholes or for decorative purposes in buildings), limeshell, kankar, and limestone used in kilns for manufacture of lime used as building material, murrum, brick earth, fuller's earth, bentonite, road metal, rehmatti, slate and shale used for building material, stones used for household utensils, marble, quartzite and sandstone when used for purpose of building or for making road metals and household utensils and saltpetre. In addition to the minerals already declared, 31 more minerals have been declared minor minerals vide Notification S.O 423(E), dated 10th February, 2015, namely, (i) Agate, (ii) Ball Clay, (iii) Barytes, (iv) Calcareous Sand, (v) Calcite, (vi) Chalk, (vii) China clay, (viii) Clay (Others), (ix) Corundum, (x) Diaspore, (xi) Dolomite, (xii) Dunite or Pyroxenite, (xiii) Felsite, (xiv) Felspar, (xv) Fireclay, (xvi) Fuschite Quartzite, (xvii) Gypsum, (xviii) Jasper, (xix) Kaolin, (xx) Laterite, (xxi) Limekankar, (xxii) Mica, (xxiii) Ochre, (xxiv) Pyrophyllite, (xxv) Quartz, (xxvi) Quartzite, (xxvii) Sand (Others), (xxviii) Shale, (xxix) Silica Sand, (xxx) Slate and (xxxi) Steatite or Talc or Soapstone.

Trade statistics

Monthly Statistics of the Foreign Trade of India, issued by the DGCI&S, Kolkata

Prices

a) Minerals	i)	Principal producers and exporters
	ii)	Coal Controller, Kolkata
	iii)	Industrial Minerals (UK)
	iv)	Basic Statistics on Indian Petroleum & Natural Gas, Ministry of Petroleum & Natural Gas, Government of India.
	v)	DGCI&S, Kolkata (Import Value)
b) Metals	i)	Producers and exporters
	ii)	Reserve Bank of India Bulletin
	iii)	World Metal Statistics (WBMS)
	iv)	London Metal Exchange (Website)
	v)	Minerals & Metals Review (Monthly/Yearly)
World information & statistics	i)	Mineral Commodity Summaries (USGS)
	ii)	World Mineral Production (BGS)
	iii)	Minerals Yearbook (USGS)
	iv)	World Metal Statistics (WBMS)
	v)	Mineral Industry Surveys (USGS)
	vi)	Canadian Minerals Yearbook
Minerals Consumption		Data obtained on statutory and non-statutory basis from industrial units consuming minerals/ores. Data have also been obtained in some cases from Central Government Ministries. The consumption indicated relates to the number of reporting units in the organised sector only. Estimated consumption data is based on statistical norms in vogue.

Reserves/Resources	Reserves/resources of minerals in India have been taken from National Mineral Inventory prepared by IBM as per UNFC system. The source of information for the world resources of minerals is given against each mineral.
Port facilities	Annual Report of the Ministry of Shipping, Indian Ports Association, Major and Minor Port Authorities and exporters of minerals.
Research and Development	IBM's Ore Processing Laboratory, National Laboratories under the Council of Scientific & Industrial Research, and Ore Dressing Division of BARC and R&D laboratories in the Public/Private Sector.

Besides, Annual Reports of various Ministries of Government of India, Annual Reports, Brochures and Websites of Public Sector undertakings and private companies, Bulletins concerned with minerals and mineral-based industries, etc. were also referred.

Information /data Liability Disclaimer

The reviews as presented in the Indian Minerals Yearbook are the product of the concerted efforts of in-house authors. In preparation of manuscripts, the authors resourced data/information from various sources, such as, published information on the internet, various publications, Annual reports etc. Major chunks of information have actually been collated internally from the different Divisions of Indian Bureau of Mines which regularly and routinely are in the cycle of gathering data /information through correspondences.

All these sourced information/data that get included in the General/Mineral Reviews are subjected to analyses, interpretations and sometimes extrapolations in the case of paucity of data.There have been instances when the data have been used 'as it is' hence it is recommeneded that the readers apply discretion in discerning the data for their further utilisation for general or scientific purposes.

Indian Bureau of Mines while processing of the sourced data/information undertakes its best efforts to ensure accuracy and to verify that the data published have been selected on the basis of thorough scientific judgement. However, IBM would make no warranties to that effect, and shall not be liable for any consequent damage that may result from errors or omissions in the database contained there in.

ABBREVIATIONS

The abbreviations and symbols/units used in the Publication are as follows:

AMD	Atomic Minerals Directorate for Exploration and Research
APMDC	Andhra Pradesh Mineral Development Corp. Ltd
BALCO	Bharat Aluminium Company Ltd
BARC	Bhabha Atomic Research Centre
BGML	Bharat Gold Mines Limited
BGS	British Geological Survey, UK
BIS	Bureau of Indian Standards
BISAG	Bhaskaracharya Institute of Space Applications & Geo-Informatics
BOT	Build, Operate, Transfer
BSMDC	Bihar State Mineral Development Corp. Ltd
CAPEXIL	Chemical and Allied Export Promotion Council
CBM	Coal Bed Methane
CCI	Cement Corporation of India Ltd
c.i.f.	Cost, Insurance and Freight
CMDC	Chhattisgarh Mineral Development Corporation
CMPDI	Central Mine Planning & Design Institute
CSO	Central Statistical Office
DAE	Department of Atomic Energy
DES	Directorate of Economics & Statistics
DGCI&S	Director General of Commercial Intelligence and Statistics
DGH	Directorate General of Hydrocarbons
DGM	Directorate of Geology and Mining
DGPS	Differential Global Positioning System
DMG	Directorate of Mining and Geology
DMF	District Mineral Foundation
EEZ	Exclusive Economic Zone
EU	European Union
FDI	Foreign Direct Investment
FIMI	Federation of Indian Mineral Industries
f.o.b.	free on board
f.o.b.t.	free on board trimmed
f.o.r.	free on rail
GMDC	Gujarat Mineral Development Corp. Ltd
GSI	Geological Survey of India
GVA	Gross Value Added
HCL	Hindustan Copper Ltd
HGML	Hutti Gold Mines Co. Ltd
Hindalco	Hindalco Industries Ltd
HZL	Hindustan Zinc Ltd
IBM	Indian Bureau of Mines
IMMT	Institute of Minerals & Materials Technology (Formerly RRL, Bhubaneswar)
IREL	Indian Rare Earths Ltd
ISRO	Indian Space Research Organisation
JPC	Joint Plant Committee
JV	Joint Venture
KCC	Khetri Copper Complex
KMML	Kerala Minerals & Metals Ltd
LAPL	Large Area Prospecting Licence
LME	London Metal Exchange
MALCO	Madras Aluminium Company Ltd
M(A)R	The Mineral (Auction) Rules
MCDR	Mineral Conservation and Development Rules
M(EMC)R	The Minerals (Evidence of Mineral Contents) Rules
MCR	Mineral Concession Rules
MECL	Mineral Exploration Corporation Ltd
ML	Mining Lease
MMDR Act	Mines & Minerals (Development & Regulation) Act
MMTC	Minerals and Metals Trading Corp. Ltd
MoEFCC	Ministry of Environment, Forest and Climate Change
MoU	Memorandum of Understanding
MSS	Mining Surveillance System
MTS	Mining Tenement System
MSTC	Metal Scrap Trade Corp. Ltd
NA	Not Available
NAS	Not Available Separately
NALCO	National Aluminium Co. Ltd
NCMT	National Centre of Mineral Targeting
ND	Not Determined
NELP	New Exploration Licensing Policy
NES	Not Elsewhere Stated
NFL	National Fertilizers Ltd
NLC	Neyveli Lignite Corporation Ltd
NMDC	National Mineral Development Corp. Ltd
NMET	National Mineral Exploration Trust
NMEP	National Mineral Exploration Policy
NMI	National Mineral Inventory
NML	National Metallurgical Laboratory
NRSC	National Remote Sensing Centre
NTPC	National Thermal Power Corp. Ltd
NQ	Not Quoted
N/v	Near Village/s
OIL	Oil India Ltd
OMC	Orissa Mining Corporation Ltd

ONGC	Oil and Natural Gas Corporation Ltd
PMKKKY	Pradhan Mantri Khanij Kshetra Kalyan Yojana
PL	Prospecting Licence
PPP	Public Private Partnership
RP	Reconnaissance Permit
RRL	Regional Research Laboratory
RSMML	Rajasthan State Mines and Minerals Ltd
SAIL	Steel Authority of India Ltd
SBICAP	SBI Capital Markets Limited
SCCL	Singareni Collieries Company Ltd
SDF	Sustainable Development Framework
SEZ	Special Economic Zone
SMC	Sikkim Mining Corporation Ltd
STD	Standard (Code of UNFC)
TAMIN	Tamil Nadu Minerals Ltd
TAMRA	Transparency, Auction Monitoring and Resource Augmentation
TERI	The Energy and Resources Institute
tpd	tonnes per day
tpy	tonnes per year
TSL	Tata Steel Ltd (formerly Tata Iron and Steel Co. Ltd)
TW	Territorial Waters
UAE	United Arab Emirates
UK	United Kingdom
UNFC	United Nations Framework Classification
USA	United States of America
USGS	United States Geological Survey
UT	Union Territory
VE	Visual Estimate
VISL	Visvesvaraya Iron & Steel Ltd
w.e.f.	with effect from
(e)	Estimated
(P)	Provisional
(R)	Revised
(U)	Under reference
--	Nil
++	Negligible

UNITS

cm	centimetre
m	metre
mm	millimetre
cu m	cubic metre
'000 cu m	thousand cubic metres
m cu m	million cubic metres
sq m	square metre
km	kilometre
ha	hectare
sq km	square kilometre
t	tonne
'000 tonnes	thousand tonnes
lkm	line kilometre
ct	carat
g	gram
kg	kilogram
`	Indian rupees
` '000	thousand rupees
kWh	kilowatt-hour
s	second

Conversion Table

Troy oz	31.1035 g
kg	2.2046 lb
tonne	Metric ton of 2,204.6 lb
ton	Long ton of 2,240 lb
cwt	112 lb
foot	0.3048 m
Crore	Ten million
Lakh	Hundred thousand

Classification of Reserves/Resources of Various Minerals as per United Nations Framework Classification (UNFC) System

The classification of reserves/ resources of various minerals based on UNFC system were first prepared by IBM as on 1.4.2000 and later, as on 1.4.2005. Reserves/resources are furnished mineralwise in State Reviews and gradewise and statewise in Mineral Reviews. Quinquennially updated resources for 43 minerals as on 1.4.2010 and for 70 minerals as on 1.4.2015 have been included in this Edition of Indian Minerals Yearbook in State Reviews and Mineral Reviews. The process for updating the National Mineral Inventory as on 1.4.2020 for 46 minerals is currently in progress. The amendment to Mineral Conservation & Development Rules,1988 vide Gazette Notification No.185 dated 17.4.2003 makes it statutory for all non-coal major mineral mine-owners to report their reserves data as per UNFC and for Mining Lease applications to submit mining plans accordingly. Detailed guidelines, definitions, etc. concerning UNFC were issued by IBM on 3 June 2003 and published in the edition of Mineral Conservation & Development Rules, 1988.

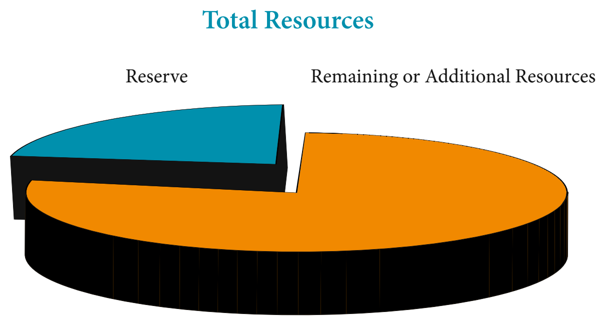
The UNFC consists of a three-dimensional system with the following three axes : Geological Assessment, Feasibility Assessment and Economic Viability. The process of geological assessment is generally conducted in stages of increasing details. The typical successive stages of geological investigation, i.e., reconnaissance, prospecting, general exploration and detailed exploration, generate resource data with a clearly defined degree of geological assurance.

These four stages are, therefore, used as geological assessment categories in the classification. Feasibility assessment studies form an essential part of the process of assessing a mining project. The typical successive stages of feasibility assessment, i.e., geological study as initial stage followed by prefeasibility study and feasibility study/mining report are well-defined. The degree of economic viability (economic or sub-economic) is assessed in the course of prefeasibility and feasibility studies. A prefeasibility study provides a preliminary assessment with a lower level of accuracy as compared to that of a feasibility study which assess the economic viability in detail.

It is a three-digit-code-based system, the economic viability axis representing the first digit, the feasibility axis, the second digit and the geologic axis, the third digit. The three categories of economic viability have codes 1, 2 and 3 in decreasing order. Similarly, the three categories of feasibility study have also codes 1, 2 and 3 while the four stages of geological assessment are represented by 4 codes, i.e., 1 (detailed exploration), 2 (general exploration), 3 (prospecting) and 4 (reconnaissance). Thus, the highest category of resources under UNFC system will have the code (111) and lowest category, the code (334). The various terms used in this classification and their definitions in brief are as follows:

Total Mineral Resources

Reserve plus Additional or Remaining Resource comprise the Total Resource, or Total Resource minus Reserve gives the Remaining Resource.



Diagramatic Representation of Reserve and Resource

A. Mineral Reserve

Economically mineable part of measured and/or indicated mineral resource.

(i) Proved Mineral Reserves (111)

Economically mineable part of Measured Mineral Resource.

(ii) Probable Mineral Reserves (121 & 122)

Economically mineable part of indicated or in some cases, a measured mineral resource.

B. Mineral Resource

A Mineral Resource (Remaining or Additional Resource) is the balance of the Total Mineral Resources that have not been identified as Mineral Reserve.

(i) Measured Mineral Resource (331)

That part of mineral resource for which tonnage, density, shape, physical characteristics, grade and mineral content can be estimated with a high level of confidence, i.e., based on detailed exploration.

(ii) **Indicated Mineral Resource** (332)

Tonnage, density, shape, physical characteristics grade and mineral content can be estimated with reasonable level of confidence based on exploration, sampling and testing information, location of borehole, pits etc.

(iii) **Inferred Mineral Resource** (333)

Tonnage, grade and mineral content can be estimated with low level of confidence inferred from geological evidence.

(iv) **Reconnaissance Mineral Resource** (334)

Estimates based on regional geological studies and mapping, airborne and indirect methods, preliminary field inspections as well as geological inference and extrapolation.

(v) **Prefeasibility Mineral Resource** (221 and 222)

That part of an indicated and in some circumstances measured mineral resource that has been shown by prefeasibility study as not economically mineable or can become economically viable subject to changes in technological, economic, environmental and/or other relevant conditions.

(vi) **Feasibility Mineral Resource** (211)

That part of measured mineral resource, which after feasibility study has been found to be economically not mineable.

Definition of Uneconomic Occurrence

Materials of estimated quantity, that are too low in grade or for other reasons are not considered potentially economic. Thus, Uneconomic Occurrence is not part of a mineral resource. If quantity and quality are considered worthy of reporting, it should be recognised that an Uneconomic Occurrence cannot be exploited without major technological and/or economic changes, which are not currently available.

Mineral Occurrence

A mineral occurrence is an indication of mineralisation that is worthy of further investigation. The term mineral occurrence does not imply any measure of volume/tonnage or grade/quality and is thus not part of a mineral resource.

1. Apatite and Rock Phosphate

311.25
(million tonnes) Total reserves/resources of rock phosphate have been established as on 1st April 2020

1,456
(thousand tonnes) Production of phosphorite/rock phosphate have been reported in 2020-21

825
(tonnes) of rock phosphate were exported in 2020-21

7.78
(thousand tonnes) of rock phosphate were imported in 2020-21

Apatite is a group of phosphate minerals named by German Geologist Abraham Werner in 1786. It is the most abundant crystalline phosphate mineral found as an accessory mineral in practically all kinds of igneous rocks. Sometimes, it is concentrated in pegmatites, metallic veins and magmatic deposits. It also occurs in metamorphic rocks and as a secondary mineral in phosphatic rocks of sedimentary origin. It is a group of phosphate minerals, usually referring to hydroxy apatite, fluorapatite and chlorapatite. Fluorapatite $Ca_5(PO_4)_3F$ is the most common variety of apatite and also a secondary source of fluorine. Collophane ($Ca_3P_2O_8$) is apparently a cryptocrystalline or amorphous calcium phosphate complex. Rock phosphates or phosphorites are sedimentary phosphatic deposits comprising fine-grained mixture of various calcium phosphates, most important being hydroxylapatite, carbonateapatite, fluorapatite and their solid solutions. About 80% phosphate production in the world is derived from phosphate rocks (phosphorite) containing one or more phosphatic minerals, usually calcium phosphate of sufficient purity and quantity to permit its use directly or after concentration in manufacturing commercial products.

Phosphate rock is also the source of by-product fluorine. Apatite & rock phosphate containing 3 to 4% CaF_2 are useful for recovery of fluorite. Hydrofluoro-silicic acid is recovered as by-product from phosphoric acid plants during processing of rock phosphate. Phosphate rocks are also considered as a significant and secondary resource of uranium.

India is deficient in Apatite & Rock Phosphate availability. In case of apatite, the country is fully dependent upon imports, while the Rock Phosphate production is only from two States, namely, Rajasthan and Madhya Pradesh.

RESERVES/RESOURCES

Apatite

The total Reserves/Resources of apatite as per NMI data, based on UNFC system as on 1.4.2020 has been placed at 21.11 million tonnes. Out of these resources, the Reserves are placed at 0.029 million tonnes, while 21.08 million tonnes are placed under Remaining Resources category. Of the total reserves/resources, West Bengal accounts for the bulk of 50%, followed by Jharkhand (34%) and Meghalaya (6%). The remaining 10% resources are located in Rajasthan, Andhra Pradesh, Gujarat and Tamil Nadu. Gradewise, soil reclamation grade accounts for 45% followed by beneficiable grade (32%), Low/Non-beneficiable grade (15%) and remaining Blendable, Unclassified & Not-known grades (7%). The resources of Chemical Fertilizer grade are about one per cent (Table-1).

Table – 1 : Reserves/Resources of Apatite as on 1.4.2020
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	Resources
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
All India: Total	27715	–	1680	29395	499149	–	–	2281521	11481250	5801338	1017646	21080904	21110299
By Grades													
Chemical Fertilizer	27715	–	1680	29395	–	–	–	30000	–	200163	–	230163	259558
Soil Reclamation	–	–	–	–	236502	–	–	2233500	6243000	800000	–	9513002	9513002
Low/Non-beneficiable	–	–	–	–	–	–	–	3360	2363000	50000	666646	3083006	3083006
Beneficiable	–	–	–	–	–	–	–	12477	1875250	4561175	351000	6799902	6799902
Blendable	–	–	–	–	262647	–	–	2184	–	–	–	264831	264831
Unclassified	–	–	–	–	–	–	–	–	1000000	–	–	1000000	1000000
Not-known	–	–	–	–	–	–	–	–	–	190000	–	190000	190000
By States													
Andhra Pradesh	27715	–	1680	29395	–	–	–	–	–	200163	–	200163	229558
Gujarat	–	–	–	–	–	–	–	–	–	–	351000	351000	351000
Jharkhand	–	–	–	–	–	–	–	2110000	1620000	3540000	–	7270000	7270000
Meghalaya	–	–	–	–	–	–	–	–	–	1300000	–	1300000	1300000
Rajasthan	–	–	–	–	–	–	–	51521	1016000	–	–	1067521	1067521
Tamil Nadu	–	–	–	–	–	–	–	–	–	240000	–	240000	240000
West Bengal	–	–	–	–	499149	–	–	120000	8845250	521175	666646	10652220	10652220

Figures rounded off.

Rock Phosphate

The total reserves/resources of rock phosphate as per NMI data, based on UNFC system as on 1.4.2020 has been placed at 311.25 million tonnes. Out of these, the reserves constitute only 30.87 million tonnes while 280.37 million tonnes are under Remaining Resources category. Of the total reserves/resources, 34% are in Jharkhand, 30% in Rajasthan, 19% in Madhya Pradesh, 8% each in Uttar Pradesh & Uttarakhand, respectively. Meagre quantities of resources are also located in Gujarat and Meghalaya. Gradewise, Low-grade account for 37%, followed by Beneficiable (22%), Soil Reclamation (15%) Blendable (10%), Chemical Fertilizer (9%) and remaining Unclassified and Not-known grades (about 7%) (Table-2).

Table – 2 : Reserves/Resources of Rock Phosphate as on 1.4.2020(P)

(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnais-sance	Total	Resources
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
All India : Total	27103158	-	3772935	30876093	13669080	29796846	34526541	2879833	3539750	186657066	9308275	280377392	311253485
By Grades													
Chemical Fertilizer	22177450	-	264965	22442415	-	1877652	1856628	-	-	2271077	-	6005357	28447772
Blendable	-	-	-	-	9384650	1660000	8349933	13333	-	12991513	-	32399429	32399429
Soil Reclamation	-	-	-	-	705867	12015437	16512812	700000	30000	16887166	-	46851282	46851282
Beneficiable	4925708	-	1053166	5978874	3578563	14243757	6976076	2166500	2769750	25288989	6650750	61674385	67653259
Low grade	-	-	-	-	-	-	-	-	-	115547549	-	115547549	115547549
Unclassified	-	-	2454804	2454804	-	-	831092	-	740000	10095773	2657525	14324390	16779194
Not-known	-	-	-	-	-	-	-	-	-	3575000	-	3575000	3575000
By States													
Gujarat	-	-	-	-	-	-	-	-	-	314820	-	314820	314820
Jharkhand	-	-	-	-	-	-	-	-	-	107370000	-	107370000	107370000
Madhya Pradesh	5258158	-	3772935	9031093	6460616	15688511	13880230	-	2730000	10615956	50625	49425938	58457031
Meghalaya	-	-	-	-	-	-	-	-	-	1311035	-	1311035	1311035
Rajasthan	21845000	-	-	21845000	4144961	13675437	15793355	119833	69750	28942783	9257650	72003769	93848769
Uttar Pradesh	-	-	-	-	-	432898	3118586	-	740000	21481960	-	25773444	25773444
Uttarakhand	-	-	-	-	3063503	-	1734370	2760000	-	16620513	-	24178386	24178386

Figures rounded off.

EXPLORATION & DEVELOPMENT

Exploration and development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION AND STOCKS

Apatite

No production of apatite was reported since 2017-18 (Table-3).

Table – 3 : Production of Apatite, 2019-20 & 2020-21
(By Sectors/States/Districts/Grades)

(Quantity in tonnes; Value in ₹ '000)

State/District	No. of mines	2019-20		No. of mines	2020-21 (p)	
		Quantity	Value		Quantity	Value
India	-	-	-	-	-	-
Public sector	-	-	-	-	-	-
Private sector	-	-	-	-	-	-
Andhra Pradesh	-	-	-	-	-	-
Visakhapatnam	-	-	-	-	-	-
West Bengal	-	-	-	-	-	-
Purulia	-	-	-	-	-	-

* Only labour reported.

The mine-head closing stocks at the end of 2020-21 was 6,306 tonnes same as in 2019-20 (Table-4). The average daily labour employed in apatite mines during 2020-21 was nil as against 01 in the previous year.

Table – 4 : Mine-head Closing Stocks of Apatite, 2019-20 & 2020-21
(By States/Grades)

(In tonnes)

State	2019-20	2020-21 (P)
India	6306	6306
Andhra Pradesh	-	-
West Bengal	6306	6306

Phosphorite/Rock Phosphate

The total production of phosphorite/rock phosphate is at 1,456 thousand tonnes in 2020-21 nearly same as compared to that in the previous year (Tables - 5 to 7).

Table – 5 : Principal Producers of Phosphorite/Rock phosphate, 2020-21

Name and address of producer	Location of mine	
	State	District
Rajasthan State Mines & Minerals Ltd, C-89-/90, Janpath Lal, Kothi Scheme, Jaipur-302 015, Rajasthan.	Rajasthan	Udaipur
Khajuraho Stones (India) Pvt. Ltd, Sagar Road Dhadari, Chhatarpur-471 001, Madhya Pradesh.	Madhya Pradesh	Chhatarpur

Table – 6 : Production of Phosphorite/Rock Phosphate, 2018-19 to 2020-21
(By States)

(Quantity in tonnes; Value in ₹ '000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	1421086	3883571	1400189	4731313	1455627	5441988
Madhya Pradesh	98600	88543	99960	94304	97880	92007
Rajasthan	1322486	3795028	1300229	4637009	1357747	5349981

TTable – 7 : Production of Phosphorite/Rock Phosphate, 2019-20 & 2020-
(By Sectors/States/Districts/Grades)

(Quantity in tonnes; Value in ₹ '000)

State/District	2019-20							2020-21						
	Grade: P_2O_5 content					Total		Grade: P_2O_5 content					Total	
	No. of mines	Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Qty	Value	No. of mines	Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Qty	Value
India	6	133422	677189	3550	586028	1400189	4731313	6	179327	561677	-	714623	1455627	5441988
Public Sector	5	133422	677189	-	489618	1300229	4637009	5	179327	561677	-	616743	1357747	5349981
Private Sector	1	-	-	3550	96410	99960	94304	1	-	-	-	97880	97880	92007
Madhya Pradesh	5	-	-	3550	96410	99960	94304	5	-	-	-	97880	97880	92007
Chhatarpur	2	-	-	3550	96410	99960	94304	2	-	-	-	97880	97880	92007
Jhabua	2	-	-	-	-	-	-	2	-	-	-	-	-	-
Sagar	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Rajasthan	1	133422	677189	-	489618	1300229	4637009	1	179327	561677	-	616743	1357747	5349981
Udaipur	1	133422	677189	-	489618	1300229	4637009	1	179327	561677	-	616743	1357747	5349981

There were 6 reporting mines in 2020-21 as same in 2019-20. Rajasthan continued to be the principal producing State contributing 93% of the total production and the remaining 7% share was contributed by Madhya Pradesh.

The mine-head closing stocks of phosphorite/rock phosphate in the year 2020-21 was 2,231 thousand tonnes as compared to 2,300 thousand tonnes in 2019-20 (Table-8).

Table –8: Mine-head Closing Stocks of Phosphorite/Rock Phosphate, 2019-20 & 2020-21

(By States/Grades)

(In tonnes)

State	2019-20					2020-21(P)				
	Grade: P_2O_5 content					Grade: P_2O_5 content				
	Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Total	Above 30%	Above 25-30%	Above 20-25%	Up to 20%	Total
India	480262	248142	81919	1489612	2299935	324547	286225	79148	1541030	2230950
Madhya Pradesh	-	1377	6527	54126	62030	-	1377	3756	62728	67861
Rajasthan	480262	246765	75392	1435486	2237905	324547	284848	75392	1478302	2163089

The average daily labour employed in phosphorite/rock phosphate mines in 2020-21 was 969 as against 961 in the previous year.

MINING AND MARKETING

Apatite mining is confined to Visakhapatnam district, Andhra Pradesh and in Purulia district, West Bengal. In apatite mine of Andhra Phosphate (Pvt.) Ltd, manual mining was carried out by developing benches along the strike length, following the dip of ore body, and by lateral developments of levels along the strike. A mineral treatment plant at Srungavarapukota, about 20 km from the apatite mine has two disintegration units of 15 hp and 50 hp that operate from two separate sheds. Apatite after disintegration is screened to 40 mesh, 60 mesh and 100 mesh. The screened material of right size is packed in quantities of 50 kg each in polythene-lined gunny bags and are despatched for sale to buyers through Srungavarapukota railway station.

West Bengal Mineral Development & Trading Corporation (WBMDTC) operates the only apatite mine in West Bengal which is located at Beldih. The mine is operated by using opencast mining method with the deployment of HEMM like JCB excavator, jackhammer drills, air compressor, tippers, etc. The mine has a production capacity of about 15,000 tonnes of in situ ore per annum. Half of the low-grade ore (10-12% P_2O_5) is blended with available high-grade ore (>22% P_2O_5) manually to produce additional quantity of saleable ore (18-20% P_2O_5). The desired grade (18-20% P_2O_5) of apatite ore is ground to 100 mesh and sold in the local market for direct application in the name of "PURULIA PHOS". However, no production was reported since 2017-18.

In the case of rock phosphate, the production of phosphorite/rock phosphate in India was reported from five State Public Sector mines. Of these, Chhatarpur, Jhabua districts of Madhya Pradesh have two mines each, and Sagar district has one mine, while Udaipur district of Rajasthan has one mine. The one fully mechanised mine under the Private Sector (Hindustan Zinc Limited) is also located in Udaipur district, Rajasthan. The strike of the mine is in NE-SW direction.

The Meghnagar mine in Jhabua district and Hirapur mine in Chhatarpur and Sagar districts of Madhya Pradesh are worked by opencast method and both the mines are operated by Madhya Pradesh State Mining Corporation Ltd. Compressed-air jack hammers are deployed for drilling. The present run-of-mine capacity of Jhabua mine is 1,50,000 tonnes per year. The production of Meghnagar Mine is used in Fertilizer Industries and Phosphorus Industries. The BRP plant at Hirapur mine is operated by Madhya Bharat Agro Industries Ltd. The processed ore from the plant is predominantly sold to manufacturers of phosphatic fertilizers and chemicals. Some parts of the ore are also internally consumed for fertilizer production.

In Rajasthan, the ore body at Jhamarkotra mine of M/s RSMML extends over a strike length of 10 km and the average width of phosphate bed is about 15 m with an average inclination of about 550 from the vertical. The height of the bench is maintained up to 10 m. Shovels (6.1 cu. m) and dumpers (85 tonnes) are used for removal of ore and overburden. The mine has an annual rock handling capacity of about 20 million tonnes. The thin and sharply dipping ore body results in long and narrow pits with great depth extension which leads to very high stripping ratio (about 1:10) with high lead distance and lift for waste and mineral. An effective dewatering scheme was implemented to tackle ground water problem. The working levels are kept dry by continuous pumping of ground water through tube-wells constructed on periphery of the pit limit. The beneficiation plant of RSMML at Jhamarkotra has 9 lakh tpy capacity to treat run-of-mine low-grade ore, with an average 16% P_2O_5. Production from Jhamarkotra mine is despatched to many phosphatic fertilizer and chemical manufacturers from Udaipur and Umra railway stations which are located at 18 km and 25 km, respectively, away from the mine. RSMML has put up a beneficiation plant for processing of 9 lakh MT of low-grade phosphate ore per annum.

RSMML produces the following products:

1) (+) 30% P_2O_5 crushed -1/2" size high-grade rock phosphate (for SSP manufacturing units).

2) 31.5% P_2O_5 high-grade rock phosphate Chips (for DAP/Phos Acid manufacturing units).

3) 18% P_2O_5 ground low-grade beneficiated rock phosphate (RAJPHOS) (direct application to acidic soils).

4) 31.54% P_2O_5 - BRP Grade (for SSP & DCP Manufacturing units, PROM, etc.)

RSMML was unable to market its low-grade rock phosphate (trade name-Rajphos) till 2005-06 because of its high R_2O_3 content which could neither be blended nor beneficiated. However, during recent years, this grade of rock phosphate has found takers especially, fertilizer manufacturers.

INDUSTRY

As per Ministry of Chemicals and Fertilizers Department of Fertilizers Annual Report 2020-21, presently, there are about 39 large size urea, 19 DAP and complex fertilizers, and 2 ammonium sulphate plants. Among the major fertilizer products, the estimated production of urea during the year 2020-21 was 24.6 million tonnes (6.66 million tonnes from Public Sector, 6.99 million tonnes from Cooperative Sector and 10.94 million tonnes from Private Sector), Diammonium Phosphate (DAP) 3.77 million tonnes (1.85 million tonnes from Cooperative Sector and 1.92 million tonnes from Private Sector), complex fertilizers 9.32 million tonnes (1.45 million tonnes from Public Sector, 2.34 million tonnes from Cooperative Sector and 5.51 million tonnes from Private Sector).

The major phosphatic fertilizer plants in Public Sector are Fertilizers and Chemicals (Travancore) Ltd (FACT) at Udyogamandal, Kochi (Kerala); Rashtriya Chemicals and Fertilizer Ltd (RCF) at Trombay, Mumbai (Maharashtra); Madras Fertilizer Limited at Chennai (Tamil Nadu); Brahmaputra Valley Fertilizers Corporation Ltd (BVFCL) at Namrup (Assam); National Fertilizers Ltd (NFL) at Noida (U.P.); FCI Aravalli Gypsum and Minerals India Ltd (FAGMIL) at Jodhpur (Rajasthan); Projects and Development India Limited (PDIL) at Noida (U.P.); Fertilizer Corporation of India Limited (FCIL) in New Delhi; and Hindustan Fertilizer Corporation Ltd (HFCL) in New Delhi.

The plants in Private Sector are Gujarat State Fertilizer Company Ltd (GSFC) at Vadodara (Gujarat); Zuari Agro Chemicals Ltd in Goa; Mangalore Chemicals and Fertilizers Ltd at Mangaluru (Karnataka); Gujarat Narmada Valley Fertilizers & Chemicals Ltd (GNFC) at Bharuch (Gujarat); Nagarjuna Fertilizer and Chemicals Ltd (NFCL) at Kakinada (Hyderabad); Chambal Fertilizers and Chemicals (CFCL) at Gadepan (Rajasthan); Tata Chemicals Ltd (TCL) at Bardala (Uttar Pradesh); Kanpur Fertilizer and Cements Ltd (KFCL) at Kanpur (Uttar Pradesh); Indo-Gulf Fertilizers Limited at Jagdishpur Uttar Pradesh, etc.

The plants in the Co-operative Sector that manufacture phosphatic fertilizer are Indian Farmers Fertilizer Co-operative Ltd (IFFCO) at Kandla (Gujarat) and Krishak Bharti Cooperative Ltd (KRIBCHO) at Surat (Gujarat). The 2 plants of IFFCO are in Gujarat (Kalol and Kandla), 2 in Uttar Pradesh (Phulpur and Aonla) and one in Odisha (Paradeep).

Besides, RSMML has a beneficiation plant in Jhamarkotra in Rajasthan, while Krishna Phoschem Ltd has set up a 600 tpd rock phosphate beneficiation plant at Meghnagar in Jhabua district of Madhya Pradesh. The Company has long-term tie-up with Madhya Pradesh State Mining Corporation Ltd.

The other associate industries on rock phosphate include Coimbatore Pioneer Fertilizer Ltd and Rashtriya Chemicals & Fertilizers Ltd, Mumbai which have domestic plants that recover by-product fluorine from rock phosphate in the form of hydrofluorosilicic acid, sodium silico-fluoride; and aluminium fluoride. Department of Atomic Energy has issued sanctions for establishment of 2 units for recovery of uranium from rock phosphatic sources and these are Rashtriya Chemicals & Fertilizers, Mumbai in association with Heavy Water Board (HWB); and SPIC, Thoothukudi in association with IREL.

RCF is also setting up a rapidwall plant for manufacture of unique building material using phospho-gypsum as a raw material which is the by-product of phosphoric acid plant. The project is estimated to cost ₹75 crore.

Red phosphorus is manufactured mainly by United Phosphorus Ltd. Red phosphorus is consumed in Matches Industry. It also has applications as fumigant in Agriculture Industry and as flame retardant.

Joint Ventures Abroad

India's dependency on import at present is to the extent of 25% of our requirements of urea, 90% in case of phosphates either as raw material or finished fertilizers (DAP/MAP/TSP) and 100% in case of potash.

The Government has been encouraging Indian companies to establish joint venture in countries which are rich in fertilizer resources with arrangements to buy back and to enter into long-term agreement for supplying fertilizer to India. The Department of Fertilizers has undertaken joint ventures abroad with 5 countries in the previous years. Although during the year 2021-22, no joint venture with any country was signed, a number of major developments place with the following countries:

Nepal

Memorandum of Understanding between the Government of India and the Government of Nepal on the supply of Urea and DAP to Nepal from India under Government to Government Arrangement has been approved by the Cabinet. MoU is to be signed shortly.

Russia

To explore the possibility of long term agreement between both the countries and to discuss the terms & conditions of arriving at a mutually long term agreement for supply of fertilizers to India VC meetings were held between both the sides on 21 June, 2021, 4 August, 2021, 09 September, 2021 and 30th December, 2021. An agreement of Intent has been signed between Indian PSUs and Russian Company, PhosAgro on 21.09.21 for supply of 2,50,000 LMT of four type of fertilizers from Russia to India during the year 2022 and options for further engagements for mutual cooperation are being explored.

Saudi Arabia

Rounds of meetings were held between Indian companies along with officials from DoF and Saudi Companies SABIC and MAADEN on 1st July,2021, 6th July, 2021 and 5th August, 2021 in coordination with Indian Embassy to Saudi Arabia for arriving at a mutually long-term agreement between Indian and Saudi Arabian Companies for collaboration in the fertilizer sector. Further, engagements for mutual cooperation are being explored.

Morocco

Rounds of meetings were held between Indian Companies along with officials from DoF and OCP, Morocco with the constitution of a joint committee/ expert committee.

Canada

A meeting held between Secretary (Fertilizers) and India's High Commissioner to Canada on 17.12.2021 was attended by representative of Indian companies importing Potash from Canada. The matter is being pursued with State Government of Gujarat to pursue the case of mining in Canada by GSFC.

Iran

Discussions were held and follow up actions were taken with Ambassador, Embassy of the Islamic Republic of Iran to strengthen the collaboration and establish a long-term relationship between both the countries for procurement of fertilizers specifically urea and ammonia from Iran.

RESEARCH AND DEVELOPMENT

RSMML has developed the organic fertilizer called Phosphate Rich Organic Manure (PROM) by using high-grade rock phosphate with farmyard waste and other organic matter. The field trials conducted through different agricultural unversities in the country have shown that the agronomic efficacy of this new P-fertilizer is higher than that of the complex phosphatic fertilizers available in the market today. 'PROM' is suitable to neutral and alkaline soils, which will prove to be a boon to the Indian farmers. RSMML with the help of GSFC is making efforts for utilisation of secondary Ore accumulated at Jhamarkotra mine either through beneficiation route or its direct conversion into phosphoric acid.

1. R&D efforts in the following areas strengthened the Company's operation through technology absorption, adaptations & innovation:
   a) Productivity studies of HEMM at Jhamarkotra Mines.
   b) Beneficiation of secondary rock phosphate.
2. Benefits derived as a result of the above R&D:
   a) Strengthening of market share.
   b) Converting waste into useful product.
   c) Conservation of Mineral.
   d) Future plan of action-Energy efficient process.
3. The Company has developed the low cost organic fertilizer "PROM".
4. Two patents have been filed by the Company jointly with MLS University, Udaipur, which got approved under the title i) "process for making slow release phosphate fertiliser". ii) "An eco-friendly process for making EPSOM and Gypsum".
5. The Company has introduced 30% crushed Rock phosphate replacing 31.5% CRP, which has improved mineral conservation.
6. Benefits derived as a result of the above efforts are product imporvement, cost reduction, product development, import substitution, etc.

Above efforts helped in satisfying the consumer needs as well as business requirements by introducing new products.

ENVIRONMENTAL CONCERNS

There are apparent concerns regarding phospho-gypsum which is formed as a by-product during manufacturing of phosphoric acid. It contains about 1% P_2O_5, 1% F and 10-30 times more radon, none of which is desirable. Environment Protection Agency (EPA) of USA stipulated in 1989 that phospho-gypsum is unsuitable for sale as common gypsum. Production of each tonne of P_2O_5 yields about five tonnes of phospho-gypsum. EPA has prescribed stringent measures for storage, transport and disposal of phospho-gypsum. In India, however, by-product phospho-gypsum is used widely in cement manufacture.

The use of phosphate also falls under scrutiny. Much attention has been paid to its role in stimulating the growth of algae and other organisms in surface water, the process known as eutrophication. This process is deleterious because it causes blooms of algae which consume dissolved oxygen in lakes and even in shallow, isolated arms of the ocean. Phosphate fertilizers are probably not the only cause of phosphate-induced eutrophication. Another concern is fertilizer phosphate does not leach readily from soil. One of the best ways to remove this phosphate is through the addition of lime which causes precipitation of apatite. However, this procedure, being relatively costly, has not been applied widely. Other application where the use of phosphate has been discouraged is in manufacturing of detergents.

USES

Most of the phosphate rock mined throughout the world is used to produce phosphate fertilizer. It is also used as animal feed supplements. Elemental phosphorus and phosphoric chemicals derived from phosphate rocks find application in detergents, insecticides, pharmaceutical products, soft drink, tooth paste, glass, photographic films, matches, fire -works, military smoke screens, incendiary bombs, etc.

Transparent specimens of apatite with vivid green, blue, yellow or pink colour and excellent clarity are often cut into faceted gemstone. Along with other phosphates, apatites are also a proposed host material for storage of nuclear waste.

SPECIFICATIONS

Elemental Phosphorus and Phosphoric Acid

BIS has prescribed the IS:11224-1985, reaffirmed 2010 specifications for rock phosphate required for the manufacture of elemental phosphorus (Type-I) and phosphoric acid (Type-II).

Single Superphosphate

The P_2O_5 content in rock phosphate for manufacturing single superphosphate should be minimum 31%. Silica up to 8% can be tolerated. Iron and alumina, i.e., R_2O_3 should not be more than 3.5%. Higher R_2O_3 may tend reversion of available P_2O_5 (water soluble P_2O_5). Carbonate up to 5% will improve the reactivity of rock phosphate by increasing the reaction temperature and making the mass porous.

Direct Application of Rock Phosphate as Fertilizer

In India, the finely-ground rock phosphate containing 16% P_2O_5 is used for direct application to the soil for soil amendment. This application is dependent upon the structure and chemical composition of the rock. Direct application is suited mostly for pastures and forage crops and for acidic soils. According to PPCL the following specifications are considered for utilising any rock phosphate as phosphatic fertilizer for direct application in acidic soils.

1. Absolute citrate solubility index 7% (max.)
2. Apatite to carbonate ratio 0.035 CO_2% : P_2O_5%
3. Origin of rock phosphate Sedimentary
4. Mesh size 100
5. Hydroxyl ion in crystal lattice 2 is higher indicating substitution of OH for PO_4:H_2O
6. Grade of rock phosphate powder 16% P_2O_5 citrate soluble fraction
7. Iron as Fe_2O_3 5%
8. CaO to P_2O_5 ratio 1:8

The use of rock phosphate for direct application as fertilizer depends on its level of solubility in acidic soil.

CONSUMPTION

The apparent consumption of apatite and rock phosphate in 2020-21 was about 9.30 million tonnes as against the 9.0 million tonnes during preceding year, i.e., increased by 3.3% in 2020-21.

POLICY

Imports of natural calcium phosphates (including apatite), natural aluminium-calcium phosphates and phosphatic chalk are allowed 'free' under Heading No. 2510 as per the Import Policy ITC(HS) 2022. All chemical fertilizers except urea continue to be decontrolled. The Government of India has been implementing a scheme of concession fixing indicative maximum retail price (MRP) for enabling sales of decontrolled phosphatic and potassic fertilizers at reasonable prices.

In case of Phosphate Fertilizer Industry, the scarcity of domestic raw material constrains the attainment of self-sufficiency in the country. A policy has, therefore, been adopted which involves the following three options:

1. domestic production based on indigenous imported rock phosphate and imported sulphur.
2. domestic production based on imported intermediates, viz, phosphoric acid.
3. imports of finished fertilizers.

The Government of India notified new Urea Policy extended for the period 01.6.2015 to 30.9.2020 for existing gas-based urea manufacturing units. Thereafter the target energy norms of NUP-2015 have been enforced on these urea units from 1st October 2020.

WORLD REVIEW

The world reserves of phosphate rock are about 71 billion tonnes, located mainly in Morocco & Western Sahara (70%), China (5%), Egypt (4%) & Algeria (3%). The remaining 18% is located in other countries (Table - 9).

The world production of phosphate rock decreased slightly by 3% to 221 million tonnes in 2020 from 227 million tonnes in 2019. China (42%), Morocco (16%), USA (11%), Russia (6%), and Jordan & Peru (4% each) have been the major producers (Table- 10).

Table – 9: World Reserves of Phosphate Rock

(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total (rounded)	**71000000**
Algeria	2200000
Australia	1100000[5]
Brazil	1600000
China[(6)]	3200000
Egypt	2800000
Finland	1000000
India*	46000
Israel	53000
Jordan	1000000
Kazakhstan	260000
Mexico	30000
Morocco & Western Sahara	50000000
Peru	210000
Russia	600000
Saudi Arabia	1400000
Senegal	50000
South Africa	1600000
Togo	30000
Tunisia	100000
Turkey	50000
USA	1000000
Uzbekistan	100000
Vietnam	30000
Other countries	2600000

Source: USGS, Mineral Commodity Summaries,2022

5 For Australia, Joint Ore Reserves Committee compliant reserves were 110 million tonnes.

*India's total reserves/ resources of rock phoshate as per National Mineral Inventory as on 1.4.2020 are 311.25 million tonnes.

Table – 10 : World Production of Phosphate Rock

(By Principal Countries)

(In '000 tonnes)

Country	2018	2019	2020
World: Total (rounded off)	232000	227000	221000
China	96326	93324	93000
Morocco	37600	35300	35000
USA	25700	23300	23400
Russia	13600	13800	13800
Jordan	8022	9223	8938
Peru	10308	11092	8594
Saudi Arabia	5444	5716	5700
Brazil[(d)]	5740	5300	5500
Vietnam	4332	4490	4390
Other countries	25519	25740	22844

Source : BGS, World Mineral Production, 2016-20.

d: Including beneficiated and directly shipped material.

To provide a generalised view of the development in various countries the country wise description as sourced from the latest available publication of Minerals Yearbook 'USGS' 2017 is furnished below:

Morocco

OCP Group continued with an expansion programme that was to increase its mine capacity from 39.0 Mt/yr to 52.1 Mt/yr during the next decade. A 12 Mt/yr expansion at Gantour was ongoing in 2017 and was planned to be completed by 2023. OCP planned to open new mines at Meskala deposit in the Essaouisa Region after 2023.

Saudi Arabia

Ma'aden Phosphate Co. (MPC) began production in mid -2017 at the Umm Wu'al Phosphate Mine on the Al-Khabra deposit. The mine was part of the Wa'ad Al Shammal phosphate project joint venture among MPC (60%), Mosaic (25%) and Saudi Arabian Basic Industries Corp. (15%). The project included the phosphate rock mine beneficiation plant and production facilities for phosphoric acid, animal feed, purified phosphoric acid, sodium tripolyphosphate and sulphuric acid. Proposals to expand the existing fertilizer plants at Ras Al Khair are also part of the project. The production capacities planned are 5.3 million tpy of phosphate concentrate, 1.5 million tpy of phosphoric acid and 3.5 million tpy of phosphate fertilizers. The new phase of the project was planned to be operational by 2024.

FOREIGN TRADE

Exports

In 2020-21, exports of rock phosphate increased drastically by 221% to 825 tonnes from 257 tonnes achieved in the previous year. Exports of phosphatic fertilizers at 385 tonnes in 2020-21 increased drastically by 124% from 172 tonnes recorded in the preceding year. The exports of phosphoric acid decreased drastically by manifold to 460 tonnes from 2,630 tonnes. Export of elemental phosphorus decreased by 10% to 583 tonnes from 650 tonnes in the preceding year. Rock phosphate was exported mainly to Malaysia (33%), Bangladesh (31%), USA (12%) and Nepal (11%). Elemental phosphorus was also mainly exported to Egypt (57%) & USA (25%). In 2020-21, exports of phosphatic fertilizers were mainly to Srilanka (49%) and Nepal (34%) while phosphoric acid was mainly exported to UAE (16%), Singapore (15%), Nepal (12%) and Mozambique (10%) (Tables- 11 to 16).

Table – 11: Exports of Rock Phosphate

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All countries	257	2015	825	5602
Malaysia	-	-	274	2040
USA	15	242	102	1923
Nepal	5	180	89	630
Bhutan	-	-	72	473
U K	-	-	22	272
Bangladesh	100	100	255	204
Kenya	-	-	6	22
New Zealand	-	-	1	16
Uganda	++	++	4	14
Thailand	10	179	++	5
Other countries	127	1314	++	3

Figures rounded off.

Table – 12 : Exports of Rock Phosphate (Ground)

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	243	1660	436	4291
Malaysia	-	-	274	2040
USA	15	242	102	1923
Nepal	1	6	60	328
Korea, Rep. of	126	1212	-	-
Bangladesh	100	100	-	-
Oman	1	100	-	-

Figures rounded off.

Table – 13: Exports of Rock Phosphate (Unground)

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	14	355	389	1311
Bhutan	-	-	72	473
Nepal	4	174	29	302
UK	-	-	22	272
Bangladesh	-	-	255	204
Kenya	-	-	6	22
New Zealand	-	-	1	16
Uganda	++	++	4	14
Thailand	10	179	++	5
Gambai	-	-	++	5
Czech Republic	++	2	-	-

Figures rounded off.

Table – 14: Exports of Phosphorus (Elemental)
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	650	256687	583	246040
USA	146	54315	144	56670
UAE	39	19382	90	43638
Russia	22	7511	68	23136
Brazil	54	24686	40	18141
Indonesia	28	12245	33	15015
Egypt	21	8058	333	13921
Israel	15	6036	28	11807
Peru	18	7067	20	8294
Hungary	-	-	20	8190
Philippines	20	8603	18	8174
Other countries	287	108784	89	39054

Figures rounded off.

Table – 15: Exports of Phosphatic Fertilizers
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	172	13729	385	15631
Nepal	35	715	130	4231
Korea, Rep. of	-	-	36	4004
Sri Lanka	++	46	190	3060
Germany	-	-	15	2317
Kenya	72	846	7	1722
New Zealand	6	394	4	258
Ethiopia	-	-	1	20
Maldives	-	-	2	14
Canada	-	-	++	5
Iran	56	11473	-	-
Other countries	3	255	-	-

Figures rounded off.

Table – 16: Exports of Phosphoric Acid
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2630	196837	460	50475
Singapore	23	7498	69	6830
UAE	160	10732	74	6559
USA	144	8470	36	4882
Nepal	96	6074	54	4612
Malaysia	++	415	10	3449
Mozambique	32	2482	45	3414
Burundi	6	608	27	2678
Bangladesh	20	2939	22	2672
Gabon	++	4	25	2149
Kenya	136	7365	29	2034
Other countries	2013	150250	69	11196

Figures rounded off.

Imports

Imports of rock phosphate increased slightly by 2% to 7.78 million tonnes in 2020-21 from 7.65 million tonnes in the previous year. Imports were mainly from Jordan (39%), Morocco (25%) and Egypt (22%). Imports of elemental phosphorus increased by 26% to 42,551 tonnes in 2020-21 from 33,751 tonnes in the previous year. The imports of elemental phosphorus were mainly from Vietnam (75%) and Russia (22%). During 2020-21, meager amount of phosphatic fertilizers were imported. Imports of phosphoric acid slightly increased by 0.5% to 2.51 million tonnes in 2020-21 from 2.50 million tonnes in the previous year. Imports were mainly from Morocco (39%), Jordan (25%) and Senegal (19%) (Tables- 17 to 22).

Table –17 : Imports of Rock Phosphate

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	7654867	54205952	7781423	53709109
Jordan	3277010	23539768	3016512	21316732
Morocco	1989978	17840735	1964608	17290552
Egypt	1260634	5499357	1725014	8042720
Togo	618143	4468832	784085	5466808
UAE	260057	1374333	237540	1275558
Algeria	214817	1221745	31500	184139
Cyprus	31800	171249	21800	121894
Hong Kong	880	30047	152	5262
Netherlands	1416	55953	96	4066
Turkey	-	-	108	1014
Other countries	132	3933	8	364

Figures rounded off.

Table – 18: Imports of Rock Phosphate (Ground)

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3354265	25970787	3673367	27621345
Morocco	1989978	17840735	1959208	17262394
Togo	385228	2758132	727418	4965344
Egypt	416107	2081194	489772	2424762
Jordan	189955	1198614	205881	1377926
UAE	260057	1374333	237540	1275558
Algeria	78750	457128	31500	184139
Cyprus	31800	171249	21800	121894
Hong Kong	880	30047	152	5262
Netherlands	1416	55953	96	4066
China	94	3367	-	-
Other countries	++	35	++	++

Figures rounded off.

Table – 19 : Imports of Rock Phosphate (Unground)
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4300602	28235165	4108056	26087764
Jordan	3087055	22341154	2810631	19938806
Egypt	844527	3418163	1235242	5617958
Togo	232915	1710700	56667	501464
Morocco	-	-	5400	28158
Turkey	-	-	108	1014
China	24	284	5	208
Denmark	-	-	2	152
Senegal	1	4	1	3
Serbia	-	-	++	1
Algeria	136067	764617	-	-
Other countries	13	243	-	-

Figures rounded off.

Table – 20 : Imports of Phosphorus (Elemental)
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	33751	6552640	42551	8199312
Vietnam	19770	3828940	32059	6159010
Russia	12432	2422015	9523	1841954
Kazakhstan	1435	275569	965	196481
Philippines	-	-	4	1799
USA	++	144	++	52
Germany	++	26	++	11
UK	++	29	++	5
Japan	96	20326	-	-
China	18	5589	-	-
Belgium	++	2	-	-
Other countries	-	-	-	-

Figures rounded off.

Table – 21: Imports of Phosphoric Acid
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2501094	119766817	2514246	124688967
Morocco	918384	43969976	986637	48714772
Jordan	605783	28552168	620569	30712792
Senegal	549630	26568795	489173	23937276
Tunisia	148353	7024339	119301	5887970
USA	142785	6831999	71003	3271520
Vietnam	74590	3804598	50127	2910996
South Africa	27891	1244510	50794	2604320
Egypt	12004	519501	30817	1476012
U A E	25	1283	29629	1474299
Philippines	++	31	28056	1466382
Other countries	21649	1249617	38140	2232628

Figures rounded off.

Table – 22: Imports of Phosphatic Fertilizers

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	16	2324	++	51
Korea	-	-	++	40
Ukraine	-	-	++	11
China	++	18	-	-

Figures rounded off.

FUTURE OUTLOOK

There is no substitute for phosphorus in agriculture. The country is deficient in all fertilizer minerals. The reserves/ resources of chemical and fertilizer grades apatite and rock phosphate in India are very limited. Therefore, detailed exploration is necessary for conversion of remaining resources into reserves. Secondly, the search for apatite and rock phosphate may have to be intensified in Andhra Pradesh, Rajasthan, Madhya Pradesh, Jharkhand, Tamil Nadu, Meghalaya, Gujarat, Uttar Pradesh, Uttarakhand, West Bengal, etc. Till the domestic resources of these two minerals are improved, the country has no alternative but to depend on imports. Concerted efforts should be made by way of constituting consortia of public-private companies to acquire assets abroad specifically in countries like Uzbekistan, Jordan, etc. Strengthening ties with mineral-rich countries and provinces with functional and specific MoUs and utilisation of IMG mechanism to align domestic stakeholders with MoUs is required. Only about 10-15% requirement of raw material for phosphate fertilizer production is met through indigenous sources. The remaining requirement is met through imports in the form of rock phosphate, phosphoric acid and direct fertilizers. Private Sector participation in rock phosphate mining needs to be promoted in order to make available the above two minerals to reduce import dependence for promotion of fertilizers for Agricultural Sector.

Demand for phosphatic fertilizer is expected to increase gradually in tandem with the growth in population and corresponding increase in food requirements.The Government has been encouraging Indian Companies to establish joint venture abroad in countries which are rich in fertilizer resources.

In India, most of the existing phosphatic fertilizer and phosphoric acid plants have been designed for high-grade imported rock phosphate, mainly from Morocco and Jordan. The Indian deposits on the other hand, are of low-grade variety. Therefore, the fertilizer and phosphoric acid plants that are likely to be set up as replacement of the existing plants may have to be designed to accept indigenous ores as feed. In addition, beneficiation of domestic low-grade ores would be a step in the right direction and should be promoted persuasively.

2. Asbestos

22.90
(million tonnes) Total reserves/resources of asbestos in the country as on 1st April 2020

299
(tonnes) of asbestos were exported in 2020-21

3,08,506
(tonnes) of asbestos were imported in 2020-21

Asbestos is a group of six naturally occurring fibrous silicate minerals. The physical properties, besides fibrous character, such as, fineness, flexibility, tensile strength & length of fibres, infusibility, low heat conductivity and high resistance to electricity & sound as also to corrosion by acids, make asbestos commercially important. Commercial asbestos is classified into two main mineralogical groups: serpentine asbestos or chrysotile asbestos and amphibole asbestos. The latter includes asbestos minerals, such as, tremolite, actinolite, anthophyllite, amosite and crocidolite. Commercially, chrysotile asbestos is far superior in physical properties and hence more valuable than amphibole asbestos.

India's asbestos requirement is met through imports from Russia, Kazakhstan, Brazil,China and other countries.

RESERVES/RESOURCES

As per NMI database, based on UNFC system, the total reserves/resources of asbestos in the country as on 1.4.2020 has been placed at 22.90 million tonnes. A total of 22.90 million tonnes of asbestos are placed under Remaining Resources. Out of the total resources, Rajasthan accounts for 13.61 million tonnes (59%) and Karnataka 8.28 million tonnes (36%). The remaining five per cent resources are estimated in States of Jharkhand, Andhra Pradesh, Odisha and Uttarakhand (Table-1) (Fig-1 to 3).

Table-1: Reserves/Resources of Asbestos as on 1.4.2020 (P)

(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	-	-	-	-	2488022	3113446	4062376	100687	2527959	10557777	57800	22908067	22908067
By Grades													
Chrysotile	-	-	-	-	684838	39126	16553	2885	17660	70843	-	831905	831905
Amosite	-	-	-	-	-	-	-	-	3987	4459680	-	4463667	4463667
Tremolite	-	-	-	-	-	94768	116516	-	2426700	1562125	-	4200109	4200109
Chrysotile mixed with others	-	-	-	-	-	3871	18309	-	-	336	-	22516	22516
Mixed Amphibole	-	-	-	-	1743560	2642595	3745856	87802	42101	4121718	-	12383632	12383632
Actinolite	-	-	-	-	-	-	-	-	311	34000	-	34311	34311
Anthophyllite	-	-	-	-	-	-	-	-	-	20000	-	20000	20000
Others	-	-	-	-	-	332459	99675	-	-	-	-	432134	432134
Not-known	-	-	-	-	59623	627	65467	-	-	279574	57800	463091	463091
Unclassified	-	-	-	-	1	-	-	10000	37200	9500	-	56701	56701
By States													
Andhra Pradesh	-	-	-	-	684839	39126	16553	-	1541	55936	-	79799	79799
Jharkhand	-	-	-	-	-	3871	18309	2885	5769	124059	-	154893	154893
Karnataka	-	-	-	-	-	-	-	-	2441037	5841420	-	8282457	8282457
Odisha	-	-	-	-	-	-	-	10000	37200	9500	-	56700	56700
Rajasthan	-	-	-	-	1803183	3070449	4027514	87802	42101	4526861	57800	13615710	13615710
Uttarakhand	-	-	-	-	-	-	-	-	311	-	-	311	311

Figures rounded off.

Fig-1: Reserve/Resources of Asbestos in India
Reserves Total - 0
Remaining Resources - 2290806/ tonnes

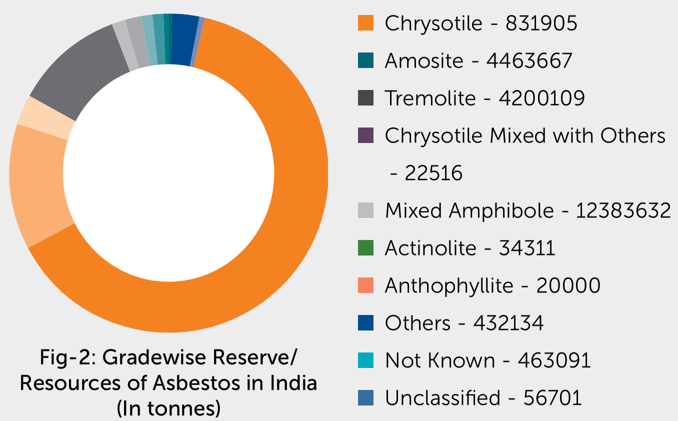


Fig-2: Gradewise Reserve/ Resources of Asbestos in India (In tonnes)

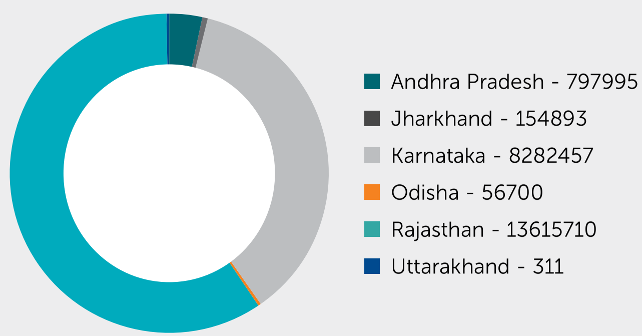


Fig-3: Statewise Reserve/ Resources of Asbestos in India (In tonnes)

Table-2 summarises the mineralogical varieties of asbestos occurring in various parts of the country.

Table-2: Occurrences of Asbestos in India

State	District	Mineralogical variety
Andhra Pradesh	Anantapur	Chrysotile
	Cuddapah	
Jharkhand	Singhbhum (East)	Chrysotile, tremolite, chrysotile mixed with other minerals
	Singhbhum (West)	
Karnataka	Chikkamagaluru	Amosite
	Hassan	Anthophyllite
	Mandya	Mixed amphibole minerals
	Mysuru	Chrysotile
	Shivamogga	Amosite
Odisha	Kendujhar	-
Rajasthan	Ajmer	Mixed amphibole minerals
	Bhilwara	-do-
	Dungarpur	-do-
	Pali	Tremolite, chrysotile mixed with other amphibole minerals
	Rajsamand	Tremolite, actinolite and mixed amphibole minerals
	Udaipur	Chrysotile, tremolite and mixed amphibole minerals
Uttarakhand	Chamoli	Others

PRODUCTION

No production of asbestos was reported in 2020-21 as well as in the previous year and there were no reporting mines in 2020-21 as well as in preceding year.

Similarly, the mine-head closing stocks of asbestos also remained 'Nil' for the year 2020-21 as well as in the preceding year 2019-20. The average daily employment of labour for both the years was 'Nil.'

MINING & MILLING

Presently there is no working mine of asbestos in India. The usual method of mining chrysotile in Pulivendla Tehsil, Cuddapah district, Andhra Pradesh, was by opening an incline along the dip varying from 200 to 250, keeping the trap as floor and limestone as roof. Two or three such inclines were converted into a regular underground mine by developing levels and winzes, connecting them and adopting board-and-pillar system of development. In almost all the mines, operations like blasting, hole drilling, hoisting, pumping and ventilation were mechanised.

The run-of-mine was subjected to manual sorting of asbestos-bearing rock (ABR). ABR was then hand-combed for chipping off the asbestos-bearing portion in small pieces of about 2.5 cm for producing asbestos concentrates. From ABR, the serpentine was removed as a waste. The asbestos concentrate was fed manually into hopper of a hammer mill. In hammer mill, asbestos and other minerals were separated and then fed to double-deck screen having 10 to 40 mesh sieves. The screening gives three fractions: (a) oversize, (b) middling and (c) tailing. Tailing was taken as a waste which generally did not contain appreciable quantity of asbestos. The oversize was recycled in the hammer mill, and the middling fibre was sucked up by a cyclone and collected.

GRADING & MARKETING

Small fibres recovered through milling process account for nearly a two-third production. The general grading system adopted is as follows:

Grade	Fibre Size	Method
Grade - As	45 mm and above	Hand-sorted
Grade - A	Between 25 and 45 mm	
Grade - B	Between 12 and 25 mm	
Grade - C	Above 16 mesh	Mill-processed
Grade - D3	24 mesh	
Grade - D4	40 mesh	
Grade - D6	60 mesh	

Note: Producers of amphibole asbestos sell their output as crude or fluff and powder.

CLASSIFICATIONS

Various classifications of chrysotile asbestos followed in India are based, by and large, on fibre length:

(1)	**Grade A or**		
	A Special -	-	25.4 mm fibres or larger
	As1	-	25.4 mm and larger fibres but brittle compared to As or A Special
	A	-	19.05 to 25.4 mm fibres
	A1	-	19.05 to 25.4 mm fibres but brittle compared to A
	A2	-	19.05 to 25.4 mm fibres but brittle compared to A1
	Grade B	**-**	**6.35 to 19.05 mm fibres**
	B1	-	6.35 to 19.05 mm fibres but brittle compared to B
	B2	-	6.35 to 19.05 mm fibres but brittle compared to B1
	C	-	Below 6.35 mm fibres
(2)	**Grade A Special**	**-**	**Above 31.5 mm**
	A	-	Between 19 and 31.5 mm
	B	-	Between 6.3 and 19 mm
	C	-	Below 6.3 mm including powder
	D	-	Dust

3) Quebec standard asbestos testing machine classification of chrysotile asbestos according to groups is given below:

Crude Asbestos		
Group No. 1 Crude No. 1	:	Consists basically of crude, 3/4 inch and longer staple
Group No. 2 Crude No. 2	:	Consists basically of crude, 3/8 to 3/4 inch staple.

Milled Asbestos	
Standard designation of grade	Guaranteed minimum spinning test
Group No. 3 (spinning fibres)	
3 D	10.5-3.9-1.3-0.3
3 Z	0-8-6-2
Group No. 4 (shingle fibres)	
4 D	0-7-6-3
4 Z	0-1.5-9.5-5
Group No. 5 (paper fibres)	
5 D	0-0.5-10.5-5
5 R	0-0-10-6
Group No. 6 (waste)	
6 D	0-0-7-9
Group No. 7 (shorts or refuse)	
7 D	0-0-8-11
7W	0-0-0-16
Group No. 7 (floats)*	
7 RF	No test
7 TF	No test
Group No. 8 (sand & gravel)	
8 S	Less than 50 lb per cu. ft loose measure
8T	Less than 75 lb per cu. ft loose measure.
Group No. 9 (gravel & stone)	
9T	More than 75 lb cu. ft loose measure

* The suffix 'F' designates 'floats' in the case of 7R and 7T grades.

USES

Industrial use of asbestos is linked with the type of asbestos. Chrysotile asbestos, being more fibrous and possessing better tensile strength than amphibole variety is used in the manufacture of asbestos fabrics, cement sheets, pipes and allied products. It is also used in brake linings, insulation and fireproof clothing. Short fibres are used with cement as binders for manufacturing asbestos-cement products. Amphibole asbestos generally finds use in heat insulation and treatment of acids. Anthophyllite and tremolite fibres, although of good length, are too weak and brittle to be spun. They are, therefore, used for boiler lagging, hard-setting magnesia composition and as a filler in asbestos paints and various asbestos-moulded articles.

SUBSTITUTION

Materials substituted for asbestos include calcium silicate, carbon fibres, fibres of cellulose, ceramic, glass & steel, wollastonite and several organic fibres like aramid, polyethylene, polypropylene and polytetrafluoroethylene. Where reinforcement properties of fibres are not required, several non-fibrous minerals are also considered for possible substitution. However, no single substitution is found to be as versatile or as cost-effective as asbestos.

ENVIRONMENTAL IMPACT OF ASBESTOS

Asbestos used as a part of construction material due to flame retardant quality, poses major risk to human health and environment. Asbestos has been linked in number of serious medical conditions. These include the lungs and respiratory problems because asbestos is made of tiny fibres that when released into the air and prolonged breathing of air laden with asbestos dust can settle inside the lungs and irritate the tissues in the chest cavities. Mesothelioma is a rare form of cancer of the lungs and digestive tract which is most commonly caused by exposure to asbestos mixed air. Besides health hazards, asbestos also has negative impact on the environment. A study presented in 2006 at the International Conference on Health, the Environment and Justice found that asbestos dust can easily travel through the air and into the water supply. It can also settle on the surface of the soil instead of getting absorbed into the ground, which means that it can still get picked up by the wind and inhaled into human respiratory system.

However, as per the report of the 'Asbestos Cement Products Manufactures' Association' in India, only chrysotile (white) asbestos fibre is used for the manufacture of asbestos-cement sheets and asbestos-cement pipes which contain a very small quantity of chrysotile fibre (only 8–10%). The other raw materials used are cement 45%, fly ash 30-35% and wood pulp. The asbestos fibres are firmly locked-in or encapsulated within the cement matrix during manufacture so that fibres cannot be emitted into the atmosphere under normal use and thus, pose no health risk to the general public or environment. Several studies abroad have concluded that use of chrysotile in the manufacture of Asbestos Cement Products under controlled conditions is safe for the workers, environment and the general public.

India has again opposed the listing of chrysotile asbestos as a hazardous substance under the Rotterdam Convention at the eighth meeting of the Conference of Parties (COP) held in Geneva from 24th April to 5th May 2017.

TRADE POLICY & LEGISLATION

No restrictions have been imposed on exports of asbestos in the Foreign Trade Policy, 2015-20. As per the prevailing Foreign Trade Policy, asbestos under Heading 2524 can be imported freely with the exception of amosite which is restricted. However, the imports of crocidolite, actinolite, anthophyllite, amosite and tremolite are restricted in terms of Interim Prior Informed Consent (PIC) Procedure of Rotterdam Convention for Hazardous Chemicals and Pesticides.

Ministry of Environment and Forest, vide Notification dated 13.10.1998, under Sections 3 (1) and 6 (2) (d) of Environment (Protection) Act, 1986 and Rule 13 of Environment (Protection) Rules, 1986, has prohibited the imports of waste asbestos (dust and fibre), on account of it being a hazardous waste detrimental to human health and environment.

WORLD REVIEW

Large reserves are located mainly in Russia, China, Kazakhstan and Zimbabwe. Russia was the leading producer with 670 thousand tonnes, followed by Kazakhstan (227 thousand tonnes) China (100 thousand tonnes) and Brazil (100 thousand tonnes) (Tables-3 and 4).

Table-3: World Reserves of Asbestos
(By Principal Countries)

(In million tonnes)

Country	Reserves
World: Total	Large
Brazil	11
China	95
Kazakhstan	Large
Russia	110
USA	Small
Zimbabwe	Large

Source: USGS, Mineral Commodity Summaries, 2022.

* India's total reserves/resources of asbestos as per NMI database, based on UNFC system, as on 1.04.2020 have been estimated at 22.90 million tonnes.

Table-4: World Production of Asbestos
(By Principal Countries)

(In '000 tonnes)

Country	2018	2019	2020
Brazil	101	100	100
China	125	150	100
Colombia	355	0	0
Kazakhstan	202	210	227
Russia	753	790	670

Source: BGS, World Mineral Production, 2016-2020.

(e) : Estimated.

FOREIGN TRADE

Exports

Exports of asbestos decreased substantially to 299 tonnes in 2020-21 as compared to 1,001 tonnes in the previous year. Exports were mainly to Bangladesh (92%) and Nepal (1%) (Fig-4). Exports of asbestos (fibre products) were at 41739 tonnes in 2020-21 as compared to 43298 tonnes in the previous year. Exports were mainly to USA (32%), UAE (8%), Egypt (5%) and Nepal, Canada, (2% each). Exports of asbestos (chrysotile) were at 275 tonnes during the year 2020-21 as compared to 997 tonnes in the preceding year.

Exports of asbestos (others) increased to 24 tonnes during the year 2020-21 as compared to 5 tonnes in the preceding year. Exports were mainly to Nepal. Exports of asbestos-cement products were 89833 tonnes in 2020-21 as compared to 91101 tonnes in the preceding year. Exports of asbestos-cement products were mainly to UAE (30%), Nepal (23%) and Qatar (20%) (Tables-5 to 9).

Table-5: Exports of Asbestos
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1001	31011	299	11991
Bangladesh	925	28048	275	11887
Nepal	4	20	24	54
Kenya	-	-	++	42
Cote D' Ivoire	-	-	++	8
Sri Lanka	72	2943	-	-

Figures rounded off.

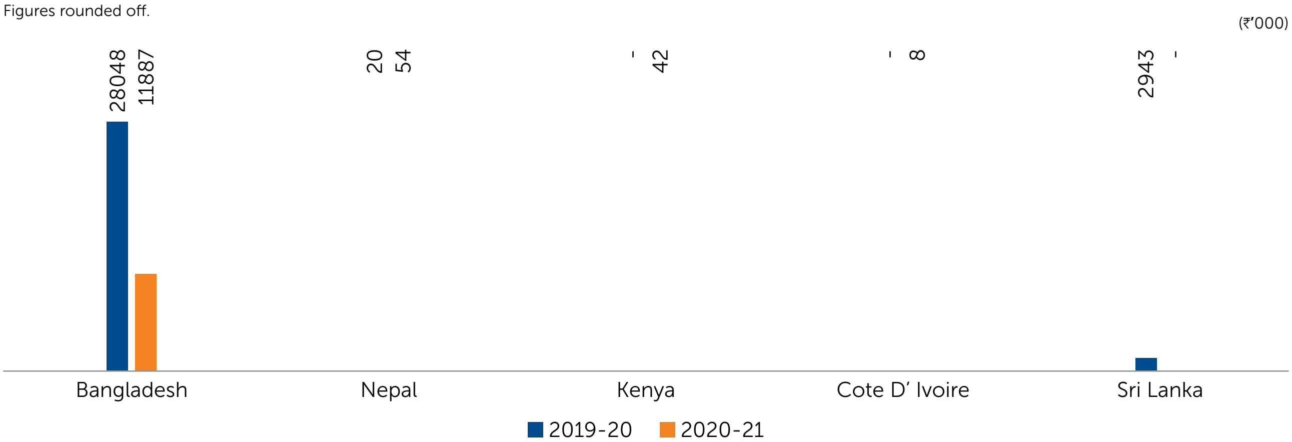


Fig 4: Country wise Value of Exports of Asbestos

Table-6: Exports of Asbestos (Fibre Products)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	43298	5071610	41739	5548536
USA	10458	1404246	13407	1834003
UAE	3137	318572	3355	388212
Brazil	534	101953	817	262332
Egypt	2392	184881	2244	179241
Canada	1252	172383	1149	160061
Nepal	1479	178182	1076	151558
Saudi Arabia	1018	149929	1203	150218
Sri Lanka	1161	166185	888	146252
Kenya	1287	132236	1440	133834
Turkey	507	113604	464	131610
Other countries	20073	2149439	15696	2011215

Figures rounded off.

Table-7: Exports of Asbestos (Chrysotile)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	997	30994	275	11895
Bangladesh	925	28048	275	11887
Cote D' Ivoire	-	-	++	8
Sri Lanka	72	2943	-	-
Nepal	++	3	-	-

Figures rounded off.

Table-8: Exports of Asbestos (Others)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4	17	24	96
Nepal	4	17	24	54
Kenya	-	-	++	42

Figures rounded off.

Table-9: Exports of Asbestos Cement Products

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	91101	1447617	89833	1444464
UAE	32432	458930	27254	389165
Nepal	23572	360084	20814	323160
Qatar	9822	148841	18132	283356
UK	3155	55953	6398	128380
South Africa	1203	19533	3319	55863
Oman	3355	47728	2577	41041
Maldives	2048	48543	1313	27240
Kuwait	972	13271	1060	19232
Angola	1687	23149	1338	18314
Seychelles	1186	20070	858	16019
Other countries	11669	251515	6770	142694

Figures rounded off.

Imports

Imports of asbestos were 3,08,506 tonnes in 2020-21 decreased by only 15% as against 3,61,163 tonnes in the previous year. Almost entire import was that of chrysotile asbestos. Imports of asbestos were mainly from Russia (63%), Brazil (23%), Kazakhstan (3%), & Hungary (5%) (Fig-5). A total of 19306 tonnes asbestos-cement products were also imported in 2020-21 as against 25008 tonnes in the previous year. Imports were mainly from Thailand (91%) and Indonesia (6%). Imports of asbestos fibre products were 2309 tonnes during the year 2020-21 as compared to 3577 tonnes in previous year. Imports of asbestos fibre products were mainly from Denmark (29%), Japan (25%) and China (22%). In addition to asbestos minerals, an unknown quantity of asbestos is traded within manufactured products, possibly including brake linings and pads, building materials, gaskets, millboard, yarn and thread (Tables-10 to 14).

Table-10: Imports of Asbestos
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	361163	12432333	308506	11851124
Russia	307429	10565063	195419	7749132
Brazil	12606	432985	72385	2454931
Hungary	11457	410060	16549	688296
Kazakhstan	9390	323600	10105	379339
Poland	7088	237275	9614	348194
South Africa	8657	324670	2816	169062
China	3667	113566	1017	33651
USA	653	19679	240	18102
Singapore	68	2008	136	4864
UK	72	2320	45	244
Other countries	76	1107	180	3107

Figures rounded off.

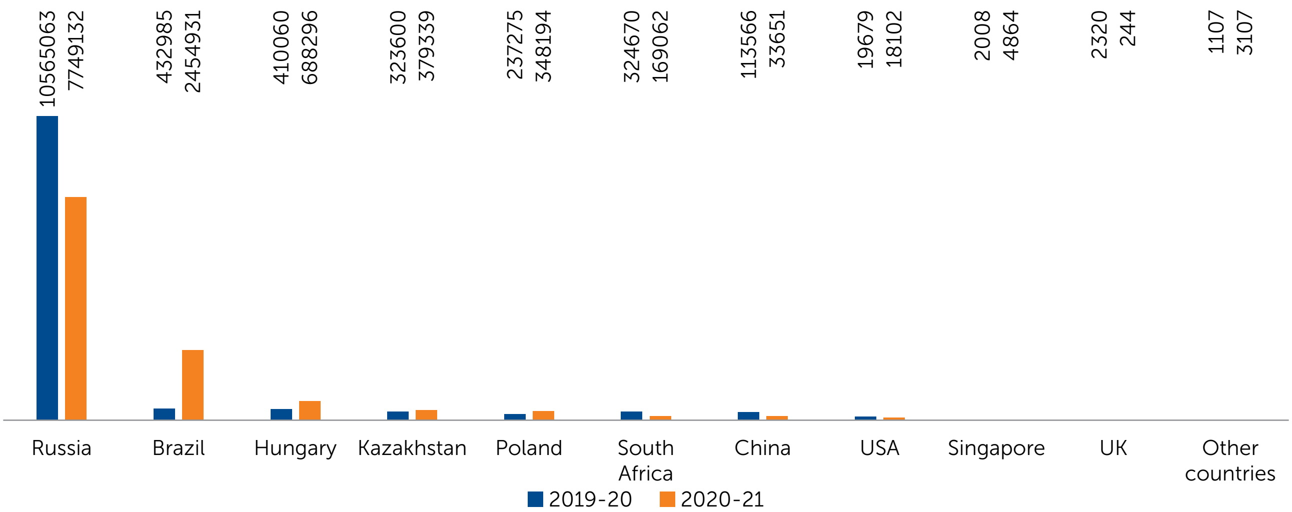


Fig-5: Countrywise Value of Imports (in ₹'000) of Asbestos

Table-11: Imports of Asbestos (Chrysotile)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	360839	12422164	308100	11840174
Russia	307159	10555466	195419	7749132
Brazil	12606	432985	72385	2454931
Hungary	11457	410060	16549	688296
Kazakhstan	9390	323600	10105	379339
Poland	7088	237275	9344	338450
South Africa	8657	324670	2816	169062
China	3667	113458	1016	33621
USA	653	19679	240	18102
Singapore	68	2008	136	4864
UK	72	2320	45	2446
Other Countries	22	643	45	1931

Figures rounded off.

Table-12: Imports of Asbestos (Others)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	324	10169	406	10950
Poland	-	-	270	9744
Turkey	54	464	135	1176
China	++	108	1	30
Russia	270	9597	-	-

Table-13: Imports of Asbestos Cement Products

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	25008	570692	19306	466845
Thailand	23191	474446	17629	373669
Indonesia	880	25624	1185	36903
USA	85	38139	24	18133
Germany	1	8198	2	14552
China	452	11374	202	8747
Turkey	20	4961	22	6063
Mexico	-	-	119	3924
Belgium	-	-	9	1431
Philippines	90	3059	7	1220
Bangladesh	206	2827	85	982
Other countries	83	2064	22	1221

Table-14: Imports of Asbestos Fibre Products

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3577	2740754	2309	2750723
Japan	826	1448298	589	1251083
Denmark	433	297280	667	526425
USA	153	187427	150	198495
China	1094	181465	510	183946
Germany	147	114685	93	182431
Korea, Rep. of	193	97026	76	110737
UK	328	83128	65	68067
Netherlands	45	42084	18	35352
France	17	6896	30	32344
Thailand	46	60937	18	31159
Other countries	295	221528	93	130684

FUTURE OUTLOOK

Consumption of asbestos minerals in India & other countries of the world will decline steadily in near future. This decline will be due to health and liability issues associated with asbestos use, leading to the displacement of asbestos from traditional domestic markets by substitutes, alternative materials and technological advancement.

While the economic impact of asbestos mining in India is minimal, mining operations do adversely affect human and environmental health. Globally, asbestos-cement products are expected to continue to be the leading market for asbestos. India's imports of chrysotile asbestos too have been showing significant growth. Owing to continued demand for asbestos products in many regions of the world, global production is likely to remain steady at approximately 2.0 million tonnes per year for the near future as per USGS report on asbestos.

3. Bauxite

4,958
(million tonnes) Total reserves/ resources of bauxite were established as on 1st April 2020

20,368
(thousand tonnes) Production of bauxite were reported in 2020-21

240
(thousand tonnes) of bauxite were exported in 2020-21

3,034
(thousand tonnes) of bauxite were imported in 2020-21

Bauxite is basically an aluminous rock that contains hydrated aluminium oxide as main constituent and iron oxide, silica & titania as minor constituents present in varying proportions. Hydrated aluminium oxides present in the bauxite ore are diaspore and boehmite, Al_2O_3. H_2O (Al_2O_3:85%; Al:45%); gibbsite or hydrargillite, Al_2O_3. $3H_2O$ (Al_2O_3: 65.4%; Al:34.6%), and bauxite (containing colloidal alumina hydrogel), Al_2O_3. $2H_2O$ (Al_2O_3:73.9%; Al:39.1%). The iron oxide in bauxite ore is present as haematite or goethite; silica as clay; and free quartz & titania as leucoxene or rutile. Bauxite is the principal ore of aluminium which is one of the most important non-ferrous metals used in the modern industry. It is also an essential ore for Refractory and Chemical industries.

RESERVES/RESOURCES

Reserves/Resources of bauxite in the country as on 1.4.2020, as per NMI database, based on UNFC system have been placed at 4,958 million tonnes. These resources include 646 million tonnes Reserves and 4,311 million tonnes Remaining Resources. By grades, about 77% resources are of Metallurgical grade (I&II). The resources of Refractory and Chemical grades are limited and together account for about 4%. By States, Odisha alone accounts for 41% of country's resources of bauxite followed by Chhattisgarh 20%, Andhra Pradesh (12%), Gujarat (8%), Jharkhand (6%), Maharashtra (5%) and Madhya Pradesh (4%). Major bauxite resources are concentrated in the East Coast bauxite deposits in Odisha and Andhra Pradesh (Table-1).

Table-1: Reserves/Resources of Bauxite as on 1.4.2020 (P)

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	560865	15553	70076	646493	268398	128409	316835	526286	843058	2044653	184116	4311754	4958248
By Grades													
Chemical	5454	480	706	6639	1936	4819	528	2877	182	5063	-	15405	22044
Refractory	30120	437	11806	42363	5705	8788	46667	6737	184	31999	628	100709	143072
Chemical/Refractory Mixed with others	1301	120	154	1575	6037	3202	793	3378	216	11161	-	24786	26362
Metallurgical-1	468244	9495	29788	507527	164431	44265	188496	390814	427586	1410328	19573	2645493	3153020
Metallurgical-2	27772	986	8342	37100	25714	21567	37982	19638	138352	334894	7640	585786	622886
Metallurgical mixed	6443	310	2030	8783	8463	5085	7378	58958	11308	38329	16846	146366	155149
Low Grade	7920	2673	16056	26649	22851	4619	17908	24414	211839	151151	88692	521473	548122
Beneficiable	832	-	-	832	-	756	-	-	34424	4610	39260	79050	79883
Mixed grade Excluding Chem./ Refrac.	7503	561	339	8403	22017	12399	7563	6839	4370	13387	-	66576	74979
Abrasive	-	-	-	-	264	740	123	92	56	961	840	3076	3076
Others	3192	-	855	4047	5971	137	8754	11999	5600	9250	1545	43257	47304
Unclassified	2084	491	-	2576	4303	22033	643	535	8940	12093	8954	57500	60076
Not-known	-	-	-	-	706	-	-	5	-	21427	138	22276	22276
By States													
Andhra Pradesh	-	-	-	-	-	-	-	188971	138120	288176	-	615267	615267
Bihar	-	-	-	-	-	-	-	-	-	4114	-	4114	4114
Chhattisgarh	19202	1073	3420	23695	14306	4727	46620	37763	75682	771015	18747	968860	992555
Goa	7963	-	1650	9613	5222	1097	8195	6820	-	36910	-	58244	67857
Gujarat	83448	2005	15777	101230	86746	41434	21913	29145	22107	82774	11678	295797	397027
Jammu & Kashmir	-	-	-	-	-	-	-	1323	182	1220	-	2725	2725
Jharkhand	29524	731	9717	39972	25895	7647	14969	25962	63224	70527	41050	249272	289244
Karnataka	126	194	4887	5207	2468	864	88	82	2220	35520	-	41242	46449
Kerala	-	-	-	-	29	-	24	2037	14637	2722	-	19449	19449
Madhya Pradesh	13584	631	4349	18564	20389	13358	1738	22060	54577	50172	-	167695	186259
Maharashtra	18833	3573	16065	38472	15794	1981	21023	38931	32875	83354	-	193958	232430
Meghalaya	-	-	-	-	-	-	-	-	-	4300	-	4300	4300
Odisha	388184	7346	14210	409740	97550	56160	193301	161842	428849	596940	11642	1647284	2057024
Rajasthan	-	-	-	-	-	-	-	-	-	528	-	528	528
Tamil Nadu	-	-	-	-	-	1141	3564	960	10084	8363	-	24112	24112
Uttar Pradesh	-	-	-	-	-	-	-	10390	500	8018	-	18908	18908

Figures rounded off.

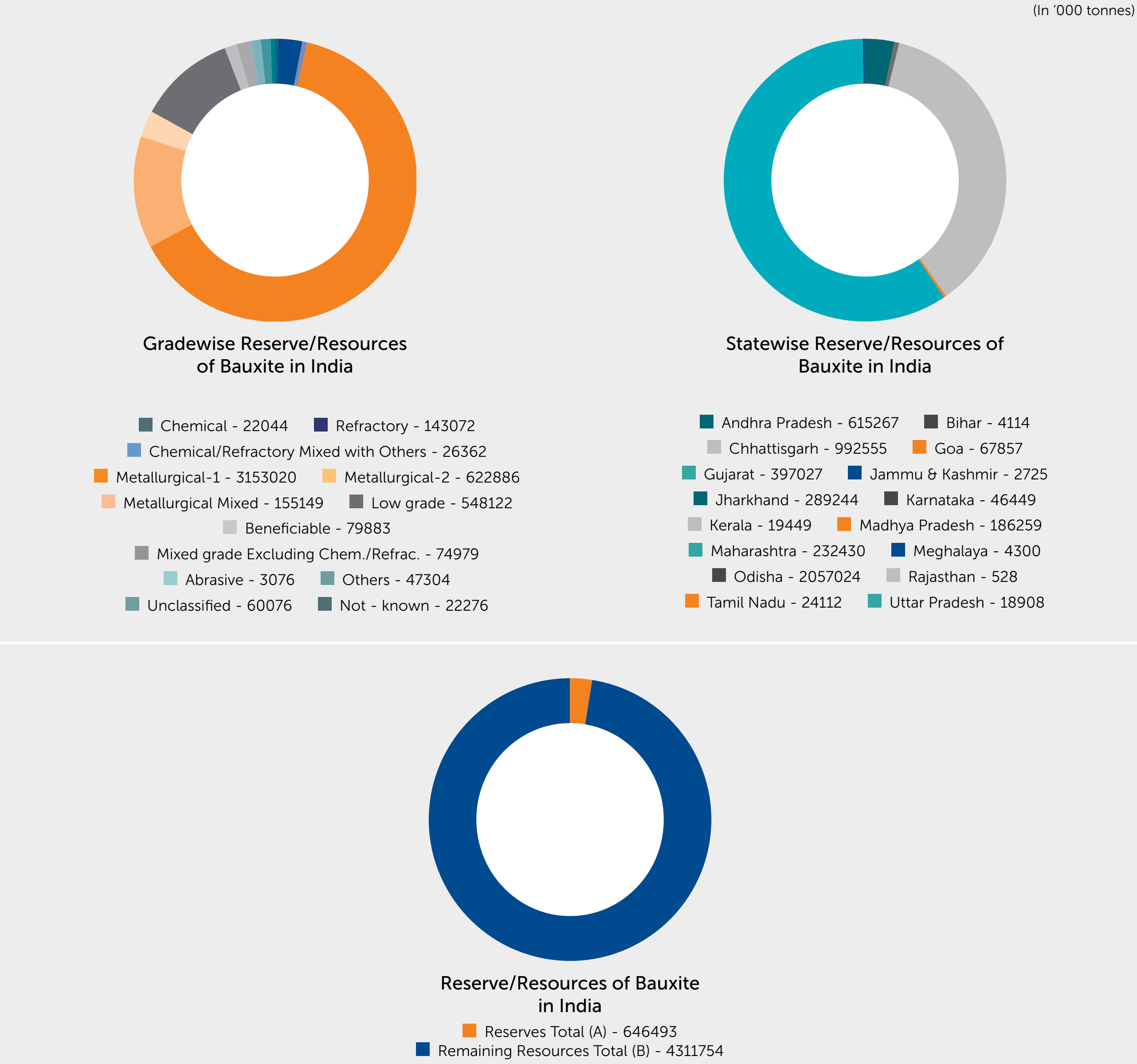


Fig 1: Reserve/Resources of Bauxite in India

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION & STOCKS

The production of bauxite at 20,368 thousand tonnes in 2020-21 decreased by about 7 % as compared to that of the previous year.

There were 131 reporting mines in 2020-21 as against 144 in the previous year. Besides, production of bauxite was reported as an associated mineral by 6 mines during the year. In all, 54 producers reported production of bauxite in 2020-21. Out of these, ten principal producers having 39 mines contributed about 99.25% of the total production.

NALCO is the leading producer of bauxite and contributed 36% to the total production. The share of Public Sector mines was about 52% of the total production in 2020-21, as against 50% in the previous year.

About 84% of the total production of bauxite was of 40–45% Al_2O_3 grade, 9% was of Cement grade, 4% of 45% to 50% Al_2O_3, 1% below 40% Al_2O_3 and the remaining production was reported in other grades except two grades 50-55%, 55-60% and (above 60% Al_2O_3 grade), during the year 2020-21.

Odisha emerged as the leading producing State accounting for about 76% of the total production during 2020-21 (Tables -2 to 5).

Table-2: Principal Producers of Bauxite, 2020-21

Name & address of producers	Location of mine	
	State	District
National Aluminium Co. Ltd, NALCO Bhawan, P-1, Nayapalli, Bhubaneswar-751 061, Odisha.	Odisha	Koraput

Contd.

Name & address of producers	Location of mine	
	State	District
Utkal Alumina International Ltd, J-6, Jayadev-Vihar, Bhubaneswar-751 013, Odisha.	Odisha	Raygada
Odisha Mining Corporation Ltd. OMC House, Unit-V, Post Box No. 34, Bhubaneswar- 751 001 Odisha.	Odisha	Koraput
Hindalco Industries Ltd, Ahura Centre, Ist Floor, B-Wing, Mahakali Caves Road, Andheri (East), Mumbai-400 093, Maharashtra.	Chhattisgarh	Surguja
	Jharkhand	Gumla Latehar Lohardaga
	Maharashtra	Kolhapur
Smt P. H. Joshi 216, Shivam Complex, Opp. Hetarth party plot, Sola sciemce city Road Gujarat-388225, Ahmedabad	Gujarat	Kheda
Minerals & Minerals Ltd, Court Road, Lohardaga-835 302, Jharkhand.	Jharkhand	Lohardaga Gumla
Gujarat Mineral Development Corporation Ltd, Khanij Bhavan, 132 Feet Ring Road, Near University Ground, Vastrapur, Ahmedabad -380052, Gujarat.	Gujarat	Devbhoomi Dwarka Kachchh
Saurashtra Minerals Pvt. Ltd. East Kadia Plots. Porbandar -360575 Gujarat.	Gujarat	Porbandar
Alimiya Imamali Saiyad, FF/16, Samruddhi Complex, Near L.I.C. Office, Himmatnagar, Dist, Sabarkantha-383 001 Gujarat.	Gujarat	Sabarkantha
Bhartesh Construction Company, Pro. of M/s Bharatesh Construction Co. Shop No. 34, Goaves, Hindwadi, Belgaum - 590 011 Karnataka	Maharashtra	Kolhapur

Table-3: Production of Bauxite, 2018-19 to 2020-21

(By States)

(Quantity in tonnes; Value in ₹'000)

Country	2018-19		2019-20		2020-21	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**23689619**	**17836033**	**21825227**	**16299333**	**20368665**	**16667101**
Chhattisgarh	1502350	1607698	1565307	1609377	715296	751480
Goa	518	104	-	-	-	-
Gujarat	2185325	1412294	2076329	1439889	1497712	1196637
Jharkhand	2412486	2479551	1418794	1400830	1497473	1586192
Madhya Pradesh	750433	599967	685929	546953	621505	472602
Maharashtra	1424865	736127	595562	401196	471068	335740
Odisha	15413642	11000292	15483307	10901088	15565611	12324450

(In tonnes)

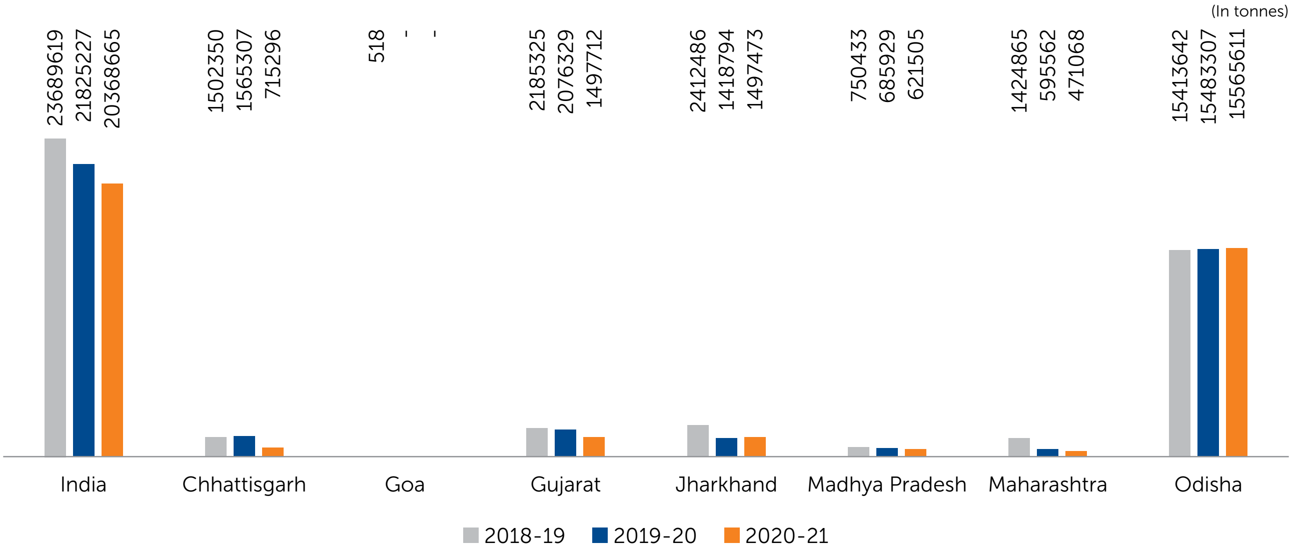


Fig 2: Production of Bauxite

Table-4 (A): Gradewise Production of Bauxite, 2019-20 (P)

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

Grade/State	For use in Alumina & Aluminium extraction : Al_2O_3 content							For use other than Alumina & Aluminum extraction				Total	
	No. of Mines	60% above	55–60%	50–55%	45–50%	40–45	Below 40%	Cement	Abrasive	Refractory	Chemical	Quantity	Value
India	144(6)	-	5665	1701	121634	18635652	260591	2283453	67789	119736	329006	21825227	16299333
Public Sector	21	-	-	-	29	10494669	16032	-	-	32832	316092	10859654	8017260
Private Sector	123(6)	-	5665	1701	121605	8140983	244559	2283453	67789	86904	12914	10965573	8282073
Chhattisgarh	15	-	-	-	29	1565278	-	-	-	-	-	1565307	1609377
Kabirdham	2	-	-	-	29	469800	-	-	-	-	-	469829	550167
Kondagaon	2*	-	-	-	-	-	-	-	-	-	-	-	-
Surguja	11	-	-	-	-	1095478	-	-	-	-	-	1095478	1059210
Gujarat	68	-	5665	1701	-	69718	16032	1533420	67705	65996	316092	2076329	1439889
Amreli	1	-	-	-	-	2000	-	-	-	-	-	2000	1626
Devbhoomi Dwarka	42	-	5665	1701	-	67718	-	266867	64335	38393	-	444679	325716
Kheda	10	-	-	-	-	-	-	471430	-	-	-	471430	337280
Kutch	7	-	-	-	-	-	16032	-	-	22373	316092	354497	327958
Porbandar	4	-	-	-	-	-	-	227283	3370	5230	-	235883	144796
Sabarkantha	4	-	-	-	-	-	-	567840	-	-	-	567840	302513
Jharkhand	20	-	-	-	82305	1281286	11873	177	84	43068	-	1418793	1400830
Gumla	14	-	-	-	82305	844431	11873	177	84	43068	-	981938	984772
Latehar	-	-	-	-	-	-	-	-	-	-	-	-	-
Lohardaga	6	-	-	-	-	436855	-	-	-	-	-	436855	416058
Karnataka	1*	-	-	-	-	-	-	-	-	-	-	-	-
South Kanara	1*	-	-	-	-	-	-	-	-	-	-	-	-
Madhya Pradesh	20(6)	-	-	-	-	124935	4223	533185	-	10672	12914	685929	546953
Anuppur	1	-	-	-	-	-	-	24360	-	-	-	24360	15639
Jabalpur	2	-	-	-	-	-	-	110030	-	-	1000	111030	84095
Katni	8(4)	-	-	-	-	-	4223	274451	-	-	-	278674	193221
Rewa	1	-	-	-	-	124935	-	13890	-	-	-	13890	10418
Satna	3(2)	-	-	-	-	-	-	35510	-	5974	11914	53398	58042
Shahdol	2	-	-	-	-	-	-	49990	-	-	-	174925	150334
Sidhi	3	-	-	-	-	-	-	24954	-	4698	-	29652	35204
Maharashtra	15	-	-	-	39300	334264	5327	216671	-	-	-	595562	401196
Kolhapur	6	-	-	-	39300	295744	5327	-	-	-	-	340371	269518
Raigad	6*	-	-	-	-	-	-	-	-	-	-	-	-
Ratnagiri	3	-	-	-	-	38520	-	216671	-	-	-	255191	131678
Odisha	5	-	-	-	-	15260171	223136	-	-	-	-	15483307	10901088
Koraput	3	-	-	-	-	10186479	-	-	-	-	-	10186479	7378697
Raygada	1	-	-	-	-	5073692	223136	-	-	-	-	5296828	3522391
Sundargarh	1*	-	-	-	-	-	-	-	-	-	-	-	-

Figures in parentheses indicate number of associated mines. * Only labour reported.

Table-4 (B): Gradewise Production of Bauxite, 2020-21

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

Grade/State	For use in Alumina & Aluminium extraction : Al_2O_3 content							For use other than Alumina & Aluminum extraction				Total	
	No. of Mines	60%& above	55–60%	50–55%	45–50%	40–45%	Below 40%	Cement	Abrasive	Refractory	Chemical	Quantity	Value
India	131(6)	-	-	-	877407	17055794	150114	1931077	89820	130735	133718	20368665	16667101
Public Sector	20	-	-	-	-	10483896	750	15465	-	60696	113813	10674620	9344498
Private Sector	111(6)	-	-	-	877407	6571898	149364	1915612	89820	70039	19905	9694045	7322603
Chhattisgarh	14	-	-	-	446215	269081	-	-	-	-	-	715296	751480
Kabirdham	2	-	-	-	-	575	-	-	-	-	-	575	533
Kondagaon	2*	-	-	-	-	-	-	-	-	-	-	-	-
Surguja	10	-	-	-	446215	268506	-	-	-	-	-	714721	750947
Gujarat	60	-	-	-	-	51506	750	1172535	89820	69288	113813	1497712	1196637
Amreli	1	-	-	-	-	-	-	500	-	-	-	500	433
Devbhoomi Dwarka	32	-	-	-	-	51506	-	170577	87876	48212	-	358171	326403
Kheda	10	-	-	-	-	-	-	457090	269	-	-	457359	343653
Kutch	9	-	-	-	-	-	750	-	-	19086	113813	133649	152161
Porbandar	4	-	-	-	-	-	-	257225	1675	1990	-	260890	198041
Sabarkantha	4	-	-	-	-	-	-	287143	-	-	-	287143	175946
Jharkhand	19	-	-	-	392196	1055260	-	-	-	50017	-	1497473	1586192
Gumla	13	-	-	-	392196	486185	-	-	-	50017	-	928398	1015133
Lohardaga	6	-	-	-	-	569075	-	-	-	-	-	569075	571059
Madhya Pradesh	21(6)	-	-	-	-	68100	-	522070	-	11430	19905	621505	472602
Anuppur	1	-	-	-	-	-	-	44548	-	-	-	44548	31494
Jabalpur	2	-	-	-	-	-	-	95551	-	-	2500	98051	66517
Katni	9(3)	-	-	-	-	-	-	273255	-	-	-	273255	195886
Rewa	1	-	-	-	-	-	-	12255	-	-	-	12255	10344
Satna	3(3)	-	-	-	-	-	-	9095	-	4046	17405	30546	32489
Shahdol	2	-	-	-	-	68100	-	65115	-	-	-	133215	95760
Sidhi	3	-	-	-	-	-	-	22251	-	7384	-	29635	40112
Maharashtra	12	-	-	-	38996	195600	-	236472	-	-	-	471068	335740
Kolhapur	6	-	-	-	38996	195600	-	-	-	-	-	234596	222672
Raigad	3	-	-	-	-	-	-	97894	-	-	-	97894	53071
Ratnagiri	3	-	-	-	-	-	-	138578	-	-	-	138578	59997
Odisha	5	-	-	-	-	15416247	149364	-	-	-	-	15565611	12324450
Koraput	3	-	-	-	-	10383785	-	-	-	-	-	10383785	9003950
Raygada	1	-	-	-	-	5032462	149364	-	-	-	-	5181826	3320500
Sundargarh	1*	-	-	-	-	-	-	-	-	-	-	-	-

Figures in parentheses indicate number of associated mines. * Only labour reported.

Table-5: Production of Bauxite, 2019-20 and 2020-21
(By Frequency Groups)

(Quantity in tonnes)

Production group	No. of mines		Production for the group		Percentage to total production		Cumulative percentage	
	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)
Total	144(6)	131(6)	21825227	20368665	100	100	-	-
Up to 1000	57(1)	54(1)	1542	2628	0.01	0.01	0	0.01
1001 – 3000	6	5(1)	10299	10951	0.05	0.05	0.06	0.06
3001 – 5000	4(1)	3	21881	12290	0.1	0.06	0.16	0.12
5001 – 10000	7	6	51718	42665	0.24	0.21	0.4	0.33
10001 – 25000	11	16(1)	192378	268693	0.88	1.32	1.28	1.65
25001 – 50000	21(3)	18	961714	728460	4.41	3.58	5.69	5.23
50001 and above	38(1)	29(3)	20585695	19302978	94.31	94.77	100	100

Figures in parentheses indicate number of associated mines.

Mine-head closing stocks of bauxite in 2020-21 were 18,204 thousand tonnes as compared to 15,290 thousand tonnes in the previous year. About 81% of the total stock was held in Gujarat at the end of the year (Tables- 6 'A' & 6 'B').

The average daily employment of labour in bauxite mines was 5,023 in 2020-21 as against 6,162 in the previous year.

Table-6 (A): Mine-head Closing Stocks of Bauxite, 2019-20 (P)
(By States & Grades)

(Quantity in tonnes)

Grade/State	For use in Alumina & Aluminium metal Extraction Al_2O_3 Content						For use other than Alumina & Aluminium metal extraction				Total
	60% & above	55–60%	50–55%	45–50%	40–45%	Below 40%	Cement	Abrasive	Refractory	Chemical	
India	-	-	-	700009	2541967	222631	10977584	98133	452513	296697	15289534
Chhattisgarh	-	-	-	1630	68727	300	-	95	-	-	70752
Gujarat	-	-	-	580919	448871	45773	10223530	98038	431961	283365	12112457
Jharkhand	-	-	-	46963	167947	20752	-	-	-	-	235662
Madhya Pradesh	-	-	-	3999	33154	32932	274002	-	20552	13332	377971
Maharashtra	-	-	-	53309	201528	111702	480052	-	-	-	846591
Odisha	-	-	-	13189	1621740	11172	-	-	-	-	1616101

Table-6 (B): Mine-head Closing Stocks of Bauxite, 2020-21 (P)
(By States & Grades)

(Quantity in tonnes)

Grade/State	For use in Alumina & Aluminium metal Extraction Al_2O_3 Content						For use other than Alumina & Aluminium metal extraction				Total
	60% & above	55–60%	50–55%	45–50%	40–45%	Below 40%	Cement	Abrasive	Refractory	Chemical	
India	-	-	-	640749	2424526	485123	13581499	509291	398583	163939	18203710
Chhattisgarh	-	-	-	19719	31091	-	-	95	1255	1261	53421
Gujarat	-	-	-	499725	461804	46501	12795022	509196	375119	128740	14816107
Jharkhand	-	-	-	22327	85139	11947	-	-	-	-	119413
Karnataka	-	-	-	-	-	-	9000	-	-	-	9000
Madhya Pradesh	-	-	-	3999	51720	303801	310782	-	22209	33938	726449
Maharashtra	-	-	-	81790	197495	111702	466695	-	-	-	857682
Odisha	-	-	-	13189	1597277	11172	-	-	-	-	1621638

MINING & TRANSPORT

The mining of bauxite is carried out by opencast method. The mines are classified in the following three categories depending upon the level of mechanisation:

(i) Manually operated mines

(ii) Semi-mechanised mines

(iii) Mechanised mines

Manually Operated Mines

Many bauxite mines are small and produce less than 10,000 tpy. The entire work of overburden removal, extraction of bauxite and loading of bauxite on to trucks is carried out manually and the bauxite is transported to respective railway siding or plants by road.

Semi-mechanised Mines

In semi-mechanised mines, mining operations are carried out by jack hammer drilling and normally ANFO mixture is used as an explosive for blasting in mineralised zone as well as in overburden, if required. Loading of mineral on to trucks or dumpers is done by payloaders or manually. Since bauxite occurs as small lenses or pockets or boulders or as segregations in murrum and laterite, it is difficult to mechanise the mining operations.

Mechanised Mines

Mechanised mining operations are carried out in a few captive mines of the alumina/aluminium plants. These mines use compressed-air drills for drilling blastholes. Sometimes, compressed-air jack hammer drills are also used for drilling blastholes for secondary blasting of boulders and also for toe drilling in irregular bauxite faces caused due to improper fragmentation of bauxite. The blasted overburden/ore materials are handled and transported separately by using shovels or excavators and trucks/dumpers. Separate benches are maintained for overburden and ores. The height of benches in ore varies from 1.5 to 7.5 m. Hindalco has done away with drilling and blasting at its Durgmanwadi mines in Maharashtra and instead has adopted the state-of-the-art ripper dozer which is regarded as "Miner's Plough". The ripper dozer silently ploughs the mine surface to extract the mineral. It eliminates ground vibrations and air pollution normally causes dust, gases and noise.

In Bagru Hill mines of Hindalco in Jharkhand, the blasted bauxite is transported with the help of dumpers to the crusher. The 4-inch crushed bauxite is then transported to Lohardaga railway station by a monocable aerial ropeway. BALCO also has monocable ropeway for transporting bauxite from its captive mines to the alumina plant at Korba in Chhattisgarh.

Computerised mine planning, use of mobile crusher, simultaneous land reclamation, restricting operations to small portions of mining area at a time, etc. have greatly helped in conserving energy and faster land rehabilitation.

In Odisha, NALCO has adopted the mechanised 'Trench method' of opencast mining at Panchpatmali (North-Central Block) mine. In this method, a pilot trench is driven through the middle of the deposit and several other trenches are opened on both sides in a staggered pattern exposing and creating more number of working faces. Transportation of ore to alumina refinery at Damanjodi has been done through a 14.6 km long single-flight, multi-curve cable belt conveyor of 1800 TPH capacity. The mining operations involve dozing aside the top fertile soil which is usually preserved and hard laterite of 3 m thickness is drilled and blasted. The overburden is removed using higher capacity mobile equipment like dumpers and wheel loaders to expose the bauxite bed. The top slice of bauxite having 8–10 m thickness is loosened by drilling and blasting and the bauxite of 3–4 m thickness at the bottom contact is removed selectively using backhoe shovels.

The Government of Odisha has extended mining lease period of Panchpatmali (North-Central Block) mine up to 16.11.2032 from 31.03.2020 and Panchpatmali (South Block) up to 19.07.2029 from 31.03.2020. The Panchpatmali (North- Central Block) has achieved 100% capacity utilisation with transportation (production) of 6.825 million tonnes for third successive year and transportation from South block was 0.4 million tonnes during the year. The bauxite production from mines of NALCO during the year 2020-21 was about 7.36 million tonnes. The higher capacity mobile equipment like dumpers, wheel loaders, ripper dozers and faster drills have been introduced.

Pottangi Bauxite Mine (75 million tonnes) in the Koraput district of Odisha has been reserved by Government of India in favour of M/s NALCO. The Government of Odisha has issued terms and condition for grant of Pottangi lease over the reduced area of 697.979 ha.

CONSUMPTION

In 2019-20, the consumption of bauxite estimated at 24.03 million tonnes increased marginally by 8% as compared to 22.17 million tonnes in the previous year. Alumina/ Aluminium Industry was the principal consumer of bauxite and accounted for 89% consumption in 2019-20 followed by Cement (8%) and Calcination (2%) (Table-7).

Gujarat was the main supplier of abrasive and refractory grade bauxite. Besides, Madhya Pradesh also produces refractory grade bauxite. Alumina plants draw supplies mostly from their captive mines. Hindalco sources bauxite from other suppliers too (Table- 8).

Table-7: Consumption* of Bauxite 2018-19 to 2020-21

(By Industries)

(In tonnes)

Industry	2018-19	2019-20	2020-21
All Industries	20630600(59)	22170700(63)	24025300(58)
Abrasives	65700	35900	74600
Alumina	18385500	19714000	21388100
Calcination	283800	116300	457700
Cement	1806200	2214100	2036400
Ferroalloys	15900	19300	30500
Refractory[1/]	65500	70200	37100
Others (ceramic, chemical, Pulversing)	8000	900	900

Figures rounded off.

* Includes actual reported consumption and/or estimates made wherever required and paucity of data, hence, coverage may not be completed.

1/ Includes consumption of calcined bauxite.

( ): Number of plants reported/estimated.

Table-8: Domestic Sources of Supplies of Bauxite to Alumina Plants

Producer	Plant	Source of supply
NALCO	Damanjodi, Koraput (Odisha)	Captive mines at Panchpatmali Hills, Koraput distt. Odisha.
BALCO	Korba (Chhattisgarh)	Captive mines in Surguja & Bodai-Daldali in Kabirdham (Kawardha) distt. Chhattisgarh.
Hindalco Industries	Renukoot (Uttar Pradesh)	Captive mines in Shahdol distt. Madhya Pradesh; Gumla & Lohardaga distts. Jharkhand and Surguja distt. in Chhattisgarh. Also other suppliers include suppliers from Odisha, Madhya Pradesh and Jharkhand; Katni Bauxite Pvt. Ltd, Satna, Laxmidasji Ramji, Katni; and Minerals & Minerals Corp., Gujarat.
	Belagavi (Karnataka), Muri, Ranchi (Jharkhand)	Captive mines in Chandgad & Durgmanwadi, Kolhapur distt. Maharashtra and Lohardaga distt. in Jharkhand. Udgiri, Gudeghar, Kolhapur distt., Maharashtra and Bhoomi Resources Pvt Ltd, Maharashtra.
Utkal Alumina	Odisha	Baphlimali bauxite mine (Odisha)
Vedanta Aluminium	Lanjigarh (Odisha)	Supplier from Gujarat, BALCO, Bagmar Bauxite Industries Pvt Ltd, Chhattisgarh; LDR, M.P. and abroad.

USES & SPECIFICATIONS

Bauxite is primarily used to produce alumina through the Bayer process. Aluminium Industry normally uses bauxite containing minimum 40% Al2O3. However, slightly inferior grades with a suitable blend are also used depending upon other characteristics, such as, solubility in caustic soda and absence of silica. The BIS has specified IS:5953-1985(Reaffirmed 2008 & 2014) specifications for metallurgical grade bauxite. Details of the industries are provided in a separate Review 'Aluminium and Alumina'.

In Steel Industry, bauxite is used as a slag corrector in place of fluorite and generally bauxite, containing 45 to 54% Al_2O_3 and 5% SiO_2 (max.) is consumed. Size preference is 25 to 125 mm with a tolerance of 5% (max.) for -25 mm & +100 mm fractions.

BIS has prescribed the specifications of bauxite 'IS : 10817-1984 (Reaffirmed in 2020) for Refractory Industry.

The IS specifications of bauxite for consumption in Chemical and Petroleum industries are given in 'IS : 3605-1984 (Reaffirmed 2020).

Apart from the chemical specifications, the physical requirements are that the material passing through 90-micron Is sieve but retained on 212-micron IS sieve should be 90% maximum; that passing through 300-micron IS sieve shall be 1% by mass maximum; and that passing through 212- micron IS sieve but retained on 300-micron IS sieve should be 10% maximum.

The other specifications laid down by BIS are 'IS:8228-1976 (Reaffirmed 2020)' for bauxite sand and 'IS:8988-1978 (Reaffirmed 2019)' for bauxite powder for foundry washes.

As per Ministry of Mines Notification dated 25th April 2018, the threshold value of bauxite mineral has been classified into the following two categories:

(i) For Aluminous laterite: Al_2O_3– 20% (min.)

(ii) For Bauxite: Al_2O_3– 30% (min.) and SiO_2 (Total) –7% (max.)

SUBSTITUTION

There is no substitute for bauxite as source for aluminium metal extraction carried out on a large scale. However, calcined clay can be substituted for refractory bauxite but only with reduction in time and stock resistance. Sillimanite, alumina, silicon carbide, magnesite–chromite and carbon–magnesite refractories are the other alternatives for high-alumina material but these would entail higher cost. Silicon carbide and diamonds can substitute for fused aluminium oxide in abrasive use but these would entail again at higher cost. Synthetic mullite is a probable substitute for bauxite-based refractories.

Silicon carbide and alumina–zirconia are costlier substitutes for bauxite-based abrasives. The raw material like alunite, anorthosite, coal wastes and oil shales are other potential sources of alumina. The extraction, however, would require new plants with different technology.

These non-bauxitic materials could satisfy the demand for primary metal, refractories, aluminium chemicals and abrasives.

TRADE POLICY

As per the Foreign Trade Policy 2015-2020 and policy on export and import, imports of aluminium ores and concentrates including natural bauxite, calcined and activated bauxite and others are permitted free. There are no policy restrictions on the export of bauxite.

WORLD REVIEW

The world bauxite reserves are estimated at 32 billion tonnes and are located mainly in Guinea (23%), Vietnam (18%), Australia (17%), Brazil (8%), Jamaica (7%) , Indonesia (4%), China (3%) and Russia (2%). Countrywise reserves of bauxite are furnished in Table-9.

The world production of bauxite increased marginally by 5% to 368 million tonnes in 2020 as compared to 349 million tonnes in preceding year. Australia continued to be the major producer and accounted for about 28% share in the total production, followed by Bosnia & Herzegovina (23%), Brazil (17%) and China (9%) (Table-10)(Fig-3).

Table-9: World Reserves of Bauxite
(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total (rounded off)	32000000
Guinea	7400000
Vietnam	5800000
Australia[a]	5300000
Brazil	2700000
Jamaica	2000000
Indonesia	1200000
China	1000000
India	660000
Russia	500000
Saudi Arabia	180000
Kazakhstan	160000
United States	20000
Other countries	5100000

Source: USGS, Mineral Commodity Summaries, 2022.

(a) For Australia, joint Ore Reserves Committee - compliant reserves were 2.2 billion tonnes.

Table-10: World Production of Bauxite 2018 to 2020
(By Industries)

(In '000 tonnes)

Country	2018	2019	2020
World: Total (rounded off)	337703	349580	368604
Australia	95947	105543	103626
Bosnia & Herzegovina	59573	70173	87766
Brazil	70751	62000	62000
China	32377	31937	32897
Colombia	13243	16592	25860
Croatia	23687	22073	19700
Dominican Republic	10058	9022	7546
Fiji	5651	5574	5570
France	4730	5031	4945
Ghana	5736	4118	4057
Other countries	15946	17513	14633

Source: BGS World Mineral Production, 2016-2020.

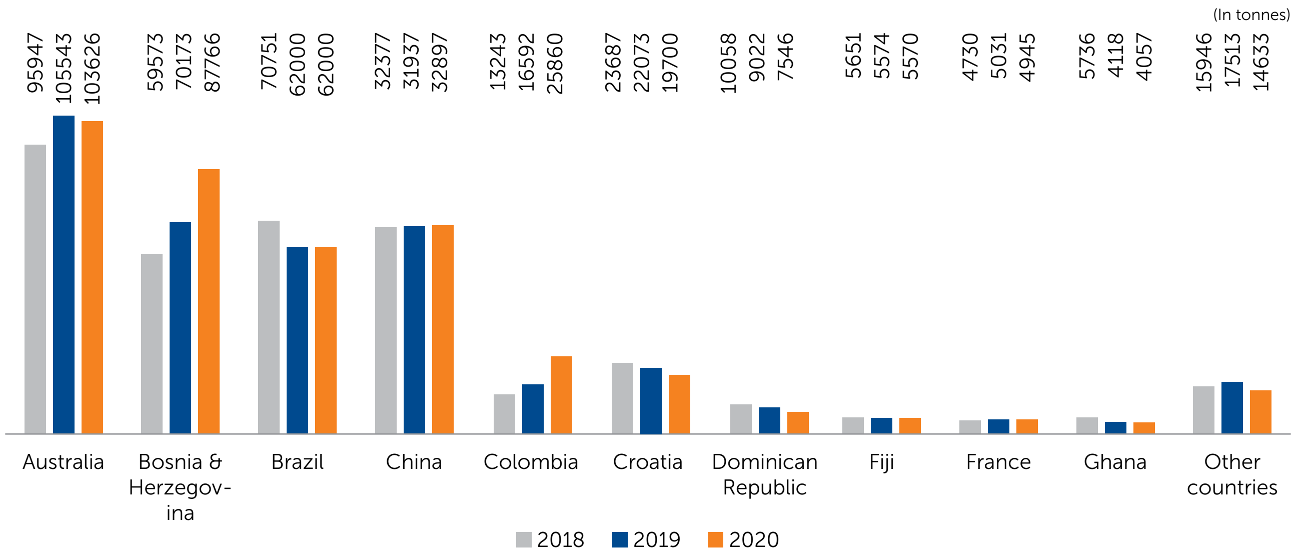


Fig 3: Countrywise Production of Bauxite

To provide generalised view of the development in various countries the country wise description sourced from latest available publication of USGS, Mineral Year Book, 2018 is detailed below:

Australia

Bauxite production decreased by 3% (3.02 Mt) and alumina production was essentially unchanged compared with that in 2017. Decreased bauxite production was attributed to a labour dispute which lasted about 8 weeks.

The capacities of the Kwinana, Pinjarra, and Wagerup refineries were 2.2 Mt/yr, 4.2 Mt/yr, and 2.6 Mt/yr, respectively. The Huntly Mine capacity was 26 Mt/yr and the Willowdale Mine capacity was 10 Mt/yr. The mines and refineries were operated by Alcoa (60%) as part of its joint venture with Alumina Ltd (40%). Rio Tinto plc continued construction of the Amrun Mine in Queensland and made the first shipment of bauxite from the mine in December. Completion of the 22.8-Mt/yr bauxite mine was scheduled for March 2019. The bauxite would be shipped through the Port of Cape York and upgraded port facilities would increase export capacity by about 10 Mt/yr.

Production from the Amrun Mine would replace production from the East Weipa Mine about 40 kilometers (km) away which was nearing the end of its reserved Metro Mining Ltd started production from the Bauxite Hills Mine in Queensland in April.

By August, the mine was producing at a rate of 2.4 Mt/yr. The mine was scheduled to reach a production rate of 3.5 Mt/yr in 2019. Further capacity expansion to 6 Mt/yr was planned by yearend 2021. The bauxite deposit reserves were reported to be 109.5 Mt.

Canada

Orbite Technologies Inc. was repairing equipment that failed during trial production from

its high-purity alumina refinery in Cap-Chat, Quebec. Trial production from the 3-metric-ton-per-day plant was halted in March after 2 months owing to equipment issues. Inspection of the plant's calciner identified problems with the heating system.

As a result of the shutdown and equipment issues, Orbite filed for protection under the Bankruptcy and Insolvency Act in April. In addition to high-purity alumina, Orbite's plant was designed to produce gallium, iron oxide, rare-earth elements, and high-purity silica from high-alumina clay.

China

Alumina production increased by 5% (3.51 Mt) to 72.5 Mt, compared with that in 2017. The increased production was attributed to production from new capacity and restarts of capacity at several refineries that had been temporarily shut down to comply with environmental regulations. Alumina capacity at yearend 2018 was estimated to be 83.4 Mt/yr, a 3% increase from 81 Mt/yr at yearend 2017. Approximately 73.5 Mt/yr of capacity was in use at yearend.

Although new capacity was added, some startups were delayed until permits were issued and because of limited bauxite supplies at some refineries in the northern part of the country. Many of the new alumina refineries under construction or planned for construction were located in port cities rather than adjacent to inland bauxite deposits.

Stricter enforcement of environmental regulations and decreasing quality of bauxite reserves discouraged new refineries in many inland cities while availability of abundant bauxite imports made port locations more attractive.

China imported 511,000 t of alumina, 82% less than the 2.86 Mt imported in 2017. The leading sources of alumina imports, in descending order, were Australia (49%) and Indonesia (12%). China exported 1.46 Mt of alumina in 2018 compared with 56,000 t in 2017, as the alumina price in the world market increased in response to refinery shutdowns in Australia and Brazil. China imported 82.6 Mt of bauxite, 20% more than the 68.6 Mt imported in 2017. The leading sources of bauxite imports, in descending order, were Guinea (46%), Australia (36%) and Indonesia (9%).

Imports from Australia, Guinea and Indonesia increased by 4.29 Mt (17%), 10.6 Mt (38%) and 6.25 Mt (483%), respectively, compared with those in 2017, accounting for the increased imports. These increases were partially offset by decreased imports from Brazil (by 1.71 Mt), India (by 1.47 Mt) and Malaysia (by 4.22 Mt).

The Government of China ordered alumina refineries and aluminum smelters in certain regions to shut down 30% of capacity from November 15, 2017, until March 15, 2018. The order to shut down capacity cited environmental concerns about pollution produced by refineries, smelters and powerplants during the winter.

Refineries and smelters in 31 cities, mainly in the central and eastern Provinces, were affected by the order. When the restrictions expired, some of the capacity affected by the policy was restarted. The Government instituted a similar shutdown from October 1, 2018, to March 31, 2019, to reduce pollution during the winter, requiring alumina refineries and aluminum smelters in 26 cities to close 30% of their capacity.

Indonesia

Bauxite production was 11 Mt in 2018 compared with 2.9 Mt in 2017, 1.4 Mt in 2016, 472,000 t in 2015, 2.56 Mt in 2014 , and 57 Mt in 2013. The overall increase in production was attributed to the rampup of production from mines that supplied two alumina refineries and some mines that were permitted to export bauxite.

Alumina production was estimated to be 1 Mt in 2018, the same as the revised estimate in 2017, compared with 600,000 t in 2016, and 70,000 t in 2015. A ban on exporting bauxite and other unprocessed mineral ores took effect on January 12, 2014. The export ban was part of the 2009 Mining Law and was intended to increase economic development in the country through investment in mineral-processing facilities.

Exports of bauxite resumed in July 2017 for the first time since the ban started in 2014. The Government of Indonesia issued export licenses to PT Aneka Tambang Tbk (Antam) and PT Bintan.

Alumina Indonesia Ltd. (Bintan) so that they could use proceeds of bauxite sales to finance construction of alumina refineries. The permit system was scheduled to end in 2023. Antam completed a bankable feasibility study for a 1-Mt/yr alumina refinery in Mempawah, West Kalimantan Province, with PT Indonesia Asahan Aluminium Ltd (Inalum). Construction was scheduled to start in the first quarter of 2019.

Expansion to 2 Mt/yr would begin after production of the first phase was ramped up. The refinery would supply Inalum's aluminum smelter in Asahan, North Sumatra Province, which Inalum planned to expand to 500,000 t/yr from 250,000 t/yr by 2020 (PT Aneka Tambang Tbk, 2018, p. 289, 322; 2019, p. 343). In December, Bintan started construction of a 1-Mt/yr alumina refinery in Galang Batang, Riau Islands Province. Bintan was a joint venture among Shandong Nanshan Aluminum Co. Ltd (China) (94%), Redstone Alumina International Pte. (Australia) (5%), and PT Makhota Karya Utama (1%). A construction schedule was not available.

Brazil

Bauxite production decreased by 24% (9.12 Mt) and alumina production decreased by 26% (2.91 Mt) compared with the revised amounts in 2017. Decreased bauxite and alumina production was attributed to environmental regulators' order to Norsk Hydro ASA to temporarily shut down one-half of the 6.3-Mt/yr capacity of the Alunorte alumina refinery on February 27. Heavy rainfall on February 16 and 17 resulted in high water levels in one of the refinery's waste disposal impounds.

Monitoring of the impounds did not detect any leakage or failure, but the water level in one impound reached a dangerous point, prompting the order to shut down some production. On October 3, the mine and refinery shut down all capacity for a few weeks when the red mud impoundment reached its maximum capacity. However, production was restarted at one half of the capacity at the end of October when permits to use a new impoundment and filter press were issued. At yearend, the mine and refinery were producing at one-half of capacity while the company waited for approval to restart the other one-half of capacity. Norsk Hydro also shut down 230,000 t/yr of capacity at the adjacent 460,000-t/yr Albras primary aluminum smelter in April citing a shortage of alumina resulting from the refinery shutdown. An expansion project, started in 2016, was completed at the Juruti Mine, increasing capacity to 6.5 Mt/yr from 5.7 Mt/yr. The mine was a joint venture of Alcoa (60%) and Alumina Ltd. (40%).

FOREIGN TRADE

Exports

In 2020-21, exports of bauxite decreased drastically by 55% to 240 thousand tonnes from 524 thousand tonnes in the previous year. Exports were mainly to Nepal (65%), Oman (22%) and Slovenia (5%) (Fig-4). Export of bauxite (aluminium ores & concentrate) were at 176 thousand tonnes during 2020-21 which increased manifold from 40 thousand tonnes reported in the preceding year. Exports were mainly to Nepal (70%) and Oman (29%). Export of bauxite (aluminium & concentrate) also decreased substantially by 87% to 63 thousand tonnes during 2020-21 from 484 thousand tonnes in the preceding year. Exports were mainly to Nepal (55%), and Slovenia (17%). (Tables-11 to 13).

Table-11: Export of Bauxite
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**524229**	**1421269**	**240841**	**951442**
Nepal	126962	300387	158165	331823
Slovenia	10749	159121	11407	178458
Oman	16500	25750	54703	123786
UK	1826	48373	2420	77353
Italy	4386	78520	1583	36292
Germany	1050	19883	1350	31087
Sweden	500	8892	1154	20465
France	1762	25699	1191	18222
Australia	475	10441	714	14989
Spain	1750	35035	600	14104
Other countries	358269	709271	7554	104863

Figures rounded off.

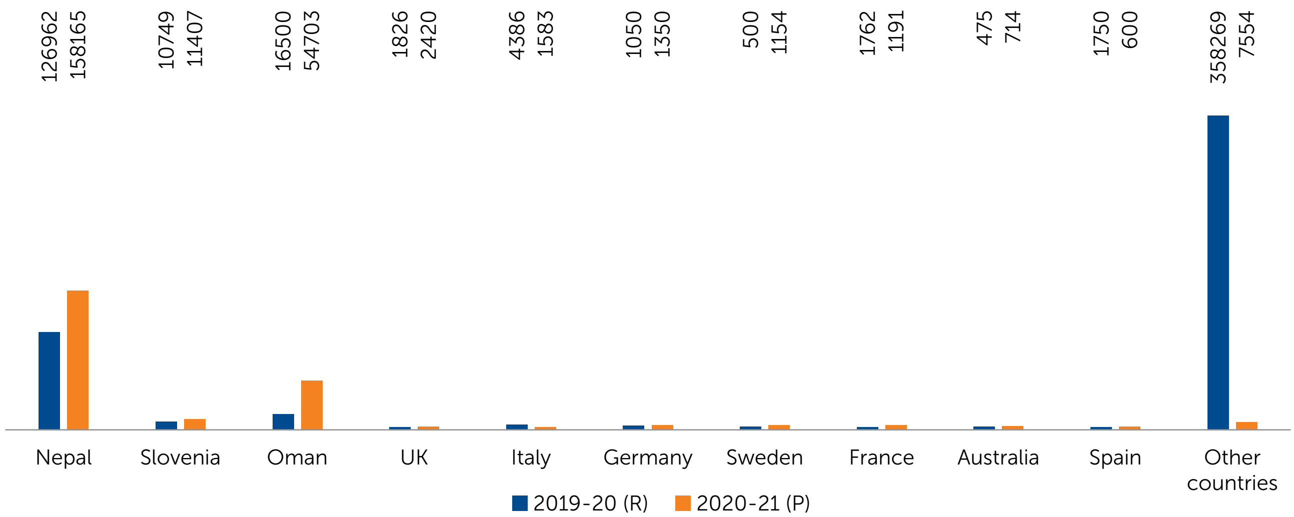


Fig 4: Countrywise Export of Bauxite

Table-12: Export of Bauxite: Other Aluminium Ores & Concentrates

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	40004	98805	176955	389007
Nepal	39308	93654	122172	264087
Oman	-	-	54690	123435
Cameroon	-	-	54	858
China	-	++	21	349
Ethiopia	-	-	10	135
Sudan	-	-	7	115
UAE	1	21	1	28
Germany	-	-	++	++
Korea, Rep. of	614	3358	-	-
Bangladesh	80	1738	-	-
Other countries	1	34	-	-

Figures rounded off.

Table-13: Exports of Bauxite: Aluminium & Concentrates

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	484225	1322464	63886	562435
Slovenia	10749	159121	11407	178458
UK	1826	48373	2420	77353
Nepal	87654	206733	35993	67736
Italy	4386	78520	1583	36292
Germany	1050	19883	1350	31087
Sweden	500	8892	1154	20465
France	1762	25596	1191	18222
Australia	475	10441	714	14989
Spain	1750	35035	600	14104
Mexico	100	1979	575	12179
Other countries	373973	727891	6899	91550

Figures rounded off.

Imports

Import of bauxite increased by 35% to 3034 thousand tonnes during 2020-21 from 2246 thousand tonnes in the previous year. Imports were mainly from Guinea (96%) and China (2%). Imports of bauxite other (aluminium ores & concentrates) increased by 52% to 333 tonnes during 2020-21 from 218 tonnes in the previous year. Imports were mainly from Turkey (48%), Ukraine (32%) and China (14%). On the other hand, imports of bauxite (aluminium & concentrates) increased by 35% to 3033 thousand tonnes during 2020-21 from 2246 thousand tonnes in the preceding year. Imports were mainly from Guinea (96%) and China (2%) (Tables-14 to 16).

Table-14: Imports of Bauxite

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2246681	10817757	3034041	13709540
Guinea	1955721	8126743	2931220	11040863
China	55765	1380225	86044	2371446
Hong Kong	9955	218474	5516	124781
Guyana	1654	27617	8324	98512
Singapore	3925	92647	1175	34591
Netherlands	222	10414	294	13528
UK	++	14	221	6073
Malaysia	-	-	325	6054
USA	++	708	245	3806
UAE	1037	12689	400	3496
Other countries	218402	948199	277	6390

Figures rounded off.

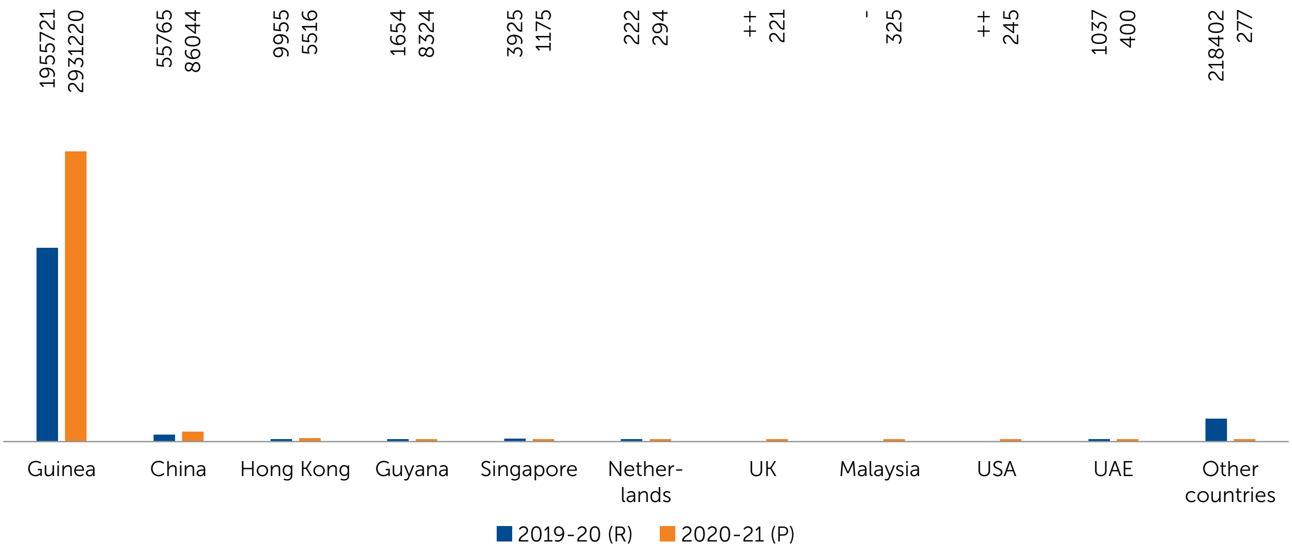


Fig 5: Countrywise Import of Bauxite

Table – 15: Imports of Bauxite:Other Aluminium Ores & Concentrates

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	218	8946	333	8419
Turkey	-	-	160	3424
Ukraine	26	388	107	1649
China	158	4447	47	1119
U K	-	-	5	889
Netherlands	13	1079	8	622
Brazil	-	-	6	590
U S A	++	324	++	126
U A E	21	2702	-	-
Italy	++	6	-	-

Figures rounded off

Table – 16 : Imports of Bauxite: Aluminium & Concentrates

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2246463	10808811	3033708	13701121
Guinea	1955721	8126743	2931220	11040863
China	55607	1375805	85997	2370327
Hong Kong	9955	218474	5516	124781
Guyana	1654	27617	8324	98512
Singapore	3925	92647	1175	34591
Netherlands	209	9335	286	12906
Malaysia	-	-	325	6054
U K	++	14	216	5184
U S A	++	384	245	3680
U A E	1016	9987	400	3496
Other countries	218376	947805	4	727

Figures rounded off.

FUTURE OUTLOOK

The total resources of bauxite that comprise various grades, as found to occur in the country as on 1.4.2020, are estimated at 4,958 million tonnes. The resources of Metallurgical grade bauxite are adequate while those of the Chemical and Refractory grade bauxite are relatively limited considering the future requirements.India's strength in aluminium is production due to its rich reserve of bauxite, a core resources used in production of aluminium. As per provision made in Mineral (Auction) Rule 2015, a total of 7 bauxite blocks were auctioned till June 2020 in the State of Maharashtra (6 blocks) and Madhya Pradesh (1block). As per the FITCH Report, the production of bauxite is estimated to grow to 50.7 million tonnes by 2027.

4. Boron Minerals

74,204	1,94,448	2,996
(tonnes) Total reserves/resources of borax were estimated as on 1st April 2020	(tonnes) of borax were imported in 2020-21	(tonnes) of borax were exported in 2020-21

Boron minerals occur mostly as borates which are deposited from volcanic gases or hot springs near volcanic activities. The deposits, predominantly of borax and sassolite are formed as a result of drying up of shallow saline and alkaline tertiary lakes called 'Playa'. The principal boron minerals are borax–hydrated sodium borate ($Na_2O._2B_2O_3$. $10H_2O$), kernite (rasorite)–hydrated sodium borate ($Na_2O._2B_2O_3.4H_2O$), colemanite– hydrated calcium borate ($Ca_2B_6O_{11}.5H_2O$) and ulexite–hydrated sodium calcium borate ($NaCaB_5O_9.8H_2O$). Besides the above four boron minerals of commercial importance, two minerals, viz., sassolite (H_3BO_3)–the natural boric acid and boracite ($Mg_3B_7O_{13}Cl$) are less important.

Borax is, presently, not produced in India. However, it was obtained since ancient times from the lakes in Jammu & Kashmir in India. The domestic requirements of boron minerals are met solely through imports of crude borate which is refined in the country for producing borax and boric acid.

RESERVES/RESOURCES

Economically viable deposits of borax have not been established in the country so far. The only deposit of little economic significance is reported from Puga Valley in Leh district, Jammu & Kashmir. As per NMI data, based on UNFC system, the total reserves/resources of borax as on 1.4.2020, has been estimated at 74,204 tonnes in Jammu & Kashmir. All resources are of Reconnaissance category viz., UNFC Code 334. Occurrences are also reported from Surendranagar district, Gujarat and Jaipur district, Rajasthan (Table-1).

Table-1: Reserves/Resources of Borax as on 1.4.2020 (P)

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources						Total Resources (A+B)
		Pre-feasibility	Measured	Indicated	Inferred	Reconnaissance	Total	
		STD221	STD331	STD332	STD333	STD334	(B)	
All India : Total	-	-	-	-	-	74204	74204	74204
By Grades								
Unclassified	-	-	-	-	-	74204	74204	74204
By States								
Jammu & Kashmir	-	-	-	-	-	74204	74204	74204

Figures rounded off.

USES

Glass and porcelain industries are the major consumers of borax and boric acid. It is an essential component of heat-resisting boro-silicate glass, glass fibres and industrial & optical glass. In glass, enamels and ceramics, it controls thermal expansion, improves durability, assists melting processes and adds to inorganic colours and decorations.

Borax is used in medicine (boric powder), leather processing, adhesive, corrosion inhibition, ferrous wire manufacture, flame-proofing and timber preservation.

Borax is used as a flux in brazing, welding, soldering and in the manufacture of artificial gems like, cubic boron nitride, (commercially called 'Borazon') which is equal to diamond in hardness and boron carbide, titanium boride and tungsten boride which are next to diamond in hardness.

Its easy solubility and property to soften hard water find applications in soaps, cleaners & detergents and for water treatment. Its mild alkalinity and germicidal nature, enable its use in manufacturing toothpastes and mouth washes. Borax is used as an antiseptic and emulsifying agent in Cosmetics Industry. As a decolourising agent, it is used in Vanaspati Industry. In Textile Industry, borax is used as a decolourising agent as well as for maintaining the alkalinity of solutions used for producing rayons. It prevents mould formation in citrus fruits. In agriculture, borax is used as an essential plant nutrient.

Boron compounds are used for fertilizers, algicides, herbicides and insecticides. Borax and boric acid are used in fire-retardant treatment and as food grain preservative, respectively.

Borate ester is used as dehydrating agent, special solvent and catalyst in Chemical Industry. In nuclear reactor, boron acts as neutron absorber. "Boron neutron capture therapy", a form of radiochemotherapy, is becoming increasingly important for treatment of certain forms of cancers and boron neutron capture synovectomy for treatment of arthritis.

Borates are consumed mainly in glass fibre for insulations and textile-grade fibre. They are also used as anti-knock agents in gasoline. Diborane (gas), pentaborane (liquid) and decaborane (solid) are potential jet and rocket engine fuels. Boron hydride also has potential value as rocket fuel. The high energy fuel value imparted by the addition of boron compounds has given considerable strategic significance to borates. Another use of borates is the invention of oxgano-sodium borate (liquibor) for use in hydraulic brake fluids.

Boron is an essential plant nutrient and boron compounds, such as, borax and boric acid are used as fertilizers in agriculture, although they are only required in small amounts, with excess being toxic.

SUBSTITUTES

Substitutes in applications, such as, soaps, detergents, enamels and insulations are available. In detergents, boron compounds can be replaced with chlorine and enzymes. Lithium compounds can be used to make enamels and glass products. Insulation substitutes include cellulose, foams and mineral wools. Substitution of borosilicate glass by plastic materials may reduce the use of boron.

Sodium percarbonate can replace borates in detergents and requires lower temperatures to undergo hydrolysis, which is an environmental consideration. Some enamels can use other glass-producing substances, such as, phosphates. In soaps, sodium and potassium salts of fatty acids can act as cleaning and emulsifying agents.

TECHNICAL POSSIBILITIES

A proprietary process called 'Hydrogen on Demand' has been developed using water and sodium borohydride. Hydrogen from the system can be used in fuel cells or internal combustion engines. A longer-life battery based on boron has also been designed. Synthetic diamond containing about 3% boron which is normally a semiconductor becomes superconductor at 4 K. Boron-doped diamond, thus, has numerous possible applications as it can carry electricity without resistance.

Improvements made in evaporating brine solutions are widening the choice of source. Production of boric acid through solution mining of colemanite is a possibility.

ENVIRONMENTAL CONCERNS

Natural borates are not very toxic to animals but can be toxic to plants though low levels of boron are essential for plant life. Boron-hydrogen compounds known as boranes which do not occur in nature are highly toxic and have posed problems in some industrial applications. Environmental concerns have hastened substitution in soaps and detergents. In Europe, borates continue to be listed under hazardous substances and the risk evaluated for their safety under conditions of normal handling and use related to classification and labelling already exists. The US Food and Nutrition Board announced that the essentiality data on boron was adequate to establish a daily tolerable Upper Intake Level for an adult at 20 mg boron.

INDUSTRY

In borax manufacturing process, crude sodium borate is dissolved in water, charged, oxidised, crystallised and centrifuged. Centrifuged material is then dried to get borax decahydrate.

Crude calcium borate lumps are crushed and wet-ground with mother liquor to make slurry. This slurry is decomposed with sulphuric acid to give calcium sulphate and boric acid. Boric acid is separated by filtration, purified, cooled and centrifuged to produce boric acid granules which are powdered as per demand.

Borax Morarji Ltd, Ambernath, Thane district, Maharashtra, is engaged in refining of imported crude borates to produce borax and boric acid. The annual production capacity for all grades of borax and boric acid are 24,000 MT at Dahej, GIDC in the State of Gujarat. Apart from two other producers, National Peroxide Limited (NPL) located at Kalyan district, Maharashtra, is the largest producer of Hydrogen Peroxide in the country.

During the year, the Company completed the expansion of its plant situated at Kalyan which resulted in an increase in the plant rated capacity from 95,000 MT per annum to 1,50,000 MT per annum based on 50% (w/w) Hydrogen Peroxide levels.

NPL is a pioneer in Hydrogen Peroxide Industry in India and has been at the forefront in development of technology, brand image and market share in the country. Indo Borax and Chemical Limited operates borax and boric acid plants at Pithampur, Madhya Pradesh.

Ferroboron is a boron ferroalloy containing 0.2% to 24% boron used primarily to introduce small quantities of boron into speciality steels.

WORLD REVIEW

The world reserves of boron in terms of boric oxide are furnished in Table-2.

Turkey was the leading producer of borates followed by USA, Kazakhstan, Chile, China and Bolivia (Table-3).

Table-2: World Reserves of Boron

(By Principal Countries)

(In '000 tonnes of boric oxide)

Country	Reserves
World: Total[1]	xx
Argentina, crude ore	NA
Bolivia, ulexite	NA
Chile, ulexite	35000
China, boric oxide equivalent	24000
Germany, compounds	NA
Peru, crude borates	4000
Russia, datolite ore	40000
Turkey, refined borates	1200000
USA	40000

Source: USGS, Mineral Commodity Summaries, 2022.

1 World totals could not be calculated because production and reserves are not reported in a consistent manner by all countries.

xx: Not applicable

Table-3 : World Production of Borates

(By Principal Countries)

(In metric tonnes)

Country	2018	2019	2020
World Total	20600000	20600000	20600000
Turkey	3970486	8555690	2819111
USA[a]	1300000	1300000	1300000
Kazakhstan	500000	500000	500000
Chile	398411	352255	288103
China[b]	75000	250000	250000
Bolivia	232268	214500*	258143
Peru	100552	111108	43645
Argentina	71212	181818	134604
Russia*	80000	80000	80000
Iran[c]	1200	2519	2500

Source: BGS, World Mineral Production, 2016-20,

*: Estimate
a: Sold or used by producers.
b: B_2O_3 equivalent.
c: Years ended 20 March following that stated.

To provide a generalised view of the development in various countries, the contrywise description sourced from latest available publication of Minerals Yearbook 'USGS' 2018 has been furnished as below:

Turkey

The first known instances of borate mining in Turkey date to Roman times, with borate mining continuing to this day. Approximately 73% of the world's boron reserves are in Turkey, with the Kirka deposit at Eskisehir reported to be the largest tincal deposit in the world. The main borate producing areas of Turkey, all controlled by the state-owned mining company Eti Maden AS, were Bigadic (colemanite and ulexite), Emet (colemanite), Kestelek (colemanite, probertite, and ulexite), and Kirka (tincal). Eti Maden opened warehouses and logistic centers with a company based in Hong Kong to distribute their products from a location closer to the majority of their customer base. Production of refined borates was expected to increase over the coming years owing to investment in new refineries and technologies. Eti Maden continued to invest in the production of boron carbide, boron nitride, and ferroboron owing to their importance in many industries, including the electronics, iron, and steel industries. In 2018, Eti Maden and China's Dalian Jinma Boron Technology Group Co., Ltd. signed a Memorandum of Understanding to build a boron carbide processing facility in Balikesir. Although this facility will process mostly boron carbide, boron nitride and ferroboron were also projected to be processed. As a result of boron carbide's numerous uses in the defense industry, it was expected to become a significant export for Turkey.

Argentina

Argentina was estimated to be the second-ranked producer of boron minerals in South America in 2018. Borate deposits are located primarily in the Puna region, which includes the northwestern tip of Argentina, the southeastern corner of Peru, the southwestern corner of Bolivia, and the northeastern border of Chile. The principal markets for borates produced in Argentina were throughout South America Borax Argentina S.A. (a subsidiary of Orocobre Ltd.), the country's leading producer of borates, operated the Tincalayu and Sijes Mines, the largest open pit operations in the country, which are 4,100 m (13,500 feet) and 4,540 m (14,900 feet) above sea level, respectively. Record-high production was reported at Borax Argentina's boric acid plant and Tincalayu open pit operation. Tincalayu deposits consisted primarily of borax, with rare occurrences of ulexite and 15 other borates with a reported production of 36,553 tonnes in 2018. Orocobre was reviewing an expansion study for their Tincalayu operation. The expansion could possibly increase Tincalayu's refined-borate-processing capacity from 30,000 metric tonnes per year (tonnes/year) to approximately 120,000 tonnes/year of borax dehydrated equivalent. The expansion review also includes a boric acid plant with a capacity of 40,000 tonnes/year. A project to build a gas pipeline to supply the expanded plant was approved in early 2018. Minera Santa Rita S.R.L.(MSR) operated mines in Catamarca, Jujuy, and Salta Provinces and operated a processing plant in Campo Quijano, which produced granular deca- and pentahydrate borax, technical-grade boric acid powder, and various grades and sizes of natural boron minerals. MSR exported the majority of its mined borates to 28 countries through the Port of Buenos Aires and by land to Brazil.

Chile

Chile was the leading borate compound producer in South America with boric acid production estimated to be 100,000 tonnes and ulexite production estimated to be 600,000 tonnes in 2018. The largest ulexite deposit in the world, Salar de Suirire, was operated by Quiborax SA, a Government entity with reserves estimated to be 1.5 million metric tonnes (Mt). Almost all the material mined at this location was exported in 2018. Quiborax operations have a boric acid production capacity of 36,000 tonnes/year, in addition to 100,000 tonnes/year capacity of borate derived agrochemical products. In May 2018, the 14-year-long dispute between the Bolivian Government and Quiborax came to an end with a ruling in favor of Quiborax. The Bolivian Government must now pay Quiborax $48.6 million for the land seized in 2004 that was used for the company's ulexite mining and revoked mining concessions.

China

China has low-grade boron resources. More than 100 borate deposits occur in 14 Provinces in China. The northeastern Province of Liaoning and the western Province of Qinghai accounted for more than 80% of the resources, mostly in the form of sassolite and tincal. China's boron resources average about 8% B_2O_3 in comparison with reserves from Turkey and the United States, which average from 26% to 31% and 25% to 32% B_2O_3, respectively.

Serbia

Erin Ventures Inc. (Canada) entered into a strategic partnership with a London-based commodity investment company, acquiring funds needed to continue development of the Piskanja Borate Project. Piskanja is a mining region in Serbia approximately 250 km (155 miles) south of Belgrade. The deposit is primarily composed of colemanite and ulexite with estimated reserves of 11.8 Million tonnes. Rio Tinto continued a prefeasibility study in Jadar Valley, in 2018. The deposit contains both boron and lithium ore. Rio Tinto was planning to conduct assessments that will consider the socioeconomic effects of constructing a mine and processing facility on the local communities, in conjunction with environmental assessments.

FOREIGN TRADE

Exports

Exports of borax (total) increased by 1% to 2,996 tonnes in 2020-21 from 2,977 tonnes in the previous year. Exports of natural borate in 2020-21 decreased substantially to 55 tonnes from 214 tonnes in the previous year. In 2020-21, exports of sodium borate were at 741 tonnes and other borates at 2,200 tonnes. Exports of Borax (total) were mainly to USA (46%), Italy (10%), Syria & Nepal (6% each), Poland (5%) and UAE (3%) (Fig-1). Exports of boric acid increased by 28% to 1,952 tonnes in 2020-21 from 1,520 tonnes in the previous year. Exports of boric acid were mainly to Iran (40%), Nigeria (17%), Nepal (7%) and Uganda (5%) (Tables-4 to 9).

Table-4: Exports of Boron
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	91	5	525
Nepal	-	-	5	198
Sudan	-	-	++	131
USA	++	29	++	117
UK	++	25	++	51
France	-	-	++	20
Spain	-	-	++	8
Bangladesh	++	25	-	-
Portugal	++	12	-	-

Figures rounded off.

Table-5: Exports of Borax
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2977	359860	2996	414601
USA	940	175743	1391	263087
Italy	315	41462	304	36116
Poland	240	30818	140	17212
Bangladesh	155	18372	74	15598
Syria	156	6813	188	9846
South Africa	37	6189	73	9796
Oman	45	9774	64	9387
Nepal	274	11733	187	9063
UAE	77	4365	81	7070
Australia	64	10862	44	5355
Other countries	674	43729	450	32071

Figures rounded off.

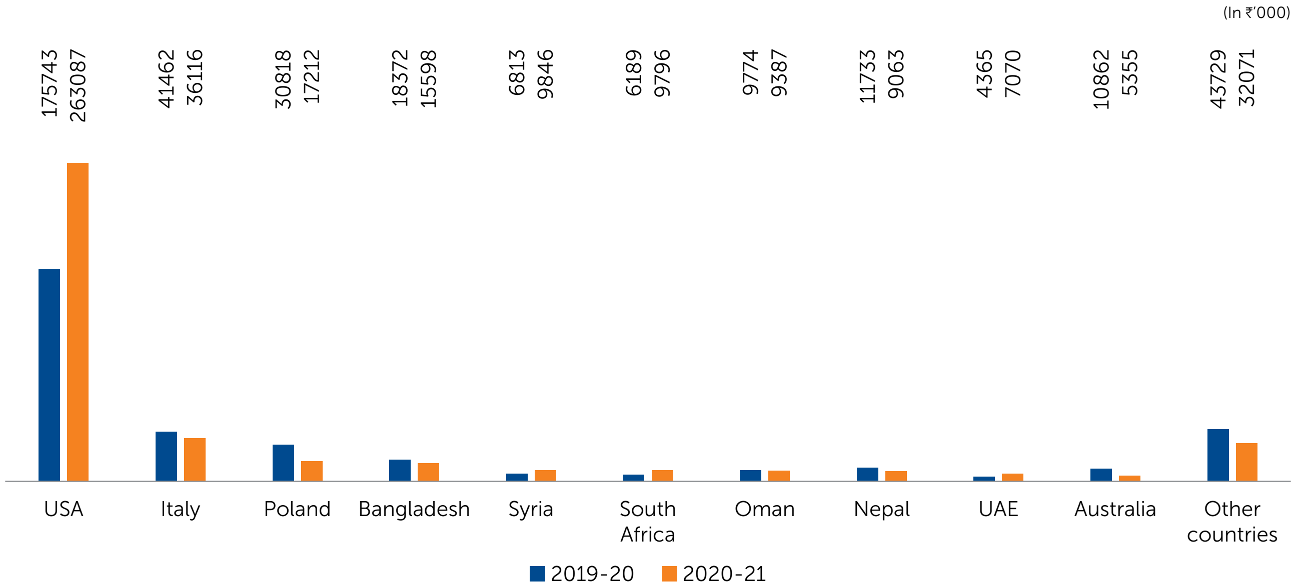


Fig 1: Countrywise Value of Export of Borax

Table-6: Exports of Natural Borate
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**214**	**6806**	**55**	**5633**
Oman	-	-	27	2417
Saudi Arabia	++	1	14	2073
Kuwait	4	272	12	753
UAE	-	-	2	360
Zambia	-	-	++	18
Nigeria	-	-	++	12
Argentina	210	6526	-	-
USA	++	5	-	-
Egypt	++	1	-	-
Kenya	++	1	-	-

Figures rounded off.

Table-7: Exports of Sodium Borate
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**773**	**54235**	**741**	**56265**
USA	25	17354	25	21815
Nepal	251	9872	151	6519
Syria	-	-	96	5637
Myanmar	88	3669	88	4016
Tanzania	2	83	92	3707
Malaysia	++	16	75	3509
Saudi Arabia	++	17	44	1936
UAE	48	1688	49	1806
South Africa	-	-	40	1666
Australia	24	1182	24	1310
Other countries	335	20354	57	4344

Figures rounded off.

Table-8: Exports of Borax: Other Borates
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1990**	**298819**	**2200**	**352703**
USA	915	158384	1366	241272
Italy	315	41462	304	36116
Poland	240	30818	140	17212
Bangladesh	94	16517	74	15449
South Africa	37	6189	33	8130
Oman	45	9771	37	6904
UAE	29	2677	30	4904
Syria	156	6813	92	4209
Australia	40	9680	20	4045
France	-	-	21	3484
Other countries	119	16508	83	10978

Figures rounded off.

Table-9: Exports of Boric Acid
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1520	121969	1952	160749
Iran	168	8577	777	43689
Nigeria	218	17901	326	27384
Nepal	129	9909	137	10942
USA	67	11857	50	9815
Uganda	48	4033	95	9335
Cote D'Ivoire	27	2222	40	3757
Congo, Dem. Rep. of	47	4225	36	3533
Guinea	11	916	28	3265
Kenya	88	6980	26	3054
Rwanda	14	1265	27	2996
Other countries	703	54084	410	42979

Figures rounded off.

Imports

Unlike exports, imports of borax (total) increased by 10% to 1,94,448 tonnes in 2020-21 from 1,76,421 tonnes in the previous year. Imports of natural borate also decreased slightly by 2% to 83,207 tonnes as compared to 84,699 tonnes in the previous year. In 2020-21, imports of sodium borate were at 1,01,477 tonnes and other borates 9,764 tonnes. Borax (total) was mainly imported from Turkey (57%), USA (21%), Spain (15%) and Bolivia (8%) (Fig-2). Imports of boric acid decreased to 6,897 tonnes in 2020-21 from 4,826 tonnes in the previous year. Boric acid was imported mainly from Turkey (81%), Singapore (15%), and Peru (2%). Import of boron was negligible in both current and the previous year (Tables-10 to 15).

Table-10: Imports of Borax
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	176421	5644322	194448	6337254
Turkey	112539	3295226	111804	3426889
USA	37463	1336546	41604	1520214
Spain	8522	308061	10461	417300
Malaysia	920	30176	7467	252633
Bolivia	9434	143418	15020	235104
China	1519	170647	1348	158480
Argentina	2045	62675	3628	105296
Singapore	1663	59882	1898	71848
UK	681	132379	220	45089
Austria	424	34950	262	23733
Other countries	1211	70362	736	80668

Figures rounded off.

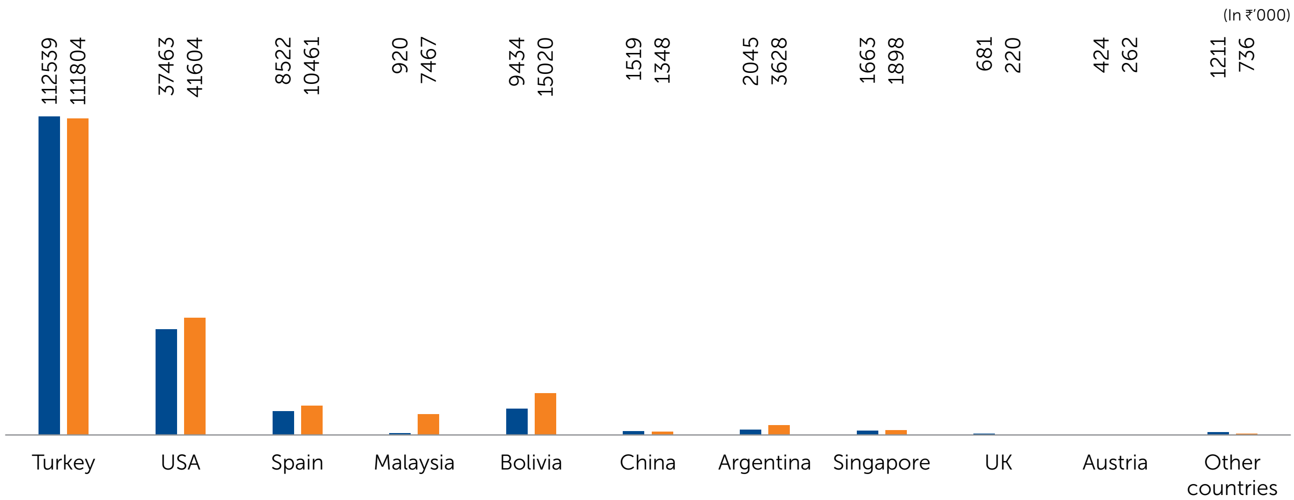


Fig 2: Countrywise Value of Import of Borax

Table-11: Imports of Natural Borate

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	84699	2157324	83207	2113660
Turkey	65016	1672500	54464	1379528
Spain	8328	295846	10443	411949
Bolivia	9434	143418	15020	235104
Argentina	1160	29936	3280	87005
Japan	-	-	++	74
Chile	684	10171	-	-
USA	36	3330	-	-
Oman	13	1420	-	-
Peru	28	692	-	-
China	++	7	-	-
Other countries	++	4	-	-

Figures rounded off.

Table-12: Imports of Borax: Sodium Borates

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	81531	2776165	101477	3557620
Turkey	42985	1427884	52927	1823516
USA	35851	1236246	39794	1412759
Malaysia	920	30176	7392	249124
Singapore	216	6784	719	25498
Netherlands	108	12369	119	15073
China	56	4305	100	8445
Argentina	780	23678	216	6727
Peru	56	4073	84	6442
Germany	4	6300	2	4132
UK	355	13003	100	3242
Other countries	200	11347	24	2662

Figures rounded off.

Table-13: Imports of Borax: Other Borates

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	10191	710833	9764	665974
Turkey	4538	194842	4413	223845
China	1463	166335	1248	150035
USA	1576	96970	1810	107455
Singapore	1447	53098	1179	46350
UK	326	119376	120	41847
Austria	424	34950	262	23733
Peru	140	10142	196	15110
Argentina	105	9061	132	11564
Slovenia	114	6463	109	9186
Slovakia	-	-	114	7429
Other countries	58	19596	181	29420

Figures rounded off.

Table-14: Imports of Boric Acid
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4826	210517	6897	313194
Turkey	2344	101845	5581	251826
Singapore	1281	55425	1028	45874
Peru	421	17668	150	6814
USA	513	21678	98	4924
China	50	3363	40	2909
Germany	5	877	++	788
Japan	1	111	++	50
France	-	-	++	4
Malaysia	-	-	++	3
UK	++	12	++	2
Other countries	211	9538	-	-

Figures rounded off.

Table – 15 : Imports of Boron
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	2193	++	1899
Hong Kong	-	-	++	850
China	-	-	++	591
Germany	++	337	++	158
Belgium	++	162	++	131
USA	++	1061	++	124
UK	++	131	++	45
Canada	++	502	-	-

Figures rounded off.

FUTURE OUTLOOK

Consumption of borates is expected to increase, spurred by strong demand in agriculture, ceramic and glass markets in Asia and South America. Continued investment in new refines and technologies and the continued increase in demand were expected to fuel growth in world production for the foreseeable future. In 2013, the European Union (EU) added borates to the Registration, Evaluation, Authorisation and Restrictions of Chemicals (REACH) Restricted Substances List, following an EU study that determined continuous exposure to humans may be harmful. The ruling required detergent makers to decrease their use of boron (Lismore, 2012). Consumption of boron-based fertilizers is expected to increase as the demand for food and biofuel cropsis on the rise. Higher crop prices have enabled farmers to invest in advanced farming techniques and higher grade fertilizers.

Consumption of boron nitride is expected to increase owing to the development of high-volume production techniques coupled with the creation of new technologies requiring boron nitride. The properties intrinsic to cubic boron nitride, such as, hardness (second only to diamond), high thermal conductivity, and oxidation resistance, make it an ideal material for a variety of emerging applications. Hexagonal boron nitride is used in producing ceramics, creating intermetallic composites, imparting thermal shock resistance, improving machinability and reducing friction.

5. Cement

537

(million tonnes) Total installed capacity of cement plants were reported in 2020-21

299.94

(million tonnes) Production of cement were reported in 2020-21

2.80

(million tonnes) of cement (total) were exported in 2020-21

2.35

(million tonnes) of cement were imported in 2020-21

The Cement Industry in India is among the Eight core Industries that is vital for economic growth and development. Ever since the Industry was delicensed in 1991, there has been remarkable growth that metamorphosed it to a globally competitive Market, making India the second largest producer of cement after China in the world. Cement is the basic building material and is used extensively in urban housing, industrial sector and infrastructure development. It has become synonymous with construction activity and the per capita consumption of cement is accepted as an important indicator of the country's economic growth.

In terms of quality, technology, productivity and efficiency, India compares well with the best in the world. The demand for cement is closely linked to the overall economic growth, particularly the housing and infrastructure sector. The recent government thrust on housing and infrastructure development augurs well for the industry. However, the per capita consumption of cement in India still remains substantially low at about 195 kg when compared with the developed world or world average which stands at about 500 kg. The Indian Cement Industry plays a key role in the national economy, not only by generating substantial revenue for State and Central Governments but also as a key industry that generates maximum employment directly or indirectly. India has a lot of potential for development in the Infrastructure and Construction Sector and the Cement Sector is poised for a positive growth in the days ahead. Some of the recent major government initiatives, such as, Housing for all concrete Highways, Dedicated fright corridors, clean India Mission, ultra Mega power Projects, waterways, development of smart cities are expected to provide a major boost to the sector.

The Department of Industrial Policy and Promotion (DIPP), Ministry of Commerce, Govt. of India publishes data on production and capacity of cement in its Annual Report. As per Annual Report 2020-21, the total installed capacity of cement plants has been placed at 537 million tonnes among which there are more than 350 mini cement plants with an estimated capacity of 11.10 million tonnes per annum. During 2020-21, the production of cement was 299.94 million tonnes which showed a slight decrease of 1% as compared to the year 2019-20 which reported a production of 334.37 million tonnes.

Three cement plants, having a total capacity of 1.338 mtpa white cement. Most of these capacities are modern and based on the energy-efficient dry processing technology.

There are as many as 175 plants with over a million tonnes or more capacity. In the Public Sector, however, there is only one Central Public Sector Undertaking i.e., CCI which had 10 units, spread over eight States/Union Territories. Out of these, only three plants, namely, Bokajan, Rajban and Tandur units are operational, the remaining cement plants have shut operations for more than a decade now. There are five large cement plants owned by various State Government Undertakings like Tamil Nadu Cement, Malabar Cements, J&K Ltd and Mawmluh-Cherra Cement Ltd, Shillong, Meghalaya.The company-wise annual installed capacity and production of cement plants during the year 2020-21 in the country is furnished in Table-1.

Table 1: Company-wise Installed Capacities and Production of Cement Plants, 2020-21

(In million tonnes)

Company/ Plant Name	Capacity	Production
ACC Ltd		
Bargarh, Bargarh, Odisha	2.5	-
Chaibasa, Singhbhum, Jharkhand	1.2	0.95
Chanda, Chandrapur, Maharashtra	3.8	2.63
Damodar (G), Purulia, West Bengal	0.7	0.62
Gagal-I & II, Bilaspur, Himachal Pradesh	4.4	2.94
Jamul, Durg, Chhattisgarh	3	2.27
Kudithini (G), Ballari, Karnataka	3	1.1
Kymore, Katni, Madhya Pradesh	2.72	-
Lakheri, Bundi, Rajasthan	1.5	2.02
Madukkarai, Coimbatore, Tamil Nadu	1	-
Sindri (G), Dhanbad, Jharkhand	3	0.53
Thondebhavi (G), Chikballapur, Karnataka	1.66	-
Tikaria (G), Sultanpur, Uttar Pradesh	2.64	2.67
Vizag (G), Vizag, Andhra Pradesh	0.3	-
Wadi & Wadi New, Wadi, Karnataka	5.45	2.73
ACL, Jaypee Group		
Durga Cement Works, Guntur, Andhra Pradesh	2.31	0.4
Vishaka Cement Works, Vizag, Andhra Pradesh	0.54	-
Ambuja Cement Ltd		
Ambujanagar I & II, Kodinar, Junagadh, Gujarat	5.7	4.06
Bathinda (G), Bhatinda, Punjab	1.2	-
Bhatapara, Raipur, Chhattisgarh	3.5	2.61
Dadri- (G), G B Nagar, Uttar Pradesh	1.5	1.9
Darlaghat, Solan, Solan, Himachal Pradesh	6.8	5.45
Farakka (G), Murshidabad, West Bengal	1.25	1.18
Magdalla (G), Surat, Gujarat	1.56	-
Maratha Cement, Chandrapur, Maharashtra	4.75	3.55
Nalagargh, Solan (G), Solan, Himachal Pradesh	1.5	0.98
Rabriyawas, Pali, Rajasthan		
Aditya Cement, Rajasthan		
Agarwal min chem Ltd,Rajasthan		
Alkon Cement Pvt.Ltd, Goa.		
Allwin Industries, Tamilnadu.		
Ambuja Cement Ltd, Rauri.		
Asntech India Ltd Karnataka.	3.6	2.27
Roorkee (G), Haridwar, Uttarakhand	1	0.84
Ropar (G), Ropar, Punjab	3	2.63

Contd....

Table-1 *(Contd)*

(In million tonnes)

Company/ Plant Name	Capacity	Production
Sankrail (G), Howrah, West Bengal	2.4	-
Suli,Rauri Himachal Pradesh	1.6	0.94
Amrit Cement		
Jaintia Hills, Jaintia Hills, Meghalaya	3	-
Andhra Cement Ltd.		
Durga Cement Works, Guntur, Andhra Pradesh	2.31	0.37
Anjani Portland Cements		
Anjani Portland Cements, Nalgonda, Telangana	1.92	0.83
Asian CCPL		
Asian Cement, Solan, Himachal Pradesh	1.3	-
Asian FCPL		
Asian Cement, Patiala, Punjab	1.5	-
Bagalkot Cement & Ind Ltd		
Bagalkot Cement, Bijapur, Karnataka	0.6	-
Barak Valley Cement		
Karimganj, Karimganj, Assam	0.33	-
Bharathi Cement		
Kadapa, Kadapa, Andhra Pradesh	5	3.68
Bhavya Cement		
Bhavya Cement, Guntur, Andhra Pradesh	1.4	0.8
Bheema Cement (Earlier Coromandel Cements)		
Bheema Cement, Nalgonda, Telangana	0.9	-
Binani Cement		
Sikar (G), Sikar, Rajasthan	1.4	2.7
Birla Corp. Ltd		
Chanderia, Chittorgarh, Rajasthan	4	3.57
Durgapur and Durga Hitech Cement (G), Bardhaman, West Bengal	2.3	-
Raebareli (G), Raebareli, Uttar Pradesh	1.3	-
Satna, Satna, Madhya Pradesh	2.2	-
Birla Corp. Ltd (erstwhile Reliance Cement)		
Butibori (G), Nagpur, Maharashtra	0.5	-
Kundanganj (G), Raebareli, Uttar Pradesh	2	-
Maihar, Satna, Madhya Pradesh	3	2.74
BMM Cement, Anantpur, Andhra Pradesh	0.95	0.86
BJCL, Jaypee Group		
Bhilai Jaypee (G), Durg, Chhattisgarh	2.2	-
Bhilai Jaypee, Satna, Madhya Pradesh	1.3	0.8
Burnpur Cement		
Asansol, Burdwan, West Bengal	0.3	-
Patratu, Ramgargh, Jharkhand	0.3	-
C.C.I. Ltd		
Bokajan, Karbi, Assam	0.2	0.1
Rajban, Sirmaur, Himachal Pradesh	0.25	-
Tandur, Rangareddy, Telangana	1	-
Century Cement, Raipur, Chhattisgarh	2.4	1.74
Maihar Cement I & II, Satna, Madhya Pradesh	4.2	3.21
Manikgarh Cement I & II, Chandrapur, Maharashtra	6	3.81
Sonar Bangla (G), Murshidabad, West Bengal	1.5	-
Chettinad Cement		
Ariyalur, Ariyalur, Tamil Nadu	5.5	2.5
Dachepalli works, Guntur, Andhra Pradesh	3.5	0.61

Contd....

Table-1 *(Contd)*

(In million tonnes)

Company/ Plant Name	Capacity	Production
Kallur, Gulbarga, Karnataka	2.5	1.25
Karikkali, Dindigul, Tamil Nadu	4.5	2.24
Puliyur, Karur, Tamil Nadu	1.7	1.01
Dalmia Cement (Bharat) Ltd		
Adhunik Cement Ltd, Jaintia Hills, Meghalaya	1.5	0.9
Ariyalur, Ariyalur, Tamil Nadu	3.4	2.1
Belagavi, Belagavi, Karnataka	4	1.6
Kadapa, Kadapa, Andhra Pradesh	4	1.84
Dalmiapuram, Trichy, Tamil Nadu	3.4	2.1
Calcom Cement India Ltd, Noagoan, Assam	1.72	-
Dalmia Cement (Bharat) Ltd (erstwhile Jaypee Group)		
Bokaro (G), Bokaro, Jharkhand	2.1	-
DCM Shriram Cement		
Shriram Cement Works, Kota, Rajasthan	0.4	-
Deccan Cement		
Nalgonda, Nalgonda, Telangana	1.8	1.77
Dhandapani Cement Ltd.		
Manachanallur, Tamil Nadu	0.02	0.01
ECO Cement		
Durgawati, Bhabhua, Bihar	1	-
Emami Ltd		
Panagarh, Burdwan, West Bengal	2	-
Risda, Baloda Bazaar, Chhattisgarh	3	2.45
Green Valley Industries		
Green Valley Industries, Jowai, Meghalaya	1	-
Grey gold Cement		
Grey gold Cement, Nalgonda, Telangana	0.05	0.04
Gujarat Siddhi Cement Ltd Junagad, Gujarat	2.01	1.15
Heidelberg Cement		
Ammasandra, Tumkur, Karnataka	0.51	-
Imlai (G), Damoh, Madhya Pradesh	3	2.8
Jhansi (G), Jhansi, Uttar Pradesh	2.7	-
Hi-Bond Cement		
Hi-Bond cement, Gondal, Gujarat	1.2	-
Hills Cement Company		
Hills Cement, Jaintia Hills, Meghalaya	1	-
Hemadri Cement Ltd Andhra Pradesh		
Hemadri Cement,Vedadri, Krishna, Andhra Pradesh	0.49	0.23
India Cements Ltd		
Chilamkur Works, Kadapa, Andhra Pradesh	1	0.3
Dalavoi, Ariyalur, Tamil Nadu	2.16	1.3
Malkapur, Rangareddy, Telangana	2.9	1.07
Parli (G), Beed, Maharashtra	1.1	-
Sankaridurg, Salem, Tamil Nadu	1.39	0.65
Sankarnagar, Tirunelveli, Tamil Nadu	2.05	1
Banswara Works, Banswara, Rajasthan	1.8	1.25
Vallur (G), Chennai, Tamil Nadu	1.1	-
Vishnupuram, Nalgonda, Telangana	3.5	1.19
Yerraguntla, Kadapa, Andhra Pradesh	1	0.4
Andaman Nicobar Islands	1.65	0.81

Contd....

Table-1 *(Contd)*

(In million tonnes)

Company/ Plant Name	Capacity	Production
J&K Cement Ltd		
Khrew, Pulwama, J & K	0.4	-
Samba, Jammu, J & K	0.1	-
J.K. Cement Ltd		
Gotan White, Nagaur, Rajasthan	0.61	0.58
Jharli(G), Jhajjar, Haryana	1.5	-
Mangrol, Chittorgarh, Rajasthan	2.5	1.71
Muddapur, Bagalkot, Karnataka	3	2.02
Nimbahera, Chittorgarh, Rajasthan	3.3	2.12
JAL, Jaypee Group		
Chunar (G), Mirzapur, Uttar Pradesh	2.5	-
Churk, Mirzapur, Uttar Pradesh	1.5	-
Rewa, Rewa, Madhya Pradesh	2.5	-
Sadva Khurd (Blending), Allahabad, Uttar Pradesh	0.6	-
JCCL, Jaypee Group		
Shahabad Cement, Shahabad, Karnataka	1.2	-
JK Lakshmi Cement Ltd		
Durg, Durg, Chhattisgarh	2.4	2.1
Jhajjar (G), Jhajjar, Haryana	1.3	-
Kalol (G), Gandhinagar, Gujarat	1	-
Sirohi, Sirohi, Rajasthan	8.7	3.4
Surat, Surat, Gujarat	1.35	-
JPVL, Jaypee Group		
Jayprakash Power Ventures (G), Singrauli, Madhya Pradesh	2	-
JSPL		
Raigarh, Raigarh, Chhattisgarh	0.85	-
JSW (erstwhile Heidelberg Cement (I) Ltd)		
Dolvi (G) , Raigad, Maharashtra	1	-
JSW Cement		
Nandyal, Kurnool, Andhra Pradesh	4.8	1.44
Salboni, P Medinipur, West Bengal	2.4	-
Vijayanagar, Bellary, Karnataka	3.2	-
JUD Cements		
Jaintia Hills, Jaintia Hills, Meghalaya	0.5	-
Kalburgi Cement		
Gulbarga, Gulbarga, Karnataka	3.6	2.07
(formerly Virat Sagar Cement Pvt Ltd)		
Kakatiya Cement & Sugar Ind.Ltd. Telangana		
Kakatiya Cement & Sugar Ind. Ltd Telangana	0.3	0.26
Kalyanpur Cement		
Kalyanpur Cement, Rohtas, Bihar	1	-
Kanodia Cement		
Kanodia Cement, Bulandsahar, Uttar Pradesh	0.33	-
Kanodia Infra, Bhabhua, Bihar	1.2	-
KCP Ltd		
Unit II, Jaggayyapeta, Krishna Andhra Pradesh	3.52	2.11
Guntur, Andhra Pradesh	0.82	0.45
Keerthi Industries (Formerly Suvarna Cement)		
Keerthi Industries, Nalgonda, Telangana	0.59	0.51
Kesoram Industries		
Kesoram Cement, Karimnagar, Telangana	1.5	1.09

Contd....

Table-1 *(Contd)*

(In million tonnes)

Company/ Plant Name	Capacity	Production
Vasvadatta Cement, Kalaburagi, Karnataka	8.65	4.23
Khyber Industries (P) Ltd		
Khyber Cement, Srinagar, J & K	0.33	-
KJS Cement		
KJS Cement, Satna, Madhya Pradesh	2.2	1.75
Nuvoco Vistas Corp Ltd., Lafarge Cement		
Arasmeta, Janjgir, Chhattisgarh	1.8	-
Chittorgarh, Chittorgarh, Rajasthan	2.6	2.08
Jojobera (G), Singhbhum, Jharkhand	4.6	-
Mejia (G), Bankura, West Bengal	1.65	1.54
Sonadih, Raipur, Chhattisgarh	1	0.54
Mawmluh Cherra Cements Ltd		
Mawmluh Cherra Cements Ltd, Garo (east), Meghalaya	0.18	0.01
Maa Chandi Cement		
Bamunara, Burdwan, West Bengal	0.33	-
Malabar Cements		
Cherthala (G), Alappuzha, Kerala	0.2	-
Walayar, Palakkad, Kerala	0.66	0.4
Mancherial Cement		
Mancherial Cement, Adilabad, Telangana	0.33	-
Jalgaon (G), Jalgaon,Maharashtra	2	-
Mangalam Cement Ltd		
Aligarh(G), Aligarh, Uttar Pradesh	0.75	-
Mangalam Cement I & II, Kota, Rajasthan	3.25	2.83
Megha Technical & Engineers Pvt. Ltd		
MTEPL-Lumshong, Jaintia Hills, Meghalaya	0.7	-
Meghalaya Cements Ltd		
Jaintia Hills, Jaintia Hills, Meghalaya	0.86	0.57
Mehta Group		
Gujarat Sidhee Cement, Junagadh, Gujarat	1.2	1.1
Saurashtra Cement, Porbandar, Gujarat	3.06	1.3
Murli Industries		
Murli Cement, Chandrapur, Maharashtra	3	-
My Home Industries Ltd		
Mellacheruvu, Nalgonda, Telangana	3.2	2.04
Mulakalapalli (G), Vizag, Andhra Pradesh	2	-
Ottapidaram,Thoothukudi, Tamil Nadu	1.5	-
NCL Industries		
Kondapalli (G), Krishna, Andhra Pradesh	0.99	-
Simhapuri, Nalgonda, Telangana	2	1.4
Nirma Ltd.		
Nirma Cement, Pali, Rajasthan	2.28	1.62
OCL India Ltd		
Bengal Works, Midnapore, West Bengal	1.35	-
Kapilas (G), Cuttack, Odisha	1.35	-
Rajgangpur, Sundargarh, Odisha	4	-
Orient Cement		
Chittapur, Kalaburagi, Karnataka	3	1.99
Devapur, Adilabad, Telangana	5	2.4
Jalgaon (G), Jalgaon, Maharashtra	2	-

Contd....

Table-1 *(Contd)*

(In million tonnes)

Company/ Plant Name	Capacity	Production
Panyam Cement		
Panyam Cement, Kurnool, Andhra Pradesh	1	-
Parasakti Cement		
Parasakti Cement, Guntur, Andhra Pradesh	1.26	0.8
Penna Cement Industries Ltd		
Boyareddypalli, Anantapur, Andhra Pradesh	2	-
Ganeshpahad, Nalgonda, Telangana	1.2	1.6
Talaricheruvu, Anantapur, Andhra Pradesh	2.2	0.94
Tandur, Rangareddy, Telangana	2	-
Prism Cement Ltd		
Prism Cement-I & II, Satna, Madhya Pradesh	6.6	-
Prism Johnson Ltd		
Karnool, Andhra Pradesh	4.8	-
Purbanchal Cement		
Sonapur, Kamrup, Assam	0.36	-
Rain Cements Ltd		
Kurnool Cem. Plant, Kurnool, Andhra Pradesh	2.77	1.62
Ramapuram Cem. Plant, Nalgonda, Telangana	1.5	0.75
Ramco Cements Ltd		
Alathiyur Works I & II, Perambalur, Tamil Nadu	3.05	1.33
Ariyalur, Perambalur, Tamil Nadu	3.5	2.6
Changelpet (G), Kancheepuram, Tamil Nadu	0.5	-
Jayantipuram, Krishna, Andhra Pradesh	3.85	1.47
Kolaghat (G), P Medinipur, West Bengal	0.95	-
Mathodu, Chitradurga, Karnataka	0.29	-
Ramasamyraja Nagar, Virudhnagar, Tamil Nadu	2	1.67
Salem (G), Salem, Tamil Nadu	1.6	-
Vizag (G), Vizag, Andhra Pradesh	0.95	-
RCCPL Pvt.Ltd,Maihar,Satana	3.6	2.76
RNB Cement		
East Khasi Hills, East Khasi, Meghalaya	0.40 -	
Sagar Cement Ltd		
BMM Cement, Anantapur, Andhra Pradesh	1	0.9
Sagar Cements		
Bayyavaram, Vizag, Andhra Pradesh	0.2	-
Mattampally, Nalgonda, Telangana	3.3	1.4
Pedaveedu, Nalgonda, Telangana	0.35	-
Sanghi Industries Ltd		
Sanghi Cement, Kachchh, Gujarat	4.1	2
Saurarashtra Cement		
Porbandar, Gujarat	3	1.39
Shree Cements		
Baloda Bazar, Raipur, Chhattisgarh	3	1.99
Bangur Cement (G), Aurangabad, Bihar	3.6	2
Bangur Cement , Suratgarh, Rajasthan	3.6	2.14
Beawar I & II, Ajmer,Rajasthan Unit-III Andheri Deori	3.6	1.1
Bulandsahar (G), Sikandrabad, Uttar Pradesh	2	2.12
Jaipur (G), Jaipur, Rajasthan	1.5	0.55
Khushkhera (G), Alwar, Rajasthan	3.5	2.5
Karnataka Cement Project, Sedam	3	1.5
Karnataka Cement Project, Gulbarga, Karnataka	3	1.53

Contd....

Table-1 *(Contd)*

(In million tonnes)

Company/ Plant Name	Capacity	Production
Shree Cements		
New Bihar Cement Plant, Aurangabad, Bihar	2	1.56
Ras, Pali, Rajasthan	3	2.8
Roorkee (G), Haridwar, Uttrakhand	1.8	-
Ras New Cement Unit, Ras Rajasthan	4	2.79
Shree Jharkhand, Saraikela, Jharkhand	2.27	0.57
Suratgarh (G), Sriganganagar, Rajasthan	1.8	0.42
Shree Cements (erstwhile Jaypee Group)		
Panipat (G), Panipat, Haryana	1.5	1.14
Shree Digvijay Cement Co.		
Shree Digvijay-Sikka, Sikka, Gujarat	1.2	1.02
Shristi Cement		
Mangalpur, Burdwan, West Bengal	0.36	-
Sparta Cements & Infra Ltd		
Sparta Cements, Bhuj, Gujarat	1	-
Sri Chakra Cements		
Annamarajupet Grinding Unit (G), Vizianagaram, Andhra Pradesh	0.26	-
Narasimhapuri Cement Unit, Guntur, Andhra Pradesh	0.31	-
Sri JayaJothi Cements Pvt. Ltd		
Sri JayaJothi Cement Plant, Kurnool, Andhra Pradesh	3.2	1.31
Sri Lalita		
Matampally, Nalgonda, Telangana	1	-
Star Cement Ltd		
CMCL-Lumshong, Jaintia Hills, Meghalaya	1	0.8
CMCL-Sonapur (G), Guwahati, Assam	2	-
Swasata Cements Ltd		
Swasata Cements, Purulia, West Bengal	1.5	-
Tamil Nadu Cement		
Alangulam, Virudhunagar, Tamil Nadu	0.29	-
Ariyalur, Ariyalur, Tamil Nadu	0.5	-
Tata Chemicals Limited		
Tata Chemicals Cement Division, Mithapur, Gujarat	0.5	-
Tamil Nadu Newsprint & Papers Limited		
Tamil Nadu Newsprint & Papers Limited	0.33	0.25
The K.C.P. Ltd		
Macherla, Guntur, Andhra Pradesh	0.82	0.3
Muktyala, Krishna, Andhra Pradesh	3.52	1.7
Topcem		
Gauripur, Kamrup, Assam	0.66	-
Udaipur Cement		
Udaipur Cement, Udaipur, Rajasthan	1.6	1.15
UltraTech Cement Ltd		
Aditya, Chittorgarh, Rajasthan	8	4.17
Aligarh(G), Aligarh, Uttar Pradesh	1.3	-
Anantapur, Andhra Pradesh Cement Works	9	3.7
Arakkonam (G), Vellore, Tamil Nadu	1.1	-
Awarpur, Chandrapur, Maharashtra	6	2.34
Bhatinda (G), Bhatinda, Punjab	1.75	-
Dadri (G), G B Nagar, Uttar Pradesh	1.3	-
Dankuni, Hooghly, West Bengal	1.6	-

Contd....

Table-1 *(Concld)*

Company/ Plant Name	Capacity	Production
Dhar, Madhya Pradesh (Nagda)	3.5	2.15
Ginigera (G), Koppal, Karnataka	1.3	-
Gujarat Cement Works, Amreli, Gujarat	6.4	4.8
Hirmi, Raipur, Chhattisgarh	1.9	2.36
Hotgi, Solapur, Maharashtra	4	2.4
Jafrabad, Amreli, Gujarat	1.45	1.25
Jhajjar (G), Jhajjar, Haryana	1.6	-
Jharsuguda (G), Jharsuguda, Odisha	2.6	-
Kotputli, Jaipur, Rajasthan	4	2.37
Magdalla (G), Surat, Gujarat	0.75	-
Nagpur, Nagpur, Maharashtra	2	-
Panipat(G), Panipat, Haryana	1.3	-
Nathdwara Cement Ltd.,(earlier Binani Cement Sirohi)	4.85	2.69
Patliputra, Patna, Bihar	1.9	-
Rajashree, Kalaburagi, Karnataka	6.1	4.1
Ratnagiri (G), Ratnagiri, Maharashtra	0.48	-
Rawan, Raipur, Chhattisgarh	2.5	2.05
Reddipalayam, Ariyalur, Tamil Nadu	1.4	1.22
Sirohi, Sirohi, Rajasthan	4.85	-
Sewagram, Kachchh, Gujarat	2.4	2.3
Vikram, Neemuch, Madhya Pradesh	3.6	2.1
Wanakbori (G), Kheda, Gujarat	2.4	-
WBCW (G), Burdwan, West Bengal	1.4	-
Bara Allahabad, Uttar Pradesh	4	-
Birla White, Katni, Madhya Pradesh	0.4	0.37
Birla White, Jodhpur, Rajasthan	0.68	0.56
UltraTech Cement Ltd (erstwhile Jaypee Group)		
Ayodhya (G), Ambedkar Nagar, Uttar Pradesh	1	-
Baga, Solan, Himachal Pradesh	2.54	1.17
Bagheri (G & B), Solan, Himachal Pradesh	2	-
Balaji Cement, Krishna, Andhra Pradesh	5	2.9
Bela, Rewa, Madhya Pradesh	2.6	-
Dalla, Sonebhadra, Uttar Pradesh	0.5	0.44
Roorkee (G), Haridwar, Uttarakhand	1.1	-
Sidhi, Sidhi, Madhya Pradesh	3.5	1.59
Sikandrabad, Bulandsahar, Uttar Pradesh	1	-
Vadraj Cement		
Mora, Surat, Gujarat	6	-
Vijay Cements		
Vijay Cements, Trichy, Tamil Nadu	0.1	0.27
Vinay Cement		
Vinay Cement, Dima Hasao, Umrangshu, Assam	1.8	1
Wonder Cement		
Wonder Cement, Chittorgarh, Rajasthan	12	6.26
Zuari Cement Ltd		
Chennai (G), Chennai, Tamil Nadu	0.9	-
Sitapuram, Nalgonda, Telangana	1.4	0.94
Solapur, Solapur, Maharashtra	1.2	-
Yeraguntla, Kadapa, Andhra Pradesh	3.8	2.3

* Survey of Cement Industry and Directory and Annual Return in Form 'M' (Erstwhile Form 'O').

- Data on capacity, production and growth in Cement Industry are reflected in Table-2.

Table-2: Capacity, Production and Growth in Cement Industry, 2019-20 to 2020-21

Year	Annual Capacity (In million tonnes)	Production (In million tonnes)
2019-20	537	334.37
2020-21	537	299.94

Source: DIPP, Annual Reports

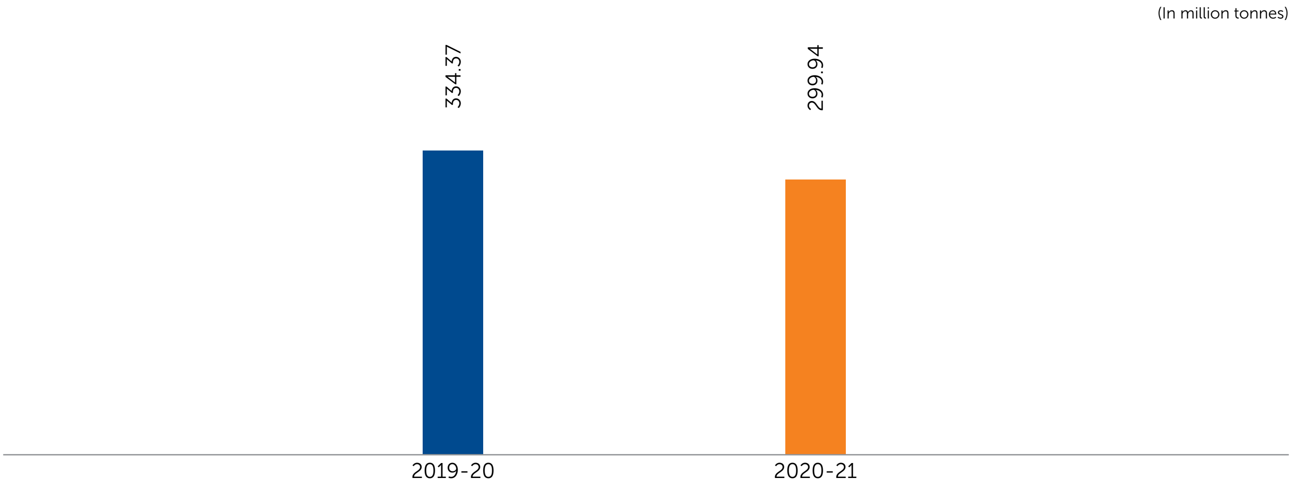


Fig 1: Production of Cement

A large number of mega plants with capacity of one million tonnes and above, possessing the latest technological features like roller process, vertical roller mills, process control equipment and efficient pollution control devices have emerged in different parts of the country. The induction of advanced technology has helped the Industry immensely to conserve energy & fuel and thereby save the raw materials substantially.

India is producing different varieties of cements like Ordinary Portland Cement (OPC), Portland Pozzolana Cement (PPC), Portland Blast Furnace Slag Cement (PBFSC), Oil-well Cement, Rapid Hardening Portland Cement, Sulphate Resistant Portland Cement (SRPC) and White Cement. BIS covers two types of PPC, viz. IS 1489 (Part1): 1991 (Reaffirmed 2009) Flyash-based and IS 1489 (Part 2):1991(Reaffirmed 2009) Calcined clay-based. PPC is suitable for all general construction, particularly, for marine & hydraulic construction and other mass concrete structures. Portland Slag Cement (PSC)-IS 455:1989 (Reaffirmed 2009) is particularly useful for marine works. BIS specifies three grades of OPC – (i) IS 269:1989 (Reaffirmed 2008), i.e., 33 grade suitable for all general constructions, particularly for masonry and plastering works (ii) IS 8112:1989 (Reaffirmed 2009), i.e., 43 grade is particularly suitable for high strength concrete work, and (iii) IS 12269:1987 (Reaffirmed 2008), i.e., 53 grade suitable for specialised work, such as, precast concrete, prestressed concrete, long span structures/bridges, tall structures, etc.

All these varieties of cement are produced strictly conforming to the BIS specifications for maintaining high quality. The Cement Quality Control Order dated February 2003 issued under the BIS Act ensures quality of cement produced and sold in the market.

Power, coal and freight constitute about 15–20% each of the total production cost of cement while capital cost (interest and depreciation) forms 20–30 per cent. Although the Industry is largely under Private Sector, Government controls more than 40% of the cost. Power, coal and freight costs are all regulated by Government bodies, such as, State Electricity Boards, Coal India Ltd and the Railways.

Operating Cost

The cement capacity in the country is mostly concentrated near the main raw material source, i.e., limestone. According to some estimates, around 1.5 tonnes of limestone and 180–250 kg of coal is required to produce a tonne of cement. Cement manufacturing also consume minerals, such as, gypsum, quartz, bauxite, coal, kaolin, and iron ore too in varying amounts. Other important raw material is coal (0.25 tonnes required per tonne of cement). Many cement plants are situated near the coal belts in eastern Madhya Pradesh, primarily due to two reasons, namely, (i) less freight cost incurred to transport coal, and (ii) inability of domestic coal producers to fulfil supply-requirements of cement plants due to fall in production and prioritised supply to power plants. However, limestone reserves have been the primary consideration in choosing the location of plants. Presence of clusters of capacity and high transportation cost make the cement market regional in nature with the producers supplying cement to areas around the location of the plant.

Power is a major parameter that influences the operating cost. Grid power purchased from SEBs is costlier than captive power from coal-based plants by more than 25–30 per cent. Where conditions are favourable, setting up captive wind power farms has become a realistic option for cement plants.

Coal Distribution

Coal, being a low value, bulk product, regional concentration of deposits entails freight costs that constitute a substantial part in the production cost of cement. Though, rail is the predominantform of transport, road transport is commonly used by plants located close to pitheads. The Government in its notification to the Cement Industry has permitted cement plants to operate their own captive coal mines. Many cement plants have expressed interest in taking up coal blocks on lease and operating the mines for coal. As proposed by the Government, cement is one of the core sectors for which captive mining blocks would be allocated.

Power Availability

The Industry's average energy consumption is estimated to be about 725 kcal/kg clinker thermal energy and 80 kWh/t cement electrical energy. The best thermal and electrical energy consumption presently achieved by the Indian Cement Industry is about 667 kcal/kg clinker and 67 kWh/t cement which are comparable to the best reported figures of 660 kcal/kg clinker and 65 kWh/t cement in a developed country like Japan. Since the controls were lifted, aggregate power requirements have grown rapidly with rising cement capacity without commensurate growth in power generating capacity in the country. To offset the power crisis situation, many cement plants have set-up installations for captive power generation. Further, as part of reform process in Coal Sector, the Government has also permitted 100% FDI in captive coal blocks in Cement Sector along with Power and Steel Sectors to facilitate and augment power availability.

Freight Costs

Logistics in the Cement Sector affect freight costs to a large extent. The basic raw materials for manufacturing cement, such as, limestone and coal are low value high bulk material and, as a result, entail huge freight cost which form the single largest cost component, usually accounting for 33% of the variable costs. During 1990s, the most significant developments were the emergence of big plants and formations of clusters of cement plants. These clusters, typically located far away from the major consumption centres meant that cement has to be transported over very long distances. The Indian Railways transported 120.40 million tonnes cement in 2020-21, an increase from 110.10 million tonnes of cement transported in 2019-20, as a part of revenue earning freight traffic. Alternatively, the cost-conscious manufacturers have attempted to use sea route for transportation as sea route is cost-effective and could benefit coast-based manufacturers. Some cement plants have set-up dedicated jetties for promoting bulk transportation and export.

Cost Control

Cement producers of the country have continuously attempted to lower the cost by various methods like:

- improved efficiency by increasing usage of captive power;
- locating units closer to the market place;
- increasing production of blended cement;
- availing of various State incentives like sales tax exemption; power tariff; exemption/concession (Himachal Pradesh and Tamil Nadu);
- conversion from wet to dry process, wherever possible, depending on quality of limestone; and
- enhanced capacities to achieve economy of scale. (Expansion is the preferred route as setting up new plant costs thrice the cost of expansion).

Environment

Ministry of Environment and Forests has notified the emission standards for cement plants in 1987, which were subsequently revised in February, 2006. In India, the permissible stack dust emissions from various sources for existing cement plants is 1.50 mg/Nm and 100 mg/Nm for plants located in critically polluted areas. However, the limit for new plants in our country is 50 mg/Nm which is at par with some of the developed countries. All large plants do have in place necessary air pollution control equipment to control dust emissions. Thermal power stations use bituminous or sub-bituminous coal and produce large volumes of fly ash. Fly ash is a fine powder recovered from gases created by coal-fired electric power generation. These micron sized earth elements consist primarily of silica, alumina and iron. When mixed with lime and water, the fly ash forms a cementitious compound with properties very similar to portland cement. The research outcomes so far have established that low-grade /dolomitic limestone up to 15–20% can be used in the manufacture of cement conforming to 43 grade OPC. Fly ash up to 45% can be used in high volume fly ash cement, thereby, enhancing the fly ash utilisation. The research outcome pursued under Swatchchta Action Plan established that poor quality fly ash can be used up to 40% by activating it through mechanical and chemical routes resulting in additional fly ash utilisation of about 15 million tonnes annually over and above the current quantum of fly ash utlisation limit of 35%. These efforts have certainly impacted the country in a big way by saving it from severe environmental consequences. Industrial wastes, such as, petcoke, tar waste and by-products, such as, red mud from aluminium industries, ferrous and non-ferrous slag from steel & other industries, phospho-chalk & phospho-gypsum from fertilizer industries, lime sludge from paper & sugar industries, carbide sludge from carbide industries, phosphorus furnace slag, etc. are now finding use in the manufacture of cement.

Ready-Mix Concrete

Ready-mix Concrete (RMC) is a relatively nascent market in India. RMC is ready-to-use concrete blend of cement, sand & aggregate and water mixed in convenient proportion. It was first launched in Mumbai a few years ago and is gaining ground in other metros in India. RMC is a corollary to bulk handling and transportation of cement. It has several advantages. It is produced under controlled conditions and hence has consistency in quality and it can be directly powered in the required form which would not only save time but also would improve the quality of construction. Leading companies operating in the RMC market of India include UltraTech Cement Ltd, ACC Ltd, Nuvoco Vistas Corp. Ltd, The India Cement Ltd, Godrej Construction. The Ramco Cement Ltd, etc. Indian RMC market is expected to grow at 9% during 2021–2026.

POLICY

The Export & Import Policy 2015-20, incorporated in the FTP for cement is free. The import of cement viz. portland cement, white cement, aluminous cement, slag cement, super sulphate cement and similar hydraulic cements, whether or not coloured or in the form of clinkers, under ITC (HS) Code 2523 is free.

Development Council for Cement Industry

Development Council for Cement Industry has been set-up under Section 6 of the Industrial (Development & Regulation) Act,1951. The activity of the Council is funded through the cess collected from Cement Manufacturers in terms of the Cement Cess Rules,1993. The Cement Council promotes development of the Cement Industry by funding development projects in areas of base level activities of National Council for Cement & Building Materials and R&D, improving productivity by reducing cost, optimum utilisation of raw materials, modernisation of cement plants, improvement of environment, standardisation and quality control progress, bulk supply and distribution of cement, training and upgradation of skill in Cement Industry.

WORLD REVIEW

The cement production in 2020 was estimated at 4,400 million tonnes. China (2,500 million tonnes) was the largest producer of cement in the world, contributing about 57% to the world output, followed by India (330 million tonnes) 8%, Vietnam (100 million tonnes) and USA (92 million tonnes) 2%, each (Table-3).

FOREIGN TRADE

Exports

Export of cement (total) decreased by 1% to 2.80 million tonnes in 2020-21 from 2.84 million tonnes in 2019-20. In 2020-21, exports of portland grey cement at 1.52 million tonnes and cement clinker at 1.09 million tonnes. Exports of portland white cement and other cements were 18,384 tonnes and 1,66,359 tonnes, respectively. Exports of cement total in 2020-21 were mainly to Sri Lanka (58%), Nepal (27%), Bangladesh (5%), Maldives (2%) and Bhutan (1%) (Tables - 4 to 8) (Fig 2).

Imports

Imports cement increased marginally in 2020-21 by 6% to 2.35 million tonnes from 2.21 million tonnes in 2019-20. Imports of portland grey cement were 0.39 million tonnes. Similarly, imports of cement clinker were 1.49 million tonnes, other cements 0.29 million tonnes and portland white cement about 0.17 million tonnes. The main suppliers in 2020-21 were UAE (43%), Iran (17%), Bhutan (10%), Oman (18%), and Bangladesh (8%) and (Tables- 9 to 13) (Fig 3).

Table-3: World Production of Cement
(By Principal Countries)

(In '000 tonnes)

Country	2020	2021
World : Total (rounded)	42,00,000	44,00,000
United States (includes Puerto Rico)	89,000	92,000
Brazil	61,000	65,000
China	24,00,000	25,00,000
Egypt	42,000	40,000
India*	2,95,000	3,30,000
Indonesia	65,000	66,000
Iran	68,000	62,000
Japan	51,000	52,000
Korea, Rep. of	48,000	48,000
Mexio	48,000	50,000
Russia	56,000	56,000
Saudi Arabia	53,000	55,000
Turkey	72,000	76,000
Vietnam	98,000	1,00,000
Other countries	7,60,000	8,10,000

Source: USGS, Mineral Commodity Summaries, 2022.

* : India's production of cement in 2018-19; 2019-20 and 2020-21 was 337.32 million tonnes, 334.37 million tonnes and 299.94 million tonnes, respectively.

Table-4: Exports of Cement: Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2840277**	**9539871**	**2806874**	**8761533**
Sri Lanka	1841183	5722780	1635909	4602601
Nepal	551552	2139850	770363	2745464
Bangladesh	146974	388193	151656	376077
Maldives	100846	438767	65156	293991
Cote D'Ivoire	-	-	104530	271903
Mauritius	6481	30394	30631	138768
Bhutan	87819	446594	27752	134224
UAE	482	10167	4480	107238
Nigeria	2535	29417	4713	43668
Reunion	15484	67521	4060	18551
Other countries	86921	266188	7624	83048

Figures rounded off.

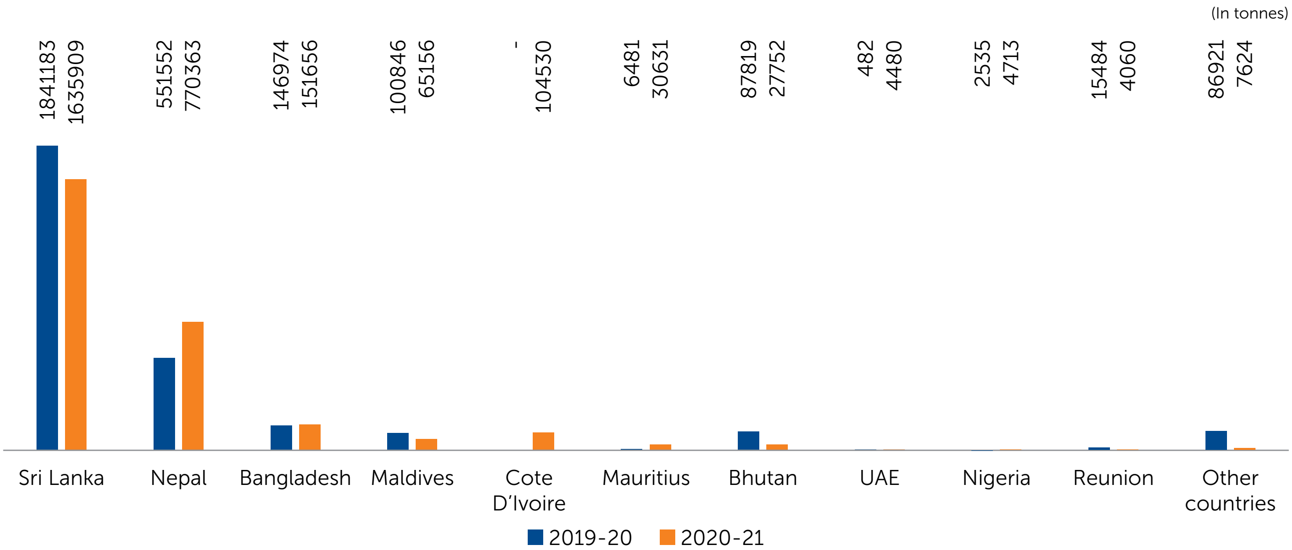


Fig 2: Countrywise Export of Cement

Table-5: Exports of Cement (Portland Grey)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1892277**	**6173135**	**1528080**	**4528743**
Sri Lanka	1720408	5377981	1422910	4040146
Maldives	85612	363168	57071	252502
Mauritius	5680	26580	27447	120805
Nepal	42037	228015	7419	44910
Bhutan	12628	77716	6661	41852
Seychelles	7868	28571	3549	13405
Reunion	11004	49078	2660	12360
China	22	219	192	1730
Kenya	-	-	108	410
Uganda	-	-	5	249
Other countries	7018	21807	58	374

Figures rounded off.

Table-6: Exports of Cement (Portland White)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**18164**	**176655**	**18384**	**179863**
Nepal	12561	122997	14085	136320
Nigeria	2535	29417	1598	19358
Qatar	1673	10030	1974	12603
Malawi	187	2487	159	2107
Ethiopia	82	956	162	2010
Maldives	18	295	50	1989
Mozambique	42	499	92	1256
Bhutan	391	3767	88	1146
Saudi Arabia	10	104	10	789
Togo	28	396	56	759
Other countries	637	5707	110	1526

Figures rounded off.

Table-7: Exports of Cement Clinker

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**800076**	**2709413**	**1094051**	**3410629**
Nepal	491979	1759074	747356	2549445
Bangladesh	146680	384241	151405	374645
Cote D'Ivoire	-	-	10450	217903
Sri Lanka	18445	50309	69920	179052
Bhutan	74662	364274	20838	89545
Qatar	-	-	1	24
Germany	3	13	1	13
Seychelles	18	367	++	2
Mozambique	68233	150212	-	-
Malawi	28	425	-	-
Other countries	28	498	-	-

Figures rounded off.

Table-8: Exports of Cement (Others)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**129760**	**480668**	**166359**	**642298**
Sri Lanka	102321	294221	143079	393403
UAE	426	9670	4480	107205
Maldives	15216	75304	8035	39500
Nigeria	-	-	3115	24310
Mauritius	779	3539	3130	17273
Nepal	4975	29764	1503	14789
Saudi Arabia	399	22043	245	13986
USA	++	10	245	12473
Malaysia	199	5027	448	9873
Reunion	4480	18443	1400	6191
Other countries	965	22647	679	13295

Figures rounded off.

Table-9: Imports of Cement: Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2214478	9003784	2350442	9302473
UAE	691409	2996046	1023987	4282567
Bangladesh	217012	1133104	209448	1176076
Bhutan	301542	1295244	255234	1171694
Oman	261459	741898	444963	1082915
Iran	526771	1384942	404141	1013290
China	6654	377689	4639	256239
Netherlands	2458	122915	2833	149272
Crotia	1407	51961	945	34979
Taiwan	225	78644	63	25800
France	383	17098	571	24880
Other countries	205158	804243	3618	84761

Figures rounded off.

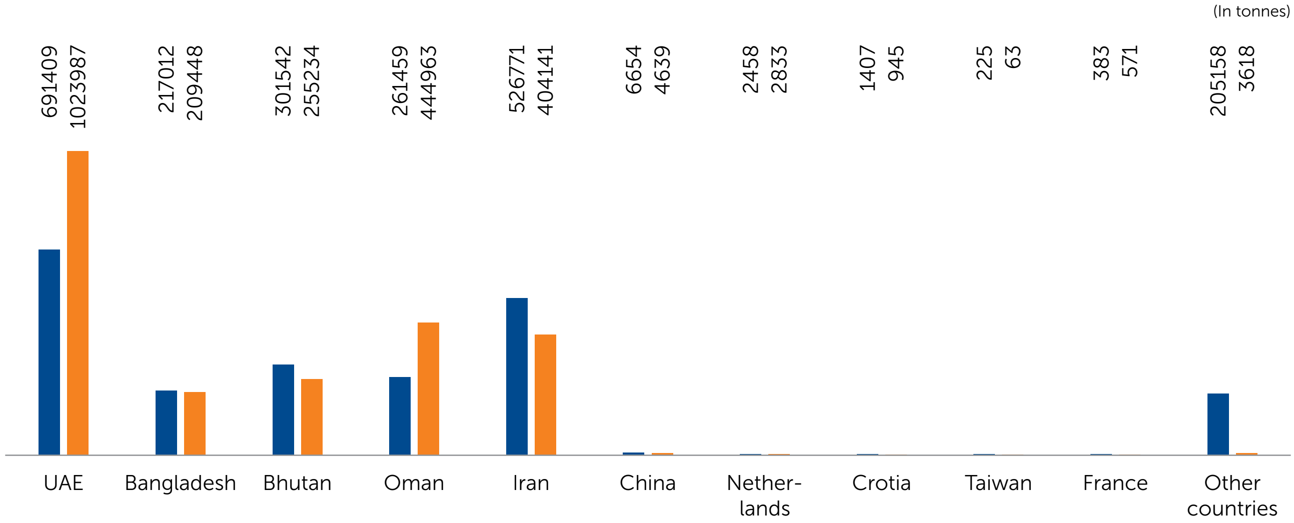


Fig 3: Countrywise Import of Cement

Table-10: Imports of Cement (Portland Grey)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	372431	1757397	393959	1851543
UAE	121599	556016	184517	824420
Bhutan	165721	762276	116445	544386
Bangladesh	81672	425992	50622	298557
Oman	-	-	40399	176919
Iran	-	-	1676	7161
Singapore	-	-	++	75
Spain	-	-	++	17
Japan	-	-	++	8
Netherlands	++	++	++	++
Pakistan	3439	13113	-	-

Figures rounded off.

Table-11: Imports of Cement (Portland White)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	148098	1115330	174241	1321486
UAE	142275	1077299	168352	1283571
Iran	4764	28479	4539	29280
Oman	216	1350	794	3921
Egypt	840	6836	420	3658
USA	-	-	54	467
Bhutan	-	-	81	346
Spain	3	1332	1	239
Malaysia	-	-	++	4
Italy	-	-	++	++
Brazil	++	34	-	-

Figures rounded off.

Table-12: Imports of Cement Clinker

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1462999	4208354	1491411	4061781
UAE	416654	1292653	628895	1896954
Iran	522007	1356463	397926	976849
Oman	261243	740538	403770	902075
Bhutan	66650	210560	58873	244012
China	11	305	498	18267
Singapore	86	3508	360	15567
Ukraine	-	-	550	4002
Malaysia	312	2187	520	3813
USA	++	166	19	237
Zimbabwe	-	-	++	3
Other countries	196036	601974	++	2

Figures founded off.

Table-13: Imports of Cement (Others)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	230950	1922703	291131	2067663
Bangladesh	135340	707112	158826	877519
Bhutan	69171	322408	79835	382950
UAE	10881	70078	42223	277622
China	6643	377384	4141	237972
Netherlands	2458	122915	2833	149272
Croatia	1407	51961	945	34979
Taiwan	225	78644	63	25800
France	383	17098	571	24880
Korea, Rep. of	380	26382	322	20013
UK	102	9351	134	12217
Other countries	3960	139370	1238	24439

Figures founded off.

FUTURE OUTLOOK

The primacy of Cement Industry would continue as cement remains paramount for the development of infrastructure all over the world and no other material would possibly substitute it in the near future. Infrastructure and industrial activity, real estate business and investment in core sectors mainly drive the demand for cement. Some emerging areas for cement demand are concrete roads, concrete canal lining and rural construction (housing). Over 65% demand for cement arises from housing and real estate, 25% from public infrastructure.

The Government of India has been laying a massive emphasis on infrastructure development, with 100 smart cities, modernisation of 500 cities, affordable housing for all by 2022, cement concreting of national highways, provision of sanitation facilities, etc. These development projects that are in the pipeline would be the main drivers of growth of Indian Cement Industry.

The country is self-sufficient in terms of cement production. Most of the cement plants in India are operated by state-of-the-art technology and with advanced production facilities. The liberalisation policies for Cement Industry enabled achievement of strong growth in the Cement Sector. The Cement Industry has presently ushered in modifications and upgradation in technology, particularly in the energy conservation front.

As per IBEF India, cement production is expected to rise between 5 and 7% backed by demands from roads, urban infrastructure and commercial real estate segments. Cement consumption is expected to grow at 6.83%. The demand for cement is expected to touch 550–600 million tonnes per annum by 2025.

Reviewing the technology status of the Indian Cement Industry, the Working Group has observed that although the modern cement plants have incorporated the latest technology, yet there is scope for further improvement in the areas of in-pit crushing and conveying, pipe conveyors, co-processing of waste derived/hazardous combustible wastes as fuel, neurofuzzy expert system, cogeneration of power, multi chamber/dome silos, bulk transport of cement, pelletising and shrink wrapping for packing & despatch.

6. Chromite

332

(million tonnes) Total reserves/ resources of chromite were estimated as on 1st April 2020

2,864

(thousand tonnes) Production of chromite were reported in 2020-21

2.87

(thousand tonnes) of chromite (total) were exported in 2020-21

156.21

(thousand tonnes) of chromite (total) were imported in 2020-21

Chromite is the single commercially viable ore of chromium (Cr) which is chemically known as iron chromium oxide ($FeCr_2O_4$). The properties of chromium that make it most versatile and indispensable are its resistance to corrosion, oxidation, wear & galling and enhancement of hardenability. Chromium is an important alloying metal in ferrous metallurgy, perhaps next only to manganese. It is used in the manufacture of alloys along with other metals, such as nickel, cobalt, molybdenum, copper, titanium, zirconium, vanadium, columbium and selenium. Chromium is traded primarily as chromium ore or as an alloy of chromium and iron, namely, ferrochrome or charge chrome. The name of the element is derived from the Greek word 'chrôma', meaning colour, because many of its compounds are intensely coloured. It is a steely-grey, lustrous, hard and brittle metal which takes high polish, resists tarnishing and has a high melting point.

RESERVES/ RESOURCES

As per NMI database based on UNFC system, the total reserves/resources of chromite in the country as on 1.4.2020 has been estimated at 332 million tonnes with 79 million tonnes as "Reserves" (24%) and 253 million tonnes as "Remaining Resources" (76%) Fig. More than 96% resources of chromite are located in Odisha, mostly in Jajpur, Kendujhar and Dhenkanal districts. Minor deposits are scattered over Manipur, Nagaland, Karnataka, Jharkhand, Maharashtra, Tamil Nadu, Telangana and Andhra Pradesh. Gradewise, Charge chrome grade accounts for 28% resources followed by Beneficiable grade (24%), Ferrochrome grade (17%), Refractory grade (16%) and Unclassified grade (10%). Low, Others, and Not-known grades together account for remaining 4% (Table- 1) (Fig-1).

Table – 1 : Reserves/Resources of Chromite as on 1.4.2020 (P)
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	Resources
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
All India: Total	40635	15229	22672	78535	52696	10545	44395	1630	53008	70440	20435	253150	331685
By Grades													
Refractory	6830	8592	11241	26663	14981	2902	3053	70	430	4238	-	25675	52338
Charge chrome	21426	3130	7340	31896	20723	4651	5205	140	26395	4699	-	61815	93711
Low	4480	-	-	4480	2545	27	-	-	-	3713	-	6284	10764
Beneficiable	7515	3507	4091	15113	11365	2964	14885	1335	14059	20805	-	65413	80526
Ferrochrome	-	-	-	-	1519	-	21083	75	11801	22951	-	57429	57429
Others	-	-	-	-	-	-	-	-	15	-	-	15	15
Unclassified	385	-	-	384	1562	-	169	9	308	13856	19889	35793	36177
Not-known	-	-	-	-	1	1	1	-	-	177	546	725	725
By States													
Andhra Pradesh	-	-	-	-	-	-	-	-	-	-	-	-	-
Jharkhand	-	-	-	-	-	-	-	15	98	623	-	736	736
Karnataka	176	340	323	499	474	378	54	-	20	392	-	1317	1817
Maharashtra	5	48	23	5	5	-	5	43	67	418	-	533	538
Manipur	-	-	-	-	3	21	52	-	504	6077	-	6657	6657
Nagaland	-	-	-	-	-	-	-	-	-	3200	-	3200	3200
Odisha	40453	15229	22349	78031	52215	10146	44289	1565	52304	59284	20435	240237	318269
Tamil Nadu	-	-	-	-	-	-	-	7	-	276	-	282	282
Telangana	-	-	-	-	-	-	-	-	15	171	-	186	186

Figures rounded off.

(In stonnes)

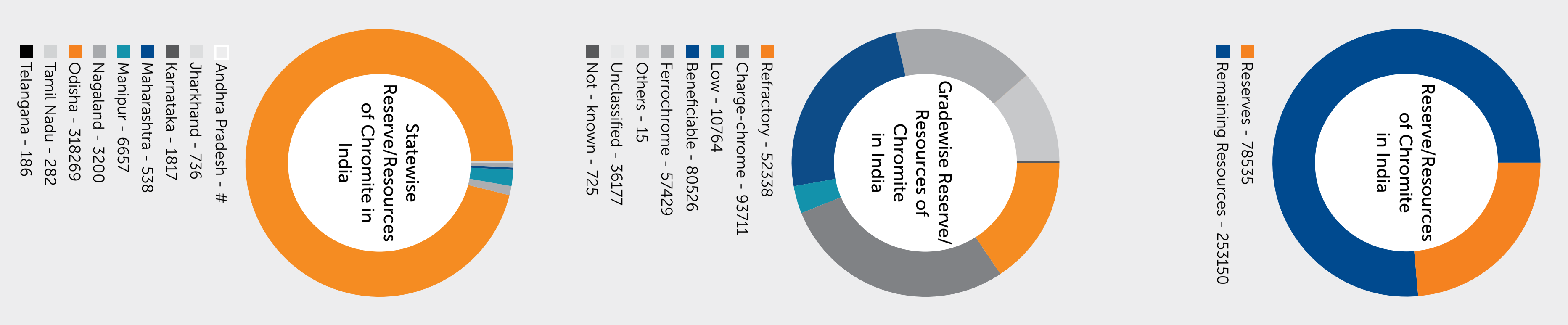


Fig 1 : Reserves/Resources of Chromite in India

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

PRODUCTION AND STOCKS

The production of chromite was 2,864 thousand tonnes during 2020-21 which decreased by 27% as compared to 3,929 thousand tonnes in the previous year. The number of reporting mines were 23 in 2020-21 as compared to 22 in the preceding year. The share of Public Sector in total production was 39% in 2020-21 as compared to 21% in the previous year. About 23% of the total production was reported from captive mines in the current year as compared to 20% in the previous year.

Odisha continued to be the sole producing State for chromite, accounting for the entire production during 2020-21 and nil production was reported from Karnataka and Maharashtra (Fig-2).

Gradewise analysis of production during 2020-21 reveals that about 47% of the total production of chromite accounted for 40% – 52% Cr_2O_3 (lumps & fines) followed by 30% accounted for below 40% Cr_2O_3(lumps & fines) grade and 21% accounted for 52% & above Cr_2O_3 fines grade.

Mine-head closing stocks of chromite in 2020-21 were 2,799 thousand tonnes as compared to 2,411 thousand tonnes in 2019-20.

The average daily employment of labour in chromite mines during 2020-21 was 4,248 as against 5,845 in the previous year (Tables-2 to 8).

Table – 2 : Principal Producers of Chromite, 2020-21

Name and address of the producer	Location of mine	
	State	District
Tata Steel Ltd, Bombay House, 24, Homi Mody Street, Fort, Mumbai – 400 001, Maharashtra.	Odisha	Jajpur
The Odisha Mining Corporation Ltd, 'OMC House', Unit 5, Post Box No. 34, Bhubaneswar – 751 001, Odisha.	Odisha	Jajpur Keonijhar
Indian Metals & Ferro Alloys Ltd, IMFA Building, Bomikhal, P.O.-Rasulgarh, Bhubaneswar – 751 010, Odisha.	Odisha	Jajpur,
Balasore Alloys Ltd, Balgopalpur, Dist. Balasore - 756 020, Odisha.	Odisha	Jajpur
Ferro Alloys Corporation Ltd., Charge Chrome Plant, D.P.Nagar, Randia, Bhadrak-756135 Odisha.	Odisha	Jajpur

Table – 3 : Production of Chromite, 2018-19 to 2020-21
(By States)

(Quantity in tonnes; Value in ₹ '000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	3970691	36850747	3929260	32134395	2863869	22910242
Maharashtra	++	++	-	-	-	-
Odisha	3970691	36850747	3929260	32134395	2863869	22910242

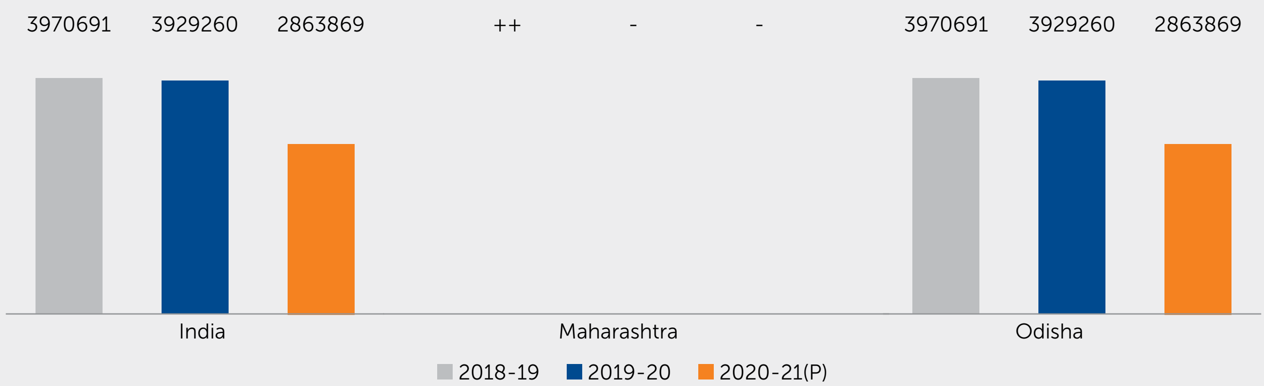


Fig 2: Production of Chromite

Table – 4 : Gradewise Production of Chromite, 2019-20
(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/ District	Production by Grades : Cr_2O_3 Content									
	No. of mines	Below 40%		40–52%		52% & Above		Concen-trates	Total	
		Lumps	Fines	Lumps	Fines	Lumps	Fines		Quantity	Value
India	22	73044	830291	94838	1078617	-	1625150	227320	3929260	32134395
Public sector	9	320	314465	238	255292	-	233999	5409	809723	5670300
Private sector	13	72724	515826	94600	823325	-	1391151	221911	3119537	26464095
Karnataka	2	-	-	-	-	-	-	-	-	-
Hassan	2*	-	-	-	-	-	-	-	-	-
Odisha	20	73044	830291	94838	1078617	-	1625150	227320	3929260	32134395
Dhenkanal	3*	-	-	-	-	-	-	-	-	-
Jajpur	14	72724	830199	94600	1078617	-	1625150	227320	3928610	32130371
Keonjhar	3	320	92	238	-	-	-	-	650	4024

* Only labour reported

Table – 5 : Gradewise Production of Chromite, 2020-21(P)
(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/ District	Production by Grades : Cr_2O_3 Content									
	No. of mines	Below 40%		40–52%		52% & Above		Concen-trates	Total	
		Lumps	Fines	Lumps	Fines	Lumps	Fines		Quantity	Value
India	23	81597	781935	131954	1219795	-	615393	33195	2863869	22910242
Public sector	8	-	182082	-	732759	-	208901	-	1123742	11481303
Private sector	15	81597	599853	131954	487036	-	406492	33195	1740127	11428939
Karnataka	2	-	-	-	-	-	-	-	-	-
Hassan	2*	-	-	-	-	-	-	-	-	-
Odisha	21	81597	781935	131954	1219795	-	615393	33195	2863869	22910242
Dhenkanal	3*	-	-	-	-	-	-	-	-	-
Jajpur	15	81597	781935	131954	1219795	-	615393	33195	2863869	22910242
Kendujhar	3*	-	-	-	-	-	-	-	-	-

* Only labour reported.

Table – 6 : Production of Chromite, 2019-20 and 2020-21
(By Frequency Groups)

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage to total production		Cumulative percentage	
	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)
Total	22	23	3929260	2863869	100	100	-	-
Up to 10000	12	13	5870	-	0.15	-	0.15	-
10001–100000	2	4	127064	266480	3.23	9.3	3.38	9.3
100001 – 200000	3	2	449445	307980	11.44	10.75	14.82	20.05
200001 – 300000	1	2	240907	521820	6.13	18.22	20.95	38.27
300001 and above	4	2	3105974	1767589	79.05	61.73	100	100

* Only labour reported.

Table – 7 : Mine-head Closing Stocks of Chromite, 2019-20
(By States/Grades)

(In tonnes)

State	Stocks by Grades: Cr_2O_3 Content							
	Below 40%		40–52%		52% & Above		Concentrates	Total
	Lumps	Fines	Lumps	Fines	Lumps	Fines		Quantity
India	18065	1711225	12132	143057	285	503141	22971	2410876
Karnataka	834	-	-	303	-	-	-	1137
Odisha	17231	1711225	12132	142754	285	503141	22971	2409739

Table – 8 : Mine-head Closing Stocks of Chromite, 2020-21
(By States/Grades)

(In tonnes)

State	Stocks by Grades: Cr_2O_3 Content							
	Below 40%		40–52%		52% & Above		Concentrates	Total
	Lumps	Fines	Lumps	Fines	Lumps	Fines		Quantity
India	27130	1898469	11300	590351	285	244964	26814	2799313
Karnataka	1038	-	-	303	-	-	-	1341
Odisha	26092	1898469	11300	590048	285	244964	26814	2797972

MINING & TRANSPORT

At present, mining operations for chromite are restricted in the Sukinda ultramafic belt, in the Baula Nausahi chromite belt in Odisha and in Hassan district of Karnataka. The method of exploitation of chromite in the areas includes both opencast and underground mining. Chromite outcrops generally are under overburden cover of 3 to 9 m. The overburden is generally soft, consists of aluminous laterite, murrum and laterite except in areas near the base of the Mahagiri Hill. The ore extracted from Kathpal mine and from all the mines in the Baula Nausahi belt is hard and massive. In all other mines, the ore occurs as friable and powdery.

The excavation of overburden in opencast mines is done by digging with shovels. The overburden generated is then loaded and transported by trucks & dumpers of 10 & 35 tonnes capacity, respectively. In the case of hard overburden of hard murrum or laterite or serpentinised quartzite etc. drilling and blasting procedures are commonly utilised. Drilling, done with jack hammer, and blasting (with appropriate quantity of explosives) loosen the hard formations which enable removal of overburden. The ores are subsequently excavated, sorted and stacked. In manual mines, ore is extracted manually by using pick axe.

South Kaliapani is the main chrome ore mine of Odisha Mining Corp. Ltd. In South Kaliapani mine, nominal blasting is done to loosen the ore which is then transported to stack yard and sorted manually. The ores for dissemination are transported and stacked separately.

Underground mining is practised in four chromite mines viz., Kathpal mine of M/s FACOR, Nausahi mine of M/s IMFA, Bangur chrome ore mine of Odisha Mining Corp. Ltd and Baula mine of M/s FACOR. The Kathpal chromite mine of M/s FACOR and Mahagiri mine of M/s IMFA are both underground and opencast. Maheswari lode is mined by underground method of mining, whereas Balaji lode is mined by opencast method.

ENVIRONMENT

The major problems associated with chromite mining are the pollution and degradation caused to the environment. The hexavalent chromium, especially in friable ore is the major cause of concern as it is carcinogenic in nature. The hexavalent chromium contamination of water bodies is a major issue that requires concerted attention. Viable treatment methods of pumping water, especially with ferrous sulphate solution, before it being discharged must be rigorously implemented as remedial measure. Ferrous sulphate solution converts the hexavalent into trivalent form which is non-carcinogenic. Incidentally, Mining Research Cell, Indian Bureau of Mines, during 2008-09 undertook a study for attenuation of hexavalent chromium in Sukinda chromite belt by bio-remediation technology which is apparently environment-friendly. This study was a S & T Project undertaken in association with the Utkal University. Air pollution by dumping is another major factor that leads to environmental degradation particularly during dry season.

Chromium contamination of air also comes from emissions of coal-based power plants and industrial chimneys of iron & steel and ferrochrome industries, from spray paintings, chrome baths, refractory industries and mining of chromite & magnesite. In rural areas, chromium in atmosphere rarely exceeds 1mg/cu.m of air, but in towns with major Iron & Steel Industries the levels may be 1,000 times more.

The inhalation of chromium compounds has been associated with the development of cancer among workers in the Chromite Industry. The relative risk for developing lung cancer has been calculated to be as much as 30 times. There is also evidence for an increased risk of developing nasal, pharyngeal, and gastrointestinal carcinomas. Quantitative epidemiological data were obtained by Mancuso and Hueper (1951), who observed increased occurrence of deaths (18.2%; $p<0.01$) from respiratory cancer among chromite workers as compared with 1.2% deaths where controls were at place. In a follow-up study conducted when more than 50% of the cohort died, the observed incidence for lung cancer deaths had increased to approximately 60%.

Protection of environment has become a major issue presently. The major environmental impacts of mining are (i) deforestation (ii) land damage (iii) water pollution and hydrological damage (iv) air pollution (v) noise pollution (vi) ground vibration and fly rock problem (vii) visual impacts, etc.

Deforestation takes place at actual site of an opencast mines and also where mineral and over- burden dumps are created or where service buildings and roads are built. Land damage takes place in opencast mining while exposing the mineral and in underground mining due to surface subsidence. In addition, land damage also takes place due to siting of surface dump of mineral, overburden refuse tips and formation of tailing dams.

After enforcement of MCDR,1988 there was afforestation in metalliferous mines in order to stabilise and reduce the impact of mining. IBM did play a major role in the restoration of mine environment. Plantation trees and other afforestation efforts to improve the environment were carried out regularly since 1989-90 and are still in practice.

CONSUMPTION

The consumption of chromite decreased by about 2% to 2.72 million tonnes in 2019-20 from 2.77 million tonnes in 2018-19. The most consuming industry was Ferroalloys/ Charge chrome Industry (96%). In addition to above, chromite in substantial quantities is also consumed by small-scale ferrochrome units, information for which is scarce. Besides, nominal consumption is reported by Refractory Industry and a negligible amount by others. Data on consumption of chromite from 2017-18 to 2019-20 is furnished in Table- 9.

Table – 9 : Estimated Consumption* of Chromite 2017-18 to 2019-20

(By Industries)

(In tonnes)

Industry	2017-18	2018-19 (R)	2019-20 (P)
All Industries	2575200(45)	2774800(42)	2718900(41)
Chemical	5000	5100	5300
Concentrates (Chrome ore/ chromite)	60700	112100	99900
Ferroalloys (including Charge chrome)	2499200	2639800	2597500
Refractory (including iron & steel)	9300	16700	15800
Others (foundry, calcination)	1000	1100	400

Figures rounded off.

* Includes actual reported consumption and/or estimates made wherever required. Owing to Paucity of data, the coverage may not be complete.

(): Number of plant reported/estimated.

USES

In metallurgy, chromite is mainly used in the manufacture of ferrochrome, silicochrome, charge chrome and chromium metal. Chromium imparts additional strength, hardness and toughness to its alloys. It also shows resistance to corrosion & prevents steel abrasion, reduces oxidation and flow of electricity. Stainless steel, high-speed tool steel and corrosion & heat-resistant steel are some of the important varieties of chromium steel.

Ferrochrome is of two types: (i) high-carbon (containing 4–8% carbon) and (ii) low-carbon (containing up to 2% carbon). The amount of chromium used in steel varies with the purpose. Low chromium steels (less than 5% chromium and small amount of nickel) are used in rails, automobiles, armour plates, armour piercing projectiles, etc. Intermediate chromium steels (3–12% Cr and small amounts of W, Mo or Si) are used in high-speed tools, valves for engines and other equipment requiring resistance to abrasion, corrosion and oxidation. Chromium steels include stainless steel (12–18% Cr) and super-stainless steel (12–30% Cr and 7–10% Ni) which are used for cutlery and cooking utensils, in aircraft & high-speed trains, respectively. Chromium (17%) along with iron (83%) is also used as ferritic stainless steel to manufacture coins.

Chromite is used in Refractory Industry because of its high chemical stability, its high temperature resistance and corrosion resistant properties. Further, its high melting point, ability to withstand sudden temperature changes, its chemically neutral character, moderate thermal expansion and mechanical strength besides abundant availability and reasonable price are added advantages for use in Refractory Industry.

Chromite is used for manufacturing important chromium compounds like chromates and bichromates of sodium and potassium, chromium pigments like chromic oxide green and chromic acid, which in turn, are used in chromium-plating solution.

Chromium is an essential trace element for human health. However, some of its compounds are highly toxic and carcinogenic. Environment concerns have reduced the use of chromite refractories and chromium chemicals.

SUBSTITUTES

Development of substitutes for chromium tends to be deterred by cost performance or the customer appeal for chromium. There are no substitutes for chromium in stainless steel or superalloys. Boron, manganese, nickel and molybdenum can be substituted in alloy steels and cast irons. Chromium containing scrap can substitute for ferrochromium in some metallurgical uses. Dolomite is an alternative for some refractory bricks. Cadmium yellow is one of the several alternative pigments. However, it is not environmentally acceptable and nickel and zinc are possible substitutes for the protection of decorative coatings.

SPECIFICATIONS

The specifications of chromite vary for different end-use industries. The Cr.Fe ratio is one of the important factors to be considered before deciding the end-use of the mineral. The BIS has specified IS:10818-1984 specifications of chromite for Metallurgical Industries Reaffirmed March 2019. IS: 10819-1999 (First Revision, Reaffirmed in January 2017) for specifications of chromite for Refractory Industry, IS: 4737-1982 (First Revision, Reaffirmed January 2021) for specification of chromite for Chemical Industry and IS : 6788: 1973 (Re-affirmed Feb.2019) for specification of chromite sand for Foundry Industry.

INDUSTRY

Chromite is mainly used in Metallurgical Industry for manufacture of ferroalloys, e.g., ferrochrome, charge chrome and silicochrome which are used as additives in making stainless steel and special alloy steel. Ferroalloys are the essential ingredients for the production of high quality special alloy steel as well as mild steel. The demand for ferroalloys is associated with the production of alloy steel.

Production of ferrochrome/charge chrome was mainly reported by Ferro Alloys Corp. Ltd, Shri Vasavi Industries Ltd, Balasore Industries Ltd, Tata Steel Ltd, Indian Metals & ferro-Alloys Ltd and Indian Charge-chrome Ltd (merged with Indian Metals & Ferro alloys Ltd in 2006) were amongst the major producers of charge chrome in India. Charge chrome contains 50 to 60% chromium and 6 to 8% carbon. Hard lumpy chromite is used for high-carbon ferrochrome while friable ores and fine briquettes are used for low-carbon ferrochrome. Briquette fines along with lumpy ores were also consumed in charge chrome plants.

The production has been at 1.0 to 1.1 million tonnes over the past 4-5 years. India consumes 15-30% of its production and exports the rest to countries like China, South Korea and Japan. The domestic consumption of ferrochrome has not grown for two main reasons a) except for the top three ferrochrome players IMFA, Tata Steel and Balasore Alloys others are in financial difficulties; b) Domestic Stainless Steel production which is largely accounted for by the Jindal Stainless Group of late is under severe duress. The Indian Ferrochrome Industry is likely to get consolidated as capacities owned by Rohit Ferro Alloys and FACOR Alloys are to be auctioned through the National Company Law Tribunal (NCLT) shortly. Recently, NCLT released the results of bidding for FACOR's assets.

The important plants which produce chromite based refractories are Tata Steel Ltd (formerly OMC Alloys), Orissa Industries Ltd, Bhilai Refractories Ltd, Burn Standard Co. Ltd, Joglekar Refractories and Ceramics (P) Ltd and Associated Ceramics Ltd.

Ferrochrome when added to steel imparts hardness, strength and augments its stainless characteristics. Carbon content classifies the ferrochrome alloy into high-carbon (6–8%), medium-carbon (3–4%) and low-carbon (1.5–3%), although chromium content in all the three grades is around 60–70 per cent. Around 2.5 tonnes chrome ore with an estimated power consumption of about 4,500 kWh is required to produce one tonne of ferrochrome.

Ferro Alloys Corpn. Ltd, Garividi, Andhra Pradesh; GMR Technologies & Industries Ltd, Srikakulam, Andhra Pradesh; Jindal Steel & Power Ltd, Raigarh, Chhattisgarh; Standard Chrome Ltd, Raigarh, Chhattisgarh; SAL Steel, Kachchh-Bhuj, Gujarat; Balasore Alloys Ltd, Balasore, Odisha; IDCOL Ferro Chrome Plant, Jajpur Road, Odisha;

Indian Metals & Ferro Alloys Ltd, Theruballi, Odisha; Jindal Stainless Ltd, Duburi, Odisha; Nava Bharat Ferro Alloys Ltd, Dhenkanal, Odisha; Rawat Ferro Alloys, Cuttack, Odisha; Rohit Ferro Tech. P. Ltd, Bishnupur, West Bengal; and Sri Vasavi Ind. Ltd, Bishnupur, West Bengal are the major ferrochrome producers in the country. A sizeable quantity of ferrochrome is also produced by units in the Small-scale Sector.

Chromite mine at Sukinda became the first unit to obtain Integrated Management System (IMS) certification (ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007). Tata Steel Ltd, FACOR and Indian Metals & Ferro Alloys Ltd (IMFA), the three major producers of charge chrome in the country have a total capacity of about 1,82,500 tpy. Tata Steel with its charge chrome plant at Bamnipal, Odisha, has a capacity of 55,000 tpy, while FACOR has a capacity of 65,000 tpy charge chrome at its Randia Plant, Bhadrak district, Odisha. Indian Metals & Ferro Alloys Ltd (IMFA), Cuttack district, Odisha, has an installed capacity of 62,500 tonnes per year.

Vishnu Chemicals Ltd has plants at Medak, Visakhapatnam (Andhra Pradesh) and Bhilai (Chhattisgarh) which produces chromium products, such as, sodium dichromate (70,000 tonnes per year), basic chromium sulphate, chromic acid (1,000 tonnes per year) and potassium dichromate (1,000 tonnes). There were two producers of chromium chemicals in small quantities in the organised sector, namely, Tamil Nadu Chromates and Chemicals Ltd and Krebs & Cie (India) Pvt. Ltd, Kolkata.

Commercially, chrome ore can be divided into three categories: (i) high-grade, containing >48% chromite, (ii) medium-grade with > 40% chromite and (iii) low-grade containing less than 40% chromite.

Chromium metal and the alloy ferrochromium are commercially produced from chromite by silicothermic or aluminothermic reactions, or by roasting and leaching processes. Chromium metal assumes high value due to its properties, such as, high corrosion resistance and imparting of hardness.

The discovery that steel could be made highly resistant to corrosion and discolouration by adding metallic chromium to form stainless steel led to major developments in the Steel Sector. This application, along with chrome plating (electroplating with chromium) are currently the major commercial use for the element. The element also finds application in the production of chromium compounds, albeit to a minor extent.

The strengthening effect of forming stable metal carbides at the grain boundaries and the strong increase in corrosion resistance has made chromium an important alloying material for steel. The high-speed tool steels contain between 3 and 5% chromium. Stainless steel, the main corrosion-proof metal alloy is formed when chromium is added to iron in sufficient concentrations usually above 11%. User's specifications of chromite in major consuming industries are furnished in Table-10.

Table – 10 : User's Specifications of Chromite in Major Consuming Industries

Industry/Name and location of plant	Specifications of ore consumed
Ferrochrome/Charge chrome	
Andhra Pradesh/Telangana	
Cronimet Alloys India Ltd, Ravivalasa, Distt Srikakulam	Lumps : Cr_2O_3 40% to 50% Fines : Cr_2O_3 40% to 52% Concentrates : Cr_2O_3 40%
Ferro-Alloys Corp. Ltd, Shreeram Nagar, Distt Vizianagaram	Lumps : Cr_2O_3 38% to 40% Fines : Cr_2O_3 38% to 40% Friable : Cr_2O_3 48% to 50% Concentrates : Cr_2O_3 48% to 50%
JSL Ltd, (formerly Jindal Stainless Steel Ltd) Jindal Nagar, Distt Vizianagaram	Lumps : Cr_2O_3 38% Cr:Fe : 2 : 9
Nav Bharat Ventures Ltd, Paloncha, Distt Khammam	Lumps: Cr_2O_3 28-42% Fines: Cr_2O_3 48-50%, 52-54%
GMR Technologies & Industries Ltd, Ravivalasa, Distt Srikakulam	Lumps: Cr_2O_3 38-45% Fines: Cr_2O_3 45-55 %
VBC Ferro Alloys Ltd, Rudragram, Distt Medak, Telangana	Lumps: Cr_2O_3 36-52%
Chhattisgarh	
Jindal Steel & Power Ltd, Raigarh	Lumps : Cr_2O_3+38% Cr:Fe : 2 : 9 Fines : Cr_2O_3+52%, Cr:Fe : 2:6
Deepak Ferro Alloys Ltd, Urla, Distt Raipur	Lumps : Cr_2O_3 36-40% Fines : Cr_2O_3 48-52%
Jammu & Kashmir	
Shree Sitaram Industries Pvt. Ltd, Distt Samba	Lumps : Cr_2O_3 40% to 52% Fines : Cr_2O_3 40% to +52%,
Odisha	
Balasore Alloys Ltd, (formerly Ispat Alloys Ltd) Balgopalpur, Distt Balasore	Lumps : Cr_2O_3 - 40% Fines : Cr_2O_3 - 40 to +52%
Ferro Alloys Corp. Ltd, Charge Chrome Division, Randia, Distt Bhadrak	Lumps : Cr_2O_3 N.A.; Friable : Cr_2O_3 40% & above; Concentrates : N.A.
IDCOL Ferro Chrome & Alloys Ltd, Jajpur Road, Distt Cuttack	Cr_2O_3 : 42-52% SiO_2 : 6% max.
Indian Metals & Ferro Alloys Ltd, (Formerly, Indian Charge Chrome Ltd) Choudwar, Distt Cuttack	Lumps: Cr_2O_3 : 40 to >52% SiO_2 : 15% max. Fines: 40 to 50% & above
Indian Metals & Ferro Alloys Ltd, Therubali, Distt Raygada	Lumps: Cr_2O_3 : 40 to 52% Fines: Cr_2O_3 : 40 to >52% Concentrates: N.A.

Industry/Name and location of plant	Specifications of ore consumed
Rohit Ferro Tech. Ltd, (Unit 2) Duburi, Distt Jajpur	Lumps, fines & concentrates
Tata Steel Ltd, (Formerly OMC Alloys Ltd) Bamnipal, Distt Keonjhar	Cr_2O_3 : 47% min. Size : 0 to 40 mm
West Bengal	
Rohit Ferro Tech Ltd, (Unit 1) Bishnupur, Distt Bankura	Lumps, fines & concentrates
REFRACTORY	
Chhattisgarh	
SAIL Refractories Unit, Marauda, Distt Durg	Friable lumps : Cr_2O_3 : 52 to 54% min. SiO_2 : 5% max.
Vishva Vishal Engineering Ltd, Bhilai, Durg	Cr_2O_3 : 50%, SiO_2 : 4.5% max. Fe_2O_3: 8%
Maharashtra	
Joglekar Refractories & Ceramics (P) Ltd, Rabale, Distt Thane	Lumps Cr_2O_3 44% min. CaO < 2%, Fe_2O_3 < 21% Imported sand - 30 to +85 mesh, Cr_2O_3 45% min. SiO_2 < 1%, Fe_2O_3 < 27%
Odisha	
Orissa Industries Ltd, Lathikata Works, Distt Sundargarh	Cr_2O_3 : 52 to 54% Fe_2O_3 : 15 to 18% max. SiO_2 : 3 to 5%
IFGL Refractories Ltd, Kalunga, Distt Sundargarh	Cr_2O_3 : 55% min. -16 to +22 mesh
TRL Krosaki Refractories Ltd, Belpahar, Distt Jharsududa	Cr_2O_3 : 48 to 50% min.
Shree Chem Industries (Pvt.) Ltd, Mandiyakudar, Distt Sundargarh	Cr_2O_3 : 54% SiO_2 : 5 to 9% min.
Kalinga Ferro Ispat Pvt Ltd, Mandia, Distt Jajpur	Fines Cr_2O_3 : 40-52% & above,
Khemka Refractories Pvt. Ltd, Kamakhyanagar - 759 018, Distt Dhenkanal	Fines Cr_2O_3 : 52% min.
Tamil Nadu	
Burn Standard Co. Ltd, Salem	Cr_2O_3 : 52 to 54% min., SiO_2 : 3 to 5% max. Fe_2O_3 : 15 to 18% max.
C. Nataraj Ceramics & Chem. Industry Dalmiapuram, Distt Tiruchirapalli	Lumps, Cr_2O_3 + 44%. Fe_2O_3 -25%
West Bengal	
National Refractories, P.O. Salampur - 713 357, Distt Burdwan	Cr_2O_3 : 52% min., above fines
CHEMICALS	
Odisha	
Krebs & Cei (India) Ltd, Kalma, Distt Mayurbhanj	Cr_2O_3 : 48 to 55%

TRADE POLICY

The Ministry of Commerce and Industry, Department of Commerce had come out with the Foreign Trade Policy (FTP) for the period 2015-2020. As per the present Export-Import Policy, ITC(HS), 2017 Schedule-2 "Export Policy" the imports of chromium ore lumps, friable ores and concentrates are freely allowed. The export policy on chromite is stated as follows: Chapter 2601 "Iron ores and concentrates, including roasted iron pyrites.

Tariff Item HS Cod	Item		Export Policy
26100000	(a)	Chrome ore lump containing (i) 47% Cr2O3 and above	-
26100020	(b)	Chrome ore lumps containing 40% or more but less than 47% Cr2O3	-
26100030	(c)	Chrome ore lumps with Cr2O3 below 40%	-
26100040	(d)	Chrome ore friable and conc. fixes containing 47% Cr2O3 and above	-
26100090	(e)	Other	-

WORLD REVIEW

World reserves of Shipping-grade chromite are about 570 million tonnes in terms of chromite ore. Countries that possess sizeable quantities of reserves are Kazakhstan (40%) and South Africa (35%). These two countries together hold about 75% of world's chromite reserves. India possesses 18% while Turkey accounts for 5% of the world reserves of chromite. The available data on world reserves of chromite (Shipping-grade) is furnished in Table-11.

Table – 11 : World Reserves of Chromite

(Shipping Grade)**

(By Principal Countries)

(In '000 tonnes of chromium content)

Country	Reserves
World: Total (rounded off)	570000
Finland	13000
India*	100000
Kazakhstan	230000
South Africa	200000
Turkey	26000
USA	620
Other countries	NA

Source: USGS, Mineral Commodity Summaries, 2022 **Shipping grade - Reserves unit are thousand tonnes of Shipping-grade chromite ore which is Deposit quantity and grade normalised to 45% Cr2O3except for United States where grade is normalised to 7% Cr2O3 and finland where grade is normalised to 26% Cr2O3.

NA-Not available. *: Reserves/resources of chromite in the country as on 1.4.2020 as per NMI database based on UNFC system have been placed at 331.69 million tonnes.

The world mine production of chromite ores & concentrates decreased by 20% to 31.05 million tonnes in 2020 from 38.6 million tonnes recorded in the previous year. South Africa was the leading producer contributing about 43% to the total world production followed by Kazakhstan (20%), Turkey (10%), India (9%), Zimbabwe & Finland (4% each) and Russia & Albania (2% each) (Table-12).

Table – 12 : World Mine Production of Chromium Ores and Concentrates

(By Principal Countries)

(In tonnes)

Country	2018	2019	2020
World: Total (rounded off)	37500	38600	31049
South Africa	17829	17664	13243
Kazakhstan	6889	7019	6327
India(e)**	3971	3837	2863
Turkey	2897	3364	3100
Zimbabwe	895	1550	1272
Albania	1143	1200*	627
Finland(f)	1099	1184	1131
Russia	469	698	689
Oman	885	608	382
Other countries	1386	1226	1414

Source: BGS World Mineral Production, 2016-20

*: Estimate, e: Years ends 31 March following that stated,

f: Concentrates.

**: production of chromite n india 2018-19, 2019-20 and 2020-21 was 3.97 million tonnes, 3.84 million tonnes and 2.86 million tonnes respectively.

Upgradation of technology and advancement in beneficiation processes, such as, agglomeration of ore, pre-heating and pre-reduction of furnace feed, closed-furnace technology and recovery of chromium from slags have brought about significant changes and are now followed worldwide. For generalised view of the development in various countries, the countrywise description sourced from the latest available publication of USGS 'Mineral Yearbook 2018' chromium (Advance Release) is furnished below:

Albania

Albania produced an estimated 9,60,000 tonnes of chromite ore in 2018 as against 9,50,181 tonnes in 2017. Ferrochromium production was estimated at 60,000 tonnes in 2018 as against 49,000 tonnes in 2017. Chromite ore and ferrochromium production increased in the past several years owing to increased investment in AlbChrome (Tirana), the leading chromite ore and ferrochromium producer in Albania.

Kazakhstan

Kazakhstan produced 66,88,700 tonnes of chromite ore in 2018 as against 63,13,300 tonnes (revised) in 2017 and an estimated 16,00,000 tonnes of ferrochromium in 2018 as compared with 16,40,300 tonnes (revised) in 2017. Kazakhstan was the third-leading producer of chromite ore and ferrochromium in the world.

Finland

Finland's production increased in 2018. The values for production in 2014 through 2017 have been revised and are now about twice as much as previously reported.

South Africa

South Africa was the world's leading producer of chromite ore in 2018. South Africa produced 1,76,17,099 tonnes of chromite ore in 2018 compared with 1,65,47,717 tonnes (revised) in 2017 and an estimated 39,00,000 tonnes of ferrochromium in 2018 compared with an estimated 36,00,000 tonnes in 2017. Afarak Group Plc (Finland) announced a transformer failure of a submerged arc furnace that produces ferrochromium in August at its Mogale Alloys processing plant. As a result, Mogale shut down the furnace, and repairs were expected to take up to 14 weeks to complete. Mogale anticipated a 7,000-tonnes/year reduction in ferrochromium capacity and production.

Zimbabwe

Zimbabwe produced 8,94,661 tonnes of chromite ore in 2018 as against 6,88,838 tonnes (revised) in 2017 and an estimated 1,80,000 tonnes of ferrochromium in 2018 compared with 1,42,800 tonnes in 2017.

Balasore Alloys Ltd. (India) agreed to acquire a 70% stake in Zimbabwe Alloys Ltd (ZimAlloys) (Gweru) in January to increase domestic and overseas production capacity. The arrangement was sanctioned by the High Court of Zimbabwe. The investment also settled ZimAlloys' debt of $50 million to creditors. With the debt cleared, ZimAlloys planned to refurbish and restart its blast furnaces within 18 months.

Brazil

Brazil produced an estimated 5,50,000 tonnes of chromite ore in 2018, unchanged from the 2017 revised estimate. Ferrochromium production was 1,75,061 tonnes in 2018 compared with 1,71,531 tonnes in 2017. Companhia de Ferro Ligas da Bahia owned more than 95% of chromite deposits operated in Brazil. Ferbasa invested $2.1 million in its "Hard Lump" project to improve treatment and mining processes in chromite ore production. An investment of $6.1 million was also allocated to machinery and equipment. Ferbasa decided to decrease its sales volume in 2018 compared to sales in 2017 owing to the decrease in the global prices of chromite ore (Companhia de Ferro Ligas da Bahia, 2019).

China

China produced an estimated 30,000 tonnes of chromite ore in 2018, unchanged from the 2017 estimate, and an estimated 52,50,000 tonnes of ferrochromium compared with a revised estimate of 49,40,000 tonnes in 2017. China was the leading producer of ferrochromium in 2018.

In response to requests from the stainless-steel billet and hot-rolled sheet and Coil Industry in China, the Ministry of Commerce of the People's Republic of China announced an investigation into imports of stainless-steel billets and stainless steel hot-rolled coil from the European Union, Indonesia, Japan and the Republic of Korea. The investigation was set to begin on July 23, 2018, and would run for 1 year but could extend into 2020 depending on special circumstances.

FOREIGN TRADE

Exports

Exports of chromite (total) decreased substantially by 91% to 2.87 thousand tonnes in 2020-21 from 33.90 thousand tonnes in the previous year (Fig-3). Out of total chromite exported in 2020-21, the share of chromite concentrate was only 7%, while chromite ore (others) accounted for 93%. Exports of chrome ore concentrate were almost fully to China in 2020-21. Export of chrome Ore (other) decreased substantially by 22% to 2,668 tonnes in 2020-21 from 3,433 tonnes in the preceding year.

In 2020-21, 168 tonnes of chromium & alloys were exported to various countries. Exports of chromium & alloys were mainly to USA (81%), Brazil (7%) and Nepal (6%). The exports of chromium & scrap was negligible. Exports of chromium unwrought (powder) was more or less unchanged to 158 tonnes in 2020-21 from 157 tonnes in the preceding year (Tables-13 to 19). The details of exports of ferrochrome are furnished in the Review entitled, 'Ferroalloys'.

Table – 13 : Exports of Chromite : Total
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	33898	867910	2872	71979
China	32069	795604	2716	65714
Spain	1500	63405	100	4602
UAE	-	-	54	1579
Nepal	37	30	2	84
South Africa	292	8871	-	-

Figures rounded off.

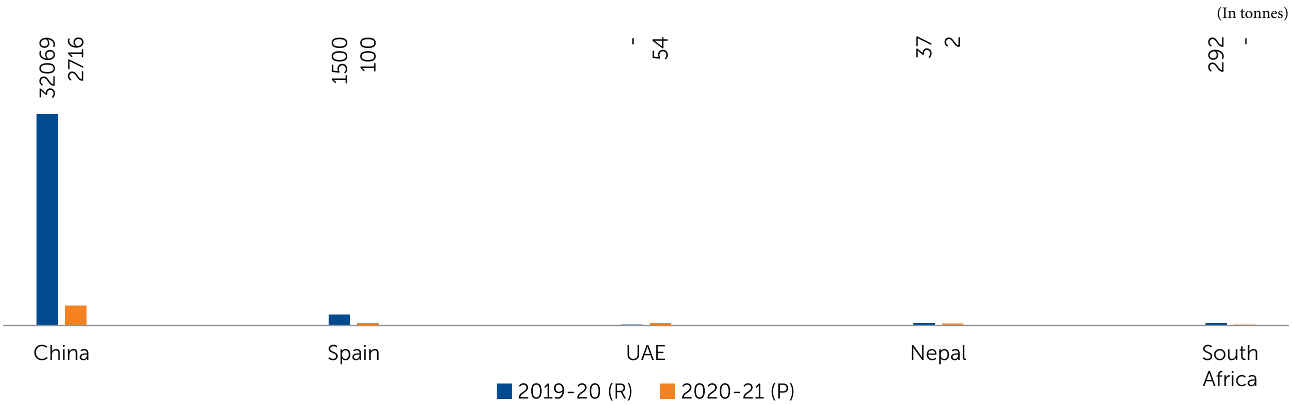


Fig 3: Exports of Chromite

Table – 14 : Exports of Chrome Ore Concentrates
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	30465	735433	204	3104
China	30377	732910	204	3104
South Africa	88	2523	-	

Figures rounded off.

Table – 15 : Exports of Chrome Ore (Others)
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3433	132477	2668	68875
China	1692	62694	2512	62610
Spain	1500	63405	100	4602
UAE	-	54	1579	
Nepal	37	30	2	84
South Africa	204	6348	-	-

Figures rounded off.

Table – 16 : Exports of Chromium & Alloys
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	157	112533	168	119457
USA	133	87667	136	83691
Nepal	-	-	10	21000
Brazil	2	2619	12	8138
U A E	3	1768	3	1902
Indonesia	++	174	1	1298
UK	1	1055	2	1038
Philippines	++	253	1	850
Egypt	++	282	1	573
Kenya	1	657	1	395
Qatar	++	51	++	315
Other countries	17	18007	1	257

Figures rounded off.

Table – 17 : Exports of Chromium Articles, Nes
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	8	10	21035
Nepal	-	-	10	21000
Italy	-	-	++	34
Australia	-	-	++	1
Bhutan	++	4	-	-
Nigeria	++	4	-	-
South Africa	++	++	-	-

Figures rounded off.

Table – 18 : Exports of Chromium & Scrap
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	30	++	32
Kenya	-	-	++	19
Qatar	-	-	++	11
UAE	-	-	++	2
Nepal	++	30	-	-
Korea	++	++	-	-

Figures rounded off.

Table – 19 : Exports of Chromium Unwrought : Powder
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	157	112525	158	98422
USA	133	87667	136	83691
Brazil	2	2619	12	8138
UAE	3	1768	3	1902
Indonesia	++	174	1	1298
UK	1	1055	2	1038
Philippines	++	253	1	850
Egypt	++	282	1	573
Kenya	1	657	1	395
Qatar	++	51	++	315
France	-	-	++	91
Other countries	17	17999	1	131

Figures rounded off.

Imports

Imports of chromite (total) increased by 20% to 156.21 thousand tonnes in 2020-21 from 124.69 thousand tonnes in the previous year. Imports were mainly from South Africa (71%), Mozambique (19%) and Switzerland (4%). Out of total quantity of chromite imported in 2020-21, chrome ore lump accounted for 50%, while concentrate and Other forms accounted for the remaining 50%. Imports of chrome ore lump were mainly from South Africa (43%), Mozambique (38%) and Switzerland (8%). 93% of the imports of chrome ore concentrate were from South Africa and the rest from Zimbabwe. Imports of chromium & alloys in 2020-21 were at 1,329 tonnes as compared to 1,514 tonnes in the previous year. Imports of chromium & alloys were mainly from Russia (49%), Netherlands (22%) and UK (19%). Imports of chromium & scrap were negligible in 2020-21 as compared to one tonne in 2019-20 (Tables- 20 to 27).The import details of ferrochrome are furnished in the Review entitled 'Ferroalloys'.

Table – 20 : Imports of Chromite : Total

(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	124693	2065047	156211	2257733
South Africa	99301	1757431	110250	1654869
Mozambique	-	-	30109	384902
Switzerland	2546	31249	6070	87789
Turkey	-	-	4450	56880
Oman	13855	141143	4319	47871
UAE	324	7951	561	12416
Netherlands	73	3302	150	7458
Zimbabwe	1819	27451	287	4275
Brazil	-	-	8	485
USA	++	++	1	319
Other countries	6775	96520	6	469

Figures rounded off.

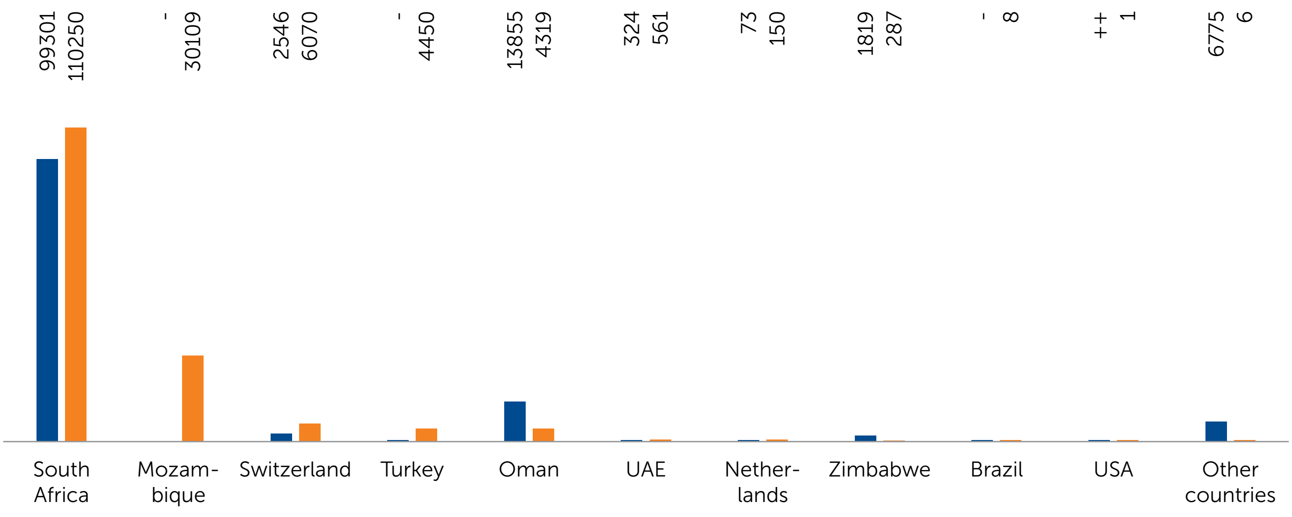


Fig 4: Imports of Chromite

Table – 21 : Imports of Chrome Ore Lump
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**80819**	**1300165**	**78845**	**1148209**
South Africa	55907	1007319	33897	570767
Mozambique	-	-	30109	384902
Switzerland	2546	31249	6070	87789
Turkey	-	-	4450	56880
Oman	13855	141143	4319	47871
Singapore	3844	51314	-	-
Madagascar	2794	40226	-	-
Zimbabwe	1819	27451	-	-
Saudi Arabia	54	1463	-	-

Figures rounded off.

Table – 22 : Imports of Chrome Ore Concentrate
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**891**	**24896**	**4013**	**93937**
South Africa	891	24896	3726	89662
Zimbabwe	-	-	287	4275

Figures rounded off.

Table – 23 : Imports of Chrome Ore Others
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**42983**	**739986**	**73353**	**1015587**
South Africa	42503	725216	72627	994440
UAE	324	7951	561	12416
Netherlands	73	3302	150	7458
Brazil	-	-	8	485
U S A	++	++	1	319
China	23	953	4	247
Germany	6	554	2	222
Hong Kong	54	2009	-	-
Spain	++	1	-	-

Figures rounded off.

Table – 24 : Imports of Chromium & Alloys
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1513**	**922166**	**1329**	**785783**
Russia	411	231277	653	309704
U S A	32	48594	38	138568
UK	375	205893	247	133905
Netherlands	337	184070	293	126282
Germany	4	18754	3	29498
Belgium	21	14425	60	27753
China	76	39722	29	12956
UAE	24	12942	2	2729
Japan	2	3615	1	1896
Sri Lanka	-	-	3	1299
Other countries	231	162874	++	1193

Figures rounded off.

Table – 25 : Imports of Chromium Unwrought : Powders
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1417	819169	1163	650313
Russia	411	231277	593	282628
U S A	32	37001	31	123694
Netherlands	337	184070	282	123540
U K	335	171329	182	82481
Belgium	1	425	60	27753
China	54	26794	9	4062
U A E	24	12942	2	2729
Japan	2	3302	1	1590
Sri Lanka	-	-	3	1299
Germany	-	-	++	457
Other countries	221	152029	++	80

Figures rounded off.

Table – 26 : Imports of Chromium Articles, Nes
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	96	102997	166	135470
UK	40	34564	65	51424
Germany	4	18754	3	29041
Russia	-	-	60	27076
USA	++	11593	7	14874
China	22	12928	20	8894
Netherlands	-	-	11	2742
Taiwan	-	-	++	528
Sweden	-	-	++	349
Japan	++	313	++	306
Korea	++	734	++	235
Other countries	30	24111	++	1

Figures rounded off.

Table – 27: Imports of Chromium & Scrap
(By Countries)

Country	2019-20(R)		2020-21(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1	1791	++	972
Austria	++	799	++	800
Germany	++	230	++	149
U S A	-	-	++	21
Singapore	-	-	++	2
U K	1	420	-	-
U A E	++	342	-	-

Figures rounded off.

FUTURE OUTLOOK

The current status of chromite production and consumption is on anticipated lines, but the consumption could increase enormously in the coming years and the country may have to depend on imports even for the domestic needs of chromite. Depletion of reserves is bound to create a serious problem for the future of the Chromite Industry in the country. An Expert Committee constituted by the Ministry of Steel, Government of India, in its recommendations put forth the need for detailed exploration of chromite in all the potential areas in Odisha, Karnataka and in the ophiolite belt of North-Eastern region with a view to prognosticate resources to a depth of 500 m in Sukinda belt and estimate resources in all other potential areas. Addressing concerns in ferrochrome production which is energy intensive segment is also essential. Setting up of such plant must strike a cost balance between raw materials and electrical energy supply. There are other imminent issues like consistent supply of chrome ore at the right cost, steady power supply and other input materials like low phosporous met coke and good market conditions that need redressal in respect of the continuous and unscrupulous exploitation of chromite.

Adherence to stringent pollution control norms, innovations in the process technology and plant equipment design would become inevitable for the future of the industry.

As per the latest available data, supply of chrome ore is expected to increase at a compound annual growth rate (CAGR) of 2.4 per cent over the 2018 to 2022 period. Demand is expected to increase at a CAGR of 2.9 per cent. This is in comparision with the previous five years, where supply grew at a CAGR of 2.8 per cent and demand at 3.0 per cent modest reflection.

7. Coal & Lignite

716.083

(million tonnes) Production of coal were reported in 2020-21

2.94

(million tonnes) of coal (excl. lignite) were exported in 2020-21

215.26

(million tonnes) of coal (excl. lignite) were imported in 2020-21

352.126

(billion tonnes) total reserves/ resources of coal were estimated as on 1st April 2021

Coal is a fossil fuel. It is a combustible, sedimentary, organic rock, which is composed mainly of carbon, hydrogen and oxygen. It is formed from vegetation, which has been consolidated between rock strata and altered by the combined effects of pressure and heat over millions of years to form coal seams.

The build-up of silt and other sediments, together with movements in the earth's crust (known as tectonic movements) buried these swamps and peat bogs, often to great depths causing the plant material to be subjected to high temperatures and pressures. Millions of year of deep burial engendered such physical and chemical changes which transformed the vegetation into peat and then into coal.

The quality of each coal deposit is determined by temperature and pressure and by the length of time in formation, which is referred to as its 'organic maturity'. Initially the peat is converted into lignite or 'brown coal' – these are coal types with low organic maturity. In comparison to other coals, lignite is quite soft and its colour can range from dark black to various shades of brown.

Many more millions of years of continuous effects of temperature and pressure produced further transformation of lignite, progressively increasing its organic maturity into the range known as 'sub-bituminous' coals.

Further chemical and physical changes have caused these coals to become harder and blacker, forming the 'bituminous' or 'hard coals'. Under the right conditions and progressive contrivance of organic maturity, finally results in the formation of anthracite.

Coal is vital for sustainable development. It is the most widely used energy source for electricity generation and an essential input for steel production. Coal is an essential resource for meeting the challenges facing the modern world. In India, coal accounts for around 55% of the country's primary commercial energy. Nearly 72% of the entire power generated in the country is coal based. India has a long history of commercial coal mining since 1774 and nationalisation of coal mines was put to effect on 01.05.1973. As per Integrated Energy Policy Committee of erstwhile Planning Commission, coal will remain India's most important energy source till 2031-32 and possibly beyond.

GEOLOGICAL RESOURCES

Coal

The coal deposits in India primarily are concentrated in the Gondwana sediments occurring mainly in the eastern and central parts of Peninsular India, although Gondwana coal deposits are also found to occur in the north-eastern part of the country mainly in Assam and Sikkim. The Tertiary coal-bearing sediments are found in Assam, Arunachal Pradesh, Nagaland and Meghalaya. As a result of exploration carried out by GSI, CMPDI and other agencies, about 352.126 billion tonnes (including that estimated in Sikkim) of geological coal resources up to 1,200 m depth have been established in the country as on 01.04.2021. Out of these resources, 177.179 billion tonnes are Proved resources, 146.949 billion tonnes are Indicated resources and the remaining about 27.998 billion tonnes are in the Inferred category. Of the total resources, the share of prime-coking coal is 5.313 billion tonnes, medium-coking 28.08 billion tonnes and blendable/semi-coking 1.708 billion tonnes. Share of non-coking coal, including high sulphur (tertiary) is 317.026 billion tonnes. State-wise/Coalfield-wise and State-wise/Type-wise Geological resources of coal as on 01.04.2021 (Fig-1)are furnished in Tables-1 & 2, respectively (Fig-2 & 3).

Table-1: Geological Resources of Coal as on 01.04.2021

(By States/Coalfields)

(In million tonnes)

State/Coalfield	Proved	Indicated	Inferred	Total
All India: Total	177179	146949	27998	352126
Gondwana Coalfields*	176585	146828	27089	350502
Andhra Pradesh/ Godavari Valley	921	901	425	2247
Assam/Singrimari	–	14	–	14
Bihar/Rajmahal	310	3143	11	3464
Chhattisgarh	31562	40425	1437	73424
Sohagpur	94	10	–	104
Sonhat	365	2304	2	2671
Jhilimili	228	39	–	267
Chirimiri	320	11	31	362
Bisrampur	1735	696	5	2436
East Bisrampur	–	165	–	165
Lakhanpur	456	3	–	459
Panchbahini	–	11	–	11
Hasdeo-Arand	2032	3273	223	5529
Sendurgarh	153	126	–	279
Korba	7055	5763	159	12976
Mand-Raigarh	17978	24859	924	43761
Tatapani-Ramkola	1145	3165	93	4403
Jharkhand	52046	28882	5288	86217
Raniganj	1538	467	32	2036
Jharia	16282	3248	–	19531
East Bokaro	3497	3923	863	8284
West Bokaro	3923	1279	17	5218
Ramgarh	937	912	58	1906
North Karanpura	10929	6173	1865	18967
South Karanpura	5176	1312	1143	7632
Aurangabad	352	2142	503	2997
Hutar	191	27	32	250
Daltonganj	84	60	–	144
Deogarh	326	74	–	400
Rajmahal	8811	9267	774	18852

Contd.

Table-1 *(Concld)*

(In million tonnes)

State/Coalfield	Proved	Indicated	Inferred	Total
Madhya Pradesh	**13479**	**13060**	**3678**	**30217**
Johilla	185	263	33	481
Umaria	178	4	–	181
Pench-Kanhan	1967	923	1166	4056
Pathakhera	291	88	68	447
Gurgunda	–	85	53	138
Mohpani	8	–	–	8
Sohagpur	2129	5659	293	8082
Singrauli	8722	6039	2064	16824
Maharashtra	**7770**	**3320**	**1847**	**12936**
Wardha Valley	4713	1785	1441	7940
Kamthi	2046	938	107	3091
Umrer Makardhokra	308	–	161	469
Nand Bander	691	596	118	1405
Bokhara	10	–	20	30
Odisha	**43326**	**35222**	**6330**	**84878**
Ib-River	16365	13509	2228	32102
Talcher	26961	21713	4103	52776
Telangana	**11089**	**8328**	**3433**	**22851**
Godavari Valley	11089	8328	3433	22851
Sikkim/Rangit Valley	**–**	**58**	**43**	**101**
Uttar Pradesh/Singrauli	**884**	**178**	**–**	**1062**
West Bengal	**15199**	**13296**	**4597**	**33092**
Raniganj	14781	7117	3680	25578
Barjora	201	–	–	201
Birbhum	218	6179	901	7298
Darjeeling	–	–	15	15
Tertiary Coalfields	**594**	**121**	**909**	**1624**
Assam	465	43	3	511
Makum	432	21	–	453
Dilli-Jeypore	32	22	–	54
Mikir Hills	1	–	3	4
Arunachal Pradesh	**31**	**40**	**19**	**90**
Namchik-Namphuk	31	40	13	84
Miao Bum	–	–	6	6
Meghalaya	**89**	**17**	**471**	**576**
West Darangiri	65	–	60	125
East Darangiri	–	–	34	34
Balphakram-Pendenguru	–	–	107	107
Siju	–	–	125	125
Langrin	10	17	106	133
Mawlong Shelia	2	–	4	6
Khasi Hills	–	–	10	10
Bapung	11	–	23	34
Jayanti Hills	–	–	2	2
Nagaland	**9**	**22**	**416**	**446**
Borjan	6	–	5	10
Jhanzi-Disai	2	22	109	133
Tiensang	1	–	2	3
Tiru Valley	–	–	7	7
DGM	–	–	293	293

Source: Coal Directory of India 2020-21, Coal Controller's Organisation, Kolkata, West Bengal.

* Including Sikkim. Figures rounded off.

(In million tonnes)

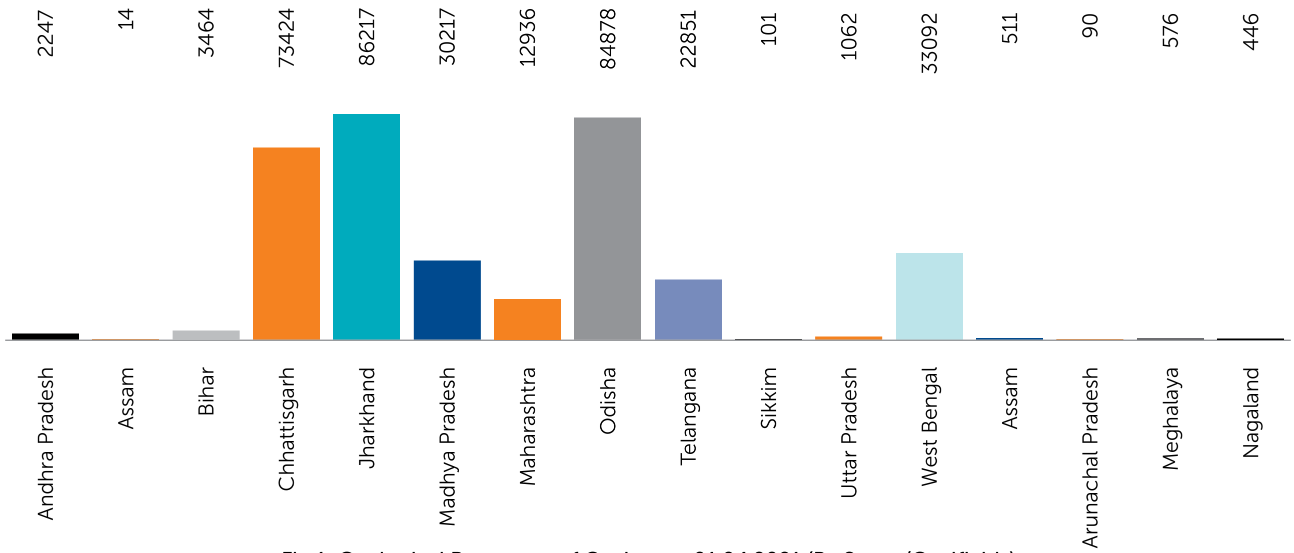


Fig 1: Geological Resources of Coal as on 01.04.2021 (By States/Coalfields)

Table-2: Geological Reserves/Resources of Coal as on 01.04.2021
(By States/Types)

(In million tonnes)

State/Type of coal	Proved	Indicated	Inferred	Total
All India: Total	177179	146949	27998	352126
Prime-coking	4668	645	–	5313
Medium-coking	14972	11245	1863	28080
Blendable/Semi-coking	530	992	186	1708
Non-coking (Incl. high sulphur)	157010	134067	25949	317026
Andhra Pradesh/Non-coking	921	901	425	2247
Arunachal Pradesh/ High sulphur	**31**	**40**	**19**	**90**
Assam	**465**	**57**	**3**	**525**
Semi-coking/Non-coking	–	14	–	14
High sulphur	465	43	3	511
Bihar/Non-coking	310	3143	11	3464
Chhattisgarh	**31562**	**40425**	**1437**	**73424**
Semi-coking	71	99	–	170
Non-coking	31419	40326	1437	73254
Jharkhand	**52046**	**28882**	**5288**	**86217**
Prime-coking	4668	645	–	5313
Medium-coking	14067	9685	1590	25342
Semi-coking	223	472	53	748
Non-coking	33088	18080	3645	54814
Madhya Pradesh	**13479**	**13060**	**3678**	**30217**
Medium-coking	354	1560	273	2187
Non-coking	13125	11500	3405	28029
Maharashtra/Non-coking	**7770**	**3320**	**1847**	**12936**
Meghalaya/High sulphur	**89**	**17**	**471**	**576**
Nagaland/High sulphur	**9**	**22**	**416**	**446**
Odisha/Non-coking	**43326**	**35222**	**6330**	**84828**
Sikkim/Non-coking	**–**	**58**	**423**	**101**
Telangana/Non-coking	**11089**	**8328**	**3433**	**22851**
Uttar Pradesh/Non-coking	**884**	**178**	**–**	**1062**

Contd.

Table-2 *(Concld)*

(In million tonnes)

State/Type of coal	Proved	Indicated	Inferred	Total
West Bengal	15199	13296	4597	33092
Medium-coking	550	–	–	550
Semi-coking	236	420	133	789
Non-coking	14414	12876	4464	31753

Source: Coal Directory of India 2020-21, Coal Controller's Organisaton, Kolkata.

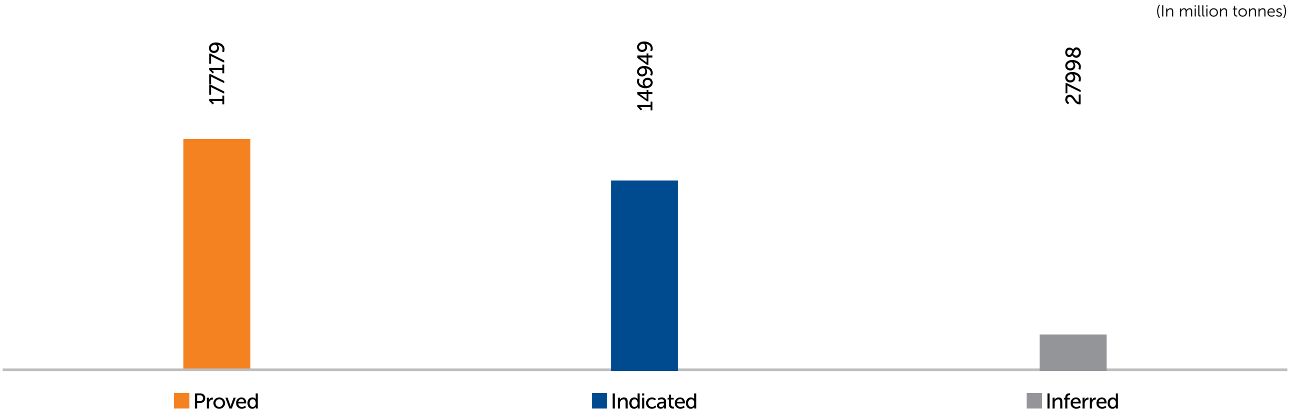


Fig 2: Geological Resources of Coal as on 01.04.2021

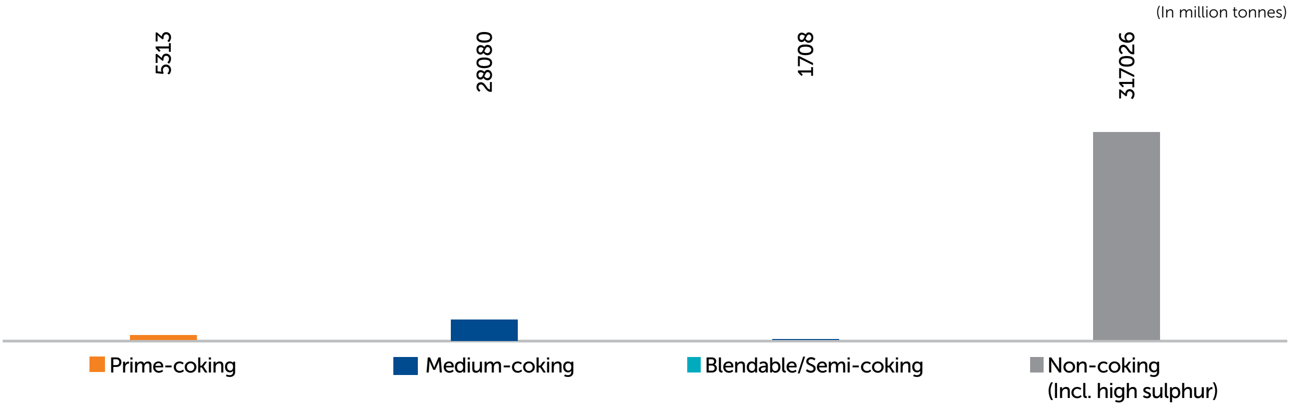


Fig 3: Geological Reserves/Resources of Coal as on 01.04.2021 (By States/Districts)

Lignite

Indian lignite deposits occur in the Tertiary sediments in the southern and western parts of peninsular shield particularly in Tamil Nadu, Puducherry, Gujarat & Rajasthan and also in Jammu & Kashmir. The total known geological resources of lignite as on 01.04.2021 is about 46.02 billion tonnes, of which 79.3% resources (about 36.49 billion tonnes) are located in Tamil Nadu, Rajasthan (13.8%) and Gujarat (5.92%). Other States where lignite deposits have been located are West Bengal and Kerala. State-wise/District-wise Geological resources of lignite as on 01.04.2021 are detailed in Table - 3.

Table-3: Fieldwise Geological Reserves/Resources of Lignite as on 01.04.2021
(By States/Districts)

(In million tonnes)

State/District	Area/Lignite field	Proved	Indicated	Inferred	Total
All India: Total		7374.1	25650.53	12993.84	46018.46
Gujarat		1278.65	283.7	1159.7	2722.05
Kachchh	Panandhro & Panandhro Extn., Barkhan Dam, Kaiyari Block-A & B, Mata-No-Madh, Umarsar, Lakhpat-Dhedadi (Punahrajpur), Akrimota, Jhularai-Waghapadar, Hamla-Ratadia & Pranpur.	335.61	56.4	33.09	425.1

Contd.

Table-3 *(Contd.)*

(In million tonnes)

State/District	Area/Lignite field	Proved	Indicated	Inferred	Total
Bharuch	Bhuri, Valia, Bhaga, Luna, Pansoli, Nani Pardi, Bhimpur, Rajpardi (GMDC leasehold) by MECL and Rajpardi (CGM) by MECL.	724.76	118.59	491.23	1334.58
Bhavnagar	Kharsalia, Rampur, Hoidad, Bhuteshwar, Surka, etc.	–	–	299.17	299.17
Surat	Tadkeswar, Dungra, East of Kamraj-Vesma, Nani Naroli, Tadkeswar block-Mongrol, Mandvi, Vastan, Ghala, etc.	218.28	108.71	336.21	663.2
Jammu & Kashmir U/T	–	**20.25**	**7.3**	**27.55**	
Kupwara	Nichahom, Nichahom-Budhasung	–	20.25	7.3	27.55
Kerala		**–**	**–**	**9.65**	**9.65**
Kannur	Madayi, Kadamkottumala, Kayyur and Nileswaram	–	–	9.65	9.65
Rajasthan		1168.53	3029.78	2150.77	6349.08
Bikaner	Palana, Barsinghsar, Gurha East & West, Bholasar, Bithnok Main & East (Extn.), Gadiyala, Girirajsar, Raneri, Mandal Chaman, Hadda, Hadda north & Hadla, Badhnu, Hira-ki-Dhani, Chak-Vijaisinghpura, west, Kuchore (Napasar), Riri, Lalamdesar, Lalamdesar Bada, East of Riri, Bania, Kuchaur-Athuni, Sarupdesar-Palana west, Palana East, Gigasar-Kesardesar, Khar Charan, Ambasar-Gigasar, Girirajsar Extn., Bapeau, Bigga-Abhaysingpura. Diyatra, Pyau, Deshnok-Ramsar-Sinthal, Borana, Bangarsar-Jaimalsar and Kmta-Ki-Basti & South of Bhane-Ka-Gao, etc.				1099.82
Barmer	Kapurdi, Jalipa, Bothia (Jalipa N Ext.), Giral, Jogeswartala, Sonari, Sachcha-Sauda, Bharka, Bothia-Bhakra-Dunga, Sindhari East & West, Kurla, Kurla East, Chokla North, Mahabar-Shivkar, Mithra, Hodu, Nimbalkot, Nimbalkot North, Nagurda, Nagurda (East), Munabao, Kawas Gravity Block, South of Nimbla and Magne-Ki-Dhani.	495.23	2509.46	1496.77	4501.46
Jaisalmer & Bikaner	Panna & Charanwala	–	–	11.47	11.47
Jaisalmer	Bhanda, Ramgarh & Khuiyala	–	–	70.44	70.44
Jaisalmer & Barmer	Khuri	–	–	13.8	13.8
Jalore	Sewara	–	–	76.08	76.08
Nagaur	Deswal, Gangardi, Indawar, Kaprion-Ki-Dhani, Kasnau-Igiar, Kuchera, Lunsara, Matasukh, Merta Road & Meeranagar, Mokala, Nimbri-Chadawatan and Ucharda,	113	289.49	156.48	558.97
Nagaur & Pali	Phalki, Phalki North and Phalodi	-	0.5	18.69	19.19

Contd.

Table-3 *(Concld)*

(In million tonnes)

State/District	Area/Lignite field	Proved	Indicated	Inferred	Total
Tamil Nadu	Neyveli Lignite Corporation (NLC) Leasehold areas,	4926.92	21910.06	9652.62	36489.6
Cuddalore	Block B, Mine-I, II & III and river), Devandgudi & areas, South of Vellar (Srimushnam), Veeranam (Lalpettai), Eastern part of NLC leasehold area, Kullanchavadi, Kudikadu, Bhuvanagiri-Kullanchavadi, Eastern part of Neyveli, Bahur*,West of Bahur*of Neyveli Lignite Field.	4022.69	1525.29	1302.23	6850.21
Ariyalur	Meensuruti, Jayamkondamcholapuram, Michaelpatti, & Michaelpatti Extn. of Neyveli Lignite Field	904.23	302.5	512.37	1719.1
Thanjavur &	Mannargudi-Central, Mannargudi-NE	–	17248.06	3123.46	20371.52
Thiruvarur	Mannargudi-NE Extn., Mannargudi SE, Melnattam-Araharam of Mannargudi Lignite Field				
Thanjavur	Cholapuram, Mannargudi-NW & SW, Maharajapuram Orattanadu-Pattukottai, Vadaseri (Orattanadu-Pattukottai), Madukkur-Anaikkadu, Veppanagulam-Kasangadu of Mannargudi Lignite Field	–	2306.17	156.33	2462.5
Thanjavur & Nagapattinam	Alangudi, Pandanallur, Kadalangudi, Tirumangaicheri and Thirumangalam of Mannargudi Lignite Field	–	359.21	926.62	1285.83
Thiruvarur & Nagapattinam	Nachiyarkudi of Mannargudi Lignite Field	–	–	574.05	574.05
Ramanathapuram	Misal, Bogalur, Bogalur (East), Uttarakosamangai & Tiyanur, Kalari North West & East of Ramanathapuram Lignite Field	–	168.83	2072.35	2241.18
Ramanathapuram & Sivaganga	Rajasing Mangalam & Settanur of Ramanathapuram Lignite Field	–	–	985.21	985.21
Puducherry U/T	Bahur & West of Bahur of Neyveli Lignite Field	–	405.61	11	416.61
West Bengal		–	1.13	2.8	3.93
Bardhaman	Rakshitpur, Gaurangapur-Bankati	–	0.29	1.82	2.11
Birbhum	Mahalla, Dhobbanpur & Djara	–	0.84	0.98	1.82

Source: Coal Directory of India 2020-21, Coal Controler's Organisation, Kolkata and Geological Survey of India.

* Both blocks cover parts of Tamil Nadu and Puducherry.

EXPLORATION & DEVELOPMENT

Exploration and development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews" i.e, Vol. I of the title.

PRODUCTION AND STOCKS

COAL

Production

The total reported production (provisional) of coal in 2020-21 was 716.083 million tonnes decreased by about 2% in comparison to that of the previous year. Chhattisgarh is the largest coal producing State with a share of about 22.12% followed by Odisha and Madhya Pradesh having contribution of 21.53% and 18.51% respectively in the national output. Next in order of share in the total production were Jharkhand (16.66%), Telangana (7.35%), Maharashtra (6.62%), West Bengal (4.83%) and Uttar Pradesh (2.38%) (Fig-4). Small quantity of coal production was produced by Assam and Union Territory of Jammu & Kashmir. Coal mining was confined mainly to the Public Sector which contributed 96% to the national production. The remaining 4% was countributed by the private sector (Table-4).

Table-4: Production of Coal, 2018-19 to 2020-21
(By Sectors/States)

(Quantity in '000 tonnes)

State/UT	2018-19	2019-20	2020-21 (P)
India	**728718**	**730874**	**716083**
Public Sector	**694983**	**698224**	**685950**
Private Sector	**33735**	**32650**	**30133**
Assam	784	517	36
Chhattisgarh	161893	157745	158410
Jammu & Kashmir	13	14	10
Jharkhand	134666	131763	119295
Madhya Pradesh	118661	125726	132531
Maharashtra	49818	54746	47435
Meghalaya	-	-	-
Odisha	144312	143016	154151
Telangana	65160	65703	52603
Uttar Pradesh	20275	18030	17016
West Bengal	33136	33614	34596

(in '000 tonnes)

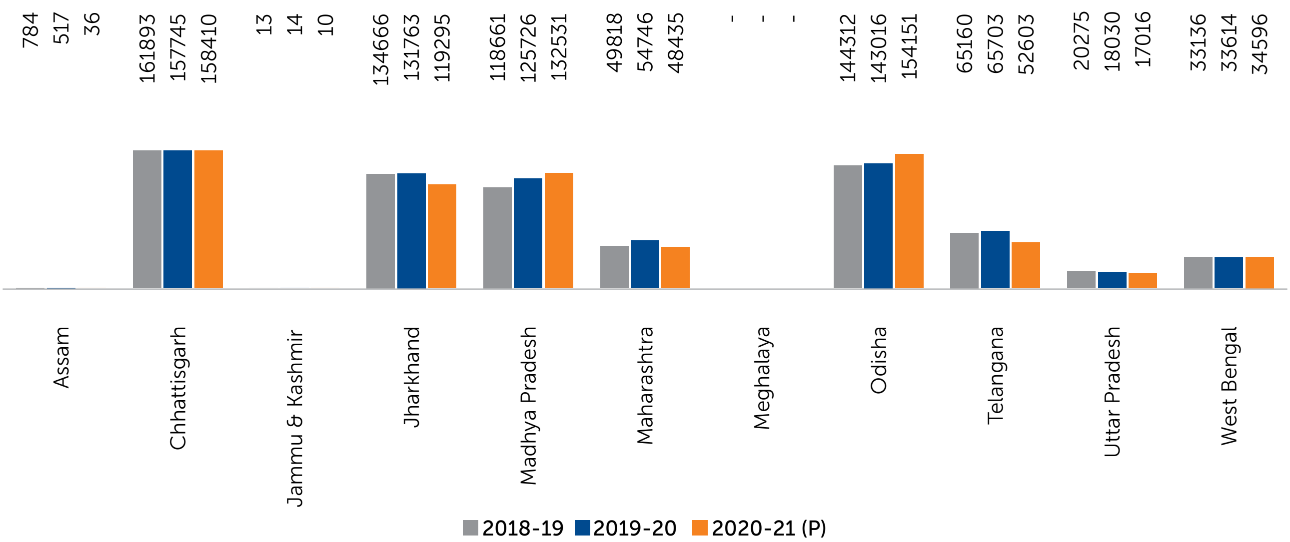


Fig 4: Stateswise Production of Coal

(in '000 tonnes)

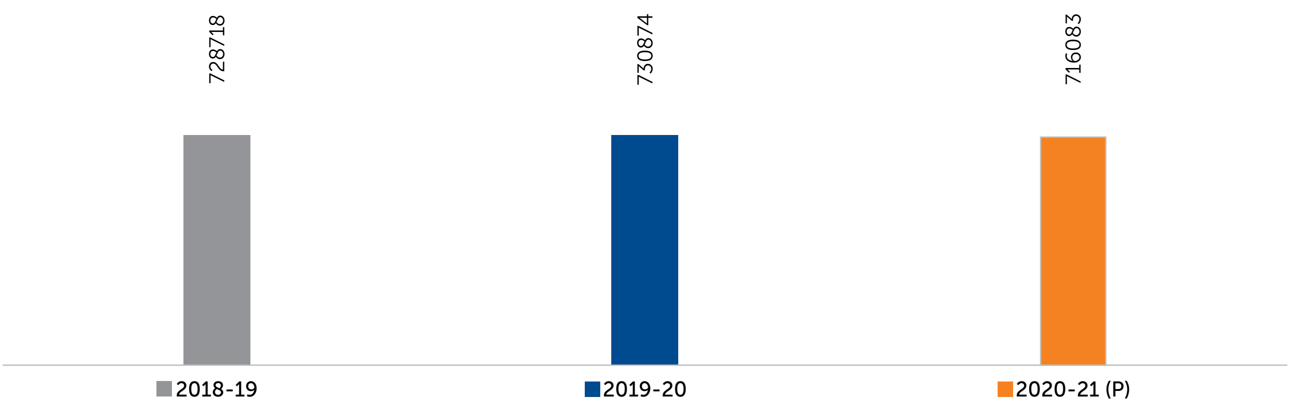


Fig 5: Coal Production (Total)

A total of 442 coal mines (as on 31.03.2021) in India reported production in 2020-21. Out of these, Jharkhand accounted for 113 mines while West Bengal 72 mines, Madhya Pradesh 61, Maharashtra 54, Chhattisgarh 53, Telangana 48 and Odisha 31. The remaining 10 mines were from Assam, Union Territory of Jammu & Kashmir and Uttar Pradesh (Table - 5).

Table-5: Number of Coal Mines, 2019-20 & 2020-21 (P)
(By States)

(No. of Mines)

State	2019-20	2020-21 (P)
India	442	442
Assam	3	3
Chhattisgarh	54	53
Jammu & Kashmir	2	2
Jharkhand	119	113
Madhya Pradesh	60	61
Maharashtra	54	54
Odisha	29	31
Telangana	46	48
Uttar Pradesh	5	5
West Bengal	70	72

Source: Coal Directory of India 2020-21.

Note: Coal Mines in the State of Meghalaya operate under the Private Sector.

#: Relates to number of mines as last day of financial year

During the year 2020-21, out of the total production of coal, 6.25% was coking coal and the rest 93.75 % was non-coking coal. As in the earlier years, bulk of the coking coal production in 2020-21 i.e., about 86.9% was reported from the Public Sector. Grade-wise analysis of coking coal in 2020-21 revealed that Washery Grade IV had the maximum share at 60%, followed by Washery Grade V (28.58%), Washery Grade II (5.28%) and Washery Grade III (4.06%). The remaining 2.08% production of coking coal was of Semi-coking Grade, Washery Grade I & VI and Steel Grade I & II. Out of the total production of coking coal in India, bulk quantity, i.e., 99.11% was produced in Jharkhand (44.387 million tonnes). The remaining 1% (0.4 million tonnes) was contributed by Chhattisgarh and Madhya Pradesh (Tables-6 & 7).

Table-6: Production of Coking Coal, 2019-20
(By States and Grades)

(In '000 tonnes)

State	All-Grades	ST-I	ST-II	W-I	W-II	W-III	W-IV	W-V	W-V1	SC
India	52936	18	132	136	2303	7361	33094	9635	7	250
Chhattisgarh	250	-	-	-	-	-	-	-		**250**
Jharkhand	52364	18	132	136	2244	7276	32916	9635	7	-
Madhya Pradesh	178	-	-	-	-	-	178	-	-	-
West Bengal	144	-	-	-	59	85	-	-	-	-

Coal Directory of India, 2020-21.

Table-7: Production of Coking Coal, 2020-21
(By States and Grades)

(In '000 tonnes)

State	All-Grades	ST-I	ST-II	W-I	W-II	W-III	W-IV	W-V	W-V1	SC
India	44787	1	8	202	2365	1820	26943	12798	431	219
Chhattisgarh	219	-	-	-	-	-	-	-	-	**219**
Jharkhand	44387	1	8	202	2365	1820	26762	12798	431	-
Madhya Pradesh	181	-	-	-	-	-	181	-	-	-
West Bengal	-	-	-	-	-	-	-	-	-	-

Source: Coal Directory of India, 2020-21, Coal Controller's Organisation, Kolkata.

* Note: Gradewise figures vis-a-vis States not available.

During 2020-21, except for a nominal quantity (4%), the balance production of non-coking coal (96%) came from the Public Sector. Out of the total production of non-coking coal grades, G11 grade accounted for 29% followed by G13 (12%), G12 (10.9%), G10 (10.4%), G14 (9.9%), G8 (7.1%) and G7 (5.6%). The remaining about 15% production was accounted for G1, G2, G3, G4, G5, G6, G9, G15,G16, G17 and UNG grades of non-coking coal. Chhattisgarh was the largest producing State of non-coking coal in 2020-21 which alone accounted for 23.6% of the national output. Next in order were Odisha with a contribution of (22.96%), Madhya Pradesh (19.7%), Jharkhand (11.8%), Telangana (7.8%), Maharashtra (7%), West Bengal (4.5%) and Uttar Pradesh (2.5%). The remaining 0.1% production came from Assam and Union Territory of Jammu & Kashmir (Tables-8 to 10).

Table-8: Production of Coal, 2019-20 & 2020-21)

(By States)

(In '000 tonnes)

State	2019-20			2020-21 (P)		
	Total	Pub. Sec.	Pvt. Sec.	Total	Pub. Sec.	Pvt. Sec.
All Grades	730874	698224	32650	716083	685950	30133
Coking	52936	46726	6210	44787	38934	5853
ST-I	18	18	-	1	1	-
ST-II	132	132	-	8	8	-
W-I	136	31	105	202	202	-
W-II	2303	1862	441	2365	1716	649
W-III	7361	6473	888	1820	1431	389
W-IV	33094	28318	4776	26943	22128	4815
W-V	9635	9635	-	12798	12798	-
W-VI	7	7	-	431	431	-
SC-I	250	250	-	219	219	-
Mg feed	-	-	-	-	-	-
Non-coking	677938	651498	26440	671296	647016	24280
G1	21	21	-	3	3	-
G2	288	288	-	27	27	-
G3	3231	3231	-	2681	2681	-
G4	14472	14472	-	14221	14221	-
G5	14633	14633	-	9707	9707	-
G6	4605	4550	55	4252	4206	46
G7	40891	40722	169	37446	37446	-
G8	45546	44108	1438	47702	47262	440
G9	37869	37869	-	36723	36723	-
G10	78135	68448	9687	69883	59558	10325
G11	193872	179693	14179	194693	181515	13178
G12	71628	70716	912	73346	73167	179
G13	86864	86864	-	80935	80823	112
G14	58795	58795	-	66297	66297	-
G15	17598	17598	-	26201	26201	-
G16	4033	4033	-	6790	6790	-
G17	5282	5282	-	236	236	-
UNG	175	175	-	153	153	-

Source: 1. Coal Directory of India, 2019-20 & 2020-21, Coal Controller's Organisation, Kolkata.

Note: Meghalaya Coal has not been graded by Coal Controller. For statistical purpose, grade may be treated as 'A'/'B' non-coking coal.

Table-9: Production of Non-coking Coal, 2019-20

(By States and Grades)

(In '000 tonnes)

State	Grades																		
	All-Grades	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17	UNG
India	**677938**	**21**	**288**	**3231**	**14472**	**14633**	**4605**	**40891**	**45546**	**37869**	**78135**	**193872**	**71628**	**86864**	**58795**	**17598**	**4033**	**5282**	**175**
Assam	517	21	288	-	14	-	194	-	-	-	-	-	-	-	-	-	-	-	-
Chhattisgarh	157495	-	-	1590	123	2512	948	2386	2662	1247	2447	121379	2089	5823	1873	4799	2483	5134	-
Jammu & Kashmir	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-
Jharkhand	79399	-	-	612	-	1301	912	3548	5503	18634	4754	13810	8566	21759	-	-	-	-	-
Madhya Pradesh	125548	-	-	-	30	579	1305	27535	13275	5020	43938	26747	6802	165	152	-	-	-	-
Maharashtra	54746	-	-	-	-	-	-	101	1350	6356	18114	17886	6355	4584	-	-	-	-	-
Meghalaya	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Odisha	143016	-	-	-	-	-	-	115	85	30	-	-	44234	37205	53605	7742	-	-	
Telangana	65703	-	-	-	-	682	42	3560	6582	6206	6514	11732	3582	16722	3165	5057	1550	134	175
Uttar Pradesh	18030	-	-	-	-	-	-	-	14926	376	2368	360	-	-	-	-	-	-	-
West Bengal	33470	-	-	1029	14305	9559	1204	3646	1163	-	-	1958	-	606	-	-	-	-	-

Source: Coal Directory of India, 2020-21, Coal Controllers' Organisation, Kolkata.

Note: Meghalaya coal has not been graded. For statistical purpose grade may be treated as "A"/"B" non-coking coal.

Table-10: Production of Non-coking Coal, 2020-21

(By States and Grades)

(In '000 tonnes)

State	Grades																		
	All-Grades	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17	UNG
India	**671296**	**3**	**27**	**2681**	**14221**	**9707**	**4252**	**37446**	**47702**	**36723**	**69883**	**194693**	**73346**	**80935**	**66297**	**26201**	**6790**	**236**	**153**
Assam	36	3	27	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-
Chhattisgarh	158191	-	-	1640	-	1860	945	2601	2212	1561	2379	120900	2039	5899	1093	8272	6790	-	-
Jammu & Kashmir	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-
Jharkhand	79041	-	-	228	43	1070	669	3396	4865	18491	6638	11939	9795	21907	-	-	-	-	-
Madhya Pradesh	132350	-	-	-	-	436	1335	25073	17696	3840	38692	33426	7825	3929	98	-	-	-	-
Maharashtra	47435	-	-	-	-	-	-	107	696	5377	16058	17635	4645	2917	-	-	-	-	-
Meghalaya	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Odisha	154151	-	-	-	-	-	-	-	76	-	-	-	44769	34105	62925	12276	-	-	-
Telangana	52603	-	-	-	-	450	76	3741	5967	6882	3159	8546	3621	11948	2181	5653	-	226	153
Uttar Pradesh	17016	-	-	-	-	-	-	-	14319	572	1957	168	-	-	-	-	-	-	-
West Bengal	30463	-	-	813	14178	5891	1221	2528	1871	-	1000	2079	652	230	-	-	-	-	-

Source: Coal Directory of India, 2020-21, Coal Controller's Organisation, Kolkata.

Note: Meghalaya coal has not been graded. For Statistical purpose grade may be treated as "A"/"B" non-coking coal; Gradewise figures vis-a-vis states not available.

Despatches

The provisional despatches of coal at 690.884 million tonnes in 2020-21 were lower by around 2.3% as compared to that of the previous year. Odisha was the leading State in the despatches in 2020-21 and accounted for 21.99% of the total despatches. The States next in the order were Chhattisgarh (21.2%), Jharkhand (17.7%), Madhya Pradesh (15.25%), Telangana (7.3%), Maharashtra (6.7%), Uttar Pradesh (5.55%) and West Bengal (4.28%). The remaining very small quantity of despatches were from the State of Assam and Union Territory of Jammu & Kashmir.

During the year 2020-21, statewise analysis revealed that there was decrease in the despatches of coal from almost all States namely Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Telangana, West Bengal, Assam and Union Territory of Jammu & Kashmir, except Odisha and Uttar Pradesh where increase in despatch was reported as against that of the previous year.

Of the total provisional despatches of raw coal effected in 2020-21, a sizeable share of 84.1% was made to the Electricity Sector (Power utility and Power captive). As much as 1.4% to the Sponge iron Industry, 1.3% was made to the Steel Industry, 1 % to the Fertilizer Industry, 0.98% to the Cement Industry, 0.15% to Pulp & Paper Industry and 0.1% to the other basic metals. The remaining 6.5% was made for other priority sectors including Chemical, Steel (boilers), Textile & Rayons, Bricks and Other (Tables-11 & 12).

Stocks

The mine-head stocks of coal at the end of the year 2020-21 were 109.06 million tonnes which increased by about 34% from that of the stocks that were available at the beginning of the year. Out of the total mine-head stocks of coal during the year 2020-21, 98.85% was confined mainly to the Public Sector and remaining 1.15 % to the Private Sector.

Similarly, the mine-head stocks of coal at the end of the year 2019-20 were 81.43 million tonnes which decreased by 41% from that of the stocks that were available at the beginning of the year.

Bulk of the coal stocks (about 99.9%) at the end of the year was accounted for by the mines located in the States of Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Telangana, Uttar Pradesh and West Bengal (Tables-13 & 14).

Table-11: Despatches of Raw Coal, 2019-20 & 2020-21 (P)

(By States)

(In '000 tonnes)

States	2019-20 (R)	2020-21 (P)
India	707176	690884
Arunachal Pradesh	-	-
Assam	562	90
Chhattisgarh	147076	146253
Jammu & Kashmir U/T	10	8
Jharkhand	132418	122238
Madhya Pradesh	109283	105384
Maharashtra	50008	46571
Meghalaya	-	-
Odisha	135878	151911
Telangana	64122	50533
Uttar Pradesh	34775	38355
West Bengal	33044	29541

Source: Coal Directory of India, 2019-20 & 2020-21, Coal Controller's Organisation, Kolkata.

Table-12: Despatches of Raw Coal, 2019-20 & 2020-21

(By Priorities)

(In '000 tonnes)

Priority	2019-20 (R)	2020-21 (P)
Total	707176	690884
Power (Utility)	540995	535447
Power (Captive)	85154	45786
Steel	11674	8875
Cement	8569	6754
Sponge Iron	10529	9565
Fertilizer	1764	1527
Paper & Pulp	1326	1045
Other Basic metal	603	683
Chemical	209	158
Textiles & Rayons	101	80
Steel (Boilers)	234	100
Bricks	26	25
Others	45992	80839

Source: Coal Directory of India, 2019-20 & 2020-21, Coal Controller's Organisation, Kolkata.

Note: Steel includes direct feed & coking washery for metallurgical use and steel (boilers); Others include non-coking washery and Bricks.

Table-13: Mine-head Stocks of Coal, 2019-20 as on 01.04.2021
(By States)

(In '000 tonnes)

State	At the beginning of the year	At the end of the year
India	57640	81432
Arunachal Pradesh	-	-
Assam	100	54
Chhattisgarh	8424	18264
Jammu & Kashmir U/T	3	7
Jharkhand	19286	17959
Madhya Pradesh	4187	4078
Maharashtra	8939	13673
Odisha	12906	20999
Telangana	1611	3192
Uttar Pradesh	759	1388
West Bengal	1425	1818

Source: Coal Directory of India, 2019-20.

Table-14: Mine-head Stocks of Coal, 2020-21 (P)
(By States)

(In '000 tonnes)

State	At the beginning of the year	At the end of the year
India	81432	109060
Arunachal Pradesh	-	-
Assam	54	-
Chhattisgarh	18264	29723
Jammu & Kashmir U/T	7	9
Jharkhand	17959	19320
Madhya Pradesh	4078	6796
Maharashtra	13673	14533
Odisha	20999	24922
Telangana	3192	5247
Uttar Pradesh	1388	5163
West Bengal	1818	3347

Source: Coal Directory of India, 2020-21.

LIGNITE

Production

During the year 2020-21, the provisional production of lignite at 37.10 million tonnes decreased by about 10% in comparison to that of the previous year. The production from Tamil Nadu alone accounted for 48%. The share of Gujarat in lignite production was 28% and that of Rajasthan was 24 % (Table-15).

Out of the total 19 mines that reported lignite production in 2019-20, ten mines are located in Gujarat, six in Rajasthan and the remaining three in Tamil Nadu (Table-16).

Table-15: Production of Lignite, 2018-19 to 2020-21
(By Sectors/States)

(Quantity in '000 tonnes)

State	2018-19	2019-20	2020-21 (P)
India	44282	42096	37895
Public Sector	43884	41366	36903
Private Sector	398	730	992
Gujarat	12565	10357	10813
Tamil Nadu	23041	23516	18026
Rajasthan	8676	8223	9056

Source: Coal Directory of India, 201920-21, Coal Controller's Organisation, Kolkata.

Table-16: Number of Lignite Mines, 2020-21
(By States)

(No. of Mines)

State	2019-20	2020-21 (P)
India	**19**	**20**
Gujarat	10	11
Rajasthan	6	6
Tamil Nadu	3	3

Source: Coal Directory of India, 2020-21.

No. of mines as on the last day of financial year

Despatches

The provisional quantum of despatches of lignite was about 38.49 million tonnes during the year 2020-21, which decreased by about 9% as compared to 42.27 million tonnes in the previous year (Table-17).

Table-17: Despatches of Lignite, 2019-20 &2020-21
(By States)

(In '000 tonnes)

State	2019-20	2020-21 (P)
India	**42267**	**38492**
Gujarat	10354	110819
Rajasthan	8138	9157
Tamil Nadu	23775	18516

Source: Coal Directory of India, 2019-20 & 2020-21.

Stocks

The mine-head stocks of lignite at the end of 2020-21 were 4,981 thousand tonnes which decreased marginally by 9% from that of the stocks that were available at the beginning of the year (Table-18).

Table-18: Mine-head Stocks of Lignite, 2019-20 & 2020-21
(By States)

(In '000 tonnes)

State	2019-20		2020-21 (P)	
	At the beginning of the year	At the end of the year	At the beginning of the year	At the end of the year
India	**5672**	**5495**	**5495**	**4981**
Gujarat	25	28	28	103
Rajasthan	328	408	408	307
Tamil Nadu	5319	5059	5059	4571

Source: Coal Directory of India, 2019-20 & 2020-21

MINING & MARKETING

Coal

Coal mining in the country is carried out by both opencast and underground methods. Opencast mining contributed 95.50 % of the total provisional production, whereas the rest of the production (4.50%) came from underground mining during 2020-21. Most of the mines are either semi-mechanised or mechanised. The machinery commonly deployed are drill machines, load-haul-dumper (LHD), ventilation fans, pumps for dewatering, haulage for transport, etc. In order to arrest the decline in production from a few underground mines, "mass production technology" by introducing 'continuous miner' is being practised. CIL has planned to introduce 26 nos. of 'continuous miner' in 19 mines and 2 PSLV in 2 mines in the coming 5 years. Modern roof-bolting technology with "flexibolts" up to 5 m length; 'smart bolting' for cost reduction of roof support; and introduction of mechanised roof bolting using hydraulic bolts for difficult roof are new technology absorptions in Indian Underground Coal Mining. Mechanised Long wall mining (long wall powered support) has also been introduced in a limited scale which yields higher output with high percentage recovery (70–80%). In opencast mines, machinery like draglines, dozers, shovels, dumpers and graders are deployed for various operations. CIL has introduced high capacity HEMM's like 42 CuM shovel with 240 tonnes rear dumper in Gevra Expansion, Dipka & Kusmunda open-cast mines.

The latest policy pursued by CIL is to encourage technology upgradation through Global Tender. Global tender approach has been used towards introduction of high productivity with the use of Continuous Miners.

Eastern Coalfields Limited (ECL), Bharat Coking Coal Limited (BCCL), Central Coalfields Limited (CCL), Western Coalfields Limited (WCL), South-Eastern Coalfields Limited (SECL), Mahanadi Coalfields Limited (MCL), Northern Coalfields Limited (NCL) and NEC (North-Eastern Coalfield are the 8 subsidiary companies of Coal India Ltd (CIL), a Government of India Undertaking. The coal mines in Assam and its neighbouring areas are controlled directly by CIL under the unit North Eastern Coalfields Ltd (NEC). CMPDIL is a subsidiary of CIL which is engaged in surveying, planning and designing work with a view to optimise coal production. The Singareni Collieries Company Limited (SCCL) is a joint venture between Government of India and Government of Telangana.

BCCL is the major producer of prime-coking coal (raw and washed). Medium-coking coal is also produced in Mohuda and Barakar areas. In addition to production of hard coke and soft coke, BCCL operates a number of sand gathering plants, a network of aerial ropeways for transport of sand and nine coal washeries, namely, Dugda-I, Dugda-II, Bhojudih, Patherdih, Mahuda, Sudamdih, Barora, Moonidih and Madhuband.

CCL operates mines in Bokaro, Ramgarh, Giridih and North & South Karanpura Coalfields in Jharkhand and four coal washeries, namely, Kathara, Swang, Rajrappa and Kedla. Its products included medium-coking coal (raw and washed), non-coking coal, soft coke and hard coke.

WCL operates coal mines located in Pench, Kanhan and Patharkheda Coalfields in Madhya Pradesh and Wardha Valley & Kamthi Coalfields in Maharashtra. This Company largely meets the requirements of thermal power plant and industries in the western region of the country.

ECL covers Raniganj Coalfields in West Bengal and Mugma & Rajmahal Coalfields in Jharkhand. It produces and supplies coal to the local and other industries which require relatively higher grades of coal.

The coalfields of Chhattisgarh, viz, Korba (East & West), Baikunthpur, Chirimiri, Hasdeo, Sohagpur, Jamuna-Kotma and Johilia are under SECL. This subsidiary continued to be the leading producer of CIL.

NEC is responsible for development and production of coal in the North-Eastern States. The present mining activities are confined to Arunachal Pradesh, Assam and Meghalaya. At present, 3 Nos.of existing mines namely Tirap, Tikale and Tipong. Out of these, Tipong colliery is on Underground mine and remains colliery are openast mines. The area has large proven reserves of low ash, high calorific value coal but because of its high sulphur content, it cannot be used directly as metallurgical coal.

SCCL operates coal mines in Telangana state which produces non-coking coal. The coal requirements of consumers in south are mostly met by this Company. SCCL contributies around 9% of the total all India production of coal.

MCL had been incorporated as another subsidiary Company of CIL. Its area of jurisdiction comprises Talcher and Ib Valley Coalfields of Odisha.

NCL covers the entire Singrauli Coalfields situated in Madhya Pradesh and Uttar Pradesh.

Jharkhand State Mineral Development Corporation Ltd (JSMDCL) and Jammu & Kashmir Minerals Ltd (JKML) are the State Government Undertakings and Damodar Valley Corporation (DVC) is the Central Public Sector Undertaking that are engaged in coal mining. IISCO steel plant of SAIL is the only Public Sector steel unit operating captive mines for coal. Bengal Emta Coal Mines Ltd (BECML), Jindal Steel & Power Ltd (JSPL), Hindalco and Tata Steel are the Companies operating captive mines in the Private Sector.

As on 31.3.2021, there were 442 operating mines for coal in the country out of which 225 were open-cast, while 190 were underground mines. The remaining 22 were mixed collieries. There were 420 Public Sector mines and 22 mines in Private Sector (Table-19). Thrust is given on further increasing production from opencast mines where the gestation period is comparatively shorter. In 2020-21, the share of provisional production of raw coal from opencast mines was 683.872 million tonnes (95.50%) and 32.211 million tonnes (4.50%) from underground mines (Table-20). Production of coal by different mining technologies employed during 2020-21 is furnished in (Table-21). The overall Output per Man Shift (OMS) in open-cast and underground mines for CIL in 2020-21 was 10.32 tonnes as against 9.64 tonnes in 2019-20. The overall OMS in open-cast and underground mines for SCCL was 5.62 tonnes in 2020-21 as against 7.29 tonnes in 2019-20.

Under the Colliery Control Order, 1945, the Central Government was empowered to fix the prices of coal gradewise and collierywise. As per recommendations of the Bureau of Industrial Costs & Prices and the Committee on Integrated Coal Policy, prices of different grades of coal were subjected to deregulation since 22.3.1996, in a phased manner. As the prices of all grades of coking coal got deregulated with effect from 1.4.1996, distribution fell under the purview of CIL/coal companies. The Government of India amended the provisions of Colliery Control Order 1945 and Colliery Control Order 2000 were notified, according to which, the price & distribution of all grades of coal with effect from 1.1.2000 have been deregulated.

Coal movements by coastal shipment to southern and western regions through Haldia, Paradip and Vizag ports continued as usual. Major portion of the despatches was achieved through railways, followed by roads, Merry-Go-Round System, belt conveyor, ropeways and sea route.

Lignite

As on 31.03.2021, the total number of operating lignite mines was 20 and all are worked by open-cast method. Out of these, 16 are captive and the remaining four are non-captive. Four mines are owned by Neyveli Lignite Corporation (NLC), six by Gujarat Mineral Development Corporation Ltd (GMDCL), three each by Rajasthan State Mines & Minerals Limited (RSMML) & Gujarat Industries Power Co. Ltd (GIPCL) and one each by Gujarat Heavy Chemicals Ltd (GHCL), Barmer Lignite Mining Company Limited (BLMCL), GPCL & V S Lignite Power Pvt. Ltd

(VSLPPL). Sector-wise, seventeen mines are under Public Sector and the remaining three are under Private Sector, i.e., GHCL, GPCL & VSLPPL.

The Neyveli Lignite Mine is the largest open-cast mine in the country with eco-friendly technology. To increase the power demand and to manage both social and environmental externalities, NLC has now diversified into coal mining, coal-based power generation and green energy. NLC operates three open-cast mines at Neyveli, Tamil Nadu and one opencast mine at Barsingsar, Rajasthan. The present installed capacity in lignite mining of all NLC mines stands at 30.60 MTPA viz. Mine-I with 10.5 MTPA, Mine-IA with 3.0 MTPA, Mine-II with 15.0 MTPA, Barsingsar with 2.1 MTPA Besides, additional planned capacity of lignite mining of 31.55 MTPA viz. Bithnok Lignite Mine (2.25 MTPA), Hadla Mine (1.9 MTPA), Barsingsar expansion (0.40 MTPA), Mine-III project (11.50 MTPA) and South of Vellar & Palayamkottai lignite blocks (11.50 MTPA) is under implementation. The planned capacity of coal mining of 31.00 MTPA viz. Talabira II & III block (20.00 MTPA) in the State of Odisha and Pachwara South Coal block (11.00 MTPA) in the State of Jharkhand has been allotted to Neyveli Uttar Pradesh Power Ltd (NUPPL) and is under implementation. The production of lignite for all NLC mines was 192.62 lakh tonnes during 2020-21 which decreased by 2.2% from 248.64 lakh tonnes in the previous year. Due to poor demand on account of pandemic situation and shutdown of few units, Lignite production is restricted accordingly during 2020-21. The NLC's mines are highly mechanised. Presently, these mines are linked to three thermal power stations.

In Power Sector, NLC has added 500 MW Thermal Power and 17.5 MW Renewable power during the year 2020-21 and retired 350 MW of its installed capacity with addition and retirement of unit.

The Corporate Plan Document envisages increase in overall lignite production by 62.15 MTPA, coal production by 31.00 MTPA and power generation up to 21 GW by the year 2025.

Therefore, as on 31.03.2020, the total number of coal blocks that existed was 105. Out of these, 82 blocks were vested/ allotted which accounted for 10,994.79 million tonnes; 11 blocks were under Auction by Competitive Bidding Rules, 2012 with 4,054.84 million tonnes; 8 blocks were that of Custodian with 417.02 million tonnes; and 4 blocks with 2,262.88 million tonnes remained as 'not cancelled' by the Hon'ble Supreme Court.

Up to 2020-21, a total of 126 coal blocks with 21488.45 million tonnes geological/extractable reserves have been allotted in various States (Table - 22). Of these, 80 coal blocks with18853.48 million tonnes are under Public Sector Undertakings (PSU) and the remaining 46 blocks with about 2634.97 million tonnes are under Private Sector companies. Among these,62 blocks with 14146.41 million tonnes have been allocated for Power, 26 blocks with 1018.90 million tonnes for Non-regulated Sector (NRS), 2 blocks with 350.11 million tonnes for Ultra Mega Power Project (UMPP) and 36 blocks with 5971.33 million tonnes for commercial mining.

Table-19: Number* of Coal Mines, 2020-21

(By States)

(No. of collieries)

State	OC	UG	Mixed	Total
All India	225	190	27	442
Public Sector	212	183	25	420
Private Sector	13	7	2	22
Arunachal Pradesh	-	-	-	-
Assam	2	1	-	3
Chhattisgarh	24	28	1	53
Jammu & Kashmir U/T	-	2	-	2
Jharkhand	73	26	14	113
Madhya Pradesh	22	37	2	61
Maharashtra	38	16	-	54
Meghalaya	-	-	-	-
Odisha	23	8	-	31
Telangana	19	29	-	48
Uttar Pradesh	5	-	-	5
West Bengal	19	43	10	72

Source: Coal Directory of India, 2020-21, Coal Controller's Organisation, Kolkata.

* Relates to no. of mines as on last day of the financial year (As on 31.3.2021).

Note: OC - Open-cast UG - Underground. U/T - Union Territory

Table-20: Production of Raw Coal

(In million tonnes)

Year	Production from open-cast mines (% share)	Production from Under-Ground mines (% share)	Total production
2018-19	686.212	42.506	728.718
	-94.20%	-5.80%	
2019-20	690.208	40.666	730.974
	-94.44%	-5.56%	
2020-21(p)	683.872	32.211	716.083
	-95.50%	-4.50%	

Source: Coal Directory of India, 2020-21
Coal Controller's Organisation, Kolkata

Table-21: Production of Coal, 2020-21
(By Technology)

(In million tonnes)

Technology adopted	Production	Percentage
All India: Total	716.83	100
Open-cast (Total)	**683.87**	**95.5**
Mechanised	683.872	100
Manual	-	-
Underground (Total)	**32.21**	**4.5**
Conventional B&P	0.427	1.33
Mechanised B&P	23.779	73.82
Conventional LW	0.157	0.49
Mechanised LW	0.116	0.36
Other methods	**7.732**	**24.00**

Source: Coal Directory of India, 2020-21,
Coal Controller's Organisation, Kolkata.
Note: B&P - Board-and-pillar; LW - Longwall

Table-22: Statewise Allotment of Captive Coal Blocks that stand Allocated/Vested/ including Blocks Allotted Under MMDR Act up to 2020-2021 (Except CIL as custodian)

(In million tonnes)

State	No. of blocks	Geological/ extractable Reserves
Coal		
Chhattisgarh	23	4078.24
Jharkhand	36	7027.08
Madhya Pradesh	18	1415.58
Maharashtra	13	370.92
Odisha	19	5472.26
Telangana	2	151.79
West Bengal	15	2972.58
Total	**126**	**21488.45**

Source: Coal Directory of India 2020-21, Coal Controller's Organisation, Kolkata.
Note: Extractable reserves (in million tonnes) have been shown against the newly allocated/vested coal blocks as per CM(SP)Act, 2015.

Similarly, up to 31.03.2021, 23 captive lignite blocks stand allocated with 1,555.33 million tonnes geological/ extractable reserves have been allocated. Of these, 21 blocks with 1,502.87 million tonnnes are under Public Sector Undertakings (State PSU) and the remaining 2 blocks are under Private Sector with 52.46 million tonnes. By sectors, 12 blocks with 1,138.60 million tonnes have been allocated for power generation and 11 blocks with 416.73 million tonnes for commercial end-use. Statewise, 13 lignite blocks with 762.84 million tonnes for Gujarat and 10 blocks with 792.49 million tonnes for Rajasthan have been allocated.

FOREIGN COLLABORATION

To meet the country's growing demand for coal, Coal India Limited (CIL) has expressed intent for foreign collaboration with the following objectives:

(a) bringing in proven technologies and advanced management skills for running underground (UG) and open-cast (OC) mines and in coal preparation;

(b) exploration and exploitation of coal-bed methane, in situ gasification of coal

COAL WASHERIES

Presently, 16 coal washeries (12 in Public Sector and 4 in Private Sector) with 29.98 million tonnes per annum (MTPA) capacity of washed coking coal produced about 4.22 million tonnes of coking coal in 2020-21 out of which about 1.303 million tonnes were produced by the Public Sector and 3.119 million tonnes by Private Sector. Under Public Sector, BCCL operates 6 coking coal washeries (Dugda, Bhojudih, Sudamdih, Moonidih, Mahuda and Madhuban), CCL operates 4 washeries (Kathara, Swang, Rajrappa and Kedla), WCL operates one (Nandan) and SAIL too has one (Chasnala), whereas 4 washeries (West Bokaro-II, West Bokaro-III, Jamadoba and Bhelatand) are operated by Tata Steel Ltd (TSL) under Private Sector. Similarly, 19 coal washeries with 110.88 million tonnes per annum capacity washed non-coking coal of about 47.912 million tonnes during the year. Of these, about 5.510 million tonnes have been under Public Sector and about 19.211 million tonnes under Private Sector. Under Public Sector, 2 non-coking coal washeries (in CCL) were operational, whereas under Private Sector, 17 non-coking coal washeries were in operation.

By and large ash content in raw coal used by washeries varied between 24% and 33%. The ash content in the washed coal and middlings produced by washeries ranged from 19 to 22% and 35 to 40%, respectively. The rejects in most washeries contained over 50% ash.The capacity and production of washed coking/non-coking coal are shown in Tables - 23 to 26, respectively.

Table-23: Production of Washed Coking Coal, 2019-20 & 2020-21
(Sector-wise/Company-wise)

(In million tonnes)

Country	2019-20	2020-21
All India: Total	**5.285**	**4.518**
Public Sector	**1.812**	**1.399**
BCCL	0.664	0.365
CCL	0.762	0.437
IISCO	0.386	0.597
Private Sector	**3.473**	**3.119**
Tata Steel Ltd	3.473	3.119

Source: Coal Directory of India, 2020-21,
Coal Controller's Organisation, Kolkata.

Table-24: Capacity of Washed Coking Coal, 2020-21
(Sector-wise/Company-wise)

(In million tonnes)

Coalfield/Washery	State	Raw Coal Capacity
Grand Total		**29.98**
Public Sector	Total	**21.98**
BCCL		**10.93**
Dugda	Jharkhand	2
Bhojudih	West Bengal	1.7
Sudamdih	Jharkhand	1.6
Moonidih	-do-	1.6
Mahuda	-do-	0.63
Madhuban	-do-	2.5
CCL		**9.35**
Kathara	Jharkhand	3
Swang	-do-	0.75
Rajrappa	-do-	3
Kedla	-do-	2.6
WCL		**1.2**
Nandan (Pench-Kanhan)	Madhya Pradesh	1.2
SAIL		**1.4**
Chasnala	Jharkhand	1.4

Contd.

Table-24 *(Concld)*

(In million tonnes)

Coalfield/Washery	State	Raw Coal Capacity
Private Sector	**Total**	**8**
Tata Steel Ltd		**8**
West Bokaro-II	Jharkhand	2.5
West Bokaro-III	-do-	2.7
Jamadoba	-do-	1.3
Bhelatand	-do-	1.3

Source: Coal Directory of India, 2020-21,
Coal Controller's Organisation, Kolkata (except totals).

Table-25: Production of Washed Non-coking Coal: 2019-20 & 2020-21

(Sector-wise/Company-wise)

(In million tonnes)

Sector/Company	2019-20	2020-21
All India: Total	**41.802**	**24.721**
Public Sector	**6.48**	**5.51**
CCL	6.48	5.51
Private Sector	**35.322**	**19.211**
Adani Enterprises Ltd	11.709	12.17
Aryan Coal Beneficiation Pvt. Ltd	18.003	4.444
Aryan Energy Pvt. Ltd	1.426	0.549
Global Coal & Mining Pvt. Ltd	2.79	1.138
Jindal Power Ltd	0.372	0.463
Kartikay Coal Washeries Pvt. Ltd	0.089	0.009
Maruti Clean Coal	0.933	0.438

Source: Coal Directory of India, 2020-21,
Coal Controller's Organisation, Kolkata.

Table-26: Capacity of Washed Non-coking Coal, 2020-21

(Sector-wise/Company-wise)

(In '000 tpy)

Washery/Location	Coalfield	State	Raw Coal Capacity
Grand Total			
Public Sector	**Total**		**11720**
CCL			
East Bokaro Coalfield, Jharkhand			**11720**
Gidi	East Bokaro	Jharkhand	2500
Piparwar	N. Karanpura	-do-	6500
Kargali	Bokaro	-do-	2720
Private Sector	Total		101880
Adani Enterprises Ltd			15000
AEL	Parsa	Chhattisgarh	15000
Aryan Coal Beneficiation Pvt. Ltd			60690
Chakabura	Korba	Chhattisgarh	7500
Dipka	-do-	-do-	14000
Pander Pauni	Ballarpur	Maharashtra	2620
Gevra	Korba	Chhattisgarh	6250
Binjhri	-do-	-do-	4800
Hemgir	Hemgir	Odisha	5000
Ratija	Korba	Chhattisgarh	11000
Talcher	Bharatpur	Odisha	9520
Aryan Energy Pvt. Ltd			2340
Talcher	Talcher	Odisha	2340
Global Coal & Mining Pvt. Ltd			10000
Ib Valley	Ib Valley	Odisha	3500
Ramagundam	Ramagundam	Telangana	1000

Contd.

Table-26 *(Concld)*

(In '000 tpy)

Washery/Location	Coalfield	State	Raw Coal Capacity
Talcher	Talcher	Odisha	4000
Manuguru	Manuguru	Telangana	1500
Jindal Power Ltd			4750
JPL	Raigarh	Chhattisgarh	4750
Kartikay Coal Washeries Pvt. Ltd			2500
Wani	Wardha	Maharashtra	2500
Maruti Clean Coal			6600
Maruti	-	Chhattisgarh	6600

Source: Coal Directory of India, 2020-21, Coal Controller's Organisation, Kolkata.

IMPORT POLICY OF COAL

The present import policy of coal allows imports to be carried out freely under Open General Licence by the consumers themselves considering their needs. Coking coal is imported by Steel Sector and coke manufacturers mainly on availability and quality consideration. Coal-based power stations and cement plants are also importing non-coking coal on consideration of transport logistics and commercial precedence. In spite of hardening prices of both coking and non-coking coal internationally and increase in ocean freight, large amounts of coal continue to be imported.

FDI POLICY

Indian Government permits 100% automatic FDI approval for coal & lignite mining only for captive consumption by power projects, iron & steel and cement units and for other eligible activities subject to the provisions of Coal Mines (Nationalisation) Act, 1973. This is in addition to the existing stipulated policy applied for the Power Sector.

CLASSIFICATION AND GRADES

Indian coal is classified into two main categories, namely, coking and non-coking. Coking coal is a type of coal from which, on carbonisation, coke suitable for use in metallurgical industries, particularly, in Iron and Steel industries can be produced. Parameters determining coking property of coal are coking index, volatile matter (VM %), vitrinite %, crucible swell no., fluidity, reflectance, etc. Although for commercial gradation, ash percentage is the sole criterion, for semi-weakly-coking coal, along with ash percentage, moisture percentage too is considered as an added criterion. For non-coking coal, an empirical formula is used to determine Useful Heat Value (UHV) of coal in kcal/kg.

The classification of coal as per the Ministry of Coal is reflected in Table - 27.

In order to adopt the best international practices, India decided to switch over from the grading based on Useful Heat Value (UHV) to the grading based on Gross Calorific Value (GCV); and, consequently on 16.01.2011 the Ministry of Coal notified the switch over. As per the new system, the following nomenclature has been introduced for gradation of non-coking coal:

Grades	GCV Range (kcal/kg)
G1	GCV exceeding 7,000
G2	GCV exceeding 6,701 but not above 7,000
G3	GCV exceeding 6,401 but not above 6,700
G4	GCV exceeding 6,101 but not above 6,400
G5	GCV exceeding 5,801 but not above 6,100
G6	GCV exceeding 5,501 but not above 5,800
G7	GCV exceeding 5,201 but not above 5,500
G8	GCV exceeding 4,901 but not above 5,200
G9	GCV exceeding 4,601 but not above 4,900
G10	GCV exceeding 4,301 but not above 4,600
G11	GCV exceeding 4,001 but not above 4,300
G12	GCV exceeding 3,700 but not above 4,000
G13	GCV exceeding 3,400 but not above 3,700
G14	GCV exceeding 3,101 but not above 3,400
G15	GCV exceeding 2,801 but not above 3,100
G16	GCV exceeding 2,501 but not above 2,800
G17	GCV exceeding 2,201 but not above 2,500

Based on the GCV ranges of proposed gradation and erstwhile gradation, a Concordance Table has been generated for better understanding. However, it may be noted that this concordance does not depict exact one-to-one relation between the two systems.

Concordance Table

Old grading based on UHV	New grading based on GCV
A	G1, G2, G3
B	G4, G5
C	G6
D	G7, G8
E	G9, G10
F	G11, G12
G	G13, G14
Non-coking coal Un-graded	G15, G16, G17

Source: Coal Directory 2019-20, Coal Controller's Organisation, Kolkata.

CONSUMPTION

Thermal power plants, iron & steel, sponge iron and cement continued to be the major consuming industries for coal in India. Sizeable quantities are also consumed by the railways, collieries and as domestic fuel. Data regarding consumption in these sectors is not available. However, industry-wise despatches of coal during 2018-19, 2019-20 and 2020-21 are depicted in Table-28.

Table-27: Classification of Coal

Sl. No	Class	Grade	Grade/Specification
1	Non-coking coal produced in all States	A	Useful Heat Value exceeding 6,200 kcal per kg.
	other than Assam, Arunachal Pradesh,	B	Useful Heat Value exceeding 5,600 kcal per kg but not exceeding 6,200 kcal per kg.
	Meghalaya and Nagaland	C	Useful Heat Value exceeding 4,940 kcal per kg but not exceeding 5,600 kcal per kg.
		D	Useful Heat Value exceeding 4,200 kcal per kg but not exceeding 4,940 kcal per kg.
		E	Useful Heat Value exceeding 3,360 kcal per kg but not exceeding 4,200 kcal per kg.
		F	Useful Heat Value exceeding 2,400 kcal per kg but not exceeding 3,360 kcal per kg.
		G	Useful Heat Value exceeding 1,300 kcal per kg but not exceeding 2,400 kcal per kg
2	Non-coking coal produced in Arunachal Pradesh, Assam,	A	Useful Heat Value between 6,200 and 6,299 kcal per kg and corresponding ash plus moisture content between 18.85 and 19.57%.
	Meghalaya and Nagaland	B	Useful Heat Value between 5,600 and 6,199 kcal per kg and corresponding ash plus moisture content between 19.58 and 23.91%.
3	Coking coal	Steel Grade I	Ash content not exceeding 15%.
		Steel Grade II	Ash content exceeding 15% but not exceeding 18%.
		Washery Grade I	Ash content exceeding 18% but not exceeding 21%.
		Washery Grade II	Ash content exceeding 21% but not exceeding 24%.
		Washery Grade III	Ash content exceeding 24% but not exceeding 28%.
		Washery Grade IV	Ash content exceeding 28% but not exceeding 35%.
		Washery Grade V	Ash content exceeding 35% but not exceeding 42%.
		Washery Grade VI	Ash content exceeding 42% but not exceeding 49%.
4	Semi-coking and	Semi-coking Grade I	Ash plus moisture content not exceeding 19%.
	weakly-coking coal	Semi-coking Grade II	Ash plus moisture content exceeding 19% but not exceeding 24%.
5	Hard coke	By-product Premium	Ash content not exceeding 25%.
		By-product Ordinary	Ash content exceeding 25% but not exceeding 30%.
		Beehive Premium	Ash content not exceeding 27%.
		Beehive Superior	Ash content exceeding 27% but not exceeding 31%.
		Beehive Ordinary	Ash content exceeding 31% but not exceeding 36%.

Table-28: Despatches* of Coal 2018-19 to 2020-21
(By Industries)

(In million tonnes)

Industry	2018-19	2019-20 (R)	2020-21 (P)
Total	**732.79**	**707.18**	**690.884**
Electricity	637.95	626.15	574.731
Iron & steel$	17.66	11.91	8.975
Sponge iron	12.23	10.53	9.565
Fertilizer	1.79	1.76	1.527
Cement	8.82	8.57	6.754
Others (Chemical, other basic metals, paper & pulp, textile & rayon, bricks, others, etc.)	54.34	48.26	82.83

Source: Coal Directory of India 2020-21.

* Data on consumption is not available.

$ Includes direct feed, coking washery and steel (boilers).

DEMAND & SUPPLY

To comprehend the requirement of coal in real term, the erstwhile Planning Commission of India did maintain the practice of estimating demand for each year in advance. However, the apparent supply (Despatch + Import – Export) did show variance from the projected estimates. Against the estimated demand of coking coal and non-coking coal, the data on actual despatch, import and export of coal (coking coal and non-coking coal) during 2019-20 and 2020-21 are provided in Table -29.

Table-29: Demand-Supply of Coal, 2019-20 & 2020-21

(In million tonnes)

Year	Demand*	Despatch	Apparent Supply		Total
			Import	Export	
2019-20 (R)	991.35	706.77	248.537	1.029	954.278
2020-21 (P)	1000	690.884	215.251	2.945	903.19

Source: Coal Directory of India 2020-21.

*Annual Plan, Ministry of Coal.

WORLD REVIEW

World proved coal reserves were estimated at 1074.108 billion tonnes at the end of 2020 of which 753.639 billion tonnes (70%) has been classified as anthracite & bituminous coal and 320.469 billion tonnes (30%) as sub-bituminous coal & lignite. USA has the largest coal reserves with about 23% share of the total world reserves, followed by Russian Federation (15%), Australia (14%) and China (13%) (Table-30).

Table-30: World Proved Coal Reserves at the end of 2020
(By Principal Countries)

(In million tonnes)

Country	Anthracite and bituminous coal	Sub- bituminous coal and lignite	Total
World: Total	753639	320469	1074108
USA	218938	30003	248941
Russian Federation	71719	90447	162166
Australia	73719	76508	150227
China	135069	8128	143197
India*	105979	5073	111052
Indonesia	23141	11728	34869
Germany	-	35900	35900
Ukraine	32039	2336	34375
Poland	22530	5865	28395
Kazakhstan	25605	-	25605
Turkey	550	10975	11525
South Africa	9893	-	9893
Serbia	402	7112	7514
Brazil	1547	5049	6596
Canada	4346	2236	6582
Colombia	4554	-	4554
Other countries	23608	29109	52717

Source: BP Statistical Review of World Energy, 2021.

*India's resources of coal as on 1.4.2021 are estimated at about 352.126 billion tonnes to a depth of 1,200 m and those of lignite are estimated at about 46.02 billion tonnes.

World production of coal and lignite slightly decreased from about 8.105 billion tonnes in 2019 to 7.658 billion tonnes in 2020. China continued to be the largest producer of coal & lignite in 2020 with about 50% share in total world production, followed by India (9.08%), USA (5.70%), Indonesia (7.35%), Australia (6.08%) and Russia (5.19%) (Table-31).

Table-31: World Production of Coal and Lignite
(By Principal Countries)

(In million tonnes)

Country	2018	2019	2020
World: Total	**8022**	**8105**	**7658**
Australia			
Bituminous1[j]	457	462	426
Brown coal[g]	45	42	40
Bosnia & Herzegovina			
Brown coal & lignite	14	13	13
Bulgaria			
Lignite	29	29	29
Brown Coal	1	1e	1e
Canada			
Coal	55	52	48
China			
Coal	3698	3846	3850
Colombia			
Bituminous	81	79	45
Czech. Rep.			
Bituminous	4	3	2
Brown Coal	39	37	29
Country	2016	2017	2018
Germany			
Anthracite & Bituminous	3	-	-
Brown coal	166	131	107
Greece			
Lignite	36	26	14
India*			
Bituminous[h]	728	729	716
Lignite(h)	44	42	36
Indonesia			
Anthracite & Bituminous	557	616	563
Kazakhstan			
Bituminous coal	107	104	104
Lignite	6	6	5
Korea, Dem. Rep. of			
Coal	18	18	17
Mexico			
Bituminous	12	1	7
Mongolia			
Brown coal & Lignite	51	55	43
Poland			
Bituminous	51	50	42
Lignite	61	52	47
Romania			
Anthracite & Bituminous	1	1	1
Lignite	23	21	15
Russia			
Coal	439	439	398
Serbia[d]			
Lignite & brown coal	37	38	39

Contd...

Table-31 *(Concld)*

(In million tonnes)

Country	2018	2019	2020
South Africa			
Anthracite & Bituminous	249	251	244
Thailand			
Lignite	14	14	13
Turkey			
Anthracite	1	1	1
Lignite	97	92	84
USA			
Bituminous	326	307	215
Sub-Bituminous	305	282	222
Ukraine			
Bituminous	26	25	24
Vietnam			
Anthracite	42	47	48
Other countries			
Coal & Lignite	199	193	170

Source: BGS, World Mineral Production, 2016-2020.

Hard coal – Including anthracite, bituminous & sub-bituminous coal. Coal- All ranks of coal.

d- excluding production in Kosovo, 1- including sub-bituminous.

*India's production of coal during 2018-19, 2019-20 & 2020-21 was 728.71, 730.87 & 716.10 million tonnes, respectively.

* India's production of lignite during 2018-19, 2019-20 & 2020-21 was 44.28.42.09 & 37.89 million tonnes, respectively.

(j) includes sub-bituminous.

(g) year ended 30th June of that stated.

(h) year ended 30th March following that stated.

Global coal demand rebounded strongly in 2021 to 5640 million tonnes of coal equivalent (Mtce) as economies recovered from the pandemic and coal-fired power generation reached a historic high in 2021. Both China and India have boosted investment in domestic coal production, but global production struggled to keep pace with demand increases, causing coal prices to surge. Russia – the world's third-largest coal exporter – and its invasion of Ukraine complicated coal market dynamics and brought additional pressure on prices.

The outlook for coal is heavily dependent on the strength of the world's resolve to address climate change. In the Stated Policies Scenario (STEPS), coal demand declines gradually. In the Announced Pledges Scenario (APS), it declines about 20% below current levels by 2030, and 70% by 2050; coal demand peaks in China in the early 2020s and in India in the late 2020s. In the Net Zero Emissions by 2050 (NZE) Scenario,demand falls 45% by 2030 and 90% by 2050.

Coal use in industry falls by 20% to 2030, in part reflecting an increase in the production of near zero emissions primary steel and near zero emissions clinker for use in cement. In India, coal demand in the STEPS rises by 25% to 2030. Strong economic growth – the economy expands 90% between 2021 and 2030 – brings with it more demand for coal-fired power generation and in the use of coal to produce iron and steel and cement. Coal-fired power capacity increases from 240 GW in 2021 to 275 GW in 2030, while there is limited use of electric arc furnaces in industry. In the APS, coal demand in India increases by just under 15% between 2021 and 2030, reflecting increased deployment of renewables, improvements in energy efficiency, and the installation of gas and electricity-based equipment in industry. The increase in coal demand in the industry sector is around half of that seen in STEPS, and the increase in the power sector is about 20% less. To provide generalised view of the development in various countries, the countrywise description sourced from the latest available publication of USGS is detailed below.

Australia

Queensland remained Australia's leading producer of anthracite and bituminous coal (reported as black coal by Geoscience Australia), accounting for 54% of the country's production in 2017, followed by New South Wales, 44%; Western Australia, 1%; and Tasmania, 0.1%. The BHP Billiton Mitsubishi Alliance (BMA) (owned by BHP Billiton, 50%, and Mitsubishi Corp. of Japan, 50%) was the leading producer of anthracite and bituminous coal in Australia. BMA operated seven mines in Queensland. In March, Cyclone Debbie affected coal operations at multiple mines in the Bowen basin in northern Queensland and caused coal export delays, which led to an increase in global coal prices. The affected mines stockpiled coal while repairs to rail and port infrastructure were completed. The majority of lignite was produced in Victoria and used for domestic energy generation. Loy Yang Power Ltd. operated the Loy Yang Mine, which was Australia's leading lignite mine by capacity. The Hazelwood Mine, which was owned by ENGIE SA of France, and the associated Hazelwood coal-fired powerplant closed in March owing to the powerplant no longer being commercially viable.

China

In 2019, coal production increased by 4.6% to 3.85 Gt. China accounted for 51.7% of the world's coal production (in terms of contained energy) in 2019. China's coal production reached a peak of about 4 Gt in 2013 and had declined since then until 2016 owing to the slowdown in the economy, weak domestic demand, and low prices for coal. Production had gradually increased since 2016 because of increasing demand, the restart of some inactive existing capacity, and the commissioning of new capacities. As of 2019, there were 5,271 coal mines in the country with total production capacity (including capacity under construction) of 5.2 Gt/yr, of which 3.9 Gt/yr capacity was in operation, 1.0 Gt/yr capacity was under construction, and about 300 Mt/yr capacity was inactive. Coal imports in 2019 were 299.7 Mt, which was an increase of 6.6% compared with imports in 2018. China's leading import trade partners (in terms of energy content of imported coal) in 2019 were Indonesia, which supplied 34% of China's coal imports; Australia 32%; Mongolia 16%; Russia 13%; and Canada 2%. Coal exports in 2019 were 6.03 Mt, which was an increase of 22.3% compared with those of 2018. Coal consumption increased by 1.0% in 2019 to 4.0 Gt, of which 2.37 Gt was used for electricity generation; 660 Mt, by the steel industry; 380 Mt, for construction material production; 300 Mt, by the chemical industry; and 320 Mt, for other uses. In 2019, the revenue of the coal industry totaled $360 billion, which was an increase of 3.2% compared with that of 2018, and the profits of these companies totaled $41 billion, which was a decrease of 2.4%

FOREIGN TRADE

Exports

Exports of coal (excl. lignite) increased substantially by 181% to about 2.94 million tonnes in 2020-21 from 1.04 million tonnes in the previous year. On the other hand, exports of coke increased by about 86% to207.41 thousand tonnes in 2020-21 from 111.50 thousand tonnes in 2019-20. Coal (excluding lignite) was mainly exported to Nepal (74%), Bangladesh (22%), and Bhutan (1%). Coke was exported predominantly to Bhutan (30%),Vietnam (29%), Brazil (20%), Nepal (7%) and Bangladesh (3%). Exports of lignite were 2 thousand tonnes during the years 2020-21 as compared to 3 tonnes during 2019-20 (Fig-6). (Tables - 32 to 35).

Table-32: Exports of Coal (Excl. Lignite)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	1045	5929549	2943	5736794
Nepal	823	4685902	2200	4294441
Bangladesh	201	992977	665	738728
Bhutan	20	211431	48	472514
China	++	2	30	208910
UAE	1	14109	++	8436
Saudi Arabia	++	2385	++	5091
Myanmar	++	4121	++	2489
Oman	++	1714	++	1359
Qatar	++	1977	++	1326
Singapore	-	-	++	684
Other countries	++	14931	++	2816

Figures rounded off.

Table-33: Exports of Coal, Water Gas, etc. (Except Gaseous Hydrocarbons)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	++	100	-	-
Bangladesh	++	100	-	-

Figures rounded off.

Table-34: Exports of Coke

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	**111507**	**2383337**	**207412**	**4771075**
Vietnam	-	-	60500	1547731
Bhutan	52999	1294897	62746	1531890
Brazil	33500	804168	40501	964977
Indonesia	68	1603	14872	365032
Nepal	18080	141989	15096	120403
Oman	20	475	5500	103103
Bangladesh	4169	67647	6707	93940
Qatar	459	14280	520	15427
Sri Lanka	214	6599	205	6741
Jordan	451	13917	228	6520
Other countries	1547	37762	537	15311

Figures rounded off.

Table-35: Exports of Coal: Lignite

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	**3**	**319838**	**2**	**234709**
Saudi Arabia	2	138879	2	159214
Oman	1	80041	++	29999
Singapore	-	-	++	22430
UAE	++	14191	++	7543
Indonesia	++	4154	++	5422
Ukraine	++	6347	++	5160
Thailand	++	5217	++	2547
Russia	++	29419	++	2394
Germany	-	-	++	++
USA	-	-	++	++
Other countries	++	41590	-	-

Figures rounded off.

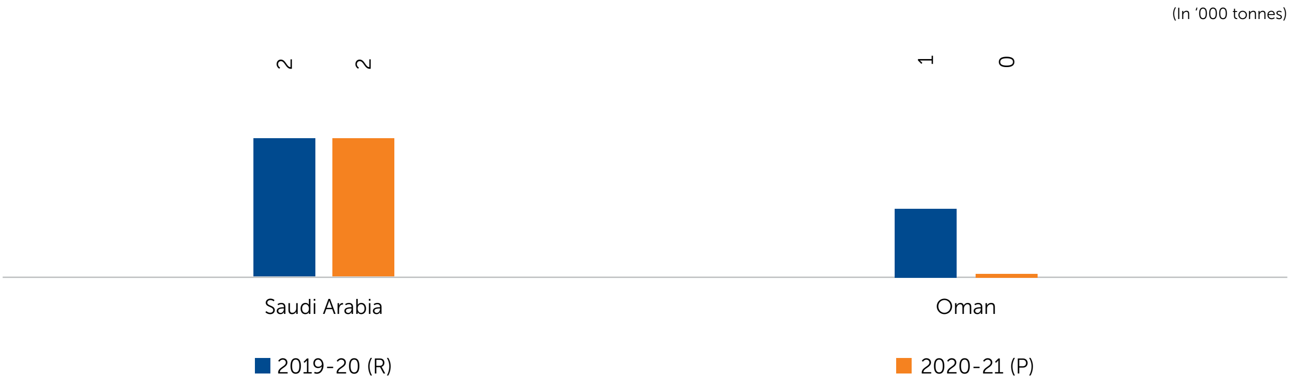


Fig 6: Countrywise Export of Coal: Lignite

Imports

Imports of coal (excl. lignite) decreased by 14% to 215.26 million tonnes in 2020-21 from 248.54 million tonnes in the previous year. Imports of coke decreased by 16% to about 2.46 million tonnes in 2020-21 from about 2.91 million tonnes in the previous year. Coal (excl. lignite) was mainly imported from Indonesia (43%), Australia (25%), South Africa (14%), USA (5%), Russia (3%) and Singapore (2%) whereas coke was imported mainly from Poland (38%), Colombia (20%) & Japan (16%). Imports of lignite remained unchanged in 2020-21 as compared to preceding year. Lignite was imported solely from China. (Tables - 36 to 38).

Table-36: Imports of Coal: Lignite

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	1	5170	1	5746
China	1	5168	1	5738
Ghana	-	-	++	8
Indonesia	++	2	-	-

Figures rounded off.

Table-37: Imports of Coal (Excl. Lignite)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	248545	1527478152	215260	1160506410
Australia	46719	510169875	54952	426857044
Indonesia	116662	460848909	92535	341262086
South Africa	42481	212693029	31095	142867128
USA	12159	97484006	12203	86477695
Russia	8227	60491642	6748	45686817
Singapore	5728	45071484	4486	28538085
Canada	4685	57586236	2963	27359117
Mozambique	5476	40272625	3570	23492408
Colombia	1913	9529639	2349	11949444
Switzerland	1329	8934503	1968	11401971
Other countries	3166	24396204	2391	14614615

Figures rounded off.

Table-38: Imports of Coke

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	2912775	61067396	2463036	4421773
Poland	814762	19526722	956636	18379850
Colombia	394210	7123899	511793	8254215
Japan	413660	8706920	396558	7439354
Switzerland	30531	565136	212135	3437938
Indonesia	132088	2898905	134664	2877509
Russia	322561	6659793	118850	2223214
China	347189	7263253	33179	777874
Singapore	176351	3439457	51878	765451
Australia	141056	2491709	21519	225853
Chile	-	-	11364	194459
Other countries	140367	2391602	14460	246056

Figures rounded off.

FUTURE OUTLOOK

Coal is the backbone of Indian economy on which modern electricity generation rests. Coal currently supplies around 30% of primary energy and 41% of global electricity generation. The forecast for coal-use is that, it would rise to over 50% by 2030, with developing countries being responsible for 97% of this increase, primarily to meet their futuristic electrification targets.

To meet the country's growing demand for coal, foreign collaborations with advanced coal producing countries are also being considered by the Government with an aim to bring in new technologies both in underground and open-cast sectors for efficient management of the Coal Industry along with building adequate support mechanism through comprehensive skill development and training activities.

As per the draft National Energy Policy (NEP), (version as on 27.06.2017) formulated by the NITI Aayog, India Vision 2040 envisages demand-driven provision of energy at affordable prices, high per capita consumption of electricity, access to clean cooking energy & electricity with universal coverage, low emission and security of supply as criteria that would characterise the energy parameters of India in 2040.

The installed coal-based electricity generation capacity is expected to grow to 330- 441 GW by 2040. This is likely to translate into a coal demand of 1.1-1.4 billion tonnes. The known levels of proven coal reserves of about 177 billion tonnes as of 01.04.2021 may only be able to support an annual peak production of 1.2-1.3 billion tonnes till 2037, with a gradual decrease thereafter. This fact calls for intensifying exploration to enhance the proven coal reserves. Multiple institutions, such as, GSI and CMPDI are responsible for exploration of coal in India. There is a need to synergise the efforts of all these agencies to undertake 100% resource mapping of coal.

India aims to become an economy of USD 5 trillion by 2024 and for this investing heavily in infrastructure would be an essential imperative. This will boost energy demand for industry and consequently improving electricity production would be high in the agenda. Although India has succeeded in bringing some form of electricity access to almost all of its citizens, the country's per capita power consumption is still low, giving it significant scope to grow. Power generation from renewables is forecasted to expand strongly, with wind capacity doubling and solar photovoltaics (PV) projected to increase fourfold between 2018 and 2024. But that is not enough to prevent coal power generation from increasing by 4.6% per year through 2024. Overall, India's coal demand is expected to grow by more than that of any other country, in absolute terms, over the forecast period.

8. Cryolite

149
(tonnes) of cryolite and chiolite were exported in 2020-21

6,338
(tonnes) of cryolite and chiolite were imported in 2020-21

Cryolite is a double fluoride of sodium and aluminium and has a stoichiometry very near the formula Na_3AIf_6 and a melting point of about 1,010°C. It was found to occur in substantial quantities in Greenland, and was mined extensively there in the early twentieth century, but the mine is now essentially exhausted. Synthetic cryolite can be produced by reacting hydrofluoric acid with an alkaline sodium aluminate solution. It is colourless to white but occurs in other shades too, for instance brown, red and sometimes black. It has a specific gravity of about 2.5 to 3. It has a low index of refraction close to that of water. Synthetic cryolite is used as an electrolyte in the reduction of alumina to aluminium due to non-availability of natural cryolite. Composition and properties of synthetic cryolite are the same as that of natural cryolite, but synthetic cryolite is often deficient in sodium fluoride.

INDUSTRY

Synthetic cryolites are obtained by adopting several processes. The selection of the process depends upon the availability and cost of raw materials. The simplest and most common method of obtaining synthetic cryolite is by reacting hydrofluoric acid with soda ash and alumina hydrate. Hydrofluoric acid is produced by reacting acid-grade fluorspar with sulphuric acid and this process also yields gypsum as by-product. In the secondary reaction between hydrofluoric acid and sodium chloride brine, sodium fluoride and hydrochloric acid are produced. In the primary reaction, dry aluminium hydroxide reacts with hydrofluoric acid to produce aluminium fluoride which reacts with sodium fluoride produced earlier and forms synthetic cryolite.

Besides fluorspar, fluorine gas produced as by-product at plants that produces phosphatic fertilizer and phosphoric acid, has emerged as an important alternative source for hydrofluoric acid and other fluorine chemicals including cryolite and aluminium fluoride. Rock phosphate usually contains 7–8% CaF_2. In terms of fluorine, it works out to 3–4% which is liberated at the time of acidulation of rock phosphate with sulphuric acid. Fluorine combines with silica to form silicon tetrafluoride which when scrubbed with water forms fluorosilicic acid. By recycling, 18–24% fluorosilicic acid is obtained, which serves as a raw material for manufacturing various fluoro-chemicals, including synthetic cryolite. From fluorosilicic acid, fluorine values are precipitated as sodium fluorosilicate by treating it with sodium salts. Sodium fluorosilicate becomes starting point for the production of synthetic cryolite.

For manufacture of synthetic cryolite from sodium fluorosilicate, two routes are generally adopted in the country. In the first route, sodium fluorosilicate is reacted with ammonia and in other route, sodium fluorosilicate is reacted with soda ash.

Important known units producing synthetic cryolite are highlighted below:

1. Navin Fluorine International Ltd, Udhana-Navasari Road, Surat, Gujarat-395 023.
2. Navin Fluorine International Ltd, Agra-Mumbai Road, Dewas, Madhya Pradesh-455 002.
3. Tanfac Industries Ltd, Kudikadu, Cuddalore, Tamil Nadu-607005.
4. Harshil Industries Sarigam, Vapi, Gujarat-396195.
5. Triveni Interchem Pvt. Ltd, GIDC, Vapi, Gujarat.
6. S.B. Chemicals, GIDC, Char Rasta, Vapi, Gujarat-396195.
7. J.N. Chemicals, GIDC, Vapi, Gujarat.
8. Balaji Amines Ltd, Solapur, Maharashtra.
9. Arti Chemicals, Ankleshwar, Gujarat.

Navin Fluorine International Ltd is one of the largest manufacturers of speciality fluorochemicals comprising synthetic cryolite Aluminium Fluoride & Fluorocarb gases.

It is also understood that Triveni Chemicals, S.B. Chemicals, Jay Intermediates & Chemicals (Vapi, Gujarat), Madras Fluorine Pvt. Ltd (Manali, Chennai, Tamil Nadu) and Tarun Fluo-Chem Pvt. Ltd, (Delhi) manufacture synthetic cryolite besides other fluorine chemicals. They also manufacture potassium cryolite (K_3AlF_6) which is a foundry flux and used in welding, chemicals and explosives.

The total installed capacity of aluminium fluoride in Organised Sector was about 25,600 tonnes per annum.

SPECIFICATIONS

The Indian Standard specifications of cryolite for use in Aluminium Industry defined vide IS - 5893 : 1989 (Second Revision; reaffirmed 2008) are as follows:

Constituents (on dry basis)	Specification
F	53% min.
Na	31 to 34%
Al	13 to 15%
SiO_2	0.20% max.
Fe_2O_3	0.10% max.
CaF_2	0.06% max.
Al_2O_3	1.00% max.
SO_3	0.50% max.
P_2O_5	0.01% max.
Loss on Ignition (LOI)	0.50% max.
NaF/AlF3(by mass)	1.45 max. (ration required to maintain in acidic region)

Note:

i) LOI is to be determined at 550°C for 60 minutes.

ii) Moisture should not be more than 0.20% when determined at 110 + 5°C.

CONSUMPTION

The consumption of cryolite is nowadays not estimated because many industries prefer the use of synthetic cryolite instead of natural cryolite. However, consumption was reported earlier in bonded abrasives as a filler, insecticides, porcelaneous glass and salts of sodium & aluminium.

USES AND TECHNOLOGY

The commercial application of cryolite is confined mainly to aluminium metallurgy where it is used as an electrolyte in the reduction of alumina to aluminium metal by the Hall-Heroult process. Alumina is a bad conductor of electricity and its melting point is 2,348°C. It is very expensive to carry out electrolysis at this temperature. To facilitate electrolysis, alumina is dissolved in molten cryolite as it lowers the melting point. Further, addition of certain additives, such as, aluminium fluoride improve the physical and electrical properties of the electrolyte, besides lowering the melting point. The amount that is added is, however, limited as it also causes reduction in electrical conductivity. Addition of calcium fluoride (CaF_2) further depresses the melting point with less adverse effect on conductivity. In contrast to this advantage, too much CaF_2 raises the density of the melt closer to that of liquid aluminium metal, thus inhibiting the separation of metal from electrolyte. The substituent, sodium fluoride, though is known to improve the density and conductivity, it also affects current efficiency.

A compromise made on all these factors has led to the following general composition of the bath to be in use —80–85% cryolite, 5–7% AlF_3, 5–7% CaF_2, 0–7% LiF and 2–8% Al_2O_3. The electrolyte bath tends to deplete AlF3 content of cryolite during the process. Hence, the composition of the electrolyte has to be adjusted regularly by addition of AlF_3.

In aluminium refining, high density electrolyte capable of floating aluminium is required. For this purpose, barium fluoride is used to raise density. Aluminium fluoride can be used to improve current efficiency of cryolite bath.

Cryolite is obtained as a by-product during the production of phosphatic fertilizer/phosphoric acid. When utilised in the Aluminium Industry, necessary precautions are observed as even 0.01% P in the electrolyte could cause 1–1.5% reduction in current efficiency in the production process of aluminium.

Other metallurgical uses of cryolite are in aluminising steel, in compounding of welding rod coatings and as fluxes. In glass, cryolite functions as a powerful flux because of its excellent solvent power for oxides of silicon, aluminium & calcium and for its ability to reduce melt viscosity at lower melting temperatures. Cryolite is used as a filler for resin-bonded grinding wheels in Abrasive Industry to impart longer life. Sodium fluoride (NaF) or fluorosilicic acid is also used for this purpose. Cryolite is used in certain nitrocellulose-based gun propellants required in small-calibre weapons, cannons and small & large rockets.

FOREIGN TRADE

Exports

In 2020-21, exports of cryolite and chiolite increased substantially by 187% to 149 tonnes from 52 tonnes in the previous year. Turkey (54%), Saudi Arabia (14%), USA (13%), France (7%), Indonesia & UAE (6% each) and Brazil (3%) were the main buyers from India in 2020-21. (Table-1) (Fig-1).

Table-1: Exports of Cryolite and Chiolite

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	52	4296	149	8467
Turkey	14	782	81	2536
Saudi Arabia	12	839	21	1271
USA	18	1466	20	1206
UAE	2	235	9	1097
Indonesia	2	422	4	894
France	1	93	10	761
Brazil	++	65	1	203
Malaysia	-	-	++	190
Uganda	1	100	2	165
Egypt	++	16	1	100
Other countries	2	278	++	44

Figures rounded off.

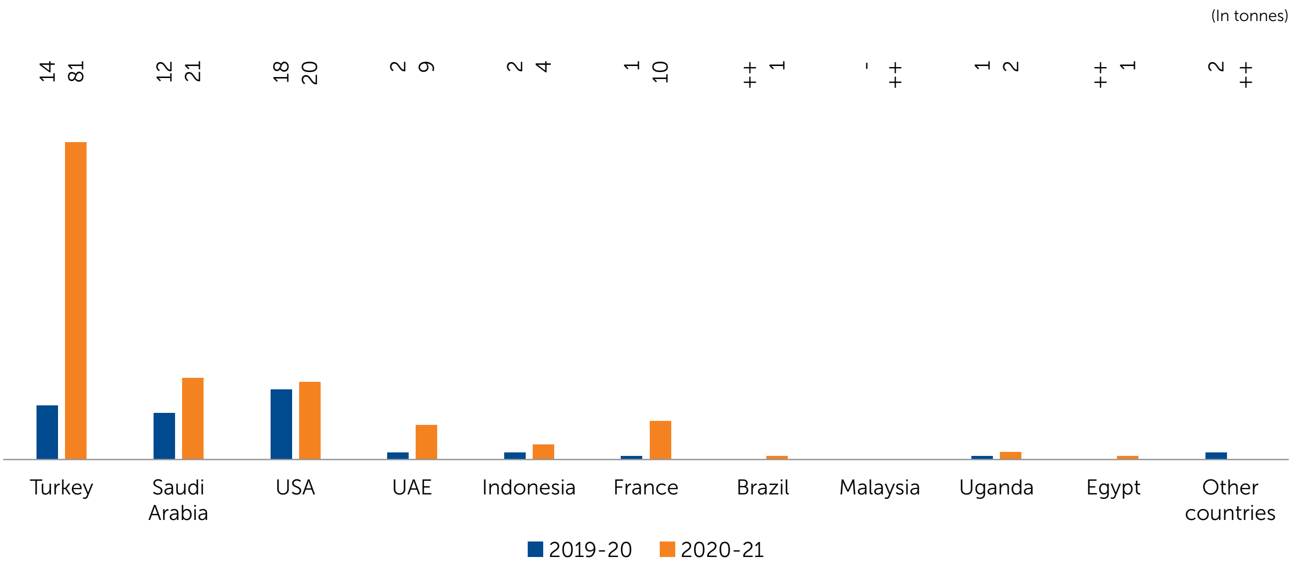


Fig 1: Countrywise Export Cryolite and Chiolite

Imports

In 2020-21, imports of cryolite and chiolite increased drastically by 129% to 6,338 tonnes from 2,763 tonnes in the previous year. Imports were from China & Bahrain (38% each), UAE (13%), Mozambique (6%) and Germany (2%) (Table-2) (Fig-2).

Table-2: Imports of Cryolite and Chiolite

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2763	129329	6338	174382
China	1602	82250	2419	104486
Bahrain	24	174	2404	33317
Germany	108	12006	148	15986
UAE	200	1641	848	9537
Mozambique	350	5918	396	5680
Belgium	147	12599	42	2814
Spain	-	-	5	977
South Africa	100	1287	50	548
Switzerland	-	-	24	542
Hungary	6	890	2	495
Other countries	226	12564	-	-

Figures rounded off.

(In tonnes)

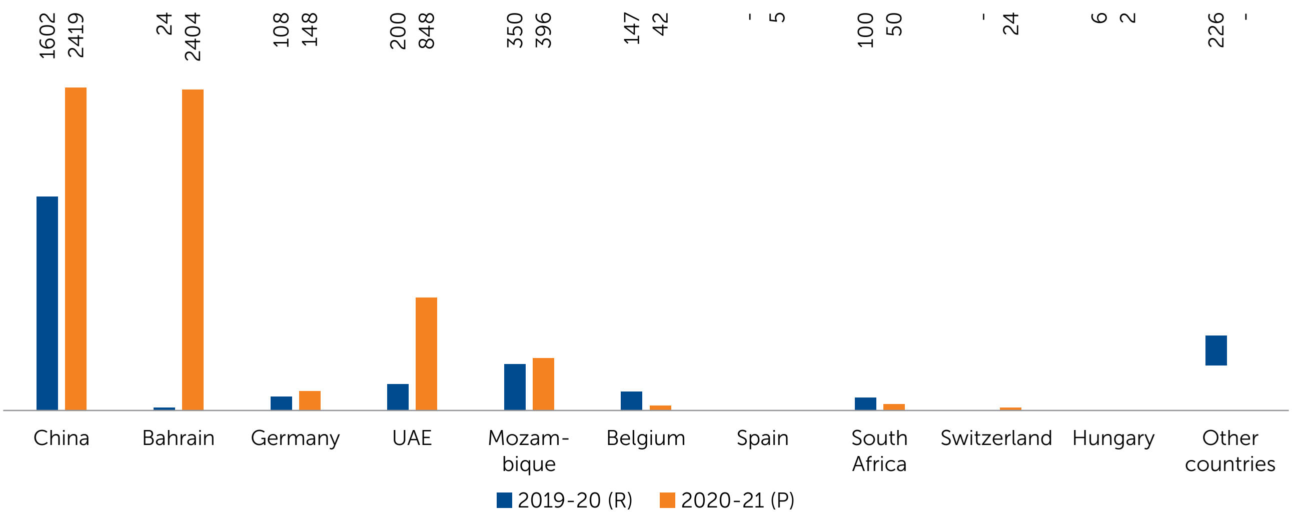


Fig 2: Country wise Import Cryolite and Chiolite

FUTURE OUTLOOK

The future of cryolite is dependent upon its use in the Aluminium Industry. Increased usage of aluminium and high performance fluoropolymers in automobiles will drive growth in inorganic and specially fluorochemicals segments. It is learnt that some US firms have registered success in their research and pilot plant tests for the production of aluminium directly from the mineral bauxite without the intermediate process of reduction cell. Viability of this may probably diminish the use of cryolite in the near future.

9. Diamond

13,917

(carats) Production of diamond were reported in 2020-21

₹1,25,820

(crore) Value of Exports of diamond were reported in 2020-21

₹1,28,351

(crore) Value of Imports of diamond were reported in 2020-21

31.72

(million carats) total reserves/ resources of diamond were estimated as on 1st April 2020

Diamond has been the most valuable among gems for more than 2,000 years. Diamond occurs in two types of deposits, primarily in igneous rocks of basic or ultrabasic composition and in alluvial deposits derived from the primary sources. Its composition is pure carbon and has cubic crystal system and common form octahedron. India is known for its diamond cutting & polishing business especially for small sized diamonds. Most of the world's diamond cutting and polishing business comes to India, particularly to Surat in Gujarat. India depends largely on imports of rough gem diamonds for its Cutting and Polishing Industry as there is no notable production except for two producers in Madhya Pradesh whose limited production is too sparse to meet the Cutting and Polishing Industry's requirements. The cut and polished diamonds are predominantly re-exported.

Diamond has a high refractive index and strong dispersion which gives it exciting brilliance when cut as a faceted stone. Gem diamonds are transparent and colourless or show faint shades of different colours.

Flawless stones of good colour are abundantly used in gem trade while off-colour, flawed & defective stones, chips & cuttings as well as small grains & dust are used in many other ways in the industry. Industrial grade diamond, i.e., diamond that does not meet gem quality standards in terms of colour, clarity, size or shape and those that are produced as a by-product of mining gem diamonds continue to be used principally as abrasives in many applications despite their initial cost. Although diamond is more expensive than other abrasive materials, it is more cost-effective in numerous industrial processes because it lasts longer than any other material.

Broadly, industrial diamonds have three varieties viz, 'ballas' which is mass of minute diamond crystals difficult to cleave; 'bort' is yellowish grey to black colour and massive, flawed or irregular in shape and 'carbonado' is black, very hard, opaque and without cleavage.

RESERVES/RESOURCES

Diamond occurrences are reported since prehistoric times in the country. Presently, diamond fields of India are grouped into four regions:

1. South Indian tract of Andhra Pradesh, comprising parts of Anantapur, Kadapa, Guntur, Krishna, Mahabubnagar and Kurnool districts;
2. Central Indian tract of Madhya Pradesh, comprising Panna belt;
3. Behradin-Kodawali area in Raipur district and Tokapal, Dugapal, etc. areas in Bastar district of Chhattisgarh; and
4. Eastern Indian tract mostly of Odisha, lying between Mahanadi and Godavari valleys.

As per the NMI data, based on UNFC system as on 1.4.2020, all India reserves/resources of diamond have been placed at 31.72 million carats. Out of these, 0.84 million carats are placed under Reserves category and 30.87 million carats under Remaining Resources category. By grades, about 3.32% resources are of Gem variety, 3.45% of Industrial variety and bulk of the resources (93.22%) are placed under Unclassified category. By States, Madhya Pradesh accounts for about 90.14% resources followed by Andhra Pradesh 5.74% and Chhattisgarh 4.11% (Table-1).

Table-1: Reserves/Resources of Diamond as on 1.4.2020

(By Grades/States)

(In carats)

States/Grades	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India:Total	847400	0	159	847559	0	0	0	304601	1524317	29047514	0	30876432	31723991
By Grades													
Gem	297692	0	0	297692	0	0	0	158819	1017	596929	0	756765	1054457
Industrial	254559	0	0	254559	0	0	0	41664	223	798936	0	840823	1095382
Unclassified	295149	0	159	295308	0	0	0	104118	1523077	27651649	0	29278844	29574152
By States													
Andhra Pradesh	0	0	0	0	0	0	0	200483	1524317	98155	0	1822955	1822955
Chhattisgarh	0	0	0	0	0	0	0	0	0	1304000	0	1304000	1304000
Madhya Pradesh	847400	0	159	847559	0	0	0	104118	0	27645359	0	27749477	28597036

Figures rounded off.

Table-2: Principal Producers of Diamond, 2020-21

Name and address of producer	Location of the mine	
	State	District
National Mineral Development Corporation Ltd 10-3-311/A, Khanij Bhavan, Castle Hills, Masab Tank, Hyderabad-500 028, Andhra Pradesh	Madhya Pradesh	Panna
Directorate of Geology & Mining (Diamond Project), Government of Madhya Pradesh, Khanij Bhavan, 29-A, Arera Hills, Bhopal - 462 016, Madhya Pradesh.	Madhya Pradesh	Panna

EXPLORATION & DEVELOPMENT

The Exploration & Development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

PRODUCTION & STOCKS

Production of diamond at 13,917 carats decreased by 52% in 2020-21 as against 28,816 carats in the previous year (Fig-2). There were two reporting mines, both under Public Sector located in district Panna of Madhya Pradesh (Tables- 2 & 3).

Table-3: Production of Diamond, 2018-19 to 2020-21

(By Producers)

Quantity in carats; Value in ₹'000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	38437	539062	28816	352472	13917	220304
Madhya Pradesh	38437	539062	28816	352472	13917	220304

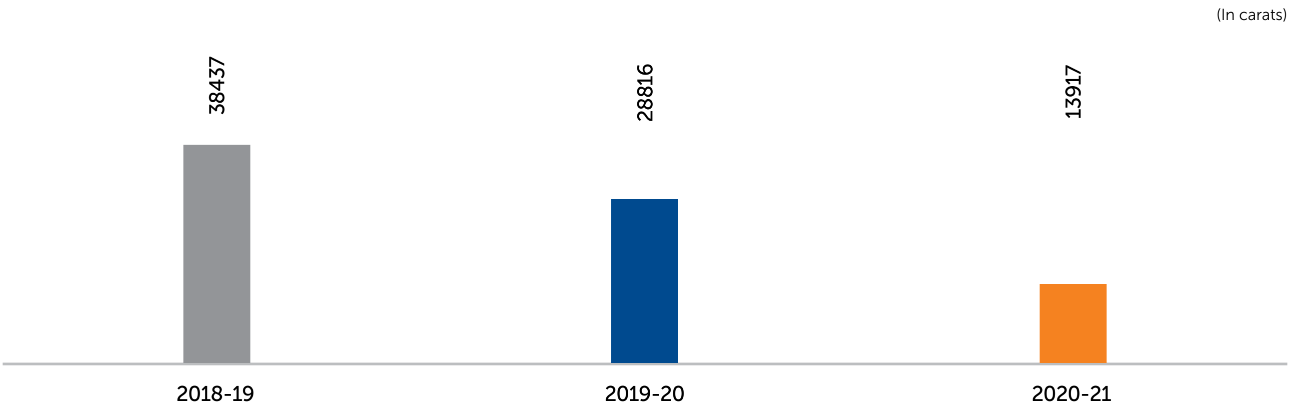


Fig 2: Production of Diamond (in carats)

Out of the total output, Gem variety covering rough & uncut constituted 36% and the remaining 64% was of Industrial grade and other varieties (Table-4).

Table-4: Production of Diamond, 2019-20 & 2020-21

(By Sector/State/District/Grades)

(Quantity in carats; Value in ₹'000)

State/ District	2019-20						2020-21 (P)					
	No. of mines	Quantity				value	No. of mines	Quantity				value
		Gem (rough & uncut)	Industrial*	other	Total			Gem (rough & uncut)	Industrial*	other	Total	
India	2	10400	9862	8554	28816	352472	2	4941	4619	4357	13917	220304
Public Sector	2	10400	9862	8554	28816	352472	2	4941	4619	4357	13917	220304
Madhya Pradesh	2	10400	9862	8554	28816	352472	2	4941	4619	4357	13917	220304
Panna	2	10400	9862	8554	28816	352472	2	4941	4619	4357	13917	220304

* Includes off-colour and dark-brown varieties of diamond.

Mine-head closing stocks during the year 2020-21 were 25,329 carats as against 33,938 carats in the previous year (Table-5).

Table-5: Mine-head Closing Stocks of Diamond, 2019-20 & 2020-21
(By State)

(In carats)

State	2019-20	2020-21 (P)
India	**33938**	**25329**
Madhya Pradesh	33938	25329

The average daily employment of labour during 2020-21 was 137 as against 161 in 2019-20.

MINING & PROCESSING

Majhgawan in Madhya Pradesh is a fully mechanised mine operated by National Mineral Development Corporation Ltd. It is worked by opencast method in tuff rock by deploying 4.1 cu. m hydraulic shovel and 40 tonnes dumpers in combination. The mine benches have been designed with a height of about 10 m. A few benches are of 4-5 m in height. Drilling is done by 4-inch diameter drills and charged with slurry explosives, and about 40–50 holes are blasted at a time with delay pattern. The capacity of the mine is about 30,000 carats per year. Diamonds are also recovered from conglomerate and gravel beds at shallow depths by small operations on the basis of annual permits granted by Diamond Officer, Government of Madhya Pradesh. At Majhgawan, kimberlite rock, after mining the ore is stockpiled for weathering action and then is fed to crushing plant. It is processed through Heavy Media Separation System in processing plant for recovery of diamond. Recently, X-ray diamond sorter has been installed for sorting of diamonds from ore and this has increased the recovery of raw diamonds to 98%.

Diamond Mining Factors

Grade

Grade is the weight of diamond expressed as carats per tonne (ct/t) of ore. It varies widely from one mine to another but generally falls somewhere between 0.3 and 1.3 ct/t. One carat is equivalent to 0.2 grams.

Size (weight) of Rough Diamonds in Deposit

Individually, rough diamonds can range from microweight to stones weighing more than 1,000 carats. Depending on the mine, the average size of rough diamond recovered can weigh from 0.01 ct (about 1 mm) to more than 0.7 ct. Many mines in the world show an average of about 0.4 to 0.5 ct per tonne.

INDUSTRY

Indian Diamond Industry enjoys credible standing and reputation in the world market, particularly for small diamonds used in jewellery. Indian diamond manufacturing standards are reckoned as the best in the world. Workmanship & skill of Indian artisans at polishing small diamonds economically and efficiently has been widely acknowledged. Surat in Gujarat is the main centre of the Cutting and Polishing Industry.

The Indian Diamond Industry thrives in the atmosphere of secrecy and informality that envelops the diamond trade and has for long been labeled as an unorganised sector of the economy. However, it resembles a close-knit community composed of thousands of small, medium and large sized CPD (cut and polished diamonds) units and has grown to become one of the highest foreign exchange earners for the country. An in-depth study of the Industry reveals that the so called unorganised sector is in fact highly organised and has great potential to offer useful insights to the field of management in terms of new forms of organising, networking, business processing and conducting international business.

India's predominance as leader in the world market is due to a combination of pragmatic policies of the Government and sustained efforts of exporters. Policy changes, such as, creation of Special Economic Zones (SEZ) is expected to boost the export prospects further. Several diamond polishing companies have already established offices in India for trading in rough & polished diamonds. India obtains rough diamonds from Belgium, UK, Hong Kong, UAE, Israel, etc. Indian diamond traders seek opportunities to establish direct trade ties with mining companies. The expectations of the Indian Diamond Industry are to access rough diamonds at competitive rates directly from the producers to maintain its lead in the world market.

Tripartite MoU among Government of Madhaya Pradesh (MRD, through DGM), MPSMCL & NMDC was signed for geological and geophysical exploration in various Districts of Madhaya Pradesh In this regard, Government of Madhya Pradesh issued Gazette Notifications of 20 diamond prospective blocks which are applied under MoU for exploration and subsequent reservation.

Remote Sensing Studies have been completed in collaboration with NRSC in Chhattarpur-Panna Block 1, Chhattarpur-Panna Block 2 and Damoh Block, Panna (5 Prospective Blocks) and Additional 12 Diamond Blocks.

Several target areas were established after conducting ground magnetic, VLF-EM & Gravity surveys and stream sediment sampling and several additional anomalous areas were demarcated in the diamond blocks by processing the Raw Aeromagnetic Data acquired/provided by GSI in Diamond Blocks.

Forest applications for drilling has been prepared and submitted. The matter is being pursued with Forest Department for obtaining permission for drilling.

Proposals were submitted by NMDC to the Government of Chhattisgarh for Baloda–Belmundi Diamond Block over an area of 156.80 sq km in Saraipali tehsil, Mahasamund district for reservation under Section 17(A) (2A) of MM (D&R) Amendment Act, 2015 for undertaking prospecting and exploitation operations. Ministry of Mines, Goverment of India vide G.S.R.744(E) dt 14.10.2021 granted reservation of Baloda–Belmundi Diamond Block for PL or ML in favour of NMDC-CMDC limited under Section 17A(1A) of MMDR Act, 1957. NCL vide letter dated 13.01.2022, submitted application to Secretary, MRD, Government of Chhattisgarh for grant of Prospecting Licence for Baloda–Belmundi Diamond Block.

CONSUMPTION

Industrial diamonds are mostly consumed by manufacturers of drill bits, grinding tools and Stone cutting & polishing machines and demand of industrial diamonds is mostly met by imports. There are many small-scale sector units that operate in cutting & polishing trade.

SUBSTITUTES

Synthetic Diamond

Today, market for industrial diamond is dominated by synthetic stones, first developed in 1950s. Synthetic diamonds manufactured using high pressure and high temperature methods compete as an abrasive mineral with natural industrial diamonds and also with manufactured materials like silicon carbide (SiC), alumina (Al_2O_3), tungsten carbide (WC) and carbide boron nitrate (CBN). Synthetic diamonds being marketed are mostly 0.6 to 0.8 mm and smaller in size. Synthetic Diamond Abrasives (SDA) are used for sawing, drilling or milling hard stones, concrete aggregate, refractory materials, masonry and asphalt. In general, large crystals are used for cutting softer materials and smaller crystals for tougher jobs. Synthetic diamonds now account for bulk supply of industrial diamonds and are preferred over natural diamonds because their quality can be controlled to suit customer's requirements.

Synthetic diamonds were produced earlier by using graphite with a metal catalyst under very high pressure & temperature.

Of late a new process, such as, Chemical Vapour Deposition (CVD) has been evolved which requires relatively low pressure for production of synthetic diamonds. This process involves depositing tiny crystals of diamond on a film which can be built in complicated shapes and used at desired places or instruments, such as, machine part, heat conductors in micro circuit, shortwave UV, microwave sources and radiation detectors. In future, CVD can be a substitute for silicon in Computer Industry. In USA, developments have taken place in CVD method of growing 100% pure diamond using microwave plasma technology. This method is more economical and also enables production of larger crystals.

TRADE POLICY

Import of diamond under HS Code 7102, Diamonds, whether or not worked, but not mounted or set, fall under 'Free' category as per the Import Policy ITC(HS), 2022 Schedule 1. Foreign Direct Investment (FDI) in diamond mining up to 100% is admissible for automatic approval of Reserve Bank of India.

WORLD REVIEW

The world reserves of industrial diamond are about 1,800 million carats located mainly in Russia (61%), Botswana (17%), Congo (Kinshasa) (8%), South Africa (7%) and Australia (0.6%). The world reserves of diamond are furnished in (Table-6).

The total world production of diamond decreased by about 22% from 136.2 million carats in 2019 to 106.00 million carats in 2020.

The principal producers were Russia (29%), Botswana (16%), Canada (14%), Dem. Rep. of Congo (10%), Australia (9%), South Africa (8%) and Angola (7%). During the year, decrease in diamond production was observed in Russia Botswana,Australia,canada while increase in production was observed in South Africa and Zimbabwe (Table-7).

Table-6: World Reserves of Diamond

(Industrial)

(By Principal Countries)

(In million carats)

Country	Reserve
World : Total (rounded off)	1800
Australia	11[a]
Botswana	300
Congo (Kinshasa)	150
Russia	1100
South Africa	120
USA	NA
Zimbabwe	NA
Other countries	120

Source: Mineral Commodity Summaries,USGS, 2022

a - In Australia, Joint Ore Reserves Committee - compliants reserves were 10 million carats.

Table–7: World Production of Diamond
(By Principal Countries)

(In '000 carats)

Country	2018	2019	2020
World: Total	**149400**	**136200**	**106000**
Angola	8409	9150	7734
Australia	14008	12155	9980
Botswana	27373	23687	16868
Canada	22789	18491	15036
Congo, Dem. Rep. of	15131	13470	10783
Namibia	2092	1745	1484
Russia	43161	45271	31187
South Africa	9911	7177	8478
Zimbabwe	3252	2119	2670
Other countries	3263	2960	1739

Source: BGS World Mineral Production, 2016-2020

Figures rounded off.

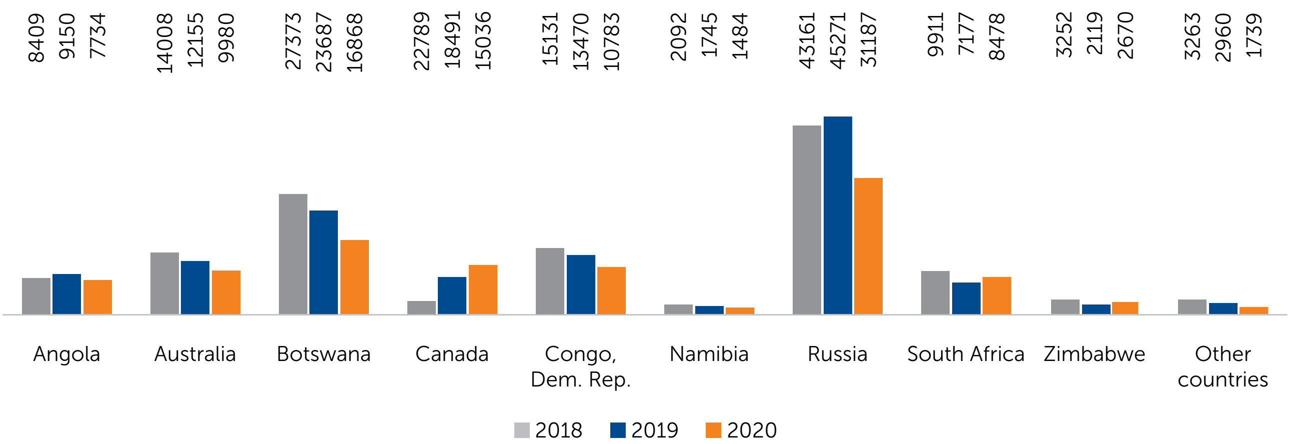


Fig 3: Countrywise Production of Diamond (In '000 carats)

Natural diamonds are cut in about 52 countries. The major diamond cutting centres in the world are Antwerp in Belgium, Ramat Gan in Israel, New York in USA, Surat in India and Guangzhou & Shenzhen in China.

For a generalised view of the development in various countries, the countrywise description sourced from the latest available publication of Minerals Yearbook 'USGS 2018' is furnished below.

Lesotho

The Liqhobong Diamond Mine in the Maluti Mountains of northern Lesotho began ramping up production in late 2016 and had its first full year of commercial production in 2018, when reported production was 8,36,000 carats. The mine was owned by Firestone Diamonds plc (75%) and the Government of Lesotho (25%).

Russia

ALROSA officially commissioned and started mining at the Verkhne-Munskoe Diamond Field in Yakutia on October 31, 2018. Four kimberlite pipes were explored during the last quarter of 2018. ALROSA estimated that the deposit would yield 1.8 million carats of rough diamonds per year, and the estimated reserves of the Verkhne-Munskoe diamond field were sufficient to operate for more than 20 years.

South Africa

De Beers Consolidated Mines Pty. Ltd. safely closed the mine in December 2018, but the South African Department of Mineral Resources continued looking for an operator capable of purchasing the mine. De Beers also operated the Venetia Mine in Limpopo Province, where it was conducting a $2 billion project to take the mine underground and extend its operating life into the 2040.

FOREIGN TRADE

Exports

Value of exports of diamond decreased considerably by 10% to ₹1,25,820 crore in 2020-21 against ₹1,40,033 crore in the previous year. Diamond (mostly cut) alone accounted for almost cent per cent exports in terms of value during this year. The share of industrial diamonds and diamond powder was about ₹68 crore and ₹17 crore, respectively in 2020-21. Exports were mainly to USA (36%), Hong Kong (34%), Belgium & UAE (7% each) and Israel (5%) (Tables-8 to 11).

Table-8: Exports of Diamond : Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty **	Value (₹'000)	Qty **	Value (₹'000)
All Countries	**	**1400336074**	**	**1258209200**
USA	**	490574966	**	457334506
Hong Kong	**	455362427	**	428968079
Belgium	**	147907639	**	93205300
UAE	**	90364448	**	82269885
Israel	**	64023387	**	60576761
Thailand	**	39823323	**	43003607
Japan	**	24916627	**	20619224
Botswana	**	8706004	**	9885172
Australia	**	9117527	**	9784895
UK	**	9541465	**	7183160
Other countries	**	59998261	**	45378611

Figures rounded off.

Note:'**'Not additive

Table-9: Exports of Diamond

(Industrial)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (Carats)	Value (₹'000)	Qty (Carats)	Value (₹'000)
All Countries	**7410678**	**387188**	**7015880**	**688082**
UAE	132131	10833	888985	246629
Belgium	747702	46232	910757	131789
China	334208	26696	625042	119753
USA	892165	80051	532191	57876
Israel	1941004	45155	2360952	50514
Taiwan	1061	23588	1067	23159
Ireland	1135564	34091	794330	22380
U K	1969601	72923	812206	21261
Botswana	53061	20586	4421	4641
Germany	139177	15324	4777	4377
Other countries	65004	11709	81152	5703

Figures rounded off.

Table-10: Exports of Diamond (Mostly Cut)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty **	Value (₹'000)	Qty **	Value (₹'000)
All Countries	**	**1399742298**	**	**1257345848**
USA	**	490408946	**	457215875
Hong Kong	**	455355721	**	428965865
Belgium	**	147833341	**	93050333
UAE	**	90353611	**	82023002
Israel	**	63945997	**	60500703
Thailand	**	39823237	**	43003607
Japan	**	24915356	**	20616732
Botswana	**	8685418	**	9880102
Australia	**	9117527	**	9784891
UK	**	9450922	**	7139914
Other countries	**	59852222	**	45164824

Figures rounded off.

Note:'**'Not additive

Table-11: Exports of Diamond (Powder)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (TCA)	Value (₹'000)	Qty (TCA)	Value (₹'000)
All Countries	8650	206588	10628	175270
USA	4373	85969	4002	60755
Israel	1614	32235	1710	25544
Germany	482	13922	781	24045
Belgium	970	28066	716	23178
UK	558	17620	894	21985
Ireland	254	9278	231	7428
China	94	4504	1327	5966
Switzerland	163	10625	707	1844
Russia	-	-	60	1542
Egypt	10	131	38	539
Other countries	132	4238	162	2444

Figures rounded off.

Imports

In 2020-21, imports value of diamond decreased by about 14% to ₹1,28,351 crore from ₹1,48,735 crore in the previous year. Diamond (mostly cut) shared the bulk, i.e., almost cent per cent of the imports in terms of value. Imports of industrial diamond and diamond powder were about 8.72 million carats and 839.96 million carats, respectively, valued at ₹436 crore and ₹189 crore, respectively. Imports were mainly from UAE (29%), USA (21%), Belgium (20%), Hong Kong (13%), Russia (4%) and South Africa (3%) (Tables-12 to 15).

Table-12: Imports of Diamond
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty **	Value (₹'000)	Qty **	Value (₹'000)
All Countries	**	1487354319	**	1283511854
UAE	**	351172420	**	367595066
USA	**	307848602	**	263507101
Belgium	**	361643797	**	256742721
Hong Kong	**	193079963	**	171122660
Russia	**	37913083	**	50361552
South Africa	**	41472377	**	40613537
Israel	**	45890141	**	16243763
Botswana	**	52770671	**	32833354
Thailand	**	16907190	**	18361551
Japan	**	1215438	**	9450366
Other countries	**	66504637	**	20680183

Figures rounded off.
Note:'**'Not additive

Table-13: Imports of Diamond (Industrial)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (carats)	Value (₹'000)	Qty (carats)	Value (₹'000)
All Countries	**10427197**	**6024784**	**8725537**	**4362112**
UAE	7883170	4493361	6759538	3532523
Russia	647071	525002	423311	343374
Belgium	1048934	538646	752966	301629
South Africa	445066	182159	187761	81527
Hong Kong	187810	227557	78669	63307
Israel	140644	19915	499907	35363
Switzerland	-	-	5272	1866
UK	14617	2014	9471	1023
Ireland	3200	638	3150	562
Brazil	-	-	17	405
Other countries	56685	35492	5475	533

Figures rounded off.

Table-14: Imports of Diamond (Powder)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (TCA)	Value (₹'000)	Qty (TCA)	Value (₹'000)
All Countries	**816431**	**1813540**	**839962**	**1898403**
China	793988	1594178	809594	1645875
Ireland	9439	85508	11283	95603
Hong Kong	3174	19055	9914	57581
U S A	3348	43875	3286	40671
Belgium	1495	27648	1660	19964
Switzerland	1601	17656	929	17559
Korea, Rep. of	2504	19259	1406	10624
Chile	-	-	1480	4598
UK	58	2403	80	1890
Italy	39	595	60	1391
Other countries	785	3363	270	2647

Figures rounded off.

Table-15: Imports of Diamond (Mostly cut)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty **	Value (₹'000)	Qty **	Value (₹'000)
All Countries	**	**1479515995**	**	**1277251339**
UAE	**	346677341	**	364062543
USA	**	307804695	**	263466281
Belgium	**	361077503	**	256421128
Hong Kong	**	192833351	**	171001772
Russia	**	37388081	**	50018178
South Africa	**	41290218	**	46532010
Israel	**	45870052	**	46208400
Botswana	**	52735211	**	32833354
Thailand	**	16906828	**	18360627
Japan	**	12151438	**	9450319
Other countries	**	64781277	**	18896727

Figures rounded off.
Note:'**'Not additive

FUTURE OUTLOOK

The Diamond Industry in the country currently employs over 8 lakh artisans who are experts in cutting and polishing of small diamonds and are now in a position to process full range of sizes and qualities of gemstones using latest technology.

The Chinese Government has begun to initiate multi-billion dollar deals for rough diamonds in exchange for things that China produces like medicines, oils and industrial goods & services. Also, China's investment in Africa is a large threat to the Indian Diamond Cutting and Polishing Industry. There is a growing preference for polishing diamonds in countries where the diamonds are mined, like in Africa. It means that the Indian sector may face problems as India is not a large producer, and depends on import of rough diamonds from Africa. Low profit margins in the cutting and polishing segment have heightened midstream players' interest in synthetic diamonds, but synthetics have to be contented with only limited acceptance among jewellery retailers and end consumers.

With the support in the form of increasing urbanisation, middle-class expansion and appeal as engagement rings, India will emerge as a third largest market for diamond jewellery leaving behind Europe and Japan. Meanwhile, China and the US are expected to remain as the leading diamond jewellery markets.

10. Diatomite

2.89	3,240	7,099
(million tonnes) total resources of diatomite were estimated as on 1.4.2020.	(tonnes)of diatomite were exported in 2020-21.	(tonnes) of diatomite were imported in 2020-21.

Diatomite is a chalk-like, soft, friable, very-fine-grained siliceous sedimentary rock that is light in colour (white and yellowish) white if pure, commonly buff to grey in situ. It is composed of fossilised remains of unicellular aquatic algae-like plants called diatoms which are both marine & lacustrine in origin. Diatoms are microscopic, single-celled organisms, often appearing as colonial aquatic plants (algae). Diatom cells contain an elaborate internal siliceous skeleton. More than 10,000 living diatom species have been identified, in addition to another 10,000 known diatom fossil forms. Diatomite deposits are the remains from the cell wall of diatoms, which are composed of amorphous hydrous silica. Diatomite has the ability to absorb soluble silica to form a highly porous skeletal framework. The dead remains of these diatoms over the ages have fossilised and formed the deep-bedded deposits in ocean & lake floors. The special properties of diatomite, i.e., light weight (low in density), high porosity and high absorptivity have facilitated its application as filter medium and absorbents. It is chemically inert & highly stable. Diatomite consists of approximately 90 per cent silica and the remainder consists of compounds, such as, aluminium and iron oxides. It is also called 'Kieselguhr'. Diatomaceous earth is a common alternate name, but the term is more appropriate for unconsolidated or less lithified rock of the same origin.

Another lesser known mineral, namely, siliceous earth has many similarities with diatomite in character. Siliceous earth is, however, an inorganic material which has chemical composition of more than 80% of amorphous silica. This amorphous phase is very rare and used widely in industrial-scale because of its high porosity, fine particle size, very low density and its high surface area. Its chemical and physical features are same as diatomites which is also amorphous silica consisting of fossilised remains of diatoms, a type of hard-shelled algae. Siliceous earth differs from diatomite in its origin and seems to be formed from volcanic ash. However, due to the many similarities in both materials, siliceous earth finds similar uses as diatomites and therefore, has been included in the Review.

RESERVES/RESOURCES

The occurrences of diatomite are reported from Gujarat, Rajasthan, Tamil Nadu, Andhra Pradesh and Camorta & Trincat Islands in Andaman and Nicobar archipelago. As per NMI database, based on UNFC system, the total resources of diatomite as on 1.4.2020 has been estimated at 2.89 million tonnes, all of which fall under Remaining Resources. The resources are distributed in Rajasthan (72%) and Gujarat (28%) (Table - 1).

PRODUCTION

Diatomite

Production of diatomite has not been reported since 1991-92. Pandava and Khadraliya areas in Bhavnagar district, Gujarat, were the producing areas prior to 1991-92.

Siliceous Earth

The production of siliceous earth was 18,429 tonnes during 2020-21 as against 19,367 tonnes in 2019-20 (Fig-1) (Tables - 2 to 4).

There were eleven reporting mines in the year 2020-21 as against twelve reporting mines in 2019-20.

Mine-head closing stocks of siliceous earth in the year 2020-21 were 79,484 tonnes as against 80,622 tonnes in 2019-20 (Table-5).

The average daily employment of labour in 2020-21 was 38 as against 85 in the previous year.

Table-1: Reserves/Resources of Diatomite as on 1.4.2020(P)

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves	Remaining Resources			Total Resources (A+B)
	Total	Feasibility	Inferred	Total	
	(A)	STD211	STD333	(B)	
All India : Total	–	634	2251	2885	2885
By Grades					
Unclassified	–	634	2251	2885	2885
By States					
Gujarat	–	–	811	811	811
Rajasthan	–	634	1440	2074	2074

Figures rounded off.

Table-2: Principal Producers of Siliceous Earth 2020-21

Name & address of producer	Location of mine	
	State	District
Mr.Narayan Singh Rathore, Chandan Singh ki Dhani, Shiv. Barmer -344 001, Rajasthan.	Rajasthan	Barmer
Mr. Ishwar Singh Rathore, Vill. Jayani, P.O.Kathoti, Jayal Nagaur-341001 Rajasthan.	Rajasthan	Jaisalmer
M/s. Seema Minerals & Metals, 203 A, Mewar Industrial Area, Madri Udaipur-313003, Rajasthan.	Rajasthan	Jaisalmer
Mr. Ashok Kumar Khatri, Inko ki Pol, Pokaran, Jaisalmer-345 021, Rajasthan.	Rajasthan	Jaisalmer
Mr. Ram Swaroop Meghwal, 359,Gotan, Merta, Nagaur- 341 510, Rajasthan.	Rajasthan	Jaisalmer

Table-3: Production of Siliceous Earth, 2018-19 to 2020-21(P)
(By States)

(Qty in tonnes; Value in ₹'000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	80237	50205	19367	11710	18429	12184
Rajasthan	80237	50205	19367	11710	18429	12184

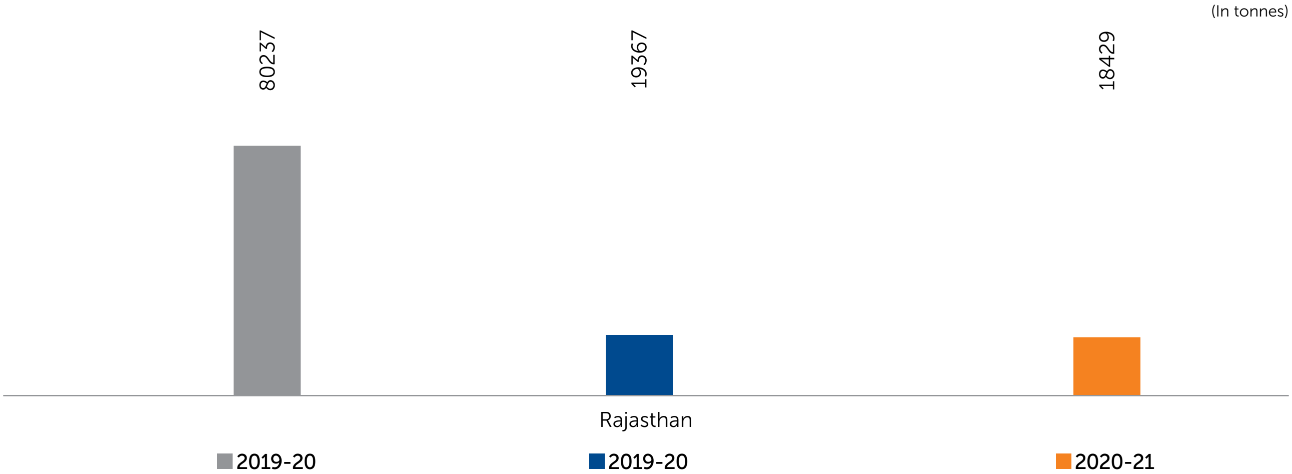


Fig 1: Production of Siliceous Earth (By States)

Table-4: Production of Siliceous Earth, 2019-20 and 2020-21(P)
(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/District	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	12	19367	11710	11	18429	12184
Private Sector	12	19367	11710	11	18429	12184
Rajasthan	12	19367	11710	11	18429	12184
Barmer	5	9810	6776	4	7585	6089
Jaisalmer	7	9557	4934	7	10844	6095

Table-5: Mine-head Closing Stocks of Moulding Sand, 2019-20 & 2020-21(P)
(By States)

(In tonnes)

State	2019-20	2020-21 (P)
India	80622	79484
Rajasthan	80622	79484

USES

Diatomite is commonly used after calcination in plate and frame filter units. Processed diatomite finds a wide range of applications due to its properties like porosity, low bulk density, soluble impurities, high absorptive capacity for liquids, large surface area, low thermal conductivity, mild abrasive nature and chemical inertness.

Diatomite is an excellent filtering material for many liquids especially beverages, fruit juices, soft drinks, beer and wine. It is used in chemicals like sodium hydroxide, sulphuric acid and gold salts. Filtration of cooking oils (vegetable and animal) and sugar (cane, beet and corn) is an application where diatomite is predominantly used. It is also used as an absorbent of vegetable oil, polyethylene, rayon liquors and as a flattening agent in paint, plastic, rubber, drugs, toothpaste, polishes and chemicals. Diatomite is utilised for safe handling and storage of hazardous chemicals like sulphuric acid. Besides, diatomite is also used as an abrasive in metal polishing in automobiles and toothpastes; as pozzolanic admixtures in Cement Industry; as animal feed stuff conditioners; and in explosives. It is also used as a coating material in the manufacture of ammonium nitrate fertilizer which is hygroscopic. Diatomite clay is the new revolution in hydroponics. In pharmaceuticals, it is used to filter syrups and other bulk drugs in liquid form. It is used as a facial exfoliator to promote skin health. Research has also shown that food-grade diatomaceous earth may offer positive benefits for controlling cholesterol levels which in turn would improve heart health. The cleaning of grease and oils continued to be the largest end use for diatomite. In Oil Industry, before packing, it is used for filtering oil which not only gives it a shine but also helps in removing any suspended impurity. Wine and beer are filtered through diatomite filters before packing to remove molasses. Filter candles are made from diatomite filter aids for drinking water purification. Processed diatomite granules 15 to 50 mm, are used in denim wash (commonly known as stonewash) to give it shine and design.

Diatomite is also used as caking agent in fertilizers, plastics and as a natural insecticide for organic pest control. Potable water treatment and biological filtration are areas of expansion in diatomite consumption. Siliceous earth is mainly used as filler & filter, heat & sound resistant material and in Ceramic Industry. Filtration and cleaning of vegetable oils and animal fats and manufacturing of medicines are other uses. In advance applications, it is used as carrier for catalyst in chemical processes and for mineral fertilizers & herbicides, pesticides and fungicides. It is also used as raw material for refination and filtration as well as constituent of synthetic molding mass. It is increasingly used for the removal of microbial contaminants, such as, bacteria, protozoa and viruses, from public water systems. Recently, diatomite derived products included filter aids (50 per cent), filters (15 per cent), absorbents (5 per cent), and other minor uses, including specialised pharmaceutical and biomedical applications (less than 1 per cent).

Siliceous earth, on the other hand, is used in powder form which may vary from 80 mesh to 500 mesh powder. It is also used in granule form in some specific operations and in paint, filler, rubber, catalyst, fertilizer, pesticides, agriculture and many other industries.

Diatomite is increasingly used in agriculture segment in fungicides, insecticides and rodenticide owing to its dehydration properties. Other diatomite applications include its use as a growing medium in hydroponic gardens wherein its characteristics, such as, inertness, water holding capability and porosity allows the soil to breathe.

PROCESSING

Diatomite deposits are usually mined as open pit operations. If necessary, the mined crude is dried and crushed. Dried diatomite is collected in cyclones and fed through air separators to remove coarse material and impurities. Calcination and flux calcination are used to thermally volatise organic material and oxidise iron. Calcination is also used to increase diatomic hardness, specific gravity and refractive index. The fusing of small diatomite particles into clusters can also be accomplished through calcination, which results in increased pore size and volume. Diatomite products are sold as various grades of calcined powders.

INDUSTRY

M/s Seema Minerals & Metals, Udaipur, Rajasthan, produces various grades of diatomaceous earth of which some grades are as follows:

- Diatomaceous Earth for insulation in Fire Proof Cabinets and safes.
- Diatomaceous Earth for calcium silicate boards.
- Diatomaceous Earth for water purification.
- Diatomaceous Earth for Animal Feed.
- Diatomaceous Earth for agriculture crops.
- Diatomaceous Earth for filtration.
- Calcined Diatomaceous Earth.
- Diatomaceous Earth Oil absorbents.
- Diatomaceous Earth for insecticides.

SUBSTITUTION

Many materials can be substituted for diatomite. However, the unique properties of diatomite assure its continued use in many applications. Expanded perlite and silica sand compete for filtration. Filters made from manufactured materials, notably ceramic, polymeric, or carbon membrane filters and filters made with cellulose fibers are becoming competitive as filter media. Alternate filler materials include clay, ground limestone, ground mica, ground silica sand, perlite, talc, and vermiculite. For thermal insulation, materials, such as, various clays, exfoliated vermiculite, expanded perlite, mineral wool and special brick can be used. Transportation costs will continue to determine the maximum economic distance that most forms of diatomite may be shipped. Diatomite still remain competitive despite availability of alternative materials. Many alternatives exist for diatomite as a pozzolan, however, its use as an ingredient of portland cement has not diminished but on the cotrary has increased in recent years. The encroachment of natural and synthetic substitute materials into diatomite markets has not been significant.

TRADE POLICY

As per the Foreign Trade Policy, 2015-2020, the imports and the exports of siliceous fossil meals (kieselguhr, tripolite, diatomite) and similar siliceous earth, whether or not calcined under ITC (HS) Code 251200 (25121010, 25120020, 25120030 and 25120090) are free.

WORLD REVIEW

World reserves/resources of crude diatomite are adequate for the foreseeable future. The USA has the largest reserves at 250 million tonnes followed by China with 110 million tonnes and Turkey with 44 million tonnes. World's largest producing district in terms of volume is near Lompoc, CA in USA (Table- 6).

The world diatomite production was 2.1 million tonnes in 2020. The USA dominated the world production by accounting for 36% output which was followed by China & Mexico (7% each), Denmark, Turkey & Argentina (5% each), Germany & Peru (4% each) and Mozambique (3%). Production in Denmark was mostly of molar, an impure diatomite containing a large proportion of clay (Table- 7).

Table-6: World Reserves of Diatomite

(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total	Large
Argentina	NA
China	1,10,000
Denmark[5] (processed)	NA
France	NA
Germany	NA
Japan	NA
Korea, Rep. of	NA
Mexico	NA
New Zealand	NA
Peru	NA
Russia	NA
Spain	NA
Turkey	44,000
United States[1]	2,50,000
Other countries	NA

Source:USGS, Mineral Commodity Summaries,2022

NA - Not available.

[1] Processed ore sold or used by producers.

[5] Include sales of molar production.

Table-7: World Production of Diatomite

(By Principal Countries)

(In tonnes)

Country	2018	2019	2020
World: Total	2600000	2100000	2100000
USA(e)	957000	768000	770000
China(e)	420000	150000	150000
Turkey	242789	220757	100327
Denmark (Molar)(d)	99375	108750	115000
Peru	96532	91103	85406
Mexico	152058	129274	144102
France(e)	90000	90000	90000
Argentina	72436	84610	98575
Mozambique	66429	72439	70000
Other countries	386929	404228	428339

Source: BGS, World Mineral Production, 2016-2020.

(b) Including the mineral Tripoli,

(c) Sold or used by producers

(d) Molar is an impure diatomite containing a large proportion of clay

FOREIGN TRADE

Exports

Exports of diatomite decreased substantially by 25% to 3,240 tonnes in 2020-21 from 4,302 tonnes in the previous year. Exports were mainly to Taiwan (56%), Morocco (15%), Ecuador (6%), Kuwait (5%) and Korea (4%) (Fig-2). (Table-8).

On the other hand exports of kieselguhr decreased drastically by 76% to 27 tonnes in 2020-21 from 113 tonnes in the previous year. Exports were mainly to Switzerland (96%) and Bangladesh (4%) (Fig-3) (Table-9).

Imports

Unlike exports, imports of diatomite increased substantially by 43 % to 7,099 tonnes in 2020-21 from 4,950 tonnes in the previous year. Imports were mainly from Australia (75%), USA (15%), China (9%) and Mexico (1%) (Table-10).

Imports of kieselguhr were at 10 tonnes in 2020-21 which decreased substantially by 85% as compared to 66 tonnes in preceding year. Imports of kieselguhr were mainly from France (100%). (Table-11).

Imports of tripoli earth were nil in 2020-21 as compared to 19 tonnes in the previous year. (Table-12).

Table-8: Exports of Diatomite
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4302	72842	3240	69439
Taiwan	1896	25170	1830	25704
USA	15	8323	29	9917
Korea, Rep. of	-	-	119	5812
Tanzania	67	4277	64	4681
Morocco	-	-	500	4491
France	33	3679	34	4194
Ecuador	260	4415	208	3564
Malaysia	17	689	42	2045
Kuwait	31	309	162	1755
Sri Lanka	96	1691	85	1515
Other countries	1887	24289	167	5761

Figures rounded off.

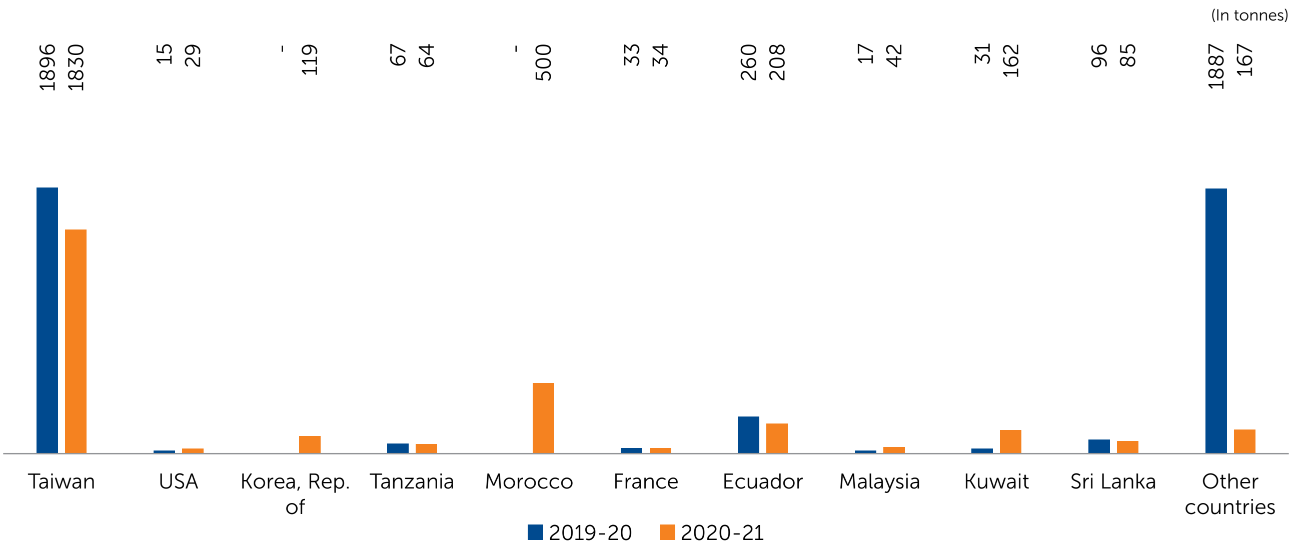


Fig 2: Country-wise Export of Diatomite

Table-9: Exports of Kieselguhr
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	113	2399	27	917
Switzerland	51	1500	26	790
Bangladesh	-	-	1	112
China	35	599	++	8
Vietnam	-	-	++	4
Sri Lanka	-	-	++	3
UAE	27	203	-	-
Tanzania	++	78	-	-
Germany	++	13	-	-
Botswana	++	2	-	-
Philippines	++	2	-	-
Other countries	++	2	-	-

Figures rounded off.

Table-10: Imports of Diatomite

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4950	152229	7099	212766
Australia	2312	49902	5340	118345
USA	916	42157	1071	65861
China P Rp	958	31536	615	21753
Mexico	703	24463	57	3811
Spain	15	3650	16	2996
Turkey	46	398	-	-
Thailand	++	82	-	-
Germany	++	21	-	-
France	++	20	++	-

Figures rounded off.

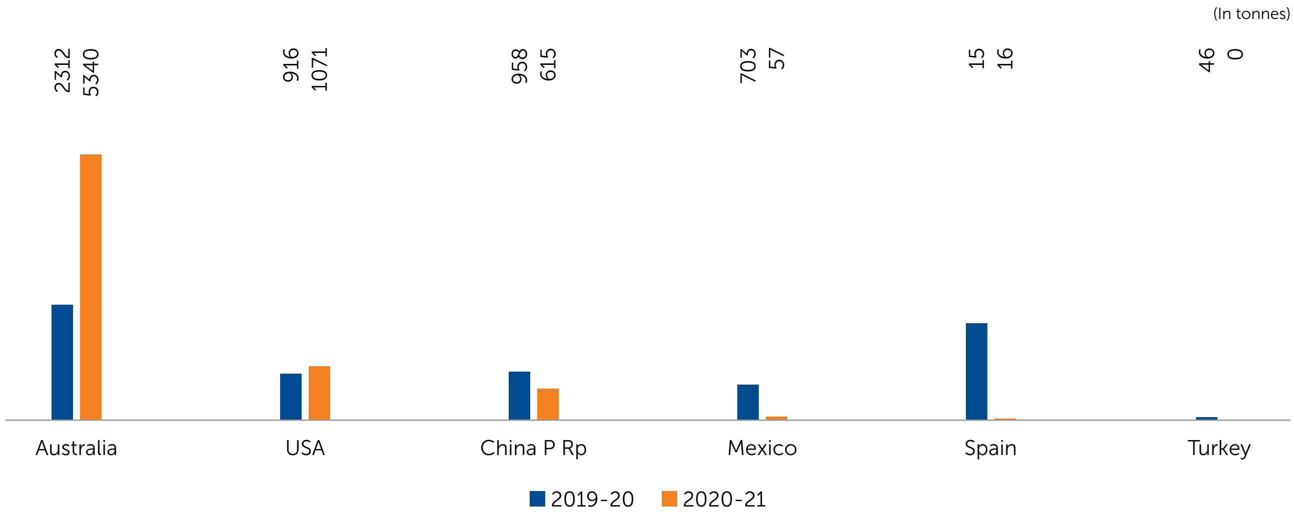


Fig 3: Country-wise Import of Diatomite

Table-11: Imports of Kieselguhr

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	66	9247	10	1543
France	-	-	10	1382
UK	++	68	++	99
USA	++	59	++	38
Germany	++	337	++	20
Belgium	++	25	++	4
Netherands	56	7368	-	-
Spain	10	1390	-	-

Figures rounded off.

Table-12: Imports of Tripoli Earth

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	19	1116	-	-
USA	19	1088	-	-
Germany	++	28	-	-

Figures rounded off.

FUTURE OUTLOOK

Diatomite market is expected to witness substantial growth owing to increasing use in industrial applications including filter aid and filler material. Natural filtering characteristics due to its unique honeycomb structure and its rising use in filtration application as well as food and beverage market are key drivers for the growth of diatomite market.

Filtration market is the largest consumer of diatomite owing to high levels of purifying capabilities. In addition, growing use of diatomite in industries, such as, paints, plastics, insecticides, pharmaceuticals, chemicals, adhesives, sealants, paper etc. is expected to propel market growth over the forecast period. In addition, its use in Plastic Industry as an anti-blocking agent assists in separation of plastic parts during manufacturing and separation of plastic bags. Growing health and safety concerns associated with inhalation of crystalline silica during diatomite processing is expected to affect market growth.

North America accounted for largest market share in terms of demand owing to large amount of diatomite reserves available in the region. In addition, increasing demand from various industrial applications including water treatment, absorbents and crop protection chemicals is expected to augment market growth.. Asia Pacific accounted for second largest market share owing to increasing demand from crop protection chemicals and industrial applications, particularly in China. Furthermore, demand from countries including India, Korea, Japan and Australia are expected to provide better opportunity for diatomite market. Europe contributed for a significant share for diatomite owing to increasing demand from crop protection and water treatment particularly in Spain, Germany and United Kingdom. Middle East is expected to witness significant growth owing to increasing use of diatomite in various stages of oil & gas exploration.

The economic stability of diatomite was largely on account of its use as a viable filtration medium. Despite challenging market condition for many industrial commodities, world diatomite production remained stable. The demand for diatomite as filtration medium still remains strong particularly in the filtration of spirit as well as human blood plasma and in other biotechnical applications.

11. Emerald

55.87
(tonnes) Total reserves/resources of emerald were estimated as on 1st April 2020

₹799.78
(crore) value of emerald (cut & uncut) were imported in 2020-21

₹531.67
(crore) value of emerald (cut & uncut) were exported in 2020-21

Emerald commonly called as 'Panna' in Hindi, is a variety of mineral beryl and is chemically a complex silicate of aluminium and beryllium ($Be_3Al_2(SiO_3)_6$. The hardness of Emerald is about 7.5-8 on Moh's scale. Emeralds are rare & precious gemstones that command immense value on account of their cut, colour, clarity and carat. Beauty, rarity and durability are the main virtues of a gemstone. The cut stones are known as gems, while the uncut ones are gemstones. Emeralds occur in hues varying from yellow-green to blue-green. However, emeralds with unique velvety green colour with high degree of transparency are considered as most precious among gemstones. The rose variety of beryl is called morganite, and the golden yellow variety is termed 'golden beryl'. If the colour is bluish green or blue then it is called 'aquamarine'. When emerald contains chromium as an impurity, it imparts the colour green. Emerald is generally found at the contact of pegmatites intruding schists, mainly amphibole schists.

RESERVES/RESOURCES

As per NMI data, as on 01.04.2020 based on UNFC system, the total resources of emerald in the country are estimated at 55.87 tonnes. All resources are placed under Reconnaissance category and Unclassified grade resources have been reported in the State of Jharkhand (Table-1).

Occurrences of emerald are also reported from Rajasthan, Odisha and Chhattisgarh. However, resources have not been estimated so far. In Rajasthan, emeralds have been found to occur at a number of places in districts of Rajsamand and Ajmer. In Ajmer-Rajsamand belt of Rajasthan, emerald occurrences are confined to the upper fringes of pegmatites. Emerald deposit is found in the 221 km long belt stretching from Gam Gurha in Rajsamand district to Bubani and Muhami in Ajmer district. Important localities are Rajgarh, Tikhi and Kalaguman (Rajsamand). The occurrences are highly sporadic and variable.

In Odisha, occurrences of emerald are reported from Bira-Mohorajpur belt in district Bolangir. In Chhattisgarh, occurrences of emerald are reported from Deobhog area in Raipur district. Sporadic and irregular crystals of emerald, aquamarine and amethyst are also reported in a few localities in district, Coimbatore Tamil Nadu.

Table-1: Reserves/Resources of Emerald as on 1.4.2020 (P)
(By Grades/States)

(In kg.)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	-	-	-	-	-	-	-	-	-	-	55869	55869	55869
By Grade													
Unclassified	-	-	-	-	-	-	-	-	-	-	55869	55869	55869
By State													
Jharkhand	-	-	-	-	-	-	-	-	-	-	55869	55869	55869

Figures rounded off.

PRODUCTION

Production of emerald has not been reported since 1983. However, a single lease of 46.32 ha area was granted to M/s Serva Shri Mining & Mineral Industries in district Ajmer, Rajasthan in the year 1998. The mine-head closing stocks of emerald at the end of the years 2020-21 and 2019-20 were 20 kg each (Table-2). The average daily employment was nil in both the years.

Table-2: Mine-head Stocks of Emerald, 2019-20 & 2020-21

(By States)

(In tonnes)

State	2019-20	2020-21 (P)
India/ Rajasthan	20	20

MINING AND MARKETING

Mining of emerald was mostly undertaken manually by opencast method. The pits were worked at shallow depths. The stones collected during mining were sorted out according to size, shape and quality. The stones so collected were deposited with the State Government under the supervision of DMG officials and mine owners. Worldwide, crude emerald was sold through public auction from time to time.

The beauty of rough stone is enhanced by skillful cutting and polishing into faceted or rounded form for use in jewellery. The rough stones are sorted out to determine the angles to which facets can be cut. They may be sawed or polished in any direction according to shape, size and colour to be retained. After the shape and size are determined, the next process of 'pre-shaping' is done. The third and important process called 'calibration' gives the pre-shaped stone a definite proportion and size. The process that follows is 'faceting' and 'polishing'. The aim of this process is to achieve maximum internal reflection enhancing the beauty of the stones. Emeralds are generally given a step-cut or cabochon-cut.

India is the leading exporter of cut and polished gem, but continued to depend on raw materials. The Diamond and Gem Development Corporation of India has set up Diamond and Gem Parks for cutting and polishing of gems in different States. Jaipur in Rajasthan is the major centre for processing emeralds. Like diamonds, uncut emerald is imported and part of it is exported after processing. Emerald is next to diamond (uncut) amongst precious and semi-precious stones, being imported and re-exported after cutting and polishing.

Prices are governed by many factors including beauty, clarity, defect, demand, durability and rarity. Prices of precious stones also vary over time.

WORLD REVIEW

World production of emerald is reported mainly from Colombia, Pakistan, Afghanistan, Africa, Nigeria, Mozambique, United States of America, Madagascar, Brazil, Zambia and Zimbabwe.

Afghanistan

Afghanistan's Panjshir Valley has shown potentiality for commercial emerald production. Emeralds have been found only on the eastern side of the valley, even though the western side has been searched extensively. The emerald mines of Afghanistan are located approximately 70 miles (113 km) north east of Kabul and extend from the village of Khenj to Dest-e-Rewat. The emerald mines are located at elevations between approximately 7,000 and 14,300 ft. (2,135 and 4,270 m) in mountainous terrain on the eastern side of River Panjshir. The Panjshir emerald crystals vary in quality from mine to mine. In general, Panjshir emeralds are mined and marketed in a free-enterprise system.

Madagascar

Madagascar was a globally significant producer of gemstone that included emerald, ruby and sapphire. Emerald was produced from the Kianjavato emerald mines which are located in the rain-forest region of eastern Madagascar, approximately 60 km west of the coastal city of Mananjary. Emeralds are also mined at the Ianapera (Sakalava) emerald deposits in the Ianapera (Janapera) area of Tuléar (Toliara) Province, 350 km east of the town Toliara. Societe Orgaco of France mined the emerald (536 kg Heaven's gift) in matrix at the Morafeno mine near Mananjary and exported it to Reunion.

Pakistan

In Pakistan, the Fizzagat emerald mine is situated near the district headquarters of Mingora in Swat valley.

Brazil

Since the 1970's, Brazil has been consistent source of emerald. Brazilian emerald deposits are found in a typical geological setting with Archean basement and supracrustal, ultramafic and granitoid rocks. Brazil emerald mines are located in the states of Bahia, Minas Gerais and Goias. Brazil's emerald production goes to both domestic cutting and foreign buyers who take the rough back to cutting centres in their own country.

Colombia

In Colombia, the mining activity of emerald has been concentrated in the departments of Cundinamarca and Boyaca, in the denominated East and West emerald belts. Mining districts of Chivor, Gachala and Macanal (Eastern Belt) and Muzo, Coscuez, Penas Blancas, La Palma-Yacoi and La Pita (Western Belt) are located in Colombia. The most representative mines are Muzo, Cunas, Coscuez, La Pita and Chivor.

Zambia

Zambia is one of the world's most significant sources of fine-quality emerald and has been called the second most important producer by value after Colombia. The emerald mines are located in the Kafubu area of central Zambia, about 45 km southwest of the town of Kitwe. The majority of the gems produced in Zambia are found in the Kamakanga and Kagem mines. Both are located in the north-eastern region of the country. Gemfields, the world's biggest emerald miner has found a gem that weighs more than 1.1 kg at its mine in Lufwanyama. Earlier 5,655 carat stone was found at the Kagem Mines.

Others

Zimbabwe produces rough emeralds from the Sandawana mine, located in the southwest of the country. In the United States of America, in Beaver County, Utah rare red emeralds are found in the eastern slopes of the Wah Wah Mountains. In Ethiopia, a new deposit of high-quality (4%), Thailand (2%) (emeralds has been found in the rural areas of Kenticha and Dermi, in the district Seba Boru.Mining is done through hand tools, without heavy machinery.

FOREIGN TRADE

MMTC is an authorised agency of the Government of India for import of precious & semi-precious stones including emerald and supply these items to jewellers for domestic sales and exports.

Exports

In 2020-21, exports of emerald (cut & uncut) by value decreased substantially by 69% to ₹531.67 crore from ₹1738.79 crore in the previous year. Exports were mainly to Hong Kong (39%), USA (24%), Thailand (11%), Italy (6%), Belgium (4%) (Fig-1). Out of the total export value of emerald (cut & uncut), the share of the export value of emerald (cut) was about almost cent per cent. The export value of emerald (cut) decreased considerably by 70% to ₹527.09 crore in 2020-21 from ₹1,732.78 crore in the preceding year. In terms of quantity, the export of emerald (cut) decreased substantially to 4,076 thousand carat in 2020-21 from 21,960 thousand carat in the preceding year. Exports were mainly to Hong Kong (28%), UK (27%), USA (19%), Thailand (13%), Italy (4%) and UAE (1%) (Fig-2). On the other hand, the share of the export value of emerald (uncut) was negligible. The export value of emerald (uncut) decreased drastically by 24% to ₹4.57 crore in 2020-21 from ₹6 crore in the preceding year. While in terms of quantity, the export of emerald (uncut) decreased drastically by more than 99% to less than one tonnes in 2020-21 from 34 tonnes in preceding year. Exports were mainly to Hong Kong (83%), USA (9%), Belgium (4%) and Thailand (2%) Tables- 3 to 5) (Fig-3).

Table-3: Exports Value of Emerald

(Cut & Uncut): Total
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**	17387875	**	5316603
Hong Kong	**	9190549	**	2060857
USA	**	3679049	**	1293175
Thailand	**	1584651	**	561998
Italy	**	468393	**	314455
UAE	**	180594	**	241815
Belgium	**	404137	**	188189
Israel	**	99915	**	94847
UK	**	275892	**	90841
France	**	197372	**	77620
Switzerland	**	481511	**	59761
Other countries	**	825812	**	333045

Figures rounded off.

Note: Quantity not given due to partial coverage; value figures, however, have full coverage.

(Value in ₹'000)

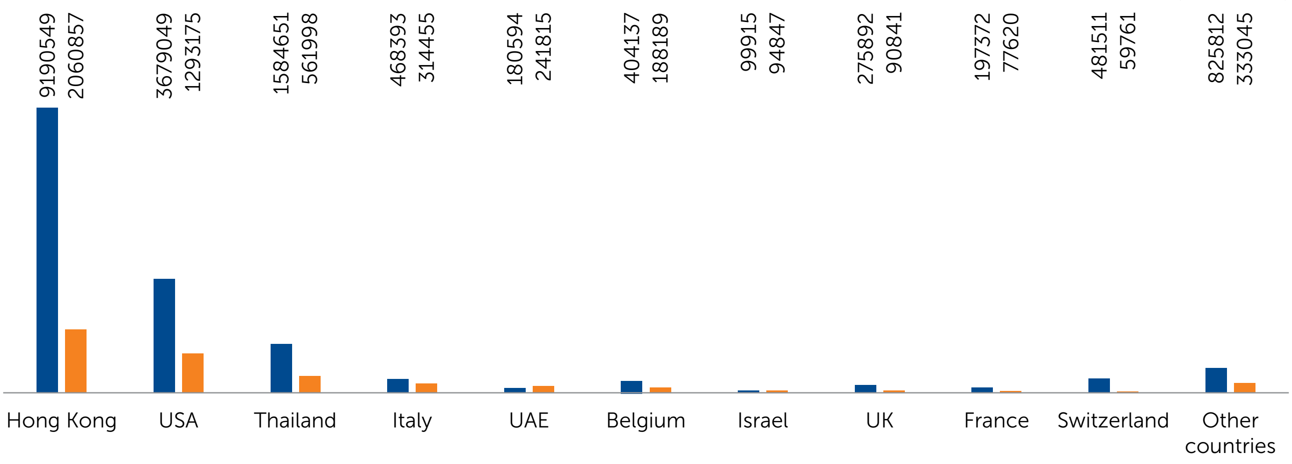


Fig 1: Countywise Exports of Emerald (Cut & uncut)

Table-4: Exports of Emerald (Cut)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	21960	17327835	4076	5270862
Hong Kong	4943	9162031	1130	2023042
USA	8454	3674691	777	1289117
Thailand	2947	1574841	542	561091
Italy	833	468387	148	314455
UAE	118	179021	39	241353
Belgium	17	393742	17	186418
Israel	31	97267	9	94847
UK	1990	275607	1107	90764
France	17	197371	7	77580
Switzerland	77	481511	2	59761
Other countries	2533	823366	298	332434

Figures rounded off.

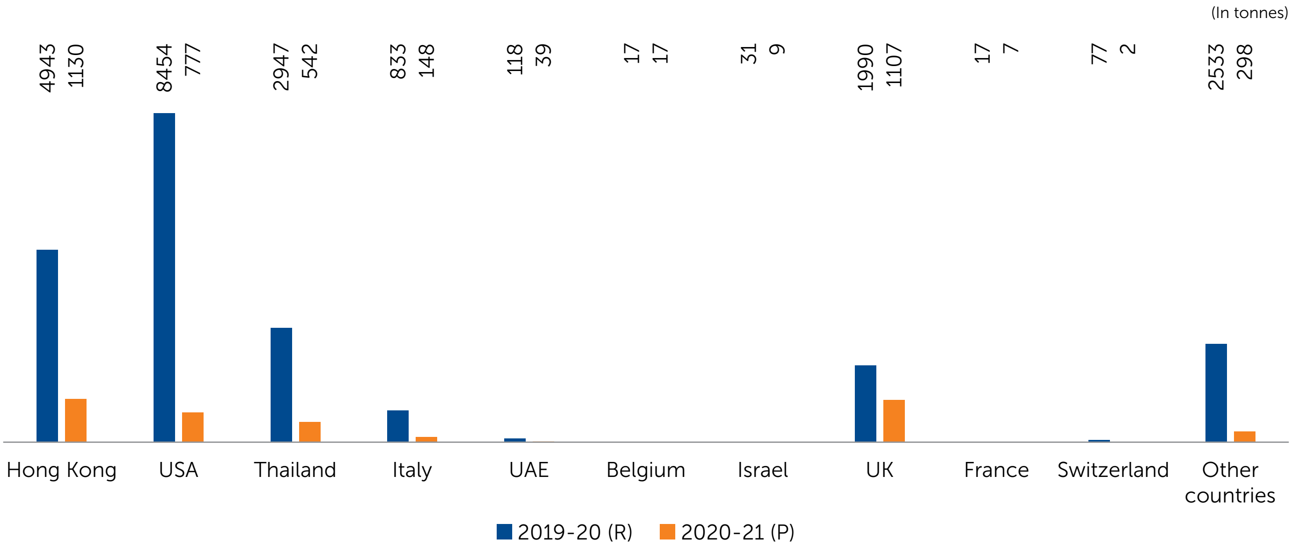


Fig 2: Countrywise Export of Emerald (Cut)

Table-5: Exports of Emerald (Uncut)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	34	60040	++	45741
Hong Kong	2	28518	++	37815
USA	5	4358	++	4058
Belgium	++	10395	++	1771
Thailand	++	9810	+	907
UAE	++	1573	++	462
China	24	321	++	397
Japan	++	250	++	126
UK	++	285	++	77
Australia	++	151	++	56
France	++	1	++	40
Other countries	3	4378	++	32

Figures rounded off.

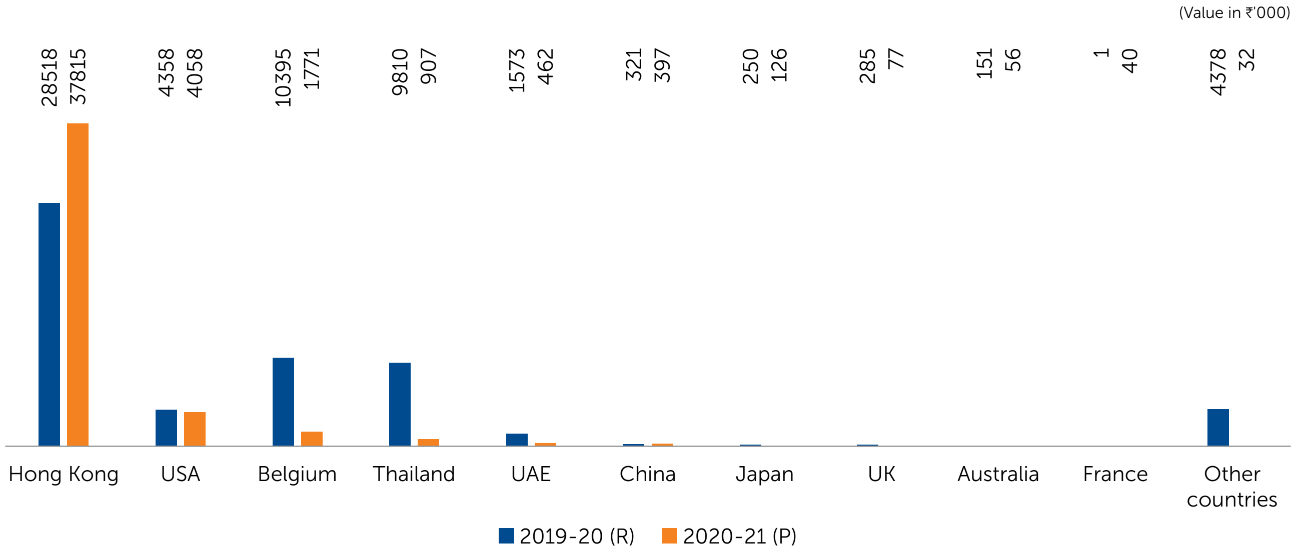


Fig 3: Countrywise Value of Export of Emerald (Uncut)

Imports

In 2020-21, the total imports of emerald (cut and uncut) by value decreased drastically by 67% to ₹799.78 crore from ₹2,440.35 crore in the preceding year. Imports were mainly from Zambia (40%), UAE & Hong Kong (19% each), USA (7%), Singapore(6%), Thailand (2%), Brazil (2%) and Russia (2%). In the total import value of emerald (cut & uncut), the share of imports value of emerald (cut) was (17%), while the share of imports value of emerald (uncut) was 83%. The imports value of emerald (cut) decreased substantially by 87% to ₹135.78 crore in 2020-21 as compared to ₹1,053.16 crore in the preceding year. In terms of quantity, the imports of emerald (cut) decreased substantially by 89 % to 9,842 thousand carat in 2020-21 from 90,367 thousand carat in the preceding year. In terms of quantity, imports were mainly from Russia (76%), Hong Kong (10%), China (5%), USA (2%) and Thailand (1%) (Fig-4). The import value of emerald (uncut) also decreased by 109% to ₹664 crore in 2020-21 as compared to ₹1,387.19 crore in the preceding year. In terms of quantity, the imports of emerald (uncut) also decreased substantially by 64% to 49 tonnes in 2020-21 from 136 tonnes in the preceding year. In terms of value imports were mainly from Zambia (48%), UAE (22%) and Hong Kong (14%) (Fig-5) (Tables-6 to 8).

Table-6: Imports of Emerald (Cut & Uncut) : Total
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**	24403510	**	7997796
Zambia	**	7514560	**	3180916
UAE	**	254308	**	1494356
Hong Kong	**	8595961	**	1483680
USA	**	1921788	**	578980
Singapore	**	359564	**	467434
Brazil	**	480561	**	192980
Thailand	**	2606037	**	175476
Russia	**	35586	**	134343
China	**	103730	**	86106
Israel	**	18573	**	30376
Other countries	**	2512842	**	173149

Figures rounded off.

Note: Quantity not given due to partial coverage; value figures, however, have full coverage.

Table-7: Imports of Emerald (Cut)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**90367**	**10531610**	**9842**	**1357766**
Hong Kong	3172	4757745	1001	524784
USA	2425	1234090	214	394861
Thailand	70914	2053978	98	120151
China	10400	21658	475	86106
Italy	21	94446	1	30230
Switzerland	54	788977	++	27652
UK	2	38189	1	27194
Israel	++	15818	1	23588
Russia	--	--	7500	22490
France	1	123966	++	20559
Other countries	3378	1402743	551	80151

Figures rounded off.

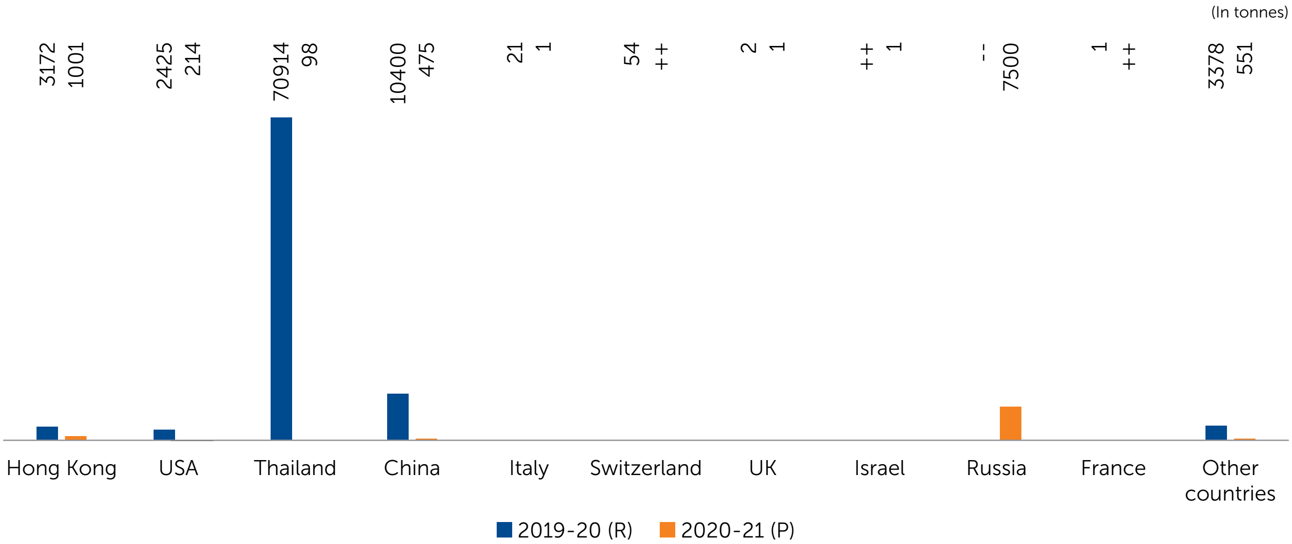


Fig 4: Countrywise Import of Emerald (Cut))

Table-8: Imports of Emerald (Uncut)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**136**	**13871900**	**49**	**6640030**
Zambia	46	7348701	35	3180916
UAE	++	227258	1	1485854
Hong Kong	6	3838216	1	958896
Singapore	++	327882	1	451865
Brazil	11	465145	6	189902
USA	++	687698	++	184119
Russia	++	35586	2	111853
Thailand	1	552059	++	55325
Estonia	++	2593	1	7861
Israel	++	2755	1	6788
Other countries	72	384007	1	6651

Figures rounded off.

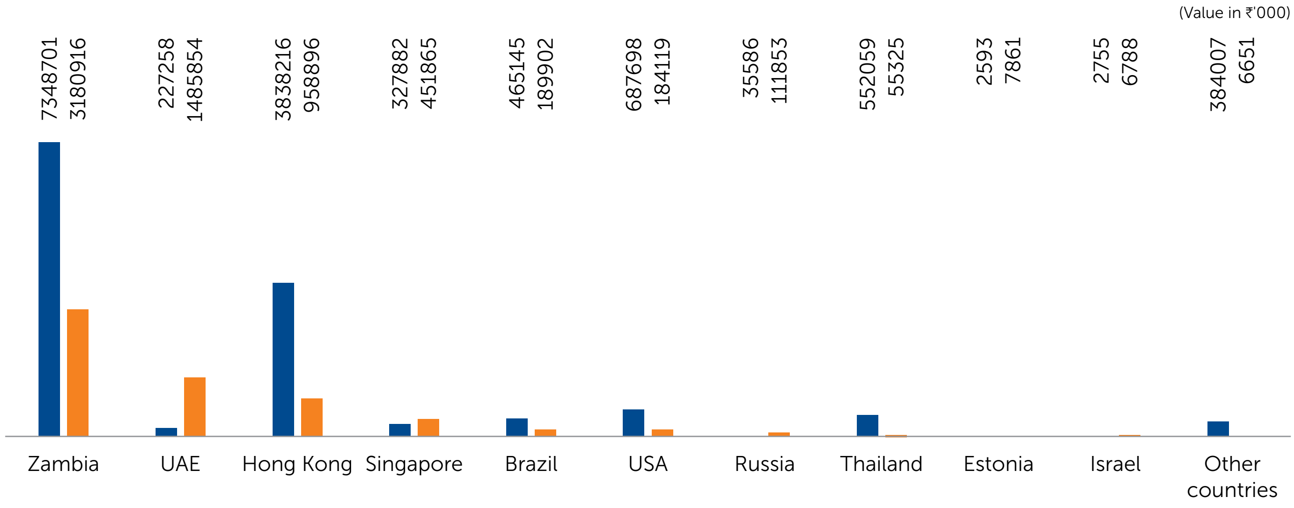


Fig 5: Countrywise Value of Import of Emerald (Uncut)

FUTURE OUTLOOK

Gems and Jewellery Export Sector has been contributing about 13%-15% to India's total merchandise exports during the last five years. As per industry estimates, this sector employs more than 4.64 million employees. With a view to strengthen the Gems & Jewellery Industry in the country, the Government has taken a number of steps, such as, establishment of Special Notified Zone (SNZ); announcement of separate ITC HS Code for lab-grown diamonds; introduction of Gold Monetisation Scheme; amendment of wastage and value addition norms for gems and jewellery items; approved scheme for setting up of Common Facility Centres for Gem and Jewellery Sector; and providing financial assistance for participation in international fairs, organising buyer-seller meets etc. under Market Development Assistance (MDA) and Market Access Initiative (MAI) Schemes of the Department of Commerce.

12. Fluorite

20.99
(million tonnes) Total reserves/resources of fluorite have been estimated as on 1st April 2020

1,052
(tonnes) Production of fluorite (graded) were reported in 2020-21

474
(tonnes) of fluorite were exported in 2020-21

2.21
(lakh tonnes) of fluorite were imported in 2020-21

Fluorite is a very popular mineral, and it naturally occurs in all colours of the spectrum. It is one of the most varied coloured mineral in the mineral kingdom, and the colours may be very intense and most electric. Pure fluorite is colourless and the colour variations are caused by various impurities. It is a mineral with veritable bouquet of brilliant colours from hallmark colour purple to blue, green, yellow, colourless, brown, pink, black and reddish orange. The rich purple colour is by far the most famous and popular colour. It is an important commercial source of fluorine. Fluorite plays a vital role in the manufacturing Industry and major consuming industries are chemical, cement, iron & steel, electrode, etc. It is also used in the production of synthetic cryolite without which aluminium extraction is not possible.

Fluorite is commonly deposited by hydrothermal solution sourced from igneous intrusions. The mineralisation occurs as veins or replacement deposits either by the filling of cavities and fissures or by the replacement of the host rock, typically carbonates.

Mainly two grades of fluorite are involved in consumption and trade, namely, the Acid grade (acidspar) containing more than 97% CaF_2 and the Sub-acid grade analysing 97% or less CaF_2. The Sub-acid grade includes Metallurgical (60 to 85% CaF_2) and Ceramic (85 to 95% CaF_2) grades and is commonly known as Metallurgical grade (metspar). Fluorite production in the country is meagre when compared with the world production. In addition to the natural fluorite production, synthetic fluorite is recovered as by-product during uranium processing, petroleum alkylation and stainless pickling. The by-product, fluorosilicic acid, obtained from phosphoric acid plants while processing phosphate rock also supplements fluorite as a source of fluorine.

RESERVES/RESOURCES

As per NMI database, based on the UNFC system, the total reserves/resources of fluorite in the country as on 1.4.2020 has been estimated at 20.99 million tonnes. Out of these, 0.40 million tonnes are placed under Reserves category (of which 0.23 million tonnes are under Proved category and 0.18 million tonnes under Probable category). The Remaining Resources comprise 20.59 million tonnes.

By States, Gujarat accounts for 68% of the total reserves/resources having 14.35 million tonnes, followed by Rajasthan with 5.60 million tonnes (27%), Chhattisgarh 0.54 million tonnes (3%) and Maharashtra 0.49 million tonnes (2%). Gradewise, the resources are classified into Marketable grade which accounted for 82% of the total resources followed by low grade (15%) and Unclassified grade (2%) (Table-1).

Table-1: Reserves/Resources of Fluorite as on 1.4.2020 (P)
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	228393	163860	11988	404241	9340556	771934	768573	1727945	6239589	1578067	161575	20588239	20992480
By Grades													
Marketable	228393	163860	11988	404241	9313407	586080	384943	14112	5778178	509522	145183	16731425	17135666
Not Known	-	-	-	-	27149	26544	218430	-	-	43542	16392	332057	332057
Low	-	-	-	-	-	3790	9680	1710348	445660	1000003	-	3169481	3169481
Unclassified	-	-	-	-	-	155520	155520	3485	15751	25000	-	355276	355276
By States													
Chhattisgarh	-	-	-	-	65889	153132	9288	185485	5573	126088	-	545455	545455
Gujarat	-	-	-	-	8630000	-	-	-	5723360	1920	-	14355280	14355280
Maharashtra	222282	163860	-	386142	-	-	-	-	-	100000	-	100000	486142
Rajasthan	6111	-	11988	18099	644667	618802	759285	1542460	510656	1350059	161575	5587504	5605603

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

PRODUCTION & STOCKS

The production of fluorite (graded) at 1,052 tonnes in 2020-21 decreased substantially by 20% as compared to the previous year.

There was only one reporting mine in both the years 2020-21 as well as in 2019-20. The entire output was reported from one Public Sector mine which is located in district Chandrapur of Maharashtra owned by Maharashtra State Mining Corporation Ltd. (Fig-1). The mine-head closing stocks of fluorite (graded) was 97,818 tonnes in 2020-21 as against 97,749 tonnes in 2019-20 (Tables-2 to 5).

The average daily labour employed in fluorite mines in 2020-21 was 44 which was same in the previous year.

The domestic price of fluorite is furnished in the General Review on 'Prices'.

Table-2: Producer of Fluorite 2020-21

Name & address of producers	Location of mine	
	State	District
Maharashtra State Mining Corporation Ltd, Plot No. 7, Ajni Square, Wardha Road, Nagpur-440 015, Maharashtra.	Maharashtra	Chandrapur

Table-3: Production of Fluorite (Graded), 2018-19 to 2020-21

(By States)

(Quantity in tonnes; Value in ₹'000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	1079	8117	1315	8844	1052	7897
Maharashtra	1079	8117	1315	8844	1052	7897

Table-4: Production of Fluorite 2019-20 & 2020-21

(By Sector/States/Districts)

(Quantity in tonnes; Value in ₹'000)

State/District	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	1	1315	8844	1	1052	7897
Public Sector	1	1315	8844	1	1052	7897
Maharashtra	1	1315	8844	1	1052	7897
Chandrapur	1	1315	8844	1	1052	7897

Fig 1: Production of Fluorite in India

Table-5: Mine-head Closing Stocks of Fluorite, 2019-20 & 2020-21

(By States)

(In tonnes)

State	2019-20	2020-21 (P)
India	97749	97818
Gujarat	84371	84372
Maharashtra	13378	13446

MINING

Maharashtra State Mining Corporation (MSMC) operates Dongargaon fluorite mines in District Chandrapur, Maharashtra. Mining is carried out by semi-mechanised opencast method. The run-of-mine is hand sorted for marketing of fluorite (graded).

BENEFICIATION

Fluorspar is beneficiated by hand sorting followed by gravity concentration methods, such as, heavy media, jigs and tables in order to separate calcite and silicate mineral impurities. Low-grade fluorite produced is used after beneficiation in the industries. GMDC has a beneficiation plant of 500 tpd capacity located at Kadipani to produce Acid grade (96% CaF_2) and Metallurgical grade (90% CaF_2) fluorite by upgrading the low-grade fluorspar ore from 23–25% CaF_2 by flotation method. Besides, it has facility to produce MFC & MET grade powder analysing 75 to 85% CaF_2 & 85 to 92.5% CaF_2, respectively and other products, such as, starch briquettes (81% CaF_2 min.) and silicate briquettes (79% CaF_2min.). As per annual report of GMDC 2020-21, the Government of Gujarat has accorded approval for setting up beneficiation plant of 40,000 MTPA capacity at Kadipani, district Vadodara, in joint venture with Gujarat Fluoro Chemicals Ltd, Noida and Navin Fluorine International, Mumbai. Based on pilot test report, Global tender will be floated for selection of EPC contract. Valuation report for Kadipani assets has been received, on which basis, land will be leased to JV Company and asset transfer will be carried out in favour of JV Company.

CONSUMPTION

The apparent consumption of fluorite was about 3,24,704 tonnes in 2019-20, as against the 2,64,752 tonnes in 2018-19.

SPECIFICATIONS

BIS has prescribed IS: 8587-1993 (First Revision, reaffirmed 2011) for Acid grade fluorite for use in Chemical industries, and IS: 4574-1989 (Second Revision, reaffirmed 2008) for fluorite in Metallurgical industries.

USES

Acid grade fluorite is used as a feedstock in the manufacture of hydrofluoric acid (HF) and to produce aluminium fluoride (AlF_3). The major use of HF is for the production of a wide range of fluorocarbon chemicals, including hydrofluorocarbons (HFCs) hydrochlorofluorocarbons (HCFCs), and fluoropolymers. But, owing to environmental concerns, part of chlorofluorocarbons (CFCs) are replaced by HCFCs. HF is used in the manufacture of uranium tetrafluoride, an important ingredient used for producing nuclear fuel and fission explosives. It is also used in stainless pickling, petroleum alkylation, glass etching, oil & gas well treatment and as etcher/cleaner in Electronic Industry.

HF is used in the manufacture of a host of fluorine chemicals used in dielectrics, metallurgy, wood preservatives, herbicides, mouthwashes, decay-preventing dentifrices, plastics and water fluoridation. AlF_3 manufactured from Acid grade fluorite is used as a flux in electrolytic recovery of aluminium. On an average, worldwide consumption of fluorides is about 21 kg for every tonne of aluminium produced. This ranged from 10 to 12 kg per tonne in a modern pre-baked aluminium smelter and about 40 kg in an old Soderberg smelter without scrubber.

Ceramic grade fluorite containing 85 to 95% CaF_2 is used in Ceramic Industry as a flux and as an opacifier in the production of flat glass, white or opal glass and enamels. The addition of 10–30% Ceramic grade fluorspar to glass makes it opaque, white and opalescent. It is also used in the manufacture of magnesium, some manganese chemicals and welding rod coating.

Metallurgical grade fluorite is used primarily as fluxing agent by Steel Industry. It is added to slag to make it more reactive through increased fluidity. Fluorite of different grades is used in the manufacture of aluminium, cement and glass fibres. It is also used in the melt shop by Foundry Industry.

INDUSTRY

Many fluorine-based chemicals like hydrofluoric acid, aluminium fluoride, cryolite, sodium silicofluoride and hydrofluorosilicic acid are produced by Chemical and Fertilizer industries in the country.

In addition to material produced indigenously, substantial quantity of high- grade fluorite was also imported to meet the demand of the fluorine-based Chemical Industries.

The Tanfac Industries Ltd is a Joint Sector Company of Tami Nadu Industrial Development Corporation (TIDCO) and Aditya Birla Group at Cuddalore, Tamil Nadu. It is engaged in the manufacture of fluorine chemicals, such as, aluminium fluoride, anhydrous hydrofluoric acid, sodium silicofluoride, ammonium bifluoride, potassium fluoride, and various other fluorine-based chemicals. The Company has an annual installed capacity of 15,600 tonnes each of aluminium fluoride and anhydrous hydrogen fluoride, 67,200 tonnes of sulphuric acid, 14,000 tonnes of hydrofluoric acid and 3,400 tonnes of speciality fluorides, Though the Company's sales performance had decreased by 10% due to reduction in sale price of sulphuric Acid, due to spurt in the volume and realization of one of its Value-Added Products (VAP), Earnings before Depreciation, Interest and Tax (EBDITA) had gone up by 25% compared to previous year.

Navin Fluorine Industries Ltd, Surat, Gujarat, has an installed capacity of about 22,000 tpy of hydrofluoric acid. The Company produces a number of fluorine chemicals, namely, hydrofluoric acid, cryolite, aluminium fluoride and various other organic and inorganic fluorine-based chemicals.

Apatite and rock phosphate containing 3 to 4% CaF2 was another useful source for recovery of fluorine. Coimbatore Pioneer Fertilizer Ltd has reported production of sodium silicofluoride in the past. Similarly, hydrofluorosilicic acid was reportedly produced by Rashtriya Chemicals & Fertilizer Ltd, Mumbai, whereas Dharamsi Morarji Chemical Co. Ltd, Ambernath, Maharashtra no longer reported production of fluorine chemicals.

Aluminium fluoride is produced by Southern Petrochemical Industries Corporation Ltd, Thoothukudi, Tamil Nadu, with an installed capacity of 2,560 tpy.

SUBSTITUTES

Olivine or dolomitic limestone can be used as substitute for fluorite in Iron & Steel industry. The by-product fluorosilicic acid from phosphoric acid production could also be used as a substitute in aluminium fluoride production.

ENVIRONMENT

Fluorine attracts environmental concern. Use of fluorine in drinking water has begun to wane. Fluorine is toxic in high concentration but beneficial in low concentration. Although fluorine has been under attack ever since its use in water in 1949, the only significant health problem with which it has been linked was 'Fluorosis', a disease that involves health defects and bone lesions. This problem is caused by concentration of fluoride that is much higher than the permissible levels in municipal water supplies. As per Indian Standards, the permissible limit of fluoride in the drinking water is 1.5 mg/l. "Defluoridisation by adsorption" is a common economical and efficient method for removal of excess fluoride from drinking water. Electrolytic precipitation based on use of aluminium salts and by electrochemical route, etc. are the other few methods used for defluoridisation.

Fluorine is at the centre of controversy over chlorofluorocarbons (CFCs), which causes depletion of atmospheric ozone layer that protects the earth from ultraviolet radiation, a major cause of skin cancer. The hydrofluorocarbon (HFC) and hydrochlorofluorocarbon (HCFC) compounds, which have been developed as an alternative to CFC, require more hydrofluoric acid than CFC and are expected to boost fluorite consumption. These greenhouse gases are being phased out in stages. It is reported that even if CFC emission is stopped, the present level of these gases may take up to ten years to reach the upper atmosphere where they could persist for a century or more.

According to United Nations Environment Programme (UNEP), an international agreement to curtail illegal trade in CFC and other ozone depleting chemicals came into effect on 10th November 1999. The agreement, which was authorised through an amendment to the Montreal Protocol in 1997, requires nations to create licensing system for international sales of ozone depleting chemicals. Further, as a part of the Montreal Protocol, 129 nations agreed on a three-year funding package to enable developing countries to continue their efforts to phase out CFC and other ozone depleting chemicals, and accordingly, the Fund's Executive Committee approved major agreements with China and India to finance the shutdown of CFC production facilities in the two countries during the next ten years.

The United Nations Environment Programme (UNEP) has prepared a Montreal Protocol Handbook that provides additional detail and explanation of the provisions. CIESIN's Thematic Guide on Ozone Depletion and Global Environmental Change presents an in-depth look at causes, human and environmental effects, and policy responses to stratospheric ozone depletion.

The use of the low global warming Potential (GWP) hydyrofluroolefins refrigerant HFO-1234 yf is suggested as a preferred replacement of HFC- 134a by both the U.S. Environmetal protection Agency and the EU. Daimler in Europe has opted for CO_2 based air conditioning refrigerant in its 2017 Mercedes E and S class cars.

WORLD REVIEW

The world total reserves of fluorite fluorspar were at 320 million tonnes.World reserves are concentrated mainly in Mexico (21%), China & South Africa (13% each), Mongolia (7%) and Spain (3%) (Table- 6).

World production of fluorite in 2020 decreased marginally by 3% to 6.50 million tonnes as compared to 6.70 million tonnes in the previous year (Table-7).

China (66%), Mexico (14%), South Africa (5%) Spain & Vietnam (3% each) and Mongolia (2%) were the principal producing countries of fluorite in 2020.

To provide generalised view of the development in various countries, the countrywise description as sourced from the latest available publication of Minerals Yearbook 'USGS 2017' is furnished below :

Canada

Canada Fluorspar Inc. (CFI)(St.Lawrence, Newfoundland and Labrador) continued development of its project in Newfoundland and Labrador Burin Peninsula. CFI's resources totalled 8.8 million tonnes of fluorspar from four vein deposits, including the AGS, Blue Beach North, Director and Tarefare veins, which together had an average grade of 39% CaF_2. The mine officially opened in August, and construction continued on the 2,00,000-metric-ton-per-year flotation mill. Ore from three open pits would be stockpiled until the mill is commissioned. First production of acid-grade concentrate was expected in early 2018.

Morocco

Groupe Managem (Casablanca) reported acid-grade concentrate production of 56,395 tonnes from the El Hammam Mine operated by Samine, a 15% decrease from that of 2016. In response to the decrease in Acid-grade concentrate production, the Company increased production of Metallurgical-grade fluorspar for use in the cement market by more than five times that of 2016.

South Africa

In July, 2016, SepFluor Ltd began construction on the Nokeng Mine and milling project in Rust de Winter, Gauteng Province. Nokeng is located in the Bushveld Complex directly south of the Minersa Group's Vergenoeg Mine, the country's only operational fluorspar mine. Open pits would be developed at two of three fluorspar-haematite deposits that make up the Nokeng Mine—the Outwash Fan, which has an average ore grade of 22.7% CaF_2, and Plattekop, which has an average ore grade of 38.2% CaF_2. A processing plant with a capacity of 1,80,000 tonnes/year of Acid-grade fluorspar and 30,000 tonnes/year of Metallurgical-grade fluorspar was designed to accommodate different types of ore. The estimated life of the mine was 19 years, and first production was expected in early 2019.

Vietnam

Nui Phao Mining Co. Ltd produced Acid-grade fluorspar as well as bismuth, copper, and tungsten concentrates from its Nui Phao polymetallic mine in Thai Nguyen Province in northern Vietnam. The Company had reported increased production of fluorspar each year since the mine went into operation in 2014. The production increases were attributed to the implementation of successive capital upgrades to increase ore throughput and enhance recovery rates, particularly in the tungsten and fluorspar processing circuits. Mill recovery rates of fluorspar increased to 57% in 2017 from 49% in 2016, which resulted in an 8% increase in fluorspar production.

Table-6: World Reserves of Fluorspar Fluorite

(By Principal Countries)

(In 000' tonnes)

Country	Reserves
World: Total (rounded)	3,20,000
Burma	NA
Canada	NA
China	42,000
Germany	NA
Iran	3,400
Mexico	68,000
Kazakhstan	NA
Mongolia	22,000
Morocco	210
Pakistan	NA
South Africa	41,000
Spain	10,000
USA	4,000
Vietnam	5000
Other countries	1,20,000

Source: USGS, Mineral Commodity Summaries,2022

Table-7: World Production of Fluorite

(By Principal Countries)

(In tonnes)

Country	2018	2019	2020
World Total	6400000	6700000	6500000
China*	4000000	4300000	4300000
Mexico	1182058	1231465	914597
South Africa*	242000	210000	320000
Vietnam	238702	238003	219920
Mongolia	101200	156100	127300
Spain	176188	145185	185958
Morocco	87874	73240	70000*
Iran[c]	89102	49705	50000
Kazakhstan	100000*	87800	88000*
Other countries	142923	171129	184488

Source : BGS, World Mineral Production, 2016-20

*) Estimated

c) Year ended 20 March following that stated

FOREIGN TRADE

Exports

Exports of fluorite decreased by 63% to 474 tonnes in 2020-21 from 1,368 tonnes in the previous year. Exports were mainly to Indonesia (53%), Philippines & Oman (9% each), Jordan (6%), Brazil, Qatar & Bangladesh (4% each) and UAE (3%) (Fig-2). While, exports of aluminium fluoride increased by 50% to 2,045 tonnes in 2020-21 as compared to 1,362 tonnes in the previous year. Exports were mainly to UAE (88%), Japan (6%) and Turkey (5%). Exports of hydrofluoric acid decreased by 22% to 1,931tonnes in 2020-21 as compared to 2,474 tonnes in the preceding year (Tables- 8 to 10).

Table-8: Exports of Fluorite
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1368**	**51562**	**474**	**22436**
Indonesia	466	24719	249	13604
Philippines	44	2155	44	2297
Brazil	47	3334	17	1218
Qatar	25	1173	21	1099
Jordan	16	676	28	1069
UAE	++	25	14	621
Bangladesh	47	1237	20	570
Oman	-	-	44	488
Israel	-	-	10	478
Togo	-	-	6	255
Other countries	723	18243	21	737

Figures rounded off.

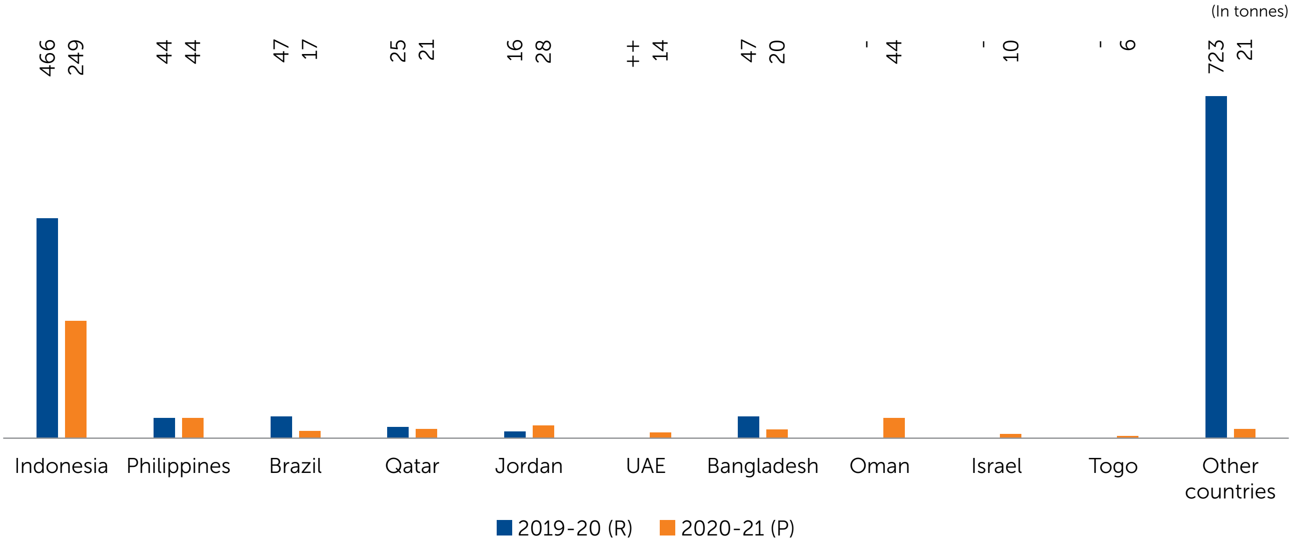


Fig 2: Countrywise Export of Fluorite

Table-9: Exports of Aluminium Fluoride
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1362**	**120976**	**2045**	**187158**
UAE	1100	101073	1800	170576
Japan	140	14362	120	13790
South Africa	122	5481	24	1277
Turkey	-	-	100	1245
UK	-	-	1	135
Belgium	-	-	++	120
Germany	++	9	++	9
Kuwait	-	-	++	6
Bhutan	-	-	++	++
Singapore	++	33	-	-
Other countries	++	18	-	-

Figures rounded off.

Table-10: Exports of Hydrofluoric Acid
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2474	237996	1931	164258
Thailand	650	74802	489	56720
USA	357	33221	544	36901
Saudi Arabia	269	30388	202	22211
Turkey	280	15783	348	18792
Singapore	90	19004	36	7998
Japan	55	5204	87	6720
Australia	143	7720	91	4186
Korea, Rep. of	-	-	16	1981
Spain	17	1302	23	1918
Indonesia	-	-	18	1554
Other countries	613	50572	77	5277

Figures rounded off.

Imports

Imports of fluorite decreased marginally by 8% to 2.21 lakh tonnes in 2020-21 as compared to 2.40 lakh tonnes in the previous year. Imports were mainly from South Africa (64%), Thailand (12%),Vietnam (8%),and China (6%). Imports of aluminium fluoride however, increased substantially by 52% to 61,225 tonnes in 2020-21 from 40,362 tonnes in the previous year. Imports were mainly from China (37%), Italy (22%), Qatar (12%), Mexico (11%) and UAE (9%). While imports of hydrofluoric acid more than doubled to 2,095 tonnes in 2020-21 from 969 tonnes in the preceding year. Imports were mainly from China (48%), Sri lanka (23%) and Germany (20%) (Tables- 11 to 13).

Table-11: Imports of Fluorite
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	239589	7225937	220573	6090596
South Africa	89467	2700348	141117	3858569
Thailand	35719	1132821	27492	696512
Vietnam	7989	224040	16980	540087
China	82424	2482331	14089	433550
Canada	72	2461	4015	119504
Hong Kong	2176	58172	3680	102833
Morocco	9612	329740	3127	94265
UAE	4041	89781	3534	74254
Spain	2106	42152	1778	45304
Netherlands	3279	97955	1100	33761
Other countries	2704	66136	3661	91957

Figures rounded off.

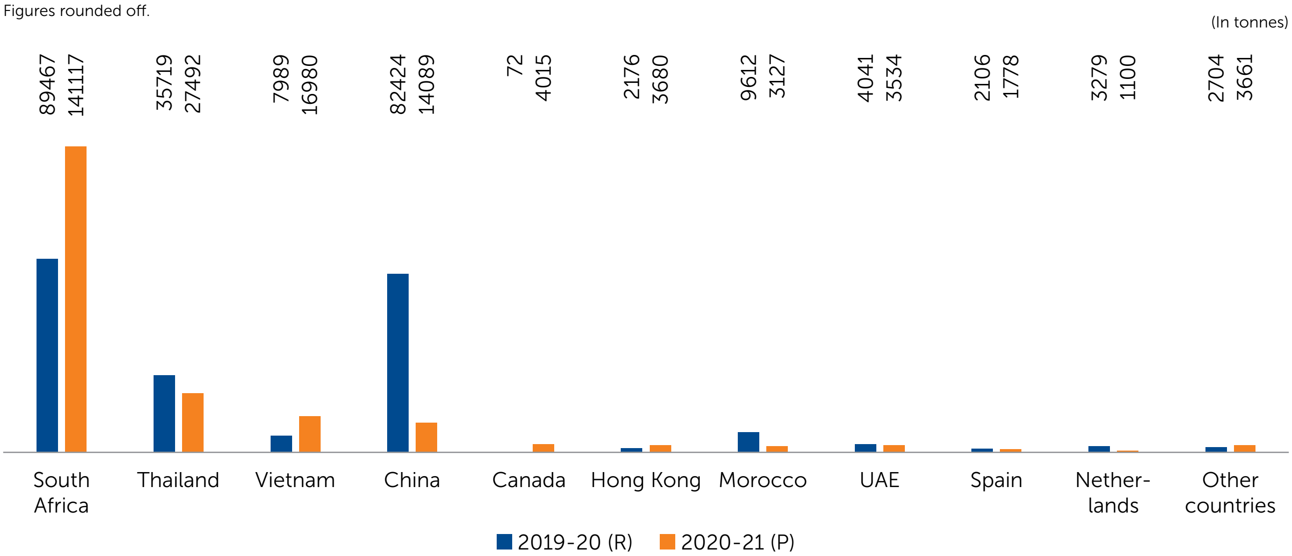


Fig 3: Countrywise Import of Fluorite

Table-12: Imports of Hydrofluoric Acid
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	969	89459	2095	177923
China	616	59287	1016	86508
Germany	76	7328	424	40235
Sri Lanka	-	-	487	38386
Taiwan	276	20971	167	12173
USA	++	179	++	307
Spain	++	18	++	134
Japan	1	1069	1	102
Belgium	++	96	++	78
Swedan	++	438	-	-
UK	++	65	-	-
Other countries	++	8	-	-

Figures rounded off.

Table-13: Imports of Aluminium Fluoride
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	40362	3791019	61225	4805867
China	19842	1930671	22846	2014359
Italy	5832	559817	13284	1156118
Mexico	2500	306144	7000	576887
UAE	-	-	5324	494244
Hong Kong	-	-	2484	245723
Indonesia	4320	377171	1140	103653
Qatar	221	2798	7496	94853
Jordan	6015	449707	1020	74328
Lithuania	-	-	600	42817
Sri Lanka	-	-	23	2220
Other countries	1632	164711	8	665

Figures rounded off.

FUTURE OUTLOOK

The major driving factors for fluorite market are the growing Chemical Industry and increasing use of fluorite in Cement, Iron & Steel, Glass Industries. The Chemical Industry and Glass Industry account for the major share of the fluorite demand globally. As per TANFAC Annual Report 2020-21,Global Fluorochemical market is estimated around 5 million tonnes in 2020 (US$ 20 billion) and expected to grow at a CAGR of 3.5% and reach USD 26 billion by 2026. Asia Pacific accounted for significant share of the global market and expected to reach USD 4 billion by 2026. The growing industrialisation in emerging economies like China, India and South East Asian countries will continue to increase demand for refrigerants. The rapidly growing demand of air-conditioning and refrigeration systems in the domestic and industrial sectors is expected to drive the growth for fluorochemicals.

Due to pandemic, the demand for fluorochemical in health care sectors have increased during the year and with significant spend in R&D, it is expected use of fluorine compound in the manufacture of pharma products will increase in future. Added to this the growing preference for electric vehicles will also drive the demand for fluorochemicals. However, the industry will face challenges like increased regulatory restrictions from the Governments, environment scrutiny due to growing environment concerns, etc., China is one of the largest Fluorine producing and consuming countries in the world and the market size is expected to grow to USD 5 billion by 2026. Auto industry is expected to make a strong comeback Worldwide with the impending launch of electric vehicles which will strengthen demand of fluorochemicals in the production of aluminium and electric components.

Indian Chemical industry, 6th largest in the world, is expected to contribute around 7% to India's GDP. Specialty chemicals alone constitutes 45% of the Indian Chemical Market and expected to grow at CAGR 10% till 2025 from the current level of USD 30 billion.

In India, the market growth of fluorochemicals is driven by downstream sectors like Automobile, Air Conditioning, Refrigeration, Construction, Cold Storage and Pharma / Life Science segments. Life Science segment has emerged one of the key drivers over the years. India is expected to become 4th largest chemical producer in the world by 2030,benefitting from rising export opportunities, stability of prices, faster end user industry growth and low penetration of specialty chemicals.

As per USGS report, improvements in steel making technology have also reduced the unit consumption of fluorite per unit tonnes of steel produced. In less developed countries, the quantity of fluorite used as a flux in steel making continues to be much higher, but further efficiency improvements are expected to moderate growth.

As on 01.04.2020, the resources of fluorite in India are20.99 million tonnes which is considered to be limited. Hence, to meet the requirements, the domestic Chemical Industry will have to depend, both qualitatively and quantitatively, on imported fluorite in the coming years, both for direct use and for blending with the domestic Acid grade fluorite.

13. Garnet

8.60

(million tonnes) Total reserves of garnet (including proved and probable categories) were estimated as on 1st April 2020

9,307

(tonnes) Production of garnet (abrasive) were reported in 2020-21

76,799

(tonnes) of abrasive garnet were exported in 2020-21

345

(tonnes) of abrasive garnet were imported in 2020-21

Garnet is the collective name for a group of minerals which crystalise in cubic system with different chemical composition. The principal members of the Garnet group are Almandine (Fe-Al), Pyrope (Mg-Al), Spessartine (Mn-Al), Grossularite (Ca-Al), Andradite (Ca-Fe) and Uvarovite (Ca-Cr). Almandine is hardest amongst all varieties and is often used for abrasive purpose. Garnet is dense & hard with sharp angular chisel-edged fracture, containing small amounts of free silica and exhibits high resistance to physical and chemical attacks. It is used both as semi-precious stone and as an abrasive. The hardness of garnet varies from 6.5 to 7.5 on Mohs scale. This allows it to be used as an effective abrasive.

RESERVES/RESOURCES

In India, garnet deposits suitable for use in Abrasive Industry occur in Andhra Pradesh, Chhattisgarh, Jharkhand, Kerala, Odisha, Rajasthan, Tamil Nadu and Telangana. Gem variety of garnet occurs in Ajmer, Bhilwara, Jhunjhunu, Sikar and Tonk districts, Rajasthan; Nellore and Srikakulam districts, Andhra Pradesh; Khammam district, Telangana and Coimbatore, Ramanathapuram, Tirunelveli, Kanyakumari, Tiruchirappalli and Tiruvarur districts, Tamil Nadu. Garnet is found to occur in beach sands along with ilmenite, rutile, sillimanite, etc. in the States of Kerala, Odisha and Tamil Nadu.

The total reserves/resources of garnet in India as on 1.4.2020, as per UNFC system has been placed at 56.01 million tonnes of which Reserves under Proved and Probable categories together constituted 8.60 million tonnes. Of the total resources, about 20.87 million tonnes are of Abrasive grade, whereas resources of Semi-precious grade are mere 8,468 tonnes. Tamil Nadu alone accounted for about 46% of the total resources followed by Andhra Pradesh (31%), Odisha (17%) and Telangana (3%). The remaining States together shared less than 3% (Table- 1).

Table-1: Reserves/Resources of Garnet as on 1.4.2020 (P)
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	8539521	50946	5	8590472	1835546	1624128	4622014	138905	10226601	28066885	902574	47416654	56007126
By Grades													
Gem	-	-	1	1	5847	16279	23919	0	0	110	4	46158	46160
Abrasive	8486371	50920	4	8537296	1705715	1526269	4568321	102866	15602	3514907	902570	12336249	20873545
Semi-precious	612	26	-	637	2093	132	1630	39	1249	2688	-	7831	8468
Others	-	-	-	-	9051	36358	-	-	-	215573	-	260982	260982
Unclassified	52538	-	-	52538	85485	43806	394	36000	10208995	23951287	-	34325967	34378505
Not-known	-	-	-	-	27355	1284	27750	-	756	382321	-	439466	439466
By States													
Andhra Pradesh	-	-	-	-	1196087	237025	1359988	18	8800000	5674011	-	17267129	17267129
Chhattisgarh	-	-	-	-	-	-	-	-	-	28800	-	28800	28800
Jharkhand	-	-	-	-	-	-	88303	-	-	21768	-	110071	110071
Kerala	-	-	-	-	-	-	45797	100874	-	52190	-	198861	198861
Odisha	8330045	-	1	8330046	5	-	1	-	-	348001	-	1177318	9507364
Rajasthan	156938	50946	4	207888	310712	191094	33115	2013	17606	215120	73263	842923	1050811
Tamil Nadu	52538	-	-	52538	266555	1153976	3094811	36000	1408995	19871019	-	25831356	25883894
Telangana	-	-	-		62187	42033	-	-	-	1855976	-	1960196	1960196

Figures rounded off.

EXPLORATION & DEVELOPMENT

The details about the exploration and development, if any, are covered in the Review on "Exploration and Development" under "General Reviews".

PRODUCTION AND STOCKS

Garnet (Abrasive)

Production of garnet (abrasive) is at 9,307 tonnes during 2020-21 compared to 568 tonnes in the preceeding year. Similarly, there were only 6 reporting mines during 2020-21 as against 7 mines reported in the year 2019-20. Only four principal producer accounted for about 100 % of the total production during the year.

Unlike previous year the share of Public Sector in the total output was nil in 2020-21 as same in the previous year. Similarly, the share of Private Sector in the total output was cent per cent in 2020-21 as same in the preceding year.

In 2020-21, unlike that of previous year, production was reported only from the State of Rajasthan, i.e.,three principal producers from Rajasthan accounted for about cent per cent of the total output during the current year (Tables-2 to 4) (Fig-1).

Table-2: Principal Producers of Garnet (Abrasive), 2020-21

Name & address of producers	Location of mine	
	State	District
AKD Gem Garnet Mines, F-203, Near Mahapragya Circle, Azad Nagar,Bhilwara - 311 001, Rajasthan.	Rajasthan	Bhilwara
Arun Bagdiya,C/o,Shri Ramdev Bagdiya Resi No.110,Kendriya Vihar Sector-8,Bidyadhar Nagar, Jaipur-302039, Rajasthan.	Rajasthan	Ajmer
Ummed Singh Ranawat, Vill- Basda,P.O.Gondali Bhilwara-311001,Rajasthan.	Rajasthan	Bhilwara

*Producing as an associated mineral with sillimanite.

Table-3: Production of Garnet (Abrasive) 2018-19 to 2020-21

(By States)

(Quantity in tonnes; Value in ₹'000)

Country	2018-19		2019-20		2020-21	
	Quantity	Value	Quantity	Value	Quantity	Value
India	123404	1746756	568	1775	9307	33585
Andhra Pradesh	72521	1068152	-	-	-	-
Odisha	38376	545745	-	-	-	-
Rajasthan	5166	23662	568	1775	9307	33585
Tamil Nadu	7341	109197	-	-	-	-

(In tonnes)

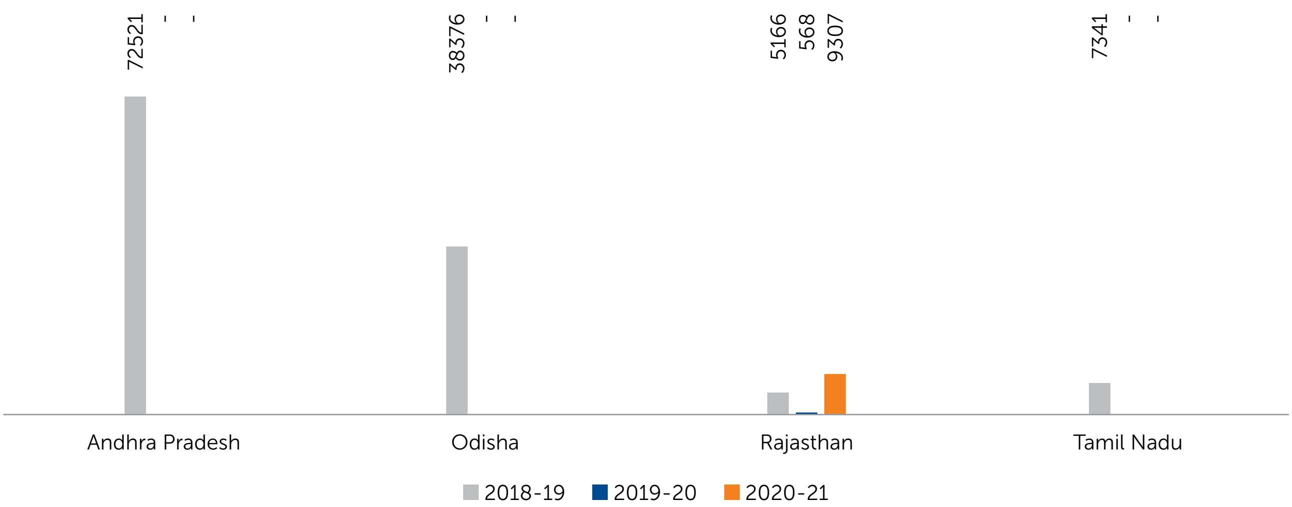


Fig 1: Production of Garnet (Abrasive) (In tonnes) in India

Table-4: Production of Garnet (Abrasive), 2019-20 & 2020-21

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

Country	2019-20 (R)			2020-21 (P)		
	No. of mines	Qty (t)	Value (₹'000)	No. of mines	Qty (t)	Value (₹'000)
India	7	568	1775	6	9307	33585
Public sector	-	-	-	-	-	-
Private sector	7	568	1775	6	9307	33585
Rajasthan	5	568	1775	4	9307	33585
Ajmer	2	-	-	1	4560	15062
Bhilwara	2	553	1670	2	4741	18494
Tonk	1	15	105	1	6	29
Tamil Nadu	2	-	-	2	-	-
Tiruchirapalli	2	-	-	2	-	-

Note-The main reason for decrease in number of mines is classification of some Garnet producing mines, such as BSM mines in Andhra Pradesh, Odisha and Tamil Nadu. Earlier, these mines were considered under Garnet (Abrasive) as a part of MCDR mineral as there was no seperate classification of Beach Sand Minerals (BSM) and Non-Beach Sand Minerals (Non-BSM).

Mine-head closing stocks of garnet (abrasive) for the year 2020-21 were 3,832 tonnes as against 45,947 tonnes in the previous year (Table -5). The average daily employment of labour during 2020-21 was 51 as against 39 in the previous year.

Table-5: Mine-head Closing Stocks of

Garnet (Abrasive) 2019-20 & 2020-21

(By States)

(In tonnes)

State	2019-20	2020-21 (P)
India	45947	3832
Andhra Pradesh	326	326
Odisha	-	-
Rajasthan	3424	2864
Tamil Nadu	42197	642

Garnet (Gem)

No production of garnet (gem) was reported since 2018-19.

USES & CONSUMPTION

The most important industrial use of garnet in the form of garnet sand is as an abrasive. About 90% production of abrasive garnet is used for manufacturing of garnet-coated papers, clothes and discs. Garnet-coated abrasives are used in the form of belts, covers for drums, discs or as small sheets. It is used for cleaning spark plugs, paints, polishing and grinding of plate-glass. The remaining 10% output is used in the form of loose grains for surfacing and polishing soft stones (marble, slate, soapstone, etc.). Clear, flawless and rich-coloured crystals of garnet are used as semi-precious stones. The principal variety among them are pyrope, deep-crimson almandine, orange-yellow grossularite, etc. Other uses are in Electronic and Television Industry for polishing glass and TV tubes. Garnet granules are used in 'abrasive blasting'commonly called 'sand blasting'in order to smoothen, clean and remove oxidation products from metals, stone and other material. MMTC's specifications of garnet sand used for sand blasting/jet cutting/other uses for exports to USA, Europe, Middle East and Taiwan are as follows: Al_2O_3: 20.8 to 21.2%, Bulk density; 2.17 kg/m^3, Hardness in Mohs scale should be 7.5 to 8.

Water jet cutting machines generally use finely-ground 80-120 mesh size garnet as cutting medium with high pressure water. Owing to its inertness to a wide range of chemicals and relatively high specific gravity, it is used as filter medium for water and other liquids.

SUBTITUTES

Other natural and manufactured abrasives can substitute to some extent for all major end uses of garnet. In many cases, however, using the substitutes would entail sacrifices in quality or cost. Fused aluminum oxide and staurolite compete with garnet as a sandblasting material. Ilmenite, magnetite and plastics compete as filtration media. Corundum, diamond and fused aluminum oxide compete for lens grinding and for many lapping operations. Emery is a substitute in nonskid surfaces. Fused aluminum oxide, quartz sand and silicon carbide compete for the finishing of plastics, wood furniture and other products.

WORLD REVIEW

Garnet group of minerals are found throughout the world in metamorphic, igneous and sedimentary rocks.

World resources of garnet are large and occur in a wide variety of rocks, particularly, gneisses and schists. Garnet also occurs in contact-metamorphic deposits in crystalline limestones, pegmatites, serpentinites and in vein deposits. In addition, alluvial garnet is present in many heavy-mineral sand and gravel deposits throughout the world. Large domestic resources of garnet also are concentrated in coarsely-crystalline gneiss near North Creek, NY; other significant domestic resources of garnet occur in Idaho, Maine, Montana, New Hampshire, North Carolina, and Oregon. In addition to those in the United States, major garnet deposits exist in Australia, Canada, China, India and South Africa, where they are mined for foreign and domestic markets; deposits in Russia and Turkey also have been mined in recent years, primarily for internal markets.

Additional garnet resources are in Chile, Czechia, Pakistan, Spain, Thailand and Ukraine; small mining operations have been reported in most of these countries.

In 2021, Australia produced about 33% of total global production of garnet (Industrial), followed by China (28%), South Africa (13%), India (12%), USA (7%) and the remaining 5 % was contributed by other countries. Russia and Turkey are also mining garnet for domestic markets. Garnet is also mined in Canada, Chile, Czech Republic, Pakistan, South Africa, Spain, Thailand and Ukraine.

Worldwide the end uses of garnet and market shares are: abrasive blasting media 30%, abrasive grains for water jet cutting 35%, water filtration 20%, abrasive powder 10% and other end uses 5 per cent.

The world reserves/resources and production of industrial garnet are furnished in Tables- 6 and 7.

Table-6: World Reserves of Garnet (Industrial)

(By Principal Countries)

(In 000' tonnes)

Country	Reserves
World: Total (rounded)	Moderate to Large
Australia	Moderate to large
China	Moderate to large
India*	13000
South Africa	NA
USA	5000
Other countries	6500

Source:USGS Mineral Commodity Summaries, 2022

* In India as per NMI data based on UNFC system the total reserves/resources of garnet as on 1.4.2020 are estimated at 56.01 million tonnes.

Table-7: World Production of Garnet (Industrial)

(By Principal Countries)

(In tonnes)

Country	2019	2020	2021
World:Total (rounded)	1120000	1100000	1100000
Australia	352000	360000	360000
China	310000	310000	310000
South Africa	179000	140000	140000
India*	120000	130000	130000
USA	104000	101000	75000
Other countries	60000	60000	60000

Source: USGS, Mineral Commodity Summaries 2022,

Note : Figures are rounded off

* India's production of garnet (abrasive) during 2018-19, 2019-20 and 2020-21 was at 123 thousand tonnes, 568 tonnes and 9,307 tonnes, respectively.

FOREIGN TRADE

Exports

In 2020-21, exports of abrasive garnet increased drastically by 3% to 76,799 tonnes from 74,697 tonnes in the previous year. Exports were mainly to USA (26%), UAE (12%), Malaysia & Saudi Arabia (9% each) and Italy (7%) (Fig-2). Exports in terms of value in respect of cut & uncut garnet variety decreased drastically by 23% to 28.08 crore in 2020-21 from 36.69 crore in the previous year. In terms of value, exports were mainly to Thailand (28%), Hong Kong (25%), USA (17%), Japan (5%) and UAE (4%) (Fig-3).

Out of the total exports in terms of value of cut & uncut garnet in 2020-21, cut variety of garnet accounted for 93 % share and the remaining 7 % was contributed by the uncut garnet. In terms of value Exports of cut variety were mainly to Thailand (29%), Hong Kong (21%), USA (18%), Japan (5%) & UK (7%). Similarly, exports of uncut garnet were mainly to Hong Kong (68%),Thailand (21%),China (6%) USA (3%) and the remaining 2% share was contributed by the other countries (Tables- 8 to 11).

Table-8: Exports of Garnet (Abrasive)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	74697	1254539	76799	1265586
USA	42965	712791	19989	308885
UAE	8344	155561	9184	157482
Saudi Arabia	3696	67251	6540	116809
Malaysia	5692	84781	7057	113156
Italy	2100	34965	5208	91648
Canada	2718	43360	3325	57665
Kuwait	2156	36960	3472	53941
Qatar	448	8262	2986	52016
Oman	1232	23534	2688	46263
Egypt	280	4597	2352	38622
Other countries	5066	82477	13998	229099

Figures rounded off.

(In tonnes)

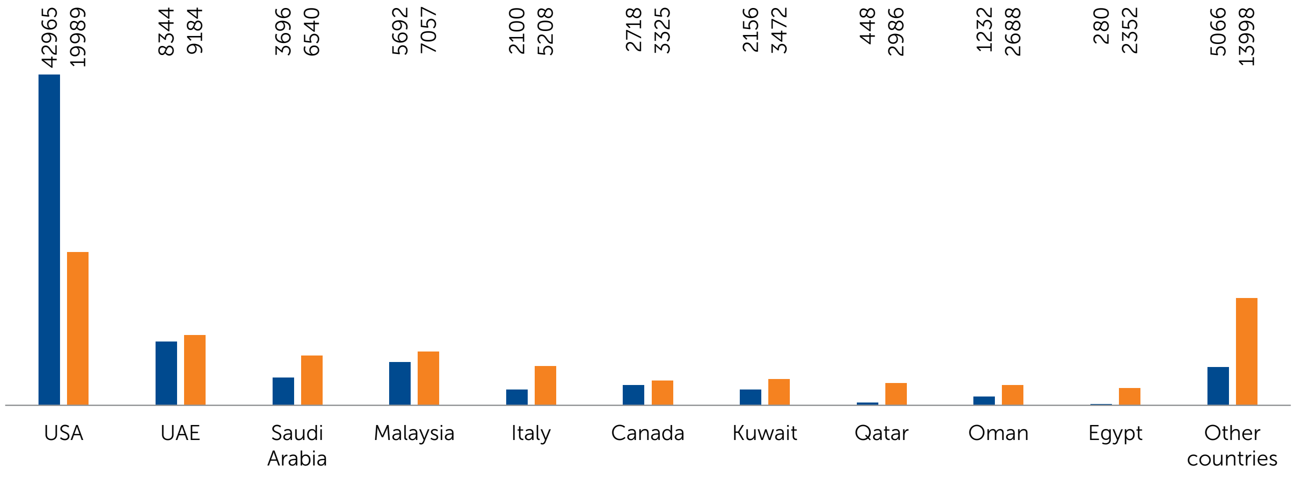


Fig 2: Country-wise Exports of Garnet (Abrasive)

Table-9: Exports of Garnet (Cut & Uncut)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**	366806	**	280824
Thailand	**	116128	**	79120
Hong Kong	**	114741	**	69715
USA	**	63982	**	47384
UK	**	8603	**	18439
Japan	**	15624	**	13710
UAE	**	9008	**	10032
Armenia	**	5450	**	7682
Germany	**	6215	**	6396
Sri Lanka	**	1551	**	4267
Italy	**	7580	**	4082
Other countries	**	17924	**	19997

Note : ** - Not additive. The total may not tally.
Figures rounded off.

(In ₹'000)

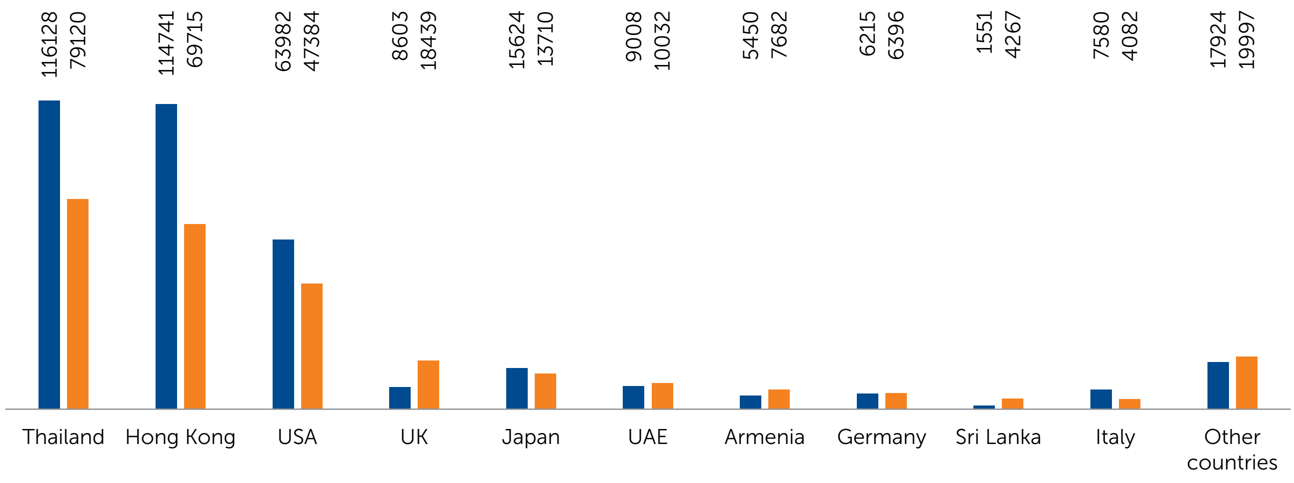


Fig 3: Country-wise Value of Exports of Garnet (Cut & Uncut)

Table-10: Exports of Garnet (Cut)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 crt)	Value (₹'000)	Qty ('000 crt)	Value (₹'000)
All Countries	42177	333070	76049	260630
Thailand	4095	112291	1473	74972
Hong Kong	2236	90241	1502	55990
USA	11499	60578	2398	46737
UK	473	8340	1647	18157
Japan	291	15624	350	13673
UAE	224	9008	173	10032
Armenia	113	5450	109	7682
Germany	693	5447	277	6396
Sri Lanka	1	1551	++	4263
Italy	170	7580	104	4082
Other countries	22382	16960	68016	18646

Figures rounded off.

Table – 11 : Exports of Garnet (Uncut)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	134	33736	111	20194
Hong Kong	134	24500	84	13725
Thailand	++	3837	++	4148
China	++	37	27	1240
USA	++	3404	++	647
UK	++	263	++	282
Australia	-	-	++	57
France	++	160	++	49
Japan	-	-	++	37
Sri Lanka	-	-	++	4
Taiwan	-	-	++	4
Other countries	++	1535	++	1

Figures rounded off.

Imports

In 2020-21, imports of abrasive garnet decreased marginally by 12 % to 345 tonnes from 391 tonnes in the previous year. Imports were from UK (70%), UAE (30%). Imports in terms of value in respect of cut & uncut garnet variety decreased drastically by 47% to 9.73 crore in 2020-21 from 18.45 crore in the previous year. In terms of value, imports were mainly from Thailand (25%), Hong Kong (23%),USA (12%), Kenya (11%), Sri lanka (10%), Tanzania (7%) & Czech Republic (5%) (Fig-4).

Out of the total imports in terms of value of cut & uncut garnet in 2020-21, uncut variety of garnet accounted for 67% share and the remaining 33% was contributed by the cut garnet. In terms of quantity, imports of uncut variety were mainly from Mozambique (55%) and Thailand, Hong Kong, Tanzania, Zambia & Nigeria (9% each). Similarly, imports of cut garnet were mainly from Hong Kong (47%), Sri Lanka (43%), Thailand (7%) and USA (2%) (Tables-12 to 15).

Table-12: Imports of Garnet (Abrasive)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	391	6189	345	14712
UK	-	-	241	12734
UAE	391	6130	104	1978
New Zealand	++	59	-	-

Figures rounded off.

Table-13: Imports of Garnet (Cut & Uncut)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (**)	Value (₹'000)	Qty (**)	Value (₹'000)
All Countries	**	184466	**	97335
Thailand	**	52000	**	24582
Hong Kong	**	26025	**	22559
USA	**	12869	**	11447
Kenya	**	37664	**	10668
Sri Lanka	**	12119	**	9393
Tanzania	**	7138	**	6826
Czech Republic	**	342	**	4639
UK	**	50	**	1406
Zambia	**	406	**	1351
Nigeria	**	1114	**	1330
Other countries	**	34739	**	3134

Note : ** - Not additive. The total may not tally.
Figures rounded off.

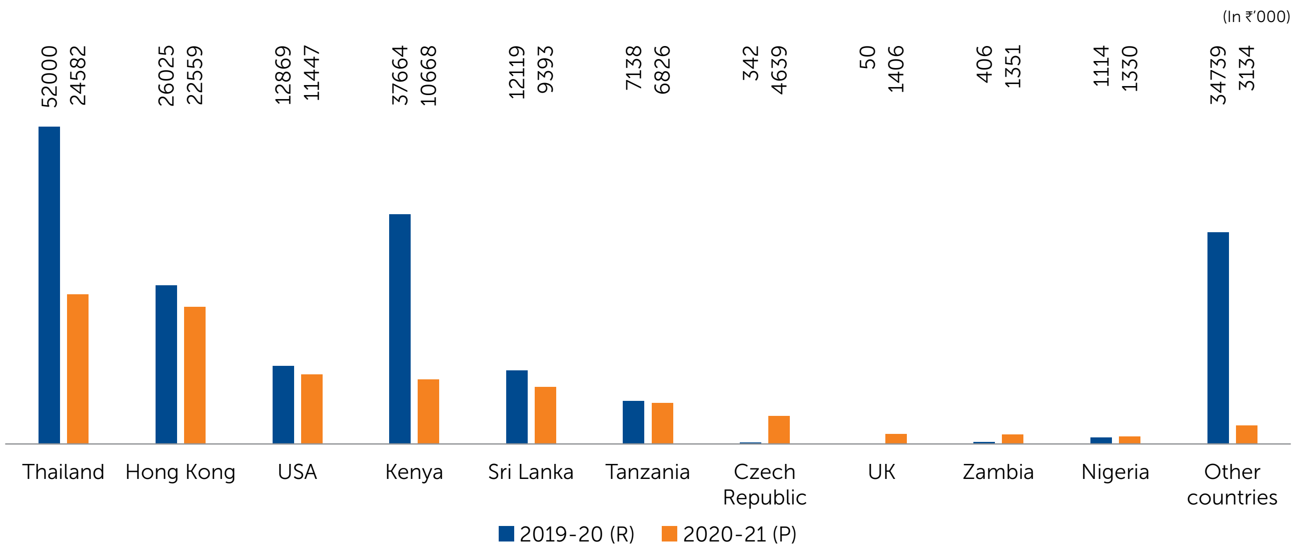


Fig 4: Country-wise Exports of Garnet (Cut & Uncut)

Table-14: Imports of Garnet (Cut)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 crt)	Value (₹'000)	Qty ('000 crt)	Value (₹'000)
All Countries	4969	55401	1437	32565
Sri Lanka	1313	12119	622	9393
Thailand	761	15419	105	7548
Hong Kong	2024	14278	669	6260
Tanzania	-	-	7	3053
USA	539	11273	22	2809
UK	++	18	4	1406
Germany	13	83	1	512
France	-	-	1	73
Canada	3	206	++	36
Vietnam	-	-	++	31
Other countries	316	2005	6	1444

Figures rounded off.

Table-15: Imports of Garnet (Uncut)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	56	129065	11	64770
Thailand	3	36581	1	17034
Hong Kong	8	11747	1	16299
Kenya	1	37664	++	10668
USA	++	1596	++	8638
Czech Republic	++	342	++	4623
Tanzania	7	7138	1	3773
Zambia	++	406	1	1351
Nigeria	++	1114	1	1330
Mozambique	11	7610	6	716
Madagascar	25	4698	++	165
Other countries	1	20169	++	173

Figures rounded off.

FUTURE OUTLOOK

Garnet has a wide range of applications, such as, in production of abrasives, sand blasting, water filtration materials, abrasive blasting media and water-jet cutting. Garnet is expected to continue replacing silica sand blasting media, owing to latter's associated occupational health risks. Moreover, garnet is safer for the environment and cheaper to dispose of after recycling. Hence, the worldwide demand for garnet is expected to increase, especially for waterjet cutting and for abrasive blasting media.

China and India are expected to steadily increase garnet production and will become significant garnet sources for other countries. The garnet market is very competitive. To increase profitability and remain competitive with imported material, production may be restricted to only high-grade garnet ores as a by-product of other saleable mineral products that occur with garnet, such as, kyanite, marble, metallic ores, mica minerals, sillimanite, staurolite or wollastonite.

14. Graphite

211.62
(million tonnes) Total reserves/resources of graphite were estimated as on 1st April 2020

30,168
(tonnes) Production of graphite were reported in 2020-21

716
(tonnes) of graphite (natural) were exported in 2020-21

40,153
(tonnes) of graphite (natural) were imported in 2020-21

Graphite, also known as plumbago or blacklead or mineral carbon, is a stable form of naturally occurring carbon. Structurally, graphite is known to crystalise in hexagonal system and occurs in layered & lamellar form with grey-to-black metallic lustre and a greasy feel. Natural graphite is categorised into two commercial varieties (i) crystalline (flaky) graphite and (ii) amorphous graphite. Both flaky and amorphous varieties of graphite are produced in India. The quality of graphite depends upon its physical qualities and carbon content. Besides natural graphite, there is synthetic or artificial graphite which is manufactured on a large-scale in electric furnaces, using anthracite or petroleum coke as raw feed.

RESERVES/RESOURCES

Graphite occurrences are reported from various States but the deposits of economic importance are located in Chhattisgarh, Jharkhand, Odisha and Tamil Nadu.

As per NMI database, based on the UNFC system, the total reserves/resources of graphite as on 1.4.2020 have been placed at about 211.62 million tonnes, out of which 8.56 million tonnes are in the Reserves category and 203.6 million tonnes are placed under Remaining Resources category. Resources containing +40% fixed carbon constitute about 2.91 million tonnes and resources analysing 10–40% fixed carbon constitute 43.98 million tonnes. The balance 164.73 million tonnes fall under Benificiable 'Others', 'Unclassified' and 'Not-known' grades. Arunachal Pradesh accounts for 36% of the total resources which is followed by Jammu & Kashmir (29%), Jharkhand (9%), Madhya Pradesh (5%), Odisha (9%), and Tamil Nadu (4%). However, in terms of reserves, Tamil Nadu has the leading share of about 36% followed by Jharkhand (30%) and Odisha (33%) of the total reserves (Table-1).

Table-1: Reserves/Resources of Graphite as on 1.4.2020 (P)
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon-naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	4386467	-	4176944	8563411	7964326	3461288	6166401	796464	10679490	31827080	142165128	203060176	211623587
By Grades													
+ 40% F.C.	1121513	-	266338	1387851	327513	39106	315485	338686	263391	243723	-	1527904	2915755
10-40% F.C.	3264954	-	3910606	7175560	6461456	3199689	3337518	408852	2810895	17699258	2891244	36808911	43984471
Benificiable	-	-	-	-	48639	-	733621	-	-	11070	-	793330	793330
Others	-	-	-	-	511778	30600	1211011	-	6526906	6767064	4106000	19153359	19153359
Unclassified	-	-	-		614940	191893	536585	9090	7253	5876995	62249569	69486325	69486325
Not-known	-	-	-	-	-	-	32181	39836	1071045	1228970	72918315	75290347	75290347
By States													
Andhra Pradesh	-	-	-	-	-	-	1135	-	1122	1136018	-	1138275	1138275
Arunachal Pradesh	-	-	-	-	-	-	-	-	-	3200000	73118257	76318257	76318257
Chhattisgarh	5282	-	-	5282	-	1330	-	-	-	-	-	1330	6612
Gujarat	-	-	-	-	-	-	-	-	2520805	835000	-	3355805	3355805
Jammu & Kashmir	-	-	-	-	-	-	-	-	-	1059520	61681035	62740555	62740555
Jharkhand	2091442	-	512637	2604079	1341224	491883	3020107	60607	5167431	6639828	681208	17402288	20006367
Karnataka	-	-	-	-	203673	30600	48821	-	41605	667933	-	992632	992632
Kerala	-	-	15443	15443	-	8376	-	-	1088550	322606	-	1419532	1434975
Madhya Pradesh	-	-	-	-	-	-	-	-	-	6254000	6386000	12640000	12640000
Maharashtra	-	-	-	-	-	-	-	-	-	1160000	-	1160000	1160000
Odisha	-	-	2838414	2838414	6371790	2889564	2927932	696021	838841	3119932	298628	17142707	19981121
Rajasthan	-	-	-	-	47600	-	165920	-	250000	1450034	-	1913554	1913554
Tamil Nadu	2289743	-	810450	3100193	39	39535	2486	29136	647500	5886390	-	6605086	9705279
Telangana	-	-	-	-	-	-	-	-	123636	95818	-	219455	219455
Uttarakhand	-	-	-	-	-	-	-	10700	-	-	-	10700	10700

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Review".

PRODUCTION & STOCKS

Production of graphite at about 30,168 tonnes in 2020-21 decreased by 13% as compared to that in the preceding year.

There were 12 reporting mines in 2020-21 same as in the previous year. Five principal producers accounted for 90% of the total production during the year.

About 59% of the total production in 2020-21 was accrued from two mines, each producing more than 5,000 tonnes annually, while 41% was contributed by five mines in the production range of 1,000 to 5,000 tonnes per annum.

Odisha was the leading producing State contributing 42% to the total output during 2020-21, followed by Tamil Nadu (Fig-1).

Mine-head closing stock in the year 2020-21 was 1,78,865 tonnes as against 1,79,191 tonnes in the previous year. The average daily employment of labour during 2020-21 was 121 against 219 in the preceding year (Tables-2 to 6).

Table-2: Principal Producers of Graphite, 2020-21

Name & address of producers	Location of mine	
	State	District
Tamil Nadu Minerals Limited, 31, Kamarajar Salaitwad House, Chepauk, Chennai-600 005, Tamil Nadu.	Tamil Nadu	Shivaganga
Pramod Kumar Agrawal, Shantikunj Farm Road Modipara, Sambalpur – 768 002, Odisha.	Odisha	Nawapara
Parijat Mining Industries (India) Pvt. Ltd, Town Hall Road, Opp. Shiavajee Maidan, Daltonganj, Palamu – 822 101, Jharkhand.	Jharkhand	Latehar
Prabhas Chandra Agrawal, Shantikunj Farm Road Modipara, Sambalpur – 768 002, Odisha.	Odisha	Nawapara
Krishna Kumar Poddar, 3P, Shree Gopal Complex, Court Road, Ranchi - 834 001, Jharkhand.	Jharkhand	Palamu

Table-3: Production of Graphite, 2018-19 to 2020-21
(By States)

(Quantity in tonnes; Value in ₹'000)

Country	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**39030**	**36233**	**34674**	**55908**	**30168**	**60054**
Chhattisgarh	-	-	908	409	1701	1765
Jharkhand	15831	17974	21202	20661	5674	5795
Odisha	23199	18259	12564	34838	12767	41633
Tamil Nadu	-	-	-	-	10026	10861

(In tonnes)

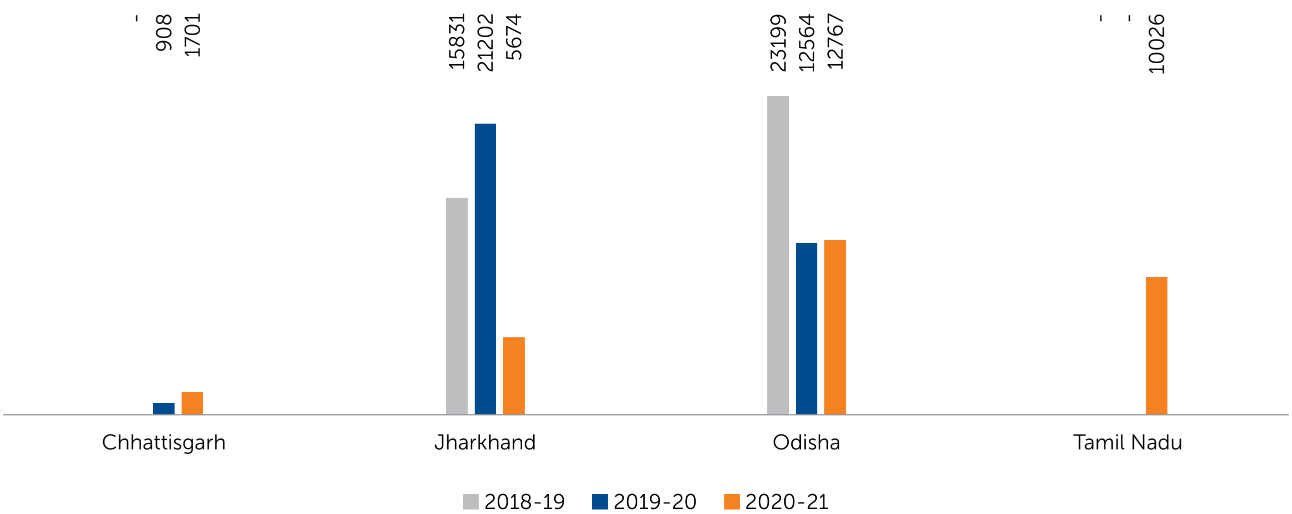


Fig 1: Production of Graphite in India

Table-4: Production of Graphite, 2019-20 and 2020-21
(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

Grade/State	2019-20						2020-21 (P)					
	No. of Mines	Grade: Fixed Carbon content			Total		No. of Mines	Grade: Fixed Carbon content			Total	
		80% or more	40% or more but less than 80%	Less than 40%	Qty.	Value		80% or more	40% or more but less than 80%	Less than 40%	Qty.	Value
India	12	615	651	33408	34674	55908	12	821	472	28875	30168	60054
Public Sector	1	-	-	-	-	-	1	-	-	10026	10026	10861
Private Sector	11	615	651	34408	34674	55908	11	821	472	18849	20142	49193
Chhattisgarh	1		-	908	908	409	1	-	-	1701	1701	1765
Surguja	1	-	-	908	908	409	1	-	-	1701	1701	1765
Jharkhand	3	-	-	21202	21202	20661	3	-	-	5674	5674	5795
Latehar	1	-	-	4676	4676	2703	1	-	-	3259	3259	3184
Palamau	2	-	-	16526	16526	17958	2	-	-	2415	2415	2611
Karnataka	2*	-	-	-	-	-	2*	-	-	-	-	-
Mysore	2*	-	-	-	-	-	2*	-	-	-	-	-
Odisha	5	615	651	11298	12564	34838	5	821	472	11474	12767	41633
Nawapara	2	-	-	11298	11298	12049	2	-	-	11464	11464	11801
Raygada	3	615	651	-	1266	22789	3	821	472	10	1303	29832
Tamil Nadu	1*	-	-	-	-	-	1	-	-	10026	10026	10861
Sivaganga	1*	-	-	-	-	-	1	-	-	10026	10026	10861

* : Only labour reported during the year.

Table-5: Production of Graphite, 2019-20 & 2020-21
(By Frequency Groups)

(Quantity in tonnes)

Production group	No. of mines		Production for the group		Percentage to total production		Cumulative percentage	
	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)
India	12	12	34674	30168	100	100	-	-
Up to 1000	6	5	908	10	2.62	0.03	2.62	0.03
1001 to 2000	1	2	1266	2994	3.65	9.92	6.27	9.95
2001 to 5000	3	3	12967	9394	37.4	31.14	43.67	41.09
5001 to 10000	1	1	7915	7744	22.83	25.67	66.5	66.76
Above 10000	1	1	11618	10026	33.51	33.23	100	100

Table-6: Mine-head Closing Stocks of Graphite, 2019-20 & 2020-21
(By States)

(In tonnes)

Grade/State	2019-20				2020-21 (P)			
	Grade: Fixed Carbon content				Grade: Fixed Carbon content			
	80% or more	40% or more but less than 80%	Less than 40%	Total	80% or more	40% or more but less than 80%	Less than 40%	Total
India	161	185	178845	179191	86	104	178675	178865
Chattisgarh	-	-	4633	4633	-	-	6308	6308
Jharkhand	-	-	9963	9963	-	-	11989	11989
Karnataka	-	-	1742	1742	-	-	1742	1742
Kerala	-	-	180	180	-	-	-	-
Odisha	161	185	-	346	86	104	12	20
Tamil Nadu	-	-	162327	162327	-	-	158624	158624

* : Only labour reported during the year.

MINING & MARKETING

Graphite mines, barring a few underground mines, are mostly small and opencast. Active mining centres of graphite are in Palamu district in Jharkhand; Nawapara & Balangir districts in Odisha; and Madurai & Sivagangai districts in Tamil Nadu. Disseminated deposits of flaky graphite containing 5 to 20% Fixed Carbon (F.C.) are found in Palamu district of Jharkhand. In Odisha, areas in and around Balangir are the chief mining centres where several graphite grades are produced. At Balangir, a few opencast workings are deeper than 45 m from surface and the r.o.m. from such mines generally contains 10 to 20% F.C. Sargipalli underground mine in Sambalpur district, operated by M/s T.P. Mineral Industries (TPMI), produced graphite that analysed up to 40% F.C. in the past. Water seepage beyond 6 m depth is the main problem faced by almost all mine owners in Odisha.

Graphite of Balangir district is utilised mostly by the Graphite Crucible Industry. The technological changes in recent years have considerably reduced the use of graphite as a lubricant. However, recycled graphite is still used in production of clay bonded graphite crucibles.

The Sivagangai graphite is of flaky variety with 14% average Fixed Carbon (F.C.) used in the manufacture of refractory bricks, expanded graphite, crucibles and carbon brushes. It is being mined by opencast mining method.The mined graphite is subjected to size reduction by crushing, grinding, flotation and dewatering to upgrade the graphite concentrate from other gangue minerals.

Mining is considered to be easy and safe as regards graphite deposits in view of their comparatively soft nature and presence of hard rocks on either side. In order to expose graphite deposit, thickness of 1 to 2 meters of top lateritic soil is dozed out using dozer or removed by excavator and loaded through dumper and transported to separate dump yard located in non-mineralised zone in the lease area. The graphite ore obtained usually is transported to stock yard for blending. In stock yard, both high-grade and low-grade ores are stacked separately. Depending on plant requirements, blending work is carried out and blended ore is despatched for consumption.

Tamil Nadu Minerals Ltd (TAMIN) has over 600 acres of graphite-bearing areas in Pudupatti, Kumaripatti and Senthiudayanathapuram of Sivagangai district, Tamil Nadu.

BENEFICIATION

During graphite beneficiation one of the challenges is to maximise the recovery of flaky graphite from low–grade graphite ore without breaking the flakes of graphite. This is because flaky graphite has a huge industrial demand due to its distinct properties such as excellent lubricity and higher thermal conductivity.

Graphite occurs generally admixed with country rocks, and hence, it requires beneficiation for obtaining desired grade for various end-uses. Processes for graphite beneficiation depend upon nature and association of gangue minerals present. The common processes adopted are washing, sorting, tabling, acid leaching and froth flotation. Amongst these, froth flotation process is used widely as it helps in producing a fairly high-grade graphite concentrate. Sometimes, beneficiated concentrate is further enriched by chemical treatment (acid leaching, chlorination, etc.) to obtain a very high-grade concentrate containing 98 to 99% F.C.

Prominent beneficiation plants for graphite in India are Chota Nagpur Graphite Industries and Carbon & Graphite Products, Daltonganj; Agrawal Graphite Industries, Gandhamardhan Graphite Udyog and T. P. Minerals Private Limited, Sambalpur; Tamil Nadu Minerals Ltd (TAMIN), Sivagangai, etc.

The ROM, containing an average of about 10% F.C. has to be invariably beneficiated before marketing. Indigenously fabricated equipment is used generally to upgrade the ROM to produce marketable grade graphite which contains normally 70 to 80% F.C. About 92% F.C. product has been obtained by many producers after repeated cycles of beneficiation. A few plant owners have claimed to have obtained product containing as high as 95% F.C.

Beneficiation plants in Odisha seem to have been designed for treating +10% F.C. graphite (ROM). In practice, it is seen that lower grade graphite having +5% F.C. is blended with higher grades to meet the requirements of beneficiation plant, i.e., +10% F.C. Thus, low-grade ore analysing +5% F.C. also gets used.

Tamil Nadu Minerals Ltd (TAMIN) produces flaky graphite from a mine in Sivagangai district in Tamil Nadu. The beneficiation plant located adjacent to the mine site is designed to produce 8,400 tpy of natural graphite concentrate containing 96% F.C. with 92% recovery from ROM.

USES & SPECIFICATIONS

Traditional uses of graphite are in crucibles, foundries, pencils, etc. More sophisticated applications of graphite are in refractories that are used in the manufacture of steel, cement and glass, expanded graphite-based sealing gaskets, graphitised grease, braid, brushes, brake lining, etc. It is also used for speciality applications, such as, in the Nuclear Industry, soil conditioners and graphite foils, which is used for sealing in the Chemical and Petrochemical industries as well as in the Energy, Engineering and Automotive industries. It is also used in minor amounts as a vital additive for producing foundry coatings to prevent fusion of liquid metal with sand at the mould or core face. Such coatings are either applied by spraying or painting in the form of suspension or by dusting or by rubbing as dry powders. Graphite used for coating is of high quality which does not peel off as flakes on drying and imparts a smooth surface to the casting. Graphite, a major additive to many coating systems, is known for its multifarious functions, such as, refractory, lubricant, thermal conductor, electrical conductor, UV shield, electromagnetic pulse shield, corrosion shield and pigment. It is also used as moderator in nuclear reactors and in Lithium-ion (Li-ion) batteries which is used in the electric vehicles, that require high purity flake graphite in their anode material. Li-ion battery anode are typically made of graphite, which can absorb and hold the lithium ions between the layers in its atomic structure, while at the same time conducting electric charge.

The BIS has prescribed the following specifications of graphite for use in various industries:

IS: 1132-1985 (Reaffirmed 2008) - graphite for use in Graphite Crucible Industry;

IS:1305-1984 (Reaffirmed 2012) - graphite for use in foundry coatings;

IS: 14852-2000 (Reaffirmed 2010) - flaky graphite for Refractory Industry;

IS: 495-1967 (First Revision, Reaffirmed 2007) - graphite flakes for lubricants;

IS: 62-2006 (First Revision, Reaffirmed 2011) - graphite for paints; and

IS: 2079-1982 (First Revision, Reaffirmed 2010) - graphite for pencil slips.

The specifications of graphite adopted for various industrial purposes are detailed as below:

Specifications of Graphite

End product	Percentage of graphite used	Quality of the graphite used	
		Fixed Carbon (F.C.)	Size (micron)
Mag-Carb refractories	12	87–90%	150–710
Alumina-Carb (graphitised)	8–10	85% min.	150–500
alumina refractories Clay-bonded crucibles	60–65	+80%	–20 to +100
Silicon carbide crucibles	35	80–89%	+150
Expanded (or flexible) graphite foils and products based thereon (e.g. sealing gaskets in refineries, fuel pumps, automobiles)	100	90% min. (preferably +99%)	250–1800

End product	Percentage of graphite used	Quality of the graphite used	
		Fixed Carbon (F.C.)	Size (micron)
Pencils	50–60	+95–98%	50 max.
Brake-linings	1-15	98% min.	75 max.
Foundry	–	40-70%	53-75
Batteries			
a) Dry cells	–	88% min.	75 max.
b) Alkaline	–	98% min.	5-75
Brushes	–	Usually 99%	Usually less than 53
Lubricants	–	98–99%	53–106
Sintered products (e.g. clog wheels)	–	98–99%	5
Paint	Up to 75	50-55% 75% min.	Amorphous powder flake
Braid used for sealing (e.g. in ship)	40-50	95% min.	–
Graphitised grease (used in seamless steel tube manufacturing)	–	+99%	38 max.
Colloidal graphite	100	99.9%	Colloidal

CONSUMPTION

As per the information received from various graphite consuming units and estimates, the consumption of various grades of graphite during 2019-20 was 19,000 tonnes which showed a decline of about 18 % as compared to 23,200 tonnes in the preceding year. Out of the total consumption in 2019-20, graphite products (crucible, pencil etc.) were 11,700 tonnes (62%), Foundary Industry 5,500 tonnes (29%), Refractory Industry 700 tonnes (4%) and Others (Dry Cell battery, cement, Iron & Steel, Paint, paper etc.) 1,100 tonnes (6%). Industrywise consumption data are provided in Table - 7.

Table-7 : Consumption* of Graphite 2017-18 to 2019-20

(By Industries)

(In tonnes)

Industry	2017-18	2018-19	2019-20(p)
All Industries	71700(23)	23200(16)	19000(12)
Chemicals	13800	13800	-
Foundry	4800	5600	5500
Graphite products (Crucible, Pencil, etc.)	50400	2000	11700
Refractory	1200	700	700
Others (Dry cell battery, cement, iron & steel, paint, paper, etc.)	1500	1100	1100

Figures rounded off.

*Includes actual reported consumption and/or estimates made wherever required and due to paucity of data, consumption may not be complete.

( ) Number of plants reported /estimated. The apparent cosumption graphite has been estimated as 68.9 thousand tonnes.

SUBSTITUTION

In principle, it is possible to substitute graphite by either synthetic graphite, produced primarily from high carbon precursors, such as, petroleum coke and coal tar pitch (e.g. in batteries or for increasing the carbon in steel) or by replacing the product as in the case of pencils or by other compounds as in high temperature applications (e.g. refractories). In the later case, it is difficult to fully substitute graphite as it is tough to replicate the same level of performance that graphite provides.

There is a limit to how much charge graphite can store and lithium moves relatively slowly through graphite. Therefore, while considering the improvement required for large scale EV, tin and silicon may be the future competitor because of higher charge capacity and also tin conducts lithium-ion faster.

WORLD REVIEW

The world resources of graphite are believed to exceed 800 million tonnes of recoverable graphite However, world reserves of graphite have been placed at 320 million tonnes of which Turkey accounts for 28% followed by China (23%), Brazil (22%), Madagascar & Mozambique (8% each), Tanzania 5%, India & Uzbekisthan (2% each) and Mexico & Dem. P. R. of Korea (1% each) (Table-8).

World production of graphite was 1.12 million tonnes in 2020 as compared to 1.39 million tonnes in 2019 Austria was the leading producer, with a share of about 58% which is followed by Brazil (8%), Canada (4%), Madagascar (5%) and Dem. P.R of Korea (4%) (Table-9).

A generalised view of the development in various countries with countrywise description sourced from latest available publication of minerals yearbook 'USGS 2017' is furnished below:

Brazil

Brazil was one of the leading country of graphite with estimated production of 90,000 tonnes of marketable natural graphite in 2017. Nacional de Grafite Ltda. was the only producer of natural flake graphite in Brazil during 2017. High-grade crystalline flake graphite projects were being developed in Brazil with at least two companies conducting or considering graphite exploration and development.

Canada

Canada was one of the leading country of graphite with a production of 40,000 tonnes of natural flake graphite reported from two active open pit mines in 2017. About 80% production reported from the Lac des Iles flake graphite mine in Quebec, operated by Imerys Graphite & Carbon, and approximately 20% from the Black Crystal flake graphite quarry in British Columbia, owned by Eagle Graphite Corp. During 2017, 24 potential graphite producers were exploring and developing flake graphite projects in Canada.

Table-8: World Reserves of Graphite (Natural)
(By Principal Countries)

(In 000' tonnes)

Country	Reserves
World: Total (rounded off)	320000000
USA	4
Austria	4
Brazil	70000000
Canada	4
China	73000000
Germany	4
India*	8000000
Korea,North	2000000
Madagascar	26000000
Maxico	3100000
Mozmbique	25000000
Norway	600000
Russia	4
Sri Lanka	1500000
Tanzania	18000000
Turkey	90000000
Ukraine	4
Uzbekistan	7600000
Vietnam	4

Source: USGS Mineral Commodity Summaries, 2022

*India's reserves of graphite as per NMI database, based on UNFC system as on 1.4.2015 have been placed at about 7,960 thousand tonnes.

Austria, Canada, Germany, Pakistan, Russia, Ukraine, United States and Vietnam are included in world total.

Table-9: World Production of Graphite
(By Principal Countries)

(In tonnes)

Country	2018	2019	2020
World Total	1417884	1397568	1125264
Austria	693000	700000	650000
Brazil	95000	96000	95000
Canada	54587	53400	48500
China	39030	31991	30168
Germany	40000	40000	30000
India	106773	113803	18159
Korea, Dem.P.R.of	17800	16600	16600
Madagascar	25000	20000	16500
Mexico	16752	9990	15205
Mozambique	15000	15000	15000
Other countries	314942	300784	190132

Source: BGS World Mineral Production, 2016-20,

a: Crude, b: Material, c: Years ended 31 March following that stated, d: Including flake graphite, f: Years ended 30june of that stated, h:Export, j:Sales

India's productiom of graphite during 2017-18, 2018-19 and 2019-20 was at 34 thousand tonnes, 39 thousand tonnes and 31 thousand tonnes, respectively.

FOREIGN TRADE

Exports

In 2020-21, exports of graphite (natural) increased by 18 % to 716 tonnes as compared to 607 tonnes in the previous year. Graphite (natural) was exported mainly to Tanzania (25%), Nepal (15%), Malaysia (11%) and U A E (10.1%) (Fig-2)

The exports of graphite (artificial) decreased by 12% to 21,744 tonnes in 2020-21 from 24,745 tonnes in the previous year. Graphite (artificial) was exported mainly to Germany (35%), U S A (3%), Bhutan (20%), UAE (9%), Kuwait (6%),

The exports of graphite crucibles increased to 416 tonnes in 2020-21 from 20 tonnes in the preceding year, while those of silicon carbide crucibles also increased to 3728 tonnes in 2020-21 from 3023 tonnes in the previous year. Graphite crucibles were mainly exported to Taiwan (32%), Netherland (13%) and Rwanda (10%). Silicon carbide crucibles were exported mainly to UAE (14%), Turkey (6%), South Africa (4%), Exports of graphite bricks and shapes increased by to 515 tonnes in 2020-21 from 95 tonnes in the preceding year. Graphite bricks and shapes were mainly exported to Ethiopia (72%), UAE (7%), and Jordan (2%) (Tables - 10 to 14).

Table-10: Exports of Graphite (Natural)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	607	32629	716	42994
Tanzania	158	6732	185	8683
Nepal	2	242	106	8013
Malaysia	190	11081	81	4470
UAE	16	1236	77	4379
Sudan	72	3748	60	3930
Bangladesh	35	1760	40	2389
Bahrain	++	31	25	1545
France	-	-	30	1346
Sri Lanka	3	417	13	1230
Kenya	++	33	24	1047
Other countries	131	7349	75	5952

Figures rounded off.

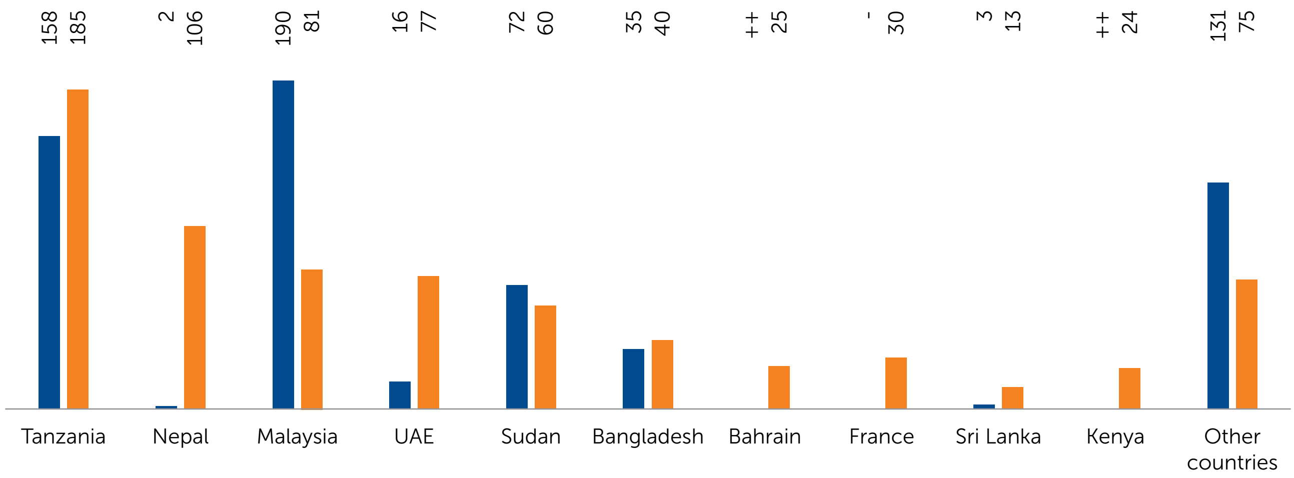


Fig 2: Countrywise Exports of Graphite (Natural)

Table-11: Exports of Graphite (Artificial)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	24745	3555899	21744	2820004
Germany	7971	2098318	7684	1531046
USA	1702	401302	760	236726
Bhutan	4952	209278	4364	170055
UAE	1923	128200	2011	153408
Kuwait	1180	58525	1397	75080
Oman	1421	67346	1192	61639
Turkey	150	23560	120	61497
Saudi Arabia	41	7726	231	54641
Bangladesh	1265	51072	1548	54222
Belgium	124	62903	75	40903
Other countries	4016	447669	2362	380787

Figures rounded off.

Table-12: Exports of Graphite Bricks & Shapes

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	95	5141	515	8408
Ethiopia	22	168	373	3271
U A E	1	54	37	1595
Jordan	4	1012	14	1220
Kenya	-	-	36	920
Nepal	24	734	41	708
South Africa	12	236	8	288
Saudi Arabia	1	154	3	218
Sri Lanka	-	-	++	60
Oman	10	297	1	59
Taiwan	-	-	2	46
Other countries	21	2486	++	23

Figures rounded off.

Table-13: Exports of Graphite Crucibles

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	20	2256	416	28081
Taiwan	-	-	135	8145
Netherlands	-	-	58	6059
Rwanda	-	-	40	3637
UK	++	81	21	2666
Zimbabwe	-	-	60	1825
Iraq	-	-	20	1690
U S A	8	139	44	1141
Mali	-	-	5	873
Congo	-	-	8	765
Bangladesh	-	-	15	544
Other countries	12	2036	10	736

Figures rounded off.

Table-14: Exports of Silicon Carbide Crucibles

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3023	690399	3728	624851
UAE	690	135876	534	115347
Turkey	210	40797	238	70602
South Africa	144	50730	142	59960
USA	203	76141	116	45080
Korea, Rep of	118	41141	94	35173
Egypt	219	56101	141	34186
Thailand	110	23567	136	33512
Germany	140	44391	88	26113
UK	104	22566	92	19465
Indonesia	76	18622	52	16214
Other countries	1009	180467	2095	169199

Figures rounded off.

Imports

Imports of graphite (natural) decreased marginally by 3% to 40,153 tonnes in 2020-21 from 41,405 tonnes in the preceding year. Graphite (natural) was imported mainly from China (54%), Madagascar (23%), Mozambique (10%) and Vietnam (8%) (Fig-3).

Imports of graphite (artificial) increased by 14% to 54,327 tonnes in 2020-21 from 47,511 tonnes in the previous year. Imports of graphite (artificial) were mainly from China (47%), Germany (9% each), Poland 9%) and remaining 35% share was contributed by other countries.

Imports of graphite bricks and shapes drastically decreased to 5430 tonnes in 2020-21 from 9408 tonnes in the preceding year. Imports of graphite bricks and shapes were mainly from USA (63%) followed by Japan (35%) and remaining share was contributed by USA & Belgium. Imports of graphite crucibles drastically increased to 906 tonnes in 2020-21 from tonnes in the preceding year. Italy was the main supplier country. Imports of silicon carbide crucibles increased to 386 tonnes in 2020-21 from 69 tonnes in the previous year. Imports were mainly from China (82%), Germany (6%) and USA (6%) (Tables - 15 to 19).

Table-15: Imports of Graphite (Natural)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	41405	1863220	40153	1808218
China	25189	948797	21800	799903
Madagascar	6543	381377	9437	544250
Mozambique	6355	248014	3644	133914
Vietnam	568	16878	3281	103613
Germany	253	57957	223	61892
USA	270	38401	244	51868
Austria	71	5850	272	21823
Tanzania	260	9923	594	17738
Italy	30	4541	89	14533
Brazil	1060	77889	160	11957
Other countries	806	73593	409	46727

Figures rounded off.

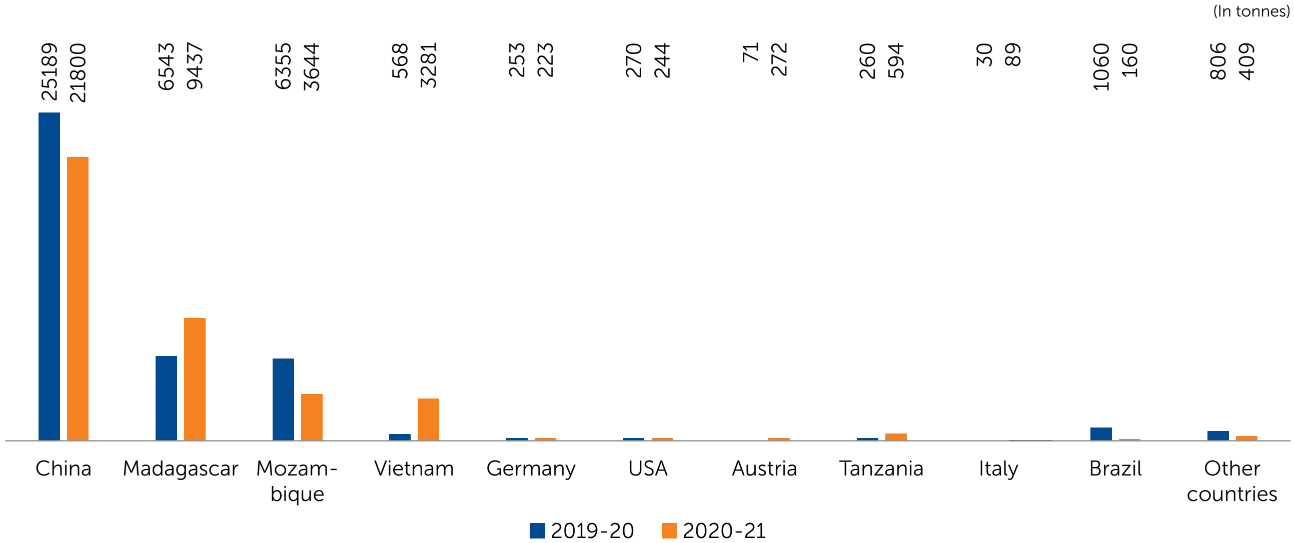


Fig 3: Countrywise Imports of Graphite (Natural)

Table-16: Imports of Graphite (Artificial)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	47511	4870675	54327	5422418
China	25822	2251296	25414	1996380
Germany	2993	996637	4789	1345986
Poland	883	95647	5214	398786
France	1934	373387	1858	287110
Norway	4592	269822	4506	253365
USA	882	152935	846	220126
U K	645	81361	1473	217548
Japan	434	221804	377	184622
Netherlands	57	22281	221	78416
Belgium	19	16512	147	75903
Other countries	9250	388993	9482	364176

Figures rounded off.

Table-17:Imports of Graphite Bricks & Shapes

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	9408	16170	5430	21390
China	741	5884	90	11574
U S A	8663	7797	3440	7545
Japan	4	2489	1900	2263
Belgium	-	-	++	8

Figures rounded off.

Table-18: Imports of Graphite Crucibles

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1	2573	906	50672
China	++	4	312	42252
Hong Kong	-	-	2	5820
Italy	1	1982	551	2199
Canada	-	-	++	209
Korea	-	-	1	189
U S A	++	18	40	3
Japan	++	273	++	++
Germany	++	296	-	-

Figures rounded off.

Table-19: Imports of Silicon Carbide Crucibles

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	63	20742	386	70638
China	21	1722	319	55172
Germany	12	3627	26	8518
U S A	5	8212	25	3903
Japan	20	443	5	1076
Czech Republic	++	514	++	836
Belgium	-	-	9	616
Canada	1	283	++	263
U K	2	422	1	220
Italy	2	5519	1	34

Figures rounded off.

FUTURE OUTLOOK

Worldwide demand for combined natural and synthetic graphite is expected to rise along with improvements in the global economic conditions. Demand is also expected to augment further with the development of non-carbon energy applications, such as, batteries used in electric vehicles, electric devices and energy storage devices that use graphite. The graphite reserves having +40% Fixed Carbon are rather limited in the country. Detailed exploration of graphite deposits in Odisha, Jharkhand, Jammu & Kashmir and Kerala should be carried out. Cost-effective beneficiation technologies for low-grade graphite ore need to be developed. Silicon carbide-graphite crucibles are being diversified and manufactured to improve upon the use of inferior grade material with less quantity and at the same time ensuring longer life of crucible. Of late, a few emerging & important specialised applications of exfoliated graphite have been reported especially in the manufacture of sealings, gaskets, braids and brushes. New products of synthetic graphite, such as, graphite fibres/ropes and graphite insulation blankets have been introduced. In the world scenario, there seems to be a rapid diversification in respect of potential large-volume end-use for natural graphite, such as, in heat sinks, also called spreader shield, which is a graphite foil material that conducts heat only in two directions. It has thermal conductivity above aluminium and almost equal to copper. These are used for dissipating heat in laptop computers, flat-panel displays, wireless phones, digital video cameras, etc. Such emerging & high growth applications of graphite are certainly causing noticeable impacts on the demand & consumption patterns within the country & globally. The demand for high purity graphite is increasing exponentially due to increase in the demand of lithium-ion batteries for electric vehicles, laptops, smartphones, home/business applications and traditional uses for expanded graphite foils are also the potential areas that are expected to be major drivers for graphite consumption. It represents 23% of global flake graphite demand. The demand for graphite in the Battery segment is forecasted to double in the next six years.

15. Ilmenite and Rutile

351
(thousand tonnes) Total reserves/ resources of ilmenite were estimated as on 1st April 2020

0.24
(million tonnes) of titanium ores & conc. were exported in 2020-21

78,747
(tonnes) of titanium ores & conc. were imported in 2020-21

India is endowed with large resources of heavy minerals which occur mainly along coastal stretches of the country and also in inland placers. Heavy mineral sands comprise a group of seven minerals, viz, ilmenite, leucoxene (brown ilmenite), rutile, zircon, sillimanite, garnet and monazite. Ilmenite ($FeO.TiO_2$) and rutile (TiO_2) are the two chief minerals of titanium. Titanium dioxide occurs in polymorphic forms as rutile, anatase (octahedrite) and brookite. Though brookite is not found on a large-scale in nature, it is an alteration product of other titanium minerals. Leucoxene is an alteration product of ilmenite and is usually found associated with ilmenite.

RESERVES/RESOURCES

Ilmenite and rutile along with other heavy minerals are important constituents of beach sand deposits found right from Saurashtra coast (Gujarat) in the west to Digha coast, West Bengal in the east. These minerals are concentrated in five well-defined zones:

* Over a stretch of 22 km between Neendakara and Kayamkulam, Kollam district, Kerala (known as 'Chavara' deposit after the main mining centre).
* Over a stretch of 6 km from the mouth of River Valliyar to Colachal, Manavalakurichi and little beyond in Kanyakumari district, Tamil Nadu (known as MK deposit).
* On Chatrapur coast stretching to about 18 km between Rushikulya river mouth and Gopalpur lighthouse with an average width of 1.4 km in Ganjam district, Odisha (known as 'OSCOM' deposit after IREL's Orissa Sands Complex).

* Brahmagiri deposit stretches for 30 km from Girala nala to Village Bhabunia with an average width of 1.91 km in Puri district, Odisha.
* Bhavanapadu coast between Nilarevu and Sandipeta with 25 km length and 700 m average width in Srikakulam district, Andhra Pradesh.

The AMD of the Department of Atomic Energy has been carrying out exploration of these mineral deposits. Of the total, coastal length of 5,921 km spread in Odisha, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Maharashtra, Goa, Gujarat and West Bengal about 451 km, 1,873 km, and 112 km have been covered by detailed exploration, general exploration and preliminary exploration respectively. A coastal length of 2,272 km have not been covered due to various reasons viz., mangrove, port activity etc., leaving an unexplored coastal length of 1,214 km. The distribution of area coverage (sq km) in different geological domains are Beach & Dune (1845), Inland Sand Body (180), Terrace sediments (368), River Channel (32), Inland alluvium (646) and Lake & Sea Beds (38). The ilmenite resource estimation for the areas explored up to March, 2020 has been completed and the resources are up from 629.57 million tonnes (including leucoxene) in the year 2016 to 687.57 million tonnes in the year 2020. The resources include Measured, Indicated and Inferred categories. Though, the latest state-wise /deposit-wise details are not available, the state-wise/deposit-wise details as received from DAE vide letter dated 26.07.2018 are furnished in Tables-1 & 1A.

Table-1: Ilmenite Reserves, Resources/ Deposits in India

(In million tonnes)

State/Deposit	Ilmenite reserves
Andhra Pradesh	
1. Bhavanapadu	10.18
2. Kakinada (Phase I-VIII)	13.81
3. Kalingapatnam	7.03
4. Narasapur	2.92
5. Nizampatnam	19.26
6. Srikurman (South)	8.6
7. Visakhapatnam (Bhimunipatnam)	2.88
8. Amalapuram (Phase I-IV)	4.72
9. Pandurangapuram-Voderevu (Bapatla-Chirala coast)	10.38
10. Vetapalem Coast (Chirala coast)	5.31
Kerala	
1. Chavara Barrier beach	13.17
2. Chavara Eastern Extension (Phase-I)	17.02
3. Chavara Eastern Extension (Phase-II)	49.26
4. Trikkunnapuzha-Thotapally Beach& Eastern Extension	9.5
5. Alapuzha-Kochi	5.88
Maharashtra	
Ratnagiri	3.68
Munge-Achra-Malvan	1.12
Vijayadura-Mithbav	0.7
Gujarat	
Moti Daman-Umbrat coast	2.77
Odisha	
1. Brahmagiri (Phase I-V and NW extension)	86.04
2. Chatrapur	26.72
3. Gopalpur	6.42
Tamil Nadu	
1. Kudiraimozhi	22.86
2. Ovari-Periyatalai-Manapadu (Teri)	24.01
3. Sattankulam Teris	41.26
4. Cuddalore-Pudupattuchavadi (beach sand)	4.67
5. Vayakallur (beach sand)	4.52
6. Manavalakurichi (beach sand)	3.07
7. Midalam	1.64

Source: As per letter received from Department of Atomic Energy, Mumbai dated 26/07/2018

Table-1 A: Reserves/Resources of Ilmenite and Rutile

(In million tonnes)

State	Total
Ilmenite* : Total	**629.57**
Andhra Pradesh	156.17
Jharkhand	0.73
Gujarat	2.77
Kerala	144.02
Maharashtra	5.5
Odisha	150.62
Tamil Nadu	167.7
West Bengal	2.06
Rutile : Total	**33.95**
Andhra Pradesh	10.55
Jharkhand	0.01
Gujarat	0.02
Kerala	8.74
Maharashtra	0.01
Odisha	6.58
Tamil Nadu	7.85
West Bengal	0.19

Source: As per letter received from Department of Atomic Energy, Mumbai dated 26/07/2018. The resources of beach sand minerals (BSM) viz. Ilmenite, Rutile, Zircon, Garnet, leucoxene, monazite and Sillimanite were last updated in the year 2016 by AMD. # Inclusive of Indicated, Inferred and Speculative categories. * Including leucoxene

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on "Exploration and Development" under "General Reviews".

PRODUCTION AND PRICES

Ilmenite

The production of ilmenite was 351 thousand tonnes in 2020-21 increased by 0.24% as compared to that in the preceding year. Odisha was the leading producer of ilmenite during the year under review, contriubting 65% of the total production followed by Kerala (25%) and Tamil Nadu (9%).

Rutile

The production of rutile at 13 thousand tonnes in 2020-21 decreased by 2% as compared to that in the previous year. Kerala was the leading producer of rutile accounting for 73% of the total production followed by Kerala (17%) and Tamil Nadu (10%). Production and prices of ilmenite and rutile are furnished in Tables -2 to 4.

Table-2: Production of Ilmenite and Rutile
(By States)

(In tonnes)

State	2018-19	2019-20	2020-21* (P)
ILMENITE			
India : Total	**292226**	**350535**	**351387**
Kerala	74834	75593	88110
Odisha	191492	241009	230040
Tamil Nadu	25900	33933	33237
RUTILE			
India : Total	**12593**	**13102**	**12845**
Kerala	8384	8669	2197
Odisha	3270	3257	9409
Tamil Nadu	939	1176	1239

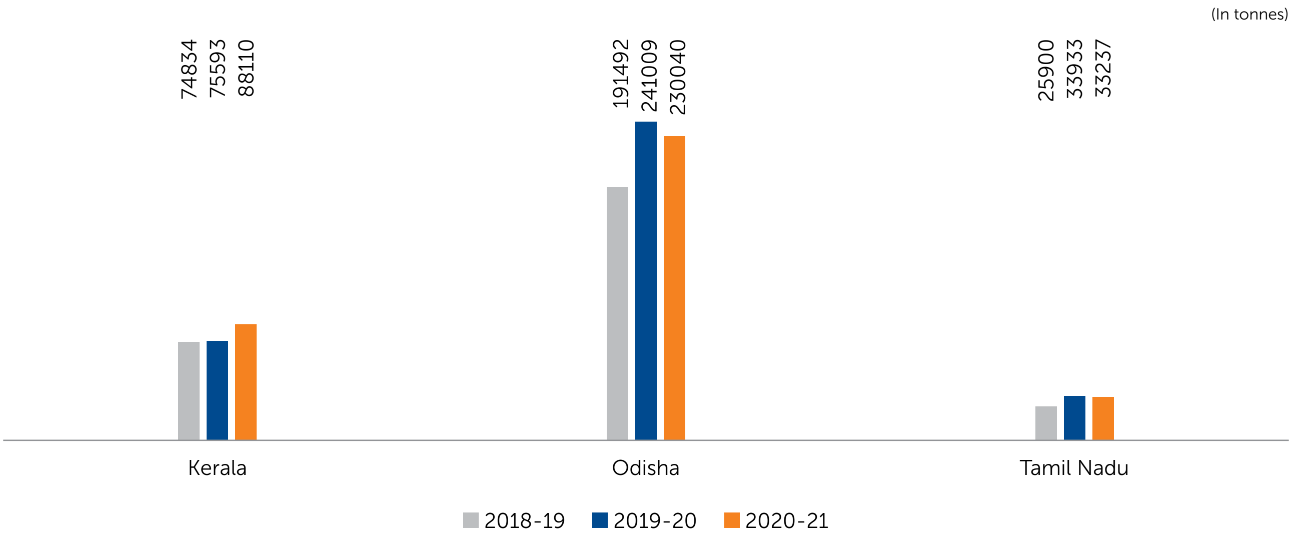


Fig 1: Production of Ilmenite in India

(In tonnes)

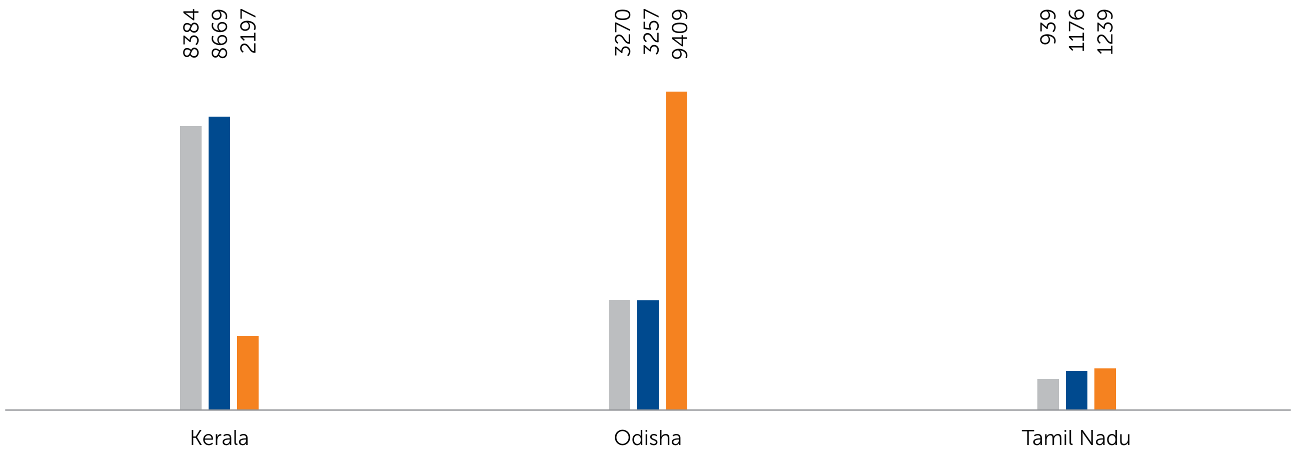


Fig 2: Production of Rutile in India

Table-3: Prices of Rutile 2017-18 to 2019-20

(₹ per tonne)

Year	Grade	Price	Remarks
IREL			
2017-18**	Q	60748	Ex-works, Bagged
	MK	-	Ex-works, Bagged
	OR	61070	Ex-works, Bagged
2018-19	Q	76995	Ex-works, Bagged
	MK	79627	Ex-works, Bagged
	OR	76798	Ex-works, Bagged
2019-20	Q	92138	Ex-works, Bagged
	MK	93052	Ex-works, Bagged
	OR	92788	Ex-works, Bagged
KMML			
2017-18	-	52083	Average
2018-19	-	66916	Average
2019-20	-	NA	-
V.V. Mineral			
2017-18	-	NA	Average
2018-19	-	NA	-
2019-20	-	-	-

Source: Department of Atomic Energy, Mumbai

Note: Q: Quilon; MK: Manavalakurichi; OR: Odisha

**During the financial year 2017-18 MK unit not despatches any material due to non- availability of transport permit.

Table-4: Prices of Ilmenite 2017-18 to 2019-20

(₹ per tonne)

Period	Grade	Price	Remarks
IREL			
2017-18**			
	Q*	11922	Ex-works, loose
	MK*	-	Ex-works, loose
	OR*	11618	Ex-works, loose
2018-19			
	Q*	12978	Ex-works, loose
	MK*	12667	Ex-works, loose
	OR*	12512	Ex-works, loose
2019-20			
	Q*	14618	Ex-works, loose
	MK*	14235	Ex-works, loose
	OR*	13167	Ex-works, loose

Contd.

Period	Grade	Price	Remarks
KMML			
2017-18		NA	
2018-19		NA	
2019-20		NA	
V.V. Mineral			
2017-18	-	-	
2018-19	-	-	
2019-20	-	-	
BMC			
2017-18		NA	
2018-19		NA	
2019-20		NA	
DCW Ltd			
2017-18	-	8423	
2018-19	-	14489	
2019-20	-	15265	

Source: Department of Atomic Energy, Mumbai.

Note: Q: Quilon; MK: Manavalakurichi; OR: Odisha

Ilmenite is usually sold on NAW (naked at works) basis from all production center

*: Regular Price

MINING & PROCESSING

A notification dated 27.07.2019, was issued for reserving the prospecting and mining rights of offshore minerals under Offshore Areas Minerals (Development and Regulation) Act, 2002 exclusively to Government and Government owned companies for curbing illegal mining of atomic minerals by private parties. Mining and processing of beach sand is carried out by the IREL, a Government of India Undertaking and KMML, a Kerala State Government Undertaking. Exploitation work of beach sand deposits located at Chavara in Kerala, Gopalpur in Odisha and Manavalakurichi in Tamil Nadu by IREL is under progress.

At IREL, Chavara, Beach Sand was collected over a stretch of 22 km between Neendakara and Kayamkulam in Kerala and was transported to plant site. The unit has adopted wet mining operations involving use of two Dredge and Wet Concentrator (DWC) of 100 tph capacity each to exploit the inland deposits away from the beaches. Chavara ilmenite is the richest in TiO_2 content (75.8% TiO_2) and has great demand in India and abroad for manufacture of pigments.

At Manavalakurichi, the deposit is spread over 300 hectares at Thuthoor-Ezudesam villages, vilavancode tehsil, district Kanyakumari, Tamil Nadu. All the raw sand required for the mineral separation plant to operate to its full capacity is collected from nearby beaches. Deposits are also exploited by DWC of 100 tph capacity. Manavalakurichi is next to Chavara in terms of TiO_2 content which is more than 55%.

The sand deposits of OSCOM at Chatrapur in district Ganjam extend along the coast of Bay of Bengal with an average width of 1.4 km and average depth of 7.5 m. Mining operations involve suction dredging to 6 m depth below water level on a much larger scale (500 tph) augmented by a smaller sized (100 tph) supplementary. The ilmenite from OSCOM is inferior in grade in terms of TiO2 content (50%) in comparison to Chavara and Manavalakurichi. The Synthetic Rutile Plant of OSCOM is presently not working. As a result, the majority of OSCOM ilmenite produced of late is routed to the international market as feedstock for production of both slag grade and anatase grade pigment.

In dry mining, beach washings laden with 40-70% Heavy Minerals (HM) are collected through front-end loaders and bulldozers for further concentration to 90% HM at land-based concentrators. Though dry mining is very simple and economic, there is considerable opposition by local people for this form of mining for reasons that removal of sand would expose the land area to sea erosion. Therefore, collection of beach washings has reduced significantly in recent past.

As an alternate approach, IREL has adopted wet mining involving dredging and wet concentration (DWC) from inland areas away from the beach lines. In this mode, an artificial pond is created, the sand bed is cut and the slurry is pumped to spiral concentrator for removal of quartz. Manavalakurichi was the first plant to install a DWC (100 tph) followed by one (500 tph) at OSCOM and two (each 100 tph) at Chavara. The concentrate (90% HM) of beach washing plant from DWC is further upgraded to 97% HM grade at a Concentrate Upgradation Plant (CUP) before sending it to Mineral Separation Plant (MSP).

Execution of Supplimentary Mining Lease deed for OSCOM Mines till a period up to the year 2047 has been completed under the provision of AMCR 2016. Communication on precious area of the Bramhagiri Mineral Sands Deposit in Puri District under AMCR 2016 is in the final stages of issuance by Government of Odisha.

After much persuasion, the precise area communication over an extent of 855 ha out of the identified area of 1,817 ha in Kanyakumari district is also expected to be issued by Government of Tamil Nadu. The Government is showing keen interest in exploiting the resources through a joint venture between IREL and TAMIN, a State PSU. This initiative would be a breather for MK operations as the mineable land within the mining leasehold areas are on the verge of exhaustion. Further, it will also pave way for formation of a new subsidiary of IREL in the same line as that of IREL and IDCOL.

KMML collects seasonal accretions of heavy mineral sand from the beach front. The pit so formed gets filled by fresh accretions of heavy mineral sand. The mineral sand is collected using bulldozers and wheel loaders and transported in tippers to Mineral Separation Plant.

The mineral separation plants use variety of equipment, such as, gravity concentrators, high tension electrostatic separators and magnetic separators. Making use of difference in physical properties like electrical conductivity, magnetic susceptibility and difference in specific gravity, etc., individual minerals like ilmenite, rutile, zircon, sillimanite and garnet are separated. The mined beach sands are pre-concentrated and dried after sieving (30-mesh) to separate the heavies from rejects. The heavy minerals are passed through electrostatic separators where conducting minerals – ilmenite and rutile – are separated from other non-conducting minerals. Ilmenite and rutile are further subjected to low-intensity magnetic separators where magnetic fraction - ilmenite is separated from rutile. Similarly, non-conducting fractions are subjected to high-intensity magnetic separators where weak magnetic fraction (monazite and garnet) is separated from non-magnetic fraction (zircon and sillimanite). The fractions are further processed on wind tables to separate garnet from monazite and sillimanite from zircon.

Installed capacity and production of ilmenite, rutile and other associated heavy minerals by various separation plants are furnished in Table-5.

Table-5: Installed Capacity & Production of Ilmenite, Rutile and Other Heavy Minerals, 2017-18 to 2019-20

(In tonnes)

Company/ Location	Mineral/ Product	Installed capacity (tpy)	Production		
			2017-18	2018-19	2019-20
Indian Rare Earths Ltd	Ilmenite	90000	-	25745	320485
Manavalakurichi,# Distt Kanyakumari, Tamil Nadu.	Rutile	3500	-	938	11674
	Zircon	10000	-	2190	11490
	Sillimanite	8778	-	-	26052
	Monazite	6000	-	-	69748
	Garnet	10000	-	7425	5034
Chavara, Distt Kollam, Kerala.	Ilmenite	200000	43253	48694	
	Rutile	11400	1515	1723	
	Zircon	17500	2649	3072	
	Rare Earths	4500*	-	-	
	Sillimanite	10000	6826	7953	
Orissa Sands Complex,	Ilmenite	220000	184657	191492	
Distt Ganjam, Odisha.	Rutile	7400	7860	8384	
	Zircon	5000	5696	6694	
	Sillimanite	13000	16698	17930	
	Garnet	20000	34170	31332	
Kerala Minerals & Metals Ltd	Ilmenite	61600	56757	26140	30009
Chavara, Distt Kollam. Kerala.	Rutile	4400	2454	1548	1428
	Zircon	6500	4844	4762	4110
	Sillimanite	3600	701	271	1329
V.V. Mineral	Ilmenite	450000	-	-	
Distt Thoothukudi, Tamil Nadu.	Rutile	12000	-	-	NA
	Zircon	18000	-	-	
	Zircon-sillimanite	24000	-	-	
Beach Minerals Co. Pvt. Ltd	Ilmenite	150000	-	-	
Kuttam, Distt Tirunelveli, Tamil Nadu.					
V.V. Titanium Pigments Pvt. Ltd	Titanium Dioxide	18000	13801	11902	9419
Distt Thoothukudi Tamil Nadu.					

Source: Department of Atomic Energy, Mumbai and IREL.

* In terms of rare earths chloride. '-' Not Available # During the year 2017-18, Manavalkurichi Plant was non-operating from Jan 2017 because of non-availability of environmental clearence (EC). V.V.Mineral mine is not in operation since 2017-18

INDUSTRY

For manufacturing titanium dioxide pigment, ilmenite is first treated chemically to obtain upgraded ilmenite, commonly called as synthetic rutile. There are two major pigment production processes, namely, chloride process and sulphate process depending on different operating characteristics and feedstock requirements. Plants employing chloride process consume high TiO_2 content feedstocks like synthetic rutile and chloride slag. On the other hand, plants employing the sulphate process use lower-grade ilmenite and sulphate slags.

Ilmenite obtained from Mineral Separation Plant (MSP) is chemically treated to remove impurities, such as, iron to obtain synthetic rutile (90% TiO_2) in Synthetic Rutile Plant (SRP). Indian SRP are based on reduction roasting followed by acid leaching with or without generation of hydrochloric acid. Plants of IREL (OSCOM) and KMML depend on acid regeneration from the leach liquor while those of Cochin Minerals & Rutile Ltd (CMRL) and DCW use fresh acid and recover ferric chloride from the leach liquor for its use in water purification.

At OSCOM plant of IREL, reduction-roasting of ilmenite with coal is followed by leaching with HCL to separate iron as soluble ferrous chloride. The leached ilmenite is calcined to yield synthetic rutile and the acidic leach liquor is treated in an acid regeneration plant to recover HCL for recycling with iron oxide as waste. The unit stopped production in 1997, as it was not viable economically. Against the Request for Proposal floated to set up titanium slag plant under Build-Own-Operate (BOO) model, a CPSE has shown keen interest and based on their request, the due date of submission has been extended. Considering the formidable investment and difficulties in sourcing technology in the field, the progress, though slow is in the right direction.

Environment Clearence for setting up nano titania/zirconia facilities have been received. However, in consideration of the stringent norms of Zero Effluent Discharge, work has been taken up to use alternate feed material to meet the stipulations. The KMML is manufacturing rutile grade titanium dioxide pigment by chloride route at its Sankaramangalam plant near Chavara in Kerala. The project for the production of one lakh tonnes of TiO_2 in a phased manner is under implementation. The Company also has plans to enhance pigment capacity to 60,000 tpy for which detailed project report is under preparation. In 2009, the Company had developed Nano Titanium Dioxide particles on laboratory scale and in July 2011, India's first commercial plant for synthesis of Nano titanium Dioxide was commissioned.

The DCW Ltd procures ilmenite from Manavalakurichi which is then roasted with coke fines to convert Fe_2O_3 into FeO. The reduced ore is leached with concentrated hydrochloric acid to remove oxides of iron and other metals. The leached ore is washed and calcined to get upgraded ilmenite which contains more than 95% TiO_2. The upgraded ilmenite is micronised to 2 microns by using high-pressure steam. This is marketed as Titox. The liquor from ilmenite leaching process contains fine TiO_2 particles and chlorides. The TiO_2 recovered by filtration & washing in filter process is marketed as Utox. The Company has plans to increase the plant capacity to 48,000 tpy and also to install facilities for the manufacture of ferrite grade iron oxide from the effluent of the ilmenite plant.

Cochin Minerals and Rutile Ltd (CMRL), which began production at its 10,000 tpy synthetic rutile plant in Kerala in 1990 as a 100% EOU, has gradually raised the production capacity to around 45,000 tpy since 2008-09 for exports. It also has ferric chloride & ferrous chloride plants having capacities of 24,000 tpy & 72,000 tpy, respectively.

The Travancore Titanium Products Ltd (TTPL), a Kerala State Government Undertaking, manufactures titanium dioxide pigment by sulphate process at its plant at Kochuveli, Thiruvananthapuram. Ilmenite is reacted with sulphuric acid in digesters and a porous cake is formed. The mass in the solid form is dissolved in dilute sulphuric acid to get titanium in solution as titanium oxysulphate along with other metallic ingredients in ilmenite as their sulphate. The liquor is reduced using scrap iron, when ferric iron gets completely reduced to the ferrous state. The liquor is clarified, concentrated and boiled to precipitate the titanium content as hydrated titania which is then filtered by vacuum filters and calcined. Sulphuric acid required for captive consumption is produced at site using elemental sulphur. Till recently, TTPL was the only unit producing anatase grade titanium dioxide pigment in India. TTPL has capacity to produce 17,000 tpy of titanium dioxide, and with plans to modernise and diversify in stages, the Company has chalked out targets to produce both anatase and rutile grades titanium dioxide pigment.

Tata Steel has proposed a project to produce 1,00,000 tonnes per year titanium dioxide from ilmenite mined from beach sands of Tirunelveli and Thoothukudi districts in southern Tamil Nadu.

Present domestic titanium metal production is negligible. KMML has setup a 500 tpy titanium sponge plant with Defence Metallurgical Research Laboratory (DMRL) technology and first batch of titanium was delivered in September 2011. The plant will be further expanded to 1,000 tpy. IREL is to setup a 10,000 tpy titanium sponge plant at OSCOM for which proposals have been invited on "build, operate and own" basis. Two forward looking MoUs have been entered by IREL, one with UKTMP, Kazakhstan for setting up of facility for production of titanium slag using ilmenite produced from OSCOM mines, while the other one is with Sultanate of Oman for Co-operation in the field of rare earths. Depending upon feasibility, further value addition to TiO2 pigment and titanium sponge will be taken up, subsequently. Titanium sponge is imported by Mishra Dhatu Nigam Ltd (MIDHANI) for further processing in the country.

The available data on plantwise installed capacities of synthetic rutile and TiO_2 pigment are furnished in Table-6.

Table-6: Installed Capacity of Synthetic Rutile/Titanium dioxide Pigment,

(In tonnes)

Plant	Location	Specification	Installed capacity (tpy)
IREL	Orissa Sands Complex, Distt Ganjam, Odisha.	90.5% TiO_2 (min.)	100000 (Synthetic rutile)
KMML	Chavara, Distt Kollam, Kerala	92-93% TiO_2 ww	55000 (Synthetic rutile) 60000 (TiO_2 - Chloride Process)
DCW Ltd	Sahupuram, Distt Thoothukudi, Tamil Nadu.	95% TiO_2	42000 (Synthetic rutile)
CMRL	Edayar, Distt Ernakulam, Kerala.	96.5% TiO_2	50000 (Synthetic rutile)
TTPL	Kochuveli, Distt Thiruvananthapuram, Kerala.	97.5% TiO_2	17000 (TiO_2-Sulphate Process)
VVTi Pigments Pvt. Ltd* (formerly Kilburn Chemicals)	Thoothukudi, Tamil Nadu.	98% TiO_2 (min.)	18000 (TiO_2-Sulphate Process)
Kolmark Chemicals Ltd	Kalyani, Distt Nadia, West Bengal.	NA	4800 (TiO_2- Sulphate Process)

Source: Department of Atomic Energy, Mumbai and individual companies

Note: KMML captively consumes synthetic rutile while CMRL and DCW export synthetic rutile

* Including Kilburn Chemicals

USES

About 90% of the world's titanium mineral production is used in the manufacturing of white titanium dioxide pigment. The unique combination of superior properties of high refractive index, low specific gravity, high hiding power and opacity and non-toxicity enable titanium dioxide in its application in the manufacture of all types of white and pastle shades of paints, white-walled tyres, glazed papers, plastics, printed fabrics, flooring materials like linoleum, pharmaceuticals, soaps, face powders and other cosmetic products. Besides, its non-toxic nature facilitate its use in cosmetics, pharmaceuticals, and even in foodstuffs as well as in toothpastes. Titanium dioxide is used in the manufacture of many sunscreen lotions and creams because of its non-toxicity and ultraviolet absorption properties. Synthetic rutile is used for coating welding electrodes as flux component and for manufacture of titanium tetrachloride which in turn is used in making titanium sponge. Synthetic rutile is also used as ingredient of special abrasives. Titanium metal is a versatile material with exceptional characteristics. The lightness, strength and durability of the metal make it an essential metal for the Aerospace Industry. It is also used in desalination and power generation plants and corrosive chemical industries because of its inertness and resistance to corrosion and high thermal conductivity. Its non-reactive property makes titanium metal one of the few materials that can be used in the human body for orthopaedic use and in pacemakers.

CONSUMPTION

The ilmenite consumption is placed at 2,25,100 tonnes in 2019-20 which is lower as compared to the previous year. The bulk of ilmenite is consumed by the Chemical Industry (99 %). Moderate proportions are consumed by Welding Electrode Industry. The consumption of rutile in 2018-19 was 10,500 tonnes as compared to 9,700 tonnes in 2017-18. The entire consumption was reported from Electrode Industry since last two years (Table-7).

Table-7: Consumption* of Ilmenite and Rutile 2017-18 to 2019-20

(By Industries)

(In tonnes)

Industry	2017-18	2018-19 (R)	2019-20 (P)
Ilmenite			
All Industries	**295000 (36)**	**222900 (36)**	**164800 (26)**
Chemicals	294100	222000	163900
Electrode	800	800	900
Others (Ceramic, Ferroalloys)	100	100	-
Rutile			
All Industries	**9700**	**10500**	**NA**
Electrode	9700	10500	NA
Paint	-	-	NA

Figures rounded off.

* Includes actual reported consumption and/or estimates made wherever required.Paucity of data, hence, the coverage may not be complete.

():Number of plants reported/estimated.

POLICY

A notification dated 27.07.2019, was issued for reserving the prospecting and mining rights of offshore minerals under Offshore Areas Minerals (Development and Regulation) Act, 2002 exclusively to Government and Government owned companies for curbing illegal mining of atomic minerals by private parties. The Government of India had notified in October 1998, a policy on exploitation of beach sand minerals in the country, which inter alia allows participation of the Private Sector with or without foreign companies subject to conditions stipulated. This will encourage further exploitation of mineral deposits through a judicious mix of Public & Private Sector participation including foreign collaboration. The ceiling on FDI on mining of titanium minerals has been raised to 100 per cent.

Joint ventures with foreign participation were being pursued by IREL for production of value-added products, keeping in view the Beach Sand Mineral Policy of the Government.

The minerals, ilmenite and rutile, were grouped as 'prescribed substances' as per notifications issued under the Atomic Energy Act, 1962. However, as per the revised list of Prescribed Substances, Prescribed Equipment and Technology notified by Department of Atomic Energy vide S.O.No.61(E), dated 20.1.2006, the titanium ore minerals like ilmenite, rutile and leucoxene have been delisted as prescribed substances by the Department of Atomic Energy subject to the note as below:

"These minerals shall remain prescribed substances only till such time the policy on Exploration of Beach Sand Minerals notified vide Resolution No.8/1(1)/97-PSU/1422, dated 6.10.1998, is adopted/revised/modified by the Ministry of Mines or till 1.1.2007, whichever occurs earlier and shall cease to be so thereafter".

As per notification No 26/2015-2020, the export of Beach Sand Minerals have been brought under State Trading Enterprise (STE) and shall be canalised through Indian Rare Earths Limited (IREL). Beach Sand Minerals, permitted anywhere in the export policy under Sl. No. 98A of Chapter 26 of schedule 2 Export Policy.

As per Gazette Notification No : GSR.134 (E) dated 20.2.2019, the particulars of threshold values for atomic minerals in respect of Beach Sand Minerals (BSM) shall be regulated as Schedule A [Rule 2(1)(m) and Rule 36]of Atomic Mineral Concetion Rules,2016. (Table-7A).

Table - 7 A : Particulars of Threshold Value for Atomic Minerals
[See Rule 2 (1)(m) and Rule 36]

Uranium-bearing tailings left over from ores after extraction of copper and gold, ilmenite and other titanium ores.	60 ppm U_3O_8 and/or 250 ppm ThO_2
Zirconium-bearing minerals and ores including zircon.	All cases of zirconium-bearing minerals occurring in Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e. the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade. In other cases, zircon containing less than 2,000 ppm of Hafnium.
Beach Sand Minerals, i.e., economic heavy minerals found in the teri or beach sand, which include ilmenite, rutile, leucoxene, garnet, monazite, zircon and sillimanite.	All cases of Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e., the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade.

SUBSTITUTES

There are no cost-effective substitutes for titanium dioxide pigments. Synthetic rutile made from ilmenite can be substituted for natural rutile. Nickel steels, stainless steels and some non-ferrous metal alloys can sometimes replace titanium alloys in industrial uses although at the expense of performance or economics. Tungsten carbide competes with titanium carbide for surface cutting machine tools. Titanium slag competes with ilmenite and rutile.

Environmental awareness indicates that titanium dioxide plants are likely to use chloride technology in future as it produces much less quantity of waste products. Synthetic rutile or slag (made from ilmenite) is likely to be used as feed in increasing amount. There is also a strong pressure to reduce the radioactive content of feedstocks because it affects the marketability of beach sand ilmenite. Titanium alloys could be replaced in aerospace applications by lithium-aluminium alloys or carbon-epoxy composites.

WORLD REVIEW

World resources of anatase, ilmenite and rutile are more than 2 billion tonnes. World reserves of ilmenite are estimated at 700 million tonnes in terms of TiO2 content. Major reserves are in China with 230 million tonnes (33%) followed by Australia with 160 million tonnes (22%), India with 85 million tonnes (12%), Brazil with 43 million tonnes (6%), Norway with 37 million tonnes & South Africa with 35 million tonnes (5% each), Canada with 31 million tonnes & Mozambique with 26 million tonnes (4% each) and Madagascar with 22 million tonnes (3%). The world reserves of rutile are 49 million tonnes in terms of TiO2 content. Major rutile reserves are located in Australia with 31 million tonnes (63%), followed by India with 7.4 million tonnes (15%), South Africa with 6.5 million tonnes (13%) and Ukraine with 2.5 million tonnes (5%).

World production of ilmenite and rutile concentrates was 12 million tonnes and 0.58 million tonnes, respectively, in 2020. China and Canada contributed 4.2 million tonnes (35%) and 2.1 million tonnes (17%) of ilmenite production, followed by South Africa with 1 million tonnes (8%), Ukraine with 0.77 million tonnes and Mozmbique with 0.75 million tonnes (6%).

Australia produced 0.15 million tonnes of rutile, contributing 26% of world rutile output, followed by Sierra Leone with 0.11 million tonnes (19%), Ukraine with 0.11 million tonnes (18%), South Africa with 0.10 million tonnes (17%) and Kenya with 0.07 million tonnes (12%). World reserves and production of ilmenite and rutile are furnished in Tables-8 to10.

Table-8: World Reserves of Ilmenite and Rutile

(By Principal Countries)

(In '000 tonnes of contained TiO_2)

Country	Reserves	
	Ilmenite	Rutile
World: Total (Rounded)	700000	49000
China	230000	-
Australia[(a)]	160000	31000
India	85000	7400
Brazil	43000	-
Norway	37000	-
South Africa[(d)]	35000	6500
Canada[(d)]	31000	-
Mozambique	26000	890
Madagascar[(d)]	22000	400
Ukraine	5900	2500
USA[(b)(c)]	2000	-
Kenya	390	170
Senegal	NA	NA
Sierra Leone	-	490
Vietnam	1600	-
Other countries	26000	NA

Source: USGS, Mineral Commodity Summaries, 2022

a:Joint Ore Reserves Committee- compliant reserves for ilmenite and rutile were estimated to be 38 million and 9.4 million tonnes respectively

b:Rounded to nearest 1,00,000 tonnes to avoid disclosing company proprietary data

c:US rutile reserves data are included with ilmenite.

d: Mine production is primarily used to produce titaniferous slag

Table-9: World Production of Ilmenite

(By Principal Countries)

(In '000 tonnes)

Country	2018	2019	2020
World: Total (Wt of Conc.)	12242	12722	12193
China	4200	4200	4200
Canada	2000	2100	1900
South Africa	765	1100	1000
Ukraine	745	818	773
Mozambique	958	892	756
Australia	569	596	634
Norway	630	630	630
Senegal	506	491	505
Madagascar	381	461	424
Kenya	463	352	334
Other countries	1021	1079	1036

Source: BGS, World Mineral Production,2016-2020.

*:Estimate

a:Canada produces some ilmenite which is sold as such and not processed into slag, but tonnages are small

b:It is believed that the majority of this is processed in to slag

c:Years ended 30 June of that stated

d:Years ended 31 March following that stated

m:Including natural rutile

Table-10: World Production of Rutile

(By Principal Countries)

(In '000 tonnes)

Country	2018	2019	2020
World: Total (wt of conc)	657	635	585
Australia[(c)]	209	154	156
Sierra Leone	108	136	116
Ukraine	106	115	110
South Africa	103	110	100
Kenya	98	85	72
India	11	11	11
Madagascar	5	6	6
Mozambique	8	8	5
Malaysia	5	5	5
Sri Lanka	2	1	1

Source : BGS, World Mineral Production,2016-2020.

c: Years ended 30 June of that stated.

d: Years ended 31 March following that stated

* : Estimated

Metal

Commercial production of titanium metal involves the chlorination of titanium-containing mineral concentrates to produce titanium tetrachloride ($TiCl_4$), which is reduced with magnesium (Kroll process) or sodium (Hunter process) to produce a commercially pure form of titanium metal. The metal formed has a porous appearance and is referred to as sponge. Titanium ingot and slab are produced by melting titanium sponge or scrap or a combination of both, usually with various other alloying elements.

Pigment

Global TiO_2 pigment production capacity was estimated to be 5.7 million tonnes per year. TiO_2 pigment produced is categorised by crystal form as either anatase or rutile. Rutile pigment is less reactive with the binders in paint when exposed to sunlight than the anatase pigment and is preferred substance in outdoor paints. Anatase pigment has a bluer tone than rutile, is somewhat softer and is used mainly in indoor paints and in paper manufacturing. Depending on the manner in which it is produced and subsequently finished, TiO_2 pigment can exhibit a wide range of functional properties, including dispersion, durability, opacity and tinting.

FOREIGN TRADE

Exports

Exports of titanium ores & conc. increased to 0.24 million tonnes during 2020-21 from 0.24 million tonnes in the preceding year. Exports were mainly to China (38%), Japan (26%), Republic of Korea (13%), Belgium (12%) and Malaysia (9%) (Fig-3).

Exports of titanium and alloys (including waste & scrap) were at 253 tonnes, registering an decrease of 52% from 486 tonnes in the previous year. Exports were mainly to Russia (20%), USA (19%) and Republic of Korea (9%). Exports of titanium oxide and dioxide (total) decreased by 27% to 28,419 tonnes in 2020-21 from 38,506 tonnes in the preceding year (Fig-4). Out of the total exports in 2020-21, those of titanium dioxide were 6481 tonnes and exports of titanium oxides (other than titanium dioxides) were 21,938 tonnes (Tables-11 to 18).

Table-12: Exports of Titanium Ores & Conc. (Ilmenite)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**246179**	**4992946**	**246534**	**5348321**
Japan	71337	2407794	65624	2134372
China	87300	1166713	95596	1767412
Malaysia	3484	311364	22314	504675
Korea, Rep. of	44000	579319	33000	489294
Belgium	40000	525768	30000	452568
Bangladesh	24	1041	-	-
Kenya	14	323	-	-
Qatar	7	186	-	-
UAE	7	166	-	-
Taiwan	5	141	-	-
Other countries	1	131	-	-

Figures rounded off.

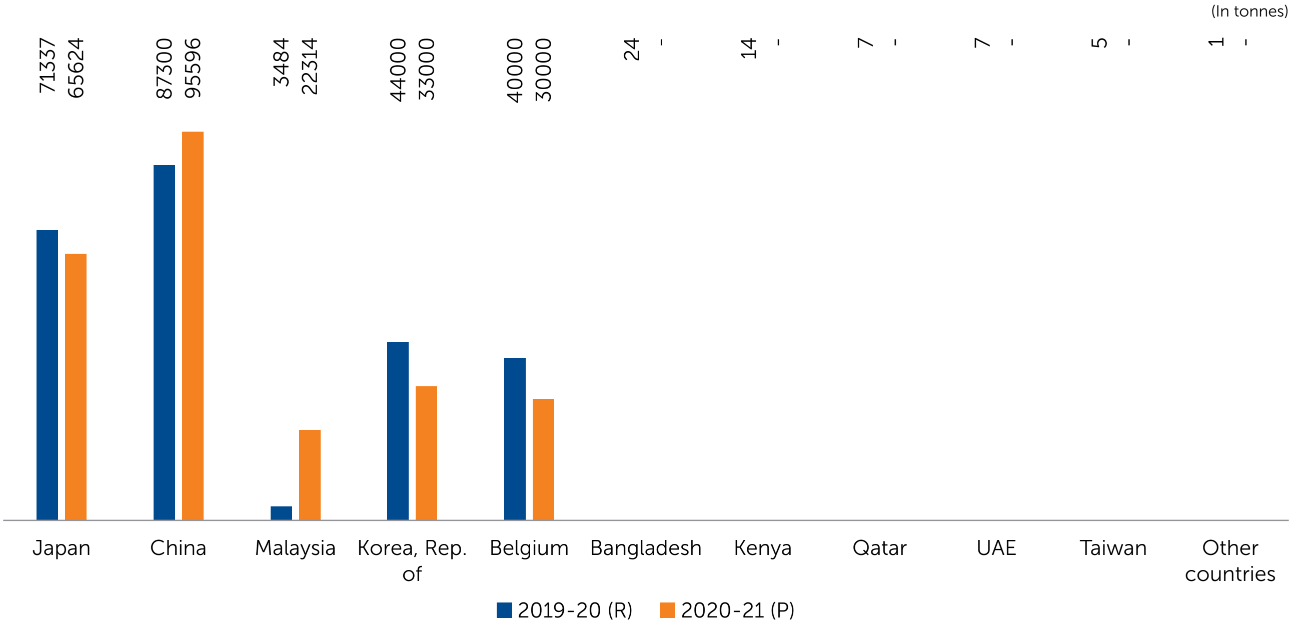


Fig 3: Countrywise Exports of Titanium Ores & Conc.

Table-12: Exports of Titanium Ores & Conc. (Ilmenite)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**246179**	**4992946**	**246534**	**5348321**
Japan	71337	2407794	65624	2134372
China	87300	1166713	95596	1767412
Malaysia	3484	311364	22314	504675
Korea, Rep. of	44000	579319	33000	489294
Belgium	40000	525768	30000	452568
Bangladesh	24	1041	-	-
Kenya	14	323	-	-
Qatar	7	186	-	-
UAE	7	166	-	-
Taiwan	5	141	-	-
Other countries	1	131	-	-

Figures rounded off.

Table-13: Exports of Titanium Ores & Conc. (Rutile)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**16**	**2000**	**++**	**2**
UAE	2	242	++	2
UK	7	829	-	-
Cyprus	5	610	-	-
Pakistan	2	296	-	-
Egypt	++	23	-	-
Nepal	++	++	-	-

Figures rounded off.

Table-14: Exports of Titanium Ores & Conc. (Others)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**8**	**817**	**-**	**-**
Brazil	7	812	-	-
Sri Lanka	1	5	-	-

Figures rounded off.

Table-15: Exports of Titanium & Alloys

(Incl. Waste & Scrap)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**486**	**546039**	**253**	**443579**
Turkey	4	16499	7	124135
Russia	128	204663	50	77552
Israel	1	44101	4	44775
Indonesia	++	486	31	33614
USA	116	29684	49	24311
Korea, Rep. of	98	86285	24	17920
UK	14	12934	8	14795
Finland	1	10598	3	13780
France	3	17285	1	13156
Japan	-	-	25	12748
Other countries	121	123504	51	66793

Figures rounded off.

Table-16: Exports of Titanium Oxide & Dioxide : Total
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	38506	3779067	28419	2990597
Japan	30544	2612449	16183	1513268
USA	2270	377398	2518	438301
China	++	82	5078	352282
Italy	1032	186369	1220	241144
Malaysia	2268	181340	1517	101894
Egypt	186	56135	178	38318
Nepal	125	25000	152	31846
Sri Lanka	160	26763	157	25509
Spain	420	73139	140	25477
Bahrain	40	7537	120	24440
Other countries	1465	232855	1156	198118

Figures rounded off.

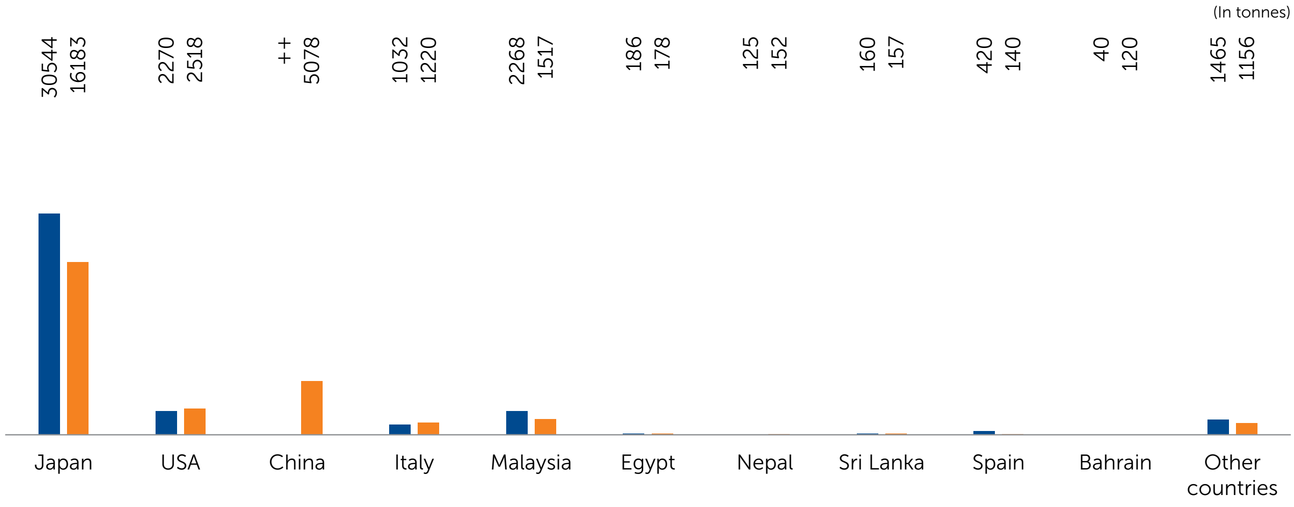


Fig 4: Countrywise Exports of Titanium Oxide & Dioxide : Total

Table-17: Exports of Titanium Dioxide
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	6231	1065352	6481	1152120
USA	2250	375637	2464	432755
Italy	1032	186369	1220	241144
Japan	1122	161844	1135	158562
Nepal	123	24631	125	27309
Sri Lanka	121	20909	148	25070
Bahrain	40	7537	120	24440
Spain	420	73139	120	24101
Egypt	96	15661	142	22752
UAE	178	27619	113	22252
Iran	138	37777	102	21620
Other countries	711	134229	792	152115

Figures rounded off.

Table-18: Exports of Titanium Oxide (Other than Titanium Dioxide)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	32275	2713715	21938	1838477
Japan	29418	2450605	15048	1354706
China	++	17	5026	332038
Malaysia	2268	181335	1515	101371
Egypt	90	40474	36	15566
Mexico	20	3638	40	7691
USA	20	1761	54	5546
Brazil	146	9673	85	5315
Nepal	2	369	27	4537
Turkey	74	5968	29	3462
Tanzania	31	2228	38	2986
Other countries	206	17647	40	5259

Figures rounded off.

Imports

Imports of titanium ores & conc. decreased drastically by 43% to 78,747 tonnes in 2020-21 from 1,38,042 tonnes in the preceding year. Imports were mainly from Mozambique (53%), Norway (9%), Australia (3%) and Thailand (5%) (Fig-5).

Imports of titanium and alloys (including waste & scrap) were 8,875 tonnes in 2020-21 as compared to 8,347 tonnes in the previous year. Imports were mainly from USA (30%), China (15%), Japan (9%) and Singapore (8%). Imports of titanium oxide and dioxide (total) were 13,514 tonnes in 2020-21 as compared to 16,591 tonnes in the preceding year. Imports were mainly from Republic of Korea (42%), China (32%), and Japan (6%). Bulk of these imports were of titanium dioxide (13,389 tonnes) and titanium oxides (other than titanium oxides) were 125 tonnes in 2020-21 (Tables - 19 to 26).

Table-19: Imports of Titanium Ores & Conc. : Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	138042	3965292	78747	3440562
Mozambique	91132	1614268	42300	855800
USA	725	27509	4452	363880
Thailand	3483	237875	4537	331018
China	4155	350068	3188	295112
Australia	4844	422285	2966	252003
UAE	46	3372	2440	204925
Netherlands	2533	88994	6977	204437
Sri Lanka	4781	330561	2335	189085
Brazil	++	6	2160	183593
Ukraine	1680	155318	1714	164630
Other countries	24663	735036	5678	396079

Figures rounded off.

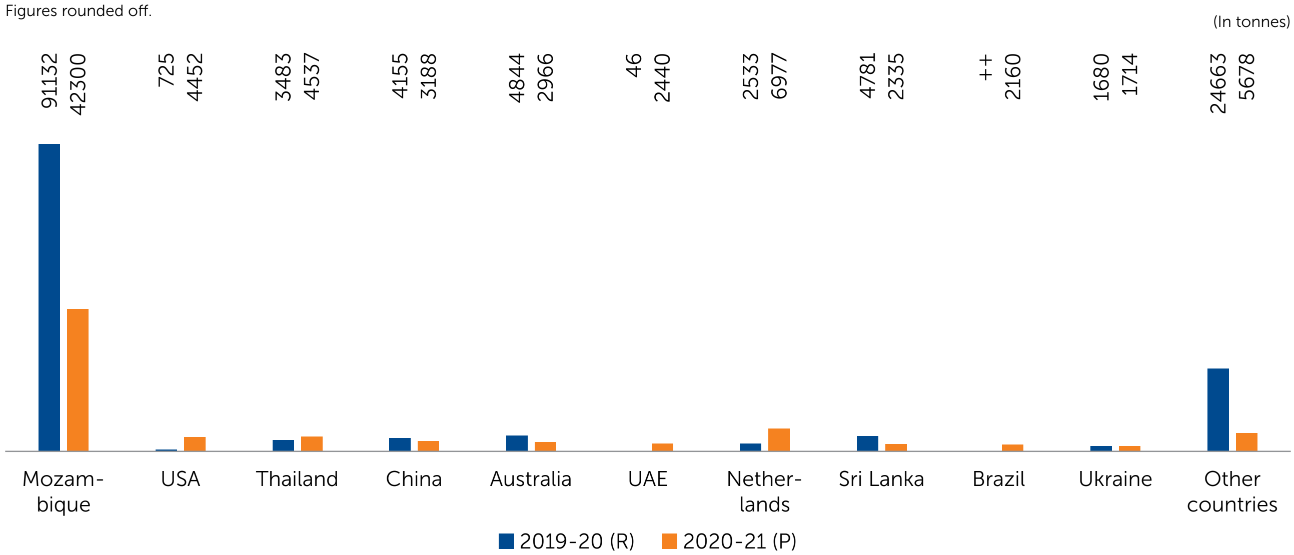


Fig 5: Countrywise Imports of Titanium Ores & Conc. : Total

Table-20: Imports of Titanium Ores & Conc. (Ilmenite)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	109771	1963147	43894	907344
Mozambique	91132	1614268	41624	796023
Sri Lanka	1294	94928	898	69473
Vietnam	25	1874	250	20703
Malaysia	1710	20130	946	12893
China	20	1063	120	6904
Ukraine	-	-	56	1348
Norway	15538	229440	-	-
Sierra Leone	26	727	-	-
Netherlands	26	711	-	-
Brazil	++	6	-	-
Other countries	-	-	-	-

Figures rounded off.

Table-21: Imports of Titanium Ores & Conc. (Rutile)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	20589	1689194	29562	2224774
USA	234	18905	4212	347314
Thailand	3483	237875	4537	331018
China	3199	275464	2392	225104
UAE	46	3319	2440	204925
Brazil	-	-	2160	183593
Australia	4224	372804	1856	164402
Netherlands	646	56191	5333	163365
Ukraine	1652	152615	1602	157659
South Africa	2212	199534	1636	150260
Sri Lanka	2435	220131	1124	114540
Other Contries	2458	152356	2270	182594

Figures rounded off.

Table-22: Imports of Titanium Ores & Conc. (Others)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	7682	312951	5291	308444
Australia	620	49481	1110	87601
Senegal	980	67577	1080	81475
China	936	73541	676	63104
Netherlands	1861	32092	1644	41072
USA	491	8604	240	16566
UK	-	-	88	6801
Ukraine	28	2703	56	5623
Sri Lanka	1052	15502	313	5072

Figures rounded off.

Table-23: Imports of Titanium & Alloys (Incl. Waste & Scrap)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	8347	7448533	8875	5480218
China	1445	2130090	1349	1603114
USA	2448	1479858	2683	1077148
Japan	1051	1119974	877	454878
UK	240	569578	224	347683
Germany	225	526619	259	332159
Italy	365	304899	554	302330
Belgium	18	8917	242	193844
Singapore	742	177512	769	180260
Netherlands	110	92193	149	154954
France	75	264565	69	154026
Other countries	1628	774328	1700	679822

Figures rounded off.

Table-24: Imports of Titanium Oxide & Dioxide : Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	16591	3164190	13514	2579284
Korea, Rep. of	6350	991895	5678	939060
China	5521	928826	4359	727242
Germany	571	161576	720	217144
Japan	838	252812	862	215069
Belgium	566	139462	484	128415
Netherlands	1780	443328	393	114442
Hong Kong	66	8679	452	80621
Canada	129	42684	176	63772
Taiwan	200	49685	107	29672
Russia	120	18027	140	19631
Other countries	450	127216	143	44216

Figures rounded off.

Table-25: Imports of Titanium Dioxide

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	16416	3082535	13389	2510726
Korea, Rep. of	6350	991895	5678	938957
China	5464	916752	4322	720044
Germany	570	148788	719	202767
Japan	773	218707	796	177150
Belgium	526	130055	464	123286
Netherlands	1780	443324	393	114442
Hong Kong	66	8679	452	80621
Canada	129	42684	176	63772
Taiwan	200	49685	107	29672
Russia	120	18027	140	19631
Other countries	438	114539	142	40384

Figures rounded off.

Table-26: Imports of Titanium Oxide (Other than Titanium Dioxide)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	175	81655	125	68558
Japan	65	34705	66	37919
Germany	1	12788	1	14377
China	57	12074	37	7198
Belgium	40	9407	20	5129
France	1	3558	++	1687
UK	++	751	1	1542
Sweden	-	-	++	226
USA	10	7772	++	190
Poland	++	108	++	119
Korea, Rep. of	-	-	++	103
Other countries	1	492	++	68

Figures rounded off.

FUTURE OUTLOOK

As per Technology Vision Document 2035, the demand for titanium in India would be approximately 1,000 tonnes by 2035. The contribution to the demand would be from Space Sector (100 tonnes), General Engineering (50 tonnes), Atomic Energy (125 tonnes), Aeronautical (50 tonnes), Power Generation (150 tonnes), Petroleum Refinery (50 tonnes) and Chemical Industry (475 tonnes).

As per data available, the defence, atomic energy and space research which are critical sectors have been assigned targets to increase communication set-up, safeguard India's security with modern arms, ammunitions & control and to increase power generation by three-fold. For meeting these targets, Indian Engineering Industry will dependent on input materials like titanium sponge. Titanium sponge was not available in India till 2012, the first ever commercially indigenously made Ti-sponge was released as late as 2013 at KMML, Chovara Kerala, with the support of ISRO. However, with the successful commissioning of the titanium sponge plant, India has joined the elite club of seven countries capable of producing aerospace-grade titanium sponge. The plant has the basic infrastructure for increasing the capacity to 1,000 tpa in future with sponge to metal yield at 35%, the requirement of titanium sponge on a conservative estimate would be 2,500 tpa for India. The gap, therefore, will remain and would have to be met by import. The plant capacity now will be just sufficient to serve Strategic Industry like the indigenous space & defence programmes.

Titanium Sponge Industry is get to come out of the input of the pandemic as its demand is mainly depend on the aviation sector which is badly affected due to the pendemic restrictions.Global demand growth for TiO2 is expected to trend with the prospects of economic growth and production of paint, paper and plastics.

Aerospace, defence and industrial uses are expected to strongly influence the consumption of titanium metal in the near future.

The impetus by the Government for renewal energy and infrastructure, however, augurs well for demand for steel and that for IREL's rutile which finds application in production of welding electrodes.

16. Iron Ore

24,057
(million tonnes) Total reserves/ resources of haematite were estimated as on 1st April 2020

204.48
(million tonnes) Production of iron ore were reported in 2020-21

57.72
(million tonnes) of iron ore were exported in 2020-21

0.76
(million tonnes) of iron ore were imported in 2020-21

Iron & steel is the driving force behind industrial development in any country. The vitality of the Iron & Steel Industry largely influences a country's economic status. The mining of iron ore, an essential raw material for Iron & Steel Industry is arguably of prime importance among all mining activities undertaken by any country. With the total resources of over 33.276 billion tonnes of haematite (Fe_2O_3) and magnetite (Fe_3O_4), India is one of the leading producers of iron ore in the world.

RESERVES/RESOURCES

Haematite and magnetite are the most important iron ores in India. About 79% haematite ore deposits are found in the Eastern Sector (Assam, Bihar, Chhattisgarh, Jharkhand, Odisha & Uttar Pradesh) while about 93% magnetite ore deposits occur in Southern Sector (Andhra Pradesh, Goa, Karnataka, Kerala & Tamil Nadu). Karnataka alone contributes 72% of magnetite deposit in India. Of these, haematite is considered to be superior because of its higher grade. Indian deposits of haematite belong to the Precambrian Iron Ore Series and the ore is within banded iron ore formations occurring as massive, laminated, friable and also in powdery form.

As per NMI database based on UNFC system, the total reserves/resources of haematite as on 1.4.2020 have been estimated at 24,057 million tonnes of which 6,209 million tonnes (25.80%) are under 'Reserves' category and the balance 17,848 million tonnes (74.20%) are under 'Remaining Resources' category. By grades, Lumps constitute about 45% followed by Lumps with Fines (26%), Fines (13%), and the remaining 15% are Black Iron ore, Beneficiable grade, Others, Unclassified, Not-known and Lumps & fines & blue dust unclassified grade.

Major reserves/resources of haematite are located in Odisha (9,409 million tonnes or 39%), Jharkhand (4,710 million tonnes or 20%), Chhattisgarh (4,592 million tonnes or 19%), Karnataka (2,835 million tonnes or 12%) and Goa (1,197 million tonnes or 5%). The balance 5% resources of haematite are spread in Andhra Pradesh, Assam, Bihar, Madhya Pradesh, Maharashtra,Meghalaya, Rajasthan, Telangana and Uttar Pradesh (Table-1).

Table-1 : Reserves/Resources of Iron Ore (Haematite) as on 1.4.2020 (P)

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon-naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	4559856	508158	1141020	6209034	3181005	2404790	2005363	1010484	1805532	4827512	2614185	17848870	24057905
By Grades													
Lump, high grade	773270	7710	51205	832185	457627	114235	150606	40724	31400	141760	3742	940095	1772279
Lump, medium grade	1066104	59274	307207	1432585	1140155	335227	594409	243736	601353	1180044	93864	4188788	5621372
Lump, low grade	594586	8710	83034	686331	309262	200290	67277	222298	316657	1025039	247723	2388547	3074877
Lump, unclassified grade	194	-	16	210	54880	28	7782	16768	31742	112248	22800	246248	246459
Fines, high grade	146830	-	-	146830	7222	1592	4849	44930	8451	147	-	67192	214022
Fines, medium grade	76699	9401	61729	147829	38835	235664	46988	170724	268811	442248	932	1204201	1352029
Fines, low grade	122319	7765	18216	148301	224999	190987	98102	21053	161961	505004	6212	1208318	1356619
Fines, unclassified grade	300	190	-	490	343	341	-	8734	12610	78658	15200	115885	116375
Lumps & fines high grade	244340	117770	109568	471678	57490	92283	44972	16730	602	154257	112375	478709	950387
Lumps & fines medium grade	675056	92861	248507	1016424	175016	327566	73775	92791	28418	203097	240896	1141559	2157983
Lumps & fines low grade	494490	7347	196706	698544	400738	721773	660343	50884	53254	459916	88688	2435597	3134141
Lumps & fines unclassified	120995	51430	15719	188144	70934	17172	24675	1061	6543	29174	4101	153661	341805
Black iron ore	-	-	-	-	7017	3014	1355	-	1059	6661	-	19106	19106
Beneficiable grade	98514	139886	32121	270521	144495	114029	164994	72012	280639	242950	99318	1118438	1388959
Others	20546	-	3360	23905	15825	8913	16996	-	332	10774	745	53585	77490
Unclassified	68922	3824	13393	86138	57610	19631	39663	5495	1548	53912	152046	329906	416044
Not-known	1330	-	239	1569	621	20000	2992	-	151	180168	1524850	1728782	1730351
Lumps & fines & blue dust													
low grade	-	-	-	-	-	-	410	-	-	1437	0	1847	1847

Contd...

Table-1 *(Concld)*

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon-naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Lumps & fines & blue dust unclassified grade	55361	1990	-	57351	17935	2046	5175	2543	-	16	692	28408	85759
By States													
Andhra Pradesh	32893	-	11851	44744	42461	68382	66330	377	5863	144374	23085	350872	395616
Assam	-	-	-	-	-	-	-	-	8600	22290	-	30890	30890
Bihar	-	-	-	-	-	-	-	-	-	55	-	55	55
Chhattisgarh	1289443	99927	204363	1593732	348648	17215	46166	171548	552653	993652	868497	2998379	4592111
Goa	96558	7666	13012	117235	435300	255162	182675	22126	12727	166631	5701	1080322	1197557
Jharkhand	388078	16760	129839	534677	324634	902980	814308	101700	122673	617586	1291588	4175469	4710146
Karnataka	897256	39779	106177	1043212	330334	46621	84816	592180	62882	504234	171714	1792781	2835992
Madhya Pradesh	24363	11326	18440	54129	30076	15080	29885	12613	3993	151523	59700	302870	356999
Maharashtra	9464	2124	3653	15241	1672	6632	9191	81116	95545	59673	32474	286304	301544
Meghalaya	-	-	-	-	-	-	-	-	-	225	-	225	225
Odisha	1817247	328296	653206	2798749	1662944	1068654	770861	28824	925717	2019410	134173	6610582	9409331
Rajasthan	4555	2280	479	7314	3775	3962	1132	-	11510	7776	13	28166	35480
Telangana	-	-	-	-	1162	102	-	-	3370	73754	27240	105627	105627
Uttar Pradesh	-	-	-	-	-	20000	-	-	-	66330	-	86330	86330

Figures rounded off.

Magnetite is another principal iron ore that also occurs in the form of oxide,either in igneous or metamorphosed banded magnetite-silica formation. As per NMI database based on UNFC system, the total reserves/resources of magnetite as on 1.4.2020 have been estimated at 11,227 million tonnes of which 'Reserves' constitute a 202 million tonnes while 11,024 million tonnes are placed under 'Remaining Resources'. Classification on the basis of grades shows that 20% resources are of Metallurgical grade while 80% resources belong to grades that are categorised as Unclassified, Not-known and Coal Washery. The resources of others and Foundry grades constitute meagre proportions. India's 96.70% magnetite reserves/ resources are located in five States, namely, Karnataka (7,802 million tonnes or 69.50%) followed by Andhra Pradesh (1,472 million tonnes or 13.10%), Rajasthan (794 million tonnes or 7.10%), Tamil Nadu (528 million tonnes or 4.70%) and Goa (266 million tonnes or 2.30%). Assam, Bihar, Chhattisgarh, Jharkhand, Kerala, Maharashtra, Meghalaya, Nagaland, Odisha and Telangana together account for the remaining 3.30% resources (Table-2).

Table – 2 : Reserves/Resources of Iron Ore (Magnetite) as on 1.4.2020 (P)

(By Grades/States)

(In '000 tonnes

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India: Total	71930	385	130508	202823	307652	16082	72127	1513168	2036982	6383274	695507	11024791	11227614
By Grades													
Metallurgical	231	65	19	315	165948	24	21583	690596	391192	968646	255	2238244	2238559
Coal washery	35972	-	82706	-118678	-	518	1981	411	318	41545	79596	124368	243045
Foundry	-	-	-	-	330	125	-	-	-	381	-	836	836
Beneficiable	-	-	-	-	-	-	-	-	4016	23602	9180	36798	36798
Others	909	-	443	1351	3796	985	170	-	-	1791	-	6923	8274
Unclassified	34818	320	47341	82479	65421	13720	48387	822161	1641456	5066985	606428	8264559	8347038
Not-known	-	-	-	-	71978	709	6	-	-	280324	48	353064	353064
By States													
Andhra Pradesh	-	-	-	-	114210	-	-	13800	1266666	68527	9180	1472383	1472383
Assam	-	-	-	-	-	-	-	-	-	15380	-	15380	15380
Bihar	-	-	-	-	-	-	-	-	48850	589	-	49439	49439
Chhattisgarh	29319	-	46557	75876	12263	-	17782	-	-	-	-	30045	105921
Goa	4364	-	626	4990	59509	14516	33512	-	-	151811	1997	261345	266336
Jharkhand	-	-	-	-	-	518	1986	411	3948	3722	82	10667	10667
Karnataka	133	185	-	318	120131	-	18375	1498957	479372	5345018	340000	7801853	7802171
Kerala	-	-	-	-	-	-	-	-	59912	23523	-	83435	83435
Maharashtra	481	65	32	578	329	24	267	-	-	590	-	1210	1788
Meghalaya	-	-	-	-	-	-	-	-	-	3380	-	3380	3380
Nagaland	-	-	-	-	-	-	-	-	5280	-	-	5280	5280
Odisha	-	-	-	-	79	-	120	-	-	43	-	242	242
Rajasthan	376631	136	83294	121060	1131	1023	85	-	3566	588463	79595	673866	794926
Tamil Nadu	-	-	-	-	-	-	-	-	169388	110728	248785	528901	528901
Telangana	-	-	-	-	-	-	-	-	-	71500	15866	87366	87366

Figures rounded off.

EXPLORATION & DEVELOPMENT

The Exploration & Development details, if any, are covered in the Review "Exploration & Development" in Volume-I of Indian Minerals Yearbook titled "General Reviews".

PRODUCTION

The production of iron ore constituting lumps, fines and concentrates was 204.48 million tonnes in the year 2020-21, showing an decrease of about 16.22% as compared to that in the preceding year. There were 273 reporting mines in 2020-21 as against 271 in the previous year. Out of the total, 41 mines were in the Public Sector and 232 in Private Sector. Besides, production of iron ore was reported as associated mineral by 8 mines in 2020-21 which is same compared to 2019-20. The contribution of Public Sector to the total production was about 37.19% as against about 29.03% in the preceding year. The remaining 62.81% of the production in 2020-21 was from Private Sector. Among 41 iron ore mines in Public Sector, 19 iron ore mines each producing more than one million tonnes annually accounted for about 96.06% of the total output in Public Sector during 2020-21. Out of 232 iron ore mines and 8 associated mines in Private Sector, 34 iron ore mines each producing more than one million tonnes annually accounted for about 84.31% of the total output of Private Sector during the year. Thus, 53 iron ore mines, each producing more than one million tonnes of iron ore annually, contributed about 88.68% of the total output in 2020-21. The captive mines reported production of 83.01 million tonnes comprising about 40.60% of total production and non-captive mines reported production of 121.46 million tonnes, i.e., about 59.40% during 2020-21.

Gradewise analysis of the current year's output reveals that out of total output of 204.48 million tonnes, iron ore lumps constituted 61.59 million tonnes (i.e., about 30.12%), fines constituted 141.70 million tonnes (i.e., about 69.30%) and concentrates constituted 1.19 million tonnes (i.e., about 0.58%).

Among the States, Odisha recorded the highest production of 104.63 million tonnes, i.e., about 51.17% of the country's total production in 2020-21. Chhattisgarh was at the second place with a production of 36.98 million tonnes, i.e., about 18.09% of the total production followed by Karnataka with a production of 34.54 million tonnes, i.e., about 16.89% and Jharkhand with 21.43 million tonnes, i.e. about 10.48% of the country's production. The remaining 6.90 million tonnes, i.e., 3.37% production was reported from Andhra Pradesh, Goa, Madhya Pradesh, Maharashtra, Rajasthan and Telangana (Tables 3 to 6) (Fig-1).

STOCKS AT MINE-HEAD

The mine-head closing stocks of iron ore for the year 2020-21 were 120.97 million tonnes as compared to 146.71 million tonnes in 2019-20 (Tables 7A & 7B).

EMPLOYMENT

The average daily employment of labour was 42,742 during 2020-21 as against 45,687 in the preceding year.

Table-3: Principal Producers of Iron ore 2020-21

Name & address of producers	Location of mine	
	State	District
National Mineral Development Corporation Ltd 10-3-311/A, Khanij Bhavan, Castle Hills, Masab Tank, Hyderabad –500 028	Chhattisgarh Karnataka	Dantewada Ballari
Steel Authority of India Ltd Ispat Bhavan, Lodhi Road, New Delhi – 110 003	Chhattisgarh Jharkhand Odisha	Durg Singhbhum (West) Keonjhar Sundargarh
Tata Steel Ltd, Bombay House, 24, Homi Mody Street, Fort, Mumbai – 440 001, Maharashtra	Jharkhand Odisha	Singhbhum (West) Keonjhar
JSW Steel Ltd, Jsw Centre Bandra Kurla Complex, Bandra (East) - Mumbai-400051, Maharashtra	Karnataka	Ballari
Rungta Sons (P) Ltd, 8A Express Tower, 42 A-Shakespeare Sarani, Kolkata – 700 017, West Bengal	Jharkhand Odisha	Singhbhum (West) Keonjhar
Odisha Mining Corporation Ltd, OMC House, Unit-5, P.B. No.34 Distt Khurda, Bhubaneswar-751 001, Odisha	Odisha	Keonjhar Sundargarh
Sarda Mines (P) Ltd, Room No. 64, 6th Floor, Circular Court,8-AJC Bose Road, Kolkata- 700 017, West Bengal	Odisha	Keonjhar
Essel Mining & Industries Ltd Industry House, 18th Floor, 10 Camac street,	Odisha	Sundargarh Keonjhar

Contd...

Table-3 *(Contd)*

Name & address of producers	Location of mine	
	State	District
Kolkata-700 017 West Bengal.		
Vedanta Ltd Sesa Ghor, EDC complex, Patto, Panaji, Tisavadi-403 001 Goa	Karnataka	Chitradurga
ArcelorMittal India Pvt. Ltd office No.126 101-104,GCP Business Centre Opp. Memnagar Fire Station, Vijay Cross Road, Memnagar, Ahmedabad-380014 Gujarat	Odisha	Keonjhar
Indrani Patnaik, A/6, Commercial Estate, Civil Township,	Odisha	Keonjhar

Contd...

Table-3 *(Concld)*

Name & address of producers	Location of mine	
	State	District
Rourkela - 769 004 Odisha		
Mysore Minerals Limited, A Block, 5th floor, Santhinagar, Bangaluru – 560 027, Karnataka	Karnataka	Ballari
Jindal Steel & Power Ltd O.P. Jindal Marg, Delhi Road, Hissar - 125 005 Haryana	Odisha	Sundargarh
Serajuddin & Co, P-16, Bentink Street, Kolkata- 700069 West Bengal	Odisha	Keonjhar
Sri Kumaraswamy Minerals Exporters, NO. 24, 2nd Link Road, Parvathi Nagar, Ballari- 583102, Karnataka	Karnataka	Ballari

Table-4: Production of Iron Ore, 2018-19 to 2020-21

(By States)

(Quantity in '000 tonnes; Value in '000)

States		2018-19		2019-20		2020-21 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
India	Total	206494	453465829	244083	496430578	204481	493959913
	Lumps	66679	192771883	76012	195781171	61590	189609204
	Fines	138355	255838795	166889	296322689	141701	299980089
	Concentrates	1460	4855151	1182	4326718	1190	4370620
Andhra Pradesh	**Total**	**654**	**402616**	**825**	**613393**	**360**	**275300**
	Lumps	362	269587	508	424030	219	193085
	Fines	292	133029	317	189363	141	82215
Chhattisgarh	**Total**	**34893**	**96985465**	**34728**	**99153323**	**36989**	**134222836**
	Lumps	11657	34056295	12191	38230890	12686	52484987
	Fines	23236	62929170	22537	60922433	24303	81737849
Goa	**Total**	**-**	**-**	**-**	**-**	**94**	**181419**
	Lumps	-	-	-	-	31	60320
	Fines	-	-	-	-	63	121099
	Concentrates	-	-	-	-	-	-
Jharkhand	**Total**	**23433**	**27673520**	**25015**	**29411760**	**21434**	**25694610**
	Lumps	6272	8506371	6954	9627055	4827	6689282
	Fines	17161	19167149	18061	19784705	16607	19005328
Karnataka	**Total**	**29823**	**71114250**	**31392**	**67326043**	**34542**	**85430466**
	Lumps	9175	27209485	3248	25077852	10137	32995840
	Fines	20648	43904765	22144	42248191	24405	52434626

Contd...

Table-4 *(Concld)*

States		2018-19		2019-20		2020-21 (P)	
		Quantity	Value	Quantity	Value	Quantity	Value
Madhya Pradesh	**Total**	**2802**	**1448203**	**3343**	**1729068**	**4094**	**2165967**
	Lumps	535	272805	1467	687760	859	470699
	Fines	2267	1175398	1876	1041308	3235	1695268
	Concentrates	-	-	-	-	-	-
Maharashtra	**Total**	**660**	**936022**	**1131**	**1340244**	**1249**	**1680086**
	Lumps	283	447395	93	197711	113	268184
	Fines	377	388627	1038	1142533	1136	1411902
Odisha	**Total**	**113119**	**251111210**	**146637**	**293179734**	**104631**	**240326857**
	Lumps	38238	121963240	45363	121484813	32661	96411951
	Fines	74374	128140568	100916	170994093	71810	143490894
	Concentrates	507	1007402	358	700828	160	424012
Rajasthan	**Total**	**1108**	**3893253**	**1012**	**3677013**	**1088**	**3982372**
	Lumps	155	45415	188	51060	57	34856
	Fines	++	89	++	63	1	908
	Concentrates	953	3847749	824	3625890	1030	3946608
Telangana	**Total**	**2**	**1290**	-	-	-	-
	Lumps	2	1290	-	-	-	-
	Fines	-	-	-	-	-	-

(In '000 tonnes)

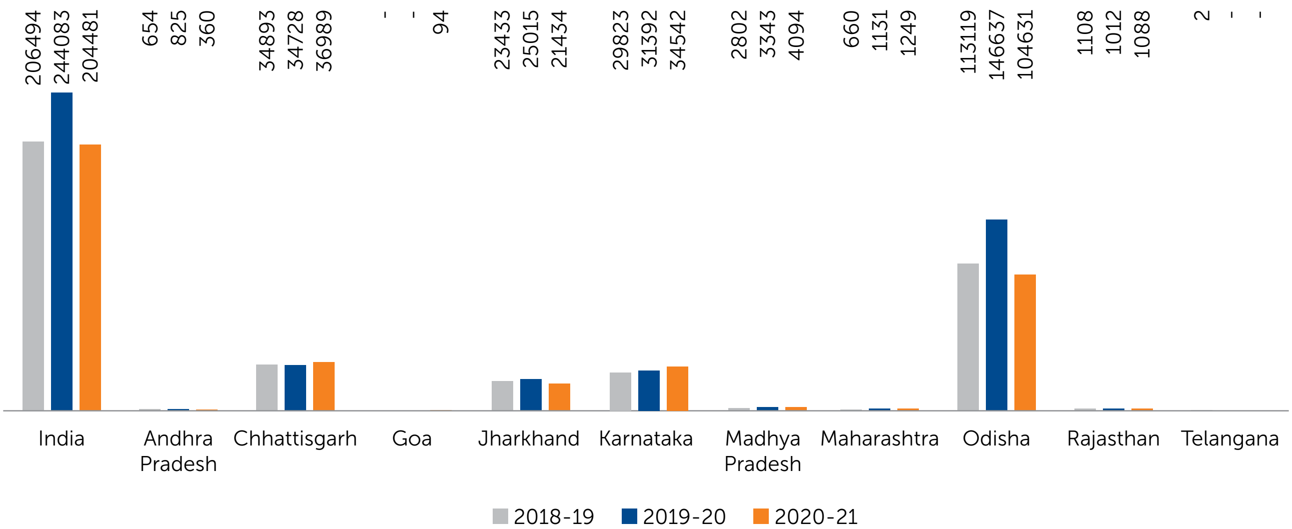


Fig 2: Statewise Production of Iron ore

Table-5 (A): Production of Iron Ore, 2020-21
(By Sectors/States/Districts/Grades)

(Quantity in '000 tonnes; Value in '000)

Sector/ State/ District	No. of Mines	Lumps						Total		Fines						Total		Concentrates		Total	
		Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Qty	Value	Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Qty	Value	Qty	Value	Qty	Value
India	273(8)	3463	1942	6023	9300	24759	16103	61590	189609204	11150	17891	12857	30194	48947	20662	141701	299980089	1190	4370620	204481	493959913
Public Sector	41	82	153	327	3271	13712	9089	26634	95933571	209	1114	1769	17115	22599	6618	49424	126244809	-	-	76058	222178380
Private Sector	232(8)	3381	1789	5696	6029	11047	7014	34956	93675633	10941	16777	11088	13079	26348	14044	92277	173735280	1190	4370620	128423	271781533
Andhra Pradesh	12	219	-	-	-	-	-	219	193085	141	-	-	-	-	-	141	82215	-	-	360	275300
Anantapur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cuddapah	3	213	-	-	-	-	-	213	188342	140	-	-	-	-	-	140	81309	-	-	353	269651
Krishna	1	-	-	-	-	-	-	-	-	++	-	-	-	-	-	++	35	-	-	++	35
Kurnool	7	6	-	-	-	-	-	6	4743	1	-	-	-	-	-	1	871	-	-	7	5614
Nellore	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prakasam	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chhattisgarh	21	185	378	133	707	2581	8702	12686	52484987	745	650	717	3844	11445	6902	24303	81737849	-	-	36989	134222836
Dantewara	7	-	-	-	4	21	8667	8692	47829092	-	20	119	1124	9783	6112	17158	72239497	-	-	25850	120068589
Durg	4	29	61	62	565	2501	34	3252	3720617	23	35	-	2115	1515	104	3792	4352844	-	-	7044	8073461
Kanker	6	96	252	53	136	59	1	597	707211	697	530	576	599	147	686	3235	4955976	-	-	3832	5663187
Narayanpur	2	-	-	++	-	-	-	++	74	-	++	-	-	-	-	++	130	-	-	++	204
Rajnandgaon	2	60	65	18	2	-	-	145	227993	25	65	22	6	-	-	118	189402	-	-	263	417395
Goa	38	14	17	-	-	-	-	31	60320	35	28	-	-	-	-	63	121099	-	-	94	181419
North Goa	13	9	-	-	-	-	-	9	3824	20	-	-	-	-	-	20	8217	-	-	29	12041
South Goa	25	5	17	-	-	-	-	22	56496	15	28	-	-	-	-	43	112882	-	-	65	169378
Jharkhand	16	7	5	466	1560	2109	680	4827	6689282	106	503	652	5798	6888	2660	16607	19005328	-	-	21434	25694610
Singhbhum (West)	16	7	5	466	1560	2109	680	4827	6689282	106	503	652	5798	6888	2660	16607	19005328	-	-	21434	25694610
Karnataka	65	1391	924	1708	1466	4337	311	10137	32995840	3292	5023	6452	3254	5677	707	24405	52434626	-	-	34542	85430466
Bagalkot	3*	99	-	-	-	-	-	99	260960	16	-	-	-	-	-	16	1504	-	-	115	276264
Ballari	56	1202	800	1076	1149	4086	311	8624	27968696	2912	2666	3493	3254	5677	707	18709	42839305	-	-	27333	70808001
Chitradurga	6	90	124	632	317	251	-	1414	4766184	364	2357	2959	-	-	-	5680	9580017	-	-	7094	14346201
Tumakuru	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Madhya Pradesh	21(7)	841	18	-	-	-	-	859	470699	3125	110	-	-	-	-	3235	1695268	-	-	4094	2165967
Balaghat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chhatarpur	1	61	15	-	-	-	-	76	36690	18	-	-	-	-	-	18	8533	-	-	94	45223
Gwalior	1	-	-	-	-	-	-	-	-	232	-	-	-	-	-	232	92969	-	-	232	92969
Jabalpur	18 (7)	772	-	-	-	-	-	772	422174	2864	110	1	-	-	-	2974	1583594	-	-	3746	2005768
Sagar	1	8	3	-	-	-	-	11	11835	11	-	-	-	-	-	11	10172	-	-	22	22007
Maharashtra	11	52	17	44	-	-	-	113	268184	808	91	237	-	-	-	1136	1411902	-	-	1249	1680086
Chandrapur	1	-	-	5	-	-	-	5	15226	17	2	3	-	-	-	22	26534	-	-	27	41760

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Table-5 (A)-*(Concld)*

Sector/ State/ District	Lumps							Total		Fines						Total		Concentrates		Total	
	No. of Mines	Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Qty	Value	Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Qty	Value	Qty	Value	Qty	Value
Gadchiroli	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gondia	3	10	-	-	-	-	-	10	18907	12	-	-	-	-	-	12	6264	-	-	22	25171
Sindhudurg	6	42	17	39	-	-	-	98	234051	779	89	234	-	-	-	1102	1379104	-	-	1200	1613155
Odisha	80(1)	700	580	3672	5567	15732	6410	32661	96411951	2897	11486	4799	17298	24937	10393	71810	143490894	160	424012	104631	240326857
Keonjhar	47	459	207	1606	2135	9713	6103	20223	49907355	909	3458	3828	11956	14603	10390	45144	76852565	-	-	65367	126759920
Mayurbhanj	5	40	29	193	-	64	3	329	1117161	290	9	-	1	28	-	328	325282	-	-	657	1442443
Sundargarh	28 (1)	201	344	1873	3432	5955	304	12109	45387435	1698	8019	971	5341	10306	3	26338	66313047	160	424012	38607	112124494
Rajasthan	9	54	3	-	-	-	-	57	34856	1	-	-	-	-	-	1	908	1030	3946608	1088	3982372
Bhilwara	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1030	3546608	1030	3946608
Jaipur	3	9	-	-	-	-	-	9	2764	-	-	-	-	-	-	-	-	-	-	9	2764
Jhunjhunu	1	11	-	-	-	-	-	11	5603	-	-	-	-	-	-	-	-	-	-	11	5603
Karauli	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sikar	2	34	3	-	-	-	-	37	26489	1	-	-	-	-	-	1	908	-	-	38	27397
Telangana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Khammam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

++ Negligible,* Only labour reported, ( ) : No. of mines reported as associated mineral.

Table-5 (B): Production of Iron Ore, 2019-20 (P)

(By Sectors/States/Districts/Grades)

(Quantity in '000 tonnes; Value in '000)

Sector/ State/ District	Lumps							Total		Fines						Total		Concentrates		Total	
	No. of Mines	Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Qty	Value	Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Qty	Value	Qty	Value	Qty	Value
India	271(8)	3542	2999	5207	10512	35077	18675	76012	195781171	7793	15182	10963	28343	85948	18660	166889	296322689	1182	4326718	244083	496430578
Public Sector	38	116	11	388	2614	13405	9600	26134	68068589	310	798	1428	11254	23828	7127	44745	89823999	-	-	70879	157892588
Private Sector	233(8)	3426	2988	4819	7898	21672	9075	49878	127712582	7483	14384	9535	17089	62120	11533	122144	206498690	1182	4326718	173204	338537990
Andhra Pradesh	18	507	1	-	-	-	-	508	424030	317	-	-	-	-	-	317	189363	-	-	825	613393
Anantapur	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cuddapah	3	408	1	-	-	-	-	409	337741	287	-	-	-	-	-	287	172233	-	-	696	509974
Krishna	1	-	-	-	-	-	-	-	-	++	-	-	-	-	-	++	225	-	-	++	225
Kurnool	12	99	-	-	-	-	-	99	86289	30	-	-	-	-	-	30	16905	-	-	129	103194
Nellore	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prakasam	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chhattisgarh	20	192	287	126	582	2539	8465	12191	38230890	965	427	626	3387	9515	7617	22537	60922433	-	-	34728	99153323
Dantewada	7	-	-	36	-	178	8255	8469	34049959	7	28	137	876	8147	6709	15904	52368234	-	-	24373	86418193
Durg	4	46	-	8	414	2278	209	2955	3262200	51	-	-	2040	1368	229	3688	4058844	-	-	6643	7321044

Contd...

Table-5 (B)-*(Concld)*

Sector/ State/ District	Lumps							Total		Fines						Total		Concentrates		Total	
	No. of Mines	Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Qty	Value	Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Qty	Value	Qty	Value	Qty	Value
Kanker	6	28	207	66	165	83	1	550	563152	439	338	469	468	-	679	2393	3410313	-	-	2943	3973465
Narayanpur	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rajnandgaon	2	118	80	16	3	-	-	217	355579	468	61	20	3	-	-	552	1085042	-	-	769	1440621
Goa	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
North Goa	14*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South Goa	31*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jharkhand	21	67	360	616	1273	3295	1343	6954	9627055	181	853	807	2848	12477	895	18061	19784705	-	-	25015	29411760
Singhbhum (West)	21	67	360	616	1273	3295	1343	6954	9627055	181	853	807	2848	12477	895	18061	19784705	-	-	25015	29411760
Karnataka	61	700	1670	1174	1782	3575	347	9248	25077850	2283	3623	6560	1851	7208	619	22144	42248191	-	-	31392	67326043
Bagalkot	3	209	1	-	-	-	-	210	410700	64	-	-	-	-	-	64	75550	-	-	274	486250
Ballari	50	432	1295	1040	1161	3171	347	7446	20298987	1569	3484	2559	1851	7204	619	17286	35132646	-	-	24732	55431633
Chitradurga	7	59	374	134	621	404	-	1592	4368135	650	139	4001	-	4	-	4794	7039995	-	-	6386	11408160
Tumakuru	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Madhya Pradesh	19(7)	1464	2	1	-	-	-	1467	687760	1876	-	-	-	-	-	1876	1041308	-	-	3343	1729068
Chhatarpur	1	96	1	-	-	-	-	97	43683	11	-	-	-	-	-	11	4898	-	-	108	49138
Jabalpur	16 (7)	1363	-	-	-	-	-	1363	629073	1791	-	-	-	-	-	1791	1006740	-	-	3154	1635813
Gwalior	1	-	-	-	-	-	-	-	-	74	-	-	-	-	-	74	29670	-	-	74	29670
Sagar	1	5	1	1	-	-	-	7	15378	-	-	-	-	-	-	-	-	-	-	7	15378
Maharashtra	13	42	-	39	12	-	-	93	197711	598	118	322	-	-	-	1038	1142533	-	-	1131	1340244
Chandrapur	2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gadchiroli	2	1	-	-	-	-	-	1	54874	-	-	-	-	-	-	-	-	-	-	1	54874
Gondia	3	8	-	-	-	-	-	8	15933	4	-	-	-	-	-	4	2274	-	-	12	18207
Kolhapur	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sindhudurg	6	33	-	39	12	-	-	84	126904	594	118	322	-	-	-	1034	1140259	-	-	1118	1267163
Odisha	64 (1)	382	679	3251	6863	25668	8520	45363	121484813	1573	10161	2648	20257	56748	9529	100916	170994093	358	700828	146637	293179734
Keonjhar	37	17	96	922	1190	19436	7840	29501	78211229	818	7552	383	12887	40371	9493	71504	125045486	-	-	101005	203256715
Mayurbhanj	2	42	206	1204	-	303	266	2021	6011631	23	195	55	134	9	9	425	484139	-	-	2446	6495770
Sundargarh	25 (1)	324	377	1125	5673	5929	414	13841	37261953	732	2414	2210	7236	16368	27	28987	45464468	358	700828	43186	83427249
Rajasthan	10	188	-	-	-	-	-	188	51060	++	-	-	-	-	-	++	63	824	3625890	1012	3677013
Bhilwara	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	824	3625890	824	3625890
Jaipur	3	148	-	-	-	-	-	148	38416	-	-	-	-	-	-	-	-	-	-	148	38416
Jhunjhunu	2	-	-	-	-	-	-	-	25	-	-	-	-	-	-	-	-	-	-	++	25
Karauli	1*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sikar	2	40	++	-	-	-	-	40	12619	++	-	-	-	-	-	++	63	-	-	40	12682
Telangana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Khammam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Warangal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

++ Negligible,* Only labour reported, ( ) : No. of mines reported as associated mineral.

Table-6: Production of Iron Ore, 2019-20 and 2020-21
(By Frequency Groups)

Production group (In tonnes)	No. of mines		Production (In '000 tonnes)		Percentage to total production		Cumulative percentage	
	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)
Total	271(8)	273 (8)	244083	204481	100	100	-	-
Up to 50,000	144 (6)	152 (6)	582	808	0.24	0.4	0.24	0.4
50,001 –100,000	16	9	1268	706	0.52	0.35	0.76	0.75
100,001 –500,000	39 (2)	45 (2)	11037	11587	4.52	5.67	5.28	6.42
5,00,001 –10,00,000	17	14	13313	10040	5.45	4.91	10.73	11.33
1,000,001–1,500,000	12	15	14512	18492	5.95	9.04	16.68	20.37
15,00,001 –20,00,000	9	4	15622	6887	6.4	3.37	23.08	23.73
20,00,001 and above	34	34	187749	155961	76.92	76.27	100	100

( ) : No. of mines reported as associated mineral

Table –7 (A) : Mine-head Closing Stocks of Iron Ore, 2019-20
(By States/Grades)

(In '000 tonnes)

State	Lumps							Fines							Concentrates Total	Total Lumps, Fines & Concentrates
	Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Total	Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Total		
India	8408	1899	2186	2713	9071	2455	26732	28968	49131	6055	45004	16727	3691	119576	410	146718
Andhra Pradesh	474	9	-	++	-	-	483	1089	-	-	1	-	-	1090	-	1573
Chhattisgarh	32	27	82	10	172	615	938	233	117	6	296	788	1050	2490	-	3428
Goa	357	211	11	++	1	-	580	402	207	10	14	++	-	633	21	1234
Jharkhand	368	576	136	224	278	256	1838	1359	36544	603	838	1880	241	41465	-	43303
Karnataka	4397	315	307	562	763	83	6427	2336	682	901	399	1008	45	5369	-	11796
Madhya Pradesh	1044	40	10	17	-	-	1075	2939	-	5	-	-	-	2944	++	4019
Maharashtra	66	11	++	1	++	-	78	333	84	10	-	-	-	427	-	505
Odisha	1484	746	1640	1899	7857	1501	15127	20265	11499	4520	13456	13051	2355	65146	367	80640
Rajasthan	185	++	-	-	-	-	185	12	-	-	-	-	-	12	22	219
Telangana	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1

++ Negligible

Table-7 (B): Mine-head Closing Stocks of Iron Ore, 2020-21 (P)

(By States/Grades)

(In '000 tonnes)

State	Lumps							Fines							Concentrates Total	Total Lumps, Fines & Concentrates
	Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Total	Below 55% Fe	55%-below 58% Fe	58%-below 60% Fe	60%-below 62% Fe	62%-below 65% Fe	65% Fe & above	Total		
India	7509	1229	2496	2480	6038	2164	21916	21510	45155	5978	10915	12509	2683	98750	312	120978
Andhra Pradesh	486	6	-	++	-	-	492	1103	-	-	1	-	-	1104	-	1596
Chhattisgarh	54	33	18	7	73	544	729	193	65	13	715	1099	967	3052	-	3781
Goa	27	148	11	++	1	-	187	221	62	++	++	++	-	283	5	475
Jharkhand	351	408	132	270	257	151	1569	1342	36962	862	1010	1852	119	42147	-	43716
Karnataka	4580	273	586	337	1007	100	6883	1949	868	905	581	940	37	5280	-	12163
Madhya Pradesh	841	5	10	17	-	-	873	2778	5	4	-	-	-	2787	++	3660
Maharashtra	56	5	10	1	++	-	72	368	62	7	-	-	-	437	-	509
Odisha	906	351	1729	1848	4700	1369	10903	13543	7131	4187	8608	8618	1560	43647	297	54847
Rajasthan	208	++	-	-	-	-	208	13	-	-	-	-	-	13#	10	231
Telangana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

++ Negligible , # : under refrence

MINING, MARKETING & TRANSPORT

Iron ore mining is carried out by opencast method through manual, semi-mechanised and mechanised operations.

The method of mining and deployment of machinery vary from place to place depending upon characteristics of iron ore as per geological set up. Large mechanised mines are mostly in the Public Sector. Manual and semi-mechanised mines are mainly in Private Sector. Some mechanised mines in Jharkhand and Odisha are also operated by the Private Sector.

Manual Mines

Generally, these mines are confined to float ores where mining is done by digging the ore with pick axes, crow bars, chisels and spades. The mined material is screened manually to separate +10 mm float ore which is then stacked separately. The waste is backfilled into the pits. In some reef workings, 35 – 40 mm diameter holes are drilled to 0.6 m depth by hand-held jackhammers at a spacing of about 0.6 m and each hole is charged with 150 –200 g gunpowder or special gelatine cartridges. Blasted tonnage per kg gunpowder is usually 2.5 – 3 tonnes. Blasted ore is manually loaded into trucks for transport to either railway sidings or to buyer's destination directly.

Mechanised Mines

Most of the mechanised mines are captive belongings of different steel plants and have been developed to cater to specific requirements. Mining is done by formation of systematic benches in overburden and ore. The height of the benches normally varies from 10 to 12 m and width up to 20 m in the ore. Drilling holes of 300 mm diameter and till 12 m depth by crawler drills and use of explosives, such as, ANFO, SMS and emulsion explosives for blasting are in practice. Loading is done by earth-moving machinery powered by diesel or electric engines, such as, hydraulic excavators in the range from 1.9 cu. m to 10 cu. m. Ripper dozers and motor graders are also deployed for excavation and levelling purposes.

Mines, where ore is predominantly in powdery form, hydraulic shovels with boom height of around 9 m may be used for excavation and loading. Heavy-duty Ripper-Dozers are preferred for such mining as the ores are soft. Height of the benches is restricted to 7 m for safe and efficient operations. Width of working benches is maintained at more than 15 m and bench slope is maintained at about 80o. The ore produced is transported to short distances by dumpers up to 40 tonnes capacity. For longer distances and barge loading, dumpers/trucks up to 10 tonnes capacity are used. The barges carry the ore to harbours. The ore from the barges is loaded on to ships either through berth or through transshippers.

Almost all the Public Sector mines including Kiriburu, Barsua, Gua, Bailadila, Donimalai, Daitari and Dalli-Rajhara operated by SAIL, NMDC and OMC are fully mechanised. In Private Sector, most of the captive mines are mechanised. Approximately, 90% iron ore production comes from mechanised mines. NMDC operates a couple of large mechanised iron ore mines in the country at Bailadila (Chhattisgarh) and Donimalai (Karnataka). The Company has three highly-mechanised iron ore mine complexes. Two are located in Chhattisgarh and one in Karnataka.

The processing of iron ore in the country involves crushing, screening, washing and in some cases beneficiation and agglomeration. Crushing and screening are adopted mainly for sizing the ore and also for removing the adherent gangue minerals. Dry and wet grinding is also resorted to in some cases.

The lumps and fines of iron ore are marketed after screening and beneficiation. Fines are converted into sinters for use in steel plants while pellets made from concentrates/fines are exported and also are utilised for internal consumption in domestic iron & steel industries.

ENVIRONMENTAL FACTORS

Afforestation, waste dump management, top soil management, management of sub-grade minerals, mechanical beneficiation, dust suppression, monitoring of water & air quality, vibration survey, publicity and propaganda are some common environmental restoration efforts pursued by all mechanised and semi-mechanised iron ore mines. Mining and beneficiation of ores carried out on large-scale cause environmental problems. A specific problem in iron ore mining is the disposal of tailings and other deleterious silica minerals and phosphorous.To safeguard the environment and prevent ecological degradation, thrust has been laid on green belt development, solid waste management, monitoring of liquid & air effluents and other crucial environmental parameters.

Goa region is prone to siltation of agricultural fields, nallahs, riverbeds and creeks due to wash off from iron ore dumps in rainy season. Loss in crop yield and reduction in fish population in streams and navigation difficulties are the problems caused by silting. To overcome these problems, check dams and water filter beds at higher contours have been constructed. Tailing ponds are also being maintained at some mines. Afforestation is the mainstay in reclaiming the mined out areas in Goa. In a few cases, pits are used as water reservoir for pisciculture. But, in early 2018, the apex court had quashed 88 mining leases for violation of mining procedures and asked the state government of Goa to issue fresh leases instead of renewing existing ones. In February 2021, it will be three years since India's apex court stopped iron ore mining in Goa.

In Ballari-Hosapete area, Karnataka, dust concentration (suspended particulate matter) is the main environmental problem. In Bailadila Sector, Chhattisgarh, forest is fairly widespread and dense, supported by good rainfall and rich flora and fauna. The deforestation taking place due to mining and waste dumping needs to be compensated continuously by afforestation at suitable slopes and in township areas. In Jharkhand, afforestation of land is the main recourse adopted for reclamation of degraded lands or improvement in land uses.

INDUSTRY

Iron ore is the basic raw material used for making pig iron, sponge iron and finished steel. The iron ore is used mainly in blast furnaces, mini-blast furnaces (MBF), DRI & sintering and pelletisation plants.

Pelletisation

In general, the pelletisation process involves mixing of iron ore and required limestone with water which later is ground in ball mills to the desired size. The discharged slurry from ball mills is filtered in pressure filters. The filter cake from filters is then mixed with dry-ground coke fines to which bentonite is mixed in suitable proportion to form green pellets in pelletising discs. The coke fines and bentonite are ground separately. The green pellets are then dried, heated and fired in indurating machine to produce iron ore pellets. There is an increasing trend for utilisation of pellets or sinters in the recent years. The use of pellets as feed in the blast furnace has several advantages because of their uniform size, known composition and strength. Iron ore pellet is a kind of agglomerated fines which has better tumbling index as compared to that of parent ore and can be used as a substitute used in blast furnaces in countries where lump ore is not available.

The fourty-eight pelletisation plants in the country about which information is available, have a total capacity of 126.4 million tonnes per annum. The JSW Steel Ltd has a manufacturing capacity of 17.20 million tonnes of pellets annually at Vijayanagar. Amba River Coke Limited, a wholly owned subsidiary Company of JSW Steel, has set up a 4.30 million tpy pellet plant at Dolvi and has produced 3.21 million tonnes of pellet during the FY 2020-21. The pellets produced are primarily supplied to the Dolvi unit of the company. During the year 2020-21, all India production of pellets was 61.64 million tonnes.

With a strong belief in prudent forward and backward integrations, JSPL established India's largest 10 MTPA Pelletisation Complex at Barbil, Odisha. The plant includes dry grinding facility that harnesses recuperation type of straight grate technology. The Company's Barbil Plant is India's largest single-location pellet manufacturing facility with 4.5 MTPA Dry Grinding Unit and a 4.5 MTPA Wet Grinding Unit. JSPL pellet plant helps to process low-cost iron ore fines as against expensive lumps, thereby handing a cost advantage. Laced with state-of-the art technology backed with proximity to iron-ore access, JSPL's Barbil Plant has emerged as India's largest pellet exporter in recent years.

Arcelor Mittal Nippon Steel India, i.e. , ('AM/NS India'), (formerly known as Essar Steel as Essar Steel was acquired jointly by Arcelor Mittal and Nippon Steel in December 2019) has 8 MTPA iron ore pellet plant in Visakhapatnam, Andhra Pradesh to cater to the pellet requirements of the HBI plant in Hazira, Gujarat. The plant has an assured supply of high-quality iron ore from the beneficiation plant at Bailadilla, Chhattisgarh. The plant is capable of producing both DR and BF grade pellets and is linked to the Visakhapatnam port through conveyors to enable easy material movement in and out of the plant. The plant is located strategically near a deep draft, all-weather port that ensures the movement of large vessels to supply pellets throughout the year to the Hazira steel-making facility. A 6 million tpy pellet plant is located at Paradip in the iron ore rich State of Odisha. The plant has an assured supply of high-quality iron ore from the beneficiation plant at Dabuna, Odisha. The Paradip Pellet plant may add another 6 million tpy to its capacity which is under completion. After completion of this plant AM/NS India's total pelletisation capacity at Paradip would get augmented to 12 million tpy and supported by a 20-million-tonnes pellet-making capability, the Company is on its way to become the largest pellet producer in India.

NMDC has forayed in pellet-making through setting up of a 1.2 MTPA pellet plant at Donimalai. Another 2 MTPA pellet plant is in the process of being set up at Nagarnar, Chhattisgarh.

KIOCL is currently engaged in the business of manufacturing and selling of iron ore pellets. The state-of-the-art pelletisation plant with 3.5 million tpy rated capacity and 0.216 million tpy Blast Furnace Unit is located at Mangaluru. During the year 2019-20, KIOCL Ltd achieved production of 2.210 million tonnes of pellets.

Steel plants are likely to increase usage of pellets in their production process to reduce pollution and increase productivity. Moreover, the forecast of spike in growth in Infrastructure, Real Estate and Automobile Sectors in the ensuing years are expected to augment demand for steel, which in turn would raise the demand and prices of pellets in the near future.

Sintering

In sintering process, iron ore fines, other iron- bearing wastes and coke dust are blended and combusted. The heat fuses the fines into course lumps that can be charged to a blast furnace. There are about thirty-nine sintering plants in the country about which information is available and have a total capacity of about 96.131 million tonnes per annum. Most of the Integrated Steel Plants (ISP) in the country have their own sintering plants. Sinter plants receive raw material mostly from their captive mines. Information on capacity and production of pellets and sintering plants is provided in Table-8.

Pig Iron

Pig iron is one of the basic raw materials required by Foundry and Casting Industry for manufacturing various types of castings for the engineering section.The post-liberalisation regime has witnessed Expression of Interest from a large number of entrepreneurs for setting up mini-blast furnaces for production of hot metal/pig iron. Commissioned pig iron units are mostly of stand-alone type.

The production of pig iron has increased from 1.6 million tonnes in 1991-92 to 4.84 million tonnes in 2020-21. Production of pig iron in 2019-20 was 4.84 MT, a decline of 10.70% over that of last year.The Private Sector accounted for 86% of the total production of pig iron (4.17 MT) in the country in 2020-21. As per National Steel Policy

2017, the demand for pig iron for merchant use, such as, for castings and supplementary metallic in the electric arc or induction furnaces is projected to increase to 17 million tonnes by 2030- 31.

Sponge iron

India is the world's largest producer of sponge iron or Direct Induced Iron (DRI) with a host of coal-based units located in the mineral-rich States of the country. Over the years, the coal-based route has emerged as a key contributor and accounted for 82% of the total sponge iron production in the country. The growth of Sponge Iron Industry during the last few years in terms of capacity has been substantial. The installed capacity of sponge iron increased from 1.52 million tonnes per annum in 1990-91 to around 47.85 million tonnes in 2019-2020. Production has increased from 0.9 million tonnes in 1990-91 to 34.15 million tonnes in 2020-21. As per National Steel Policy 2017, the demand for sponge iron is projected to increase to 80 million tonnes by 2030-31. It is projected that the sponge iron capacity may increase to 114 million tonnes by 2030-31 with around 30% share of gas-based capacities on account of increased environmental considerations and long-term availability of gas.

Sponge iron is a good substitute for scrap which is required by the electric arc furnaces and induction furnaces or mini-steel plants in the country. The availability of indigenous metal scrap is scarce, and therefore, to meet the domestic demand, scrap is usually imported. Sponge iron is a viable alternative for scrap and is produced by direct reduction of high-grade iron ore or pellets to metallic iron ore in solid state by using coal or natural gas as reductant. It is also known as Direct Reduced Iron (DRI) or Hot Briquetted Iron (HBI).

Iron & Steel

The details of the Iron & Steel Industry are provided in the Review on "Iron, Steel & Scrap and Slag".

Ferroalloys

Iron is an important constituent of ferro-alloys, like ferromanganese (high carbon, medium carbon and low carbon), ferrosilicon, ferrochrome (high carbon and low carbon)/charge chrome, ferromolybdenum, ferrovanadium, ferrotungsten, ferro-silicon-magnesium, ferroaluminium, ferro-silicon-zircon, ferrotitanium, etc. Ferroalloys are used in Steel Industries to impart some special qualities in steel making process also.They are consumed in domestic industries and are also exported. The details about the Ferroalloys Industry are provided in the Review on 'Ferroalloys'.

Cement

Iron ore lumps and powder containing +58% Fe are normally used in the Cement Industry as they improve burning properties, impart colour and balance the composition of the mix. Further details about the Cement Industry are provided in the Review on 'Cement'.

USES & SPECIFICATIONS

Iron ore is mainly used for manufacturing pig iron, sponge iron and steel. It is also used in Cement, Coal Washeries, Ferroalloys, Foundry and Glass Industries. The specifications of iron ore consumed by major sponge iron plants are furnished in Table-9.

CONSUMPTION

In 2019-20, about 180.68 million tonnes iron ore that were consumed in various industries like Iron & Steel, Sponge Iron, alloy steel, ferroalloys and cement were slightly higher than 174.551 million tonnes consumed in the preceding year. Iron & Steel including pelletisation (87.57%) and Sponge Iron industries (11.95%) were the major consumers of iron ore and accounted together for over 99.52 % of the consumption. Plantwise consumption of iron ore in steel plants has been furnished in Table-10 and industrywise consumption of iron ore from 2017-18 to 2019-20 has been provided in Table-11.

Table-8: Installed Capacity & Production of Pellets and Sinters, 2018-19 & 2019-20

(By Plants)

(In '000 tonnes)

Name & location of plant		Annual installed capacity	Production		Iron ore fines consumed	
			2018-19	2019-20 (P)	2018-19	2019-20 (P)
A)	Pellet Plants					
1	Amba River Coke Ltd, (A wholly owned subsdiary co. of JSW Steel Ltd), Dolvi, Maharashtra	4000	1368	1869	2894	1817
2	Atibir Industries Co. Ltd. Unit-II, Bhorandiha, Jharkhand	300	229	155	1011	769
3	Ardent Steel Ltd, Phulj Keonjhar, Odisha	600	NA	NA	NA	NA
4	Arya Iron and Steel Company (AISCO) Barbil, Odisha	1200	803	NA	NA	NA
5	Pellet Sponge Iron Plant BMM Ispat, Karnataka	2400	1696	2040	2248	2448

Contd...

Table-8 *(Contd)*

(In '000 tonnes)

	Name & location of plant	Annual installed capacity	Production		Iron ore fines consumed	
			2018-19	2019-20 (P)	2018-19	2019-20 (P)
6	Arcelor Mittal Nippon Steel India, Visakhapatnam, Andhra Pradesh	8000	NA	NA	NA	NA
7	Arcelor Mittal Nippon, Steel India, Paradip Port,Odisha.	6000	NA	NA	NA	NA
8	Godawari Power & Ispat Ltd Siltara, Chhattisgarh	2100	NA	NA	NA	NA
9	Jindal Steel & Power Ltd, Barbil, Odisha	9000	NA	NA	NA	NA
10	Jindal Saw Ltd, Bhilwara, Rajasthan	1500	1415	1380	1350	1367
11	Jindal Saw Ltd, Gujarat	NA	NA	NA	185	211
12	JSW Steel Ltd, Tornagallu, Toranagally, Ballari, Karnataka	9200	7870	8048	NA	17232
13	Jayaswal Neco Industries Ltd, Siltara, Raipur, Chhattisgarh	1200	1200	1128	1834	1902
14	KIOCL Ltd, Panambur, Mangaluru, Karnataka	3500	2238	2375	2173	2367
15	Mandovi Pellets Ltd, Near Borim Bridge, Shiroda, Goa – 403 103	1800	NA	NA	NA	NA
16	Minera Steel & power Private Ltd, Ballari, Karnataka	600	543	599	597	678
17	Monnet Ispat and Energy Raigarh, Chhattisgarh	1200	NA	NA	NA	2018
18	MSP Steel & Power Ltd, Raigarh, Chhattisgarh	900	1007	1092	NA	949
19	NMDC Ltd, Donimalai, Karnataka.	1200	1156	1105	NA	NA
20	Orissa Metalics Private Ltd, Paschim Mednapore, West Bengal	2520	1328	2047	NA	2809
21	Orissa Manganese & Minerals Limited (OMML), Kandra Saraikela Kharsawan, Jharkhand	1200	NA	NA	NA	NA
22	Rashmi Metaliks Ltd, Shyamraipur, Gokulpur, West Midnapore, West Bengal	900	743	559	NA	1508
23	Rexon Strips Ltd, Kumakela, Lathikata Rourkela, Sundargarh, Odisha	300	NA	NA	NA	NA
24	Sarda Energy and Minerals Ltd, Siltara, Mandhar, Raipur, Chhattisgarh	600	600	600	NA	549
25	Shri Bajarang Power & Ispat Ltd, Borjhara, Tilda & Gondwara, Raipur, Chhattisgarh	1400	NA	NA	NA	NA
26	Tata Steel Limited, Jamshedpur	6000	6330	5600	NA	13208

Contd...

Table-8 *(Contd)*

(In '000 tonnes)

	Name & location of plant	Annual installed capacity	Production		Iron ore fines consumed	
			2018-19	2019-20 (P)	2018-19	2019-20 (P)
27	Usha Martin Ltd, Usha Alloy & Steel, Division, Jamshedpur	1200	NA	NA	NA	NA
28	Xindia Steels Ltd, Kunikere & Hirebaganal Ginigera, Koppal, Karnataka	800	NA	NA	NA	NA
B)	Sintering Plant					
1	Atibir Industries Co. Ltd. Unit-II, Bhorandiha, Jharkhand	680	582	415	1011	769
2	Bokaro Steel Plant, Jharkhand	6900	5870	5681	NA	3882
3	Bhilai Steel Plant, Bhilai, Durg, Chhattisgarh.	6334	NA	NA	NA	NA
4	Bhushan Steel Ltd, Dhenkanal, Odisha	6680	4951	4967	4449	4297
5	Durgapur Steel Plant, West Bengal	3009	3374	3299	NA	2531
6	Electrosteel Casting Ltd Khardah, Barrackpore, West Bengal	365	365	363	326	292
7	Electrosteels Ltd, Siyaljori, Jharkhand	2980	1948	2265	NA	1444
8	Gerdau Steel India Ltd, Tadipatri, Anantpur, A.P.	470	NA	NA	NA	NA
9	IISCO Steel Plant, SAIL Burnpur, West Bengal	3880	3277	3709	398	462
10	Jayaswal Necco Industries Ltd, Siltara Growth Centre, Raipur-493 221, Chhattisgarh	729	NA	NA	1834	1902
11	Jindal Steel & Power Ltd, Raigarh, Chhattisgarh	2300	NA	NA	NA	NA
12	Jindal Saw Ltd, Mundra, Gujarat	900	747	708	262	1124
13	JSW Steel Ltd, Tornagallu, Toranagallu, Ballari, Karnataka	12950	13996	12925	NA	17232
14	JSW Steel Ltd, Dolvi Works, Raigad, Maharashtra	5400	4160	4503	4570	5316
15	JSW Steel Ltd Salem works, Mkalipatti, Metturdam, Tamil Nadu	1106	1329	1380	NA	774
16	Jai Balaji Industries Banskopa, West Bengal	608	513	526	546	466
17	Kalyanigerdua Steels Ltd, formerly sjk steel plant, Jambulapadu, Tadipatri, Andhra Pradesh	500	456	437	283	229
18	Kirloskar Ferrous Industries Ltd, Bevinahalli, Koppal, Karnataka.	500	460	455	NA	378

Contd...

Table-8 *(Contd)*

(In '000 tonnes)

Name & location of plant		Annual installed capacity	Production		Iron ore fines consumed	
			2018-19	2019-20 (P)	2018-19	2019-20 (P)
19	KIC Metaliks Ltd, Raturia, Angadpur, Durgapur. West Bengal	336	179	144	NA	115
20	Monnet Ispat and Energy Raigarh, Chhattisgarh	962.3	NA	NA	NA	2018
21	Mukund Ltd, M/s Hospet Steel Ltd, Ginigera, Koppal, Karnataka	500	NA	NA	359	223
22	Neometaliks Ltd, Gopalpur, Durgapur, West Bengal	316	266	290	NA	208
23	Neelachal Ispat Nigam Ltd, Kalinga Nagar, Industrial Complex, Duburi-755 026, Distt Jajpur, Odisha.	1710	NA	NA	215	215
24	Rashmi Metaliks Ltd, Shyamraipur, Gokulpur, West Midnapore, West Bengal.	1440	508	515	NA	1508
25	RINL, Visakhapatnam Steel Plant No. -1& 2 , Visakhapatnam, Andhra Pradesh	5256	4240	3590	5317	4787
26	RINL, Visakhapatnam Steel Plant No. -3, Andhra Pradesh	3600	NA	NA	NA	NA
27	Rourkela Steel Plant, Odisha	5300	6310	6020	3963	3802
28	SBQ Steel Ltd, Gudur, Nellore, Andhra Pradesh	240	NA	NA	NA	NA
	29. Sri Kalahasthi Pipes Ltd, Chitoor, Andhra Pradesh	500	402	425	394	388
30	SLR Metaliks Ltd, Ballari, Karnataka	350	361	361	NA	189
31	Sesa Goa Ltd, Vedanta Ltd, North Goa	1000	NA	NA	NA	NA
32	Sunflag Iron & Steel Co. Ltd, Warrthy, Bhandara, Maharashtra	450	312	429	67	14
33	Tata Steel Ltd, Jamshedpur, Jharkhand	8000	8179	8611	17060	16807
34	Tata Metaliks Ltd, Kharagpur, West Bengal	528	NA	NA	338	329
35	Tata Steel Ltd, Kalingnagar, Odisha	5750	NA	NA	1111	896
36	Usha Martin Ltd (Usha Alloys and Steel Division), Jamshedpur.	715	NA	NA	2312	2312
37	Uttam Galva, Metallics Ltd,	887	623	620	724	756

Contd...

Table-8 *(Concld)*

(In '000 tonnes)

Name & location of plant		Annual installed capacity	Production		Iron ore fines consumed	
			2018-19	2019-20 (P)	2018-19	2019-20 (P)
	Wardha, Maharashtra					
38	Vedanata Ltd.	1000	NA	NA	NA	NA
	Amona, Goa					
39	Value Added business,	1000	0	0	NA	490
	Amona, Goa					

Table-9: Specifications of Iron Ore Consumed by Major Sponge Iron Plants

Sl.	Name of the Plant	Specifications				
		Size	Fe	$Al_2O_3 + SiO_2$	P	S
1.	Orissa Sponge Iron Plant	5– 18 mm	65% min.	4.5% max.	0.03% max.	N. A.
2.	Welspun Max Steel Ltd	9– 16 mm	66%	2.6% max.	0.05%	0.01%
3.	Sunflag Iron & Steel Ltd	5– 20 mm	67.50%	–	–	–
4.	NMDC Ltd (Sponge iron unit)	6– 20 mm	55–58% &	–	–	–
					64–66%	
5.	Essar Steel Ltd	10– 40 mm	67%	2.60% max.	0.05%	0.01%
6.	Jindal Steel & Power Ltd	10– 30 mm	65% min.	3% max. (SiO2)	0.05%	–
7.	Tata Sponge Iron Ltd	5– 18 mm	65% min.	5% max.	–	–
8.	Steel Exchange India Ltd	10– 40 mm	62%	–	–	–
9.	Sarda Energy & Minerals Ltd	5– 18 mm	65–66%	–	–	–
10.	OCL Iron & Steel Ltd	Sized	62% min.	–	–	–
11.	Nalwa Steel & Power Ltd	5– 20 mm	63% min.	–	–	–
12.	Shri Bajrang Power & Ispat Ltd	5– 18 mm	64% min.	–	–	–
13.	Jai Balaji Industries Ltd	5– 18 mm	65%	5%	0.05%	0.03%
		10– 30 mm	–	–	–	–
		10-150 mm	–	–	–	–

Table-10: Consumption and Specifications of Iron ore, 2018-19 and 2019-20

(By Steel Plants)

(In '000 tonnes)

Steel plant	Iron ore consumption				Specifications
	2018-19		2019-20 (P)		
	Lumps	Fines	Lumps	Fines	
Bokaro Steel Plant, Bokaro, Jharkhand	NA	NA	2622	3882	Lumps: Fe-63.40%, SiO_2:2.25%, Al_2O_3 2.39%, Size: 10-40 mm Fines: Fe - 62.24%, SiO_2 - 3.36%, Al_2O_3 - 3.45%
Durgapur Steel Plant, Durgapur, West Bengal	NA	NA	1439	2531	Lumps : Fe - 62.48%, Al_2O_3 - 2.42%, Size: 10-50 mm Fines: Fe - 62.8%, SiO_2 - 2.28%, Size : -10 mm
IISCO Steel Plant, Burnpur, West Bengal	1137	2698	1098	3173	Lumps: Fe - 62.86%, SiO_2 - 2.56%, Al_2O_3 - 2.56% (max.), Size: 10-40 mm
Bhilai Steel Plant, Chhattisgarh	NA	NA	NA	NA	

Contd...

Table-10 *(Concld)*

(In '000 tonnes)

Steel plant	Iron ore consumption				Specifications
	2018-19		2019-20 (P)		
	Lumps	Fines	Lumps	Fines	
Rourkela Steel Plant SAIL, Rourkela, Odisha	2428	3963	2419	3802	
JSW Steel Ltd Dolvi Works Raigad, Maharashtra.	296	4570	283	5316	
JSW Steel Ltd Tornagallu, Sandur, Ballari Karnataka	NA	NA	14052	17232	-
JSW Steel Ltd Salem works, Mkalipatti, Metturdam, Tamil Nadu	1003	4156	755	774	
Tata Steel Limited, Jamshedpur	NA	NA	3598	13208	
RINL Vishakhapatnam Steel Plant, Andhra Pradesh	3547	5317	3117	4787	Lumps : Fe 65.5 % min. SiO_2 2.25 % max., Al_2O_3 2.25 % max. Fines : Fe 64.5 % min. SiO_2 3.00 % max. Al_2O_3 3.00 % max.

Tabl-11 Estimated Consumption* of Iron Ore@ 2017-18 to 2019-20

(By Industries)

(In tonnes)

Industry	2017-18	2018-19 (R)	2019-20 (P)
All Industries	**159575800(308)**	**174551400(343)**	**180684900(330)**
Cement	826400	1079700	824800
Iron & steel **	144129900	154365100	158231600
Sponge iron	14603200	19087700	21606200
Others (electrode,foundry, paint, chemical, Pulverising & refractory)	16300	18900	22300

Figures rounded off.

*Includes actual reported consumption and/or estimates made wherever required.

@Does not include consumption of pellets & sinters; includes consumption of iron ore (fines) consumed in the production of pellets & sinters.

** including pelletisation, Alloy steel & Ferroalloys.

() No. of plant reported/estimated.

TRADE POLICY

To ensure easy availability of raw material in domestic market at reasonable prices, export duty on iron ore is @ 30% for both lumps and fines varieties of 58% Fe content and above. The export duty is @ 0% for both lumps and fines varieties of iron ore less than 58% Fe content. The export duty on iron ore pellets is NIL. Export duty on iron ore originated from NMDC is @ 10% when exported by MMTC Ltd under LTA to Japan and South Korea.

As per the Foreign Trade Policy (FTP) for 2015-20 and the amended Export and Import Policy incorporated in the FTP, the present export policy for iron ore as construed is furnished below in brief. As per the policy, imports of iron ore lumps, fines, concentrates and agglomerated pellets are freely allowed.

HS Code	Item	Export Policy
2601	Iron ore and concentrates, including roasted iron pyrites	Free
260111	Iron ore and concentrates, other than roasted iron pyrites:	Free
	Non-agglomerated	
26011111	60% Fe or more but below 62% Fe	Free
26011112	62% Fe or more but below 65% Fe	Free
26011119	65% Fe and above	Free
26011121	Iron ore lumps (below 60% Fe, including black iron ore containing up to 10 % Mn)–Iron Ore lumps below 55% Fe	Free

HS Code	Item	Export Policy
26011122	Iron ore lumps (below 60% Fe, including black iron ore containing up to 10 % Mn) – Iron Ore lumps 55% Fe or more but below 58% Fe	Free
26011129	Iron ore lumps (below 60% Fe, including black iron ore containing up to 10 % Mn) – Iron Ore lumps 58% Fe or more but below 60% Fe	Free
26011131	Iron ore fines (62% Fe or more)– 62% Fe or more but below 65% Fe	Free
26011139	Iron ore fines (below 62% Fe or more)– 65% Fe and above	Free
26011141	Iron ore fines (below 62% Fe) – below 55% Fe	Free
26011142	Iron ore fines (below 62% Fe) –55% Fe or more but below 58% Fe	Free
26011143	Iron ore fines (below 62% Fe) – 58% Fe or more but below 60% Fe	Free
26011149	Iron ore fines (below 62% Fe) – 60% Fe or more but below 62% Fe	Free
26011150	Iron ore concentrates	Free
26011190	Others	
260112	Iron ore and concentrates other than roasted iron pyrites: Agglomerated	Free
26011210	Iron ore pellets	Free
26011290	Other	Free
26012000	Roasted iron pyrites	Free

Source: ITC(HS), 2018, Schedule 2 Export Policy ; STE: State Trading Enterprise

WORLD REVIEW

The world reserves of crude iron ore are estimated to be around 180 billion tonnes. In terms of iron content, the iron ore reserves are estimated to be around 84 billion tonnes. The world reserves of crude iron ore and iron content by principal countries are furnished in Table - 12.

In 2020, the world production of iron ore was 3,016 million tonnes as against 3,057 million tonnes in the previous year. Australia 918 million tonnes (30%), China 845 million tonnes (28%), Brazil 388 million tonnes (13%), India 204 million tonnes (7%), Russia 100 million tonnes (3%), Iran 91 million tonnes (3%), South Africa 55 million tonnes (2%), Ukraine 78 million tonnes (3%) and Canada 60 million tonnes (2%) were the principal producers. These nine countries accounted for about 91% of the world production of iron ore and remaining 9% was contributed by the other countries. The world production of iron ore is provided in Table-13.

To provide a generalised view of the development in various countries, country-wise description sourced from the latest available publication of Minerals Yearbook 'USGS' 2018 is furnished below.

Australia

Production of iron ore in Australia was 900 million tonnes in 2018, a slight increase from 885 million tonnes in 2017. Three iron-ore mining companies in Australia—BHP Billiton Ltd., Fortescue Metals Group Ltd., and Rio Tinto Ltd.—were among the four leading iron ore producers in the world and accounted for most of the iron ore produced in Australia. BHP Billiton's iron ore production in Australia in fiscal year (FY) 2018, which ended June 30, 2018, was 238 million tonnes, a 3% increase from that of FY 2017. The company reported a decrease in production costs and an increase in seaborne ore prices in FY 2018 compared with those in the FY 2017. In 2018, BHP Billiton planned to improve productivity through transportation improvements at Port Hedland and a dumper car maintenance program to achieve between 241 and 250 million tonnes of iron ore production in FY 2019. Fortescue's iron ore shipments were 168 million tonnes in FY 2019, a slight decrease from 170 million tonnes in FY 2018. Fortescue approved the $2.6 billion Iron Bridge Magnetite Project to develop 22 million tonnes/yr of 67% concentrates by midyear 2022. The company continued its autonomous haulage truck project, completing conversion to a fully autonomous fleet by midyear 2020. Rio Tinto's share of iron ore production at its operations in Australia was 281 million tonnes in 2018, a 4% increase from 271 million tonnes in 2017. In December 2018, Rio Tinto launched the world's first automated heavy-haul, long-distance rail network. The company approved the Koodaideri Mine Project, a $2.6 billion, 43-million tonnes/yr iron ore mine and processing facility to be completed in late 2021.

Brazil

Production of iron ore in Brazil was 460 million tonnes in 2018, a slight increase from 454 million tonnes in 2017. Vale S.A., leading iron ore producer in Brazil, increased production in 2018 to 385 million tonnes, a 5% increase from 367 million tonnes in 2017, and increased its pellet production in 2018 to 55.3 million tonnes, a 10% increase from 50.3 million tonnes in 2017 In December 2018, Anglo American plc restarted operations at the Minas Rio Mine in Minas Gerais following the March 2018 discovery of leaks in a slurry pipeline that transported ore to a port in Rio de Janeiro. Repairs required the replacement of approximately 4 kilometers (2.5 miles) of pipeline.

China

China produced 335 million tonnes of iron ore in 2018, a 3% decrease from 345 million tonnes in 2017. Increasing demand from steel producers in China for high-grade iron ore blends, primarily originating in Australia and Brazil, were driven by stricter emissions requirements from the Government of China for steel producers.

Table-12: World Reserves of Iron Ore

(By Principal Countries)

(In million tonnes)

Country	Reserves	
	Crude ore	Iron content
World: Total (rounded off)	**180000**	**84000**
Australia[a]	751000	24000
Brazil	34000	2300
Canada	6000	2300
Chile	NA	NA
China	20000	6900
India*	5500	3400
Iran	2700	1500
Kazakhstan	2500	900
Mexico	NA	NA
Peru	2600	1500
Russia	25000	14000
South Africa	1000	640
Sweden	1300	600
Turkey	130	38
Ukraine[b]	86500	2300
USA	3000	100
Other countries	18000	9500

Source: USGS, Mineral Commodity Summaries, 2022.

(a): For Australia Joint Ore Reserves Committee compliant reserves were about 23 billion tonnes for crude ore and 11 billion tonnes for iron content.

(b): For Ukraine, reserves consist of the A and B categories of the Soviet reserves classification system.

* As per UNFC system as on 1.4.2020, India's reserves/resources of Iron ore (Haematite) and Iron ore (Magnetite) were estimated at 24,057 million tonnes and 11,227 million tonnes respectively.

NA - Not available.

Table-13: World Production of Iron Ore

(By Principal Countries)

(In tonnes)

Country	2018	2019	2020
World : Total (rounded off)	**2945000000**	**3057000000**	**3016000000**
Australia	907818648	917045579	918063223
China	763374000	844356000*	845000000
Brazil	450393000	396841000*	388000000
India[h]*	206446000[h]	246081000[h]	204481000
Russia	96100000	97500000	100200000
Iran[e]	93365420[e]	91778118[e]*	91800000
Ukraine	60549000	76134000	78837700
Kazakhstan	41876500	45221900	62865000
Canada[c]	52358000[g]	59013000[c]	60059572
South Africa[c]	74263738[c]	72430288[c]	55635308
Other countries	198644399	210858080	210989359

Source: BGS World Mineral Production, 2016-2020.

Note : World Total may not tally as data has been rounded off

(a) Including by-product iron ore.

(b) Years ended 31st March following that stated

(c) Years ended 20th March following that stated

(d) Including by-product magnetite; (e) estimated

* India's production of iron ore in 2018-19, 2019-20 and 2020-21 was 206.49 million tonnes, 244.08 million tonnes and 204.48 million tonnes respectively.

FOREIGN TRADE

Exports

Exports of iron ore increased by 57% to 57.72 million tonnes in 2020-21 from 36.62 million tonnes in the previous year. Exports were mainly to China (90%), Japan (3 %) (Fig 2). The total exports of iron ore in 2020-21, in terms of quantity comprised iron ore fines 40.66 million tonnes (70%), iron ore pellets 14.46 million tonnes (25%), iron ore lumps 2.23 million tonnes (4%) and negligible quantity of iron ore non-agglomerated concentrate and iron ore pyrites. (Tables- 14 to 19).

Imports

Unlike exports, imports of iron ore decreased drastically by 62% to 0.76 million tonnes in 2020-21 from 1.24 million tonnes in the previous year. Imports of iron ore were from Bahrain (50%), South Africa (21%), Ukraine (12%) and Australia (7%) and negligible amount from other countries (Fig-3). The total imports in 2019-20 comprised iron ore lumps (21%), non-agglomerated concentrates (20%) (Tables-20 to 25).

Table-14: Exports of Iron Ore: Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	36625	186092710	57723	362556021
China	31607	151430366	51975	314421802
Japan	1956	12842147	2000	15053929
Malaysia	266	1678942	742	6605067
Oman	531	3927902	698	6283030
Korea, Rep. of	1016	7187095	658	5710435
Indonesia	53	417540	594	5375145
Brazil	54	419716	331	4076384
Bahrain	-	-	154	1976368
Vietnam	47	307924	192	1036766
Poland	-	-	73	592883
Other countries	1095	7881078	306	1424212

Figures rounded off.

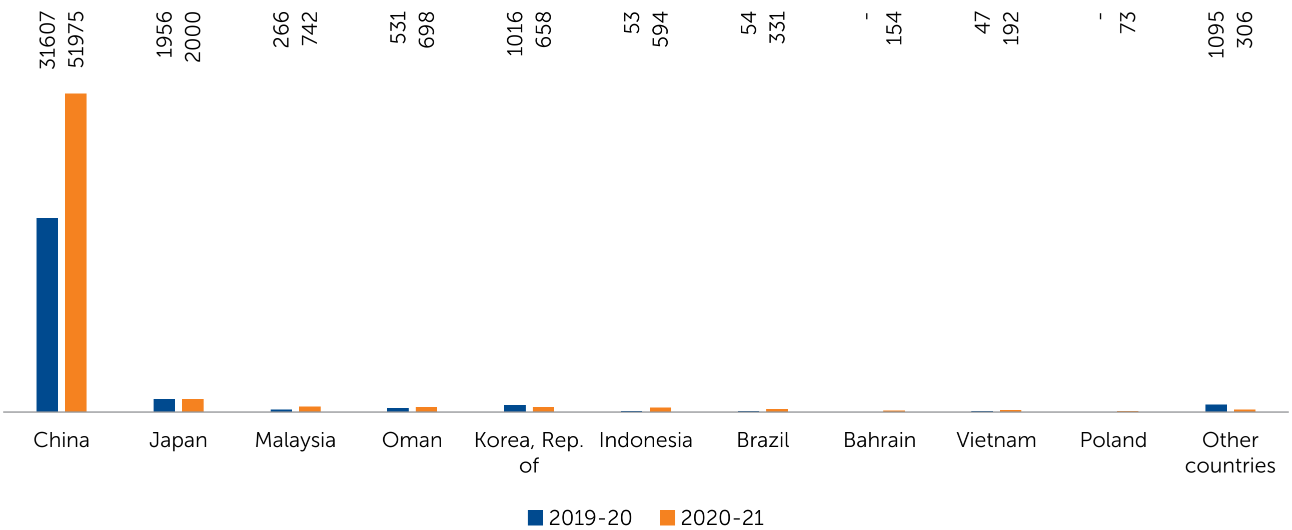


Fig 2: Countrywise Exports of Iron Ore: Total

Table-15: Exports of Iron Ore: Lumps
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	1480	8779976	2239	13118637
China	521	1991320	1502	6811960
Japan	935	6755427	723	6279621
UAE	-	-	13	25884
Nepal	1	666	1	732
Ethiopia	-	-	++	235
Congo.D.Rep	-	-	++	117
Australia	-	-	++	54
Zambia	-	-	++	34
Germany	++	5	++	++
Saudi Arabia	23	32558	-	-

Figures rounded off.

Table-16: Exports of Iron Ore: Fines
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	22374	83422738	40661	215190641
China	20702	73961561	38388	200434020
Japan	919	5486160	1277	8774308
Korea, Rep. of	581	3597258	516	4109204
Vietnam	-	-	170	860475
Indonesia	-	-	97	469465
Malaysia	48	149165	65	234948
Nepal	75	127673	85	171405
UAE	22	62982	39	118907
Bangladesh	-	-	24	17896
USA	-	-	++	12
Other countries	27	37939	++	1

Figures rounded off.

Table-17 : Exports of Iron Ore: Pyrites
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	++	25049	++	46040
Taiwan	++	124	++	14965
China	-	-	++	11204
Saudi Arabia	++	2501	++	5567
Netherlands	++	4187	++	2573
Bangladesh	++	3880	++	2465
Thailand	++	1270	++	2246
UAE	++	2777	++	1585
Malaysia	++	772	++	703
Australia	++	1910	++	614
Uganda	++	171	++	614
Other countries	++	7457	++	3504

Figures rounded off.

Table- 18: Exports of Iron Ore: Concentrates Non-agglomerated

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	153	559743	363	1781069
China	152	557777	309	1707189
Qatar	-	-	44	59508
Nepal	1	1905	9	13018
Kenya	-	-	1	1329
Australia	-	-	++	12
Reunion	-	-	++	7
Finland	-	-	++	2
France	-	-	++	2
Germany	-	-	++	2
Austria	++	29	-	-
Other countries	++	32	-	-

Figures rounded off.

Table-19: Exports of Iron Ore: Pellets

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	12618	93305204	14460	132419634
China	10232	74919708	11776	105457429
Malaysia	218	1529005	677	6369416
Oman	531	3927820	698	6283030
Indonesia	53	417540	497	4905680
Brazil	54	419697	331	4076384
Bahrain	-	-	154	1976368
Korea, Rep. of	435	3589369	142	1600668
Poland	-	-	73	592883
Egypt	-	-	60	563127
France	55	428204	30	416870
Other countries	1040	8073861	22	177779

Figures rounded off.

Table-20: Imports of Iron Ore: Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	1245	9409772	766	8445221
Bahrain	++	3838	379	4612542
South Africa	543	4528314	166	1793445
Ukraine	-	-	96	853813
Australia	171	874461	58	593329
Finland	++	7067	61	461841
Turkey	2	23867	3	36744
France	++	1160	++	26141
Croatia	2	19967	2	20341
Russia	++	579	1	14161
Sweden	++	14484	++	11707
Other countries	527	3936035	++	21151

Figures rounded off.

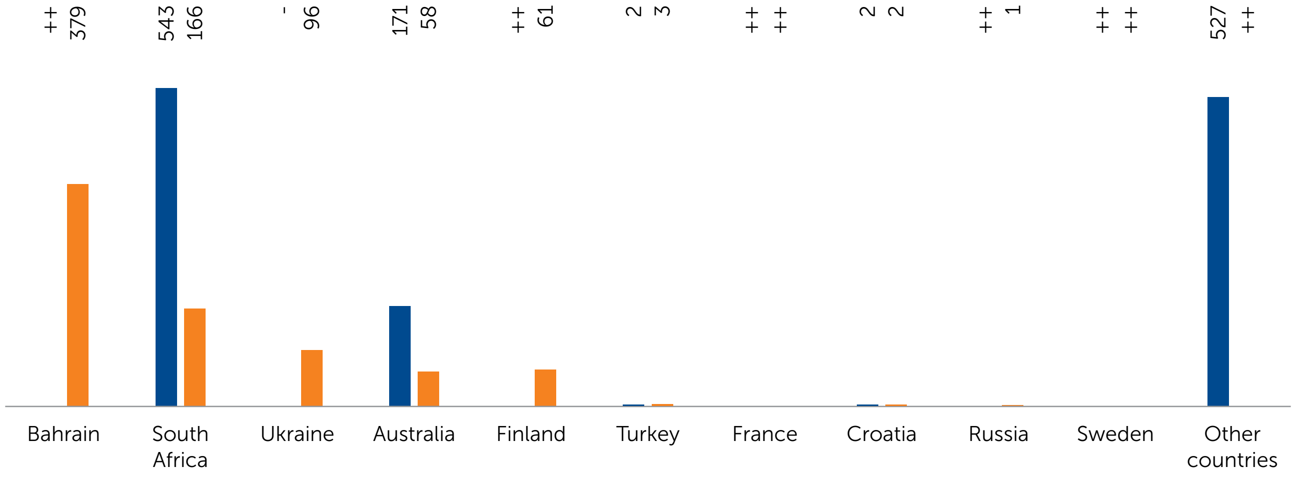


Fig 2: Countrywise Imports of Iron Ore: Total

Table-21: Imports of Iron Ore: Concentrates Non-agglomerated

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	420	3063619	154	1484523
Ukraine	-	-	96	853772
Australia	-	-	58	593329
France	++	1160	++	25291
Sweden	++	13251	++	11270
Singapore	-	-	++	353
USA	++	314	++	321
Mali	++	52	++	102
China	-	-	++	49
UK	++	57	++	31
Japan	-	-	++	5
Other countries	420	3048785	-	-

Figures rounded off.

Table-22: Imports of Iron Ore: Pellets

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	54	438140	379	4612581
Bahrain	-	-	379	4612542
Ukraine	-	-	++	39
Iran	54	438138	-	-
Japan	++	2	-	-

Figures rounded off.

Table-23: Imports of Iron Ore: Pyrites
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	5	86330	67	546483
Finland	++	7067	61	461841
Turkey	2	23867	3	36744
Croatia	2	19967	2	20341
Russia	++	579	1	14161
China	++	10240	++	8601
Italy	++	5738	++	3901
Malaysia	-	-	++	545
USA	++	81	++	349
UAE	1	15438	-	-
Serbia	++	2940	-	-
Other countries	++	413	-	-

Figures rounded off.

Table-24: Imports of Iron Ore Lumps
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	543	4530382	166	1800782
South Africa	543	4528314	166	1793445
Mozambique	-	-	++	6768
Sweden	++	824	++	437
Germany	++	14	++	127
Japan	-	-	++	5
Belgium	++	715	-	-
Brazil	++	515	-	-

Figures rounded off.

Table-25: Imports of Iron Ore: Fines
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty ('000 t)	Value (₹'000)	Qty ('000 t)	Value (₹'000)
All Countries	223	1291301	++	852
France	-	-	++	850
Ukraine	-	-	++	2
Australia	171	874461	-	-
Philippines	52	416840	-	-

Figures rounded off.

FUTURE OUTLOOK

India is one of the leading producers of iron ore in the world. Among the consuming industries, Cement Industry is the second major consumer of iron ore after Iron & Steel Industry (including Sponge Iron Industry).

The Ministry of Steel under Government of India has introduced the new National Steel Policy, 2017 and with the roll out of the National Steel Policy, 2017 and the DMI & SP policy, it is envisaged that the industry can be steered with appropriate policy support in creating an environment for promoting domestic steel and thereby ensuring a scenario where production meets the anticipated pace of growth in consumption. Thus, the Indian Steel Sector is all set to achieve its vision thereby setting a global benchmark in terms of quality, standards and technology. It is anticipated that crude steel capacity of 300 million tonnes will be required by 2030-31 and to fulfill this capacity, about 437 million tonnes of iron ore is required. However, achieving crude steel capacity up to 300 million tonnes will require extensive mobilisation of natural resources, finances, manpower and infrastructure including land. To address the concerns regarding availability of raw material (iron ore) intensive & deeper exploration would have to be promoted for augmentation of resource base. Eco-friendly viable underground mining techniques for optimal utilisation of magnetite ore deposits locked in Western Ghats would also have to be explored in collaboration with mining research institutes. The Government has already promulgated the Mines and Minerals (Development and Regulation) Amendment Act, 2015 and therein has laid great emphasis on time bound mine development with increased stress on mineral exploration and sustainable mining operations which may support ore output growth.

The Act has brought clarity on mine allocation process (through auction) and procedures for mining lease renewal. The Act, further, provides for reservation of any particular mine for a particular end use and put conditions permitting auction among such eligible end users.

17. Kyanite, Sillimanite and Andalusite

105.68
(million tonnes) Total reserves/ resources of kyanite were estimated as on 1st April 2020

72.26
(million tonnes) Total reserves/ resources of sillimanite were estimated as on 1st April 2020

12.60
(million tonnes) Total reserves/ resources of andalusite were estimated as on 1st April 2020

4,925
(tonnes) Production of kyanite were reported in 2020-21

11,110
(tonnes) Production of sillimanite were reported in 2020-21

252
(tonnes) of kyanite were exported in 2020-21

Kyanite, sillimanite and andalusite are unhydrous aluminosilicate minerals that have the same chemical formula Al_2O_3 but differ in crystal structure and physical properties. When calcined at high temperature around 1,350 ^{0}C to 1,380 ^{0}C for kyanite and slightly higher for andalusite and sillimanite, these minerals are converted to mullite, (3 $Al_2O_3.2SiO_2$) and silica (SiO_2) which are refractory minerals.

Synthetic mullite is made by heating mixtures of alumina and silica or bauxite and kaolin at around 1,550 ^{0}C to 2,000 ^{0}C. Refractories are heat resistant materials used in high temperature applications, such as, furnaces, ladles, kilns, in the metallurgical, glass, chemical, cement and other industries.

RESERVES/RESOURCES

Kyanite

The total reserves/resources of kyanite as per NMI database, based on UNFC system as on 1.4.2020 in the country has been placed at 105.68 million tonnes. Out of these resources, only 0.84 million tonnes are Reserves and 104.83 million tonnes are under Remaining Resources. Out of total resources, high and medium-grade resources together account for merely 1.44%, low-grade 8.17%, mixed-grade 0.52%, quartz kyanite rock, kyanite gneiss rock & kyanite schist 78.4% and granular, others & not-known grades 1.63%. Statewise, share of Telangana is 45.75% of the total resources followed by Andhra Pradesh with 30.28%, Karnataka 12.46% and Jharkhand 7.22%. The remaining 3.69% resources are in Kerala, Maharashtra, Rajasthan, Tamil Nadu and West Bengal collectively (Table-1)

Table-1: Reserves/Resources of Kyanite as on 1.4.2020 (P)
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	3933558	331193	122314	846865	1331061	940452	1864398	561680	3577402	96560462	-	104835455	105682321
By Grades													
High grade	-	-	-	-	-	4317	21867	-	297827	114689	-	438700	438700
Medium grade	325113	-	43449	368562	34540	-	276651	-	34410	371144	-	716745	1085307
Low grade	66562	992	-	67554	691161	29990	1191151	386247	2214900	4063596	-	8577045	8644599
High & medium mixed	-	-	-	-	-	-	-	-	93640	47750	-	141390	141390
Medium & low mixed	-	-	-	-	-	-	-	-	-	48000	-	48000	48000
High, medium & low mixed	-	-	-	-	13097	89650	10606	-	45000	210025	-	368378	368378
Granular	1620	-	-	1620	578	117	-	700	167000	79434	-	247829	249449
Quartz kyanite rock	-	330202	-	330202	-	816378	38000	-	-	81696358	-	82550736	82880938
Kyanite gneiss rock	-	-	-	-	-	-	-	-	-	5370800	-	5370800	5370800
Kyanite schist	-	-	-	-	-	-	-	-	724625	4250000	-	4974625	4974625
Unclassified	63	-	-	63	-	-	-	-	-	-	-	-	63
Others	-	-	78865	78865	591685	-	326123	-	-	73046	-	990854	1069719
Not-known	-	-	-	-	-	-	-	174733	-	235620	-	410353	410353
By States													
Andhra Pradesh	-	-	-	-	-	-	399	-	-	32003829	-	32004228	32004228
Jharkhand	-	331193	-	331193	1017105	920088	523589	-	1754900	3727685	-	7943367	8274560
Karnataka	181600	-	-	181600	230660	15930	119368	386247	1610502	10628753	-	12991460	13173060
Kerala	-	-	-	-	-	-	-	174733	-	10000	-	184733	184733
Maharashtra	210075	-	122314	332389	69621	4317	1210436	-	45000	1734241	-	3063615	3396004
Rajasthan	-	-	-	-	13097	-	10606	-	-	-	-	23703	23703
Tamil Nadu	1683	-	-	1683	578	117	-	700	167000	79434	-	247829	249512
Telangana	-	-	-	-	-	-	-	-	-	48350000	-	48350000	48350000
West Bengal	-	-	-	-	-	-	-	-	-	26520	-	26520	26520

Figures rounded off.

Sillimanite

The total reserves/resources of sillimanite as per NMI database, based on UNFC system in the country as on 1.4.2020 has been placed at 72.26 million tonnes. Out of these resources, 8.26 million tonnes are under Reserves Category, while about 64.00 million tonnes are under the Remaining Resources. Out of total resources, more than 73.89% are granular high-grade, while quartz sillimanite rocks and sillimanite-bearing rocks are about 21.03%. Resources of massive sillimanite of all grades are about 4.80%. The resources are located mainly in Odisha (24.49%), Tamil Nadu (24.01%), Uttar Pradesh (15.84%), Andhra Pradesh (15.32%), Kerala (9.58%) and Assam (6.38%). The remaining 4.38% resources are in Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Rajasthan and West Bengal (Table-2).

Table-2: Reserves/Resources of Sillimanite as on 1.4.2020 (P)
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	7968445	3655	290200	8262300	503301	23406	20549508	4771654	17630364	16115664	4411195	64005091	72267391
By Grades													
Massive high grade	91790	3655	68112	163557	-	-	-	-	-	11903	-	11903	175460
Massive medium grade	59084	-	3619	62703	-	4000	-	-	-	29705	-	33705	96408
Massive low grade	38000	-	-	38000	15300	-	519	15000	850000	2258786	-	3139605	3177605
Massive high & medium	-	-	-	-	-	-	-	-	-	19800	-	19800	19800
Massive medium & low	-	-	-	-	-	-	-	-	-	38	-	38	38
Quartz sillimanite rock	-	-	-	-	-	-	-	-	-	-	3748000	3748000	3748000
Sillimanite-bearing rock	-	-	-	-	-	-	-	2100000	9350000	-	-	11450000	11450000
Others	-	-	-	-	-	11070	-	-	-	-	-	11070	11070
Unclassified	3458	-	-	3458	84000	-	-	-	-	-	-	84000	87458
Not-known	-	-	-	-	-	-	-	-	64	516	101600	102180	102180
Granular high	7776113	-	218469	7994582	404001	8336	20548989	2656654	7430300	13794916	561595	45404791	53399373

Contd...

Table-2 *(Concld)*

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
By States													
Andhra Pradesh	1451556	-	218469	1670025	-	11070	462830	-	7430300	1491539	-	9395739	11065764
Assam	-	-	-	-	-	-	-	-	850000	6700	3748000	4604700	4604700
Jharkhand	-	-	-	-	-	-	-	-	-	83000	-	83000	83000
Karnataka	-	-	-	-	-	-	-	-	-	982725	-	982725	982725
Kerala	553000	-	-	553000	432713	-	-	2564254	-	3369200	-	6366167	6919167
Madhya Pradesh	-	-	-	-	-	-	-	-	-	-	101600	101600	101600
Maharashtra	174474	3655	3619	181748	15000	-	-	15000	64	516	-	30580	212328
Meghalaya	14400	-	68112	82512	-	-	-	-	-	55807	-	55807	138319
Odisha	5640985	-	-	5640985	-	-	6557013	-	-	4943600	561595	12062208	17703193
Rajasthan	-	-	-	-	300	-	519	-	-	-	-	819	819
Tamil Nadu	134030	-	-	134030	55288	12336	13529146	92400	-	3529577	-	17218747	17352777
Uttar Pradesh	-	-	-	-	-	-	-	2100000	9350000	-	-	11450000	11450000
West Bengal	-	-	-	-	-	-	-	-	-	1653000	-	1653000	1653000

Figures rounded off.

Andalusite

The total reserves/resources of andalusite in the country as on 1.4.2020 as per NMI database, based on UNFC system has been placed at 12.60 million tonnes. Most of the resources are of Reconnaissance category located in Uttar Pradesh (Table-3).

Table-3: Reserves/ Resources of Andalusite as on 1.4.2020
(By Grades/States)

(In '000 tonnes)

State	Reserves Total (A)	Remaining Resources				Total Resources (A+B)
		Indicated	Inferred	Reconnaissance	Total	
		STD332	STD333	STD334	(B)	
All India : Total By Grades	-	58040	56210	11800	126050	126050
Low	-	58040	56210	11800	126050	126050
By States						
Jharkhand	-	-	-	11800	11800	11800
Uttar Pradesh	-	58040	56210	-	114250	114250

Figures rounded off.

EXPLORATION & DEVELOPMENT

Details of exploration & development, if any, are covered in the Review of "Exploration & Development" under "General Reviews".

PRODUCTION & STOCKS

Kyanite

The production of kyanite was 4,925 tonnes in 2020-21, this increased by 41% as compared to 3,498 tonnes in previous year (Fig-1). There were 5 reporting mines in 2020-21 against 4 reporting mines in the previous year. Three principal producers contributed the entire production of kyanite during the year.

In 2020-21, 605 tonnes, i.e., about 12.28% of the total production of kyanite was of grade 40% Al_2O_3 & above and the remaining 87.72%, i.e., about 4,320 tonnes was of grade below 40% Al_2O_3. About 10.96% out of the total production was reported by the Public Sector and 89.04% by Private Sector (Tables - 4 to 6).

Mine-head closing stocks of kyanite for 2020-21 were at 11,263 tonnes as against 9,622 tonnes in 2019-20 (Table-7).

The average daily employment of labour was 57 in 2020-21 as against 69 in the preceding year.

Table-4: Principal Producers of Kyanite, 2020-21

Name & address of producer	Location of mine	
	State	District
Pavri Kyanite Mines, A-1, Indra Sagar, Ravindranath Tagore Marg, Civil Lines, Nagpur- 440 001, Maharashtra.	Maharashtra	Bhandara
Maharashtra State Mining Corporation Ltd Plot No. 7, Ajni Chowk, Wardha Road, Nagpur - 440 015, Maharashtra.	Maharashtra	Bhandara
Mohammad Akram Rasheed, 3 Marcha Halli, H.D.Kote Mysore-571 125. Karnataka	Karnataka	Mysore

Table-5: Production of Kyanite, 2018-19 to 2020-21
(By States)

(Quantity in tonnes)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	4889	15757	3498	12728	4925	10837
Karnataka	-	-	400	880	3780	7414
Maharashtra	4889	15757	3098	11848	1145	3423

(Quantity in tonnes)

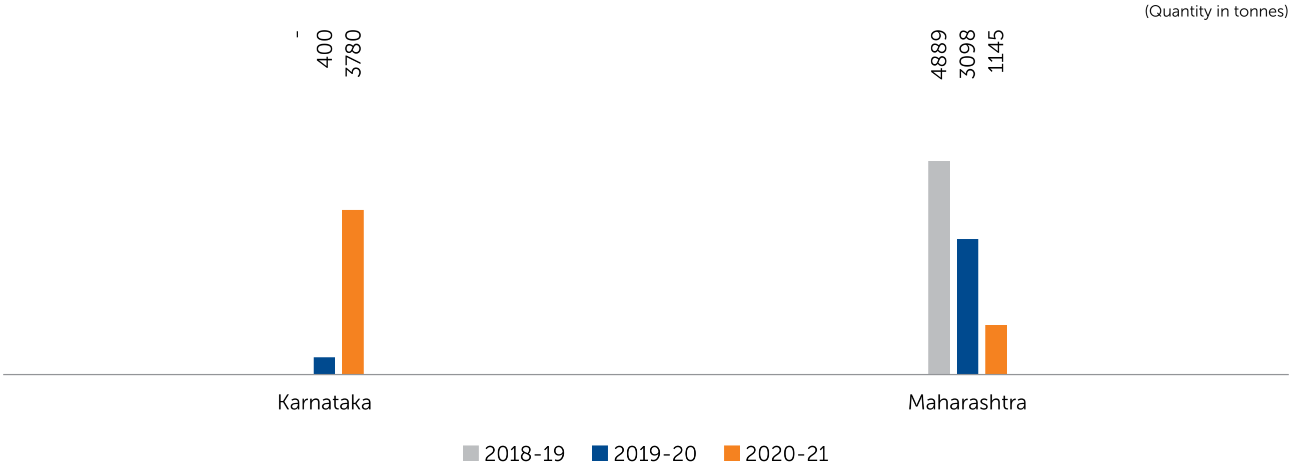


Fig 1: Production of Kyanite in India

Table-6: Production of Kyanite, 2019-20 and 2020-21
(By Sectors/States/Districts/Grades)

(Qty in tonnes; Value in ₹'000)

State/District	2019-20					2020-21 (P)				
	Quantity					Quantity				
	No. of mines	40% Al_2O_3 & above	Below 40% Al_2O_3	Total	Value	No. of mines	40% Al_2O_3 & above	Below 40% Al_2O_3	Total	Value
India	5	2248	1250	3498	12728	4	605	4320	4925	10837
Public sector	1	13	850	863	1511	1	-	540	540	1106
Private sector	4	2235	400	2635	11217	3	605	3780	4385	9731
Karnataka	1	-	400	400	880	1	-	3780	3780	7414
Mysuru	1	-	400	400	880	1	-	3780	3780	7414
Maharashtra	4	2248	850	3098	11848	3	605	540	1145	3423
Bhandara	4	2248	850	3098	11848	3	605	540	1145	3423

Table-7: Mine-head Closing Stocks of Kyanite, 2019-20 & 2020-21
(By States/Grades)

(Qty in tonnes)

State	2019-20			2020-21 (P)		
	40% Al_2O_3 & above	Below 40% Al_2O_3	Total	40% Al_2O_3 & above	Below 40% Al_2O_3	Total
India	249	9373	9622	1646	9617	11263
Jharkhand	-	1327	1327	1325	1	1326
Karnataka	-	7915	7915	-	9440	9440
Maharashtra	249	131	380	321	176	497

Sillimanite

The production of sillimanite at 11,110 tonnes in 2020-21 decreased by 16% as compared to 13,221 tonnes in the previous year(Fig-2). There were 1 reporting mine in 2020-21 as against 6 mines reported in the year 2019-20. The main reason for decrease in number of mines is on account of classification of some sillimanite producing mines, as Beach Sand Minerals (BSM) mines in Andhra Pradesh, Odisha and Kerala. Earlier these mines were considered under sillimanite as a part of MCDR mineral prior to separate classification as BSM and Non-BSM. This has also resulted in shrinking of production. Besides, three mines reported production of sillimanite as an associated mineral with kyanite during the year. (Table-8, 9 & 10)

The whole production of sillimanite was reported by Private Sector during the year 2020-21. Maharashtra is the only State which contributed cent per cent production of sillimanite during the year 2020-21.

Mine-head closing stocks for the year 2020-21 were 1479 tonnes as against 10,113 tonnes in the previous year (Table - 11).

The average daily employment of labour during 2020-21 was 4 as against 36 in the previous year.

Table-8: Principal Producers of Sillimanite, 2020-21

Name & address of producer	Location of mine	
	State	District
*Dighori Kyanite Mine, Apna Nagar, Tkiya Ward, Nagpur Road Bhandara, Bhandara-441 904, Maharashtra.	Maharashtra	Bhandara
*Pavri Kyanite Mines, A/1, Indrasagar, Ravindranath Tagore Road, Civil Lines, Nagpur- 440 001, Maharashtra.	Maharashtra	Bhandara

* Producing as an associated mineral with kyanite

Table-9: Production of Sillimanite, 2018-19 to 2020-21
(By States)

(Quantity in tonnes)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	69919	564498	13221	37903	11110	26611
Andhra Pradesh	31243	288810	-	-	-	-
Kerala	7318	82173	-	-	-	-
Maharashtra	13404	49477	13221	37903	11110	26611
Meghalaya	24	168	-	-	-	-
Odisha	17930	143870	-	-	-	-

Note: The main reason for decrease in number of mines is classification of some sillimanite producing mines, as BSM mines in Andhra Pradesh, Kerala and Tamil Nadu. Earlier, these mines were considered under sillimanite mineral as a part of MCDR mineral as there was no separate classification of Beach Sand minerals (BSM) and Non-Beach Sand Minerals (Non-BSM).

(Quantity in tonnes)

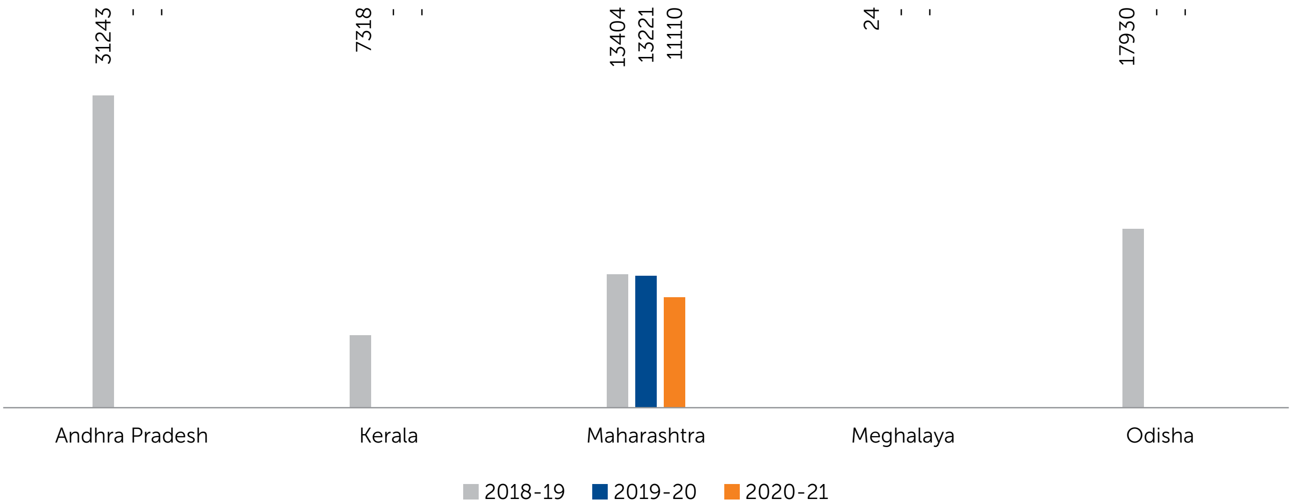


Fig 2: Production of Sillimanite in India

Table-10: Production of Sillimanite, 2019-20 & 2020-21
(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/District	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	2(3)	13221	37903	1(2)	11110	26611
Public sector	2	-	-	1	-	-
Private sector	-3	13221	37903	-2	11110	26611
Andhra Pradesh	-	-	-	-	-	-
Srikakulam	-	-	-	-	-	-
Kerala	-	-	-	-	-	-
Kollam	-	-	-	-	-	-
Maharashtra	2(3)	13221	37903	1(2)	11110	26611
Bhandara	2(3)	13221	37903	1(2)	11110	26611
Meghalaya	-	-	-	-	-	-
Khasi Hills West	-	-	-	-	-	-
Odisha	-	-	-	-	-	-
Ganjam	-	-	-	-	-	-

Figures in parentheses indicate the number of associated mines with kyanite

Note: The main reason for decrease in number of mines is classification of some sillimanite producing mines as BSM mines in Andhra Pradesh, Kerala and Tamil Nadu. Earlier, these mines were considered under sillimanite mineral as a part of MCDR mineral as there was no separate classification of Beach Sand minerals (BSM) and Non-Beach Sand Minerals (Non-BSM).

Table – 11: Mine-head Closing Stocks of Sillimanite, 2019-20 & 2020-21
(By States)

(In tonnes)

State	2019-20	2020-21 (P)
India	10113	1479
Andhra Pradesh	-	-
Kerala	-	-
Meghalaya	188	188
Maharashtra	9925	1291
Odisha	-	-

Andalusite

There was no production of andalusite reported since 1988.

MINING & MARKETING

Kyanite

Kyanite mines are worked by opencast manual as well as semi-mechanised methods. Generally, the mineral is marketed under three grades: 60% Al_2O_3 and above, 50 - 60% Al_2O_3 and less than 50% Al_2O_3. These three grades are used in the manufacture of refractories.

Sillimanite

Sillimanite mines are also worked by opencast method. Pohra mine of Maharashtra State Mining Corporation Ltd is semi-mechanised.

USES

Kyanite, sillimanite and andalusite are mainly used in refractories and ceramic products because of their ability to form mullite phase at high temperature. Mullite is an essential component of high-alumina refractories forming the inner lining of furnaces and high temperature vessels widely used in the production of metals, ceramics, glass and cement. These are used in manufacturing refractory products like dense bricks, insulating bricks, monolithic & castables. Sillimanite refractory bricks are extensively used in steel and glass industries and also in ceramics, cement kilns, heat treatment furnaces and petrochemical industries.

SPECIFICATIONS

BIS has prescribed IS:14301-1995 (reaffirmed in 2011) for kyanite used in Refractory Industry. There are two grades, i.e., Grade-1 and Grade-2. Composition of kyanite under this specification is Al_2O_3 58% min. Grade-1 and 54% min. for Grade-2; Fe_2O_3 1.50% max., K_2O + Na_2O 1% max.; other constituents would be for as agreed between the supplier and purchaser. Pyrometric Cone Equivalent (PCE) specified would have to be not less than 36 for Grade-1 and 35 for Grade-2. Size of the material is 50 to 150 mm or 10 to 50 mm. BIS has laid down IS:14302-1995 (reaffirmed in 2011) in respect of beach sand sillimanite for use in Refractory Industry, while IS:2045-1962 in respect of natural sillimanite blocks for glass melting tanks furnaces has been withdrawn.

CONSUMPTION

Kyanite

The consumption of kyanite in various industries was 7,700 tonnes in 2019-20 which is about 51% more than previous year. Nearly 88% consumption of kyanite was accounted for by the Refractory Industry and the remaining12% by other industries (Table-12).

Sillimanite

The consumption of sillimanite was 23,400 tonnes in 2019-20, which is about 58% less than that of the previous year. Refractory Industry alone accounted for about 89% of consumption. Ceramic Industry (2%), Foundry Industry (5%) and Other Industries accounted for the rest. (Table-12).

Table-12: Consumption* of Kyanite and Sillimanite 2017-18 to 2019-20

(By Industries)

(In tonnes)

Industry	2017-18	2018-19 (R)	2019-20 (P)
Kyanite			
All Industries	6600	5100	7700
Refractory	6600	5100	6800
Others	++	++	900
Sillimanite			
All Industries	75900	56100	23400
Ceramic	8700	2500	500
Foundry	4000	5400	1100
Refractory	59000	43800	20800
Others (abrasives, cement, chemicals, etc.)	4200	4400	1000

Figures rounded off.

Includes actual reported consumption and/or estimates made from dispatches (as reported in Form FH under Rule-45 & MCDR, 2017/1988)wherever required and coverage may not be complete due to paucity of data.

WORLD REVIEW

World reserve of kyanite and related minerals is large in the USA. Andalusite is limited to only a few countries. The main producer and exporter of andalusite is South Africa and Peru while USA and India are the main producers of kyanite. India is the leading producer of sillimanite. World production of kyanite and related minerals is indicated in (Table-13).

The availability of inexpensive refractory-grade bauxite from China served to increase demand for refractories from alternative raw material, such as, andalusite. Demand for refractories in iron and steel production is expected to have larger increases in countries with higher growth rates in steel production. Increased demand also is anticipated for refractories used for producing other metals and in the industrial mineral market because of increasing production of cement, ceramics, glass, and other mineral products.

FOREIGN TRADE

Exports

Exports of kyanite during 2020-21 at 252 tonnes increased drastically by 76% from 143 tonnes in the previous year. Exports were mainly to Greece (85%), Saudi Arabia (3%) and UAE (4%) (Fig-3). Similarly, exports of sillimanite increased by manifold to 4998 tonnes in 2020-21 from 1025 tonnes in the previous year. Sillimanite was exported mainly to Nepal (4%), Japan (7%) and China (80%). Exports of about 1% were to USA, Vietnam,Thailand and other countries. Exports of andalusite during 2020-21 also decreased manifolds to 9 tonnes from 19 tonnes in the previous year. Andalusite was exported solely to UAE (100%) (Fig-5) (Tables - 14 to 16).

Table-13: World Production of Minerals (Kyanite, Sillimanite & Andalusite)

(By Industries)

(In tonnes)

Country	2018	2019	2020
France(a)			
Andalusite(e)	65000	68000	65000
India*			
Kyanite(e)	4889	3497	4925
Sillimanite(e)	69033	13236	11110
Madagascar			
Andalusite	4200	-	-
Nepal			
Kyanite(d)	1	-	-
South Africa			
Andalusite (e)	200000	190000	180000
USA			
Kyanite(e)	anite(b) 89200	91300	85000

Source: BGS World Mineral Production, 2016-2020, BGS.

(a) May Include other sillimanite minerals.

(b) Including related minerals.

(c) Years ended 31st March following the at stated.

(d) Years ending 15th July of the stated.

(e) Estimated.

*India's production during 2018-19, 2019-20 and 2020-21 in respect of kyanite is 4889 tonnes, 3498 tonnes & 4925 tonnes respectively and in respect of sillimanite is 69919 tonnes, 13221 tonnes & 11110 tonnes respectively.

Table-14: Exports of Kyanite

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	143	2627	252	9033
Greece	72	1575	216	4871
Bhutan	-	-	4	3500
UAE	13	421	12	404
Saudi Arabia	50	541	10	153
Ghana	-	-	10	90
Japan	-	-	++	14
Germany	-	-	++	1
China	1	59	-	-
Nigeria	7	16	-	-
Nepal	++	15	-	-

Figures rounded off.

(In tonnes)

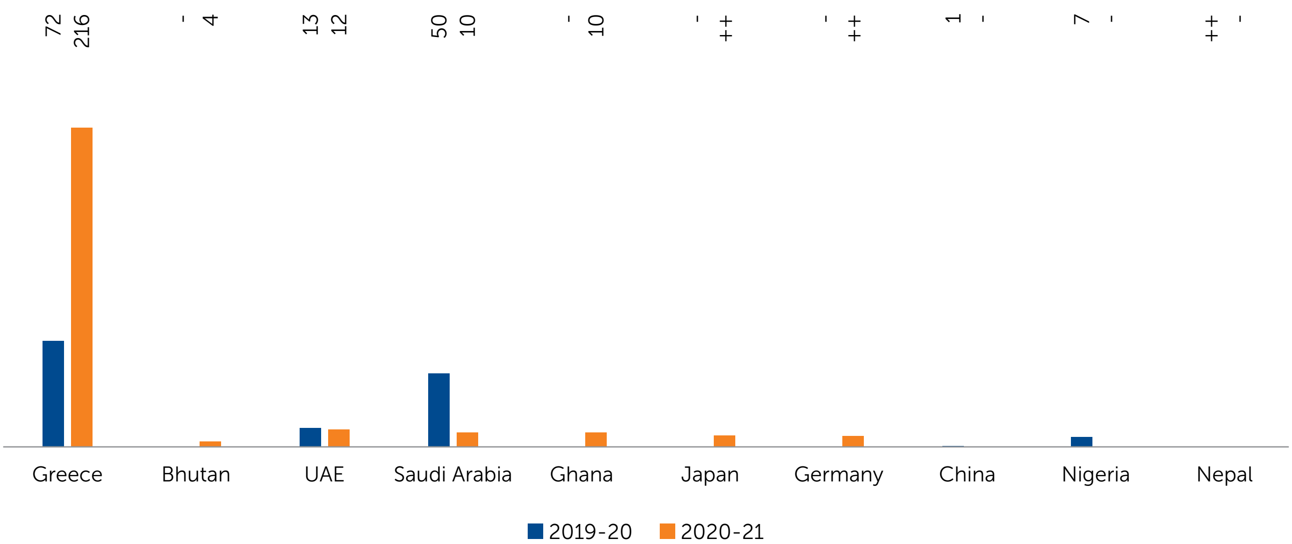


Fig 3: Countrywise Exports of Kyanite

Table-15: Exports of Sillimanite
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1025	14961	4998	94359
China	216	3570	4004	72772
Japan	231	7431	378	12700
Malaysia	-	-	298	5399
Nepal	487	2809	235	1296
Thailand	25	374	50	990
Vietnam	10	351	25	963
Hong Kong	-	-	3	69
USA	++	23	1	62
Mauritius	-	-	3	22
UK	-	-	++	22
Other Countries	56	403	1	64

Figures rounded off.

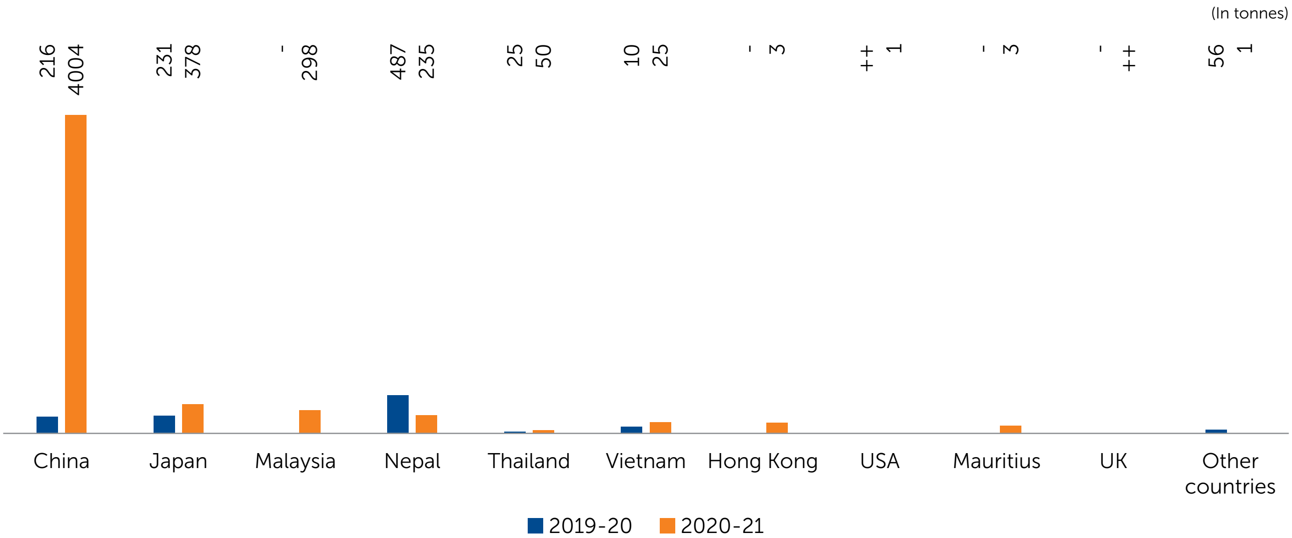


Fig 4: Countrywise Exports of Sillimanite

Table-16: Exports of Andalusite
(By Countries)

Country Vietnam	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	19	1240	9	476
UAE	19	1240	9	476

Figures rounded off.

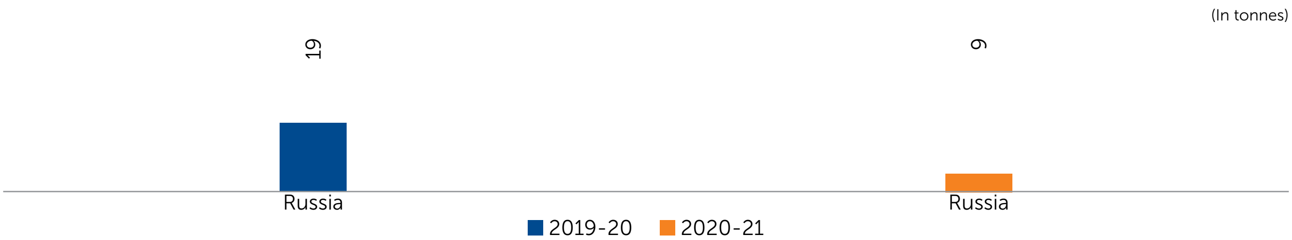


Fig 5: Countrywise Exports of Andalusite

Imports

In 2020-21, imports of kyanite were at 1,238 tonnes as against 1,112 tonnes in the previous year registering an increase of 11%. Imports of sillimanite were at 606 tonnes which decreased manifolds during 2020-21 as compared to 609 tonnes in the previous year. Imports of andalusite at 15,217 tonnes decreased by 13% during 2020-21 from that of the previous year. The imports of kyanite were mainly from USA (79%) and China (14%) (Fig-6) while Ukraine (67%), Hong Kong (33%) were the main suppliers of sillimanite (Fig-7) and South Africa (77%) and France (21%) were the main suppliers of andalusite in 2020-21 (Fig-8) (Tables - 17 to 19).

Table-17: Imports of Kyanite
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1112	33476	1238	42080
USA	790	28596	985	36136
China	260	3721	180	3823
South Africa	-	-	54	1442
UAE	-	-	10	282
Australia	-	-	4	228
Malaysia	6	314	5	169
Ukraine	56	825	-	-
Japan	++	20	-	-

Figures rounded off.

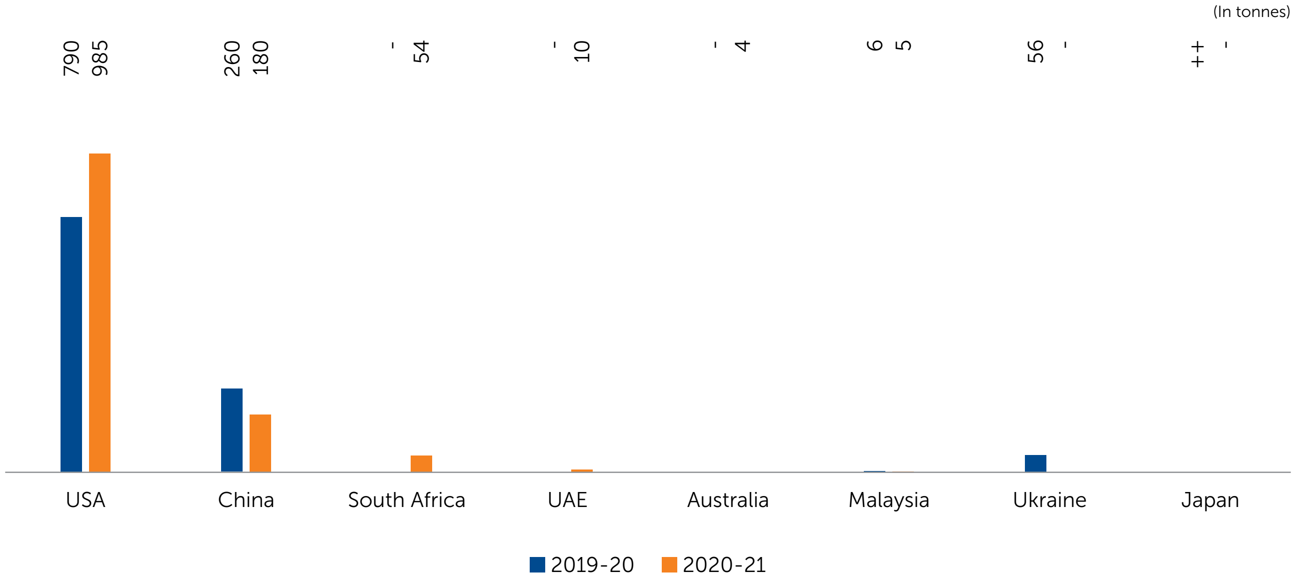


Fig 6: Countrywise Imports of Kyanite in India

Table-18: Imports of Sillimanite
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	609	10781	606	11571
Ukraine	416	6321	405	7080
Hong Kong	112	1696	200	3890
USA	17	850	++	341
Japan	3	241	1	147
China	6	131	++	80
Taiwan	1	132	++	22
Burundi	-	-	++	11
South Africa	54	1398	-	-
Vietnam	++	7	-	-
UK	++	3	-	-
Other countries	++	2	++	++

Figures rounded off.

(In tonnes)

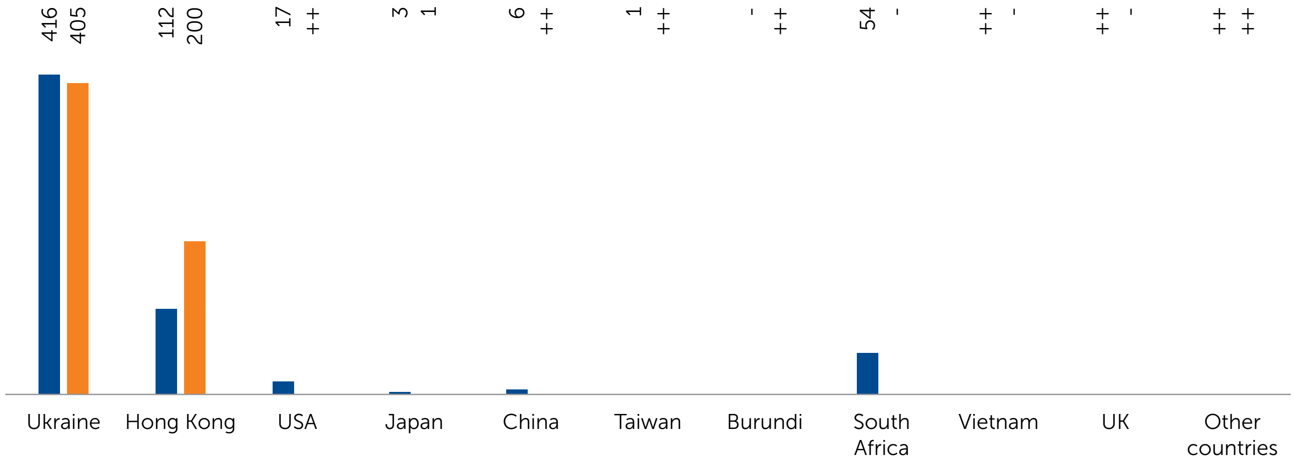


Fig 7: Countrywise Imports of Sillimanite in India

Table-19: Imports of Andalusite

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**17618**	**425962**	**15217**	**428831**
South Africa	14661	343391	11762	323009
France	2871	80220	3291	100507
USA	60	1877	150	4534
UAE	-	-	14	643
China	-	-	++	71
UK	-	-	++	67
Netherlands	26	474	-	-

Figures rounded off.

(In tonnes)

Fig 8: Countrywise Imports of Andalusite in India

FUTURE OUTLOOK

The demand for high quality raw and calcined sillimanite minerals is closely linked to the need for high performance refractories with increased operational lifespans. As the predominant consumer of refractory products, the Steel Manufacturing Industry provides a reliable market indicator of the demand for sillimanite minerals.

The Asia-Pacific region remains the largest market for refractories. The production of sillimanite is likely to increase in the coming years to meet the demand. China will remain the leading market on global front. Demand for refractory minerals in India is likely to scale up in commensurate with steel production which is also likely to show an increasing trend.

18. Limestone & Other Calcareous Materials

2.28
(million tonnes) resources were estimated as per NMI database

349
(million tonnes) Production of limestone werre reported in 2020-21.

3.53
(million tonnes) of limestone were exported in 2020-21.

22.80
(million tonnes) of limestone were imported in 2020-21.

Limestone is a sedimentary rock composed mainly of calcium carbonate ($CaCO_3$) in the form of the mineral calcite. About 10% of sedimentary rocks are limestone and most cave systems are through limestone bedrock. The two most important constituents of limestone are calcite and dolomite. Limestone often contains magnesium carbonate, either as dolomite $CaMg(CO_3)_2$ or magnesite ($MgCO_3$) mixed with calcite. Such rocks are termed as 'dolomitic' or 'magnesian' limestone. Limestone altered by dynamic or contact metamorphism become coarsely crystalline and are referred to as 'marble' and 'crystalline limestone'. Other common varieties of limestone are 'marl', 'oolite' (oolitic limestone), shelly limestone, algal limestone, coral limestone, pisolitic limestone, crinoidal limestone, travertine, onyx, hydraulic limestone, lithographic limestone, etc. However, the limestone which is used by industries in bulk quantity is a bedded type sedimentary limestone.

Other calcareous material used by industry are 'limeshell', the thick calcareous shells of molluscs deposited in the form of beds as well as present in ancient lakes and shallow seas. "Marl", a lime-rich mud contains variable amounts of clays and silt.

A limestone rock which separates well along the stratification into a few centimetres thick slab is termed 'flagstone'. The dimensional limestone is used for building and ornamental stone.

RESERVES/RESOURCES

The total reserves/resources of limestone of all categories and grades as per NMI database based on UNFC system as on 1.4.2020 has been estimated at 2,27,589 million tonnes, of which 19,028 million tonnes (8%) are placed under Reserves category and 208,560 million tonnes (92%) are under Remaining Resources category. Karnataka is the leading State having 24% of the total resources followed by Andhra Pradesh (13%), Rajasthan (12%), Gujarat (10%), Meghalaya (10%), Telangana (7%), Chhattisgarh (5%) and Madhya Pradesh (4%). The remaining 15% is shared by other states. Grade-wise, Cement grade (Portland) has leading share of about 68% followed by Unclassified grades (11%) and BF grade (6%). The remaining 15% is shared by various other grades [Table-1 (A)].

Table–1(A): Reserves/Resources of Limestone as on 01.04.2020 (P)
(By Grades/States)

(In '000 tonnes)

States/Grades	Reserves				Remaining Resources								Total Resources
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon-naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
All India:Total	14701910	1065305	3261256	19028470	7665106	6442697	9261072	7528921	32250068	135833401	9579524	208560789	227589259
By Grades													
Chemical	146938	24096	83801	254835	193447	136909	614181	49055	1852736	2334325	17172	5197825	5452660
S.M.S.(O.H.)	84202	544	18824	103570	37598	347821	750421	473258	872586	2351376	12338	4845398	4948968
S.M.S.(L.D.)	27026	64	289	27379	4535	107078	11723	6933	218226	240547	2202	591243	618622
S.M.S.(O.H. & L.D. mixed)	143912	-	-	143912	-	-	-	-	69460	167182	-	236642	380554
B.F.	447043	17379	282224	746646	236231	423320	345685	513408	941805	10947453	18551	13426453	14173099
S.M.S. & B.F. mixed	5579	6543	9459	21580	18093	15425	99785	15303	139338	712250	240733	1240926	1262506
Cement (portland)	13072953	940605	2699398	16712957	6584396	5046475	6977585	5557939	17983254	89232763	8258746	139641159	156354115
Cement (white)	27140	-	866	28006	2132	7949	3629	-	27225	5862	-	46798	74804
Cement (portland& white)	29172	-	26239	55411	14126	7694	67824	338670	60000	516850	39000	1044164	1099575
Cement (blendable beneficiable)	479513	3638	105356	588507	284744	204927	198066	75132	2699758	3432109	156607	7051343	7639850
B.F. & cement mixed	6583	-	13281	19864	36032	26131	35249	485	479069	40442	-	617408	637273
S.M.S., chemical& paper	182	-	-	182	1732	2174	1329	-	-	1228344	517	1234096	1234278
Paper	53899	-	2375	56274	41846	-	3164	125453	27073	643601	-	841137	897411
Blendable (CaO 34-38%)	-	-	-	-	6641	6730	2762	39760	310215	113006	404770	883884	883884
Others	43886	2312	2516	48714	34178	32246	35476	64646	558849	2687647	27316	3440357	3489071
Unclassified	105382	54583	5127	165092	116840	65050	94908	224091	5666344	19835715	380040	26382988	26548080
Not-known	28500	15540	11502	55542	52535	12767	19286	44789	344129	1343930	21532	1838969	1894511
By States													
Andhra Pradesh	2815170	2133	439387	3256690	1302360	404217	1164592	115264	2129536	1866740	3399422	26582132	29838822
Arunachal Pradesh	-	-	-	-	-	-	-	-	49220	433575	1	482796	482796
Assam	23442	-	164687	188130	170039	27593	100319	67000	39859	1278730	-	1683540	1871670
Bihar	11807	-	-	11807	3388	2558	1675	67926	135740	772343	10558	994188	1005995
Chhattisgarh	1364595	65530	56227	1486351	1658144	903350	298720	1456579	1778018	5630057	-	11724867	13211218
Daman & Diu	-	-	-	-	-	-	-	-	-	128670	-	128670	128670
Gujarat	722663	115984	64467	903115	507311	254583	176439	79919	2593098	18317659	160	21929169	22832284
Haryana	-	-	-	-	1425	15507	3382	-	2200	52163	-	74677	74677
Himachal Pradesh	696165	249863	75984	1022012	78403	653158	21105	1529950	5079	3295168	14271	5597134	6619146
*Jammu & Kashmir	156757	15852	12881	185490	122422	45566	58608	67456	26704	1703261	218054	2242071	2427561

(In '000 tonnes)

States/Grades	Reserves				Remaining Resources								Total Resources
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon-naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
Jharkhand	6780	3512	395	10687	74071	50565	11535	91922	13220	356962	11803	610078	620765
Karnataka	1766001	2013	503208	2271221	584131	522239	778646	1776165	15091800	35135248	11008	53899236	56170457
Kerala	10475	-	65	10540	123286	103	-	21161	2888	36622	-	184059	194599
Madhya Pradesh	1252455	128972	311004	1692431	772476	342790	1119260	498580	791417	4128019	308205	7960747	9653178
Maharashtra	528636	137773	34940	701349	765567	235543	126780	69286	681879	1220928	7060	3107044	3808392
Manipur	-	-	-	-	-	-	-	10197	2138	33718	-	46053	46053
Meghalaya	133298	50979	66766	251043	57639	104791	16452	697286	4167752	17819716	720309	23583945	23834988
Nagaland	-	-	-	-	825	-	-	-	1005500	745875	-	1752200	1752200
Odisha	388084	67346	13150	468580	156898	456006	260485	139924	239877	435449	38785	1727424	2196004
Puducherry	-	-	-	-	-	-	-	4433	4333	6966	-	15732	15732
Rajasthan	3299838	220062	1284254	4804154	454148	1838217	4541298	441902	2261727	12946106	1673697	24157095	28961249
Sikkim	-	-	-	-	-	-	-	-	-	2380	-	2380	2380
Tamil Nadu	537272	3836	5915	547024	317801	239742	120594	95885	114647	687457	900	1577025	2124049
Telangana	984751	1450	227926	1214127	509737	142386	299243	118735	893077	11342869	3132280	16438327	17652454
Uttar Pradesh	3720	-	-	3720	-	111910	101510	142763	40000	43540	-	439723	443443
Uttarakhand	-	-	-	-	5035	91872	60429	29486	164879	1191059	33011	1575771	1575771
West Bengal	-	-	-	-	-	-	-	7104	15482	22120	-	44706	44706

Figures rounded off.

* Notified as Union Territory and is to be known as Union Territory of Jammu & kashmir comprising the territory of the existing State of Jammu & Kashmir (Gazette Notification No. 53, New Delhi, Friday, August 9, 2019)

Table – 1 (B) : Reserves/Resources of Marl as on 01.04.2020

(By Grades/States)

(In tonnes)

States/Grades	Reserves				Remaining Resources								Total Resources
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon-naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
All India : Total	50825000	17210000	110000	68145000	26474477	4189000	-	-	-	390000	-	31053477	99198477
By Grade													
Unclassified	50825000	17210000	110000	68145000	26474477	4189000	-	-	-	390000	-	31053477	99198477
By State													
Gujarat	50825000	17210000	110000	68145000	26474477	4189000	-	-	-	390000	-	31053477	99198477

Figures rounded off.

The total reserves/resources of marl of all categories and grades as per NMI database based on UNFC system as on 1.4.2020 has been estimated in Gujarat at 99.20 million tonnes of which 68.15 million tonnes (69%) are under Reserves category and 31.05 million tonnes (31%) are under Remaining Resources category [Table-1 (B)].

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION AND STOCKS

Limestone

The production of limestone in 2020-21 at 349 million tonnes decreased marginally by about 2.86% as compared to that of the previous year.

There were 663 reporting mines in 2020-21 as against 691 during the previous year. Twenty six mines, each producing more than 3 million tonnes per annum contributed 39 per cent of the total production of limestone in 2020-21. The share of 27 mines, each in the production range of 2 to 3 million tonnes was 20% of the total production. About 20% of the total production was contributed by 49 mines, each producing 1 to 2 million tonnes annually. The remaining 21% of the total production was reported by 561 mines and 4 associated mines during the year. Ten principal producers contributed about 53% of the total production. About 2.47% of the production was reported by Public Sector mines as against 2.82% in the previous year.

About 97% of the total production of limestone during 2020-21 was of Cement grade and the remaining 3% was of other grades (Tables-2 to 6).

Rajasthan was the leading producing State accounting for (21%) of the total production followed by Madhya Pradesh (13%), Andhra Pradesh & Chhattisgarh (12% each),Karnataka(9 %),Telangana (7%) ,Tamil Nadu & Gujarat (6% each) and the remaining 14% was contributed by Assam, Bihar, Himachal Pradesh, UT of Jammu & Kashmir, Jharkhand, Kerala, Maharashtra, Meghalaya, Odisha and Uttar Pradesh.

Mine-head closing stocks of limestone for the year 2019-20 was 24.7 million tonnes and for the year 2020-21 is 24.3 million tonnes.

Average daily labour employment in limestone mines in 2020-21 was 18,838 as against 21,335 in the previous year.

Table-2: Principal Producers of Limestone, 2020-21

Name and address of producer	Location of mine	
	State	District
UltraTech Cement Ltd,	Andhra Pradesh	Kurnool
'B' Wing, Ahura Centre,	Chhattisgarh	Baloda Bazar
2nd Floor, Mahakali		Raipur
Caves Road,	Gujarat	Amreli
Andheri (E)		Bhavnagar
Mumbai-400 093,	Himachal Pradesh	Solan
Maharashtra	Karnataka	Gulbarga
	Madhya Pradesh	Dhar
		Neemuch
		Rewa
		Satna
		Sidhi
	Maharashtra	Chandrapur
	Rajasthan	Chittorgarh
		Jaipur
		Nagaur
	Tamil Nadu	Ariyalur
		Perambalur
	Uttar Pradesh	Sonbhadra
Shree Cement Ltd,	Chhattisgarh	Raipur
Post Box No. 33,	Karnataka	Gulbarga
Bangur Nagar,	Rajasthan	Ajmer
Beawar – 305 901,		Pali
Rajasthan		
Ambuja Cement Ltd,	Chhattisgarh	Baloda Bazar

Table-2 *(Concld)*

Name and address of producer	Location of mine	
	State	District
Elegant Business Park,		Raipur
MIDC Cross Road B	Gujarat	Junagadh
Off Andheri Kurla Road,	Himachal Pradesh	Solan
Andheri-(East),	Maharashtra	Chandrapur
Mumbai - 400 059	Rajasthan	Nagpur
Maharashtra		Pali
The ACC Ltd,	Chhattisgarh	Durg
Cement House, 121,	Himachal Pradesh	Bilaspur
Maharshi Karve Road,	Jharkhand	Singhbhum (W)
Mumbai – 400 020,	Karnataka	Gulbarga
Maharashtra	Madhya Pradesh	Katni
	Maharashtra	Yavatmal
	Odisha	Bargarh
	Rajasthan	Bundi
Dalmia Cement	Andhra Pradesh	Cuddapah
Ltd (Bharat),	Karnataka	Belgaum
Dalmiapuram, Main Road,	Odisha	Sundargarh
Kallakudi Lalgudi,	Tamil Nadu	Ariyalur
Tiruchirappalli- 621 651,		Tiruchirapalli
Tamil Nadu		
J.K.Cement Ltd.	Karnataka	Bagalkot
Kamla Tower,	Rajasthan	Chittorgarh
Kanpur-208 001		Nagaur
Uttar Pradesh		
The Ramco Cement Ltd,	Andhra Pradesh	Krishna
5th Floor, Auras Corporate	Karnataka	Chitradurga
Centre,98 A,	Tamil Nadu	Ariyalur
Dr Radhakrishanan Salai,		Perambalur
Mylapore,Chennai.- 600 004,		Thoothukudi
Tamil Nadu		Virudhunagar
Century Textiles &	Chhattisgarh	Raipur
Industries Ltd,	Madhya Pradesh	Satna
Century Bhawan,	Maharashtra	Chandrapur
Dr Annie Besant Road,		
Worli, Mumbai– 400 030,		
Maharashtra.		
J.K. Lakshmi Cement Ltd,	Chhattisgarh	Durg
4th Floor, Nehru House 4,	Rajasthan	Siroho
Bahadur Sah Zafar Marg,		
New Delhi-110 002		
Jaiprakash Associates Ltd,	Andhra Pradesh	Krishna
Jaypee Group, Sector-128,	Gujarat	Kutch
Noida- 201304,	Madhya Pradesh	Rewa
Uttar Pradesh.		

Table-3: Production of Limestone, 2018-19 to 2020-21
(By States)

(Qty in '000 tonnes; Value in ₹'000)

Country	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	379974	89584491	359464	88890081	349170	82659807
Andhra Pradesh	48295	10227864	42532	9267248	41148	8766490
Assam	1652	531733	1552	500950	1552	468677
Bihar	240	138931	556	263446	1000	193047
Chhattisgarh	42398	9663426	42699	10200663	40378	9416969
Gujarat	26651	5662241	22868	5204303	22245	5017115
Himachal Pradesh	12034	2519275	12527	2746801	11987	2605856
Jammu & Kashmir*	1228	359423	959	280284	1173	322897
Jharkhand	1248	417940	785	339164	324	157084
Karnataka	34378	6103939	34165	6672035	33189	5965087
Kerala	325	230958	398	342144	376	315113
Madhya Pradesh	50102	12271100	47118	12332360	45978	11824339
Maharashtra	14991	3459779	14614	3475512	13939	3341414
Meghalaya	7195	2950307	7248	2988280	6028	2676672
Odisha	5289	1728521	5627	1848621	7187	2234688
Rajasthan	76567	19496173	72390	19094468	74450	18357853
Tamil Nadu	23864	6895558	24461	7151088	21144	5531065
Telangana	30895	6078898	26161	5249950	24498	4740215
Uttar Pradesh	2622	848425	2804	932764	2574	725226

*Formed a new Union Territory to be known as the Union Territory of Jammu and Kashmir comprising the territory of the existing state of Jammu & Kashmir vide Gazette Notification No. 53, New Delhi, Friday, August 9, 2019/Shravana 18,1941 (SAKA).

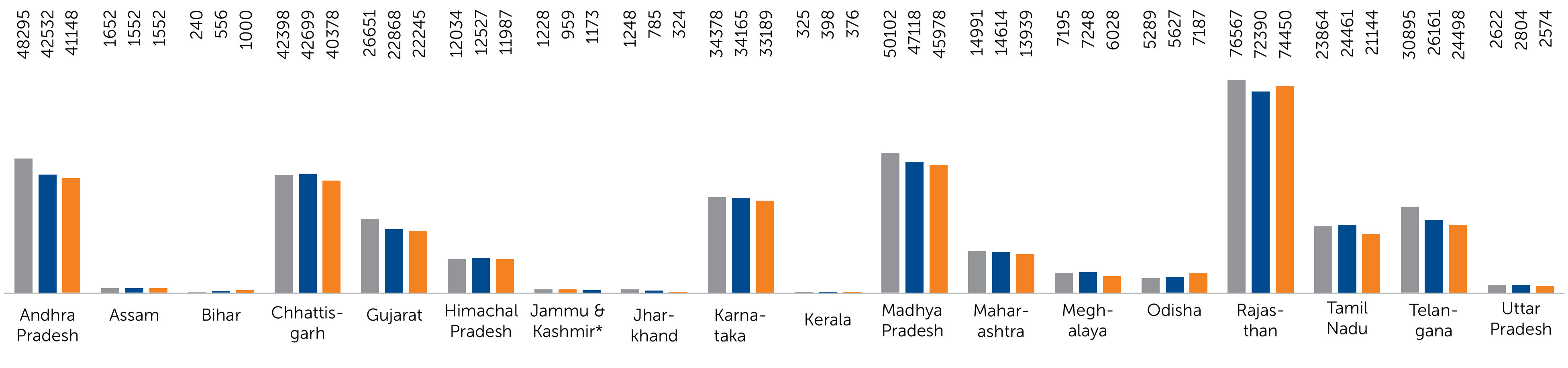


Fig 3: Production of Limestone in India

Table-4: Production of Limestone, 2019-20 and 2020-21
(By Frequency Groups)

(Qty in '000 tonnes; Value in ₹'000)

Production group (In tonnes)	No. of mines		Production for the group ('000 tonnes)		Percentage in total production		Cumulative percentage	
	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)
All Groups	**691(3)**	**663(4)**	**359464**	**349170**	**100**	**100**	**-**	**-**
Up to 10000	227(1)	225(3)	278	324	0.08	0.09	0.08	0.09
10001-50000	121(2)	106	3571	2916	0.99	0.84	1.07	0.93
50001-100000	70	62	5257	4501	1.46	1.29	2.53	2.22
100001-200000	47	52(1)	7189	7604	2	2.18	4.53	4.4
200001-300000	32	31	8150	7827	2.27	2.24	6.8	6.64
300001-400000	20	23	7132	8011	1.98	2.29	8.78	8.93
400001-500000	21	16	9670	7471	2.69	2.14	11.47	11.07
500001-600000	15	7	8366	3897	2.33	1.12	13.8	12.19
600001-700000	7	8	4598	5312	1.28	1.52	15.08	13.71
700001-800000	10	9	7547	6831	2.1	1.96	17.18	15.67
800001-900000	7	11	5899	9526	1.64	2.73	18.82	18.4
900001-1000000	7	11	6737	10551	1.87	3.02	20.69	21.42
1000001-2000000	51	49	69721	68553	19.4	19.63	40.09	41.05
2000001-3000000	26	27	62905	68181	17.5	19.53	57.59	60.57
3000001 & above	30	26	152444	137665	42.41	39.43	100	100

Figure in parenthesis indicates mines of chalk, dolomite & shale with limestone as an associate mineral.

Table–5: Production of Limestone, 2019-20 & 2020 -21
(By Sectors/States/Districts/Grades)

(Qty in '000 tonnes; Value in ₹'000)

State/District	2019-20						2020-21 (P)					
	Grades				Total		Grades				Total	
	No.of mines	Cement	LD, SMS & BF	Chemical	Qty	Value	No.of mines	Cement	LD, SMS & BF	Chemical	Qty	Value
India	691(3)	348520	7928	3016	359464	88890081	663(4)	339520	7194	2456	349170	82659807
Public Sector	23	6027	4117	-	10144	4383783	22	5382	3259	-	8641	3717411
Private Sector	668(3)	342493	3811	3016	349320	84506298	641(4)	334138	3935	2456	340529	78942396
Andhra Pradesh	**72(1)**	**41919**	**613**	**-**	**42532**	**9267248**	**68(1)**	**40665**	**483**	**-**	**41148**	**8766490**
Anantapur	10	3550	22	-	3572	897067	8	4339	15	-	4354	800173
Cuddapah	6	12154	-	-	12154	2504274	6	10301	-	-	10301	1995735
Guntur	12	3586	-	-	3586	738342	12	4360	-	-	4360	811517
Krishna	10	9686	288	-	9974	2617609	10	9627	236	-	9863	2840242
Kurnool	34(1)	12943	303	-	13246	2509956	32(1)	12038	232	-	12270	2318823
Assam	**3**	**1552**	**-**	**-**	**1552**	**500950**	**3**	**1552**	**-**	**-**	**1552**	**468677**
Karbi Anglong	1	98	-	-	98	35302	1	131	-	-	131	44584
North Cachar Hills	2	1454	-	-	1454	465648	2	1421	-	-	1421	424093
Bihar	**1**	**556**	**-**	**-**	**556**	**263446**	**1**	**1000**	**-**	**-**	**1000**	**193047**
Rohtas	1	556	-	-	556	263446	1	1000	-	-	1000	193047
Chhattisgarh	**57**	**42453**	**246**	**-**	**42699**	**10200663**	**54**	**39925**	**453**	**-**	**40378**	**9416969**
Baloda Bazar	4	5832	-	-	5832	1271640	3	5919	-	-	5919	1205809
Bastar	9	27	++	-	27	11846	9	35	++	-	35	10802
Bilaspur	2	290	++	-	290	92628	2	130	240	-	370	147963
Durg	23	7592	246	-	7838	2052474	21	6858	213	-	7071	1819493
Janjgir-Champa	2	2055	-	-	2055	539845	2	1464	-	-	1464	345807
Kabirdham	1	31	-	-	31	19009	1	20	-	-	20	12804
Raipur	16	26626	-	-	26626	6213221	16	25499	-	-	25499	5874291
Gujarat	**115(1)**	**20030**	**-**	**2838**	**22868**	**5204303**	**83(1)**	**19982**	**22**	**2241**	**22245**	**5017115**
Amreli	2	4390	-	-	4390	892665	2	3597	-	-	3597	649089
Bhavnagar	1	181	-	-	181	107513	2	211	-	-	211	36823
Jamnagar	23	1129	-	232	1361	319727	19	2040	-	267	2307	489620

Table–5 *(Contd.)*

(Qty in '000 tonnes; Value in ₹'000)

State/District	2019-20						2020-21 (P)					
	Grades				Total		Grades				Total	
	No.of mines	Cement	LD, SMS & BF	Chemical	Qty	Value	No.of mines	Cement	LD, SMS & BF	Chemical	Qty	Value
Junagarh	48	7032	-	1098	8130	1803822	26	6494	-	953	7447	1776636
Kutch	3	5203	-	-	5203	1148636	3	5385	-	-	5385	1183365
Porbandar	35(1)	1522	-	1508	3030	780754	28(1)	1886	22	1021	2929	771238
Rajkot	2	292	-	-	292	54677	2	99	-	-	99	21261
Surat	1	281	-	-	281	96509	1	270	-	-	270	89083
Himachal Pradesh	**25**	**12383**	**144**	**++**	**12527**	**2746801**	**23**	**11856**	**131**	**-**	**11987**	**2605856**
Bilaspur	1	3735	-	-	3735	683459	1	3084	-	-	3084	571108
Sirmour	22	991	144	++	1135	395983	20	626	131	-	757	335567
Solan	2	7657	-	-	7657	1667359	2	8146	-	-	8146	1699181
Jammu & Kashmir	**17**	**959**	**-**	**-**	**959**	**280284**	**18**	**1173**	**-**	**-**	**1173**	**322897**
Anantnag	6	83	-	-	83	34536	8	-	-	-	-	-
Pulwama	8	455	-	-	455	116907	7	644	-	-	644	146654
Srinagar	3	421	-	-	421	128841	3	529	-	-	529	176243
Jharkhand	**5**	**785**	**-**	**-**	**785**	**339164**	**5**	**324**	**-**	**-**	**324**	**157084**
Palamau	1*	-	-	-	-	-	1*	-	-	-	-	-
Ranchi	2*	-	-	-	-	-	2*	-	-	-	-	-
Singhbhum (West)	2	785	-	-	785	339164	2	324	-	-	324	157084
Karnataka	**64**	**33774**	**391**	**-**	**34165**	**6672035**	**54**	**32835**	**354**	**-**	**33189**	**5965087**
Bagalkot	44	2810	371	-	3181	866767	35	29919	326	-	3245	852715
Belgaum	6	2041	20	-	2061	439082	5	1858	28	-	1886	420766
Chitradurga	1*	-	-	-	-	-	1*	-	-	-	-	-
Gulbarga	11	28923	-	-	28923	5366186	11	28058	-	-	28058	4691606
Shimoga	1*	-	-	-	-	-	1*	-	-	-	-	-
Tumkur	1*	-	-	-	-	-	1*	-	-	-	-	-
Kerala	**1**	**398**	**-**	**-**	**398**	**342144**	**1**	**376**	**-**	**-**	**376**	**315113**
Palakkad	1	398	-	-	398	342144	1	376	-	-	376	315113
Madhya Pradesh	**134**	**42811**	**4170**	**137**	**47118**	**12332360**	**156(2)**	**42190**	**3686**	**102**	**45978**	**11824339**
Damoh	1	3970	-	-	3970	940816	1	3858	-	-	3858	908986

Table–5 *(Contd.)*

(Qty in '000 tonnes; Value in ₹'000)

State/District	2019-20						2020-21 (P)					
	Grades				Total		Grades				Total	
	No.of mines	Cement	LD, SMS & BF	Chemical	Qty	Value	No.of mines	Cement	LD, SMS & BF	Chemical	Qty	Value
Dhar	3	2535	-	-	2535	484472	5	2800	-	-	2800	496978
Jabalpur	1	-	28	-	28	25083	1	-	29	-	29	11061
Katni	49	4592	3466	137	8195	298790	62(2)	3664	2893	102	6659	2073049
Narasinhapur	1	-	43	-	43	8216	1	-	28	-	28	6684
Neemuch	4	3380	-	-	3380	636909	4	3887	-	-	3887	716509
Rewa	9	4190	-	-	4190	1265519	9	3847	2	-	3849	1195021
Satna	62	22401	633	-	23034	5564239	69	21888	734	-	22622	5805319
Sidhi	4	1743	-	-	1743	419206	4	2246	-	-	2246	610732
Maharashtra	**18**	**14614**	**++**	**++**	**14614**	**3475512**	**17**	**13939**	**++**	**-**	**13939**	**3341414**
Chandrapur	7	11285	-	-	11285	2543325	5	10888	-	-	10888	2461303
Yavatmal	11	3329	++	-	3329	932187	12	3051	++	-	3051	880111
Meghalaya	**19**	**7248**	**-**	**-**	**7248**	**2988280**	**19**	**6028**	**-**	**-**	**6028**	**2676672**
Jaintia Hills	16	4874	-	-	4874	1436116	16	3796	-	-	3796	1113102
Khasi Hills East	3	2374	-	-	2374	1552164	3	2232	-	-	2232	1563570
Odisha	**7(1)**	**5609**	**18**	**-**	**5627**	**1848621**	**7**	**7187**		**-**	**7187**	**2234688**
Bargarh	1	957	-	-	957	386567	1	842	-	-	842	408891
Koraput	1	167	-	-	167	50157	1	172	-	-	172	51704
Sundargarh	5(1)	4485	18	-	4503	1411897	5	6173	-	-	6173	1774093
Rajasthan	**38**	**70022**	**2327**	**41**	**72390**	**19094468**	**38**	**72309**	**2028**	**113**	**74450**	**18357853**
Ajmer	2	1961	-	-	1961	502366	2	2341	-	-	2341	551710
Banswara	1	1237	-	-	1237	309335	1	1084	-	-	1084	243015
Bundi	1	1159	-	-	1159	333771	1	1041	-	-	1041	324756
Chittorgarh	10	26676	-	-	26676	6945130	11	29173	-	-	29173	7019056
Jaipur	1	4333	-	-	4333	1364824	1	3901	-	-	3901	1275374
Jaisalmer	2	578	2327	-	2905	1256648	2	592	2028	-	2620	1352168
Jhunjhunu	1	-	-	-	-	-	1*	-	-	-	-	-
Kota	1	2562	-	-	2562	702072	1	2760	-	-	2760	753448

Table–5 *(Concld)*

(Qty in '000 tonnes; Value in ₹'000)

State/District	2019-20						2020-21 (P)					
	Grades				Total		Grades				Total	
	No.of mines	Cement	LD, SMS & BF	Chemical	Qty	Value	No.of mines	Cement	LD, SMS & BF	Chemical	Qty	Value
Nagaur	5	1021	-	41	1062	470267	7	1156	-	113	1269	557932
Pali	6	18514	-	-	18514	3866910	6	18310	-	-	18310	3651314
Sikar	1*	-	-	-	-	-	-	-	-	-	-	-
Sirohi	5	10559	-	-	10559	2991799	3	10425	-	-	10425	2246381
Udaipur	2	1422	-	-	1422	351346	2	1526	-	-	1526	382699
Tamil Nadu	**82**	**24442**	**19**	**-**	**244461**	**7151088**	**83**	**21107**	**37**	**-**	**21144**	**5531065**
Ariyalur	38	12089	19	-	12108	2926303	39	11288	37	-	11325	2644441
Coimbatore	3	901	-	-	901	392471	-	-	-	-	-	-
Dindigul	4	3209	-	-	3209	1012239	4	2544	-	-	2544	753939
Karur	1	737	-	-	737	248241	1	529	-	-	529	177864
Perambalur	19	3001	-	-	3001	812122	18	2576	-	-	2576	689990
Salem	4	483	-	-	483	256784	4	479	-	-	479	159861
Thoothukudi (Tuticorin)	2	1185	-	-	1185	635598	4	1070	-	-	1070	502658
Tiruchirapalli	9	2385	-	-	2385	529381	9	2317	-	-	2317	459945
Tirunelveli	1	150	-	-	150	181477	1	-	-	-	-	-
Virudhunagar	1	302	-	-	302	156472	1	304	-	-	304	142367
Telangana	**31**	**26161**	**-**	**-**	**26161**	**5249950**	**31**	**24498**	**-**	**-**	**24498**	**4740215**
Adilabad	3	3717	-	-	3717	750872	3	2954	-	-	2954	575505
Karimnagar	2	846	-	-	846	337102	2	958	-	-	958	342266
Nalgonda	22	16623	-	-	16623	3288683	22	16676	-	-	16676	3120238
Rangareddy	4	4975	-	-	4975	873293	4	3910	-	-	3910	702206
Uttar Pradesh	**2**	**2804**	**-**	**-**	**2804**	**932764**	**2**	**2574**	**-**	**-**	**2574**	**725226**
Sonbhadra	2	2804	-	-	2804	932764	2	2574	-	-	2574	725226

F++): Negligible

( ): Figure in parenthesis indicates mines of chalk, dolomite and shale with limestone as an associate mineral.

(*) Only labour reported.

** Formed a new Union Territory to be known as the Union Territory of Jammu and Kashmir comprising the territory of the existing state of Jammu & Kashmir vide Gazette Notification No. 53, New Delhi, Friday, August 9, 2019/Shravana 18, 1941 (SAKA).

Table-6: Mine-head Closing Stocks of Limestone, 2019-20 & 2020-21
(By States/Grades)

(In '000 tonnes)

Country	2019-20				2020-21 (P)			
	Grades				Grades			
	Cement	LD, SMS & BF	Chemical	Total	Cement	LD, SMS & BF	Chemical	Total
India	**20541**	**2739**	**1495**	**24775**	**19992**	**2898**	**1466**	**24356**
Andhra Pradesh	370	85	6	461	314	99	6	419
Assam	25	-	-	25	21	-	-	21
Chhattisgarh	1900	54	-	1954	2498	148	-	2646
Gujarat	1334	3	1322	2659	1245	-	1326	2571
Himachal Pradesh	242	58	-	300	189	48	-	237
Jammu & Kashmir*	48	-	-	48	226	-	-	226
Jharkhand	11	4	-	15	11	4	-	15
Karnataka	3773	657	-	4430	2664	610	-	3274
Kerala	1	-	-	1	1	-	-	1
Madhya Pradesh	4501	1299	39	5839	4721	1228	51	6000
Maharashtra	45	9	++	54	83	6	++	89
Meghalaya	109	-	-	109	132	-	-	132
Odisha	394	422	-	816	310	413	-	723
Rajasthan	6147	33	127	6307	6251	221	83	6555
Tamil Nadu	894	115	1	1010	899	121	++	1020
Telangana	747	-	-	747	427	-	-	427

++: Negligible

*Formed a new Union Territory to be known as the Union Territory of Jammu and Kashmir comprising the territory of the existing state of Jammu & Kashmir vide Gazette Notification No. 53, New Delhi, Friday, August 9, 2019/Shravana 18, 1941 (SAKA).

Limeshell

The production of limeshell is nil during 2020-21 compared to 4600 tonnes in the preceding year.

There were nil reporting mines in 2020-21 as compared to 2 reporting mines in 2019-20.

Mine-head closing stocks of limeshell in the year 2020-21 was 609 tonnes as against 6,921 tonnes in the previous year.

The average daily employment of labour during the year 2020-21 was nil as against 244 in the previous year (Tables-7 to 9).

Table-7: Production of Limeshell, 2018-19 to 2020-21
(By States)

(Qty in tonnes; Value in ₹'000)

Country	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**7534**	**27780**	**4600**	**18730**	**-**	**-**
Karnataka	3538	10699	1017	3051	-	-
Kerala	3996	17081	3583	15679	-	-

Table-8: Production of Limeshell, 2019-20 & 2020-21
(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/District	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**2**	**4600**	**18730**	**-**	**-**	**-**
Public sector	-	-	-	-	-	-
Private sector	2	4600	18730	-	-	-
Karnataka	**1**	**1017**	**3052**	**-**	**-**	**-**
North Kannada	1	1017	3051	-	-	-
Kerala	**1**	**3583**	**15679**	**-**	**-**	**-**
Kottayam	1	3583	15679	-	-	-

Table-9: Mine-head Closing Stocks of Limeshell, 2019-20 & 2020-21
(By Sectors)

(in tonnes)

State	2019-20	2020-21 (P)
India	**6921**	**609**
Karnataka	6921	609

Marl

Production of marl during 2020-21 was 2,202 thousand tonnes as compared to 2,149 thousand tonnes in the preceding year. The entire production of marl was reported as an associated mineral with limestone in both the years. There were 9 associate mines reporting production of marl during 2020-21 as compared to 8 associate mines in the previous year. The entire production was reported by Private Sector mines. Entire production of marl during 2020-21 was reported from Gujarat and Tamil Nadu. Mine-head closing stock at the end of 2020-21 was 600 thousand tonnes as against 881 thousand tonnes in the previous year (Tables-10 to 13).

Table – 10 : Principal Producers of Marl, 2020-21

Name and address of producer	Location of mine	
	State	District
*Ultra Tech Cement Ltd, B-Wing, 2nd Floor, Ahura Centre, Mahakali Caves Road, Andheri (E), Mumbai– 400 093.	Gujarat	Amreli
*Saurashtra Cement Ltd, N.K. Mehta International House, 178, Backbay Reclamation, Mumbai-400 020.	Gujarat	Porbandar
*Rajesh Sadurbha Kar,, Ashapura Society, Near SBI, Surajkaradi, Okhamandal, jamnagar-361347	Gujarat	Jamnagar
*Chettinad Cement Corpn. Ltd, 4th floor, Rani Seethai Hall Building, b603, bAnna Salai Chennai-600 006	Tamil Nadu	Aryalur
*The Ramco cements Ltd, 3rd floor, Auras corporate, Centre-98A, Dr. Radhakrishanan, Salai, Malypore Chennai-600 004	Tamil Nadu	Aryalur

*Producing as an associated mineral with limestone

Table-11: Production of Marl, 2018-19 to 2020-21
(By States)

(Qty in tonnes, Value in ₹'000)

Country	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**1890308**	**349420**	**2148854**	**412463**	**2202331**	**379778**
Gujarat	1794940	324720	1646104	318711	1286248	219191
Tamil Nadu	95368	24700	502750	93752	916083	160587

Table-12: Production of Marl, 2019-20 and 2020-21
(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/District	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**8**	**2148854**	**412463**	**9**	**2202331**	**379778**
Private Sector	8	2148854	412463	9	2202331	379778
Gujarat	**5**	**1646104**	**318711**	**5**	**1286248**	**219191**
Amreli	2	1397544	274767	2	1197567	208477
Jamnagar	1	39431	8557	1	23048	3236
Junagadh	1	27306	3932	1	15733	3286
Porbandar	1	181823	31455	1	49900	4192
Tamil Nadu	**3**	**502750**	**93752**	**4**	**916083**	**160587**
Ariyalur	3	502750	93752	4	916083	160587

*Formed a new Union Territory to be known as the Union Territory of Jammu and Kashmir comprising the territory of the existing state of Jammu & Kashmir vide Gazette Notification No. 53, New Delhi, Friday, August 9, 2019/Shravana 18,1941 (SAKA).

Table-13: Mine-head Closing Stocks of Marl, 2019-20 & 2020-21
(By States)

(Qty in tonnes)

State	2019-20	2020-21 (P)
India	**880715**	**600254**
Gujarat	661770	381309
Tamil Nadu	218945	218945

MINING & MARKETING

In India, limestone mines are worked by opencast method. Captive mines are mechanised and supply feed to cement and iron & steel units. Some mines have well-laid road-cum-rail routes. The large mines are developed by forming benches in overburden and limestone bed. The face length, width and height of the benches correspond to the mining machinery deployed and production schedule. Heavy earth-moving machinery like 3.3 to 4 cu.m capacity hydraulic excavators in combination with 10-35 tonnes dumpers are normally used. Other mines are mainly worked by semi-mechanised and manual opencast mining methods. As per MCDR reports, drilling is done by Jack hammer & Wagon drill and blasting is done by ANFO, Slurry explosives, emulsion explosives etc.

Limestone production from Kurnool, Andhra Pradesh and from Adilabad in Telangana is used in paper mills, sugar, cement and steel plants. Tile, mossaic, chip and polished stonemakers also use limestone.

Limestone produced in Bihar is supplied mainly to cement plants, foundries and lime kiln units.

In Raipur and Durg districts of Chhattisgarh, the limestone produced is suitable for Iron & Steel Industry. The Bhilai Steel Plant fulfills its requirements of limestone from Nandini mines in Durg district. The Cement-grade limestone is also produced in the region and there is large cluster of cement plants in and around Raipur.

Limestone produced in Gujarat is consumed mainly in cement and chemical industries and also in textile, foundries and steel plants. The dolomitic limestone in Gujarat is used for making slabs and tiles.

Limestone produced in Himachal Pradesh is supplied to cement plants, paper industry, sugar mills and lime kilns. The limestone production from Bilaspur district is despatched to fertilizer unit of National Fertilizers Ltd (NFL) at Naya Nangal.

Limestone produced in Jammu & Kashmir is suitable for cement manufacturing.

In Karnataka, limestone is supplied generally to paper mills and cement plants. However, limestone of Kalaburagi district, commonly known as 'Shahabad stones', is used as flagstone or flooring stones.

Limestone from Madhya Pradesh is used in cement, sugar, paper, steel and lime industries.

In Maharashtra, apart from cement and sugar industries, limestone is used in Ferromanganese Industry as flux and also in Tanning Industry.

Limestone mined in Rajasthan is consumed in captive cement plants on a large scale. Limestone of Nagaur district is utilised as feed for white cement plants as well as in steel plants as low silica SMS grade flux and in Chemical Industry. Crystalline limestone of Rajasthan is widely known as a decorative ornamental stone. The limestone worked in Bundi district and Raghunathgarh in Jaipur district is an excellent flagstone which find use as paving stone.

The limestone produced in Dehradun-Garhwal areas of Uttarakhand was supplied to Sugar, Paper, Steel, Glass, Chemical and Cement Industries in the past.

Limestone in Tamil Nadu is consumed by various industries like Cement, Steel, Paper, Foundry, Fertilizer and Chemicals.

Limeshell from Kerala is used mainly in Chemical, Cement and White cement Industries. It is also used in the manufacture of polyfibre and in Tanning Industry.

USES

Limestone used for industrial purpose falls under 'major mineral', while the use of limestone in lime kilns and for building purposes comes under 'minor mineral' as per Mines and Minerals (Development and Regulation) Act, 1957.

The threshold value of limestone as per the revised Notification issued by IBM vide No.C-284/3/CMG/2017 dated 25th April 2018 is CaO 34% (min.) and MgO 5% (max.).

The principal use of limestone is in the Cement Industry. Other important uses are as raw material in the manufacture of quicklime (calcium oxide), slaked lime (calcium hydroxide) and mortar. Pulverised limestone is used as a soil conditioner to neutralise acidic soils (agricultural lime). It is used in sculptures because of its suitability for carving. It is often found in medicines and cosmetics. In some circumstances, limestone is used for glass making. As a reagent in fuel-gas desulphurisation, it reacts with sulphur dioxide which enables air pollution control. It can suppress methane explosions in underground coal mines. It is added to toothpaste, paper, plastic, paint, tiles and other materials as both white pigment and cheap filler. In blast furnaces, limestone binds with silica and other impurities and facilitates their removal from iron.

Lime is prepared by heating limestone in kilns up to 1,000 ^{o}C. The CO_2 released is effluxed and 'quicklime' (CaO) formed remains as hard white lumps. This when slaked with water and mixed with sand, forms mortar or plaster. Commonly, the commercial lime is prepared as dry hydrated lime $Ca(OH)_2$ by adding to quicklime the right amount of water (18 parts to 56 parts of CaO). The value of lime for most purposes depends upon its CaO (or CaO + MgO) content.

The manufacture of metallic calcium is one of the latest uses of lime. Calcium is used in reducing organic compounds, desulphurising petroleum, debismuthising lead production of hard lead alloys and calcium-silicon alloys, and in the manufacture of calcium hydride which is further used as an efficient hydrogen carrier.

Limeshell is used mainly in Chemical and White Cement Industries. It is also used in the manufacture of polyfibre and in Tanning Industry. Marl is used as lithographic stone.

SPECIFICATIONS

Cement Industry

Cement is a binder, a substance used in construction that sets, hardens and adheres to other materials. Cement used in construction is usually inorganic, often lime or calcium silicate based. Magnesia, sulphur and phosphorus are regarded as deleterious elements. As per end use grade classification of IBM, it is mentioned that as reported by Cement Manufactures Association, limestone containing CaO 44 to 52% and MgO not more than 3.5% should be classified under Portland Cement. Limestone containing 38-44% CaO and up to 5% MgO should be placed under Blendable/Beneficiable Cement. Limestone containing CaO 48% (min.) should be placed under White Cement. The broad chemical specifications of Cement grade limestone (r.o.m.) for cement manufacture suggested by the National Council for Cement and Building Materials, New Delhi, are specified in Table-14.

Table-14: Broad Chemical Specifications of Cement Grade (Run-of-Mine) Limestone (Clause 6.1.1)

Oxide component/Other Constituents	Acceptable range for manufacture of Ordinary Portland Cement (33, 43 & 53 Grade) (per cent)	Limiting values taking into con-sideration other types of cements, scope of beneficiation and blending (per cent)
CaO	44-52	40 (min.)
MgO	3.5 (max.)	5.0 (max.)
SiO_2	To satisfy LSF, silica	–
Al_2O_3	Modules and alumina	–
Fe_2O_3	Modules	–
TiO_2	<0.5	<1.0
Mn_2O_3	<0.5	<1.0
R_2O (Na_2O + K_2O)	<0.6	<1.0
Total S as SO_3	<0.6	<0.8
P_2O_5	<0.6	<1.0
Cl	<0.015	<0.05
Free silica	<8.0	<10.0

Source: Report on Norm for limestone deposits for cement manufacture by National Council for Cement and Building Materials, New Delhi, May 2001

Iron & Steel Industry

In Iron & Steel Industry, limestone is used both in blast furnace and steel melting shop as a flux after calcining. It is also added as flux in self-fluxing iron ore sinters. It has two basic functions in steel making, first to lower the temperature of melting and second, to form calcium silicate which comes out as a slag, as it combines with silica in iron ore.

For use in the blast furnace, the calcium carbonate ($CaCO_3$) content in limestone should not be usually less than 90 per cent. The combined SiO_2 and Al_2O_3 should not exceed 6% though up to 11.5% is allowed, MgO should be within 4% and sulphur & phosphorus as low as possible.

In Steel Melting Shop (SMS), insolubles in limestone should not exceed more than 4 per cent. Good fluxing limestone should naturally be low in acid constituents like silica, alumina, sulphur and phosphorus. Limestone should be dense, massive, preferably fine-grained, compact and non-fritting on burning.

BIS has prescribed specifications for Flux grade limestone for use in steel plants as per IS : 10345 - 2004 (Second Revision; Reaffirmed 2009).

Glass Industry

Glass Industry requires high calcium limestone (94.5% $CaCO_3$) and 97.5% of combined $CaCO_3$ and $MgCO_3$. Iron and other colouring matters are regarded as objectionable and Fe_2O_3 should be up to 0.20% (max.). For colourless glass, limestone should contain 98.5% $CaCO_3$ (min.), iron content as Fe_2O_3 should not be more than 0.04%; and for bottle glass, Fe_2O_3 up to 0.05% is used. The BIS specifications (IS : 997 - 1973), First Amendment (Reaffirmed Feb. 2013) for limestone for use in Glass Industry are as follows:

Silica as SiO_2	2.5%
Total iron (Fe_2O_3)	
a) Calcite or marble	0.05%
b) Limestone 0.10%	
c) Dolomitic limestone or dolomite	0.15%
Lime (as CaO)	53.0%
Total lime and magnesia	54.50%
(as CaO + MgO)	

Chemical Industry

The calcium carbide manufacturers generally prefer lime containing 95% CaO (min.) with limitations of not more than 3% SiO_2, not more than 0.95% phosphorus and other impurities not exceeding more than 2%. For the manufacture of bleaching powder, lime containing 95% and above CaO is required. The total Fe_2O_3 +Al_2O_3+MnO_2 should be less than 2%; MgO should be below 2%; and SiO_2 less than 1.5%. Bleaching powder is prepared by absorption of chlorine by dry hydrated lime. The hydrated lime should not contain more than 2% excess water. Iron and manganese oxides lead to unsuitability of the product and iron oxides tend to discolour the bleached material. Magnesia renders the bleaching powder hygroscopic. Silica and clay impede solution and settling of bleaching powder.

BIS has prescribed specification for limestone for use in Chemical Industry as per IS: 3204:1978 (First revision, Feb, 2009).

Sugar Industry

In Sugar Industry, lime is used for clarification of cane and beet juice, viz, removing the impurities from the juice and also for precipitating sugar from impurities. Milk of lime 1% in volume of cane juice is added to pre-heated juice. Limestone used in Sugar Industry must be high in active lime (CaO 80% min.), but low in iron, alumina and silica. Magnesia should be less than one per cent. Excess silica is undesirable because it separates as a gelatinous precipitate which covers the sugar crystals and retards their growth and filtration. Magnesia is objectionable because magnesium carbonate is soluble in sugar juice. Presence of iron tends to colour the finished product.

Fertilizer Industry

Limestone is used only as carrier in the manufacture of calcium ammonium nitrate fertilizer. For this purpose, limestone should contain $MgCO_3$+$CaCO_3$ 85% (min.), SiO_2 5% (max.) and acid insolubles 14% (max.).

Foundry Industry

The chemical requirements of limestone for use in foundries as per BIS specification (IS : 4140 -1978) have been withdrawn.

INDUSTRY & CONSUMPTION

Limestone comprises 95% of core raw material for cement production. As per report of Mines & Minerals-CMA India, around 180-250 kg of coal and about 1.5 tonnes of limestone is required to produce one tonne of cement.

India was the second largest cement producing country in the world after China. The total installed capacity of cement in 2019-20 was thus about 537 million tpy against 532.16 million tpy in the preceding year. Besides, there are three white cement plants having a total 9,90,000 tpy capacity. The total production of cement reached 334.37 million tonnes in 2019-20 registering a negetive growth of about 0.87% over that of the preceding year.

In 2019-20, the total cosumption of limestone, as reported by different industries was 328.62 million tonnes which decreased marginally by 5.41% from 347.42 million tonnes in the preceding year. Cement was the major consuming Industry accounting for 308.66 million tonne (94%) consumption, followed by Iron & Steel 12.68 million tonne (4%) and Chemical 5.29 million tonne (2%). Negligible consumption was reported by aluminium, sugar & other industries etc. Consumption of limestone from 2017-18 to 2019-20 is furnished in Table - 15.

Table-15: Consumption* of Limestone, 2017-18 to 2019-21
(By Industries)

(In tonnes)

Industry	2017-18	2018-19 (R)	2019-20 (P)
All Industries	313767100 (216)	347421600 (217)	328619800 (208)
Aluminium/Alumina	126100	67200	57800
Cement	295644300	327466600	308659600
Chemical	5116100	5162200	5293100
Iron & Steel	11135600	12723600	12680700
Sugar(c)	780000	858000	648000
Others**	965000	1144000	1280600

Figures rounded off.

* Includes actual reported consumption and/or estimates made wherever required. Due to paucity of data, coverage may not be complete.

** Includes, Alloy steel, calcination, ceramic, electrodes, oil well drilling, refractory, petroleum refining, sponge iron fertilizers, ferroalloys, foundry, glass, paper, metallurgy & thermal power.

( ) Parenthesis indicates total no. of plants

FOREIGN TRADE

Exports

Exports of limestone decreased by 6% to 3.53 million tonnes in 2020-21 from 3.76 million tonnes in the previous year. Limestone in bulk was exported mainly to Bangladesh (98%) and UK (1%). On the other hand, during the same period, exports of chalk decreased moderately by 16% to 1,104 tonnes from 1,317 tonnes in the previous year. Chalk was exported mainly to Nepal (85%), Congo (7%), Nepal (4%) and UAE (2%).

Exports of bleaching powder decreased moderatly by 10% at 21,509 tonnes in 2020-21 as compared to 23,948 tonnes in the previous year. Bleaching powder was exported mainly to Bangladesh (74%), Sri Lanka (8%) and Nepal (5%) besides other countries.

In 2020-21, about 129 tonnes of calcium carbide was also exported as against 370 tonnes in the previous year registering a massive decrease of 65%. Exports were mainly to Bangladesh (64%) and Bhutan (36%). (Tables-16 to 19).

Table-16: Exports of Limestone
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3760402	4656567	3528973	42939083
Bangladesh	3651531	3048496	3447674	41950799
UK	49217	527767	31871	379721
USA	8670	552076	7481	175659
Nepal	15818	90626	17098	106929
Ireland	5426	63966	6136	77425
Korea, Rep. of	2491	24577	3308	34268
Belgium	2997	37964	1670	21699
UAE	1431	35296	741	21454
Cango, P Rep.	954	7338	1440	15583
Bhutan	1463	13968	1211	14676
Other countries	20404	254493	10343	140870

Figures rounded off.

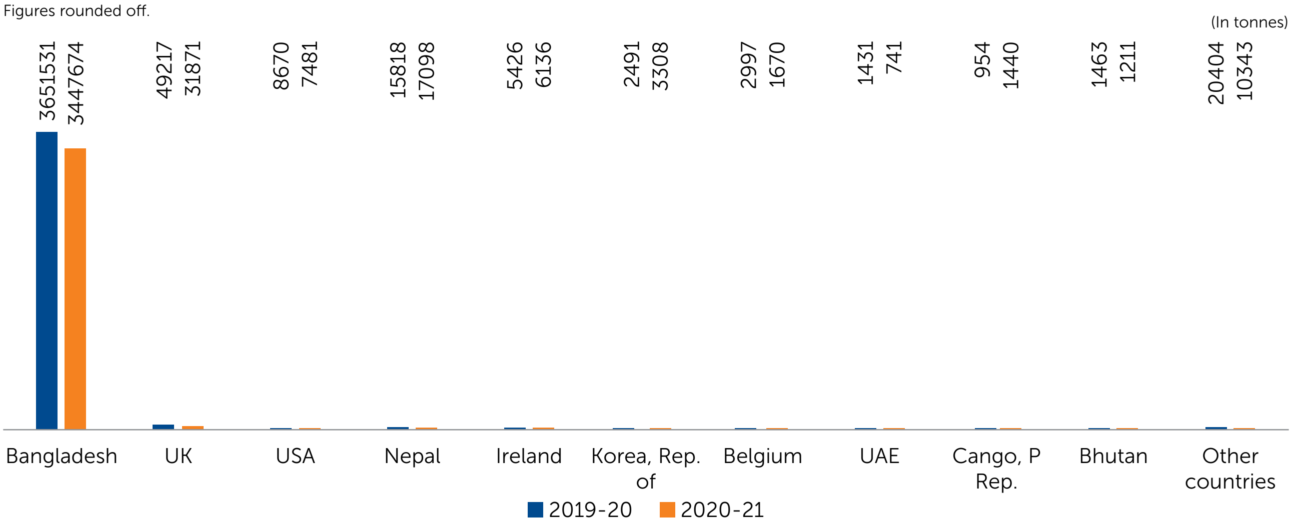


Fig 1: Country wise Export of Limestone

Table-17: Exports of Chalk
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1317**	**8022**	**1104**	**6155**
Nepal	1170	6230	936	4281
Egypt	40	463	47	495
UAE	3	86	25	449
Congo	14	208	79	446
Qatar	9	112	8	332
Sri Lanka	16	140	1	31
USA	3	6	4	25
Myanmar	--	--	1	19
Bhutan	++	6	1	12
Maldives	++	31	1	11
Other countries	62	740	1	54

Figures rounded off.

Table-18: Exports of Bleaching Powder
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**23948**	**677278**	**21509**	**734237**
Bangladesh	19120	485468	15834	468720
USA	869	80581	814	71779
Sri Lanka	1420	42572	1615	52816
Vietnam	201	12793	639	40912
Nepal	1353	22759	1160	23736
Malaysia	494	15835	484	19394
Kenya	--	--	146	12132
Canada	22	1608	110	8520
Ethiopia	87	3368	166	6127
Saudi Arabia	72	2694	120	5481
Other countries	310	9600	421	24620

Figures rounded off.

Table-19: Exports of Calcium Carbide
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**370**	**24367**	**129**	**11213**
Bangladesh	210	13157	82	6221
Bhutan	15	1554	47	4706
USA	++	5	++	109
Mozambique	--	--	++	72
Singapore	++	31	++	45
Germany	1	739	++	30
UAE	--	--	++	24
Tanzania Rep	--	--	++	4
Ghana	--	--	++	2
Saudi Arabia	98	5727	--	--
Other countries	46	3154	--	--

Figures rounded off.

Imports

Imports of limestone decreased moderately by 11% to 22.80 million tonnes in 2020-21 from 25.64 million tonnes in the previous year. On the other hand, imports of chalk in 2020-21 drastically decreased by 37% to 66 tonnes as against 105 tonnes in the previous year. Limestone was imported mainly from UAE (83%), Oman (12%), Vietnam (2%) and Malaysia (3%), while chalk was imported mainly from France (61%), Belgium (15%), Germany (8%) and Italy & China (6% each).

Imports of calcium carbide increased marginally by 5% to 32,665 tonnes in 2020-21 from 31,217 tonnes in the previous year. Calcium carbide was imported mainly from China (90%) and Indonesia (10%).The imports of bleaching powder during 2020-21 increased considerably by 100% to 34 tonnes as against 17 tonnes in the previous year. Imports were mainly from USA (82%) and Argentina (12%) (Tables-20 to 21).

Table-20: Imports of Limestone

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**25639508**	**37429909**	**22797801**	**32911759**
UAE	20486739	25649009	18835897	23618001
Oman	2976722	5135376	2623396	4505778
Malaysia	858121	3597632	635579	2739907
Vietnam	973044	2045668	489553	1172453
Egypt	49421	149651	52930	209827
Thailand	32064	263272	14338	163346
Philippines	64900	114234	66950	129086
China	7487	94729	7070	120656
Iran	16720	48189	20090	63539
Bhutan	36317	78063	27261	61919
Other countries	137973	254086	24737	127247

Figures rounded off.

Table-21: Imports of Chalk

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**105**	**4131**	**66**	**2661**
France	40	1042	40	1110
Belgium	8	400	10	583
Italy	11	958	4	381
China	2	261	4	182
Taiwan	--	--	++	179
Germany	15	331	8	167
Vietnam	++	6	++	58
UK	12	538	++	1
Switzerland	6	277	--	--
Spain	11	233	--	--
Other countries	++	85	--	--

Figures rounded off.

Table-22: Imports of Calcium Carbide

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**31217**	**1450665**	**32665**	**1774852**
China	30559	1417839	29248	1580788
Indonesia	540	29707	3384	193334
Dominica	--	--	33	730
Bhutan	34	1613	--	--
UAE	84	1487	--	--
Germany	++	19	--	--

Figures rounded off.

Table – 23 : Imports of Bleaching Powder

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**17**	**2780**	**34**	**5524**
USA	15	1919	28	3656
Argentina	2	836	4	1714
Japan	--	--	2	129
Switzerland	++	3	++	22
Germany	++	22	++	3

Figures rounded off.

FUTURE OUTLOOK

India has huge resources of limestone distributed over different parts of the country. It is comfortably placed in terms of annual capacity and production of cement. Cement-grade limestone occurs in all the limestone-bearing areas, while SMS, BF and Chemical-grade limestones occur in selective areas. Concerted efforts to locate SMS and BF grade limestone along with Cement-grade limestone are imperative to meet the growing demand.

The demand of raw materials for cement, such as, limestone and gypsum is expected to cause disruptive growth in the next few decades. The second largest Cement Industry in the world, the Indian Cement Industry, is expected to grow to an extent of 550 million tonnes per annum of capacity by FY2025.

The demand for paper in India is expected to rise at a healthy rate mainly due to the Packaging Industry and the increasing number of schools. The increasing number of construction projects is expected to lead to a thriving Building and Construction Industry in India. This is expected to contribute 10% to the GDP of India. Also with rising growth in Indian pharmaceutical and Food & Beverage industries, the consumption of calcium carbonate (limestone) in India is expected to increase.

India's domestic demand is being fulfilled as per the Government of India's new policy of allotment of mining blocks through auctioning. Up to 2022-23, a total of 241 blocks were auctioned. Out of these 241 blocks, 74 blocks were limestone blocks.

19. Magnesite

459

(million tonnes) Total reserves/resources of magnesite were estimated as on 1st April 2020

78

(thousand tonnes) Production of magnesite were reported in 2020-21

5,477

(tonnes) of magnesite were exported in 2020-21

3,64,577

(tonnes) of magnesite were imported in 2020-21

Magnesite ($MgCO_3$) is a carbonate of magnesium. It is usually found repeated as an alteration product of serpentine ultramafic rocks and other magnesium-rich rock types formed by replacement of dolomite and dolomitic limestone, as bedded deposits and as irregular veins. Magnesite deposits in India, generally occur as crystalline mass, amorphous and massive. Calcium and silica are the most common impurities found in magnesite along with Fe_2O_3 and Al_2O_3. It is a very important mineral for the manufacture of basic refractories, which could be largely used in the Steel Industry. In commerce, the term 'magnesite' refers not only to the mineral, but also to many products, obtained by calcining the natural carbonate, e.g., caustic magnesite (magnesia obtained by calcining crude magnesite at comparatively low temperatures, 700 to 1,000°C, and retaining 2 to 7% CO_2 as carbonate) and dead-burnt or refractory magnesite (magnesia obtained by calcining magnesite at high temperatures, 1,500 to 1,800° C, usually containing less than 0.5% CO_2). Pure magnesite calcined at still higher temperatures (1,600–1,800°C) to expel carbon dioxide completely is termed as 'periclase' (MgO) in the trade. The dead burnt magnesite and fused magnesia are used in Refractory Industry to manufacture various refractory products. The caustic magnesia or low calcined magnesite is used as animal feed stuff and in the manufacture of oxichloride cement. The Refractory Industry is the major consumer of magnesite.

RESERVES/RESOURCES

The total reserves/resources of magnesite as per NMI database, based on UNFC system, as on 1.4.2020 is about 459 million tonnes of which Reserves and Remaining Resources are 66 million tonnes and 393 million tonnes, respectively. Substantial quantities of resources are established in Uttarakhand (52%), followed by Tamil Nadu (34%) and Rajasthan (12%). Resources are also located in Andhra Pradesh, Himachal Pradesh, Jammu & Kashmir, Karnataka and Kerala.

Occurrences of magnesite in Tamil Nadu are low in lime and high in silica, whereas those of Uttarakhand are high in lime and low in silica. The Gradewise and Statewise reserves and resources of magnesite are furnished in Table-1.

Table-1: Reserves/Resources of Magnesite as on 1.4.2020

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon-naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	57934	6354	1782	66070	80983	24858	40132	59010	59652	128104	309	393047	459118
By Grades													
High Grade	-	-	-	-	3277	27	1	2	-	28	-	3336	3336
Medium Grade	55835	6354	1659	63849	75554	21443	5363	64	109	4436	-	106968	170818
Beneficiable/Low	2032	-	122	2154	886	1154	1446	648	31558	117580	264	153537	155691
High & Medium Mixed	-	-	-	-	6	173	2059	-	-	100	-	2339	2339
Medium & Low Mixed	-	-	-	-	-	429	29237	58271	27766	207	-	115910	115910
Others	6	-	-	6	1260	1448	2025	24	-	2501	-	7258	7264
Unclassified	-	-	-	-	-	-	-	-	-	83	-	83	83
Not-known	60	-	-	60	-	184	-	-	219	3170	45	3617	3677
By States													
Andhra Pradesh	-	-	-	-	-	-	-	-	-	80	-	80	80
Himachal Pradesh	-	-	-	-	-	-	-	-	-	298	-	298	298
Jammu & Kashmir	-	-	-	-	3210	740	-	-	-	150	45	4145	4145
Karnataka	997	30	-	1027	802	247	270	88	10	2834	264	4516	5543
Kerala	-	-	-	-	-	-	-	2	-	38	-	40	40
Rajasthan	-	-	-	-	1030	1574	2045	-	149	49293	-	54091	54091
Tamil Nadu	48760	6324	-	55084	71885	21695	3944	17	737	2124	-	100402	155486
Uttarakhand	8177	-	1782	9959	4056	602	33873	58902	58756	73287	-	229476	239434

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Review".

PRODUCTION

Production of magnesite in 2020-21 at 78 thousand tonnes decreased by 24% as compared to 103 thousand tonnes in the previous year. There were 11 reporting mines in 2020-21 as against 12 reporting mines in 2019-20. Five principal producers accounted for about 96% of the total output during the year 2020-21. Out of total production, about 61% of magnesite was contributed by the Private Sector and the remaining 39% by Public Sector during 2020-21.

Tamil Nadu is the major producing State with maximum contribution of 61% to the total output during 2020-21 followed by Uttarakhand and Karnataka.

Mine-head closing stocks of magnesite for the year 2020-21 was 67 thousand tonnes as against 62 thousand tonnes in the previous year.

The average daily employment of labour in magnesite mines during the year was 690 as against 811 in the previous year (Tables- 2 to 5).

MINING AND MARKETING

Magnesite is being worked by open-cast method by developing benches. In Salem area (Tamil Nadu), magnesite is found chiefly as encrustations, veins and stringers in ultrabasic rocks like dunite and peridotite. Stringers and veins occur irregularly in fractures of rocks giving rise to different patterns. Veins are broken and magnesite is sorted out manually. Major magnesite producing mines in Salem area belong to Tamil Nadu Magnesite Ltd (TANMAG a State Government Undertaking), Ponkumar Magnesite Mines, Mysore Minerals, Dalmia Magnesite Corporation (a Private Sector Enterprise) and SAIL Refractory Co. Ltd (a Central Government Undertaking).

These mines are semi-mechanised as well as mechanised and uses compressors, wagon drills, jackhammers, power shovels, loaders, dumpers, dozers and pumps in their mining operations. Normally, Ammonium Nitrate Fuel Oil (ANFO) Mixture with high explosives as booster is used for blasting. The powder factor may go up to 10. The blasted rock or run-of-mine material containing 25 to 30% magnesite is subjected to manual sorting.

The hand-picked crude magnesite is further subjected to sorting and dressing in the dressing yard. Magnesite lumps which are not considered fit for dressing (containing 10 to 20% silica) constitute 2 to 6% of the run-of-mine. These lumps are hand-picked and stacked separately as rejects. The remaining material is further dressed to obtain usable magnesite containing less than 3% silica. The usable magnesite hardly constitutes 4 to 8% of blasted rocks even though run-of-mine contains 20 to 30% magnesite. In Uttarakhand, Almora Magnesite Ltd and N.B. Minerals Corporation are the important producers having mines in Bageshwar and Nainital districts, respectively.

Magnesite is marketed generally after calcination, that is, after converting it into lightly calcined or caustic magnesite and dead-burnt variety.

At TANMAG, the recovery of magnesite from blasted earth is about one in fourteen. After picking the magnesite, the remaining reject material is removed by mechanical operation using HEMM. TAccNMAG's annual crude magnesite production capacity is in the range of 75,000 to 1,00,000 tonnes.

Table-2: Principal Producers of Magnesite, 2020-21

Name & address of producers	Location of mine	
	State	District
Almora Magnesite Ltd, Village Matela, P.O. Billori, Distt Bageshwar-263 630, Uttarakhand	Uttarakhand	Bageshwar
S. Sundararajan 5/22-A, Periyakollapatti Kannankuruchi, Post – Gorimedu, Distt Salem -636 008, Tamil Nadu.	Tamil Nadu	Salem
India Magnesia Product Limited, No. 11/239, Ramakrishna Road,Balaji Towers, 3rd floor, Distt Salem – 636 007, Tamil Nadu.	Tamil Nadu	Salem
Dalmia Bharat Sugar and Industries Limited, Dalmiapuram, Tiruchirapalli Distt. Tiruchirapalli – 621 651, Tamil Nadu.	Tamil Nadu	Salem
Tamil Nadu Magnesite Limited 5/53, Omalur Main Road Jagirammapalayam, Salem-636 302, Tamil Nadu.	Tamil Nadu	Salem

Table-3: Production of Magnesite, 2018-19 to 2020-21
(By States)

(Quantity in tonnes; Value in ₹'000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	146875	408287	102554	351947	78144	292653
Karnataka	9108	56368	7198	48309	6061	39419
Tamil Nadu	50644	198355	51147	222293	47646	208954
Uttarakhand	87123	153564	44209	81345	24437	44280

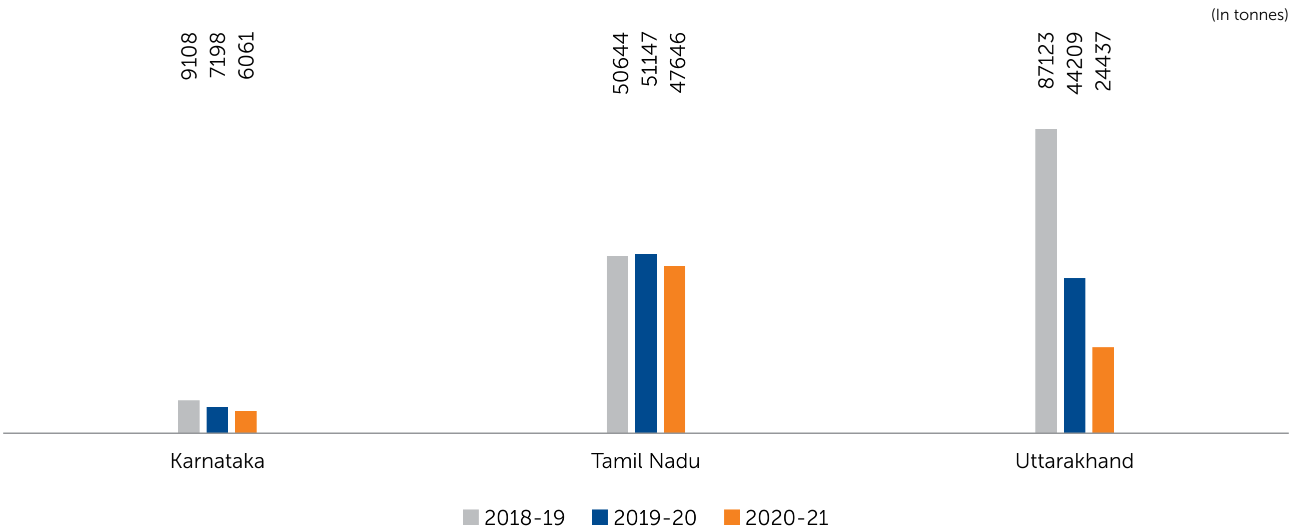


Fig 1 : Statewise Production of Magnesite

Table-4: Production of Magnesite, 2019-20 and 2020-21
(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/District	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	12	102554	351947	11	78144	292653
Public sector	6	34956	76156	6	30620	75506
Private sector	6	67598	275791	5	47524	217147
Jammu & Kashmir	-	-	-	1*	-	-
Udhampur	-	-	-	1*	-	-
Karnataka	3	7198	48309	3	6061	39419
Mysuru	3	7198	48309	3	6061	39419
Tamil Nadu	6	51147	222293	5	47646	208954
Salem	6	51147	222293	5	47646	208954
Uttarakhand	3	44209	81345	2	24437	44280
Bageshwar	1	32758	59357	1	24437	44280
Pithoragarh	2	11451	21988	1	-	-

Table-5: Mine-head Closing Stocks of Magnesite, 2019-20 & 2020-21

Garnet (Abrasive)
(By States)

(In tonnes)

State	2019-20	2020-21 (P)
India	62122	67416
Jharkhand	1012	1012
Karnataka	5507	6223
Rajasthan*	30	30
Tamil Nadu	53158	53619
Uttarakhand	2415	6532

USES AND SPECIFICATIONS

The major proportion (about 98%) of magnesite mined is used for conversion into calcined form which finds many applications. The other industries where raw magnesite is used are mosaic tiles, electrodes, chemicals and manufacture of magnesium metal. Magnesite is also used in fertilizers and by Food Processing Industry. As per the Industries Department, Govt. of Tamil Nadu, Policy Note 2016-17, about 2.7 tonnes of raw magnesite and 220 litres of furnace oil is required to produce one tonne of Dead Burnt Magnesite (DBM). Raw magnesite is dead-burnt for making basic refractory bricks, basic refractory mortars, ramming mass, tar/pitch impregnated magnesite, magnesia-carbon bricks, slide-gate plates and other refractories. As per the Industries Department, Govt. of Tamil Nadu, Policy Note 2016-17, about 2.7 tonnes of raw magnesite and 140 litres of furnace oil are required to produce one tonne of Caustic Calcined Magnesite (CCM). Caustic Calcined Magnesite is used in manufacturing sorel cement (magnesium oxychloride), castable refractories and extraction of magnesium metal. It is also the source material for manufacture of magnesium compounds like magnesium sulphate (Epsom salt) and other salts used in Paper and Pharmaceutical Industries. In Paper Industry, magnesium bisulphate produced from magnesite is used as cooking liquor for preparing pulp. It is also used in Textile, Rubber, Glass, Ceramic Industries and as animal feed stuff. Fused magnesia finds application as insulating material in tubular heating elements in Electrical Industry and refractory brick linings in steel furnaces.

Refractory Industry

Refractory Industry is one of the major consumers of magnesite in India. In the manufacture of refractories, deleterious constituents are SiO_2, CaO, Fe_2O_3 and Al_2O_3. The permissible limits for these constituents are governed by its end-use. The refractory bricks are made from Dead Burnt Magnesite by judicious blending of different types of raw magnesite before dead-burning or of different qualities of Dead Burnt Magnesite prior to brick making.

Indian steel plants use domestic DBM bricks containing up to 5% silica and 2.5% maximum CaO. By and large, Indian refractory makers prefer magnesite for making high-grade DBM containing MgO 45.5% (min.), SiO_2 2.5% (max.) and CaO 1.5% (max.).

Chemical Industry

The BIS has prescribed specification - IS : 3607-1979, First Revision, Reaffirmed 2010, for magnesite to be used in Chemical Industry.

CONSUMPTION

The consumption of magnesite in 2020-21 decreased to about 167 thousand tonnes from 180 thousand tonnes as recorded in the previous year. About 45% consumption was reported for calcination purposes followed by 39% for refractory purposes and 8% for ferroalloys purposes. The Chemical Industry consumed magnesite predominantly for producing magnesium sulphate. Magnesite consumption pattern by industries is shown in Table - 6.

The BIS has prescribed the IS specification (14303-1995, Reaffirmed 2011) for magnesite for use in Refractory Industry.

Table-6: Estimated Consumption* of Magnesite 2018-19 to 2020-21

(By Industries)

(In tonnes)

Industry	2018-19	2019-20(R)	2020-21e(P)
All Industries	194700	179900	167300
Calcination	58200	83300	75000
Chemicals	13100	12700	12500
Ferroalloys	17600	13600	13000
Refractories	80700	68500	65000
Others (foundry, iron & steel,paper,etc.)	25100	1800	1800

Figures rounded off.

* Includes actual reported consumption and/or estimates made from dispatches (as reported in form 'F'/'H', under Rule-45 of MCDR; 2017/1988) wherever required and due to paucity of data, coverage may not be complete.

e: estimated

INDUSTRY

Dead Burnt Magnesite (DBM)

Raw magnesite when calcined at temperatures in the range of 1,660–1,800 °C in the rotary kiln, carbon dioxide gets expelled completely and a dense product 'Dead Burnt Magnesite' is obtained. Dead Burnt Magnesite refers to the magnesite that is chemically unreactive or 'dead', therefore, enabling it to be used in brick making or monolithic hearths without undue difficulty arising out of hydration or shrinkage.

Caustic Calcined Magnesite (CCM)

Low calcined magnesite also known as Caustic Calcined Magnesite is obtained by calcining magnesite in a shaft or rotary kiln at temperature ranging between 800°C and 1,000 °C. The incomplete dissociation causes retention of 8 to 10% carbon dioxide as carbonate. Low calcined magnesia when mixed with water forms a feebly plastic paste. Industries like paper, rubber, ceramic, asbestos products, glass, etc. use caustic magnesia.

Fused Magnesia

Fused magnesia is produced by the fusion of the high-grade magnesite in Higgin's or electric arc tilt furnaces between 2,500 °C and 3,000 °C. It is resistant to the action of molten metals, basic slags and fluxes and high temperatures. It is used in the form of moulded vessels and as compressed material for covering resistant elements of the furnaces used in the melting of lead, tin, etc.

As per the available information, presently there are seven major plants that manufacture Dead Burnt Magnesite, while there are four plants that produce calcined magnesite and one that produces fused magnesia (Table-7). By-product magnesium carbonate and other magnesium salts were also produced during salt manufacturing from sea water. Dalmia Magnesite Corporation and Tamil Nadu Magnesite Ltd are the major producers of DBM and caustic calcined grades.

Table-7: Manufacturing Plants of Dead Burnt Magnesite (DBM), Calcined Magnesite, etc.

(By Industries)

(In tonnes)

Name of the plant	Location	Installed
Tamil Nadu Magnesite Ltd (TANMAG)	Salem, Tamil Nadu	30,000 (DBM) 19,500 (calcined magnesite)
Ramakrishna Magnesite Mines (Two Units)	-do-	21,600 (calcined magnesite)
SAIL Refractory Co. Ltd (Formerly, Burn Standard Co.Ltd)	-do-	54,000 (DBM) 18,000 (Calcined magnesite)
Dalmia Magnesite Corporation	-do-	72,000 (DBM)
Sri Ponkumar Magnesite Ltd	-do-	26,500 (DBM)
Almora Magnesite Ltd	Bageshwar, Uttarakhand	24,000 (DBM)
Minerals & Refractories	Haldwani, Uttarakhand	3,000 (DBM)
Hansaflon Plastochem Ltd	NA	1,500 (Fused magnesia)

As per Annual Report of National Mineral Development Corporation (NMDC) 2018-19, J & K Mineral Development Corporation Ltd, a subsidiary of NMDC has decided to set up a 30,000 TPA DBM plant at Panthal, Jammu. The Ministry of Environment, Forest and Climate Change granted Environment Clearance vide letter dated 03.05.2011. However, MoEF subsequently vide their letter dated 28.10.2016 had withdrawn the EC granted earlier status is maintained.

Sea Water Magnesia (SWM)

Sea water or lake bitterns is an alternative source to obtain magnesia by chemical reaction. The main raw materials required other than sea water are dolomite or limestone, fresh water and sulphuric acid.

The magnesia content of sea water is about 0.2%, and even by enrichment with dolomite, around 300 kilograms sea water need to be processed to obtain one kilogram of magnesia. The sea water magnesia can be used to manufacture Dead Burnt Magnesite, caustic magnesia and other magnesium compounds.

Marine By-products

Carbonates, chlorides and sulphates of magnesium are obtained as by-products in the production of common salt by solar evaporation. Salt Commissioner, Jaipur, reported 8,101 tonnes production of magnesium chloride and 24 tonnes of by-product magnesium sulphate in 2018-19. The production is normally reported from the salt pans in Jamnagar–Gandhidham, Gujarat.

Magnesium Metal

Magnesium metal is a fairly strong, silvery-white, light-weight metal (about one-third lighter than aluminium). It is traditionally produced in ingot form of approximately 7 kg each with purity close to 99.9%. Its chief applications are, in die casting (alloyed with zinc), to remove sulphur in the production of iron and steel, for production of titanium in the Kroll process. The other application field of magnesium is in electronic devices. Defence equipment and nuclear reactor materials also consume magnesium.

Magnesium technology and its commercial production in India are still at its infancy. India has developed silico-thermic reduction process as well as fused salt electrolytic process, with capacity of 600 t/year for each process. However, the cost of production is very high as compared to the landed cost of imported magnesium metal. Hence, its production has been stopped by one of the companies. The production is only about 15–20% of the rated capacity.

TRADE POLICY

As per import policy of ITC (HS) 2022 in schedule-1 and export policy of ITC (HS) 2022 schedule-2, Natural magnesium carbonate (Magnesite);fused magnesia,dead-burned (Sintered) Magnesia, whether are not coutaining small qualities of other oxides added before sintering; other magnesium oxide,whether or not pure are allowed freely widthout restrictions.

WORLD REVIEW

The world reserves of magnesite were 7,200 million tonnes in terms of magnesium oxide content, excluding large resources of magnesium-bearing substitutes, such as, dolomite, brucite and olivine. Further, magnesium compounds could be recovered economically from well & lake brines and from sea water. The latter, which contains 0.13% magnesium by weight, was a major source of magnesium metal and its compounds. Out of the total world reserves, the major share was that of Russia (32%) followed by China (14%), Slovakia (5%), Australia & Greece (4% each), Brazil (3%) and Turkey (2%) (Table-8). The world production of magnesite was at 28.31 million tonnes in 2020. China continued to be the leading producer accounting for about 64% production, followed by Russia (9%) and Brazil (7%) and Turkey (6%). The world production of magnesite is furnished in Table-9. China, Brazil and Russia had the largest magnesite production capacity and accounted for about 86% of the total world production. The largest capacity of magnesite processing facilities in the world are in China and Russia. These countries accounted for about two-third of world magnesia from magnesite production capacity.

Table-8: World Reserves of Magnesite

(By Principal Countries)

(In '000 tonnes of magnesium oxide (MgO) content)

Country	Reserves
World : Total (rounded off)	7200000
Australia	290000*
Austria	49000
Brazil	200000
China	1000000
Greece	280000
Russia	2300000
Slovakia	370000
Spain	35000
Turkey	110000
USA	35000
Other countries	2600000

Source: USGS, Mineral Commodity Summaries, 2021

*For Australia, Joint Ore Reserves Committee-compliant reserves were 37 million tonnes.

Table-9: World Production of Magnesite

(By Principal Countries)

(In tonnes)

Country	2018	2019	2020
World Total (rounded off)	29390053	29035289	28313481
China[e]	18500000	19000000	18000000
Russia[e]	2600000	2600000	2600000
Brazil[C]	1700000	1700000	1700000
Turkey	1958847	1496081	1560818
Australia[d]	288069	433712	820057
Austria	808239	691909	816370
Spain	738994	634580	626055
Slovakia	615500	615200	516900
Greece	464689	365792	275100
Other countries	1715715	1498015	1398181

Source: BGS, World Mineral Production, 2015-19.

* Estimated

a: Years ended 20th March following that stated

b: Officially described as magnesitic dolomite and brucite

c: Including beneficiated and directly shipped material

d: Year ended 30 June of that stated

e: Year ending 31st March following that stated.

f: Chloride produced from solution mining

g: Magnesium chloride

World capacity of primary magnesium production is about 2 million tonnes during 2017.

World production capacity for Caustic Calcined Magnesia was about 3.32 million tonnes/year and that of Dead Burnt Magnesite was about 8.62 million t/yr. Worldwide, over 98% raw ore producers convert DBM to magnesia for commercial application, mainly in Refractory Industry (75%) based on both the sintered and fused forms generally called DBM and Electrofused Magnesia (EFM), respectively, for lining furnaces used in steel production, non-ferrous metals, cement, glass, ceramic and petrochemicals. Primary producers of magnesium metal and alloys were China, USA and Russia. The consuming market segments are aluminium alloying, die-casting and desulphurisation.

To provide a generalised view of the development in various countries, the country-wise description sourced from the latest available publication of magnesium metal Minerals Yearbook 'USGS' 2018 is furnished below.

Australia

Latrobe Magnesium Ltd. was conducting a bankable feasibility study for a 3,000-t/yr primary magnesium plant in the Latrobe Valley, Victoria, which would use fly ash having a high magnesium content as the feed material. The bankable feasibility study was expected to be completed by June 2019. Construction was expected to begin in December 2019 and take about 1 year to complete once started. Future expansion to 40,000 t/yr was being considered.

Canada

Recently, an explosion and fire took place at Meridian's diecasting plant in Strathmore, Ontario, but damage to the plant was minimal. The plant was shut down for less than a week.

Quebec, to produce magnesium from asbestos mine tailings. Construction was expected to start in 2020 and be completed in about 18 months. The capacity of the first module would be 5,000 t/yr, and expansion to 50,000 t/yr was planned. In 2017, magnesium production started from a 25-kilogram-per-day pilot plant to produce ingot samples for testing by potential customers.

Mag One Products Inc. continued planning for the construction of a smelter near Danville, Quebec, to produce magnesium from asbestos mine tailings. The plant would have an initial capacity of 5,000 t/yr and the total production capacity would be scaled to market demand. The plant would also have the capability to produce high-purity magnesium compounds with ferronickel and high-purity silica as by-products.

West High Yield Resources Inc. was preparing a mine permit application for its proposed Record Ridge project in British Columbia. The Company proposed building a mine and smelter to produce magnesium from a serpentine deposit. In June 2017, West High Yield presented the results of a micro-plant test prepared by Drinkard Metalox, Inc. (Charlotte, NC). Drinkard Metalox developed a nitric acid leach extraction process that could achieve a magnesium recovery rate of 98% and allow the production of multiple saleable products, such as, magnesium nitrate, high-grade magnesium oxide and nickel hydroxide.

China

China produced 8,60,000 t of magnesium in 2018, 8% less than that in 2017. Magnesium consumption in China was estimated to be 4,50,000 tonnes, 7% more than that in 2017. In 2018, total magnesium product exports from China were 4,10,000 t, 11% less than those in 2017.

Stricter environmental regulations for magnesium smelters and associated industries were cited for decreased production throughout the year. Ningxia Hui Autonomous Region started conducting stricter enforcement of environmental regulations in June. Some coal mines decreased production in the last quarter of the year citing environmental regulations, which increased production costs and decreased output for some magnesium producers. Coal and magnesium producers in Shaanxi Province were particularly affected by these actions. Shaanxi Province was the leading producer of magnesium in China and a major producer of coal, which was used to power the magnesium smelters. Through the end of October, magnesium production decreased in Ningxia Hui Autonomous Region (58%), Shaanxi Province (9%) and Shanxi Province (34%) compared with production for the same period in 2017.

Century Sunshine Group Holdings Ltd (Hong Kong) continued increasing the capacity of its smelter in Hami, Xinjiang Uyghur Autonomous Region, to 45,000 t/yr from 15,000 t /yr. Dates for the completion and commissioning of the new capacity were not projected and would be dependent on market conditions.

Qinghai Salt Lake Magnesium Co. Ltd continued the startup of its 1,00,000-t/yr smelter in Golmud, Qinghai Province, that produced magnesium from lake brines. Construction was completed and trial runs were conducted in mid-2016. Commercial production started in October 2017, but technical issues interrupted the rampup. By May 2018, the smelter was delivering molten magnesium to Magontec Ltd (Australia) at its 56,000-t/yr casthouse adjacent to the smelter.

Turkey

In May, Esan Eczac1ba_1 Endüstriyel Hammaddeler San. ve Tic. A.S. shut down production from its 15,000-t/yr smelter in Eskisehir. High production costs and currency valuations were cited as the causes for the shutdown.

FOREIGN TRADE

Exports

The export of magnesite increased marginally by 0.44% to 5,477 tonnes in 2020-21 from 5,453 tonnes in the preceding year. Exports were mainly to Malaysia (46%), Bangladesh (13%), Singapore (7%) and China & UAE (5% each) (Fig-2). Out of the total exports in 2020-21, those of fused magnesia were at 41 tonnes as compared to 55 tonnes in the preceding year; non-calcined magnesite were at 220 tonnes as compared to 75 tonnes; other magnesite 3,468 tonnes as compared to 2,452 tonnes; and magnesium oxide

1,646 tonnes as compared to 2,152 tonnes in the preceding year. Exports of Magnesium and scrap were at 1,266 tonnes in the year 2020-21 as compared to 2,373 tonnes in the preceding year. Exports were mainly to Turkey (32%), USA (26%), Slovenia (20%), Netherlands (14%), Bhutan (4%) and UAE (2%). The total export of magnesium powder and flakes in 2020-21 was 1 tonne as compared to 12 tonnes in the preceding year. Magnesium & alloys wrought was negligible during 2020-21 as compared to 1 tonne in the preceding year (10 to 22).

Table-10: Exports of Magnesite : Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	5453	147073	5477	171020
China	175	11535	293	29547
UK	34	7308	105	27574
Bangladesh	652	21291	731	24355
Malaysia	2092	17725	2502	22498
Singapore	294	13320	367	19322
Thailand	245	14391	201	11300
Nigeria	10	178	196	3695
UAE	177	3028	247	3368
Nepal	88	2891	185	3151
Saudi Arabia	534	12084	96	2927
Other countries	1152	43322	554	23283

Figures rounded off.

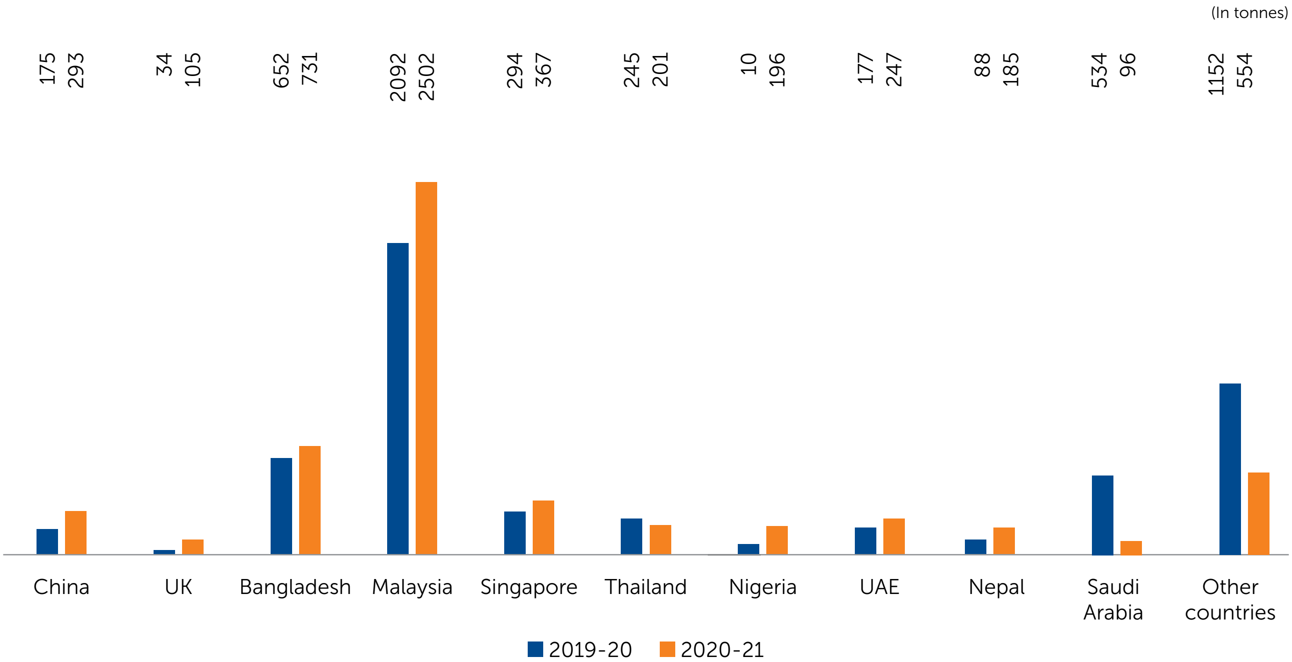


Fig 2:Countrywise of Exports of Magnesite

Table-11: Exports of Magnesia (Fused)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	55	2691	41	863
Saudi Arabia	40	599	35	647
UAE	++	93	++	130
Ethiopia	--	--	6	69
Singapore	--	--	++	11
Nepal	--	--	++	5
Sri Lanka	++	1	++	1
USA	++	9	++	++
China	15	1859	--	--
Bangladesh	++	52	--	--
Turkey	++	42	--	--
Other countries	++	36	--	--

Figures rounded off.

Table-12: Exports of Magnesite (Calcined)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	35	1111	100	2102
Nigeria	10	163	68	859
Australia	--	--	19	653
Vietnam	--	--	5	193
USA	2	203	1	144
Turkey	--	--	3	109
Spain	++	19	2	99
Nepal	23	703	2	45
Uganda	++	22	--	--
Germany	++	1	--	--

Figures rounded off.

Table-13: Exports of Magnesite (Non-calcined)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	75	1632	220	5202
Bangladesh	72	1355	193	3597
Djibouti	--	--	24	789
Saudi Arabia	1	23	3	752
Uganda	--	--	++	19
Indonesia	--	--	++	18
Kenya	++	31	++	16
UK	++	10	++	7
Nepal	++	10	++	4
Egypt	1	128	--	--
Vietnam	1	48	--	--
Other countries	++	27	--	--

Figures rounded off.

Table-14: Exports of Magnesite: Dead Burnt Magnesite

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	684	10665	2	93
Australia	4	220	2	79
France	--	--	++	9
Nepal	--	--	++	5
Saudi Arabia	430	10254	--	--
Bangladesh	250	157	--	--
UAE	++	30	--	--
USA	++	4	--	--
Germany	++	++	--	--
Turkey	++	++	--	--

Figures rounded off.

Table-15: Exports of Magnesium Oxide

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2152	103450	1646	119899
China	150	8777	293	29547
UK	34	7298	105	27567
Singapore	294	13320	367	19311
Bangladesh	226	15427	193	11473
Thailand	235	13984	166	10683
Italy	90	3538	68	2308
Ethiopia	447	14322	61	2155
Netherlands	175	3617	100	2089
Nepal	59	1974	45	1938
Cameroon	77	2530	44	1755
Other countries	365	18663	204	11073

Figures rounded off.

Table-16: Exports of Magnesium & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2373	294359	1266	143710
USA	2090	236443	332	43330
Turkey	++	22	410	30172
Netherlands	--	--	182	19689
Slovenia	--	--	250	17128
Bhutan	79	15388	48	10061
Nepal	4	2910	10	7133
UAE	33	10445	21	4497
Germany	++	4037	3	4344
Qatar	++	66	++	1228
Austria	++	32	++	903
Other countries	167	25016	10	5225

Figures rounded off.

Table-17 : Exports of Magnesite (Other)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2452	27524	3468	42861
Malaysia	2092	17702	2502	22498
Bangladesh	104	4300	345	9285
UAE	135	1565	245	2923
Nigeria	--	--	104	2200
Nepal	6	204	138	1154
USA	6	640	1	1081
Saudi Arabia	60	884	38	752
Syria	--	--	3	749
Thailand	10	407	35	617
Oman	--	--	24	556
Other countries	39	1822	33	1046

Figures rounded off.

Table-18: Exports of Magnesium Powders and Flakes
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	12	5476	1	522
Myanmar	--	--	1	205
Malaysia	1	171	++	195
Korea, Rep. of	++	41	++	40
France	--	--	++	23
Tanzania	--	--	++	15
Canada	--	--	++	14
Singapore	--	--	++	10
Hong Kong	--	--	++	9
Swaziland	--	--	++	7
Australia	--	--	++	4
Other countries	11	5264	--	--

Figures rounded off.

Table-19:Exports of Magnesium & Alloys Wrought
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1	1096	++	585
UK	++	489	++	262
USA	--	--	++	242
Nigeria	--	--	++	79
Yemen	--	--	++	2
Australia	++	345	--	--
Bhutan	1	199	--	--
Austria	++	32	--	--
Brunei	++	17	--	--
Botswana	++	13	--	--
Egypt	++	1	--	--

Figures rounded off.

Table-20:Exports of Magnesium & Alloys NES
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	392	48871	16	11713
Germany	++	4037	3	4344
USA	++	40123	10	2862
Qatar	--	66	++	1214
Austria	--	--	++	903
Sudan	--	--	2	651
Philippines	--	--	++	497
Sri Lanka	1	222	1	334
Czech Republic	++	45	++	258
Malaysia	++	162	++	177
Thailand	--	--	++	118
Other countries	30	4216	++	355

Figures rounded off.

Table-21: Exports of Magnesium Wire
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	1106	1	986
USA	++	710	++	568
Saudi Arabia	++	132	++	216
Australia	++	169	1	167
New Zealand	++	17	++	12
Israel	++	11	++	12
South Africa	++	15	++	11
Malaysia	++	33	--	--
Zimbabwe	++	9	--	--
Sweden	++	5	--	--
UAE	++	5	--	--
Other countries	++	++	--	--

Figures rounded off.

Table-22: Exports of Magnesium & Scrap
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1968	237810	1249	129904
USA	1729	195610	322	39658
Turkey	--	--	410	30172
Netherlands	--	--	182	19652
Slovenia	--	--	250	17128
Bhutan	76	14704	48	10061
Nepal	4	2907	10	7112
UAE	33	10374	21	4497
Uganda	--	--	3	469
Malaysia	++	21	1	423
Kenya	5	1355	2	365
Other countries	121	12839	++	367

Figures rounded off.

Imports

The imports of magnesite (total) decreased marginally by 0.13% to 3,64,577 tonnes in 2020-21 from 3,65,053 tonnes in the year 2019-20. Imports were mainly from China (61%), UAE (15%), Turkey (8%), Australia (7%) and Saudi Arab (3%) (Fig-3). Out of the total imports in 2020-21, those of fused magnesia were at 25,215 tonnes as compared to 16,325 tonnes in the preceding year; non-calcined magnesite were at 57,993 tonnes as compared to 63,874 tonnes in yhe pervious year; other magnesite 25,379 tonnes as compared to 18,057 tonnes; magnesium oxide 63,442 tonnes as compared to 55,765 tonnes; and Dead burnt magnesite were at 1,33,034 tonnes as compared to 1,60,465 tonnes in the year 2019-20.

Imports of magnesium & scrap were at 17,692 tonnes as compared to 16,493 tonnes in the preceding year. Imports were mainly from China (94%) and Hong Kong (3%). The total imports of magnesite powder and flakesin yhe year 2020-21 was at 2,657 tonnes as compared to 3,879 tonnes in 2019-20. The imports of magnesium & alloys wrought were at 278 tonnes during 2020-21 as compared to 264 tonnes in the preceding year (Tables-23 to 33).

Table-23: Imports of Magnesite : Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All countries	365053	9468163	364577	7657838
China	208474	3883022	221089	4071438
Australia	28420	2075811	25781	1140647
Turkey	24927	857499	28264	898836
Japan	2423	257553	2545	299721
Saudi Arabia	5039	122907	10626	228236
Ireland	15607	1215986	3692	163857
UAE	60512	159866	56124	146471
Greece	2823	104462	2675	107817
Israel	516	70725	904	103896
Netherlands	4017	252246	1384	85953
Other countries	12295	468086	11493	410966

Figures rounded off.

Fig-3: Countrywise Imports of Magnesite

Table-24: Imports of Magnesia (Fused)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**16325**	**823312**	**25215**	**1135547**
China	14957	728865	23796	1033008
UK	207	26797	251	36436
Germany	241	18682	168	14923
Austria	711	23089	415	12020
Hong Kong	91	7655	246	10363
Greece	--	--	192	10301
Mexico	80	12741	60	10094
Russia	--	--	60	2620
Belgium	3	689	8	2292
Netherlands	--	--	15	1412
Other countries	35	4794	4	2078

Figures rounded off.

Table-25: Imports of Magnesite (Non-calcined)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**63874**	**185153**	**57993**	**159537**
UAE	57885	137363	49476	100380
Malaysia	55	359	2941	20114
Turkey	946	8011	1545	15323
Saudi Arabia	--	--	2227	8543
Oman	247	1254	825	5029
China	1277	7088	379	4574
Iran	1507	8242	550	3116
Greece	422	15126	44	1664
Japan	16	2741	6	648
Germany	++	126	++	142
Other countries	1519	4843	++	4

Figures rounded off.

Table-26: Imports of Magnesite (Calcined)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**50567**	**1645695**	**59514**	**919930**
China	31062	341863	49453	529490
Saudi Arabia	3644	95404	3219	125976
Ireland	14164	1107007	2346	104929
Japan	44	4782	555	46546
Hong Kong	25	441	2008	26479
Spain	154	4995	757	25269
Austria	506	37031	437	19778
Turkey	96	7936	216	13572
Brazil	60	2499	180	8195
Netherlands	10	848	100	68882
Other countries	802	42889	243	12814

Figures rounded off.

Table-27: Imports of Magnesite: Dead Burnt Magnesia
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	160465	5018483	133034	3360002
China	102537	1842108	79856	1280794
Australia	27709	2052384	25350	1127409
Turkey	23083	833405	25620	851761
Netherlands	2880	176447	910	57624
Saudi Arabia	--	--	494	9021
USA	121	10087	101	8881
Jordan	27	792	243	5729
Brazil	325	19206	100	5317
Greece	371	11854	164	5093
Hong Kong	2678	56716	101	4161
Other countries	734	15484	95	4212

Figures rounded off.

Table-28: Imports of Magnesite (Other)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	18057	587186	25379	680448
China	8831	233407	13512	398884
Greece	1513	50352	1839	67137
Ireland	1443	108979	1346	58928
UAE	2518	19113	6648	46090
Japan	654	44403	393	37216
Netherlands	1122	74544	350	19218
Turkey	802	8147	883	18180
Germany	7	2308	48	12232
Korea, Rep. of	496	24743	54	11287
Sri Lanka	--	-	241	4699
Other countries	671	21190	65	5677

Figures rounded off.

Table-29: Imports of Magnesium & Scrap
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	16493	2943566	17692	2839776
China	15393	2762152	16603	2666630
Hong Kong	744	127596	501	80745
Br Virgin Is	--	--	377	57013
UAE	140	23489	160	26769
Singapore	29	4868	20	3612
Sweden	--	--	25	3532
Israel	--	--	6	1053
Japan	1	323	++	300
Germany	--	--	++	122
Taiwan	75	12234	--	--
Other countries	111	12904	++	++

Figures rounded off.

Table-30: Imports of Magnesium Oxide

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	55765	1208334	63442	1402374
China	49810	729691	54093	824688
Japan	1679	202417	1551	212529
Israel	516	70725	904	103896
Saudi Arabia	1388	27168	4686	84696
Mexico	619	55781	531	43110
USA	326	24817	304	26992
Germany	131	18128	171	24475
Greece	347	20829	316	19349
France	22	8418	42	19152
Belgium	115	24584	44	17890
Other countries	812	25776	800	25597

Figures rounded off.

Table-31 : Imports of Magnesium & Alloys:Wrought

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	264	72811	278	85883
China	241	68561	113	48769
Hong Kong	20	3717	158	31833
Japan	--	--	2	2481
Bulgaria	--	--	3	1768
Netherlands	--	--	1	579
Italy	3	518	1	453
Germany	++	15	--	--
Other Countries	++	++	++	++

Figures rounded off.

Table-32 : Imports of Magnesium & Alloys NES

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4044	768815	5214	1195416
China	4037	733445	5115	880335
Hong Kong	--	--	70	229632
Macao	--	--	9	51643
UK	1	26611	++	22039
Spain	2	721	17	4733
Austria	2	2553	3	4061
Taiwan	1	3162	++	1605
Bulgaria	--	--	++	1078
Germany	++	352	++	214
Korea	++	107	++	42
Other countries	1	1864	++	34

Figures rounded off.

Table-33: Imports of Magnesium Powder & Flakes

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3879	723333	2657	482988
China	3835	675021	2369	383378
Belgium	--	--	57	57052
Turkey	--	--	149	26023
Russia	--	--	66	12039
Germany	++	124	16	4395
USA	++	29	++	67
Japan	++	588	++	26
UAE	++	--	++	8
France	44	47520	--	--
UK	++	48	--	--
Other Countries	++	3	++	++

Figures rounded off.

FUTURE OUTLOOK

The Refractory Industry that consumes magnesite to a large extent is experiencing a range of challenges. However, in India, the demand for refractories is not only promising but also encouraging as it rides on the prospects of the Cement and Steel Industries, the growth of which is projected to show an upward trend in the near future. The demand for magnesite is, therefore, likely to grow correspondingly.

As Indian magnesite generally contains either high silica or high lime, the need for beneficiation concomitantly arises. Beneficiation methods of magnesite at economic cost which could yield high-grade material is probably a viable way to meet the demand for magnesite in the future.

India's Refractory Industry is set to continue its expansion and is likely to benefit from the Government's series of measures pitched specifically to stimulate the infrastructure development in the country. As the demand for magnesite is expected to rise, significant steps to explore and exploit magnesite to meet the future demand would be the right way forward.

20. Manganese Ore

503.62

(million tonnes) Total reserves/ resources of manganese ore were estimated as on 1st April 2020

2,688

(thousand tonnes) Production of manganese ore were reported in 2020-21

82,363

(tonnes) of manganese ore were exported in 2020-21

4.05

(million tonnes) of manganese ore were imported in 2020-21

Manganese occurs as silvery grey in colour and is very hard and brittle in nature. It is always available in combination with iron, laterite and other minerals. Manganese in alloy form is an essential input in steel making and steel is one of the most important indicators of growth in the industrial economy of any country. In recent years, the trade volume of manganese ore has grown worldover. Presently, India is one of the major importers of manganese ore in the world. Manganese ores of major commercial importance are: (i) pyrolusite (MnO_2, Mn about 63.2%); (ii) psilomelane (manganese oxide, containing water and varying amounts of oxides of Ba, K and Na as impurities; Mn commonly 45–60%); (iii) manganite ($Mn_2O_3.H_2O$, Mn about 62.4%); and (iv) braunite ($3Mn_2O_3$, $MnSiO_8$, Mn about 62% and SiO_2 about 10%).

Indian manganese ore deposits occur mainly as metamorphosed bedded sedimentary deposits associated with Gondite Series (Archaeans) of Madhya Pradesh (Balaghat, Chhindwara & Jhabua districts), Maharashtra (Bhandara & Nagpur districts), Gujarat (Panchmahal district), Odisha (Sundargarh district) and with Kodurite Series (Archaeans) of Odisha (Ganjam & Koraput districts) and Andhra Pradesh (Srikakulam & Visakhapatnam districts).

RESERVES/RESOURCES

The total reserves/resources of manganese ore in the country as on 1.04.2020 has been placed at 503.62 million tonnes as per NMI database, based on UNFC system. Out of these, 75.04 million tonnes are categorised as Reserves and the balance 428.58 million tonnes are in the Remaining Resources category. Gradewise, Ferromanganese grade accounts for 8%, Medium grade 6%, BF grade 29% and the remaining 57% are of Mixed, Low, Others, Unclassified, and Not-known grades including 0.16 million tonnes of Battery/ Chemical grade.

Statewise, Odisha tops the total reserves/resources with 34% share followed by Karnataka (24%), Madhya Pradesh (12%), Maharashtra (12%) & Goa (7%) , Andhra Pradesh (6%) and Jharkhand (3%). Rajasthan, Gujarat, Telangana and West Bengal together shared the remaining 2% resources (Table- 1).

Table-1: Reserves/Resources of Manganese Ore as on 01.04.2020 (P)

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India: Total	61510	6081	7450	75041	76106	51162	80580	29600	61205	117986	11944	428583	503624
By Grades													
Battery/Chemical	-	-	-	-	4	9	12	4	26	112	–	167	167
Ferromanganese	15011	602	1203	16816	5040	3775	4574	1069	3771	6556	466	25251	42067
Medium	3767	28	55	3850	3871	5182	3860	448	3933	13171	116	30581	34430
BF	7995	892	1006	9892	31427	7102	19447	14391	12904	51139	2135	138545	148437
Mixed	954	75	488	1517	262	654	8259	2024	177	12472	-	23848	25365
Medium & BF mixed	5415	425	367	6207	5123	6817	6805	28	9977	14201	1907	44877	51084
Ferromangane medium & BF mixed	24030	482	-	24512	10480	16598	13844	80	16673	1987	33	59696	84208
Ferromanganese & BF	357	1583	99	2039	256	614	11775	1260	912	4380	-	19197	21236
Low (-)25% Mn	1038	522	711	2271	8474	802	7162	3916	4060	3920	152	28485	30756
Beneficiable	28	1314	1164	2506	1938	315	356	6069	8366	2708	7074	26826	29332
Others	2618	102	1447	4167	5242	5746	1699	207	120	1757	-	14772	18939
Unclassified	297	57	911	1265	3810	3508	2730	84	130	3837	62	14160	15425
Not-Known	-	-	-	-	178	39	59	-	156	1747	-	2178	2178
By States													
Andhra Pradesh	6848	1006	234	8088	1000	718	1990	188465	10730	6838	15	21756	29844
Goa	31	-	34	65	14028	1479	9177	48	262	9442	-	34436	34501
Gujarat	695	-	-	695	-	-	-	-	-	2180	-	2180	2875
Jharkhand	132	433	493	1059	1394	1046	5198	-	1395	4658	-	13691	14749
Karnataka	15363	-	101	15464	14723	2373	9604	18700	7306	55471	329	108508	123972
Madhya Pradesh	13551	2230	3777	19558	3830	7037	4212	127	23351	1943	-	40499	60057
Maharashtra	16537	835	361	17733	1891	15354	16304	-	5055	2585	113	41303	59036
Odisha	7535	1511	2423	11469	39091	22916	33968	102600	12219	32657	8947	160058	171528
Rajasthan	568	-	-	568	-	100	-	-	-	1690	-	1790	2359
Telangana	250	66	26	342	150	139	126	-	886	320	2540	4162	4503
West Bengal	-	-	-	-	-	-	-	-	-	200	-	200	200

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION AND STOCKS

The production of manganese ore at 2,688 thousand tonnes during 2020-21 decreased by about 8% as compared to that in the previous year.

There were 135 reporting mines during the year 2020-21 as against 137 in the previous year. Besides, manganese ore production was reported as associate mineral by 13 mines in 2020-21.

In 2020-21, 32 Public Sector mines jointly accounted for 43% of the total production. The contribution of captive mines was 13% of the total production.

As per the gradewise composition of production during 2020-21, 69% of the total production was of lower grade (Below 35% Mn), 21% of medium grade (35-46% Mn) and 9% was of higher grade (above 46% Mn). Production of manganese dioxide was at 14,219 tonnes (1%) during the year.

Madhya Pradesh is the leading producing State of manganese ore accounting for 34% of total production during 2020-21 followed by Maharashtra 24% and Odisha 18% (Tables- 2 to 6).

The mine-head closing stock was 2,708 thousand tonnes for the year 2020-21 as against 6,134 thousand tonnes for the previous year [(Tables - 7 (A) and 7 (B)].

The average daily employment of labour in manganese ore mines was 10,947 in 2020-21 as against 11,755 in the previous year.

Table-2: Principal Producers of Manganese Ore, 2020-21

Name & address of producers	Location of mine	
	State	District
MOIL Ltd, MOIL Bhavan, 1A, Katol Road, Chhaoni, Nagpur- 440 013 Maharashtra	Madhya Pradesh	Balaghat
	Maharashtra	Bhandara
		Nagpur
Tata Steel Ltd, Bombay House, 24, Homi Mody Street, Fort, Mumbai- 400 001, Maharashtra	Odisha	Keonjhar
The Sandur Manganese & Iron Ores Ltd, Satyalaya. Door No.266 ,(Old no.80), Ward No. 1, Behind Taluk office, Sandur-583119, Karnataka.	Karnataka	Ballari
R.B.S.S. Durga Prasad & F.N. Das, Mor Bhavan, Ramdaspeth, Nagpur-440010, Maharashtra.	Andhra Pradesh	Vizianagaram
Suriyavansum Mining & Minerals (P) Ltd, 67/2, Patrakar Colony, Indore- 452 001 Madhya Pradesh.	Madhya Pradesh	Jabalpur
Mr. Debabrata Behera, 1234/P Govind Prasad, Bomikhal, Rasulgarh, Bhubaneswar-751010 Odisha	Odisha	Keonjhar

Contd...

Table-2 *(Concld)*

Name & address of producers	Location of mine	
	State	District
S.K. Sarawagi & Co. Pvt. Ltd, Sarojini Naidu Saranisubham, 5TH floor, Distt - Kolkata-700017, West Bengal.	Andhra Pradesh	Vizianagaram
S. R. Ferro Alloys, 9, Sidheswar Colony, Distt Jhabua- 457 661. Madhya Pradesh.	Madhya Pradesh	Jhabua
Bharat Parikh & Co. Ltd. 703/179 Sri Shanakara Keupa 4th Main 5th Cross Anjanaeya Layout, Dawangere - 577004, Karanataka	Karnataka	Dawangere
J.K Minerals Main Road, Ward No.15, Hanuman Mandir Road, Balaghat - 481001 Madhya Pradesh.	Madhya Pradesh	Balaghat

Table-3: Principal Producers of Manganese Dioxide, 2020-21

Name & address of producers	Location of mine	
	State	District
MOIL Ltd, MOIL Bhavan, 1A-Katol Road, Nagpur-440 013, Maharashtra.	Maharashtra	Bhandara
Tata Steel Ltd, Bombay House 24, Homi Mody Street, Fort, Mumbai- 400 001, Maharashtra.	Odisha	Keonjhar

Table-4: Production of Manganese Ore, 2018-19 to 2020-21

(By States)

(Quantity in tonnes; Value in ₹ '000)

Country	2018-19		2019-20		2020-21	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**2832315**	**21640165**	**2910186**	**18849100**	**2688038**	**17942596**
Andhra Pradesh	293679	1039486	330530	1059109	250255	987075
Jharkhand	4785	39839	4785	36126	-	-
Karnataka	332162	2276289	336745	2194098	371046	2347159
Madhya Pradesh	942738	7147719	962576	6220812	921147	5859476
Maharashtra	761985	7999939	720518	6096443	644484	6523574
Odisha	476821	3048997	537325	3161505	483069	2135372
Rajasthan	9410	28230	9937	29811	6940	20820
Telangana	10735	59666	7770	51196	11097	69120

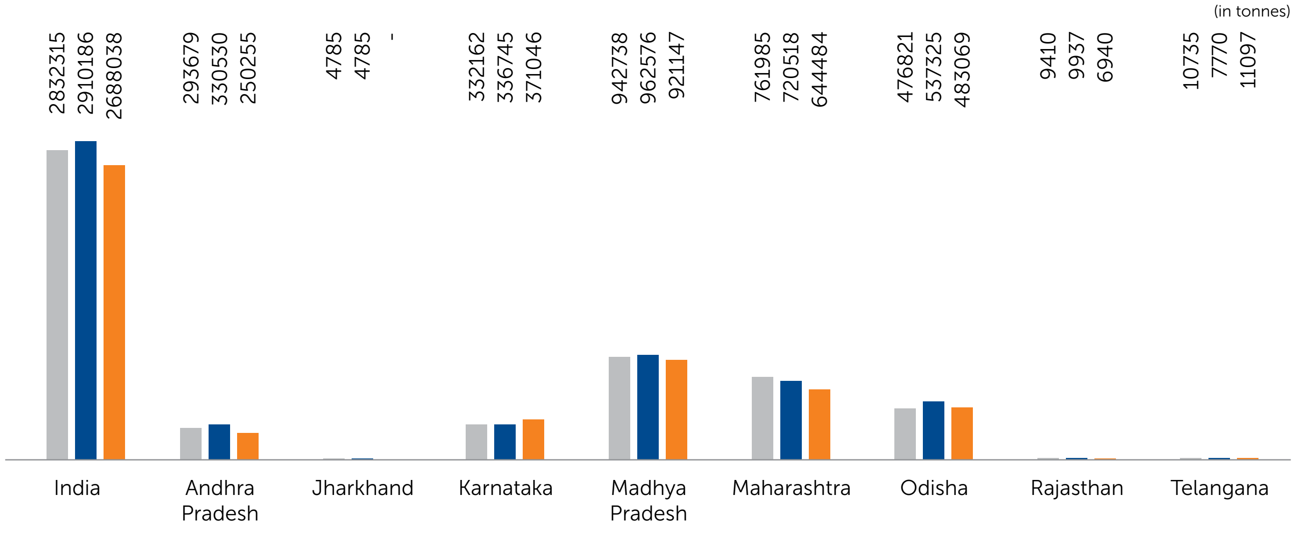


Fig 1: Production of Manganese ore

Table-5(A): Gradewise Production of Manganese Ore, 2019-20

(By Sectors/States/Districts)

(Quantity in tonnes; Value in ₹'000)

State/District	No. of mines	Production By Grades: Mn Content					Total	
		MnO_2	46% and above	35% to below 46%	25% to below 35%	below 25%	Quantity	Value
India	**137(13)**	**22572**	**270184**	**554426**	**1245952**	**817052**	**2910186**	**18849100**
Public Sector	**24**	**20701**	**151401**	**363891**	**602092**	**157831**	**1295916**	**10741120**
Private Sector	**113(13)**	**1871**	**118783**	**190535**	**643860**	**659221**	**1614270**	**8107980**
Andhra Pradesh	**27**	**-**	**-**	**23770**	**76323**	**230437**	**330530**	**1059109**
Vizianagaram	27	-	-	23770	76323	230437	330530	1059109
Goa	**3***	**-**	**-**	**-**	**-**	**-**	**-**	**-**
South Goa	3*	-	-	-	-	-	-	-
Gujarat	**1***	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Panchmahal	1*	-	-	-	-	-	-	-
Jharkhand	**2(1)**	**-**	**-**	**-**	**4785**	**-**	**4785**	**36126**
Singhbhum (West)	2(1)	-	-	-	4785	-	4785	36126
Karnataka	**9(3)**	**-**	**575**	**42824**	**209594**	**83752**	**336745**	**2194098**
Ballari	2(2)	-	525	42799	199449	53476	296249	2059532
Chitradurga	2	-	-	-	-	11296	11296	28481
Davanagere	4	-	25	-	10085	15600	25710	94015
Tumakuru	1(1)	-	25	25	60	3380	3490	12070
Madhya Pradesh	**42(5)**	**-**	**124851**	**106776**	**405373**	**325576**	**962576**	**6220812**
Balaghat	32	-	124496	101886	345272	109583	681237	5385290
Chhindwara	4	-	355	2230	12137	4932	19654	133702
Jabalpur	5(5)	-	-	-	-	202115	202115	405090
Jhabua	1	-	-	2660	47964	8946	59570	296730
Maharashtra	**20**	**20701**	**27152**	**294483**	**296138**	**82044**	**720518**	**6096443**
Bhandara	2	20701	2303	209047	125436	63614	421101	3569413
Nagpur	18	-	24849	85436	170702	18430	299417	2527030

Contd...

Table-5(A) *(Concld)*

(Quantity in tonnes; Value in ₹'000)

State/District	No. of mines	Production By Grades: Mn Content					Total	
		MnO_2	46% and above	35% to below 46%	25% to below 35%	below 25%	Quantity	Value
Odisha	**27(4)**	**1871**	**117606**	**86573**	**236032**	**95243**	**537325**	**3161505**
Keonjhar	14(2)	1504	117606	81493	158132	94444	453179	2379338
Raygada	1	-	-	-	234	-	234	1709
Sundargarh	12(2)	367	-	5080	77666	799	83912	780458
Rajasthan	**1**	**-**	**-**	**-**	**9937**	**-**	**9937**	**29811**
Banswara	1	-	-	-	9937	-	9937	29811
Telangana	**5**	**-**	**-**	**-**	**7770**	**-**	**7770**	**51196**
Adilabad	5	-	-	-	7770	-	7770	51196

Figures in parentheses indicate associate mines of iron ore, laterite, limestone and Clay (others)

* Only labour reported.

Table-5 (B): Gradewise Production of Manganese Ore, 2020-21 (P)

(By Sectors/States/Districts)

(Quantity in tonnes; Value in ₹'000)

State/District	No. of mines	Production By Grades: Mn Content					Total	
		MnO_2	46% and above	35% to below 46%	25% to below 35%	below 25%	Quantity	Value
India	**135(13)**	**14219**	**250520**	**563708**	**945571**	**914020**	**2688038**	**17942596**
Public Sector	**32**	**13611**	**125571**	**382957**	**517831**	**112579**	**1152549**	**10747111**
Private Sector	**103(13)**	**608**	**124949**	**180751**	**427740**	**801441**	**1535489**	**7195485**
Andhra Pradesh	22	-	-	15140	52814	182301	250255	987075
Vizianagaram	22	-	-	15140	52814	182301	250255	987075
Goa	**1***	**-**	**-**	**-**	**-**	**-**	**-**	**-**
South Goa	1*	-	-	-	-	-	-	-
Karnataka	**9(3)**	**-**	**420**	**51394**	**162376**	**156856**	**371046**	**2347159**
Ballari	1(2)	-	420	51394	153446	84599	289859	2187931
Chitradurga	2	-	-	-	-	18700	18700	21168
Davanagere	4	-	-	-	8870	48740	57610	130217
Tumakuru	2(1)	-	-	-	60	4817	4877	7843
Madhya Pradesh	**43(7)**	**-**	**101888**	**97846**	**368476**	**352937**	**921147**	**5859476**
Balaghat	33	-	101538	95420	317274	123610	637842	5045076
Chhindwara	4	-	350	1954	2492	5294	10090	61325
Jabalpur	5(7)	-	-	-	-	217261	217261	517675
Jhabua	1	-	-	472	48710	6772	55954	235400
Maharashtra	**26**	**13611**	**24468**	**316676**	**246285**	**43444**	**644484**	**6523574**
Bhandara	5	13611	4907	243117	119918	13245	394798	4195977
Nagpur	21	-	19561	73559	126367	30199	249686	2327597
Odisha	**28(3)**	**608**	**123744**	**82651**	**98185**	**177881**	**483069**	**2135372**
Keonjhar	17(2)	608	123744	82285	90318	147360	444315	1968297
Rayagada	1	-	-	-	544	-	544	4241
Sundargarh	10(1)	-	-	366	7323	30521	38210	162834
Rajasthan	**1**	**-**	**-**	**-**	**6940**	**-**	**6940**	**20820**
Banswara	1	-	-	-	6940	-	6940	20820
Telangana	**5**	**-**	**-**	**-**	**10497**	**600**	**11097**	**69120**
Adilabad	5	-	-	-	10497	600	11097	69120

Figures in parentheses indicate associated mines of iron ore, laterite, limestone and quartz.

* Only labour reported.

Table-6: Production of Manganese Ore, 2019-20 and 2020-21

(By Frequency Groups)

(Quantity in tonnes)

Production group	No. of mines		Production		Percentage to total production		Cumulative percentage	
	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)	2019-20	2020-21 (P)
Total	137(13)	135(13)	2910186	2688038	100	100	-	-
Up to 1000	64(1)	60(3)	8744	9485	0.3	0.35	0.3	0.35
1001 – 5000	25(5)	21(2)	74908	61718	2.57	2.3	2.87	2.65
5001 – 10000	14(1)	15(2)	119246	122748	4.1	4.57	6.97	7.22
10001 – 20000	11(3)	10(2)	195775	176444	6.73	6.56	13.7	13.78
20001 – 30000	6	5(2)	146764	184198	5.04	6.85	18.74	20.63
30001 – 40000	3	4	103485	135160	3.56	5.03	22.3	25.66
40001 – 50000	2(1)	1	142813	40557	4.91	1.51	27.21	27.17
50001 and above	14(1)	14(2)	2118451	1957728	72.79	72.83	100	100

Figures in parentheses indicate associated mines of iron ore, laterite, limestone and clay (others)

Table-7(A): Mine-head Closing Stocks of Manganese Ore, 2019-20 (P)

(By States/Grades)

(Quantity in tonnes)

State	Grades : Mn content					
	MnO_2	46% and above	35% to below 46%	25% to below 35%	below 25%	Total Quantity
India	22187	22446	97324	385257	5606694	6133908
Andhra Pradesh	-	-	19	35384	32464	67867
Goa	-	-	-	-	-	-
Gujarat	-	-	-	-	549066	549066
Jharkhand	1	18	1	3633	++	3653
Karnataka	-	525	8639	50152	206174	265490
Madhya Pradesh	-	13803	21637	36843	3664384	3736667
Maharashtra	19838	3542	33148	29452	56186	142166
Odisha	2348	4558	33880	227958	1097203	1365942
Rajasthan	-	-	-	1408	-	1408
Telangana	-	-	-	432	1217	1649

Table-7(B): Mine-head Closing Stocks of Manganese Ore, 2020-21

(By States/Grades)

(Quantity in tonnes)

State	Grades : Mn content					
	MnO_2	46% and above	35% to below 46%	25% to below 35%	below 25%	Total Quantity
India	13311	23790	76970	352676	2241019	2707766
Andhra Pradesh	-	-	109	40316	37395	77820
Goa	-	-	-	-	-	-
Jharkhand	-	1	-	120	-	121
Karnataka	-	420	8403	67228	233241	309292
Madhya Pradesh	-	12628	22841	39291	812884	887644
Maharashtra	12062	3297	24097	19834	23796	83086
Odisha	1249	7444	21520	180432	1132827	1343472
Rajasthan	-	-	-	5165	-	5165
Telangana	-	-	-	290	876	1166

MINING, PROCESSING, MARKETING & TRANSPORT

Manganese ore mining in the country is carried out by opencast as well as by underground methods. Of the 135 mines, 8 are underground (3 in Madhya Pradesh and 5 in Maharashtra). Seven underground mines were operated by MOIL Ltd, a Public Sector company, and one by M/s J.K. Minerals, Balaghat (Madhya Pradesh), a private company. All the underground mines are mechanised or semi-mechanised and adopt cut-and-fill method of stoping. In Kandri mine, hydraulic sand stowing has been introduced in place of manual filling system. This system is faster, cheaper and requires less manpower. Conventional timber supports are replaced by cable bolting pre-mining support to increase safety and productivity. In Balaghat underground mechanised mine, overhand flat back cut-and-fill method with rock bolting support and sand stowing is being practised to fill up the voids with a level interval of 30 m and size of stope block as 30 m x 30 m to 60 m x 30 m. Side Dump Loaders (SDL) of 0.66 cu. m bucket capacity were also deployed in underground levels for mechanised loading of run -of- mine (r.o.m.) in stopes. Tyre mounted Rocker shovel was also introduced in Balaghat mine for mechanised loading of ore from ore drive at stripping area. Deepening of high speed vertical shaft up to 750 m in Balaghat, up to 169 m in Chikla mine, up to 245 m in Kandri mine and up to 160 m in Mansar mine of MOIL is in progress. Sinking of high speed vertical shafts up to 160 m, 330 m and 324 m is in progress at Mansar, Gumgaon and Ukwa mines, respectively. MOIL has also plans to increase its production from present level of 1.2 million tonnes to 3.00 million tonnes by 2030.

The open-pits are usually worked manually by benching method, using portable compressors, jackhammers and dumper trucks. Tirodi mine of MOIL is worked by opencast mechanised method. Height of the benches in overburden is kept at 7.5 m and that in the ore at 6 m. Drills of 100 mm dia. with 0.9 to 1.7 m3 capacity of shovels and 20–25 tonnes dumpers are used for production, loading and transport.

The workings vary from shallow depth in lateritoid-type deposits in Odisha, Karnataka and Goa to deep operations in deposits of a more regular nature found in Madhya Pradesh, Maharashtra and Andhra Pradesh. Bulldozers are used where the overburden is soft. In a few cases, tramways are laid up to the working face and loaded tubs are pushed manually to the dumping ground. In Odisha, Goa and Karnataka, ore is worked by loosening the ground either with crowbars or by blastings. After picking up manganese ore, the waste is removed to the dumping ground. Mining of bedded ore in Madhya Pradesh and Maharashtra is generally carried out by drilling and blasting.

Hand sorting and visual grading are adopted widely to upgrade the ore. Scrubber is also used for washing the ore at some mines. Manual as well as mechanised jigging is done in a few mines.

MOIL has set up an integrated manganese ore beneficiation plant at Dongri Buzurg mine in Bhandara district, Maharashtra, with 4 lakh tonnes annual capacity to process r.o.m. The plant is equipped with handling, crushing, wet screening, drying and magnetic separation facilities in one complex. It has also installed a manganese ore beneficiation plant of 5,00,000 tonnes per annum capacity at Balaghat mine in order to conserve mineral and profitably utilise the low/medium- grade ore. The plant facilities include crushing, wet screening, classification and jigging operations.

The plant upgrades the low/medium-grade fines into high grade and the value addition is around 3-4 times, in case of low-grade fines. The Company has plans to set up a sintering plant for agglomeration of these fines. After agglomeration, these fines will be utilised in ferroalloys production.

Most of the producers market manganese ore directly to the industrial units. In a few cases, especially in case of supplies of special type of ore or a semi-processed product, middlemen are found to be involved in marketing. Ore from mines is usually sold to the domestic consumers, either at the rail-head or ex-plant. In cases of Integrated Iron & Steel and Ferromanganese Industry, the units draw their supplies largely from captive mines. However, special ore types for specific purposes are obtained from other producers. In case of ore meant for exports, producers other than MOIL Ltd supply it to MMTC, the canalising agency, either at rail-head or at the port.

Transport of manganese ore from mines to rail-head is generally done by trucks from where it is transported to ports by rail wagons. From the mine of MOIL in Balaghat district, Madhya Pradesh, the ore is transported by aerial ropeways to the loading bins at the rail-heads. Battery loco was introduced for underground transport of r.o.m. tub from ore pass chute to skip bunker. In Goa, ore in bulk is carried by road-cum-river routes up to Mormugao harbour and in a few cases by rail where the mines are close to the railways. The ore loading at river-head into barges is carried out mechanically.

ENVIRONMENTAL PROTECTION

In order to embark upon low-carbon growth trajectory, MOIL has taken up some measures, such as, recycle and reuse of water for beneficiation, construction of strong parapet walls and afforestation in all its mines. The Company has also set up a wind energy farm of 20 MW capacity at Dewas, Madhya Pradesh. The Company has also plans to install 10.5 MW capacity solar power plant at all its mines in Maharashtra and Madhya Pradesh. R&D work was taken up by MOIL to improve the safety, productivity and environmental standards in the mines by introducing newer technology in consultation with reputed academic and CSIR-R&D institutions of the country.

Various energy saving projects are under process, such as, installation of solar roof top at administrative buildings at all mines; five MW solar power projects in mine areas in Maharashtra; 5.5 MW solar power projects in Madhya Pradesh as well as installation of small size compressors in underground mines for energy saving.

Manganism-a health condition attributed to manganese poisoning-has been reported to be detected in case of five persons working with BHP Billiton's Metalloys, a manganese alloy plant in South Africa. Manganism shows symptoms similar to Parkinson's disease and psychotic behaviour but conditions of development of the disease are not properly understood.

USES & SPECIFICATIONS

Classification of manganese ore, ferruginous manganese ore, siliceous manganese ore, dioxide manganese ore, and manganiferous iron ore is laid down by BIS vide specification no. IS: 11895- 2006 (Reaffirmed March, 2019). Manganese ore is an important material in iron and steel metallurgy, where it is used both in the ore form and as ferromanganese. Manganese improves strength, toughness, hardness and workability of steel, acts as a deoxidiser and desulphuriser, and also helps in getting ingots free from blowholes. About 90 to 95% world production of manganese ore is used in metallurgy of iron and steel. High amount of phosphorous makes the manganese ore unsuitable for its metallurgical use, whereas, high phosphorous and high iron contents make it unsuitable for Battery Industry. Manganese has no satisfactory substitute in its major applications. The specifications of manganese ore by different industries are detailed below:

In Iron & Steel Industry, the BIS:11281-2005 (Reaffirmed March, 2021) specification is laid down for manganese ore. However, specifications based on the user industry indicate that normally manganese ore containing 28 to 35% Mn is used. Ore size generally varies from 10 to 40 mm. For other constituents general stipulations are Fe: 16 to 22%, SiO_2 : 2 to 8%, Al_2O_3 : 5 to 8% and P: 0.3% maximum.

For manganese ore used in Ferromanganese Industry, besides manganese content, other important considerations are high manganese to iron ratio and a very low content of deleterious phosphorous. Specifications of manganese ore for production of ferromanganese are prescribed by the Bureau of Indian Standards vide IS: 4763-2006, (Second Revision, Reaffirmed January, 2017). BIS has also laid down the specifications of manganese ore sinters for blending for ferromanganese production vide IS:12596-1989 (Reaffirmed March, 2019). User's specifications of manganese ore for Ferromanganese/Silico-manganese industries are furnished in Table-8.

Table-8: User's Specifications of Manganese Ore in different Ferromanganese/Silico-manganese Units

Name and location of plant	Specifications of ore consumed
Andhra Pradesh	
Ferro-Alloys Corp. Ltd, Shreeram Nagar, Dist. Vizianagram. Nav Bharat Ferro-Alloys Ltd, Paloncha, Khammam.	Mn: 70-75% C: 6-8% Mn: 28-50%, P: 0.1-0.3%, SiO_2: 8-30% Fe :5-8%
Chhattisgarh	
Sarda Energy & Minerals Ltd Raipur.	Mn: 28-30% (Low P) Mn: 37-40%, 42-44%, 46% (High P)
Monnet Ispat & Energy Ltd, Raipur	Mn: 28-46% Fe : 5-16% SiO_2: 6-34% S & P: 0.05-0.28% Size: 0-100% (lumps & fines)
Hira Power & Steel Ltd, Raipur	
i) Jain Carbides & Chemicals Ltd, Raipur (Unit-I).	Mn: 32-35%
ii) Jain Carbides & Chemicals Ltd, Raipur (Unit-II).	Mn: 32-35%
Karnataka	
S. R. Chemicals & Ferro Alloys, Belagavi. Thermit Alloys Ltd, Shivamogga.	Mn: 38-40%, Fe: 18-23% Mn: 48-54%
Kerala	
INDSIL Hydro Power and Manganese Ltd, Pallatheri, Palakkad.	Fe-Mn ratio 1:3 to 5% (50%) 1:5 to 8% (50%) P: 0.05% max. Al_2O_3: 3 to 5% max.
Madhya Pradesh	
MOIL, Ferro-manganese Plant, Bharveli, Dist. Balaghat.	Mn: 46-48%

Contd...

Table-8 *(Concld)*

Name and location of plant	Specifications of ore consumed	
Maharashtra		
Chandrapur Ferro Alloys Ltd, (Formerly Maharashtra Electro-Smelt Ltd) Chandrapur.	Mn: 38-46%, Fe: 6-17% $SiO_2+Al_2O_3$: 10-16% P: 0.5-0.25% max. +100 mm, 10% max. +10-100 mm, 80-85% min. +5-10 mm, 10% max.	
Nagpur Power & Industries Ltd, Nagpur.	Mn: 42-46%, Fe: 7-8%, SiO2: 3.6%, Al_2O_3: 6-7%, P: 0.10-0.12%	
Natural Sugar & Allied Ind. Ltd, Sai Nagar Ranjani, Dist. Osmanabad	Size: 5-25 mm Size: 10-80 mm	
Odisha		
Tata Steel Ltd, Joda, Kendujhar.	Mn: 43%, min. (for FeMn) 36% min. (for SiMn), Size: 10-75 mm (for FeMn & SiMn)	
	Captive Mn Ore	**Size (mm)**
	Below 35%	(10-75) + 5%
	35% to 46%	(10-75) + 5%
	46% to 49%	(10-75) + 5%
	Dioxide + 49%	(10-75) + 5%
	MOIL, Mn Ore	
	Below 35%	(10-75) + 5%
	Imported Mn	
Tamil Nadu		
Silcal Metallurgical Ltd, Ramanuja Nagar, Coimbatore.	Mn: 35-40% & above Size: 35 mm	
West Bengal		
Cosmic Ferro Alloys Ltd, Bankura.	Size: 75 mm 46 to 49%	(10-75) + 5%

Manganese dioxide is used for manufacturing dry cell batteries in which it functions as a depolariser of hydrogen. For use in dry cell battery, BIS has prescribed Specification No. IS:11153-1996 (First Revision, Reaffirmed Sept. 2015) for manganese dioxide. Suitability of ore depends not only on manganese dioxide content but also on its crystallographic structure. Ore having predominant gamma structure is required. The ore must have high manganese dioxide and low iron content, a certain degree of porosity and moderate hardness. It should be free from metallic compounds, such as, copper, nickel, cobalt, arsenic, lead and antimony, which are electronegative to zinc (container). User industry specifications are MnO_2 70% (min.), Fe 6% (max.), moisture 4% (max.), Cu 0.02% (max.) and Ni 0.02% (max.). The size requirement lays down that 90% material should pass through 300 mesh and 100% through 100 mesh. User industry specifications for electrolytic manganese dioxide (EMD) used in dry cell battery are MnO_2 90% (min.), Fe (as oxide) 0.05% (max.), moisture 4% (max.), Pb 0.15% (max.) and pH 4.5 to 5.6. The size requirements are same as those for manganese dioxide ore.

Manganese ore is also used in the manufacture of various chemicals, such as, potassium permanganate, hydroquinone, manganese sulphate, manganese chloride, manganese phosphate, etc. In Chemical Industry, generally high-grade material is used for potassium permanganate. Ore containing MnO_2 80% (min.), SiO_2 5% (max.), Fe_2O_3 5% (max.) and 200 to 250 mesh ore size is used. In Glass Industry, ore analysing MnO_2 80% (preferably 86% min.), Fe_2O_3 5% (preferably 0.75% max.), SiO_2 2.8% (max.), Al_2O_3 1.1% (max.), BaO 1.3% (max.), CaO 0.4% (max.) and MgO 0.4% (max.) is consumed.

Requirement of manganese dioxide for Explosive and Pyrotechnic compositions as laid down in IS : 5713-1981 (First Revision, Reaffirmed April 2021) by BIS.

Pyrolusite is used generally to impart glaze to the pottery and to make coloured bricks. It also finds use as driers for oils, varnishes and paints. Manganese sulphide is used in the manufacture of salts and in calico printing. Manganese chloride is used in cotton textile as a bronze dye. Manganese salts are used in photography and in leather and matchbox industries.

CONSUMPTION

The consumption of manganese ore in all industries was about 2.62 million tonnes in 2019-20 as against 2.89 million tonnes in 2018-19. Ferroalloys industries accounted for about 91% consumption followed by Iron & Steel (8%). The remaining (1%) was shared by Battery, Electrode, Chemical, Zinc Smelter and Alloy Steel industries (Table- 9).

Table-9: Estimated Consumption* of Manganese Ore, 2017-18 to 2019-20

(By Industries)

(In tonnes)

Industry	2017-18	2018-19 (R)	2019-20 (P)
All Industries	2701700	2886000	2616000
Ferroalloys	2538100	2695900	2387600
Iron & steel	128100	167700	204200
Others: (Chemical, Electrode, Pelletisation, Sponge Iron etc.)	35500	22400	24200

Figures rounded off.

* Includes actual reported consumption and/or estimates made wherever required. Paucity of data, hence coverage may not be complete.

Note: The apparent consumption of manganese ore during 2019-20 has been estimated at 6.9 million tonnes.

INDUSTRY

Manganese alloys are the largest produced ferroalloys in the world with a share of about 41% of the global production of ferroalloys. For production of one tonne of ferromanganese, about 2.6 tonnes of manganese ore, 0.5 tonne of reductant and 3 MWh of electricity inputs are required. As per Indian Ferro Alloys Producers' Association (IFAPA), the total installed capacity of manganese alloys including ferromanganese/silicomanganese in the country was estimated to be around 3.16 million tonnes per annum.

MOIL had set up a High Intensity Magnetic Separation Plant and 1,000 tpy Electrolytic Manganese Dioxide (EMD) Plant at Dongri Buzurg mine. In 2020-21, about 1070 tonnes of EMD was produced as against 925 tonnes in 2019-20.Ferromanganese plant of 10,000 tonnes per annum capacity has been set up at Bharveli, Balaghat. In 2020-21, 8,851 tonnes of ferro-manganese was produced as compared to 10,421 tonnes in the previous year.

Ferromanganese

The total production of various types of manganese alloys (high-carbon ferromanganese, medium-carbon ferromanganese and low-carbon ferromanganese) was about 5.18 lakh tonnes in 2018-19 as per Monthly Statistics of Mineral Production (March, 2020). Further, production of ferromanganese during 2019-20 is not available in the source. It is to be noted that the data coverage is partial and does not reflect the actual production.

Silicomanganese

Silicomanganese is a combination of 60-70% Mn, 10-20% silica and about 20% carbon. As per Monthly Statistics of Mineral Production (March, 2020), production of silico-manganese was reported at 3,20,594 tonnes in 2019-20 as compared to 3,42,591 tonnes in 2018-19. It is to be noted that the data coverage is partial and does not reflect the actual production. MOIL was considering setting up of ferro-manganese and silicomanganese plants through joint venture companies with RINL and SAIL, namely, 31,000 tpy ferromanganese and 75,000 tpy silico-manganese plants at Nandini near Bhilai, Chhattisgarh and a 20,000 tpy ferromanganese and 37,000 tpy silicomanganese plants at Bobbili, Vizianagaram district, Andhra Pradesh, with RINL. These projects are not viable at present especially on account of the present power tariffs of the State Electricity Boards and consequently no further development in respect of both these joint venture companies were reported during the year.

The major factor driving the production of manganese alloys is high production growth of low nickel austenitic stainless steel. India is emerging as the largest producer of this steel where manganese is added substituting the expensive nickel.

Iron & Steel

Iron & Steel Industry was the second major consumer of manganese ore wherein manganese ore is used directly as a blast furnace feed.

Details on consumption, specifications and source of supply of manganese ore to major iron & steel plants in the country in 2018-19 and 2019-20 are furnished in Table-10.

Table-10: Consumption, Specifications and Source of Supply of Manganese Ore in different Iron and Steel Plants, 2018-19 and 2019-20

(Quantity in tonnes)

Plant	Production of pig iron/hot metal (tonnes)		Consumption of Mn-ore (tonnes)		Specifications of ore consumed	Source
	2018-19	2019-20 (P)	2018-19	2019-20 (P)		
Bhilai Steel Plant, Bhilai Nagar, Durg Chhattisgarh.	Hot metal 4751515	Hot metal NA	6186	NA	Size: 25 to 85 mm Mn: 30% min. SiO_2: 30% max. Al_2O_3: 5% max. P: 0.3% max.	MOIL/ Tirodi Balaghat
Bokaro Steel Plant, Bokaro, Jharkhand.	Hot metal 4209268	Hot metal 4086135	NA	NA	NA	-
Durgapur Steel Plant, Durgapur, West Bengal.	Hot metal 2515068	Hot metal 2403284	NA	NA	NA	-
Rourkela Steel Plant,	Hot metal	Hot metal	NA	NA	-	-

Contd...

Table-10 *(Contd)*

Plant	Production of pig iron/hot metal (tonnes)		Consumption of Mn-ore (tonnes)		Specifications of ore consumed	Source
	2018-19	2019-20 (P)	2018-19	2019-20 (P)		
Rourkela, Odisha.	3836421	3624686				
IISCO Steel Plant, Burnpur, Dist. Burdwan, West Bengal- 713 325.	Hot metal 2200348	Hot metal 2505193	NA	NA	NA	-
Visvesvaraya Iron and Steel Ltd, Bhadravati, Shivamogga, Karnataka.	Hot metal NA	Hot metal NA	NA	NA	-	-
KIOCL Ltd, Pellet Plant, Mangaluru, Dakshina Kannada, Karnataka.	Hot metal NA	Hot metal NA	NA	NA	NA	-
Visakhapatnam Steel Plant, Visakhapatnam, Andhra Pradesh.	NA	NA	NA	3205	25% to below 35% Mn Below 25% Mn	-
IDCOL, Kalinga Iron Works Ltd, Barbil, Kendujhar, Odisha.	Hot metal NA	Hot metal NA	NA NA	NA NA	Size: 10-40 mm	From own/ local mines
Gordan Steel India Ltd, Jaonbulapadu, Anantapur, Andhra Pradesh.	Hot metal NA	Hot metal NA	NA	NA	Mn 28-35% Mn	-
Tata Steel Ltd, Jamshedpur, Jharkhand.	Hot metal 10839210	Hot metal 10774978	296	-	Mn 25% to below 35%	Bichakundi Mine, Keonjhar
Kirloskar Ferrous Industries Ltd, Bevinahalli, 583 234, Koppal, Karnataka.	Pig iron 397046	Pig iron 385510	8159	NA	NA	NA
LANCO Industries Ltd, Chittoor, Andhra Pradesh.	Pig iron+ (molten metal) NA	Pig iron+ (molten metal) NA	NA	NA	NA	NA
Visa Steel Ltd, Kalinganagar, Jajpur, Odisha.	Hot metal 11920	Hot metal -	-	-	25% to below 35% Mn	-
Sunflag Iron & Steel Co. Ltd, Warrthy, Bhandara, Maharashtra.	Hot metal 311821	Hot metal 304265	659	-	25% to below 35% Mn	-

Contd...

Table-10 *(Concld)*

Plant	Production of pig iron/hot metal (tonnes)		Consumption of Mn-ore (tonnes)		Specifications of ore consumed	Source
	2018-19	2019-20 (P)	2018-19	2019-20 (P)		
Jaiswal Neco Industries Ltd, Siltara, Raipur, Chhattisgarh.	Hot metal 607856	Hot metal 622867	NA	NA	NA	-
Jaiswal Neco Industries Ltd, Ballari, Karnataka.	Hot metal NA	Hot metal NA	-	-	NA	NA
JSW Steel Ltd, Salem, Tamil Nadu- 636 453.	Hot metal 950800	Hot metal 959212	NA	NA	NA	NA
JSW Steel Ltd, Vidyanagari, Ballari, Karnataka.	Hot metal 11598167	Hot metal 11195349	NA	NA	NA	NA
Rashmi Metaliks Ltd, Gokulpur, West Midnapore, West Bengal.	Hot metal 172612	Hot metal 179987	450	662	NA	NA
Sona Alloys P. Ltd, Lonad, Pune, Maharashtra.	Hot metal NA	Hot metal NA	NA -	NA -	NA -	NA -
Aparant Iron & Steel Pvt. Ltd, Goa.	Pig Iron NA	Pig Iron NA	NA	NA	NA	NA
Uttam Galva Metallics Ltd, Bhugaon- 442 001, Wardha, Maharashtra.	Hot metal 476535	Hot metal 487214	NA	NA	NA	NA
Tata Metaliks Ltd, Gokulpur, Maheshpur West Bengal.	Hot metal 518170	Hot metal 543932	9576	8976	25% to below 35% Mn Below 25% Mn	NA
Vedanta Ltd, Navelim Amona, Marcela, Goa.	683025	682726	-	642	Below 25% Mn	-
Neelachal Ispat Nigam Ltd, Kalinga Nagar, Duburi, Jajpur, Odisha.	NA	NA	NA	NA	-	-
Suraj Products Ltd, Barpali, Rajgangpur, Sundargarh, Odisha.	NA	NA	NA	NA	-	-
Jindal Saw Ltd, Mundra, Gujarat.	478861	491626	3801	3164	Mn 25% to below 35%	-
SLR Metaliks Ltd, Narayan Devara Kere, Hagari Bommana Halli, Karnataka	246651	229646	NA	61.44	-	-

Dry Battery

Dry battery Industry also consumes EMD along with natural manganese dioxide ore. The only one plant of 1,000 tpy capacity producing EMD is owned by MOIL and is located in Bhandara district of Maharashtra. Sale quantity of EMD has decreased slightly from 930 tonnes in the year 2019-20 to 918 tonnes in the year 2020-21.

RESEARCH & DEVELOPMENT

The CSRI-Institute of Scientific and Industrial Research, Bhubaneswar, in its Annual Report has reported that during 2019-20, a project was carried out for manganese ore beneficiation with an objective to meet the increased demand for manganese alloys and compounds for various industries and to offset the shortage of manganese ore to serve this demand. World manganese resources are classified into 3 major categories, i.e., oxide, siliceous and carbonate ores considering the beneficiation characteristics. Selection of the appropriate beneficiation process depends on the gangue minerals and their association. Gravity separation methods are applied on the siliceous ores and these are in industrial practice. Iron ore minerals are always found as an impurity in all kind of manganese ores, however, these are successfully removed using variety of magnetic separation processes or reduction roasting followed by magnetic separation. The Mn value could be enhanced from 28% to 40%.

With the high-grade non-renewable Mn ore depleting at a faster rate, the attention shifts to alternative routes, such as, lean-grade Mn ore to produce ferro-manganese. CSIR-IMMT, Bhubaneswar, made efforts to perform smelting reduction studies of lean-grade manganese ore supplied. The obtained lean-grade Mn ore was subjected to crushing and grinding operation followed by scrubbing, reduction roasting studies and wet magnetic separation to separate out the magnetic and non-magnetic fractions. Finally, smelting reduction studies in a plasma arc furnace were conducted to produce ferro-manganese from the non-magnetic fraction of the sinter and pig iron from the magnetic fraction of the sinter. The attempts taken to produce ferro-manganese by enriching the lean-grade Mn ore was successfully achieved by this novel pyrometallurgical technique.

Manganese Ore India Ltd. (MOIL), in its Annual Report during 2019-20, efforts taken under its R&D in the area of Mine Environment, Mining Technology-Subsidence and Patent, Mineral Conservation, Sustainable Development Framework, Underground Mechanisation, Mineral Beneficiation, Metallurgical Studies, Exploration & Petrography, Remote Sensing Study, R & D in cement Concrete and XRF analyzer. Some of the R & D activities are given below:

(A) In area of mine environment, Ventilation reorganisation studies for deeper levels have been conducted at Balaghat Mine and sinking has been commenced for 5m diameter ventilation drifts.

(B) For the mine safety, MOIL conducted (i) In-house 3-D analysis of subsidence parameters has been carried out by MOIL and found no noticeable movements in any orthogonal direction above the ground at Munsar Mine. (ii) CSIR-CIMFR, Nagpur and Dhanbad centre have been engaged to design support system for better safety and productivity of ROM at Balaghat and Ukwa underground mines. (iii) Designed in-house rock mechanics software 'MOIL-RMR' for rock mass characterisation and support design. (iv) Modern rock mechanics instruments like MPBX, Strain Bars, Load Cells for indicating displacement/load on travelling/ haulage road, stopes have been installed in all the underground mines of the company for immediate information of failure in transport and travelling roadways for safety.

(C) Mine Planning and Design Department has conducted the in-house R&D study of overburden material and bottom ash to use as a fill material in underground by hydraulic transportation at Munsar Mine.

(D) For mechanical handling of ROM in drills and stopes SDL along with modern electro-hydrostatic drill machine-Universal Drilling Machine (UDM) has been introduced on experimental basis at Chikla and Gumgaon Mine.

(E) For Mineral Beneficiation, R&D studies on "Bench scale beneficiation study on a manganese ore sample from Balaghat mine' have been carried out by Modern Mineral Processing Laboratory and Pilot Plant, Indian Bureau of Mines, Nagpur for recovery of sand and manganese separately.

(F) In the area of exploration and remote sensing study, Hydrostatic high penetration core drilling machine has been introduced in the Company for exploration. Further, MOIL has signed MoU with National Remote Sensing Centre (NRSC), Hyderabad for remote sensing studies of four districts of Madhya Pradesh, namely Balaghat, Chindwada, Jabalpur & Jhabua for identification of manganese bearing area. NRSC has submitted the report. On the basis of report, MOIL has carried out field survey and applied for permission core drilling from Govt. of Madhya Pradesh in potential zone. This will help generate new mining leases in the said area.

(G) In the field of Cement concrete, pre-cast concrete columns and beams have been prepared for concreting work in underground drifts. This has improved the safety standard and reduced time for erecting of concrete supports in underground drifts. Installation is in progress at Gumgaon Mine.

SUBSTITUTES

Cost and technology militate against substitution in major applications. However, for economic reasons, there is only limited substitution in minor applications in Chemical and Battery industries. The Steel Industry has, however, made great strides in economising the use of manganese, largely through changes in steel-making techniques.

TECHNICAL POSSIBILITIES

The deep-sea nodules can be a potential resource of manganese in the next decades to come.

There is a trend towards using lower grades of ores in ferromanganese production. New steel-making practices and techniques are reducing the amount of manganese consumed in the process. However, counter balancing this to some extent is a trend towards higher manganese specifications for modern steels.

TRADE POLICY

Export Policy

The Foreign Trade Policy, 2015-20 and the policy on export as per ITC (HS), 2018 schedule 2 as follows:

HS Code	Policy	Item description
2602 00	Manganese ores and concentrates including ferruginous Manganese ores and concentrates with Manganese content of 20% or more calculated on the dry wet.	Free

Import Policy

Imports of manganese ore and concentrates including ferruginous manganese ores and concentrates containing 20% or more manganese (calculated on dry weight basis), agglomerated manganese ore sinters, etc. are freely allowed.

WORLD REVIEW

The total world reserves of manganese ore is approximately 1500 million tonnes of metal content which is unevenly distributed (Table-11). Reserves are located in South Africa (43%), Brazil (18%), Australia (18%), Gabon (4%), China (4%) and India (2%). Only a small fraction of global manganese reserves is economical. This fact continues to prompt and support interests in deep-sea manganese nodules, which constitute an enormous untapped resource. Most nodules are found in areas of deep-sea floor at water depths of 5 to 7 km.The Pacific Ocean alone is estimated to contain about 2.5 billion tonnes nodules containing about 25% Mn, making them similar in abundance to low-grade land-based deposits. Most major steel-making nations lack manganese resources. North America reportedly has less than 1% world reserves and the United States is said to have lean-grade reserves which would potentially entail high extraction cost. This situation has created an active global trade in manganese ore and manganese alloys.

World production of manganese ore in 2020 was estimated to be around 49 million tonnes as compared to 57 million tonnes in 2019. South Africa was the leading producer contributing about 32% followed by Gabon (16%), Australia (10%), China (13%), Brazil (5%), India (5%) and Ghana (5%) (Table-12). The production of manganese ore is linked with the production of steel. The Steel Industry consumes it in the form of ore and manganese alloys.

Table-11: World Reserves of Manganese Ore
(By Principal Countries)

(In '000 tonnes of metal content)

Country	Reserves
World: Total (rounded off)	1500000
Australia(a)	11270000
Brazil	270000
Myanmar	NA
China	54000
Cote d'Ivoire	NA
Gabon	61000
Georgia	NA
Ghana	13000
India*	34000
Kazakhstan, (concentrate)	5000
Malaysia	NA
Mexico	5000
South Africa	640000
Ukraine, (concentrate)	140000
Vietnam	NA
USA	–
Other countries	Small

Source: USGS Mineral Commodity Summaries, 2022.

(a): Joint Ore Reserve Committee compliant reserves were about 76 million tonnes gross weight.

NA: Not Available; - : Zero

*: India's total reserves/resources of manganese ore as per NMI database based on UNFC system have been estimated at 503.62 million tonnes as on 1.4.2020.

Table-12: World Production of Manganese Ore
(By Principal Countries)

(In '000 tonnes)

Country (Rounded off)	2018	2019	2020
World:Total	54825	57408	49583
South Africa	14919	17008	16020
Gabon	6542	7186	8147
China	7977	6650	6500
Australia	7212	6649	4752
India*	2820	2956	2457
Brazil	3189	3726	2385
Ghana	4551	5383	2357
Ukraine	1845	1854	1850
Ivory Coast	930	1175	1280
Other countries	4837	4820	3834

Source: BGS, World Mineral Production, 2016-2020.

(a): Years ended 31st March following that stated.

* India's production of manganese ore in 2018-19, 2019-20 and 2020-21 was 3832 thousand tonnes, 2,910 thousand tonnes and 2,688 thousand tonnes, respectively.

FOREIGN TRADE

Exports

Exports of manganese ore (total) increased by 40% to 82,363 tonnes in 2020-21 from 58,198 tonnes in 2019-20 (Fig-2). Out of the total exports in 2020-21, only 10 tonnes of manganese ore having +46% Mn of value ₹3,30,000 was exported. Exports of manganese ore (others) were at 22,045 tonnes as compared to 49,206 tonnes in the preceding year. About 58% of exports of Manganese ore total were to China followed by Indonesia with 24% and UAE with 12%.

Exports of manganese oxide (total) increased by 2% to 29,116 tonnes in 2020-21 as against 28,485 tonnes in 2019-20 Manganese dioxide exports in 2020-21 decreased by 60% to 4,476 tonnes from 11,412 tonnes in 2019-20. Exports were mainly to UAE (53%), Poland (5%), & UK (3%). In 2020-21, exports of manganese & alloys (including waste & scrap) increased marginally by to 469 tonnes as compared to 418 tonnes in the previous year.

Exports of manganese & alloys (wrought & unwrought) in 2020-21 increased by 38% to 188 tonnes as compared to 136 tonnes in the previous year (Tables - 13 to 26).

Imports

Imports of manganese ore (total) decreased drastically by 6% to 4.05 million tonnes in 2020-21 from 4.31 million tonnes in the previous year. South Africa (43%), Gabon (17%), Australia (15%) and Singapore (7%) were the main suppliers of manganese ore in 2020-21 (Fig-3). Out of the total manganese ore imported, the contribution of manganese ore having +46% Mn was 1,82,048 tonnes (4%), manganese ore having 35-46% Mn was 29,42,210 tonnes (72%), manganese ore having 30 to 35% Mn was 4,49,497 tonnes (11%) and manganese ore (others) was 3,16,464 tonnes (8%). In 2020-21, imports of manganese dioxide were 12,996 tonnes. Imports were mainly from China (58%), Belgium (22%) and Peru (12%). In 2020-21, imports of manganese oxide (total) were 25,687 tonnes. During 2020-21, imports of manganese & alloys (including waste and scrap) were 37,247 tonnes, out of which manganese & alloys (wrought/unwrought) comprised 36,890 tonnes. Imports of manganese & alloys NES were 357 tonnes during 2020-21 (Tables - 27 to 41).

Table-13: Exports of Manganese Ore : Total
(By Countries)

(In '000 tonnes)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	58198	254643	82363	974940
China	27500	55197	47714	755315
UAE	5887	88687	10050	113362
Indonesia	21600	59179	22000	60852
Bhutan	-	-	2544	44283
Bangladesh	40	991	23	590
Ethopia	-	-	10	235
Sri Lanka	25	548	17	150
Kenya	16	417	++	87
Nepal	++	12	3	39
Burundi	++	17	2	27
Other countries	3130	49595	-	-

Figures rounded off.

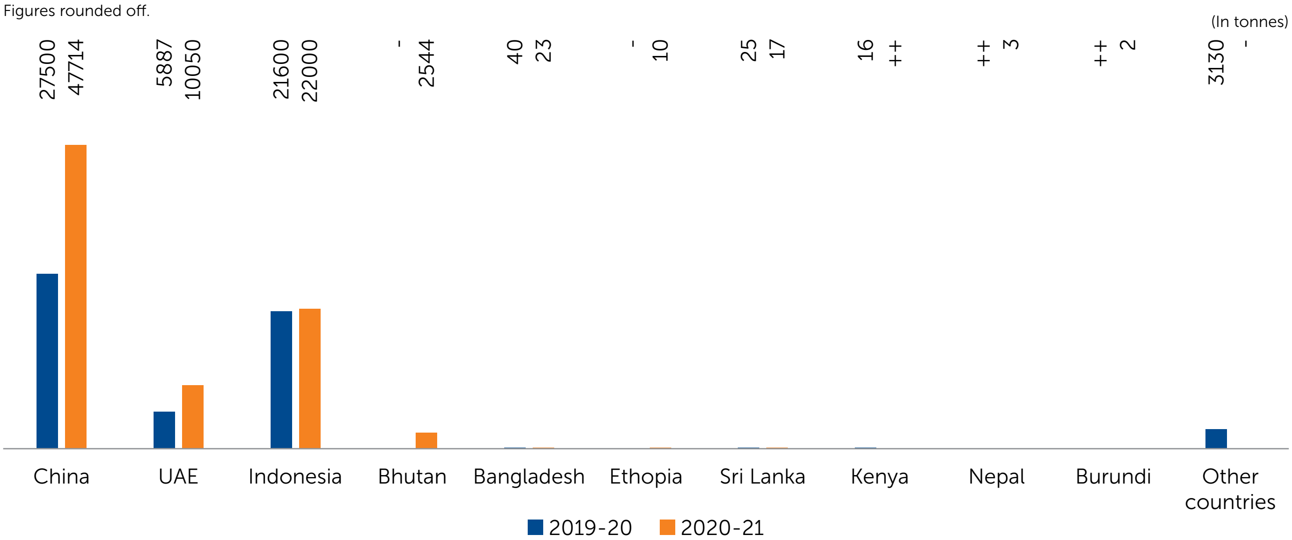


Fig 2: Countrywise Export of Manganese Ore

Table-14: Exports of Manganese Ore (46% or more Mn)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	5	299	10	330
Ethiopia	-	-	10	235
Kenya	-	-	++	87
Bhutan	-	-	++	8
Lebanon	5	298	-	-
Nepal	++	1	-	-

Figures rounded off.

Table-15: Exports of Manganese Ore (Others)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	49206	116935	22045	61658
Indonesia	21600	59179	22000	60852
Bangladesh	40	991	23	590
Sri Lanka	25	548	17	150
Nepal	++	11	3	39
Burundi	++	17	2	27
China	27500	55197	-	-
Uganda	21	527	-	-
Kenya	16	417	-	-
Tanzania	4	48	-	-

Figures rounded off.

Table-16: Exports of Manganese Oxide
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	28485	1382052	29116	1357914
USA	1373	68893	8580	368161
UAE	6143	307406	2548	129789
Vietnam	1457	79180	1785	91663
France	2805	78860	2540	77879
Canada	1070	58998	1198	62730
Thailand	882	50420	1152	59102
Turkey	1105	60290	944	49469
Russia	867	43280	944	44763
Indonesia	1876	99850	850	44317
Australia	867	42872	857	411116
Other countries	10040	492003	7718	388925

Figures rounded off.

Table-17: Exports of Manganese Dioxide
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	11412	549640	4476	227849
UAE	6063	303005	2343	118891
Poland	195	11409	222	14003
UK	250	16495	155	11428
Netherlands	175	11535	121	9223
Ireland	50	3525	100	7431
Bangladesh	161	5595	168	6503
Turkey	48	3258	75	5541
Kenya	254	5133	267	5122
Lithuania	50	3113	75	4790
Italy	13	1934	87	4701
Other countries	4153	184638	863	40216

Figures rounded off.

Table-18: Exports of Manganese Oxide
(Other than Manganese Dioxide)
(By Countries)

Country	2018-19 (R)		2019-20 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	15506	810243	17073	832412
Indonesia	1282	73387	1850	98570
France	3153	138637	2805	78860
Vietnam	1339	78499	1356	76325
Spain	775	39278	1375	68411
Canada	1151	68182	1050	57356
Turkey	521	28108	1057	57032
Thailand	438	24165	862	47558
Australia	1232	54774	867	42872
Russia	533	29400	842	42312
UK	575	30994	725	36754
Other countries	4507	244818	4284	226361

Figures rounded off.

Table-19: Exports of Manganese & Alloys
(Incl. Waste & Scrap)
(By Countries)

Country	2018-19 (R)		2019-20 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	418	343896	469	375616
France	299	242113	283	270014
Korea	++	586	12	19625
Philippines	22	5655	44	11337
Burundi	-	-	4	9390
UAE	5	734	62	8950
Solvenia	++	789	4	7050
Malaysia	3	3332	14	6433
Romania	3	4709	3	6233
Georgia	-	-	3	5928
Italy	3	6977	3	5590
Other countries	83	79001	37	25066

Figures rounded off.

Table-20: Exports of Manganese & Alloys
(Wrought/Unwrought)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	136	119131	188	106409
Korea	++	586	12	19580
Philippines	22	5655	44	11337
Burundi	-	-	4	9390
UAE	5	704	62	8950
Solvenia	++	789	4	7050
Malaysia	3	3332	14	6433
Romania	3	4709	3	6233
Georgia	-	-	3	5928
Italy	3	6790	3	5590
Indonesia	9	4143	13	4887
Other countries	91	92423	26	21031

Figures rounded off.

Table-21: Exports of Manganese: Wrought
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2	305	2	688
Brazil	-	-	1	288
Malaysia	1	109	1	197
UK	1	110	++	89
Kenya	++	11	++	60
UAE	-	-	++	54
Phillipines	++	26	-	-
Egypt	++	19	-	-
Pakistan	++	19	-	-
Bulgaria	++	11	-	-

Figures rounded off.

Table-22: Exports of Manganese & Alloys Unwrought
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	134	118826	186	105721
Korea	++	586	12	19580
Philippines	22	5629	44	11337
Burundi	-	-	4	9390
UAE	5	704	62	8896
Slovenia	++	789	4	7050
Malaysia	2	3223	13	6236
Romania	3	4709	3	6233
Georgia	-	-	3	5928
Italy	3	6790	3	5590
Indonesia	9	4143	13	4887
Other countries	90	92253	25	20594

Figures rounded off.

Table-23: Exports of Manganese & Alloys : NES
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	258	218849	249	260113
France	258	218534	249	260039
South Africa	-	-	++	33
Serbia	++	++	++	32
Bhutan	++	3	++	9
Italy	++	187	-	-
Switzerland	++	92	-	-
UAE	++	30	-	-
Congo	++	3	-	-
UK	++	++	-	-

Figures rounded off.

Table-24: Exports of Manganese Ore
(35% or More but Below 46% Mn)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	8987	137409	40108	698245
China	-	-	34614	610984
Bhutan	-	-	2544	44275
UAE	5887	88687	2950	42986
Oman	3098	48698	-	-
Australia	2	24	-	-

Figures rounded off.

Table-25: Exports of Manganese Ore
(Ferruginous, 10% or More but Below 30% Mn)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	2	-	-
Maldives	++	2	-	-

Figures rounded off.

Table-26: Exports of Manganese Waste & Scrap
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	24	5916	32	9094
France	20	5184	32	8978
China	-	-	++	71
Korea	-	-	++	45
Saudi Arabia	4	732	-	-

Figures rounded off.

Table-27: Imports of Manganese Ore : Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**4316572**	**41282100**	**4058590**	**55242138**
South Africa	2901445	20518427	1754857	19894390
Gabon	219280	3284695	680154	14231857
Australia	461946	6947206	594049	8301688
Singapore	133117	2306103	274626	3848144
UAE	185788	1847279	271579	2768760
Brazil	17863	2923247	175622	2410870
Cote d'Ivoire	97623	1203533	88229	930035
Hong Kong	56692	748618	67871	816612
France	21850	434181	54122	740638
Uruguay	-	-	41261	460361
Other countries	60468	1068811	56220	838783

Figures rounded off.

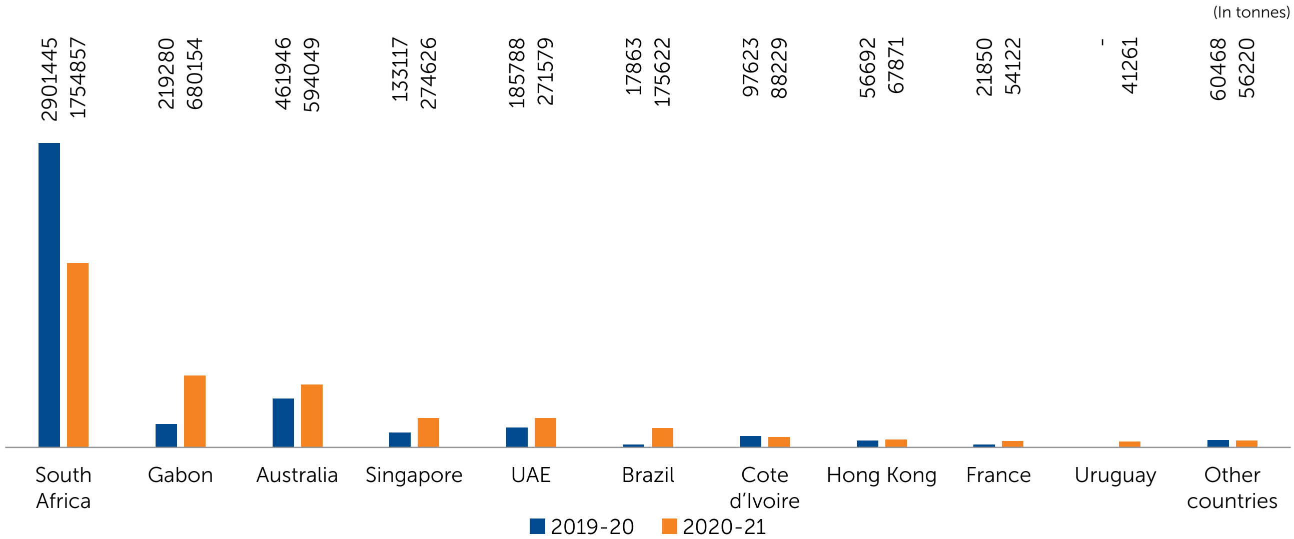


Fig 3: Countrywise Import of Manganese Ore

Table-28: Imports of Manganese Ore (46% or more Mn)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**191766**	**399776**	**182048**	**3156903**
South Africa	46805	869014	86851	1261006
Gabon	-	-	44376	868826
Brazil	34477	727823	19112	323322
Cote d'Ivoire	12607	305908	7498	182123
Tanzania	7069	137129	6699	142804
Zambia	6932	128117	8074	126450
Togo	-	-	2988	104634
China	1515	49088	1675	57809
UAE	2111	50035	1674	30651
Senegal	2147	45490	1045	22233
Other countries	78103	1685172	2056	37045

Figures rounded off.

Table-29: Imports of Manganese Ore
(35% or more but below 46% Mn)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1871739	26995931	2942210	39070738
South Africa	943644	13567432	1110682	13627236
Gabon	183230	2852359	591454	8582003
Australia	362861	4961059	564638	7842159
Singapore	40806	638022	209991	3021710
Brazil	118233	1924127	138475	1937166
UAE	49769	626849	119220	1523011
France	21850	434181	54122	740638
Hong Kong	44749	621055	58600	726597
Uruguay	-	-	41261	460361
Cote d'Ivoire	72676	793526	43080	430075
Other countries	33921	577321	10687	179782

Figures rounded off.

Table-30: Imports of Manganese Ore
(30% or more but below 35% Mn)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	432072	4049808	449497	3789163
South Africa	280837	2676028	316047	2636360
UAE	102281	869313	63170	523655
Cote d'Ivoire	12336	104073	35590	300485
Gabon	16815	189349	13727	165331
Hong Kong	10945	113897	6272	51995
Switzerland	-	-	5415	48189
China	-	-	5201	30139
Singapore	1980	19681	3669	28946
Brazil	3095	31532	406	4063
Turkey	1367	16486	-	-
Other countries	2416	29449	-	-

Figures rounded off.

Table-31: Imports of Manganese Ore (Others)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1773356	5844006	316464	8006608
Gabon	19235	242987	30597	4615697
South Africa	1606830	3207625	154548	1718613
Singapore	72414	1253884	57397	770684
Australia	37811	692451	29411	459529
UAE	10984	137245	19838	192360
Brazil	22558	239765	7233	104655
Mozambique	-	-	12075	82220
Hong Kong	-	-	2999	38020
Cote d' Ivoire	4	26	2061	17352
China	25	2317	85	3582
Other countries	3495	67706	220	3896

Figures rounded off.

Table-32: Imports of Manganese Dioxide
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	10607	963139	12996	1016479
China	6961	841248	7569	851348
Belgium	2041	68780	2906	96802
Peru	1453	40095	1530	38100
UAE	64	5999	370	9841
Australia	-	-	437	8731
Netherlands	70	3409	132	7198
Hong Kong	-	-	25	2469
Morocco	-	-	25	795
UK	++	153	1	501
Germany	3	115	++	293
Other countries	15	3340	1	401

Figures rounded off.

Table-33: Imports of Manganese Oxide
(Other than Manganese Dioxide)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	17073	832412	24640	1130065
USA	251	18914	8521	363677
Vietnam	1356	76325	1709	88671
France	2805	78860	2540	77879
Canada	1050	57356	1175	60835
Thailand	862	47558	1152	59062
Russia	842	42312	944	44664
Turkey	1057	57032	869	43928
Indonesia	1850	98570	821	40743
Australia	867	42872	780	38520
Spain	1375	68411	674	32968
Other countries	4758	244202	5455	279118

Figures rounded off.

Table-34: Imports of Manganese & Alloys
(Incl. Waste & Scrap)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	45195	6188389	37247	4933243
China	43709	5629033	35674	4602138
France	426	310078	125	111625
Hong Kong	654	82810	554	72961
Singapore	25	3016	625	72940
Sweden	130	127018	40	38775
Taiwan	-	-	100	11964
Korea, Rep. of	115	14899	69	10730
South Africa	20	4541	35	8288
Br. Virgin Is	50	6831	25	3155
USA	++	107	++	279
Other countries	66	10056	++	388

Figures rounded off.

Table-35: Imports of Manganese & Alloys (Wrought/Unwrought)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**44580**	**5882186**	**36890**	**4838565**
China	43485	5599584	35391	4566206
Hong Kong	654	82810	554	72961
Singapore	25	3016	625	72940
France	39	35019	51	53506
Sweden	130	126941	40	38775
Taiwan	-	-	100	11964
Korea, Rep. of	115	14899	69	10730
South Africa	20	4541	35	8288
Br. Virgin Is	50	6831	25	3155
UK	++	2	++	40
Other countries	62	8543	++	++

Figures rounded off.

Table-36: Imports of Manganese (Wrought)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1834**	**250991**	**758**	**96754**
China	1834	250991	660	83883
Hong Kong	-	-	98	12871

Figures rounded off.

Table-37: Imports of Manganese & Alloys NES
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**598**	**303087**	**357**	**94678**
France	370	271963	74	58119
China	224	29449	283	35932
USA	++	87	++	279
UK	1	461	++	204
Germany	++	247	++	137
UAE	3	467	++	7
Italy	++	336	-	-
Sweden	++	77	-	-

Figures rounded off.

Table-38: Imports of Manganese Ore
(Ferruginous, 10% or more but Below 30% Mn)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**47639**	**394579**	**168371**	**1218726**
South Africa	23329	198328	86729	651175
UAE	20643	163837	67677	499083
Brazil	-	-	10396	41664
Singapore	2952	28148	3569	26804
Kenya	665	3758	-	-
Nigeria	50	508	-	-

Figures rounded off.

Table-39: Imports of Manganese Oxide
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	18239	1325712	25687	1565080
China	7185	873949	8267	947140
South Africa	6226	164107	10704	275017
Belgium	2661	161633	3537	204656
UAE	80	12385	759	49779
Peru	1453	40095	1530	38100
Germany	38	13423	39	15401
Australia	-	-	437	8731
USA	85	11073	62	7997
Netherlands	70	3409	137	7602
Hong Kong	-	-	25	2469
Other countries	441	45638	196	8188

Figures rounded off.

Table-40: Imports of Manganese & Alloys: Unwrought
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	42746	5631195	36132	4741811
China	41651	5348593	34731	4482323
Singapore	25	3016	625	72940
Hong Kong	654	82810	456	60090
France	39	35019	51	53506
Sweden	130	126941	40	38775
Taiwan	-	-	100	11964
Korea, Rep. of	115	14899	69	10730
Br Virgin Is	20	4541	35	8288
South Africa	50	6831	25	3155
UK	++	2	++	40
Other countries	62	8543	++	++

Figures rounded off.

Table-41: Imports of Manganese Waste and Scrap
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	17	3116	-	-
France	17	3096	-	-
USA	++	20	-	-

Figures rounded off.

FUTURE OUTLOOK

As per World Steel Association, India's per capita steel consumption is about 74.7 kg as against the world's per capita consumption of 230.3 kg. This difference in the per capita consumption of steel in itself reflects opportunities that are bound to occur for Steel Industry which in turn would positively impact the demand for manganese ore. Production of crude steel is the single most important factor that influences the demand for manganese ore. Steel Industry accounts for approximately 90% of the world demand for manganese. India's crude steel production grew from 89.79 million tonnes in 2015-16 to 103.044 million tonnes in 2020-21. This indicates strong growth of Steel Industry in the country as steel is the principal market accounting for 65 to 70% manganese consumption.

India has set a production capacity target of 300 million tonnes of steel by 2030-31. The demand for manganese ore is expected to raise commensurately to about 10 million tonnes per year in the coming years. India's largest manganese ore producing company "MOIL Ltd" has targets to increase its production to 3 million tonnes by 2030, the gap in the demand will continue to be filled by imports in years to come.

21. Perlite

2.41

(million tonnes) resources of Perlite have been estimated in India as on 1st April, 2020

Perlite is hydrated, amorphous, siliceous volcanic glass of rhyolitic composition with perlitic texture and pearly lustre. The perlitic texture is often a visible onion peel-like concentric cracking, caused by expansion of the glass upon hydration. It expands in the form of tiny spheres when heated. Colour of crude perlite is light grey to glossy black, whereas the colour of expanded perlite ranges from snowy white to greyish white. It can expand up to 20 times of its original volume at a temperature between 850 °C and 1150 °C. This expansion is due to the presence of 2 to 5% combined water in crude perlite which when heated vaporises to form countless tiny bubbles. Expanded perlite is a white, light weight and durable material that resists decay. Expanded perlite is not only amazingly light weight, but also has exceptional physical properties. Unexpanded (raw) perlite has a bulk density around 1,100 kg/m^3 (1.1 g/cm^3), while typical expanded perlite has a bulk density of about 30–150 kg/m3.

Perlite is used in industry in both the forms-Crude Perlite and Expanded Perlite. Most perlite is expanded to produce ultra light perlite by heating. Crude perlite is prepared by crushing and screening to various size fractions.

RESERVES/RESOURCES

The only deposit of perlite is located in the Village Patanvav, Rajkot district, Gujarat. It is found to occur in Osam Hill in the form of discontinuous sill. Depending upon the colour, luster and expansion values, the grade of perlite is classified as high, medium and low grade. (i) Perlite which is jet black in colour with glassy luster with expansion values more than 15 to 20 times, is termed as High Grade; (ii) Perlite having black colour, dull luster with mixture of rhyolitic material is termed as Medium Grade; and (iii) Perlite which is black in colour with vitrified, greyish patches and mixture of rhyolitic material is termed as Low Grade.

The total resources of perlite as per NMI database, based on UNFC system as on 1.4.2020 has been estimated at 2.41 million tonnes, out of which 12% are High-Grade, 12% Medium-Grade, 6% Low-Grade and the remaining 70% fall under Unclassified category. The entire resources of perlite are placed under Remaining Resources category (Table -1).

Typical Analysis of Crude Perlite (in percentage)

By Grades	
SiO_2	72–76
Al_2O_3	11–17
K_2O	4–5
Na_2O	2.9–4.0
CaO	0.5–2.0
Fe_2O_3	0.5–1.5
MgO	0.1–0.5
TiO_2	0.03–0.20
H_2O	2–3

Table-1: Reserves/Resources of Perlite as on 1.4.2020 (P)

(By Grades/State)

(In '000 tonnes)

States/Grades	Reserves	Remaining Resources					Total
	Total	Feasibility	Pre-feasibility		Reconnaissance	Total	Resources
	(A)	STD211	STD221	STD222	STD334	(B)	(A+B)
All India: Total	0	140	683	595	988	2406	2406
By Grades							
High	0	19	0	264	0	283	283
Medium	0	79	0	221	0	300	300
Low	0	42	0	110	0	152	152
Unclassified	0	0	683	0	988	1671	1671
By State							
Gujarat	0	140	683	595	988	2406	2406

Figures rounded off..

PRODUCTION AND STOCKS

No production of perlite was reported since 2007-08 and also no stocks were reported during the year 2020-21. However, one lease having 144.88 Ha area was granted in Rajkot district, Gujarat.

USES

There are different uses of perlite in both crude and expanded form. There are many applications of perlite, such as, producing paint, ceramics, foundry sand, drilling muds, filters, abrasives, matrices for hydroponic plant culturing, for garment washing and loose filling material in insulation and packaging. Usability is mainly controlled by the swelling capacity, which is measured by comparing the bulk density of raw and swelled material. Perlite uses can be grouped under three general categories — construction, horticultural and industrial applications.

Construction Applications

In the construction and manufacturing fields, expanded perlite, on account of its acoustic properties, being light weight, fire resistant and an excellent insulator is used in light weight plasters and mortars, insulation, ceiling tiles and as filter aids.

In addition to providing thermal insulation, perlite enhances fire resistance, reduces noise transmission and is resistant to rot, vermin and termites. Perlite is also ideal for insulation against low temperature. When perlite is used as an aggregate in concrete, a light weight, fire resistant, insulating concrete is produced which is ideal for roof decks and other applications. Perlite is also used as an aggregate in portland cement and gypsum plasters (green plaster) for exterior applications and for fire protection of beams and columns. Other construction applications include: light weight curtain/ partition wall, noise reduction, under-floor insulation, chimney lining, paint texturing, ceiling tiles and roof insulation boards. Perlicon is expanded perlite based concrete. The expansion is due to presence of two to six per cent combined water in the crude perlite rock. Demand for good quality expanded perlite in India has been showing an upward trend.

Horticultural Applications

In horticulture, expanded perlite is used throughout the world as a component of soil-less growing mixes, where it provides aeration and optimum moisture retention for superior plant growth. Studies have shown that outstanding yields are achieved with perlite hydroponic systems. Other benefits of perlite in horticulture are its neutral pH value and the fact that it is sterile and weed-free. In addition, its light weight makes it ideal for growing plants in small containers. Besides, perlite is a good carrier for fertilizer, herbicides & pesticides and for pelletising seed. Horticultural perlite is used both by home gardeners as well as commercial growers. Green roofing, where perlite is used as the sole growing medium for plants on roofs, has become a popular trend, and offers a unique sustainable way to insulate a roof while adding foliage to the surface. In greenhouse plantations, landscaping and for in-house plants, use of perlite has shown encouraging results with clean & safe handling. Approximately 10% of annual perlite consumption all over the world is reported under horticultural applications. Perlite can be used by mixing with sand in about 1:1 ratio for better results.

Industrial Applications

Industrial applications of perlite are the most diverse, ranging from high performance fillers for plastics to cements, for petroleum, water and geothermal wells. Other applications include its use as a filter media for pharmaceuticals, food products, chemicals and water for municipal systems and swimming pools.

Perlite finds application additionally as an abrasive in soaps, cleaners and polishes. Its high resistance to heat is taken advantage in manufacturing refractory bricks, high temperature insulation, molten metal topping, light weight fillers, mortars and pipe insulation. Crude perlite is used in retention of heat in Foundry and Ferroalloys Industry. Small quantities of perlite are also used in cryogenic insulation and in ceramics as clay.

SUBSTITUTES

There are a number of materials for construction applications, such as, diatomite, expanded clay, shale, pumice & slag and for horticultural use, vermiculite, coco coir, wood pulp & pumice are alternative soil additives and are sometimes used in conjunction with perlite. These materials can be used in place of perlite without losing any of the benefit that perlite provides. Bentonite and Zeolite are the alternatives in animal feed suppliment.

WORLD REVIEW

Insufficient information is available to make reliable estimates of resources in perlite-producing countries. However, the perlite resources in Greece are 120 million tonnes, Iran 73 million tonnes, Turkey 57 million tonnes, USA contributed 50 million tonnes and Hungary 49 million tonnes (Table-2). Asia Pacific is expected to be the fastest growing market for expanded perlite in the next few years. The major reason for this is the growing demand for expanded perlite in developing Asian countries, such as, India, China, Malaysia, Indonesia and Thailand. The major perlite producing countries in the World during 2020 are China 1,300 thousand tonnes, Turkey 1,200 thousand tonnes and Greece 718 thousand tonnes, (Table-3). Although China was the leading producer, most of its perlite production was thought to be consumed internally. Greece and Turkey remained the leading exporters of perlite. As per the Ministry of Commerce under the HS Code: 25301020, the total imports of Perlite during 2018-19, 2019-20 and 2020-21 was 48.25, 45.72 and 35.47 thousand tonnes, respectively. However, small quantity of export of perlite was also reported during the same period.

Table-2: World Reserves of Perlite
(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total	NA
Greece	1,20,000
Iran	73,000
Turkey	57,000
USA	50,000
Hungary	49,000
Other countries	NA

Source: USGS Mineral Commodity Summaries, 2022.

Note: Sufficient information is not available to make reliable estimates of resources in perlite-producing countries.

Resources of Iran were revised based on industry information.

Table-3: World Production of Perlite
(By Principal Countries)

(In '000 tonnes)

Country	2018	2019	2020
China	1300(e)	1300(e)	1300(e)
Greece	790	719	718
Hungary	80	77	70(e)
Iran(a)	194	727	700(e)
Italy(e)	60(e)	60(e)	60(e)
Slovakia	36	32	37
Russia(e)	45(e)	45(e)	45(e)
Argentina	19	19	19(e)
Turkey	1089	1174	1200(e)
USA	510	526	520(e)
Mexico	26	24	20(e)
Ukraine	17(e)	17(e)	17(e)
Other Countries	51	55	55

Source: BGS World Mineral Production, 2016-2020.

(a) Year ended 20 March following that stated.

FUTURE OUTLOOK

Perlite is an amorphous volcanic glass. Due to its low bulk density, high heat resistance, low sound transmission, high surface area, low thermal conductivity, chemical inertness and light weight make it more acceptable in industrial applications. Expansion properties from 2 to 20 times of its initial volume in high temperatures, set perlite as a sought after raw material in construction products.

Rising construction activities all across the globe and growing application of expanded perlite in various industries including oil & gas are key factors which are anticipated to spur the growth of global market during the near future. The government has planned about 100 smart cities which will invite investment of more than 2 trillion in the coming years which will help attain significant gains to crude perlite market size. Asia Pacific is likely to be the fastest growing market of expanded perlite during the near future owing to high industrialisation and construction activities due to rapid urbanisation in emerging Asian economies growing demand for expanded perlite for gardening purposes in this region.

22. Petroleum and Natural Gas

30.494
(million tonnes) Production of Crude Oil and Condensate were reported in the country in 2020-21

17,992
(tonnes) of natural gas were exported in 2020-21

188.182
(million tonnes) of crude petroleum were imported in 2020-21

The domestic production of crude oil and Condenstate which stood at 30.49 million tonnes in 2020-21 decreased by 5.2% as compared to that of the output of the corresponding previous year. The production of natural gas (utilised) also decreased to 28,673 million cu. m (MMSCM) in 2020-21 which is about 8.1% less as against the production in 2019-20. Indian Refinery Industry has done well in establishing itself as a major player globally and has emerged as a refinery hub. India is the second largest refiner in Asia after China and is the fourth largest in the world. The country's refining capacity has touched 249.20 MMTPA as on 01.04.2021. With increase in the domestic refining capacity, which has overtaken domestic consumption, country became a net exporter of petroleum products.

Energy is a key driver of economic growth of any country. Efficient, reliable and affordable energy is essential for sustainable development and inclusive growth of the overall economy of India. India is the third largest energy consumer in the world after China and USA.

India's energy requirement is fulfilled primarily by Coal, Crude Oil, Natural Gas and Renewable Energy. Oil & Gas sector within the energy mix play a predominant role as over one-third of the energy required is met by hydrocarbons. Growing economy and population growth are the main drivers for oil & gas demand, increasing every year. Thus, Oil & Gas will continue to remain important elements for India's energy security and its share in global energy demand is set to almost double to 11% by 2040.

India is set to emerge as one of the primary drivers of growth in oil and gas demand in Asia, despite the pressing Covid-19 challenges. Current hydrocarbon demand is much more than the domestic crude oil and natural gas production. The energy needs of the country are increasing continuously, while the indigenously available energy resources are limited and may not be sufficient in the long run. With the growing energy demands, reliance on imports and limited domestic fossil fuel resources, India needs to plan to either limit its consumption or try to augment production. The country has ambitious plans to increase domestic oil & gas production and exploit all possible forms of energy to the fullest.

India's energy security is primarily about ensuring continuous availability of commercial energy at competitive prices to support its economic growth and meet the lifeline energy needs of households with safe, clean and affordable forms of energy. Oil & gas sector is pivotal in meeting the energy needs of the nation. To provide renewed impetus to India's upstream Hydrocarbon Sector and usher in favourable policies aligned with the challenging domestic and global energy landscape, Government of India has introduced systemic reforms in the Hydrocarbon Sector, that have ushered consistency, certainty and transparency in the E&P ecosystem.

In the E&P sector, Government's attention has shifted to production enhancement as compared to revenue maximisation, harnessing technological innovation, fostering collaboration and providing a stable and simplified policy and fiscal regime. The path breaking system in the Indian E&P sector clubbed with single window clearance system, strong institutional frameworks, attractive corporate taxes and revitalised regulatory regimes has generated phenomenal investment opportunities in India across the entire value chain of E&P, right from greenfield to brownfield.

To meet India's energy security and to reduce the rising import dependence, landmark policy reforms were ushered by the Government in the last 5 years that have elicited universal acclaim and fostered a conducive investment ecosystem in the Oil & Gas Sector. Time is now ripe to stead fastly build upon the policy reforms and work in tandem with the Industry needs.

RESERVES/RESOURCE

As on 1.4.2021, balance recoverable reserves of crude oil were estimated at 587.33 MMT (Million Metric Tonnes), out of which 325.73 MMT (55%) are in onshore and 261.61 million tonnes (45%) in offshore areas. ONGC (nomination) has the largest share of 71% in reserves of crude oil with OIL (nomination) and PSC regime contributing 13% and 16%, respectively.

The balance recoverable reserves of natural gas as on 01.04.2021 were placed at 1,372.64 billion cu. m, out of which 882.72 billion cu. m (64%) are in offshore and 492.91 billion cu m (36%) in onshore areas. PSC regime has the largest share of 50% in natural gas reserves followed by ONGC (nomination) and OIL (nomination) at 40% and 10%, respectively (Table-1).

Table-1: Proved and Indicated Balance Recoverable Reserves of Crude Oil and Natural Gas in India as on 1.4.2021(P)

(Crude oil in million tonnes;Natural gas in billion cu.m)

Area	Crude oil	Natural gas
India	587.33	1372.64
Onshore	325.73	492.91
Andhra Pradesh	7.33	65.5
Arunachal Pradesh	3.64	3.14
Assam	153.05	166.63
Gujarat	115.41	59.79
Jharkhand	-	8.56*
Madhya Pradesh	-	30.88*
Nagaland	2.38	0.09
Rajasthan	34.77	59.06
Tamil Nadu	9.08	37.89
Tripura	0.07	29.18
West Bengal	-	32.19*
Offshore	261.61	882.72
Western offshore	219.27	325.65
Eastern offshore	42.34	557.07

Source: Indian Petroleum and Natural Gas Statistics, 2020-21, Ministry of Petroleum and Natural Gas, Govt. of India.

Note:
(i) Proved and Indicated Balance Recoverable Reserves ONGCS contingent Resources (2C) Since 2019.
(ii) Total may not tally due to rounding off.
(iii) Western offshore includes Gujarat offshore.
* Total gas reserves includes CBM reserves CBM Related to Coal bed Methane

EXPLORATION & DEVELOPMENT

The Oil & Natural Gas Corporation (ONGC) and Oil India Limited (OIL), the two National Oil Companies (NOC) and a few Private and Joint Venture companies were engaged in exploration and production activities of oil and natural gas, including coal-bed methane, shale gas/oil, etc. in the country. As on 31.3.2021, there were in all 316 oil/gas fields including offshore areas under these companies in the country.

Under nomination regime, ONGC's jurisdiction extended to 189 onshore oil/gas fields and 31 offshore oil/gas fields. Out of the total onshore fields, 77 fields are in Cambay basin (Gujarat); 26 fields in Upper Assam (Assam); 4 fields in Assam & Assam–Arakan (Assam); 4 fields in Jodhpur (Rajasthan); 44 fields in Krishna–Godavari basin (Andhra Pradesh); 25 fields in Cauvery basin (Tamil Nadu); and 9 fields in Assam–Arakan Fold Belt (Tripura). Out of 31 offshore fields, 24 fields in Mumbai, 1 field in Kachchh in the West Coast and 16 offshore fields in Krishna-Godavari (deep) are in East Coast. Besides, OIL was engaged in 19 fields, viz., Upper Assam basin in Assam (14 fields) & Arunachal Pradesh (1 field); Jaisalmer basin (3 fields) & Bikaner–Nagaur basin (1 field) in Rajasthan.

Under PSC and RSC/CBM regime, companies were engaged in 65 onshore oil/gas fields – Cambay basin in Gujarat (38 fields); Assam–Arakan in Arunachal Pradesh (1 field), Assam (2 fields) & Tripura (2 fields); Krishna–Godavari in Andhra Pradesh (1 field); Jharia & Bokaro in Jharkhand (1 field each) (CBM); Sohagpur in Madhya Pradesh (2 fields) (CBM); Rajasthan (14 fields); Cauvery in Tamil Nadu (2 fields), Raniganj in West Bengal (2 fields) and Bengal in West Bengal (1 field) in onshore areas. In offshore areas, the companies covered 2 fields in Cauvery basin and 7 fields in Krishna–Godavari basin on the East Coast and 3 fields in Cambay basin on the West Coast.

During 2020-21, cumulative 17,051.24 LKM 2D and 1,47,107 SKM 3D seismic data was acquired. Out of which approximately 16,806.42 LKM 2D and 7,281.69 SKM 3D data were acquired. This year 55% of 2D seismic and 68% of 3D seismic data acquisition have been carried out in the offshore basins. A total of 115 exploratory wells (including inland and offshore) amounting to a drilling meterage of 3,44,175 m were drilled. Details of exploratory activities in Nomination, PSC regime & RSC regime in the year 2020-21 are furnished in (Table-2).

During 2020-21, DGH received a total of 13 discovery notifications of oil and gas from NOC/PSC/RSC operators, out of these notified discoveries, 3 discoveries were technically accepted. Directorate General of Hydrocarbons (DGH) identified the need of about 48,243 Line kilometer (LKM) 2D seismic data for appraisal for these areas. The project was introduced under broad policy framework of Geo-Scientific Data generation for Hydrocarbons in Indian Sedimentary Basins to appraise the un-appraised onland areas in 26 sedimentary basins and was notified on 20th May 2014. The project is being implemented by National Oil Companies, OIL and ONGC through service providers in North-Eastern states and rest of India respectively. OIL is undertaking seismic data API in Assam shelf & Arakan Basin whereas ONGC carrried out survey work in other basins. As on 31st March 2021, approx. 46,004 LKM of data has been acquired which is about 95% of the total target of 48,243 LKM under NSP campaign.

In-Place hydrocarbon volume of 1,159.33 MMT of Oil and Oil Equivalent Gas (O+OEG) have been established by ONGC, OIL and Pvt/JVs under Nomination, PSC and CBM regime. Ultimate reserves established were 4,374.70 MM T O+OEG and accretion in ultimate resrves in the year 2020-21 was 41.61 MMT O+OEG. Balance recoverable reserves were 1,599.69 MMT O+OEG.

During 2020-21, over 4.91 lakh geological surveys have been conducted in India to explore Oil and gas. About 562 wells (of which 79.2% were development wells and 20.8% exploratory wells) with 12.03 lakh metreage were drilled by Oil and Gas companies during 2020-21.

The details of exploration carried out and discoveries found during the year 2020-21 are covered in General Review on "Exploration & Development".

Table-2: Exploratory Efforts in Nomination, PSC and RSC Regime during 2020-21

Subject	Parameter	ONGC	OIL	PSC	RSC	Total
		(Nomination)	(Nomination)	(Pre-NELP& NELP)		
2D Seismic Data acquired	Onland (GLKM)	244.82	-	-	7502.89	7747.71
	Offshore (GLKM)		-	-	9303.53	9303.53
	Total	244.82	-	-	16806.415	17051.24
3D Seismic Data acquired	Onland (SKM)	433.05	124.61	250.05	2321.99	3129.71
	Offshore (SKM)	1,272.26			4959.69	6231.95
	Total	1,705.31	124.61	250.05	7281.69	9361.66
Exploratory well drilled	Onland	61	10	4	1	76
	Offshore	31		8		39
	Total	92	10	12	1	115
Exploratory Meterage drilled	Onland (1000 m)	176.266	42.811	13.25	1.4	233.744
	Offshore (1000 m)	83.177		27.25		110.31
	Total (1000 m)	259.443	42.811	40.5	1.4	344.175

Source: India's Hydrocarbon Outlook, 2020-21, Directorate General of Hydrocarbons.

PRODUCTION

Crude Oil and Condensate

Production of Crude Oil and Condensate in the country was 30.494 million tonnes in 2020-21. It has registered a decrease of 5.20% as compared to that in the previous year. Bulk of the total production, i.e., 76% was shared by the Public Sector companies. Private Sector companies accounted for the remaining 24 per cent (Table-3) (Fig-1).

Offshore areas continued to be the largest producer of Crude Oil and Condensate in 2020-21 and had a share of 50.47% in the country's output. Next in order were Rajasthan with a contribution of 19.3%, Gujarat with 15.2% and Assam with 12.7 per cent. The remaining 2.33% of the production was reported by Andhra Pradesh, Tamil Nadu and Arunachal Pradesh.

During 2020-21, the production of Crude Oil and Condensate decreased in Arunachal Pradesh by 3.5%, Tamil Nadu by 1.2% and Gujarat by 1.1% as compared to the previous year. Whereas, there was a decline in production in Andhra Pradesh by 20%, Rajasthan by 11% and Assam by 5% & offshore areas by 4%.

Natural Gas (Utilised)

The production of natural gas (utilised) was 28,673 MMSCM. It decreased by 8.00% in 2020-21 as compared to 31,184 MMSCM in the previous year. Offshore areas continued to be the largest producer of natural gas (utilised) with a share of 64%, followed by Assam (10%), Rajasthan (7%), Tripura (6%), Gujarat (4%), Tamil Nadu (3%) and the remaining 5% of the total production was together contributed by Andhra Pradesh, Arunachal Pradesh, Jharkhand (CBM), Madhya Pradesh (CBM) and West Bengal (CBM). As much as 85% of the total production came from the Public Sector companies whereas the remaining 15% was that of the Private Sector companies during the year 2020-21 (Table-4) (Fig-2).

During 2020-21, Statewise analysis revealed that the production of natural gas (utilised) increased in Arunachal Pradesh (24%), Tripura (11%) and Rajasthan (8%) as compared to the previous year. While decline in production was recorded in Jharkhand (CBM) (60%), Tamil Nadu (17%), Gujarat (15%), offshore area (11%), Assam (5%) and Madhya Pradesh (0.3%) as compared to the previous year.

Table-3: Production of Crude Oil and Condensate, 2018-19 to 2020-21 (P)

(By States)

(Quantity in '000 tonnes)

State	2018-19	2019-20 (R)	2020-21 (P)
India	**34203**	**32170**	**30494**
Public Sector	**24335**	**23734**	**23120**
Private Sector	**9868**	**8436**	**7374**
Andhra Pradesh	296	243	195
Arunachal Pradesh	43	56	54
Assam	4309	4093	3902
Gujarat	4626	4707	4651
Rajasthan	7667	6653	5891
Tamil Nadu	395	415	410
West Bengal	-	-	-
Offshore	16867	16003	15391

Source: Indian Petroleum and Natural Gas Statistics, 2019-20 & 2020-21, Ministry of Petroleum and Natural Gas, Govt. of India.

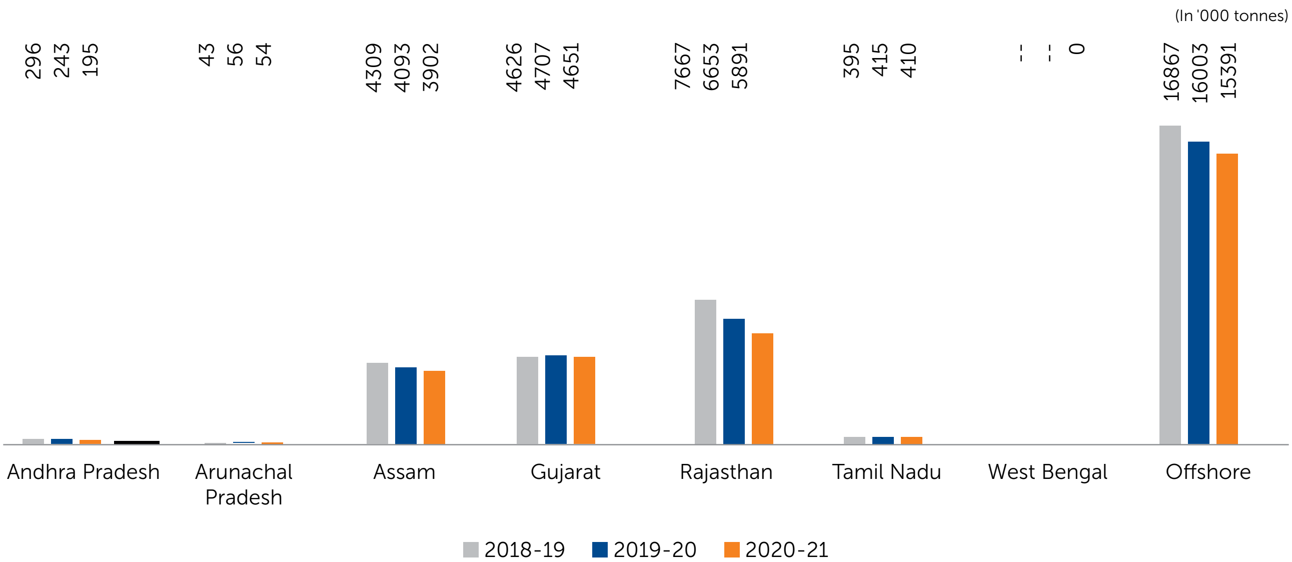


Fig 1: Statewise production of Natural Gas

Table-4: Production of Natural Gas (Utilised), 2018-19 to 2020-21 (P)

(By States)

(Qty in MMSCM)

State	2018-19	2019-20 (R)	2020-21 (P)
India	**32873**	**31184**	**28673**
Public Sector	**27396**	**26414**	**24352**
Private Sector	**5477**	**4770**	**4321**
Andhra Pradesh	1081	912	827
Arunachal Pradesh	28	45	56
Assam	3289	3141	2995
Gujarat	1402	1342	1138
Jharkhand (CBM)**	4	5	2
Madhya Pradesh (CBM)**	357	345	334
Rajasthan	1483	1883	2040
Tamil Nadu	1208	1097	911
Tripura	1554	1473	1634
West Bengal (CBM)**	350	306	307
Offshore	22117	20635	18429

Source: Indian Petroleum and Natural Gas Statistics, 2019-20 & 2020-21, Ministry of Petroleum and Natural Gas, Govt. of India.

(CBM)**: Coal-bed Methane production

Note: Total may not tally due to rounding off

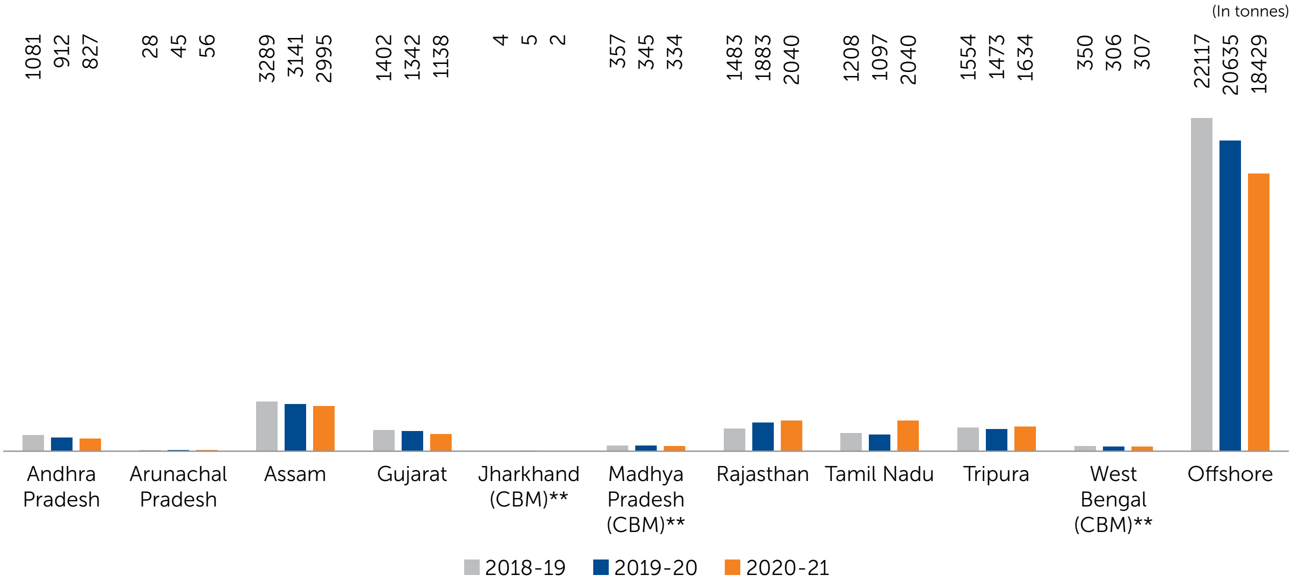


Fig 2: Statewise production of Natural Gas

INDUSTRY

Indian Refinery Industry has done well in establishing itself as a major player globally. India, is the fourth largest refiner in world and second largest refiner in Asia after China. The operational refining capacity of 23 units in the country which put together touched 249.22 MMTPA in 2020-21. Out of these 23 refineries, 18 are in Public Sector, 3 are in Private Sector and two are Joint Venture. Out of the total refining capacity of 249.22 MMT, 141.92 MMT have been accounted for by the Public Sector, 19.1 MMT by Joint Venture and the balance 88.2 MMT have been reported by the Private Sector. During 2020-21, refinery crude throughput in terms of crude oil processed decreased to 221.77 million tonnes from 254.39 million tonnes in 2019-20 (Table-5). This decrease is attributable to reached demand caused by the pandemic and lockdown that ensved in the country for several months.

As per annual report of MoPNG for 2020-21, the refining capacity augmentation to the tune of 25.75 million tonnes has been planned by 2022-23 at brownfield refineries that are IOCL, Barauni (3 MMTPA); IOCL, Guwahati (0.2 MMTPA); IOCL, Bongaigaon (0.35 MMTPA); IOCL, Mathura (1.2 MMTPA); IOCL, Haldia (0.5 MMTPA); IOCL, Koyali (4.3 MMTPA); HPCL Visakhapatnam (6.7 MMTPA); HPCL, Mumbai (2 MMTPA); and RIL, DTA, Jamanagar (7.5 MMTPA).

Besides, the Greenfield refinery that is coming up in the near future include HPCL Rajasthan Refinery Limited (HRRL), Barmer, Rajasthan (9 MMTPA) and Ratnagiri Refinery & Petrochemicals Ltd, Ratnagiri, Maharashtra (60 MMTPA).

The production of petroleum products during 2020-21 at 233.57 million tonnes decreased by 11.2% from 262.94 million tonnes in the year 2019-20. Production of various petroleum products from refineries and fractionators during 2019-20 to 2020-21 are provided in (Table-6).

Table-5: Installed Capacity and Refinery-wise Crude Oil Processed

(In '000 tonnes)

Refinery	Annual installed capacity (as on 1.4.2021)	Refinery Crude throughput		
		2018-19	2019-20	2020-21
Total	249200	257205	254386	221773
Public/Private Sector & Subsidiaries	141920	150976	144715	127504
IOCL, Digboi, Assam	650	676	664	605
IOCL, Guwahati, Assam	1000	863	892	849
IOCL, Barauni, Bihar	6000	6661	6516	5469
IOCL, Koyali, Gujarat	13700	13505	13075	11603
IOCL, Haldia, West Bengal	8000	7965	6463	6759
IOCL, Mathura, Uttar Pradesh	8000	9737	8948	8926
IOCL, Bongaigaon, Assam	2350	2513	2045	2450
IOCL, Panipat, Haryana	15000	15281	15038	13181
IOCL, Paradeep, Odisha	15000	14616	15778	12508
BPCL, Mumbai, Maharashtra	12000	14773	15017	12941
BPCL (formerly KRL), Kochi, Kerala	15500	16051	16515	13282
HPCL, Mumbai, Maharashtra	7500	8671	8065	7374
HPCL, Visakhapatnam, Andhra Pradesh	8300	9773	9115	9050
CPCL, Manali, Tamil Nadu	10500	10271	10161	8243
CPCL, Narimanam, Tamil Nadu	1000	423	-	-
Numaligarh Refinery Ltd, Numaligarh, Assam	3000	2900	2383	2707
MRPL, Mangaluru, Karnataka	15000	16231	13953	11475
ONGC, Tatipaka, Andhra Pradesh	70	66	87	81
Joint Venture	19100	18189	20155	16262
Bharat Oman Refineries Ltd, Bina@	7800	5716	7913	6190
HPCL Mittal energy Ltd (HMEL), Bathinda#	11300	12473	12242	10072
Private Sector	88200	88041	89515	78008
RIL, Jamnagar, Gujarat	33000	31752	33019	34100
RIL, Jamnagar (SEZ), Gujarat	35200	37393	35876	26841
Nyara Energy Ltd (NEL),Vadinar, Gujarat	20000	18896	20620	17067

Source: Indian Petroleum and Natural Gas Statistics, 2020-21, Ministry of Petroleum & Natural Gas, Government of India.

@: Bharat Oman Refineries Ltd (BORL) is a Joint Venture Company promoted by BPCL and Oman Oil Company Ltd (OOCL).

#: HPCL Mittal Energy Ltd is a Joint Venture Company promoted by HPCL and Mittal Energy Investment Pvt. Ltd.

Note:
(i) CPCL and BRPL are subsidiaries of IOCL; NRL of BPCL; and MRPL of ONGC.
(ii) Crude throughput in terms of crude oil processed.
(iii) Total may not tally due to rounding off.
(iv) CPCL refinery is under shutdown due to limitation in meeting required product specification.

Table-6: Production of Petroleum Products from Refineries and Fractionators, 2018-19 to 2020-21 (P)

(In '000 tonnes)

Petroleum Product	2018-19	2019-20	2020-21(P)
Total Products	262361	262944	233513
LPG	12786	12823	12072
Motor spirit	38039	38616	35779
Naphtha	19786	20679	19403
ATF	15479	15238	7092
Kerosene	4072	3141	2393
HSD	110535	111198	100441
LDO	702	643	729
Furnace oil	9598	8173	6882
LSHS/HHS/RFO	434	437	360

Contd...

Table-6 *(Concld)*

Petroleum Product	2018-19	2019-20	2020-21(P)
Lube oils	949	932	1069
Bitumen	5803	5244	5245
Petroleum coke	14676	15528	12655
Paraffin wax	90	96	97
Others	29413	30195	29296

Source: Indian Petroleum & Natural Gas Statistics, 2020-21, Ministry of Petroleum & Natural Gas, Government of India.

Note:
(i) Total may not tally due to rounding off.
(ii) Others include Propylene, Solvents, Reformate, MTO, Black Carbon Feed Stock, Sulphur, etc.

CONSUMPTION

The total consumption of petroleum products decreased by 9.26% to 194.295 million tonnes in 2020-21 from 214.127 million tonnes in 2019-20. Increase in consumption was reported in the case of LPG (4.6%), LDO (36%), Lubes/ Greases (6.8%), and Bitumen (11.96%) during 2020-21 as compared to that of the year 2019-20, whereas, the consumption showed a decline in Fuel Oil (11.36%), Naphtha (1.18%), Furnace Oil (11.9%), ATF (54%), Waxes (20.14%), Petroleum coke (28%), SKO (25%), LSHS (3%) and HSDO (12%) during the same period.

The consumption of various petroleum products from 2018-19 to 2020-21 is furnished in (Table-7).

ALTERNATIVE SOURCES

Conventional or fossil fuels, though being limited, non-renewable and polluting, will continue to play a dominant role in the energy scenario in our country in the next few decades. With the ever-increasing dependence on petroleum imports due to stagnant domestic production and spiralling growth in demand, the Government is encouraging the development of alternative sources of hydrocarbons. The Government has vigorously initiated exploration & development for tapping alternate sources, viz. coal-bed methane, gas hydrates, oil shales, underground coal gasification, etc. in the country.

Table-7: Consumption of Petroleum Products, 2017-18 to 2019-20 (P)

(In '000 tonnes)

Product	2018-19	2019-20	2020-21 (P)
Total	**213216**	**214127**	**194295**
LPG	24907	26330	27558
Motor Spirit	28284	29975	27969
Naphtha	14131	14268	14100
SKO	3459	2397	1798
ATF	8300	7999	3698
HSDO	83528	82602	72713
LDO	598	628	855
Furnace oil (FO)	6195	5912	5208
LSHS	369	390	378
Fuel Oil (FO+LSHS)	6564	6302	5586
Lubes/Greases	3668	3833	4097
Bitumen	6708	6720	7524
Petroleum coke	21346	21708	15605
Waxes	286	278	222
Others	11437	11087	12569

Source: Indian Petroleum & Natural Gas Statistics, 2020-21, Ministry of Petroleum & Natural Gas, Government of India.

Note:
(i) Consumption includes sales by oil companies, own consumption & direct private imports.
(ii) Total may not tally due to rounding off.

Coal-bed Methane

Coal-bed Methane (CBM), an eco-friendly natural gas stored in coal seams, is generated during the process of coalification and absorbed into solid matrix of the coal. It is classified as unconventional source of natural gas owing to its nature of occurrence. India, having the fifth largest proven coal reserve in the world, presents a significant opportunity for considering CBM as an alternative source for augmenting India's energy resource, keeping in line with the vision of reducing hydrocarbon import and making India gas-based economy.

The coal and lignite seam contains varying amounts of methane depending on the rank of the carbonaceous matter, the depth of burial and the geotectonic setting of basins. CBM exploration and exploitation has an important bearing on reducing the greenhouse effect. The extraction of CBM, through degassing of the coal seams prior to mining of coal, is a cost-effective means of boosting coal production and maintaining safe methane level in working mines.

In order to harness CBM potential in the country, the Government of India formulated CBM Policy in 1997, wherein CBM being Natural Gas is explored and exploited under the provisions of Oil Fields (Regulation and Development) Act, 1948 (ORD Act, 1948) and Petroleum & Natural Gas Rules, 1959 (P&NG Rules, 1959) administered by Ministry of Petroleum & Natural Gas (MoPNG). Various Policy reforms for CBM are discussed in the Chapter ''Policy and Contracts". As per annual report of Ministry of Petroleum & Natural Gas for 2020-21, the estimated resources of CBM are of the order of 2,600 billion cu. m (91.8 trillion cubic feet) spread over in 11 States in the country.

CBM blocks were offered through international competitive bidding for exploration and production of CBM in the country for the first time in May 2001. Subsequently, there were 3 other bidding rounds in the years 2003, 2005 and 2008, respectively. So far, under the CBM policy, the Government has awarded 33 CBM blocks [including 2 CBM blocks on Nomination basis and 1 block through Foreign Investment Promotion Board (FIPB) route] in four rounds of bidding to National, Private & Joint Venture Companies. These CBM blocks are in the States of Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu and West Bengal. The total prognosticated CBM resource for the awarded 33 CBM blocks, is about 62.4 TCF (1,767 BCM), of which, 10.48 TCF (296.9 BCM) has been established as Gas-Inplace (GIP). At present, out of the 33 CBM blocks, 10 are active, 4 of which are in production phase, 4 in development phase and 2 in exploration phase.

Within the next few years, CBM is expected to emerge as a new source of natural gas production in the country. The first commercial production from the CBM blocks commenced in the year 2007 from Raniganj (South) block operated by M/s Great Eastern Energy Corp. Ltd (GEECL). Raniganj (East) Block operated by M/s Essar Oil & Gas Exploration & Production Ltd (EOGEPL) started its commercial production from July 2016. Similarily, Sohagpur (West) operated by M/s Reliance Industries Ltd (RIL) started producing from March 2017 and Bokaro operated by M/s Oil and Natural Gas Ltd (ONGC) from August 2019. In addition to this incidental CBM gas is being produced during testing of CBM wells in Jharia block operated by ONGC and Sohagpur (East), operated by RIL. The cumulative CBM production from these blocks as of FY 2019-20 is 3.7 BCM. The average gas production rate during FY 2019-20 was 1.79 MMSCMD. To date, most of the CBM exploration and production activities in India are pursued by domestic Indian companies.

Gas Hydrates

Gas hydrates are formed when gas and water mixtures are subjected to high pressure and low temperature conditions in the sea, usually in water depths of more than 800 m, within sediments just below the sea bottom. They are also formed in some permafrost region of the world. The gas hydrates also act as a cap under which natural gas can get accumulated. Gas hydrates can be an unconventional energy source of the future.

In India, research and exploratory activities for Gas Hydrate are being steered under National Gas Hydrate Programme (NGHP), technically coordinated by Directorate General of Hydrocarbons (DGH). Under NGHP, various R&D studies are in progress to develop vast resources of gas hydrates in western and eastern offshore and Andaman offshore areas. Two expeditions 01 & 02 have been completed under NGHP.

NGHP Expedition-01 exploration programme was carried out in 2006 for mapping gas hydrate zones in Krishna–Godavari, Kerala, Konkan, Mahanadi and Andaman offshore areas. A total of 39 holes drilled at 21 sites and the physical presence of gas hydrate was established predominantly in Krishna–Godavari, Mahanadi and Andaman Basin, but, were non-exploitable with available technologies.

NGHP-02 was conducted successfully in Eastern offshore from 09.03.2015 to 31.07.2015. A total of 42 wells were drilled at 25 sites in Krishna–Godavari and Mahanadi areas in sand reservoirs for Gas Hydrates. NGHP-02 discovered two distinct Gas hydrate-bearing sand reservoir areas B & C in KG basin, while Area A sand-rich reservoir systems was observed to have limited formation of concentrated gas hydrate accumulations whereas in Area-E, the drilled wells indicated the presence of gas hydrate with a combination of fracture/displacement and pore-filling type gas hydrate. The results of this expedition were found to be encouraging and further extensive studies are being carried out to assess the gas hydrate resource potential, reservoir characterisation, reservoir delineation & geomechanical modelling for seafloor and wellbore stability & identification of sites for pilot production for testing. KG deep offshore Area B & C were observed to contain gas hydrate accumulations and may be suitable for gas hydrate production. Testing under NGHP Expedition-03 have to be designated.

The challenges faced for commercial exploitation or production of gas from Gas Hydrates are more or less similar all over the world. The planning and execution of NGHP Expedition-03 were to test the technology and assess the commerciality of Gas Hydrates exploitation in Indian offshore. At present, collation and interpretation of all data is being done to identify sites for pilot production testing. The objective of NGHP Expedition-03 was to carry out pilot production testing at a suitable site identified during the NGHP Expedition-02.

Extracting methane from gas hydrate in marine environments is relatively a new path. Japan has taken a lead in this direction. From the progress being made by the Indian NGHP, steps are underway to mitigate anticipated challenges in the Indian context. The NGHP expeditions are an appropriate line of research investigation which could help the country move forward by harnessing this yet elusive resource.

Shale Oil/Shale Gas

Oil Shales are usually fine-grained sedimentary rocks containing relatively large amounts of organic matter from which significant quantities of shale oil and combustible gas can be extracted by destructive distillation. An oil shale, which has a very high proportion of organic matter in relation to mineral matter, is categorised as coal. Oil shales occur in many parts of the world ranging from small occurrences of little or no economic value to those of enormous size that occupy thousands of square miles and contain many billion barrels of potentially extractable shale oil. Shale Gas/Oil is a form of Natural Gas/Oil that remain unexpelled, unmigrated and entrapped within the pore space and fractures of a source rock (commonly, shale). They are categorised as unconventional resource due to their nature of occurrence and method of extraction. In general, shales have insufficient permeability for fluid flow to a well bore. The shale gas/oil is produced commercially when sufficient fracture conductivity is induced by hydraulic fracturing.

With the continuing decline of petroleum supplies accompanied by increasing costs of petroleum, oil shale presents opportunities for supplying some of the fossil energy needs of the world in the years ahead. Thus, Shale gas can emerge as an important new source of energy in the country. India has several Shale Formations which seem to hold shale gas. The Shale Gas Formations are spread over several sedimentary basins, such as, Gangetic plain, Gujarat, Rajasthan, Andhra Pradesh and other coastal areas in the country including hydrocarbon-bearing ones - Cambay, Assam–Arkan & Damodar Basins which have large shale gas deposits.

In India, a preliminary resource assessment of Shale Gas/Oil was carried out by three different organisations.

(i) ONGC in August, 2013 has estimated Shale Gas resources of 187.5 TCF from 5 sedimentary basins, namely, Cambay, Krishna–Godavari, Cauvery, Ganga and Assam.

(ii) Central Mine Planning and Design Institute (CMPDI) in July, 2013 has estimated Shale Gas resources of 45.8 TCF in Gondwana basin.

(iii) United States Geological Survey (USGS) in January, 2011 estimated Technical Recoverable Shale Gas of 6.1 TCF in three basins, namely, Cambay, Krishna–Godavari (KG) and Cauvery. Again in 2014, it estimated a technical recoverable volume of 62 million barrels of shale oil in Cambay Basin alone.

In order to understand the prospectivity and untap the Shale Gas and Oil resource potential in India, GoI announced a Shale Gas and Oil Exploration Policy on 14th October, 2013 for the National Oil Companies (NOCs), ONGC and OIL. The companies were required to carry out exploration in their PML and ML areas in three phases.

Under the Shale Gas Policy - 2013, 50 blocks in 4 basins (Assam, Krishna Godavari, Cauvery & Cambay) were identified by ONGC and 6 blocks in 2 basins (Jaisalmer and Assam) were identified by OIL in the Phase-I of exploration which ended in April-2017. Till 2019-20, ONGC had drilled a total of 29 wells in 4 basins and OIL has drilled 4 shale wells in 2 basins.

During 2019-20, ONGC drilled two exclusive shale wells (NJSGA in Cambay Basin and MDSGA in KG Basin) and one dual objective well PGAE. At present, a dual objective well, LKEAA in KG Basin is under drilling. Out of the 29 wells completed so far, across four basins viz. Cambay, KG, Cauvery and A&AA Basins, 10 are exclusive wells and 19 are dual objective wells. Indications of presence of shale oil have been recorded in some wells, namely, JMSGA, NSGB and NJSGA in Cambay Basin and WGSGA in KG Basin during activation after hydro-fracturing. In the shale well, NGSGA (Cambay Basin), a zone encountered within the Nawagam Middle Pay (Tight Reservoir) was hydro-fractured and on activation, produced oil. The shale well WGSGA in KG Basin requires further activation whereas another well GNSGC in Cambay Basin is awaiting hydro-fracturing.

During 2019-20, OIL has completed conventional core analysis of 5 wells, namely, Dandewala-26, Sologuri-2, Matimekhena-5 and South Tinali-5. Final evaluation reports of Jaisalmer PML in Rajasthan and Dibrugarh Extn. PML, Chabua PML, Dumduma PML in Assam incorporating the above conventional core results have been submitted to DGH. Around 17 m of conventional core from well Balimara-6 of Dumduma PML was acquired for prospectivity evaluation of Barail shales. Detail laboratory analysis is currently in progress at M/s Weatherford Laboratories. Two locations have been identified in Jairampur Extn. PEL and Deomali PEL for acquiring conventional core against the target shale of Upper Tikak Parbat and Disang shales for evaluation. Environmental Clearance (EC) is awaited.

Underground Coal Gasification

Underground Coal Gasification (UCG) is a method of converting unworked coal, still in the ground, into a combustible gas which can be used for industrial heating, power generation or the manufacture of hydrogen, synthetic natural gas or diesel fuel. UCG is a new well-proven technology of coal extraction that is being investigated and implemented around the world and that avoids most of the challenges of coal mining. With a vast proven reserve of coal, India has the potential to use UCG technology to effectively utilise coal. Development of UCG is envisaged to provide for energy security.

The Government has approved a policy framework on 16.12.2015 for development of Underground Coal Gasification in coal/lignite-bearing areas in the country. A policy, broadly similar to the existing policy for Coal-bed Methane (CBM) development on revenue sharing basis, will be adopted for offering the blocks through competitive bidding. An Inter-Ministerial Committee (IMC) under the Ministry of Coal with members from concerned Ministries will be responsible for identification of the areas, deciding about blocks to be put to bidding or awarding them to PSUs on nomination basis.

ONGC has taken up Vastan Mine block site belonging to Gujarat Industries Power Company Limited (GIPCL) in Naninaroli, Surat district, Gujarat as an R&D Pilot Project to establish UCG technology in collaboration with M/s National Mining Research Center–Skochinsky Institute of Mining (NMRC–SIM), Russia. The Agreement of Collaboration (AoC) between ONGC and National Mining Research Center–Skochinsky Institute of Mining (NMRC–SIM), Russia, to co-operate in the Services, Operations, Development and Research related to UCG in India has been renewed up to March 4, 2020. Mining lease with respect to the Vastan Pilot Project has already been awarded to GIPCL.

Moreover, a number of sites have been jointly identified by ONGC and Neyveli Lignite Corporation Limited (NLC) for studying their suitability to UCG. These are Tadkeshwar in Gujarat and Hodu-Sindhari & East Kurla in Rajasthan. One more site was jointly identified by ONGC & GMDC viz. Surkha in Bhavnagar district, Gujarat. The data of all the sites have already been analysed and have been found suitable for UCG exploration.

Once the technology is established in India, UCG will emerge as a major clean coal utilisation technology capable of providing significant impact in our country in the near future.

Biofuels

Biofuels seek to provide a higher degree of national energy security in an environment- friendly and sustainable manner by supplementing conventional energy resources, reducing dependence on imported fossil fuels and meeting the energy needs of India's vast population by use of even non-food feedstocks. The Government has been promoting and encouraging production and use of ethanol derived from molasses and other non-food feedstock for blending with petrol and biodiesel derived from inedible oils, tree borne oil seeds and oil waste for blending with diesel. The Government has notified National Policy on Biofuels 2018 on 8th June, 2018 which is expected to give boost to the biofuel programme of the country. The major features of the Policy are as below:

(i) Categorisation of biofuels as "Basic Biofuels" viz. First Generation (1G) bioethanol & biodiesel and "Advanced Biofuels" — Second Generation (2G) ethanol, bio-CNG etc.

(ii) Expanding the scope of raw material for ethanol production.

(iii) The Policy allows use of surplus food grains for production of ethanol for blending with petrol with the approval of National Biofuel Coordination Committee.

(iv) The Policy indicates a viability gap funding scheme for 2G ethanol Biorefineries.

Ethanol Blended Petrol (EBP) Programme

Ethanol Blended Petrol (EBP) Programme is aimed at achieving multiple outcomes, such as, addressing environmental concerns, reducing import dependency and providing boost to Agriculture Sector. The Government, through Oil Marketing Companies (OMCs), is implementing this programme under which, OMCs sell ethanol blended petrol. The Government, with effect from 01.01.2003, resolved to supply ethanol-blended petrol in nine States and four Union Territories for sale of 5% Ethanol-blended Petrol. This was later increased to 10% w.e.f. 01.10.2008 and extended to 24 States and 5 Union Territories w. e. f. 01.04.2019.

In order to augment the supply of ethanol, the Government on 10th December, 2014, decided to procure ethanol produced from other non-food feed stocks besides molasses, like cellulosic and lignocellulosic materials including petrochemical route. It was also decided to administer the price of ethanol under EBP Programme. Different prices of ethanol have been fixed depending upon the raw material used. The Ethanol Supply Year (ESY) is taken as 1st December to 30th November of the following year so as to align it with the sugarcane crushing season.

From ESY 2018-19, additional sources like B heavy molasses, sugarcane juice, damaged food grains like wheat and rice unfit for human consumption, surplus food grains and fruit and vegetable wastes have been permitted. During ESY 2018-19, a total of 188.57 crore litres of ethanol were blended in petrol which is the highest quantity in the history of the EBP programme till date, an increase of around 25% over previous year. For ESY 2019-20, the Government has fixed an enhanced remunerative price for ethanol procurement based on raw material utilised. From ESY 2019-20, for the first time sugar and sugar syrup has been allowed for ethanol production to support the industry in liquidating their excess stocks.

The Government in recent years has taken a series of steps to boost the indigenous production of ethanol. These include re-introduction of administered price mechanism, permitting additional feedstock sources for ethanol production, amending Industries (Development & Regulation) Act, 1951 for bringing exclusive control of the Central Government over denatured ethanol, reduction in Goods & Service Tax (GST) rates from 18% to 5% on ethanol utilised under EBP Programme, notifying National Policy on Biofuels-2018 with a target of 20% ethanol blending by 2030 and an Interest Subvention Scheme for augmentation of ethanol production capacity.

Ethanol meant for EBP Programme is compulsorily denatured in the distillery itself and rendered unfit for human consumption, prior to its dispatch from the distillery. As per Notification of amendment to the Industries (Development and Regulation) Act, 1951 in 2016, the denatured ethanol, which is not meant for human consumption, will be controlled only by the Central Government. Presently, 13 States have already implemented the IDR Act amendment.

Further, MoP&NG has also issued a 'Long Term Ethanol Procurement Policy' under EBP Programme on 11.10.2019 so that the industry can plan towards long-term investments in this Sector. The salient features of this policy are as under:

(i) The ethanol procurement quantity shall be estimated by the OMCs for a period of 5 years and will form part of the procurement tender.

(ii) The annual ex-mill price from sugarcane-based raw materials shall be declared by Government.

(iii) A mechanism will be made by OMCs for change in transportation rates with the change in fuel prices over this long-term contract period.

(iv) Flexibility to introduce any new category of raw material for ethanol procurement.

(v) Mechanism to be available for induction of a new distillery/sugar mill or additional quantity offers by an existing ethanol supplier as well as a provision for exit by an existing/participating distillery/sugar mill as per ESY in the tender.

A scheme for extending financial assistance to sugar mills through interest subvention for enhancement and augmentation of Ethanol Production capacity has been notified by Department of Food and Public Distribution. Under this Scheme, 328 proposals worth ₹16,481.67 crore have been accorded in-principle approval which are estimated to add 533 crore litres per annum of ethanol distillation capacity.

With an aim to provide more choices of alternative automotive fuels to consumers, the following approvals have been given by the Government:

(i) Retailing of 100% Ethanol (E-100) as a transportation fuel on a pilot basis by OMCs at a few retail outlets in areas where ethanol is sufficiently available. After assessment of the economic, operational and developmental aspects of usage of E100 as automotive fuel, the same may be expanded to other outlets.

(ii) Retailing of petrol blended with methanol (M15) as an automotive fuel by Indian Oil Corporation Ltd, at a few outlets in Assam and NE States on a pilot basis. Based on the outcome of this pilot and availability of methanol for blending, the same may be subsequently expanded to other retail outlets.

Second Generation Ethanol

The National Policy on Biofuel announced in 2018 is aimed at accelerated promotion of Biofuels with indicative targets of achieving 20% blending of ethanol in petrol. Therefore, to maximise the production of ethanol in the country for the purpose of blending with petrol, other options/routes for enhancing ethanol production need to be explored.The Government has already allowed procurement of ethanol produced from other non-food feedstock like cellulosic and lignocellulosic materials, including petrochemical route (known as 2nd generation ethanol). Lignocellulosic biomass is being considered as a prospective source of Second Generation (2G) ethanol for supplementing the rising demand of ethanol for EBP Programme.

Subsequent to opening up of alternate route, i.e., Second Generation (2G) route for ethanol production, Public Sector Oil Marketing Companies are in the process of setting up 12 2G biorefineries and these are at various stages of development. In order to improve the financial viability of the 2G ethanol projects, Government has launched "Pradhan Mantri JI-VAN (Jaiv lndhan-Vatavaran Anukool fasal awashesh Nivaran) Yojana" for providing viability gap funding to provide initial thrust to create 2G Ethanol capacity in the country and attract investments in this sector. In this scheme, financial support to twelve Integrated Bioethanol Projects using lignocellulosic biomass & other renewable feedstock with total financial outlay of ₹1,969.50 crore for the period 2018-19 to 2023 -24 will be provided along with support to ten demo projects for 2G technology.

The foundation stone of Numaligarh Refinery Limited Bio-Refinery Project, a Joint Venture named Assam Bio-refinery Private Limited, was laid on 09.02.2019. Further, the foundation stone of IOCL's Biofuel complex for production of second generation biofuels was also laid at Gorakhpur on 18.09.2019.

Biodiesel Blending Programme

Biodiesel is a mixture of fatty acid easters having properties similar to diesel. It is derived from transesterification process which involves reaction of vegetable/animal fats and oils with alcohol preferably methanol. The properties of biodiesel are such that it can be mixed with any diesel fuel. Experiments for extraction work of biofuel from various plant seeds have been carried out in the country. Of these, Jatropha curcas has been found most suitable for the purpose. The R&D studies indicated that it enhances the life of the engine and results in less pollution.

To encourage production of biodiesel in the country, the Government announced the "Biodiesel Purchase Policy" in 2005, w.e.f. 01.01.2006. However, no biodiesel could be procured till 2014. The Government on 16.01.2015 allowed direct sale of biodiesel by manufacturers/ suppliers of biodiesel/their authorised dealers and Joint Ventures (JVs) of OMCs as authorised by MoP&NG to all consumers. On 10.08.2015, the Government allowed sale of biodiesel (B100) by private manufacturers to bulk consumers. Also, retailing of biodiesel blended diesel by Public Sector OMCs was started on the same day. The Government, vide Notification dated 29th June, 2017, has allowed direct sale of Biodiesel (B-100) for blending with High Speed Diesel to all consumers, in accordance with the specified blending limits and the standards specified by the Bureau of Indian Standards.

Ministry of Petroleum & Natural Gas has issued Gazette Notification dated 30.04.2019 regarding 'Guidelines for sale of Biodiesel for blending with High Speed Diesel for transportation purposes-2019'. Marketing Division of this Ministry has also issued "The Motor Spirit and High Speed Diesel (Regulation of Supply, Distribution and Prevention of Malpractices) Amendment Order, 2019 dated 30.05.2019 vide Gazette Notification on 31.05.2019" to incorporate the above guidelines.

During the period April, 2019 to Feb., 2020, 10.13 crore litres of biodiesel has been procured by OMCs for biodiesel blending.

Presently, Biodiesel is mainly being made through imported palm seatrain oil. In order to encourage production of biodiesel from Used Cooking Oil (UCO), OMCs have floated Expression of lnterest on 10.08.2019, for supply of biodiesel produced from UCO at 100 locations across the country and it was further extended to 200 locations on 10.10.2019. The ex-factory UCO based biodiesel price has been fixed for three years. The price for the first year has been fixed at ₹51/litre, for the second year at ₹52.7/litre and for the third year at ₹54.5/litre. GST and Transportation shall be payable in addition to this price.

POLICIES AND CONTRACTS

One of the landmark outcomes of the Liberalisation Policy vis-a-vis Petroleum Sector is the impetus for participation of foreign and other Indian Companies in exploration and development activities. The Government further sent signals of encouragement to the National Oil Companies to aggresively pursue oil and gas opportunities overseas.

The New Exploration Licencing Policy (NELP) and the Coal-bed Methane (CBM) Policy were formulated by the Government of India, with Directorate General of Hydrocarbons (DGH) as the nodal agency, during 1997-98 to provide a level playing field to both the Public and Private Sector Companies in exploration and production of hydrocarbons. NELP has steered steadily towards a healthy spirit of competition between National Oil Companies and private companies. The Government had initiated bids under the NELP in February 1999 to accelerate and expand exploration of oil and gas in the country. Under NELP, acreages are offered to the participating companies through the process of open international competitive bidding. The first round of offer of blocks was launched in 1999 and most of the ninth round awards were concluded in 2012. The Government had also formulated a CBM Policy in 1997 and implemented the same in 2000 providing attractive fiscal and contractual framework for exploration and production of CBM.

In order to bridge the gap between energy supply and demand, GoI has adopted multi-pronged strategy for giving momentum to exploration and production (E&P) activities for hydrocarbons in the country. The major steps taken in this regard include offering of exploration blocks in Indian sedimentary basins through NELP; development of alternate sources of hydrocarbon, such as, CBM and Shale Gas; Research & Development for new sources, such as, Gas Hydrate; and carrying out E&P operations in safe and environment-friendly manner.

The Government has issued "Policy Guidelines for Exploration and Exploitation of Shale Gas and Oil on 14th October, 2013. Under this Policy, the right to exploration and exploitation of Shale Gas & Oil will lie with the National Oil Companies (NOCs) holding Petroleum Exploration Licence (PEL)/Petroleum Mining Lease (PML) granted under the nomination regime.

During Pre-NELP era, 28 exploration blocks and 28 small/medium-sized discovered fields were awarded to private companies where ONGC and OIL have the rights for participation after hydrocarbon discoveries. Under NELP regime, nine rounds of bids have so far been concluded during 1999-2012, in which production sharing contracts for 254 exploration blocks have been awarded and signed. Two DSF bidding rounds have been carried out till date and 53 contract areas have been awarded. Under HELP, four bidding round has been implemented through OALP and received an overwhelming response with 94 blocks getting awarded. As on 01.04.2020, a total of 224 blocks (77 under PSCs and 147 under RSCs) are active comprising 11 Pre-NELP, 21 Small & Medium Size Field PSCs, 45 NELP, 53 Discovered Small field and 94 OALP (under HELP Policy) Blocks. The details of the blocks awarded under various policy/regime are highlighted in Table-8.

Table-8: Status of Exploration Block Awarded

Round	No. of blocks awarded	No. of blocks relinquished	No. of blocks active	Present Area sq.km
NELP-I	24	21	3	231527
NELP-II	23	22	1	267883
NELP-III	23	19	4	204596
NELP-IV	20	17	3	192810
NELP-V	20	16	4	115180
NELP-VI	52	44	8	306426
NELP-VII	41	33	8	112950
NELP-VIII	32	29	3	52573
NELP-IX	19	10	9	26431
Total NELP	**254**	**211**	**43**	**1510376**
DSF Round-I	30	11	19	777
DSF Round-II	24	5	19	3000
Total DSF	**54**	**16**	**58**	**3777**
OALP-I	55	-	55	59283
OALP-II	14	-	14	29233
OALP-III	18	-	18	29765
OALP-IV	7	-	7	18510
OALP-V	11	-	11	19789
Total	**105**	**-**	**94**	**156580**
G. Total	**413**	**227**	**186**	**1670733**

Source: Indian Statistics 2020-21, Ministry of Petroleum and Natural Gas. Outlook, 2020-21,

The Government's prime objective is to enhance domestic oil & gas production, reduce import dependency and achieve energy security. Therefore, the oil & gas regulatory ecosystem has been overhauled to achieve conducive business environment and to foster investments in the E&P sector. Major policy drives and initiatives have been ushered in by the Government in upstream hydrocarbon segments in India in the last couple of years to provide impetus to the investment climate and to scale up domestic production. The Government has formulated path-breaking policies to revolutionise the E&P sector. Through the various initiatives, the Government envisages to accelerate E&P activities that would provide impetus to expeditious production of oil & gas. Some of the notable policy reforms of recent years have been enumerated below:

1. **Categorises onshore and offshore oil & gas exploration activities as Category B2 for green clearance:** The Ministry of Environment, Forest and Climate Change (MoEF&CC) vide Notification dated 16th January 2020 categorises onshore and offshore oil & gas exploration activities as B2 category for seeking prior Environmental Clearance (EC). As exploration activities in Hydrocarbon sector have been moved from Category A to Category B2, such activities will now require environmental clearance only from the States concerned and will not require preparation of an EIA report or conduct of Public Hearing. However, Development or Production, both on offshore/onshore fields as hydrocarbon blocks, will continue to merit assessment as "Category A".

2. **Self-certification of processes under Production Sharing Contracts (PSC):** Vide Notification dated 28.02.2020, a review of the processes for various approvals and submission of documents for the same under Production Sharing Contracts (PSC) under NELP/Pre-NELP has been undertaken. The documents shall be submitted to DGH and/or MoPNG. The Government has reviewed the processes and segregated 37 processes into three categories, viz. (i) 22 Processes where documents shall be accepted on self-Certification basis and no approval is required; (ii) 3 Processes where approval will be deemed on expiry of 30 days of submission of self-certification of documents and (iii) 12 Processes where approvals shall be required under the Act/Rules or Contracts.

3. **Delegating powers to award contract areas to Minister of Petroleum & Natural Gas and Minister of Finance on the recommendations of Empowered Committee of Secretaries (ECS) (Date of Notification: 29-06-2018):** In line with the Government initiative of ease of doing business, the Government has approved delegating of powers to Minister of Petroleum and Natural Gas and Finance Minister to award the Blocks/Contract Areas to successful bidders under Hydrocarbon Exploration and Licencing Policy (HELP) after International Competitive Bidding (ICB) based on the recommendations of ECS. Under HELP the competitive bidding will be continuous and blocks will be awarded thrice a year.

4. **Exploration and Exploitation of Coal-bed Methane (CBM) from areas under Coal Mining Lease allotted**

to Coal India Limited (CIL) and its subsidiaries: The decision is in line with the Government's initiatives of Ease of Doing Business & reducing the hydrocarbon import. The amendment will expedite the exploration and exploitation of CBM, enhance the availability of natural gas and reduce the gap in demand and supply of natural gas. Production of CBM from existing coalfields will further ensure safe mining practices. The increased development activities for exploration and exploitation of CBM gas reserves in-and-around the block will generate economic activities which in turn has potential to create employment opportunities in CBM operations and in the industries.

The Cabinet Committee on Economic Affairs chaired by the Prime Minister has accorded approval for issuing a notification amending Clause 3(xiii) of the Notification dated 03.11.2015 issued by the Ministry of Petroleum & Natural Gas under Section 12 of the Oil Fields (Regulation and Development) Act, 1948 (ORD Act, 1948). Due to this amendment, relaxation is granted under the Petroleum & Natural Gas Rules 1959 (PNG Rules, 1959) to Coal India Limited (CIL) and its subsidiaries for not applying for grant of licence/lease under the PNG Rules, 1959 for extraction of Coal-bed Methane (CBM) under their Coal-bearing Areas. On 8th May 2018, Ministry of Petroleum & Natural Gas has approved the consolidated terms and conditions for grant of exploration and exploitation rights to Coal India Limited (CIL) and its subsidiaries for CBM.

CIL has come out with a tender for carrying out CBM operations in their Jharia and Raniganj Coal Fields.

5. **Policy Framework for Streamlining working of Production Sharing Contracts in respect of Pre-NELP and NELP Blocks:** The policy framework has been notified on 14.08.2018 and includes:

   i) Special dispensation for E&P activities in North Eastern Region (NER) — The Government has extended timelines for exploration and appraisal period in operational blocks of North Eastern region of India considering geographical, environmental and logistical challenges. The exploration period has been increased by two years and appraisal period by one year. Further, to stimulate natural gas production in NER, Government has also allowed marketing including pricing freedom for natural gas to be produced from discoveries which are yet to commence production as on 1st July, 2018.

   ii) Sharing of Royalty and Cess in Pre-NELP Exploration Blocks — The Government has created an enabling framework for sharing of statutory levies including royalty & cess in proportion to the participating interest of the Contractor in Pre-NELP Exploration Blocks and the same has been made cost recoverable with prospective effect.

   iii) Extending tax benefits under Section 42 of Income Tax, 1961 prospectively to operational blocks under Pre-NELP discovered fields for the extended period of contract under PSC extension policy dated 28th March 2016. Section 42 of Income Tax allows the companies to claim 100% of expenditure incurred under a PSC as tax deductible for computing taxable income in the same year.

   iv) Relaxing the timeline from 7 days to 15 days for giving written notice to notify the occurrence of a Force Majeure event in the PSCs.

6. **Policy Framework for Exploration and Exploitation of Unconventional Hydrocarbons under Existing Production Sharing Contracts (PSCs) Coal-bed Methane (CBM) Contracts and Nomination Fields:** This policy was notified on 20.08.2018 and will enable the realisation of prospective hydrocarbon reserves in the existing Contract Areas which otherwise would remain unexplored and unexploited. With this policy dispensation, new investment in Exploration and Production (E&P) activities and chances of finding new hydrocarbon discoveries and resultant increased domestic production thereof is expected. This will lead to induction of new, innovative and cutting-edge technology and forging new technological collaboration to exploit unconventional hydrocarbons. As on 31.03.2020, NOC's are carrying out shale Oil/Gas Exploration work in their PEL/PML areas. Operators of blocks Raniganj (South) and RG (East)-CBM-2001/1 have evinced their interest to carry out shale operations in their blocks.

7. **Policy framework to promote and incentivise enhanced recovery methods for Oil and Gas:** The Government notified the Policy on 10th October 2018 with objective to encourage and incentivise additional investments towards adoption of enhanced recovery techniques through fiscal waivers to increase domestic hydrocarbon production. The policy aims at building a supportive ecosystem through academic and research institutes, industry-academia collaboration and to support and encourage Exploration and Production (E&P) Contractors to deploy ER/IR/UHC Methods/techniques. Salient Features of the policy are as follows:

   (i) This ER Policy framework is to promote and incentivise Enhanced Recovery (ER)/ Improved Recovery (IR)/ Unconventional Hydrocarbon (UHC) production Methods/techniques to improve recovery factor of existing hydrocarbons reserves for augmenting domestic production of oil and gas.

   (ii) The ER includes Enhanced Oil Recovery (EOR) and Enhanced Gas Recovery (EGR), Unconventional Hydrocarbon (UHC) production methods which include shale oil and gas production, tight oil and gas production, production from oil shale, gas hydrates and heavy oil.

   (iii) The policy will be applicable to all contractual regimes and Nomination fields.

(iv) The Policy, having a sunset clause, will be effective for 10 years from the date of its notification. However, the fiscal incentives will be available for a period of 120 months from the date of commencement of production in ER/UHC projects.

(v) In case of IR Projects, the incentives will be available from the date of achievement of the prescribed benchmark.

(vi) The fiscal incentives are extended in form of partial waiver of applicable Cess/Royalty on incremental production resulting from the adoption of ER methods on designated wells.

(vii) An Enhanced Recovery (ER) Committee comprising of representatives of MoPNG, DGH, experts from upstream sector, and academia would monitor and implement the Policy.

(viii) The Policy envisages systemic assessment of every field for its ER potential, appraisal of appropriate ER techniques and fiscal incentives to de-risk the cost involved in ER Projects to make the investment financially viable.

(ix) Mandatory Screening of fields through designated institutions, to be notified by Government, and conducting Pilot-scale studies before actual implementation of ER Project on commercial level.

The implementation of the policy broadly involves 3 major stages – screening studies, pilot phase and commercial implementation. The first stage is the screening of ER methods compatible with the field/ reservoir under consideration and selection of the most appropriate ER method accordingly. The second stage is the pilot phase of an ER project which commences after the approval of ER proposals/screening report by DGH. The third stage is the commercial implementation of the ER method by the Operator post a successful pilot phase. Based on this plan for commercial ER implementation, the ER Committee decides upon the quantum of fiscal incentive to be made available to the Operator for the project under the ER Policy.

As on 31.03.2020, a total of 215 commercial fields were screened under the policy. After the first stage screening, the ER screening reports were clubbed field-wise and a total of 72 fields have been deemed to be suitable ER candidate fields. After comprehensive screening studies, a total number of 17 ER proposals have been received in 2019-20 (as on 31st March 2020). Of the 17 ER proposals submitted, 6 proposals have been approved by DGH for next stage.

8. **Reforms in Hydrocarbon Exploration and Licencing Policy for enhancing domestic exploration and production of oil and gas:** The Government notified 'Reforms in Exploration and Licencing Policy' on 28th February 2019, with the objective to intensify exploration activities, attract foreign and domestic investment and enhance domestic production. E&P companies under the Reformed Policy will get following exclusive benefits during contract period:

i) No Revenue Sharing with Government in Category– II & III sedimentary basins except in case of "Windfall Gain";

ii) Royalty concessions for early monetisation and commercial production;

iii) In Category-I, sedimentary basin Revenue share at HRP is capped at 50%;

iv) Simplified contractual terms with emphasis on cutting down approvals of Government/DGH/ Management Committee and expeditious grant of approvals;

v) Empowered Coordination Committee (ECC) under the chairmanship of Cabinet Secretary for expediting process of approvals;

vi) New Dispute Resolution Mechanism for amicable and speedy redressal of contractual dispute.

vii) Electronic Single Window mechanism based on IT workflow and processes for processing of approvals.

The benefits are applicable to OALP Bid Round IV onwards. As on 31.03.2020, 7 Blocks spread over an area of 18,510 sq. km was successfully awarded under OALP Bid Round IV, to ONGC. ONGC has committed 1,400 LKM of 2D, 2,450 SKM of 3D and 61 exploratory wells for an investment amount of USD 340.70 million. OALP Bid Round V with 11 Blocks (8 Onland, 1 Ultra- Deep-Water and 2 Shallow Water blocks) on offer spread over an area of 19,800 sq. km is under progress.

9. **Marketing including pricing freedom for gas to be produced from Discoveries in Deepwater (DW), Ultra Deepwater (UDW) and High Pressure-High Temperature areas (HP-HT):** On 10th March 2016, the Government approved marketing and pricing freedom for Gas discoveries in HP-HT, DW and UDW Reservoirs and details were notified on 21.03.2016. This shall incentivise exploration and production in DW/UDW/HPHT areas and will unlock huge Hydrocarbon potential. The ceiling gas price is determined (based on alternative fuels) by the Government. Up to 31.03.2020, ONGC has started producing gas from Discoveries in Deepwater Ultra Deepwater and High Pressure-High Temperature areas eligible under Notification dated 21.03.2016 from S1-VA field at East Coast from Aug'16. ONGC has also invited tenders for upcoming gas from KG-DWN-98/2. RIL has also invited tenders for upcoming gas from KG-DWN-98/3.

10. **Policy for the Grant of Extension to the Production Sharing Contracts signed by Government awarding small, medium-sized and discovered fields to private Joint Ventures (Date of Notification:** 28.03.2016): On 10th March 2016, the Government approved for grant

of extension to the Production Sharing Contracts for 28 small, medium-sized and discovered fields signed by Government of India and Private JVs. The Policy allows extension for a period of 10 years for both Oil and Gas fields. The Government approved the policy to grant extension for 10 years or economic life of the field, whichever is earlier, to small and medium-sized discovered fields in March, 2016. The Government share of profit Petroleum during the extended period of contract would be 10% higher for these fields. As on 31.03.2020, under this policy, 11 PSCs of Pre-Nelp Discovered Fields have been extended by 10 years and 1 PSC of Pre-Nelp Discovered Field (Hazira) has been extended by 5 years.

11. **New Hydrocarbon Exploration Licencing Policy (HELP) along with Open Acreage Licencing Programme (OALP):** Hydrocarbon Exploration and Licencing Policy (HELP) was launched (Notified on 30.03.2016) with the clear objective of boosting the production of oil & gas in the Indian sedimentary basin. The policy formally put in operation w.e.f. 1st July, 2017 with notification of Open Acreage Licencing Policy (OALP). This policy is based on the new model of Revenue Sharing Contract (RSC) which has replaced the earlier model of Production Sharing Contract (PSC). This policy is a paradigm shift which completely overhauls the regulatory regime for the future Exploration and Production (E&P) activities by reducing the regulatory burden based on the principle of 'Ease of doing business'. Under HELP, Open Acreage Licencing Policy allows the investors to carve out blocks of their choice by assessing E&P data available at NDR & by submitting an Expression of Interest (EoI) throughout the year without waiting for a formal bid round from the Government. These blocks would be subsequently offered through bi-annual formal bidding process. OALP would be manifested through National Data Repository which will provide rapid jump start to E&P activities by providing seamless access to the country's entire G&G data for interpretation and analysis. The Salient Features of HELP are as below —

    i) Unified licence for all types of hydrocarbon viz. conventional oil and gas, coal-bed methane, shale oil, gas hydrates, etc.

    ii) Revenue Sharing Model: Simple, easy to monitor; only two monitoring parameters for the Government revenue & production of the contractor, no cost recovery; no micro-management by the Government; operational freedom to the operator.

    iii) Freedom to carve out blocks under OALP

    iv) Reduced and graded royalty rates. Further, to encourage exploration in deep water and ultra-deep water areas, the royalty was exempted for first seven years (and subsequently royalty of 5% and 2% will be made applicable in deep water and ultra-deep water areas, respectively).

    v) Other fiscal incentives viz. exemption of cess on crude oil and custom duty applicable on equipment/services for exploration and production activities, reduced rate of GST on specified goods being purchased for petroleum operations.

    vi) Full marketing and pricing freedom of gas produced on arm's length basis.

    vii) Extended period for exploration and production, i.e., 8 years for onland/ shallow water and 10 years for deep water/ frontier areas.

    viii) Pre-determined Liquidated Damages (LDs) for any shortfall in committed work program.

    As on 31.03.2020, since the inception of HELP, four bid rounds have been concluded so far and Fifth Bid Round is ongoing. Under four Bid Rounds, 99 blocks were on offer and 94 exploration blocks covering an area of 1,36,790 sq. km were awarded. Five un-awarded blocks were part of OALP Round-III and in all of them CBM was the focus.

12. **Early Monetization of CBM:** The policy was notified on 11.04.2017 and it was expected to boost CBM production and generate new avenues of employment and increased investment in CBM blocks. It was also envisaged that 14 CBM blocks which are under relinquishment will be provided an easy exit option under the policy. As on 31.03.2020, after implementation of policy one GSA (Gas Sales Agreement) was signed in Raniganj East CBM Block and exit from 6 CBM Blocks was approved. CBM production during 2019-20 was ~1.80 MMSCMD in the country.

13. **Policy for the Grant of Extension to the Production Sharing Contracts signed by GoI awarding Pre-NELP Exploration Blocks (Date of Notification: 22.03.2017):** This policy enables the contractors to extract not only the remaining reserves but also plan to extract additional reserves by implementing new technologies. The policy will enable to acceleration and supplementation of indigenous production of hydrocarbon from existing blocks and will act as a progressive step towards achieving the target of 10% reduction in import of energy by 2021-22. In certain fields, additional recovery of hydrocarbons can be obtained and as such the production would extend beyond the current duration of PSC. The Government share of Profit Petroleum during the extended period of contract would be 10% higher for these fields, thus bringing additional revenues to the Government. In addition, the policy brings out detailed guidelines regarding grant of extension, criterion for evaluation of request, time frame for consideration of request, duration of extension etc. The extension of these contracts is expected to bring extra investments in the fields and would generate both direct and indirect employment. The policy aims at bringing out clear terms of extension in fair and transparent manner so that the resources can be expeditiously exploited in

the interest of energy security of the country besides improving the investment climate. As on 31.03.2020, out of 10 blocks applicable under the policy, extension of 10 years has been granted to Pre-Nelp Exploration block RJ-ON-90/1, and 6 blocks have more than 2 years for expiry of PSC. One block has been terminated and remaining 2 blocks are under exploration in PSC.

14. **Survey of Un-Appraised Areas of Sedimentary Basins of India (Date of Notification:12.09.2017):** The project was sanctioned to acquire 48,243 Line Kilometer (LKM) 2D seismic data for appraisal of Indian sedimentary basins where limited data is available. The project will be implemented by NOCs, i.e., OIL and ONGC. OIL will conduct survey in North Eastern States while remaining area will be covered by ONGC. Survey work will be carried out in 24 States over a period of 5 years. The timeline to complete the project was June 2020. DGH reviewed the progress of work and construed that reasons for shortfall in completing the project target are inevitable. Due to the Covid-19 restrictions and lockdown, MoP&NG has been requested to extend the timeline till June 2021. As on 31.03.2020, cumulative data acquisition by ONGC and OIL was 40,137.40 LKM (98.29%) and 4,637.28 LKM (76.10%) respectively. Processing of 35,431.50 LKM data and interpretation of 22,003.97 LKM data by ONGC have been completed whereas, 3,559.68 LKM data were processed in the case of OIL.

15. **New Domestic Natural Gas Pricing Guidelines, 2014:** In supersession of MoPNG's Gazette Notification no. 22011/3/2012ONG.D.V dated 10.01.2014, the Government of India notified the New Domestic Natural Gas Pricing Guidelines, 2014 on 25.10.2014, effective from 01.11.14. Domestic Natural Gas prices are being determined in accordance with the pricing formula dated 25.10.2014 and notified by MoPNG on half- yearly basis. In terms of these guidelines, domestic gas price is determined based on weighted average formula considering (a) annual average prices prevailing at Henry Hub, Alberta Hub, National Balancing Point & Russia and (b) annual volume of natural gas consumed in USA & Mexico, Canada, European Union & Former Soviet Union countries excluding Russia.

16. **Policy framework for relaxations, extension and clarifications at the development and production stage for early monetisation of Hydrocarbon discoveries under PSC regime:** The policy was notified on 10.11.2014 and the salient features of the policy initiative are as under:

    i) Extension of Appraisal period for submission of Declaration of Commerciality (DoC) in respect of Hydrocarbon discovery.

    ii) Extension of time period for submission of Field Development Plan (FDP) after review of DoC by the Management Committee.

    iii) Reduction in Minimum Work Programme (MWP) in case a block or its part is not available for exploration activities consequent to denial of permission by Government Agencies.

    iv) Swapping of 2D and 3D Seismic Minimum Work Programme, on the request of the operator.

    v) In cases where the committed Minimum Work Programme of any exploration phase is not completed, entry into subsequent exploration phases, would be permitted after paying cost of unfinished MWP of previous phases.

    vi) Condoning delays in submission of notice for entering next phase.

    vii) Condoning delays in submission of Annual Work Programme and Budget and the Appraisal work programme.

    viii) Permission for drilling of Appraisal Wells after Submission of DoC.

    ix) Probing additional reservoirs during appraisal programme.

    x) Acceptance of discoveries for which notification to the Government has not been made and also notification for testing has not been provided as prescribed.

    As on 31.03.2020, over 40 cases have been resolved under this policy. Extension of time period for submission of DoC and FDP were granted in 8 Blocks and 4 Blocks, respectively. Operator allowed to Exit in 14 Blocks whereas in 3 Blocks Minimum Work Programme (MWP) Reduction was granted and 2 applications are under consideration. Swapping of 2D and 3D seismic MWP were granted in 7 Blocks. Entry into subsequent exploration phase, after paying cost of unfinished MWP of previous phases was granted in 1 Block. One application was received for Condoning delays in submission of notice for entering next phase. Drilling of Appraisal Wells after submission DoC was granted in 1 Block. Probing of additional reservoirs during appraisal programme was approved in 3 Blocks.

17. **Policy on Testing Requirements for discoveries in NELP Blocks:** The Government of India approved (notified on 13.05.2015) a clear policy on testing requirements for discoveries made under NELP Blocks. The policy settled the long pending issue of about 13 discoveries in five blocks pertaining to ONGC (Seven discoveries) and Reliance Industries (six discoveries). The reform allows the contractors to choose one of the following three options for discoveries which are stuck on account of testing requirement:

    (i) Relinquish the blocks

    (ii) Develop the discoveries after conducting Drill Stem Test (DST) with 50 per cent cost of DST being disallowed as penalty for not conducting the test on time. The cost recovery for carrying out DST would be capped at US $ 15 million.

    (iii) Develop the discoveries without conducting DST in a ring-fenced manner.

As on 31.03.2020, after availing this policy in block KG-DWN-98/3, the Contractor has submitted DOC and FDP for D-29 and D-30 discoveries which got reviewed/approved by MC and currently it is under development. Also under this policy, Contractor has relinquished D-31 and D-42 discoveries of block KG-DWN-98/3.

18. **Discovered Small Field Policy (Earlier called as Marginal Field Policy) (Date of Notification: 14.10.2015):** To reduce the import dependency of hydrocarbons, to effectively exploit the untapped established reserves and increase indigenous production, the Government approved the Marginal Field Policy (MFP). The Government has attempted to include certain reforms in the hydrocarbon exploration and production management through this policy with sole intention to increase the production at the earliest. The policy was later rectified as Discovered Small Field Policy. The objective of the Discovered Small Field Policy is to bring discovered small fields to production at the earliest to augment the domestic production of oil and gas. For early monetisation of these fields, in September 2015, the Cabinet approved 69 marginal fields for offer under DSF Policy. These contract areas have been awarded under the new regime of Revenue Sharing Model. Award of contract is expected to provide faster development of fields and facilitate production of oil and gas thereby increasing energy security of the country.

    Under Discovered Small Field Bid Round-I & Round-II, a total of 53 contract areas comprising 100 fields were awarded. Of which, 37 Contract Areas awarded were on-land and 16 remaining Contract Areas were offshore. As on 31.03.2020, Bid Work for 111 wells and anticipated investment under FDPs to the tune of 1,600 million USD are under progress. PML has been granted for 42 contract areas (27 Onland and 15 Shallow water), while for 08 contract areas (Andhra Pradesh-05, Tamil Nadu-02, Arunachal Pradesh-01), it is pending. A total of 23 FDPs have been approved with total Inplace of 154.5 MMtoe and cumulative production of 41.9 MMtoe contribution during field life.

STRATEGIC CRUDE OIL STORAGE

Keeping in view India's high import dependence for oil & gas and country's energy security, MoPNG took up construction of crude oil reserve facilities as a buffer to deal with any situation of supply chain disruption due to external reasons. A Special Purpose Vehicle (SPV) named Indian Strategic Petroleum Reserve Limited (ISPRL), a subsidiary Company of Oil Industry Development Board (OIDB), was created on 16th June, 2004. Under Phase I, three underground rock caverns for Strategic Petroleum Reserve (SPR) with total crude oil storage capacity of 5.33 million tonnes located at Visakhapatnam (1.33 million tonnes), Mangaluru (1.5 million tonnes) and Padur (2.5 million tonnes) have been constructed and were dedicated to the nation on 10th February 2019. The National Oil Company of Abu Dhabi (ADNOC), UAE, has already stored crude oil at its own cost at one of the two cavern of Mangaluru SPRs as per restated agreement signed with ADNOC on 10th February 2018. The Indian Strategic Petroleum Reserves Ltd (ISPRL) signed an MoU with Saudi Armaco to explore possibility of filling one cavern at Padur on the sidelines of the PM's visit to Saudi Arabia in October 2019. The total reserve of Phase-I of SPRs is currently estimated to supply approximately 10 days of India's crude requirement.

In order to further augment India's preparedness during emergency oil shortage situation, the Government under Phase-II gave 'In Principle' approval for establishing additional 6.5 MMT Strategic Petroleum Reserves at locations Chandikhol (4 MMT) in Odisha and Padur (2.5 MMT) in Karnataka. The 'In Principal' approval is to take up the project under PPP model to reduce budgetary support of Government of India. On completion of 6.5 MMT storage envisaged in Phase II, there will be an additional storage capacity created to cover another 12 days of crude oil requirement. Thus, the total cover would be approximately 22 days.

WORLD REVIEW

The world proved reserves of crude oil and natural gas at the end of 2020 were estimated at 244.4 billion tonnes and 188.1 trillion cu. m, respectively (Tables - 9 & 10). The largest share of reserves of world crude oil is available in Middle East (48.3%) followed by South & Central America (18.7%), North America (14%), CIS (8.4%), Africa (7.2%), Asia Pacific (2.6%) and Europe (0.8%).

Of the total world reserves of natural gas, the largest share is from Middle East (40.3%), CIS (30.1%), Asia Pacific (8.8%), North America (8.1%), Africa (6.9%), South & Central America (4.2%) and Europe (1.7%).

The world production of crude petroleum in 2020 decreased by 7% to 4,126 million tonnes from 4,441 million tonnes in 2019. USA with share of 18% followed by Saudi Arabia (13%), Russia (12%), Iraq, China & Canada (5% each), Brazil & UAE (4% each) and Kuwait & Iran (3% each) were the principal producers of crude petroleum in 2020.

The world production of natural gas decreased to 4047 billion cu. m in 2020 from 4191 billion cu. m in 2019. USA with share of 23% followed by Russia (17%), Iran (6%), Qatar, China, Canada & Australia (4% each) and Norway & Saudi Arabia (3% each) were the major producers of natural gas in 2020 (Tables-11 & 12).

The world consumption of oil (which includes biogasoline, biodiesel and derivatives of coal & natural gas) in 2020 was estimated as 91,297 thousand of barrel per day, while that of natural gas (excludes natural gas converted to liquid fuels but includes derivatives of coal as well as natural gas consumed in gas-to-liquids transformation) was 3,822.8 billion cu. m. The share of India in the world consumption of oil and natural gas was 5.26% (4,669 thousand of barrels per day) and 1.56% (59.6 billion cu. m), respectively, during 2020.

Table-9: World Proved Reserves of Crude Oil*

(By Principal Countries)

(In billion tonnes)

Country	Reserves
World: Total	244.4
Algeria	1.5
Angola	1.1
Azerbaijan	1
Brazil	1.7
China	3.5
Canada	27.1
Iran	21.7
Iraq	19.6
Kazakhstan	3.9
Kuwait	14
Libya	6.3
Nigeria	5
Norway	1
Qatar	2.6
Russian Federation	14.8
Saudi Arabia	40.9
UAE	13
USA	8.2
Venezuela	48
Other countries	9.5

Source: BP Statistical Review of World Energy, 2021.

* At 2020 end.

Table-10: World Proved Reserves of Natural Gas*

(By Principal Countries)

(In trillion cu. m)

Country	Reserves
World : Total	188.1
Algeria	2.3
Australia	2.4
Azerbaijan	2.5
Canada	2.4
China	8.4
Egypt	2.1
India	1.3
Indonesia	1.3
Iran	32.1
Iraq	3.5
Kazakhstan	2.3
Kuwait	1.7
Libya	1.4
Malaysia	0.9
Nigeria	5.5
Norway	1.4
Qatar	24.7
Russian Federation	37.4
Saudi Arabia	6
Turkmenistan	13.6
UAE	5.9
Ukraine	1.1
USA	12.6
Venezuela	6.3
Other countries	9

Source: BP Statistical Review of World Energy, 2021.

* At 2020 end.

Table-11: World Production of Crude Petroleum

(By Principal Countries)

(In million tonnes)

Country	2018	2019	2020
World: Total	4477	4441	4126
Algeria	65	64	58
Angola	74	69	65
Argentina	26	26	26
Azerbaijan	39	38	35
Brazil	139	150	158
Canada	228	233	223
China[(a)]	189	191	190
Colombia	46	47	41
Ecuador	28	29	26
Egypt	33	32	30
India[(c)]	34	32[e]	30
Indonesia	39	37	36
Iran	219	158	143
Iraq	227	234	202
Kazakhstan	90	91	86
Kuwait[(d)]	147	143	130
Mexico	107	99[e]	99
Nigeria	96	101	87
Norway	91	85	99

Contd...

Table-11 *(Concld)*

Country	2018	2019	2020
Oman	49	48	47
Qatar	80	79	76
Russia	556	561	512
Saudi Arabia[(d)]	578	557	520
UAE	177	180	166
UK	51	52	49
USA	701	781	747
Venezuela	76	47	27
Other countries	293	278	222

Source: World Mineral Production, 2016-2020.

Note: The figures shown in this table include natural gas liquids.

(a): Including oil from shale and coal.

(c): Years ended 31 March following that stated.

(d):Including shares of production from the Neutral Zone.

Table-12: World Production of Natural Gas

(By Principal Countries)

(In bsillion cu.m)

Country	2018	2019	2020
World: Total	4039	4191	4047
Algeria	94	86	82
Argentina	40	46	42
Australia	131	154	154
Azerbaijan	19	25	26
Bahrain	22	25	25
Bangladesh	27	27	25
Brazil	27	27	25
Canada	157	161	158
China	160	176	176
Egypt	59	65	59
India[(d)]	32	30	29
Indonesia	73	67	59
Iran	232	241	251
Kazakhstan	55	57	55
Malaysia	66	69	63
Mexico	46	39*	39*
Nigeria	48	46	49
Norway	122	115	112
Oman	35	36	35
Pakistan[(c)]	41	41	40
Qatar	169	172	171
Russia	726	738	694
Saudi Arabia[(e)]	112	111	112
Tanzania	59	60	60*
Thailand	37	38	33
Trinidad & Tobago	37	37	31
Turkmenistan	62	63	59
UAE	58	58	55
UK	41	39	39
USA[(a)]	871	961	948
Uzbekistan	57	57	47
Other countries	324	318	292

Source: World Mineral Production, 2016-2020.

Note: So far as possible the figures in this table exclude flared or reinjected gas.

(a): Dry gas.

(c): Years ended 30 June of that stated.

(d): Years ended 31 March following that stated.

(e): Including one-half of the output of the Neutral Zone.

*: estimated

FOREIGN TRADE

Exports

Exports of natural gas decreased significantly by 66% to 17,992 tonnes in 2020-21 from 52,408 tonnes in 2019-20. Exports of natural gas were mainly to Nepal (99.9%) (Table -13) (Fig-3).

Table-13: Export of Natural Gas
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	52408	2202387	17992	658242
Nepal	51065	2149052	17988	657797
Bhutan	1343	53152	2	299
UAE	--	--	++	100
Nigeria	--	--	2	46
USA	++	183	--	--

Figures rounded off.

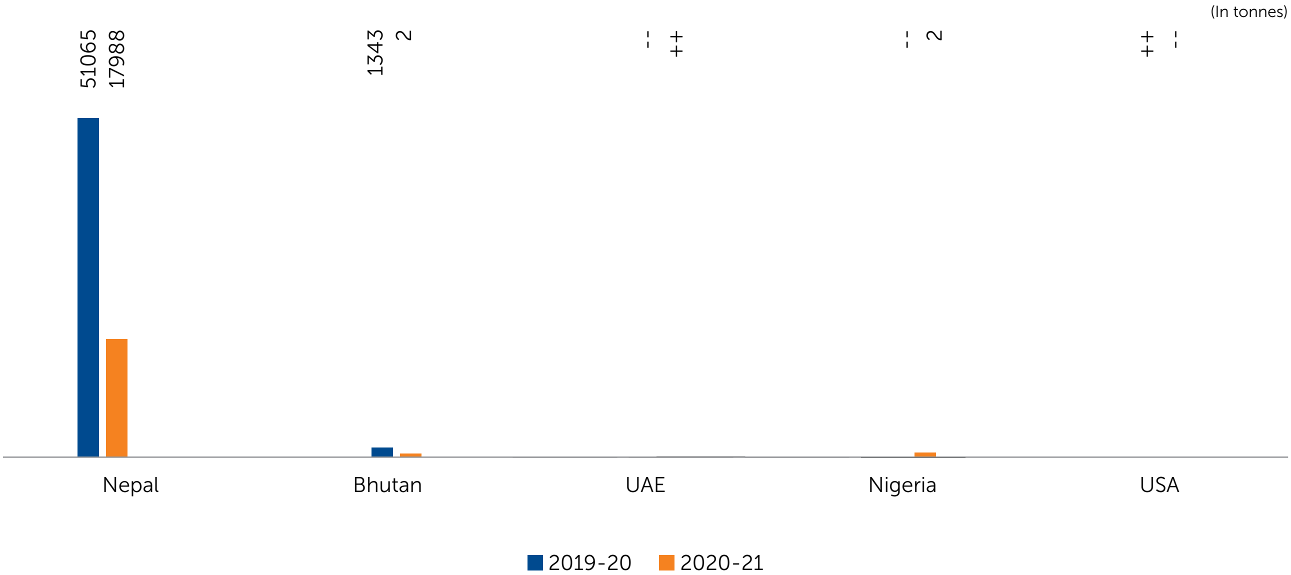


Fig 3: Countrywise Export of Natural Gas

Imports

Imports of crude petroleum decreased by 15% to 188.182 million tonnes in 2020-21 as compared to 220.870 million tonnes in 2019-20. Imports were mainly from Iraq (23%), Saudi Arabia (18%), UAE (12%), Nigeria & USA (8% each), Kuwait (5%), Mexico (4%) and Angola, Oman & Qatar (2% each). Imports of natural gas Increased marginally by 3% to 25 million tonnes in 2020-21 from 24.41 million tonnes in 2019-20. Main suppliers were Qatar (40%), UAE (13%), USA (12%), Nigeria (9%) , Angola (8%), Oman (6%) and Australia (3%) (Tables - 14 & 15) (Fig-4 & 5).

Table-14: Import of Petroleum (Crude)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	220869	7281122511	188182	4396561618
Iraq	51567	1613786345	43028	951898108
Saudi Arabia	42203	1442187301	34201	795811634
UAE	21832	777015687	21883	543546952
USA	9578	346039362	15030	396119190
Nigeria	17282	636436325	14220	361689340
Kuwait	10262	342600478	9590	230800971
Mexico	8896	234809751	7343	146424544
Angola	5325	186677388	3958	97259683
Oman	2084	71558333	3267	85023664
Qatar	2791	97112482	3161	70937986
Other countries	49049	1532899059	32501	717049546

Figures rounded off.

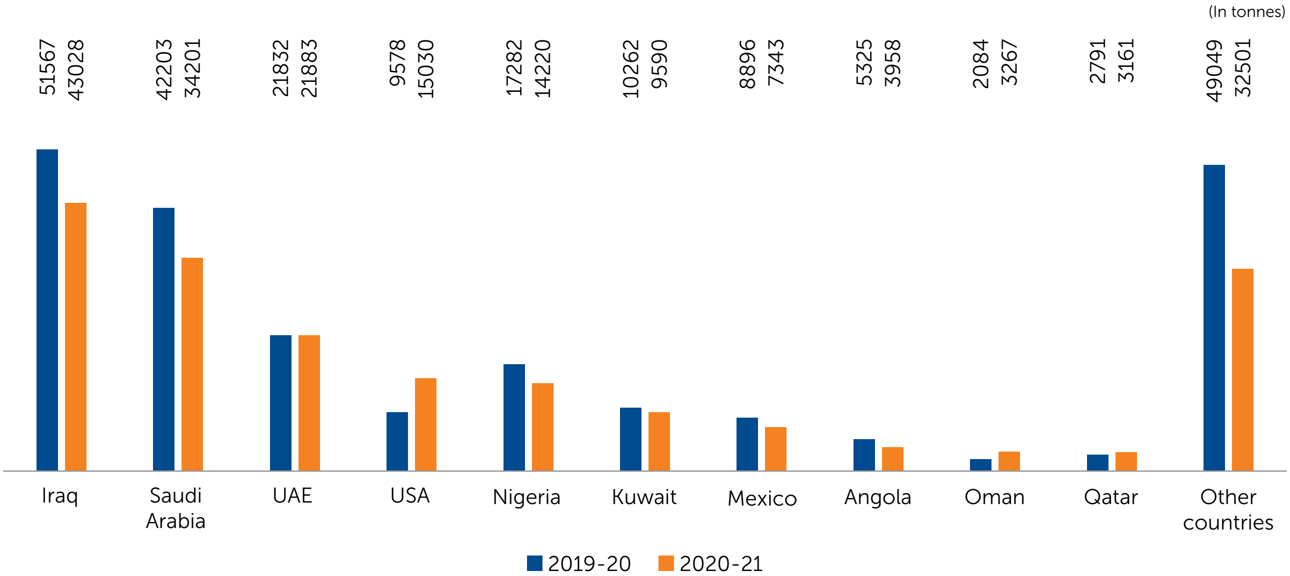


Fig 4: Countrywise Import of Petroleum (Crude)

Table-15: Import of Natural Gas

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	24416607	684667281	25054872	583289424
Qatar	10067544	315282499	9928514	232229782
USA	1636237	46834074	2903231	82166511
UAE	3028336	64064721	3222307	61110991
Nigeria	2901944	75111366	2153556	47593774
Angola	2577519	70239915	1927953	40107265
Oman	763884	22008528	1502556	34754703
Australia	957482	28474247	777058	19002493
France	242095	7527617	475546	13764633
Egypt	199962	6426573	455788	13321517
Trinidad	210344	4708890	495444	12761397
Other countries	1831260	43988851	1212919	26476358

Figures rounded off.

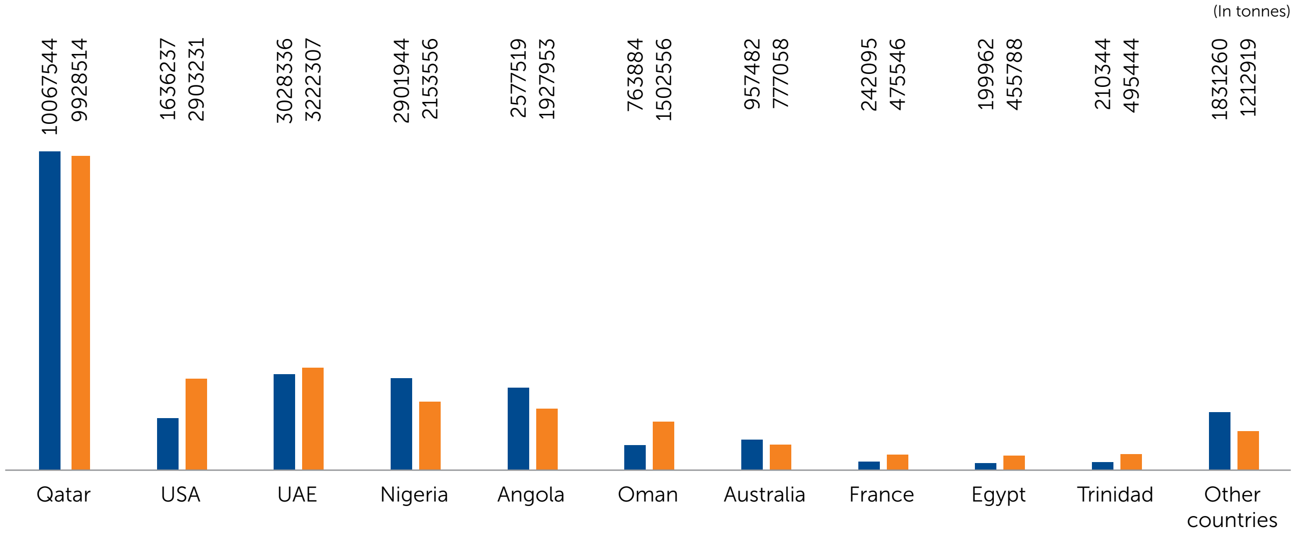


Fig 5: Countrywise Import of Natural Gas

FUTURE OUTLOOK

Energy is considered as one of the key inputs for economic development of any country. India is expected to be one of the fastest growing economies of the world in the near future. With the population anticipated to grow in the future and improvements in socio-economic developments, energy demand is expected to rise consequently. Thus, India will be the biggest contributor to energy growth demand globally in the years to come and hydrocarbons is an important component of India's energy basket in future.

As India moves towards a 5 trillion dollar economy with commensurate energy needs, the criticality of hydrocarbons in meeting this growing energy requirement hardly needs emphasis. Thus, India is set to emerge as one of the primary drivers of growth in oil & gas demand in Asia, despite the pressing Covid-19 challenges. Oil & Gas will continue to remain important elements for India's energy security and its share in global energy demand is set to almost double to 11% by 2040. Further, Government has taken an ambitious target to increase the share of natural gas from the existing 6% to 15% by 2030 to transform India into a gas-based economy.

As per the BP World Energy Outlook 2019, India's primary energy consumption is set to rise from around 754 MMtoe in 2017 to 1,928 MMtoe in 2040 (4.2% CAGR). As per the BP World Energy Outlook 2020, the growth of industrial energy demand would be concentrated in the emerging world (outside of China) – especially, India, rest of Asia and Africa.

In recent years, the Government has committed itself to a number of economic and structural reforms that are aimed at achieving strong growth in GDP over the medium to long term range. The role of renewables in India's energy basket is likely to see a quantum leap in the longer term driven primarily by increasing penetration of renewable energy. Despite the healthy outlook for renewables, the energy mix is still massively dependent on fossil fuels. Within fossil fuels, while the country benefits from abundance of cheap coal, reliance on imports for securing oil & gas requirements is not likely to change anytime soon. The country is deficient in oil resources and most of the domestic requirements are met through imports and this trend is likely to continue in the near future as well.

As per the draft National Energy Policy, 2017 put out by NITI Aayog, it is expected that in the medium term while the share of oil may not come down, share of gas would rise. Based on the present extent of knowledge of the hydrocarbons potential, the said policy anticipates that the production of oil and gas has potentials (ambitious case) to reach 61 Mtoe and 124 BCM by 2040.

As per Annual Report of MoPNG 2019-20, 100% Indian sedimentary area is to be appraised and as of now, only 48% of the basinal areas have been appraised. About 4% sedimentary basinal area has been declared as "NO GO area" by Ministry of Defence/ Ministry of Environment & Forest which remains unapprised. This means, about half of the Indian sedimentary basins have the undiscovered potential of hydrocarbons. Besides, the prognosticated conventional hydrocarbon resources in 26 sedimentary basins of the country have been reassessed or estimated at about 41.87 billion tonnes of oil and oil equivalent of gas (O+OEG), which reflected 49% increase as compared to the earlier estimates of 28.08 billion tonnes. Further, about 74% of resources, as on 1st April, 2019, are under "yet to discover" category. Out of 10,950 MMT of oil and oil equivalent gas of in-place volumes, the ultimate reserves which can be produced are about 4,259.5 MMT of oil and oil equivalent gas. The balance recoverable reserves are of the order of 1,909 MMT of oil and oil equivalent gas. Thus, Indian sedimentary basins have ample hydrocarbon potential for future exploration and production.

The Hydrocarbon Vision 2030 for Northeast aims at doubling Oil & Gas production by 2030, making clean fuels accessible, fast tracking projects, generating employment opportunities and promoting cooperation with neighbouring countries and targets an investment of ₹1.30 lakh crore by 2030.

To exploit the logistical advantage of imported crude supplies, there are potential for capacity expansion and setting up of Greenfield refineries, preferably at coastal locations.

Strategic Petroleum Reserve is estimated to supply approximately 10 days of India's crude requirement. In order to further augment India's preparedness during emergency oil shortage situation, the Government under Phase-II gave 'In Principle' approval for establishing additional 6.5 MMT Strategic Petroleum Reserves under PPP model. On completion, the total storage capacity would be sufficient to cover approximately 22 days of crude oil requirement. Further, the SPR capacity needs to be augmented on considering the 90-day consumption requirement of strategic and commercial storages.

Apart from the above, Oil India Ltd will concentrate efforts to maintain its position as the leading operator in the Northeast by consolidating acreage position through OLAP and intensifying exploration activities both in Mining Leases and Exploration Licences areas. To enhance recovery from the mature fields of Upper Assam, water injection and other IOR/EOR technologies would have to be adopted which has the ability to liberate additional production capacity. With the success of Cyclic Steam Stimulation technology in Baghewala Heavy Oil field in Rajasthan, development plans would be implemented to enhance production in an efficient manner. Apart from Northeast and Rajasthan, the Company plans to carry out detailed exploration in Mahanadi Onland, Andaman Offshore and Kerala–Kokan Offshore in quest of establishing hydrocarbon reserves.

Oil India Ltd will continue to pursue acquisition of prospective overseas E&P opportunities to ensure energy security for the country, to grow by enhancing own E&P portfolio and decrease risks in existing E&P portfolio. In addition to acquisition of conventional assets, OIL would also look towards acquisition of non-conventional assets.

Recently, ONGC reframed Perspective Plan 2030 and approved an Energy Strategy 2040 in April 2019 that outlines strategic growth initiatives across the energy value-chain. The expectation and the strategy for ONGC is to act as the fulcrum around which an ecosystem for thriving Oil & Gas Industry in the country can be created consistent with expectations to reduce import dependence. ONGC has continuously been reviewing its engagements to move up higher in value chain to concentrate on areas where the expected risk-reward payoff offers better business opportunities for growth. ONGC, in its efforts to augment production of oil and gas, is endeavouring to engage all interested players so that the concept of 'Atmanirbhar Bharat' remains central to the domestic project execution agenda ONGC has rolled out its separate Gas vertical, which will increase its activities in Gas Sector leveraging on its strong domestic and international presence. It is also taking steps to augment its renewables portfolio. ONGC is also looking into strategic relationships and close alliances with key international players through ONGC Videsh. Intention is to invite foreign participations to explore Category-II and Category-III basins which match size and scale of expectations and portfolio of these large players. ONGC has been aggressively pursuing its deepwater projects in East Coast and couple of shallow water projects in West Coast. ONGC also has plans of acquiring much larger acreage through OALP.

23. Potash

23,091
(million tonnes) of Potash resources established as on 1.4.2020

26,583
(tonnes) of Potash Fertilizer exported in 2020-21.

5.25
(million tonnes) of Potash Fertilizer were imported in 2020-21.

Potash is an impure combination of potassium carbonate & potassium (K) salts. Over 90% of potash is used as fertilizer and is one of the three primary agricultural nutrients (N-P-K). All commercial potash deposits come originally from evaporite deposits and are often buried deep below the earth's surface.

The principal ore is sylvinite, a mixture of sylvite (KCl) and halite (NaCl). In India, a few deposits of potash mineral are reported from Sidhi district of Madhya Pradesh, Sonbhadra district of Uttar Pradesh, Kaimur district of Bihar and Sawai Madhopur & Karauli districts of Rajasthan. It is in the form of Glauconitic (a potassium-bearing green mica) sandstone. The entire requirement of potash mostly utilised for producing fertilizer products is met through imports.

RESERVES/RESOURCES

As per NMI database, based on UNFC system, the total resources of potash as on 1.4.2020 have been estimated at 23,091 million tonnes, all of which are placed under Remaining Resource category. Rajasthan alone contributes 89% to the total resources, followed by Madhya Pradesh (5%) and Uttar Pradesh (4%) (Table- 1).

Table-1: Reserves/Resources of Potash as on 1.4.2020
(By Grades/States)

(In million tonnes)

States/Grades	Reserves	Remaining Resources				Total
	Total	Indicated	Inferred	Reconnaissance	Total	Resources
	(A)	STD332	STD333	STD334	(B)	(A+B)
All India:Total	0	18151	4125	814	23091	23091
By Grades						
Glauconite	0	888	1495	766	3149	3149
Polyhalite	0	13985	2179	0	16164	16164
Sylvite	0	2072	452	48	2572	2572
Unclassified	0	1206	0	0	1206	1206
By States						
Madhya Pradesh	0	1206	36	2	1244	1244
Rajasthan	0	16936	3509	127	20572	20572
Uttar Pradesh	0	10	198	685	893	893
Bihar	0	0	230	0	230	230
Jharkhand	0	0	152	0	152	152

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

OCCURRENCES

Glauconitic sandstones/greensands deposits can be used as an alternative indigenous resource for potash. Glauconite is essentially a complex hydrous silicate of iron and potassium chiefly with ferric oxide and partly with ferrous oxide. It contains about 4–7% K_2O.

Major part of these resources are located in Nagaur district of Rajasthan, followed by Panna district, Madhya Pradesh and the balance in Sonbhadra & Chitrakoot districts, Uttar Pradesh. Occurrences of potash are also reported from Tirap district of Arunachal Pradesh; Rohtas district of Bihar; Kachchh district of Gujarat; Rohtak & Sirsa districts of Haryana; Leh district of Jammu & Kashmir; Sidhi district of Madhya Pradesh; Bhatinda district of Punjab; Bhilwara & Nagaur districts of Rajasthan; Tanjavur district of Tamil Nadu and Banda, Chitrakoot, Sonbhadra & Etah districts of Uttar Pradesh.

In Rajasthan, glauconitic sandstones/shales occur in Chittorgarh, Kota, Karauli, Jaisalmer and Barmer districts. In Gujarat, glauconite is found in Ukra Formation at Guneri in Kachchh district. In Himachal Pradesh, glauconite of hydrothermal origin is found in Kumla-Kathwar area of Sirmaur district. In Kerala, glauconite occurs in Quilon Limestone and seabed sediments of Thiruvananthapuram coast

USES

Potash is the general name given to various inorganic compounds that contain potassium in a water-soluble form. A number of common potassium compounds exist, including potassium carbonate and potassium chloride. Before the industrial era, potash was obtained by leaching wood ashes in a pot (hence the name 'pot-ash'). This product was used to manufacture soap, glass, and even gun powder.

Potassium chloride (KCl) is the principal fertilizer product with 60–62% of K_2O equivalent. Other salts that are used as fertilizer and that which are known to improve nutrient value & disease resistance in food crops are potassium sulphate, potassium magnesium sulphate and potassium nitrate. Potassium chloride and potassium nitrate are used in manufacture of glass, ceramics, soap & detergent, dye, synthetic rubber and chemicals. Potassium nitrate is used in explosive manufacture. Potash is also used as a raw material for manufacturing complex fertilizers.

Potash can be used on all plants to boost plant health and nutrition as well as to increase crop yields. While all potash fertilizers contain potassium there are a number of different forms in which it exists. The two most common forms are Muriate of Potash (MOP) and Sulphate of Potash (SOP). Sulphate of Potash (SOP) is a premium potash fertilizer free of chloride (unlike MOP) which is harmful to plants. SOP is used primarily on high value crops, usually leafy plants, fruits and vegetables. MOP is commonly used on carbohydrate type crops, such as, wheat.

CONSUMPTION

As per FAI, the all India consumption of Potassic fertilizer (in K_2O content) was at 2.61 million tonnes during 2019-20, whereas it was 2.53 million tonnes in the previous year.

WORLD REVIEW

The world reserves are estimated at approximately 3,500 million tonnes of K_2O content. Reserves are located mainly in Canada (31%), Belarus (21%), Russia (11%), China (10%), USA (6%), Germany (4%) and Chile (3%) (Table-2).

The world production of potash in 2020 was 43.9 million tonnes in terms of K2O content as against 41.6 million tonnes in 2019. Canada is the leading producer of potash with 31% share in total production in 2020, followed by Belarus (17%), Russia (16%), China (12%), Germany (7%), Israel (5%), Jordan (4%) and Chile (2%) (Table-3).

Table-2: World Reserves of Potash
(By Principal Countries)

(In '000 tonnes of K_2O content)

Country	Reserves
World: Total (rounded off)	**3500000**
Canada	1100000
Belarus	750000
Russia	400000
China	350000
USA[1]	220000
Germany	150000
Chile	100000
Spain	68000
Brazil	2300
Israel	*Large
Jordan	*Large
Laos	75000
Other countries	300000

Figures rounded off.

Source: Mineral Commodity Summaries, 2022

1Data are rounded to not more than two significant digits to avoid disclosing company proprietary data

*Israel and Jordan recover potash from the Dead Sea, which contains nearly 2 billion tonnes of potassium chloride

Table-3: World Production of Potash
(By Principal Countries)

(In '000 tonnes of K_2O content)

Country	2018	2019	2020
World:Total (rounded off)	**43800**	**41600**	**43900**
Canada (Chloride)	13944	12851	13784
Belarus	7346	7348	7562
Russia (Chloride)	7015	6771	6893
China	5450	5450	5450
Germany (Potassic salts)	2754	2615	2874
Israel (Chloride)	2345	2057	2375
Jordan	1486	1517	1598
Chile (Chloride)	989	682	951
UK (Polyhalite)	400	635	709
Other countries	2089	1692	1736

Source: BGS World Mineral Production, 2016-20,

FOREIGN TRADE

Exports

There is no reported production of potash in the country. However, exports of potash fertilizer decreased substatially by 10% to 26,583 tonnes in 2020-21, as compared to 29,565 tonnes during the previous year. Exports were mainly to Nepal (58%), Netherlands (25%), UAE (5%) and Serbia (2%) (Fig-1). Exports of potassium nitrate decreased by 16% to 827 tonnes in 2020-21 from 985 tonnes in the previous year. Exports were mainly to USA (32%), Thailand (31%), China (13%), Indonesia (6%),UAE (5%) and Bangladesh (4%) (Tables- 4 & 5).

Table-4: Exports of Potash Fertilizers

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	29565	1014818	26583	673799
Nepal	5304	271904	15494	345727
Netherlands	6736	205119	6601	193619
UAE	3922	102340	1363	27518
Serbia	520	15457	1040	23810
Saudi Arabia	720	24596	518	17760
Morocco	1880	59877	480	17074
Croatia	2600	74435	546	15429
Mexico	115	7994	60	4291
USA	31	6574	16	3906
Kenya	65	3043	53	3626
Other countries	7672	243479	412	21039

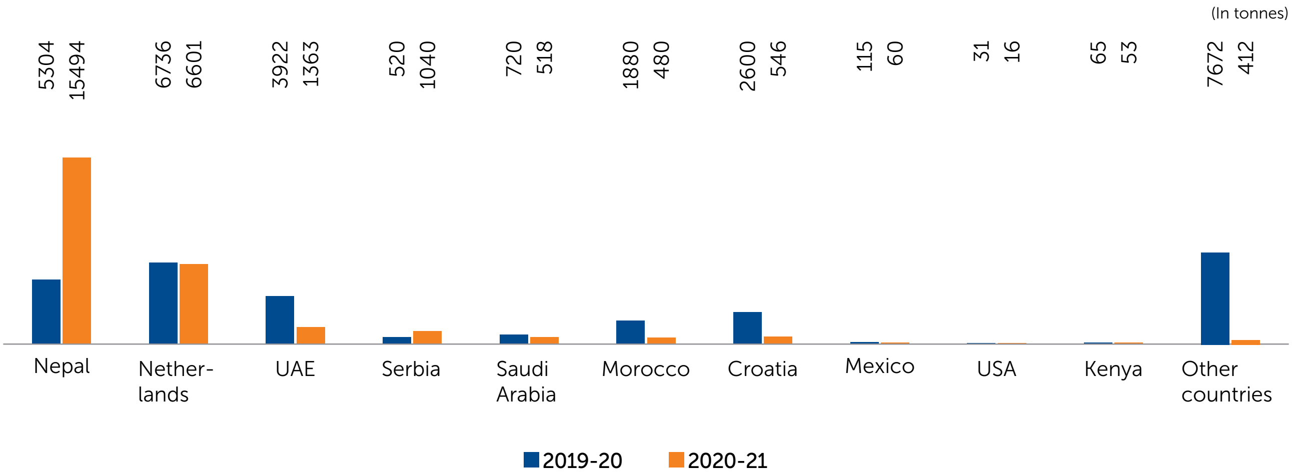


Fig 1: Countrywise Exports of Potash Fertilizers

Table-5: Exports of Potassium Nitrate
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	985	168082	827	165914
USA	275	45951	268	71190
Thailand	266	42430	257	38113
China	184	36865	104	16899
Indonesia	34	7959	46	9627
Egypt	47	14450	27	8540
UAE	17	3926	42	7655
South Africa	6	2268	21	5346
Bangladesh	50	3010	33	3387
Korea	22	3573	11	1901
Nepal	2	266	3	928
Other countries	82	7384	15	2328

Imports

Imports of potash fertilizer increased by 30% to 5.25 million tonnes in 2020-21 as compared to 4.04 million tonnes during the previous year. Imports were mainly from Canada (31%), Belarus (18%), Russia (14%), Jordan (12%), Lithuania (11%), Israel (9%) and Germany (4%)(Fig-2). Imports of potassium nitrate decreased drastically to 58 tonnes in 2020-21 from 208 tonnes in the previous year. China (93%) and Germany (3%) were the main suppliers of potassium nitrate in 2020-21 (Tables- 6 & 7).

Table-6: Imports of Potash Fertilizers
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4040268	83239621	5250814	94059271
Canada	1166314	23700186	1612329	28597032
Belarus	453536	9086784	922089	16620176
Russia	573325	11639377	747928	13133743
Jordan	466363	9586685	629092	11082614
Lithuania	668214	13626964	569610	9768040
Israel	484718	9932847	485631	8555193
Germany	137937	3101808	198887	3877702
Taiwan	10438	353040	21713	724649
UK	1458	112565	26537	469062
China	15808	536605	12841	440408
Other countries	62157	1562760	24157	790652

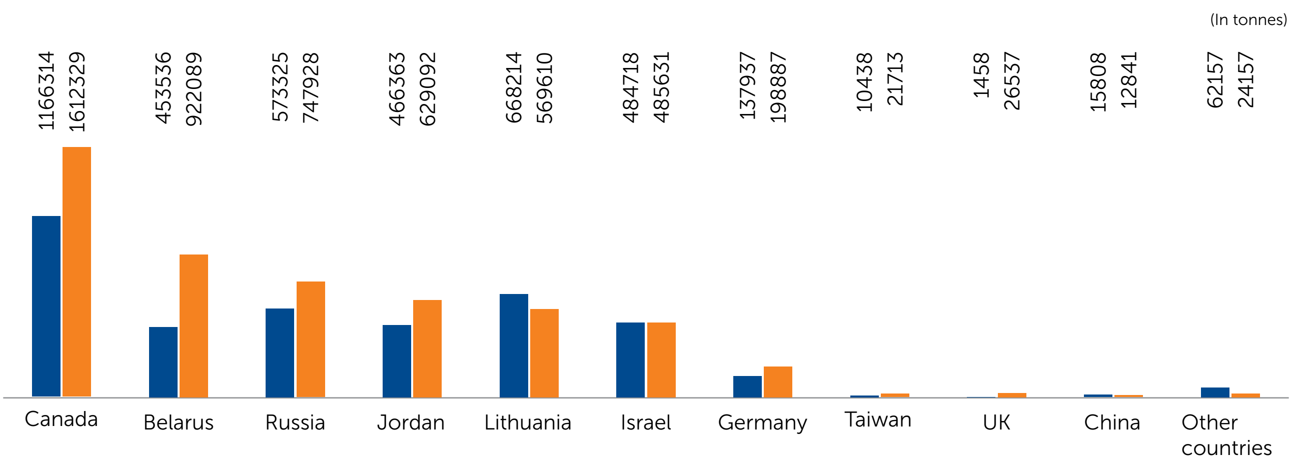


Fig 2: Countrywise Imports of Potash Fertilizers

Table-7: Imports of Potassium Nitrate
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**4040268**	**83239621**	**5250814**	**94059271**
All Countries	208	34447	58	7553
China	162	9456	54	3272
Germany	++	615	2	2474
USA	45	23978	1	1234
Italy	1	322	1	370
Spain	-	-	++	157
Switzerland	++	62	++	41
UK	++	9	++	5
Belgium	++	3	-	-
Japan	++	2	-	-

FUTURE OUTLOOK

Agriculture is the backbone of India's Economy. However, declining soil fertility impacts on crop productivity. The appropriate application of fertilizer is a key factor in enhancing soil fertility and productivity and for overcoming potassium depletion. The market of potash is expected to increase year-on-year globally. The domestic demand met almost entirely by imports require a turnaround, initiatives to promote indigenous mining of potash in India must be encouraged. Prospects of potash mining in India could mitigate the issue of import of the mineral and consequently will have positive impact in the investment opportunities in the sector which in turn could be utilised for the development of mineral wealth. To carry out the feasibility study for mining of potash in the State of Rajasthan, a Tripartite agreement between DGM, Rajasthan, RSMML and MECL was signed. The agreement may provide boost to the fertilizer industry.

24. Rare Earths

12.73
(million tonnes) estimated resource of monazite in the beach and inland placer deposits as on March, 2021

3.67
(tonnes) of Rare-earth Metals (Scandium & Yttrium) were exported in 2020-21

470.61
(tonnes) of Rare-earth Metals (Scandium & Yttrium) were imported in 2020-21

The term "rare earth" arises from the minerals from which they were first isolated, which are common oxide-type minerals (earths) found in Gadolinite extracted from one mine in the village of Ytterby, Sweden. However, with the exception of the highly-unstable promethium, rare-earth elements are found in relatively high concentrations in the earth's crust with cerium being 25th most abundant element in the earth's crust at 68 parts per million.

Rare Earths are a group of 17 elements starting with lanthanum in the periodic table of elements and include scandium and yttrium. They are moderately abundant in earth's crust but not concentrated enough to make them economically exploitable. The REEs find key applications in defence, electronics, energy systems etc. For instance, magnets made from rare earths are many times more powerful than conventional ones. Along with energy critical elements (ECE), such as, lithium which has become ubiquitous battery material, REEs have emerged as strategic elements essential for sustainable energy systems.

The Rare-earth Elements (REE) are a collection of 17 elements, namely, scandium, yttrium and lanthanides (15 elements in the periodic table with atomic numbers 57 to 71, namely, lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb) and lutetium (Lu).

Although these elements tend to occur together, the lanthanide elements are divided into two groups. (The light elements are those with atomic numbers 57 to 63 (La, Ce, Pr, Nd, Pm, Sm and Eu) and the heavy elements are those with atomic numbers 64 to 71 (Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu).

REEs are characterised by high density, high melting point, high conductivity and high thermal conductance. A number of rare-earth minerals contain thorium and uranium in variable amounts, but they do not constitute essential components in the composition of the minerals.

The principal sources of REE are bastnaesite (a fluorocarbonate which occurs in carbonatites and related igneous rocks), xenotime (yttrium phosphate) commonly found in mineral sand deposits, loparite which occurs in alkaline igneous rocks and monazite (a phosphate). The rare earths occur in many other minerals and are recoverable as by-products from phosphate rock and from spent uranium leaching. In India, monazite is the principal source of rare earths and thorium. Monazite is a complex phosphate of thorium and Rare-earth minerals [(Ce, La,Nd, Th,Y) PO_4] and this is radio active in nature.

RESERVES/RESOURES

The mineral monazite is a prescribed substance as per the Notification under the Atomic Energy Act, 1962. AMD has been carrying out its resource evaluation for over six decades. It occurs in association with other heavy minerals, such as, ilmenite, rutile, zircon, etc. in concentrations of 0.4 – 4.3% of total heavies in the beach and inland placer deposits of the country.

The resource estimates of monazite in the beach and inland placer deposits is 12.73 million tonnes as on March, 2021. The statewise breakup of 12.73 million tonnes was given in Table -1.

Table-1: Resources of Monazite

(In million tonnes)

State	No. of Deposits	Resources*
All India	130	12.73
Andhra Pradesh	24	3.78
Gujarat	2	0.07
Jharkhand	1	0.21
Kerala	35	1.84
Maharashtra	5	0.004
Odisha	12	3.16
Tamil Nadu	50	2.47
West Bengal	1	1.2

*Inclusive of indicated, inferred and speculative categories.

Source : Reply of Parliament Question No. 2564 in Rajya Sabha, it was answered on 18.03.2021.

Monazite is known to be contained in 130 deposits in the coastal beach placer sands in Kerala, Tamil Nadu, Odisha, Andhra Pradesh, Maharashtra & Gujarat and in the inland alluvium in parts of Jharkhand, West Bengal and Tamil Nadu. The major deposits which contain monazite (thorium and REE ore mineral) are :

1. Chavara barrier beach and Eastern Extension, Kollam district, Kerala
2. Manavalakurichi beach sand deposit, Kanyakumari district, Tamil Nadu
3. Sathankulam Teri sand deposit, Tamil Nadu
4. Ovari Manapadu Teri Sand deposit, Tamil Nadu
5. Navaladi-Ovari Teri Sand deposit, Tamil Nadu
6. Kuduraimoli Teri Sand deposit, Tamil Nadu
7. Bhimunipatnam beach sand deposit, Andhra Pradesh
8. Kandivalasa beach sand deposit, Andhra Pradesh
9. Kalingapatanam beach sand deposit, Andhra Pradesh
10. Srikurmam beach sand deposit, Andhra Pradesh
11. Bhavanapadu beach sand deposit, Andhra Pradesh
12. Gopalpur beach sand deposit, Odisha
13. Chhatrapur beach sand deposit, Odisha
14. Brahmagiri beach sand deposit, Odisha

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are furnished in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION AND PRICES

Indian Rare Earth Limited (IREL), a Mini Ratna Company, is a Government of India Undertaking under the Department of Atomic Energy (DAE) and KMML, a Kerala State Government Undertaking, are actively engaged in mining and processing of beach sand minerals from placer deposits. IREL is the only entity processing monazite to produce Rare-earth (RE) compounds. Some REE which are available in India such as Lanthanum, Cerium, Neodymium, Praseodymium, Samarium, etc. are in supply surplus while Dysprosium, Terbium, Europium which are classified as HREE are having supply constraint. These HREEs are not available in Indian deposits in extractable quantity. Government is actively engaged in capacity building for consumption of the LREE.

The annual installed mining, production and processing capacities are as under:

(i) Mining: 10 million tonnes

(ii) Processing capacity in terms of Rare-earth concentrate: 11,200 tonnes

(iii) Refining capacity in terms of Total Rare-earth Oxide (TREO): 5,000 tonnes

(iv) Rare-earth Concentrate Production: 5,040 tonnes

(v) Refining in terms of TREO: 2,000 tonnes (Both Government and Private sector)

As reported by KMML (The Kerala Minerals & Metals Ltd.) monazite is a strategic mineral and cannot be sold in commercial market. Therefore, the prices are not available.

MINING AND PROCESSING

Mining of beach sand is being carried out by IREL and KMML. The installed capacity of monazite (96% pure) separation plant of IREL at Manavalakurichi is 6,000 tpy while that of KMML at Chavara is 240 tpy. Details regarding mining and processing, etc., are provided in the Review on 'Ilmenite and Rutile'.

INDUSTRY

IREL has a plant at Udyogamandal, Aluva, located in Ernakulam district, Kerala, wherein the monazite obtained from Manavalakurichi is chemically treated to separate Rare-earths in its composite chloride form and thorium as hydroxide upgrade.

IREL has set up a Rare-earth Extraction plant (REEP) producing mixed Rare-earth chloride (MRCL) Tri-sodium phosphate etc., at its unit in OSCOM Odisha. MRCL produced from the above plant is processed at IREL's plant at Rare-earth Division (RED) in Aluva, Kerala, for producing separated High Pure Rare-earth (HPRE) Oxides/Compounds.

IREL implemented flow sheet developed by BARC and has produced 50 kg Nuclear Grade Gadolinium Oxide (99.99%). Same can be converted into Gadolinium Nitrate which is used by NPCIL. The Company invited research projects pertaining to products in the value chain of Ilmenite, zircon and rare-earth compounds, improvement in recovery energy efficiency, etc.

IREL is actively pursuing setting up of greenfield operations in Kanyakumari district of Tamil Nadu and Bramhagiri district of Odisha. The proposal for harnessing the beach sand mineral deposits in Tamil Nadu by constituting a Joint Venture Company with the nominated State Government Agency, TAMIN, is under active consideration by the State Government.

Ambadungar RE Project has been initiated to harness the carbonatite deposit explored by AMD in the state of Gujarat. Initially, about 1.55 Ha of the deposit is proposed to be harnessed, which will be further extended based on the exploratory results of AMD. Action has been initiated to establish the technical feasibility and financial viability of the project.

POLICY

In order to safeguard the strategic interest of the nation it is expedient in larger national interest to prohibit the grant of operating rights in terms of any reconnaissance permit exploration licence or production lease of atomic minerals as defined in part-B of the first schedule of the MM(DR) Act, 1957.

A Notification No. S.O.2685 (E) dated 27.07.2019, was issued for reserving the prospecting and mining rights of offshore minerals under Offshore Areas Minerals (Development and Regulation) Act, 2002 exclusively to Government or a Government - owned company or a corporation owned or controlled by the Government.

As per Gazette Notification No 26/2015-2020 dated 21.08.2018, the export of rare-earth compounds classified as Beach Sand Minerals (BSM), namely, [Ilmenite, Rutile, Leucoxene (Titanium-bearing mineral), Zircon, Garnet, Sillimanite and Monazite (Uranium and Thorium)], shall be regulated in terms of Sl No 98A of Chapter 26 Schedule 2 of ITC (HS) Classification.

Other minerals under Code 2617 are freely exportable, except those which have been notified as prescribed substances and controlled under Atomic Energy Act 1962.

As per the Foreign Trade Policy, import policy under ITC(HS), 2022 Schedule 1, the import policy on the import of ores & concentrates of rare-earth metals (under HS Code 25309040) are permitted 'freely' whereas export policy under ITC(HS) 2018 Schedule 2, the export policy on the export of ores and concentrates of rare-earth metals (under HS Code 25309040) are permitted 'freely'.

Export of Beach Sand Minerals have been brought under STE and shall be canalised through Indian Rare Earths Limited (IREL). Beach sand minerals, permitted anywhere in the export policy, will now be regulated in terms of policy under at Sl. No. 98A of Chapter 26 of Schedule 2 of the Export Policy.

As per Gazette Notification No : GSR.134 (E) dated 20.2.2019, the particulars of threshold values for atomic minerals in respect of Beach Sand Minerals (BSM) shall be regulated as Schedule A [Rule 2(1)(m) and Rule 36] of Atomic Mineral Concession (Second Amendment) Rules, 2019 (Table-2).

Table-2: Particulars of Threshold Value for Atomic Minerals
[See Rule 2(1)(m) and Rule 36]

Uranium-bearing tailings left over from ores after extraction of copper and gold, ilmenite and other titanium ores.	60 ppm U_3O_8 and/or 250 ppm ThO_2.
Zirconium-bearing minerals and ores including zircon.	All cases of zirconium-bearing minerals occurring in Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e., the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade. In other cases, zircon containing less than 2000 ppm of hafnium.
Beach Sand Minerals, i.e., economic heavy minerals found in the teri or beach sand, which include ilmenite, rutile, leucoxene, garnet, monazite, zircon and sillimanite	All cases of Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e., the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade.

Many projects of IREL have been initiated, such as, capacity expansion of Mineral Separation Plant of OSCOM, Rare Earth Permanent Magnet Plant and Rare Earth Theme Park. Agencies to implement these projects are in place and the projects will be commissioned within the next 2-3 years. New areas of operations, such as, Rare Earths in Ambadungar, Gujarat or Atomic Minerals in Odisha and Tamil Nadu are also in advanced stage of development.

During the year 2020-21, Licence to Operate (LTO) office has been established for centralised monitoring & managing the regulatory compliances, required to achieve and sustain the targeted production plans. Centralised monitoring and control of statutory compliances is enabled through database dashboards. Units are sensitised for complying with the statutory requirements at regular intervals. Manavalakurichi and OSCOM units are continuing their operations in a sustainable manner. OSCOM has deposited the statutory fees as desired under Stage-I Forest Clearance towards obtaining the Stage-II Forest Clearance. Chavara Unit is in the final stage of receiving the environment clearances for its mining lease areas. LTO office establishes the processes & tools for proactive information gathering and structuring of regulatory requirements.

Rare Earth Permanent Magnet plant will be set up in BARC campus, Achitapuram, Vizag, for production of Samarium-Cobalt permanent magnet for use in Atomic Energy, Defence and Space sectors. Environment clearance and clearance from Design Safety Review Committee and Safety Committee, BARC for carrying out site activities have been received. Detailed engineering has been completed and appointment of contractor to commence site activities on Engineering Procurement Construction (EPC) model too has been done.

Subsidiary IREL- IDCOL Limited (IIL), the Joint Venture company has been established to harness the beach sand mineral deposit in the state which in turn will widen the footprint of the Company. Ground work towards declaration of the precise area is in the final stages at the State after completion of DGPS survey and preparation of cadastral map. DPR for the project has been prepared. Pre-project activities such as, obtaining environment clearance, preparation of mining plan, etc. necessary for execution of the mining lease deed will be taken up in 2021-22.

USES & CONSUMPTION

The Rare Earth Permanent Magnet (REPM) in Vizag and Rare Earth and Titanium Theme Park (RETTP) in Bhopal have kick started with the funding assistance of Government of India, which will enhance the visibility of IREL in the strategic and niche sector.

Environmental clearance for REPM project has been received from MoEF&CC and M/s MECON Limited, Bengaluru, has been appointed as consulting firm for detailed engineering. As regards RETTP project, lease deed execution towards land has been completed. A Letter of Understanding has been inked with BARC towards developing and transferring laboratory-scale technologies in the value chain of Rare Earths which will be suitably upscaled by IREL to pilot-scale and installed in the theme park.

In addition, IREL has been assigned the responsibility of carrying out civil construction works on behalf of BARC for the 5 million liters per day (MLD) hybrid seawater desalination plant at OSCOM. About 60% construction of plant building has been completed.

Execution of Supplimentary Mining Lease deed for OSCOM Mines till a period up to the year 2047 has been completed under the provisions of AMCR 2016. Communication on precise area of the Bramhagiri Mineral Sands Deposit in Puri district under AMCR, 2016 is in the final stages of issuance by the Government of Odisha.

Rare-earth materials are utilised in a wide range of critical products enabling many emerging green energy technologies, high-tech applications and defence systems, such as, hybrid cars, plug-in-hybrid electric-vehicles (PHEVs), the latest generation of efficient wind power turbines, computer disc drives, missile guidance systems, etc. The lanthanide elements as a group have magnetic, chemical and spectroscopic properties that have led to their application in a wide range of end-uses. Cerium finds application in polishing of glass items like lenses & display screens of cathode-ray tubes, liquid-crystal displays & plasma-display panels, in petrol & diesel fuels as fuel additive and along with lanthanum for replacement of cadmium in red pigments. Mixed salts of the cerium group of elements, other than fluorides are used in medicine, non-irritating antiseptic dressings, waterproofing agents and fungicides in textile manufacture. The principal uses of commercially pure cerium compounds that are in the form of nitrate is in the manufacture of incandescent gas mantles and cerium compounds as oxide. It also finds usage as a polishing agent of glass. Cerium compounds are also used in ceramic and glass as colouring pigments and also as catalysts in Chemical Industry.

Department of Atomic Energy (DAE), has accorded in-principle approval for futuristic proposal of IREL towards setting up of rare earth theme park which inter alia includes setting up of pilot plants in the value chain of rare earths, skill-cum-enterpreneur development center. This will be a first of its kind theme park in the country.

To produce samarium-cobalt (Sm-Co) magnet for meeting national objectives, a Special Purpose Vehicle (SPV) has been formed. Production of Sm-Co metal and magnet is based on technologies developed by BARC, Mumbai & DMRL, Hyderabad. Activities for firming up the investment, plant location etc., are under progress.

Supply of Nuclear Grade Ammonium diuranate (NGADU) from new source, i.e, the newly commissioned monazite processing plant at OSCOM, Odisha has commenced.

Subsequent to identification and development of conditions for dissolution of Rare Earths (REE) from fly ash generated at lignite coal fired thermal power plant at Neyveli, Tamil Nadu, studies were taken up to understand the overall process efficiency and precipitate dissolved rare earths in purified form.

Cerium, lanthanum and neodymium are used as glass additives in optical lenses and display screens, as catalysts in automobiles to reduce sulphur dioxide emission, in multilayer capacitors and along with yttrium in magnesium, aluminium and hydrogen storage alloys. Mischmetal which is an alloy of cerium with small amounts of other rare-earth metals is used in lighter flints, for desulphurisation in steel and foundry, and with lanthanum alloys, in batteries and hydrogen storage systems meant for electronics and hybrid cars. Cerium oxide is used in glass polishing industries.

Lanthanum oxide and neodymium compounds are used in special glass manufacture. Lanthanum finds application in X-ray films as phosphors; yttrium in advanced ceramics like nitrides,Y-stabilised ceramics, etc., and gadolinium in magnet alloys. Yttrium, europium and terbium are used as phosphors in displays of computers, TV, etc. and with lanthanum, cerium & gadolinium as phosphors in fluorescent and halogen lamps. Neodymium, samarium, dysprosium, praseodymium and terbium have application as high intensity magnets in electronics, electric motors and audio equipment. Lanthanum, erbium and ytterbium have application in fibre optics and lasers. Lanthanum and yttrium find application in solid oxide fuel cells. Scandium is used mainly in aluminium alloys for sporting goods. Scandium in minor amounts is used in semiconductors and special lighting, including halogen bulbs. Mixed rare-earth products are used as catalysts in petroleum refining and fluid cracking. Neodymium is used in welding in heavy industries and also in MRI scanners. Praseodymium is not a primary element for any specific use, but finds use as a substitute for neodymium in magnets.

Samarium is used essentially for the Sm-Co magnets. Europium is a primary component of phosphorus and is responsible for white light in compact fluoroscent lamps when used with terbium compounds.

Erbium used as fibre optic has emerged in the nineties as a remarkable tool for communication technology through which high quality rapid data in tight pulses can be transferred in speed unthinkable in the past.

The main application for neodymium-iron-boron (Nd-Fe-B) magnets are in automobiles for anti-lock brakes, and in computer hard disk drives, videos, CD-ROMs used in many small-size electronic consumer products, such as, digital cameras, where major advantage is their small sizes. Nickel metal hydride (Ni MH) batteries, containing mischmetal, a mixture of rare-earth compounds, are used mainly in portable electronic equipment, such as, laptops, camcorders and mobile phones. Though, the market for batteries for portable electronic equipment is growing strongly, the Ni MH batteries are increasingly replaced by lithium-ion batteries.

Ground monazite is digested with caustic soda lye to produce trisodium phosphate (TSP) and mixed hydroxide slurry. This slurry is used for production of diverse rare-earth compounds. Elaborate solvent extraction and ion exchange facilities were built to produce individual RE oxides, like oxides of Y, Ce, Nd, Pr and La of specific purities. India is the second largest supplier of yttrium in the world and the maximum production is reported from the plant in Kerala. Uranium values present in monazite which are recovered in the form of nuclear grade ammonium diuranate (ADU) are vital supplement to the indigenous supply of uranium. Thorium is separated in its pure oxalate form. A part of it is taken to OSCOM for further processing by solvent extraction to produce thorium nitrate. A small part of the purified thorium nitrate is converte to nuclear grade thorium oxide powder for supply to Bhabha Atomic Research Centre (BARC) and Nuclear Fuel Complex (NFC) for developing thorium-based fuel for nuclear reactors. IREL has built a large stockpile of impure thorium hydroxide upgrade associated with rare earths and unreacted materials.

Monazite contains about 25.28% P_2O_5 which can be recovered as a by-product for manufacture of fertilizers and production of elemental phosphorus or its salts. Beside, rare earths, thorium is also recovered from monazite. It is a source of atomic energy. An important use of thorium is for addition to tungsten in minute quantity (about 0.75%) to increase the ductility of tungsten wire and thus to facilitate its drawing into filaments used in electric lamps. Metallic thorium is also used in photoelectric cells and X-ray tubes and in certain alloys. Thorium is used as catalytic agent for various processes. Amongst thorium salts, thorium nitrate is used largely in the manufacture of incandescent gas mantles. Mesothorium, the chief radioactive element recovered as a by-product in the chemical treatment of monazite, is marketed usually in the form of its bromide and used in self-luminous paints or enamels. Mesothorium is also used in the treatment of certain types of cancer and skin diseases.

World Review

The total world reserves are estimated at 120 million tonnes of rare-earth oxides equivalent content (REO) of which China alone accounts for 44 million tonnes (37%) followed by Vietnm, Brazil & Russia (18% each) and India (6%) (Table- 3).

China holds the leading position among producers of rare-earth oxides with 180 thousand tonnes. The other major producers are Myanmar, Australia, USA, Russia, India, Vietnam and Malaysia (Table-4).

Table-3: World Reserves of Rare Earths

(By Principal Countries)

(In '000 tonnes of REO equivalent content)

Country	Reserves
World: Total (rounded off)	12,00,00,000
USA	18,00,000
Australia[(a)]	40,00,000
Brazil	2,10,00,000
Burma	NA
Burundi	NA
Canada	8,30,000
China	4,40,00,000
Greenland	15,00,000
India	69,00,000
Madagascar	NA
Russia	2,10,00,000
South Africa	7,90,000
Tanzania	8,90,000
Thailand	NA
Vietnam	2,20,00,000
Other countries	2,80,000

Source: USGS, Mineral Commodity Summaries,2022

a For Australia, Joint Ore Reserves Committee-complaint or equivalent reserves were 3.0 million tons. NA - Not available

Table-4: World Production of Rare-Earth Oxides

(By Principal Countries)

(In tonnes

Country	2018	2019	2020
China[(a)]*	1,80,000	1,80,000	1,80,000
Myanmar*	34,000	29,000	36,000
USA*	10,800	16,800	22,800
Australia[(c)]	17,754	19,737	14,562
India[(b)]	4,215	4,200	4,200
Madagascar*	2,000	2,800	3,200
Russia	2,596	2,620	2,663
Vietnam*	920	1,300	1,000
Malaysia	1,012	71	14

Source: BGS, World Mineral Production, 2016-20

*) Estimated

a : Includes production from iron ore extraction, bastnaesite concentrates and ion absorption clays.

b : Year ending 31st March following that stated.

c : Year ending 30th June following that stated.

To provide a generalised view of the development in various countries, the country-wise description sourced from the latest available publication of rare earths in Minerals Yearbook 'USGS' 2018 is furnished below.

Australia

Arafura Resources Ltd continued piloting studies on its Nolan's Bore project in the Northern Territory with the goal of producing rare-earth, phosphate, and uranium products. Alkane Resources Ltd continued the development of its polymetallic Dubbo Zirconia project in New South Wales with planned production of hafnium, niobium, rare-earths, tantalum, and zirconium products. In 2018, Alkane continued test work and sought financing to advance the development of the project. Australian Mines Ltd completed a bankable feasibility study on the Sconi cobalt-nickel-scandium project in northern Queensland. Clean TeQ Holdings Ltd completed a definitive feasibility study for its Sunrise nickel-cobalt-scandium project in New South Wales. Lynas Corp. Ltd, the leading producer of rare-earth mineral concentrates outside of China in 2018, continued to operate its Mt Weld mining operations in Western Australia to support its processing operations in Malaysia. Northern Minerals Ltd continued work to develop the Browns Range project in Western Australia and the Northern Territory. In 2018, the company was commissioning pilot plant operations that included beneficiation through hydrometallurgical extraction. About 2.6 t of mixed rare-earth carbonate was produced and exported to China in the fourth quarter. Platina Resources Ltd completed a definitive feasibility study for its Owendale polymetallic (scandium-cobalt-nickel) project in New South Wales. The Company planned for an initial capacity of 20 t/yr of scandium-oxide equivalent. Scandium International Mining Corp. (Sparks, NV) continued to pursue financing and offtake agreements for its Nyngan scandium project in New South Wales. In 2018, the company was awarded two patents from the United States Patent Office related to its leaching and solvent extraction technology.

Burundi

Rainbow Rare Earths Ltd continued to commission its mining and beneficiation processing operation at its Gakara project in Bujumbura Rural Province.

Canada

Commerce Resources Corp. continued prefeasibility work on its Ashram project in northern Quebec. In 2018, Commerce Resources was collaborating with Université Laval to conduct process modeling and bench and pilot plant studies. Canada Strategic Metals Inc. merged with Matamec Explorations Inc. and was renamed Quebec Precious Metals Corp. In southwestern Quebec, the new company held joint ownership of the Kipawa project with Investissement Québec and 100% ownership of the Zeus project. In 2018, development activities at both of these adjacent projects were on hold and the company was seeking partners to further develop the projects. Medallion Resources Ltd continued with plans to develop a processing facility to produce mixed rare-earth compounds from monazite. Medallion's proposed facility would purchase monazite by-product from heavy-mineral-sand operations and produce rare-earth compounds. In 2018, the company continued its process development through collaborations with the Saskatchewan Research Council and Rare Earth Salts Separations and Refining, LLC. Search Minerals Inc. was conducting a drilling program and environmental assessments on its Foxtrot project in southeastern Labrador. According to the company, most of the rare-earth mineralisation occurred in allanite (a silicate mineral) and fergusonite (an oxide mineral). The project plan was based on a combined open pit and underground mine followed by processing to produce a mixed rare-earth concentrate.

China

China dominated the global production of rare-earth minerals, separated compounds, and metals. China's Ministry of Land and Resources (CMLR) production quotas for rare-earth mine production were 1,20,000 t of REO equivalent, of which 1,00,850 t was for light rare earths and 19,150 t was for medium and heavy rare earths. CMLR classifications for light, medium, and heavy were not defined. The production quotas for smelting and separation were 1,15,000 t. Nearly all mine, smelting, and separation quotas were allocated to the state-owned enterprises. China's exports of rare-earth compounds (HS code 2846) were 45,800 t (gross weight), nearly unchanged compared with those in 2017. The top four destinations of these exports were, in descending order, the United States (31%), Japan (28%), the Netherlands (17%), and the Republic of Korea (6%).

Greenland (Denmark)

Greenland Minerals and Energy Ltd (GMEL) continued work on its polymetallic (REE-uranium-zinc) Kvanefjeld project in southern Greenland. In 2018, the company worked to improve its technical designs and submitted environmental and social impact assessments to the Government of Greenland. GMEL was working with several companies based in China [Baotou Meng Rong Fine Materials Co. Ltd, China Communications Construction Co., and Shenghe Resources Holding Co. Ltd (Shenghe)] and North America on the commercial development of the project. Shenghe was a major shareholder in GMEL.

Kazakhstan

Kazakhstan's National Mining Co. Tau-Ken Samruk JSC acquired the Summit Atom Rare Earth Co. LLP (SARECO) from Kazakhstan's National Atomic Co. Kazatomprom JSC. The SARECO operations in Stepnogorsk were reported to have a capacity of 1,500 t/yr of REO equivalent, although the company described the production as insignificant in 2018. SARECO's REO was a by- product of uranium mining and processing.

Madagascar

In 2018, QIT Madagascar Minerals (QMM) produced 16,000 t of monazite concentrates as a by-product of processing heavy-mineral sands to produce ilmenite and zircon sillimanite concentrates.

Malaysia

Lynas continued to increase production of rare earth compounds at its Lynas Advanced Material Plant (LAMP) near the Port of Kuantan in the State of Pahang. Lynas continued efforts to increase its capacity to produce separated neodymium and praseodymium compounds. In December, Malaysia's Ministry for Energy, Science, Technology, Environment and Climate Change (MESTECC) added preconditions for the LAMP operations licence renewal. The MESTECC preconditions included the removal of residues containing radioactive materials from Malaysia and an action plan for the disposal of "neutralisation underflow" residues.

Philippines

Japan's Sumitomo Metal Mining Co., Ltd (SMM) was preparing to begin commercial-scale production of a scandium intermediate product at its subsidiary Taganito HPAL Nickel Corp. on Palawan Island. The plant was expected to recover up to 7.5 t/yr of scandium-oxide equivalent from a process stream following the leaching of nickel laterite for nickel-cobalt sulphide. Processing of the intermediate product into scandium oxide was performed at SMM's Harima operation in Japan. Russia— PJSC Acron continued to operate a 200-t/yr pilot plant to produce REEs in the form of mixed and separated rare-earth compounds at its Veliky Novgorod facility. The feed for the operation was a by-product apatite mineral concentrate sourced from the company's Oleniy Ruchey phosphate mine in the Murmansk Region. JSC Dalur continued to recover an unknown quantity of scandium-oxide equivalent at the Dalmatovskoye uranium mining and processing operation in the Kurgan Region. In 2018, the company commissioned a pilot plant to produce aluminum-scandium master alloys. United Company RUSAL Plc, one of the world's leading aluminum producers, was conducting pilot-plant studies in the Ural Mountains to recover scandium concentrate from red mud, a residue from the processing of bauxite. RUSAL was reported to have produced scandium oxide with greater than 99% purity.

South Africa

Steenkampskraal Holdings Ltd continued plans to reopen the Steenkampskraal (SKK) monazite mine that was active from 1952 to 1963. The Company expected to produce up to 2,700 t/yr of REO equivalent in mixed carbonates.

Sweden

The Swedish Mines Inspectorate notified Leading Edge Materials Corp. that it had extended the exploration licence for the Norra Karr project in southern Sweden through 2019. In 2018, the Geological Survey of Finland performed a beneficiation study focused on removing iron impurities on bulk samples from Norra Karr. The predominate REE mineralisation was eudialyte. A prefeasibility study was based on production of 5,000 t/yr of mixed REO and a 20 year mine life, using the 0.4%-REO cut-off grade.

Tanzania

Peak Resources Ltd continued the development of its Ngualla project with plans for mining operations in southwest Tanzania.

United Kingdom

In September, Peak Resources was granted an environmental permit for its Teesside extraction and separation operations located in the Wilton industrial area near Middleborough.

FOREIGN TRADE

Exports

Exports of Rare-earth Metals (Scandium & Yttrium) in 2020-21 decreased substantially by 56% to 3.67 tonnes from 8.41 tonnes in the previous year. UAE (87%) and Bhutan (12%) were the main buyers from India (Table-5) (Fig-1).

Imports

The imports of Rare-earth Metals (Scandium & Yttrium) in 2020-21 marginally decreased by 0.64% to 470.61 tonnes as comapred to 473.64 tonnes in 2019-20. China (94%) and USA (1%) were the main suppliers to India (Table-6) (Fig-2).

Table-5: Exports of Rare-Earth Metals (Scandium & Yttrium)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	8.41	3990	3.67	4178
Bhutan	7.55	3405	0.44	247
Canada	-	-	++	19
China	-	-	0.03	11
Czech Republic	-	-	++	35
Denmark	0.04	41	++	104
Ghana	0.01	3	-	-
Israel	-	-	++	23
Korea, Rep of	0.06	6	-	-
Netherlands	-	-	++	79
UAE	0.75	490	3.2	3659
USA	++	44	-	-

Figures rounded off.

(In tonnes)

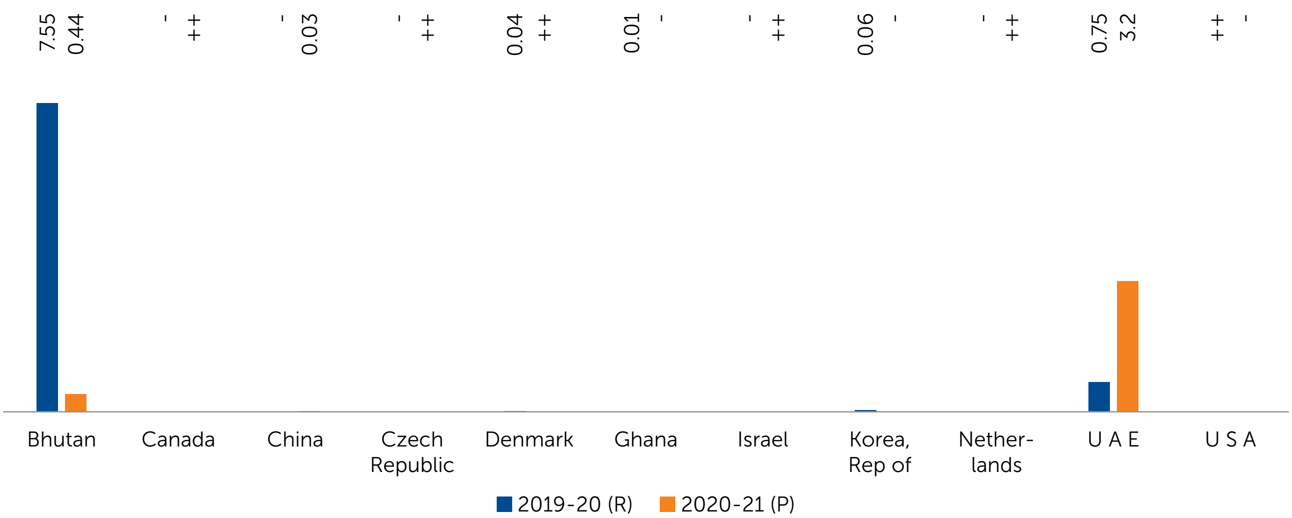


Fig 1: Country-wise Export of Rare-earth Metals (Scandium & Yttrium)

Table-6: Imports of Rare-Earth Metals (Scandium & Yttrium)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	473.64	1,62,305	470.61	1,75,172
Belgium	++	5	++	7
China	437	1,45,447	444.8	1,50,440.00
Germany	++	131	++	273
Hong Kong	34	10827	0.05	774
Japan	2	1304	11	8409
Sweden	-	-	10	519
UAE	-	-	0.04	257
UK	0.08	638	0.03	1560
USA	0.56	3954	4.69	12933

Figures rounded off.

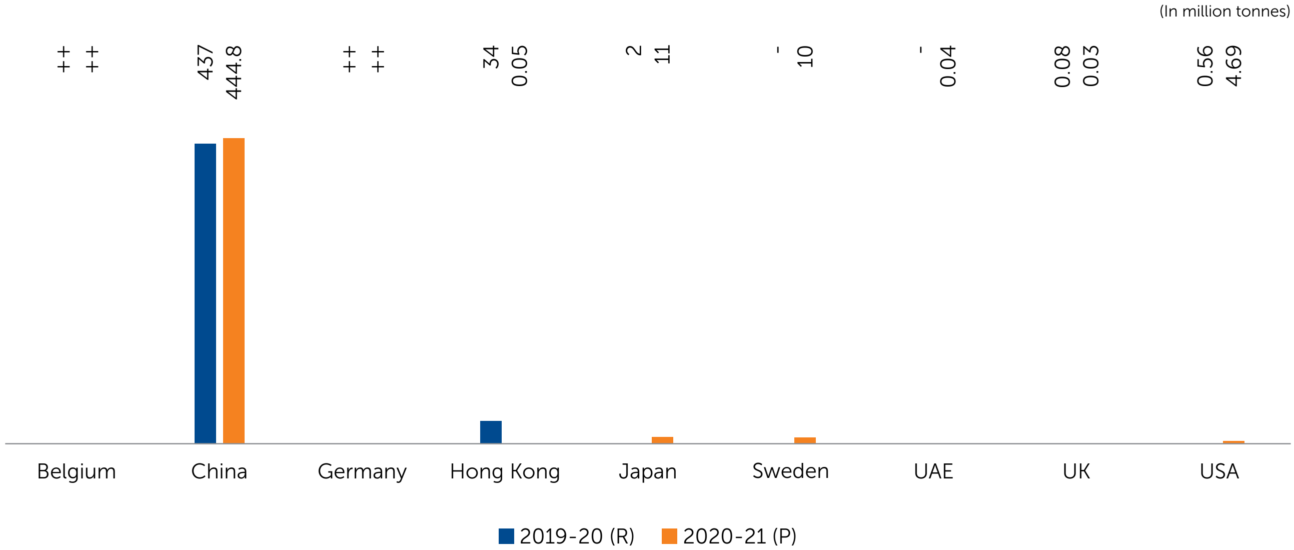


Fig 2: Country-wise Import of (Scandium & Yttrium)

FUTURE OUTLOOK

As per Roskill report 2021, the global demand of RE is to the tune of 1,31,500 tonnes and the processing capacity is of the order of 1,47,570 tonnes, while as per Argus Report 2021, the global demand of RE is to the tune of 1,59,000 tonnes and the processing capacity is of the order of 1,97,000 tonnes. Hence, as such, there is no supply chain constraint. However, Rare earth comprises of seventeen elements and are classified as light RE elements (LREE) and heavy RE elements (HREE). Some REE which are available in India, such as, Lanthanum, Cerium, Neodymium, Praseodymium, Samarium, etc. are in supply surplus while Dysprosium, Terbium, Europium which are classified as HREE are having supply constraint. These HREE are not available in Indian deposits in extractable quantity. The Government is actively engaged in capacity building for consumption of LREE.

The RE resources in India are fifth largest in the world. In comparison to China, Indian resource is significantly lean with reference to grade and it is tied with radioactivity making the extraction long drawn, complex and expensive.

Production of RE depends on deposits and end Industry consuming the products. India is one of the pioneers in processing of RE and these capabilities are available in terms of capacity, technology and skill. The Government has targeted increasing REO producing capacity by 3 times by the year 2032. Also, in order to enhance consumption of RE in Indian industries, specially Electric Vehicles, recently Government has announced a PLI scheme vide item No. 6 page 44 of Notification No. S.O. 4632(E) dated 9th November of Ministry of Heavy Industries.

AMD is presently carrying out survey and prospecting operations to augment REE in Barmer district, Rajasthan; Chhota Udaipur district, Gujarat; Cuddalore, Ariyalur, Sivaganga & Madurai districts, Tamil Nadu; and East Singhbhum district, Jharkhand. AMD is carrying out collection of xenotime-bearing polymineral concentrate in the unit established in Jashpur district, Chhattisgarh.

Further, AMD has also been undertaking exploration works to identify additional resources of monazite in the beach sand deposits along coastal tracts in parts of Ganjam and Puri districts, Odisha; Srikakulam district, Andhra

Pradesh, Thoothukudi – Kanyakumari – Tirunelveli districts, Tamil Nadu and Kottayam, Ernakulam, Thiruvananthapuram, Kollam and Alapuzha districts, Kerala.

IREL has provision for expanding the capacity of processing rare-earth-mineral to 20,000 tonnes per annum in near future.

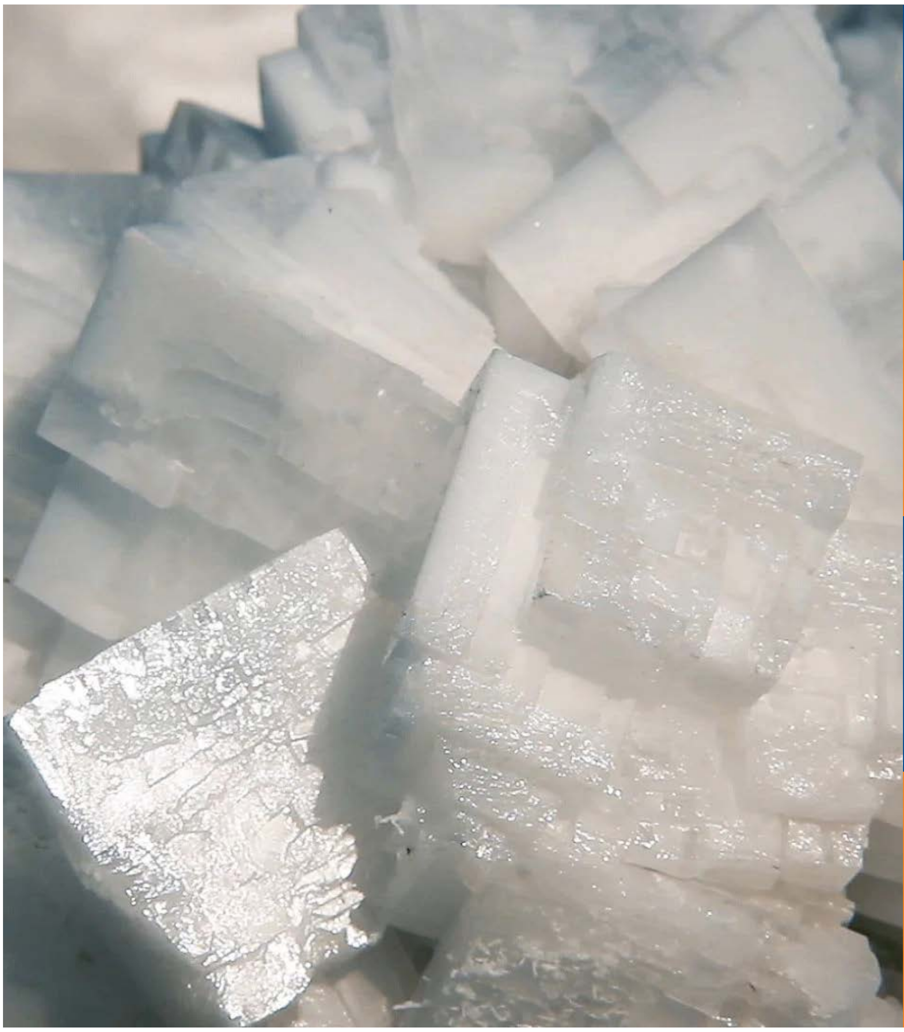
The EV car projects which were expected to boost demand for Rare-earth Magnets are likely to be put on a back burner as the industry will take some time to come back on trach.

IREL is actively pursuing setting up of greenfield operations in Kanyakumari district of Tamil Nadu and Bramhagiri district of Odisha. The proposal for harnessing the beach sand mineral deposits in Tamil Nadu by constituting a Joint Venture Company with the nominated State Government Agency, TAMIN, is under active consideration by the State Government.

As the country is gearing up towards e-mobility, green energy, e-office and other niche sectors there is need to secure rare-earth mineral resources in areas beyond the boundaries of the country. Towards the above, IREL has been given the mandate to explore and acquire rare-earth resources abroad towards which activities for constitution of a separate entity under the aegis of the Department have been taken up.

Rare-earth Magnets used in Automobiles, Consumer Durables, Smart Phones, Windmill, etc. are major end-use application for rare earths. The sales of most of these end of the chain markets are likely to see double digit reduction, this includes EV market that is a potential demand driver for Neodymium, Praseodymium and other magnetic rare earths in times to come. Demand for rare earths from Petroleum (FCC), Auto catalyst, Metallurgy, Polishing industry will stay subdued as the end-use industry would take longer to come out from the Covid-19 impact.

25. Salt



12.78
(million tonnes) Total reserves/resources of rock salt were estimated as on 1st April 2020

486
(tonnes) Production of rock salt were reported in 2020-21

8.26
(million tonnes) of salt were exported in 2020-21

98,042
(tonnes) of salts were imported in 2020-21

Salt is the most significant of all the industrial minerals. Occurrence of rock salt in India is scanty. At the time of Independence, there used to be shortfall in production of salt and the same was met through imports. Since then, India has made tremendous progress in production of salt, achieving self-sufficiency in 1953 and even started exporting salt to other countries.

Common salt, when pure, is mineral halite which is an essential item for human consumption. The per-capita consumption of salt in the country is estimated to be about 14 kg, which includes edible and industrial salt. The current annual requirement of salt in the country is estimated to be 63 lakh tonnes for edible use (including requirement for cattles) and 118 lakh tonnes for industrial use.

"Salt is a Central Subject in the Constitution of India and appears as Item No. 58 in the Union List of the 7th Schedule, which reads:

(a) "Manufacture, Supply and Distribution of salt by Union Agencies; and

(b) "Regulation and control of manufacture, supply and distribution of salt by other agencies".

The Central Government is responsible for controlling and regulating all aspects of the Salt Industry. The Salt Commissioner's Organisation (SCO), Jaipur, Rajasthan, an attached office under the Ministry of Commerce & Industry (Department of Industrial Policy & Promotion), Government of India, is the Authority entrusted with the above task. The SCO is responsible for monitoring the production, distribution, quality, prices, supply and administration of Salt Cess Act, 1953 and the Rules, made thereunder.

RESERVES/RESOURCES

As per NMI database, based on UNFC system, the total reserves/resources of rock salt as on 1.4.2020 has been estimated at 12.78 million tonnes in Mandi, Himachal Pradesh. The entire resources, fall under Remaining Resources category.

PRODUCTION AND STOCKS

The rock salt production which was only 486 tonnes during 2020-21 increased by 274% as compared to that in the preceding year (Fig-1). In the current year, production was reported by a single Public Sector mine from Himachal Pradesh (Tables-1 to 3).

Mine-head closing stocks of rock salt at the end of the year 2020-21 was 113 tonnes as against 3 tonnes in 2019-20 (Table-4).

The average daily labour employed in rock salt mines during 2020-21 was 22 as against 24 in the previous year.

India is the 3rd largest salt (common) producing country in the world after China & USA with a production of about 265.64 lakh tonnes during the year 2020-21.

Production of salt involves extensive use of renewable sources of energy. Weather conditions play an important role in production of salt.

Salt (common) is manufactured mainly by solar evaporation of sea water. Sea salt constitutes about 80% of the total salt produced in the country. Gujarat (81%) was the leading State followed by Rajasthan (8%) and Tamil Nadu (9%). Private Sector contributed significantlly in the production of salt and accounted for 97.8% of the production. Public/Joint Sector contributed 1.4% and the rest was from the Co-operative Sector during 2020-21.

The major by-products recovered in the Salt Industry are gypsum, bromine, magnesium chloride, magnesium sulphate, ammonium bicarbonate, soda ash, caustic soda and soda bicarbonate. The average number of labourers employed in the Salt Industry during 2019-20 and 2020-21 were 91,711 and 91,139, respectively.

Table-1: Producers of Rock Salt, 2020-21

Name & address of producer	Location of mine	
	State	District
Hindustan Salt Ltd, B- 427, Pradhan Marg, Rajasthan. Malviya Nagar, Jaipur - 302 017	Himachal Pradesh	Mandi

Table-2: Production of Rock Salt, 2018-19 to 2020-21

(By States)

(Quantity in tonnes; Value in ₹'000)

Country/State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	17	160	130	1447	486	14239
Himachal Pradesh	17	160	130	1447	486	14239

(In tonnes)

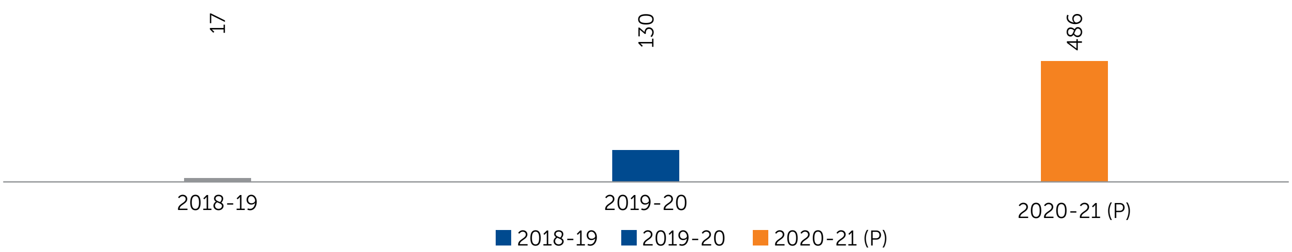


Fig 1: Production of Rock Salt in India

Table-3: Production of Rock Salt, 2019-20 and 2020-21

(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

Country/State	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	1	130	1447	1	486	14239
Public Sector	1	130	1447	1	486	14239
Private Sector	-	-	-	-	-	-
Himachal Pradesh/Mandi	1	130	1447	1	486	14239

Table- 4: Mine-head Closing Stocks of Rock Salt, 2019-20 & 2020-21

(By Principal Countries)

(In tonnes)

Country/State	2019-20	2020-21 (P)
India/Himachal Pradesh	3	113

MINING

In recent development, Drang Mohal (Bhatog) Rock Salt Mine, Village Mohal Bhatog, District Mandi, Himachal Pradesh, of M/s Hindustan Salts has started production and it produced 485 tonnes of rock salt during 2020-21. Mining is carried out by underground semi-mechanised method. The entire mining area is hill (Goverment waste land) region with no forest land cover.

USES

Salt, in addition to its culinary and domestic uses, is also used in meat packing, fish curing & its preservation, dairying, preservation & processing of hides, manufacturing of soaps, detergent & dyestuff, dyeing & finishing of fabrics, refrigeration, glazing earthenware, explosives, leather industries, bakery products, for soil stabilisation, in manufacturing artificial rubber and as wood preservative. In agriculture, salt is used for treating hay and as a fertilizer for certain crops. In countries with cold weather conditions, salt is used in deicing, i.e., removal of snow and ice, from streets and highways.

Industrial Applications

Salt is an important raw material used in Chemical Industry. It is used in the production of basic chemicals like sodium carbonate (soda ash), caustic soda, hydrochloric acid, chlorine, bleaching powders, chlorates, sodium sulphate (salt cake) and sodium metal. These basic chemicals, in turn, are used in the preparation of various end-products, such as, soaps, detergents, chlorinated hydrocarbons and carbon tetrachloride. Other important applications where salt is widely used are in food processing; as freezing-point depressant in refineries & milk supply schemes; treatment of industrial wastes; purification of drinking water; and manufacture of synthetic indigo, explosives, papers, etc.

The rock salt produced from Mandi mines contains 67.81% NaCl which is not suitable for human consumption as the content of sodium chloride is low from the required 96% NaCl necessary for human consumption. However, this salt finds application as essential suppliment in cattle feeds.

Iodised Salt

The SCO is the nodal agency for monitoring the production and quality of iodised salt at the production level and ensuring its equitable distribution in the country. Production of iodised salt continued its progressive trend and the Universal Salt Iodisation (USI), a programme under National Iodine Deficiency Disorder Control Programme (NIDDCP) reached new heights.

Iodised salt is produced by mixing potassium iodate with salt using spray, drip feed, dry mixing and submersion processes. Iodisation of salt is carried out in plants operated by Sambhar Salts Ltd (a subsidiary of Hindustan Salts Ltd), Kharagoda, Gujarat. SCO has facilitated establishment of 518 salt iodisation units including 119 refineries & washeries (152.39 lakh tonnes) with an annual installed capacity of 221.86 lakh tonnes up to March 2021. Production of 67.02 lakh tonnes of iodised salt during 2019-20 and 78.58 lakh tonnes in2020-21 was reported. During the year 2020-21, the production of refined salt was 59.11 lakh tonnes as compared to 49.95 lakh tonnes during last year 2019-20, The Bureau of Indian Standards (BIS) has revised the specifications of iodised salt and formulated new specifications for refined iodised salt and Vacuum Evaporated iodised salt under IS 7224:2006. BIS has prescribed IS 797:1982 (Reaffirmed 2012) as specification of common salt for chemical industries.

Potassium Iodate Manufacture

Potassium iodate, used for fortifying salt with iodine is produced indigenously, however, iodine, the basic raw material for its production is imported. There are about 13 potassium iodate manufacturing units, registered with the Salt Commissioner.

Statewise production of salt (common) during the year 2020-21 is furnished in Table-5.

Table-5: Statewise Production of Salt (Common), 2020-21

(By States)

(In lakh tonnes)

States	2020-21
India	265.64
Andhra Pradesh	2.85
Goa	0.01
Gujarat	216.39
Karnataka	0.12
Maharashtra	0.7
Odisha	0.02
Rajasthan	21.56
Tamil Nadu	23.93
West Bengal	0.06

Source: Salt Commissioner, Govt. of India, Jaipur, Annual Report, 2020-21

CONSUMPTION

Salt is extensively used in various industries like Caustic Soda, Soda Ash, Soaps & Detergents, Chemicals, Water softening plants, dyes etc. The Chlor-Alkali Industries, however, are the major consumer of salt. Various industries in the country consumed 101.96 lakh tonnes of salt during the year 2020-21 as against 113.66 lakh tonnes in 2019-20.

TRADE POLICY

Exports of salt have been brought under Open General Licence (OGL) with effect from 25th August, 1987 vide Ministry of Commerce, New Delhi, Export Trade Control Public Notice No. 26-ETC(PN)/87 dated 25th August, 1987. The Ministry of Commerce, Government of India, vide Notification No. 482(E) dated 25th July, 1991 has exempted certain categories of export from compulsory pre-shipment inspection.

As per Foreign Trade Policy (FTP) 2015-2020, exports and imports of rock salt and common salt (including iodised salt) under Heading no. 2501 are allowed as 'Free'.

FOREIGN TRADE

Exports

During 2020-21, the exports of salt (other than common salt) decreased by about 29% to about 8.26 million tonnes from about 11.68 million tonnes in the previous year. Exports were mainly to China (34%), Republic of Korea (22%), Japan (13%) and Qatar (8%), Indonesia (6%) & Vietnam (4% each). On the other hand, the exports of salt rock decreased by about 41% to 317.38 thousand tonnes in 2020-21 from 539.86 thousand tonnes in 2019-20. The exports were mainly to Bangladesh (82%) UAE & Republic of Korea (9% each) (Fig-2). Exports of salt (other) decreased by 29% to 7.94 million tonnes during 2020-21 from 11.14 million tonnes in the previous year. Exports were mainly to China (36%), Republic of Korea (23%), Japan (14%) and Qatar (8%) (Tables-6 to 8).

Imports

The imports of salts (other than common salt) increased by 50% to 98,042 tonnes in 2020-21 from 65,263 tonnes in the previous year. Imports were mainly from UAE (45%), Pakistan (4%) and Iran (44%) under Open General Licence (OGL) (Fig-3). Similarly, import of salt rock also decreased by 13% to 52,651 tonnes in 2020-21 from 60,441 tonnes in 2019-20. The imports were mainly from UAE (63%), Pakistan (7%) and Iran (27%). On flipside import of salt (other) increased by 841% to 45,391 tonnes during 2020-21 from 4,822 tonnes in the previous year. The imports were mainly to Iran (64%), UAE (23%), UK & China (4% each) and Thailand (2%) (Tables-9 to 11).

Table-6: Exports of Salt (Other Than Common Salt)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	11681705	13681149	8260913	10571743
China	4861999	5061355	2839885	3092014
Korea, Rep of	2059417	2406765	1835411	2363062
Japan	1329043	1624468	1105471	1389768
Qatar	584982	884589	639399	861159
Indonesia	572478	710003	460373	576752
Bangladesh	473100	574713	329621	459803
Taiwan	297473	284666	228390	272597
Nepal	37619	121911	49296	192792
Thailand	160028	181453	145698	181750
Vietnam	562459	578265	140820	175657
Other countries	743107	1252961	486549	1006389

Figures rounded off.

Table-7: Exports of Salt Rock

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	539856	558987	317376	489122
Bangladesh	310484	339612	260222	360285
UAE	313	5680	27511	34221
Korea, Rep of	-	-	27150	26485
USA	290	11466	574	15376
Singapore	66	2092	233	8903
UK	66	2856	166	3962
Australia	119	7345	125	3489
Japan	27	763	48	3286
Canada	61	2418	100	3178
Nepal	93	2008	272	2717
Other countries	228337	184747	975	27220

Figures rounded off.

(In tonnes)

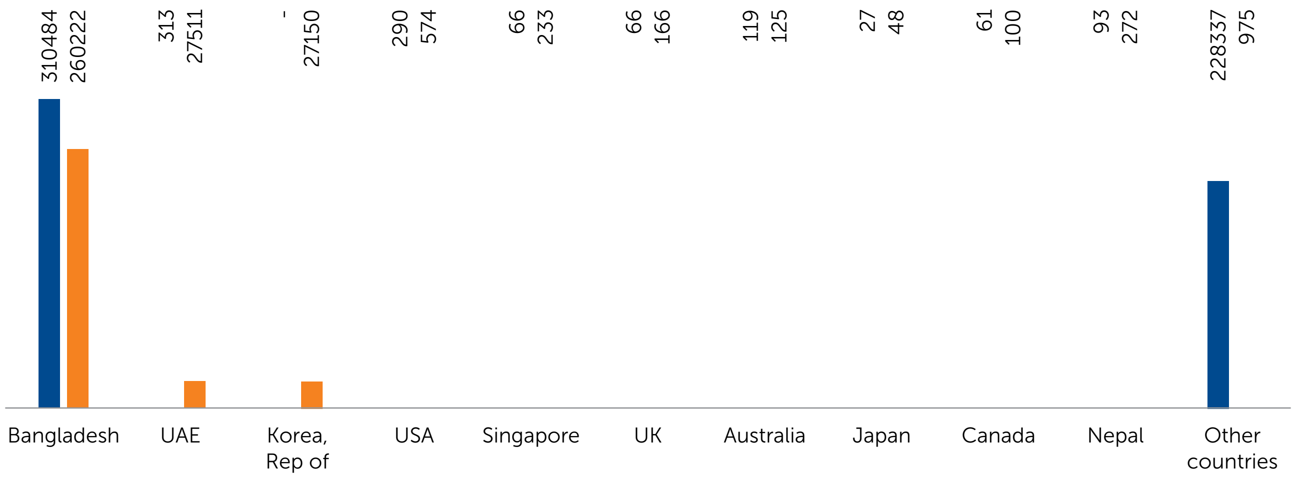


Fig 2: Countrywise Exports of Salt Rock

Table-8: Exports of Salt (Other)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	11141849	13122162	7943537	10082621
China	4689364	4931138	2839883	3091734
Korea, Rep of	2059417	2406765	1808261	2336577
Japan	1329016	1623705	1105423	1386482
Qatar	584733	880953	639279	858864
Indonesia	572478	710003	460373	576752
Taiwan	297473	284666	228390	272597
Nepal	37526	119903	49024	190075
Thailand	160005	180386	145674	179196
Vietnam	562459	578265	140820	175657
Tanzania	130172	154293	128956	149275
Other countries	719206	1252085	397454	865412

Figures rounded off.

Table-9: Imports of Salt (other than Common salt)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	65263	466170	98042	645494
Iran	9773	40069	43373	201965
UAE	32014	117221	43728	195425
Belgium	172	77531	288	47028
USA	105	24012	260	33875
UK	1282	14934	1946	21871
Spain	135	66737	43	21104
Thailand	385	11048	703	20349
Germany	311	11352	684	18554
Malaysia	442	7255	908	18516
Pakistan	19535	66989	3730	17039
Other countries	1109	29022	2379	49768

Figures rounded off.

Table-10: Imports of Salt Rock
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	60441	226758	52651	252159
UAE	31839	116411	33342	139526
Iran	9050	37719	14293	71350
Malaysia	442	7255	908	18474
Pakistan	19037	62322	3514	12678
Germany	27	802	459	8461
Afghanistan	25	328	46	638
Poland	--	--	10	259
USA	--	--	++	249
Egypt	--	--	54	198
Turkey	20	152	24	166

Figures rounded off.

(In tonnes)

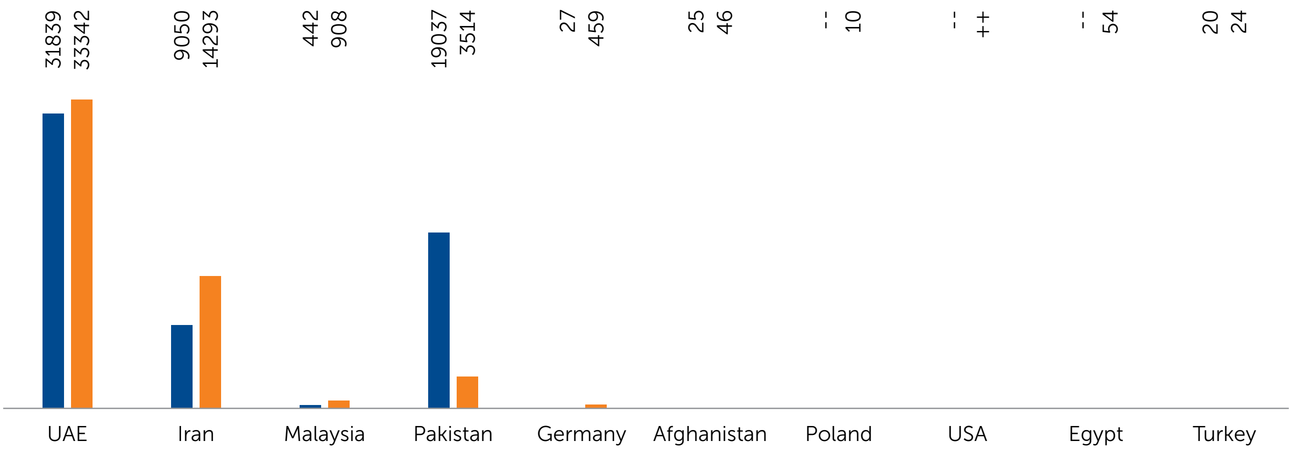


Fig 3: Countrywise Imports of Salt Rock

Table-11: Imports of Salt Rock
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	4822	239412	45391	393335
Iran	723	2350	29080	130615
UAE	175	810	10386	55899
Belgium	172	77531	288	47027
USA	105	24012	260	33626
UK	1282	14927	1946	21852
Spain	135	66737	43	21068
Thailand	385	11048	703	20349
China	806	6849	1606	15275
Germany	284	10550	225	10093
France	11	2170	11	9935

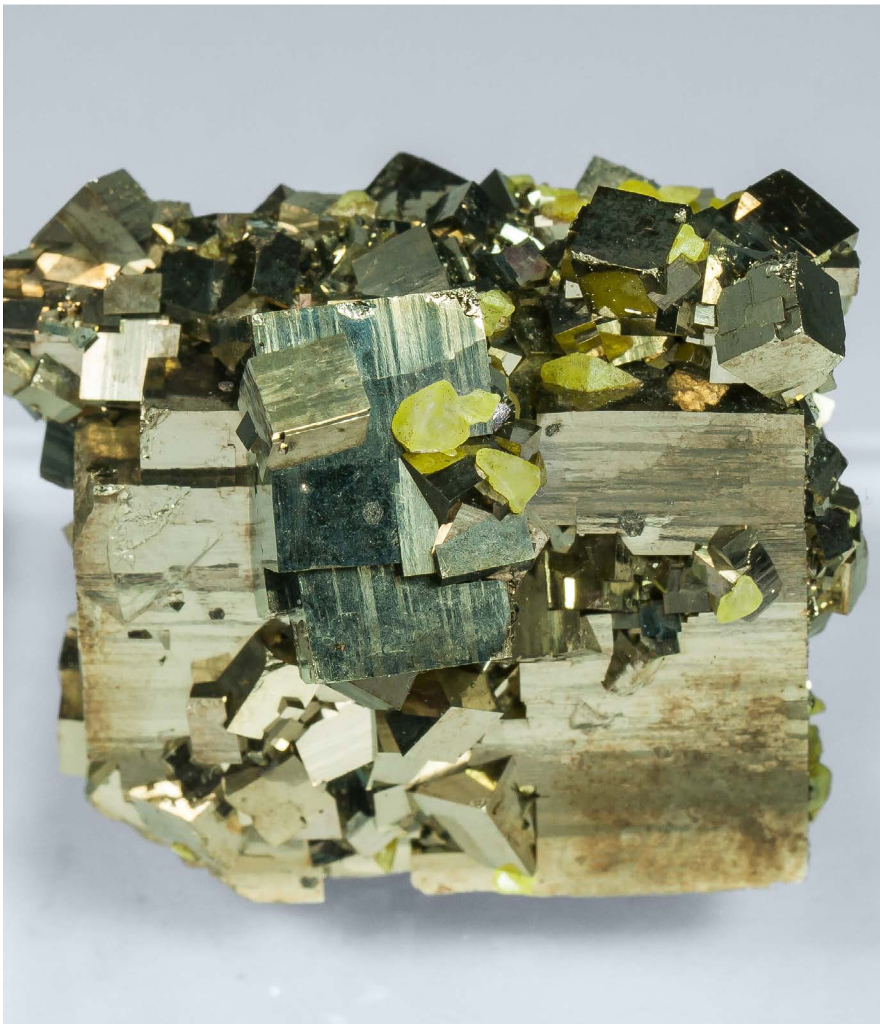
Figures rounded off.

FUTURE OUTLOOK

Sambhar Salts Ltd (SSL) approximately produces 2 lakh tonnes of raw salt every year. In addition, approximately 40,000 tonnes of processed salt are also produced. Schemes are also under preparation to enhance further capacity of raw salt production to 10 lakh tonnes per annum.

Hindustan Salt Limited has awarded the long term contract through open tender in May-2021 for large scale commercial mining of rock salt at Mandi, Wherein modern Trackless underground mining is proposed to be used to enhance production up to 50,000 MT/annum. This proposal forms a part of Hon'ble PM's vision of Atmanirbhar Bharat wherein it is planned to produce adequate quantity of Himalayan Rock Salt so that complete import of Rock Salt both from Iran and Pakistan gets stopped within 2 years,we also intend to install Salt Refinery for processing of Rock Salt with latest technology as part of contract.

26. Sulphur & Pyrites



1,674
(million tonnes) Total reserves/ resources of pyrites were estimated as on 1st April 2020

737
(thousand tonnes) Production of sulphur were reported in 2020-21

8,02,713
(tonnes) of sulphur were exported in 2020-21

1.46
(million tonnes) of sulphur were imported in 2020-21

Sulphur is an essential raw material for many chemical industries and is essentially used for the production of sulphuric acid which in turn is used for the production of chemical fertilizers, textiles, dyestuffs, pickling and galvanising of steel, storage batteries, refining of petroleum, explosives and other acids.

In India, presently there are no mineable elemental sulphur reserves. Sulphur combines directly with almost all the elements with the exception of gold, platinum and the noble gases. In its native form, sulphur is a yellow crystalline solid. It can be found as a pure element or as sulphate or sulphide minerals. The crystallography of sulphur is complex. Depending on the specific conditions, the sulphur allotropes form several distinct crystal structures, with rhombic and monoclinic S_8 best known.

Pyrites is naturally occurring mineral comprised of the elements iron and sulphur (FeS_2). It is used for manufacture of sulphuric acid, and as direct feed for soil conditioning. Pyrite is a fairly ubiquitous mineral and it occurs most commonly in sedimentary rocks. Pyrite has a brass yellow colour, brownish black streak, metallic lusture and occurs as cubic crystals. Pyrites includes a range of sulphide materials, such as, marcasite, pyrite and pyrrhotite. Marcasite usually occurs in low temperature metasediments and sedimentary rocks. Pyrrhotite occurs usually in magmatic or contact metasomatic deposits associated with basic igneous rocks and high temperature sulphide veins and is often nickeliferous. Pyrites was used as a substitute for sulphur in the manufacture of sulphuric acid. However, there was no production of pyrites since 2003.

Native sulphur deposit has been reported in Puga Valley of Leh district in the Union Territory of Jammu & Kashmir. The grade of the deposit ranges from 9% to 24% of sulphur. Small occurrences of native sulphur are also reported from Barren Island of Bay of Bengal. Sulphur along with hot springs were reported from various parts of

Chamoli, Rudraprayag, Uttarkashi, etc. districts in Garhwal & Kumaun divisions of Uttarakhand. In Andhra Pradesh, native sulphur occurs in granular form with clay and silt in coastal areas of Krishna and East Godavari districts. Occurrences are also reported from Alappuzha district of Kerala and Kangra district of Himachal Pradesh.

Sulphide occurs naturally in mineral ores, oil and coal deposits. Natural waters containing elevated concentrations of hydrogen sulphide are used for therapeutic baths and have been consumed for medical purposes. Hydrogen sulphide (H2S), which exists as a colourless gas under normal conditions, has a characteristic odour of rotten eggs and occurs naturally in coal, natural gas, oil, volcanic gases and sulphur springs and lakes; H2S is a central participant in the sulphur cycle, the biogeochemical cycle of sulphur on earth. Sulphides form an indispensable link in the sulphur cycle (the reversible interconversion of sulphide and sulphate) in nature.

Petroleum refineries and gas processing plants extract H2S when making "clean fuels" and use it as a feed stock to produce sulphur and water. The domestic production of elemental sulphur is limited to by-product recoveries from petroleum refineries and fuel oil used as feedstock for manufacturing fertilizer. Tar sands-natural sand (Oil sands) formations contain about 10% bitumen and with high hydrogen sulphide content.

The sulphide ores contain sulphur and during the production of metal from sulphide ores, sulphur is released as SO2 which is used to produce sulphuric acid. The sulphuric acid thus produced contains about 32.7% of sulphur and contributes in the industries which otherwise would have used elemental sulphur.

RESERVES/RESOURCES

The total reserves/ resources of pyrites in the country as per NMI data, based on UNFC system as on 1.4.2020 has been placed at 1,674 million tonnes. There are no reserves and all resources are grouped under 'Remaining Resources' category. Out of these, about 27 million tonnes are under Feasibility (STD211) category.

Out of the total resources, Beneficiable grade resources are 62 million tonnes, Low grade 1,555 million tonnes and Soil Reclamation grade resources are about 6 million tonnes. The balance of about 51 million tonnes resources fall under Unclassified/Not-known grades. Major reserves/ resources are located in Bihar (94%) and Rajasthan (5%) (Table - 1)

Reserves/resources of sulphur (native) have been estimated in the Inferred (STD333) category only. Entire resources are located in Jammu & Kashmir and are placed at 0.21 million tonnes as on 1.4.2020 as per NMI data, based on UNFC System (Table-2).

Table-1: Reserves/Resources of Pyrites as on 1.4.2020 (P)

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves	Remaining Resources						Total (A+B)
	Total	Feasibility	Pre-feasibility	Measured	Indicated	Inferred	Total	
	(A)	STD211	STD222	STD331	STD332	STD333	(B)	
All India : Total	–	27129	32597	9590	77729	1527356	1674401	1674401
By Grades								
Soil Reclamation	–	–	3000	–	–	3024	6024	6024
Beneficiable	–	27129	29597	–	–	4902	61628	61628
Low	–	–	–	9590	26310	1519430	1555330	1555330
Unclassified	–	–	–	–	51419	–	51419	51419
By States								
Andhra Pradesh	–	–	–	–	–	880	880	880
Bihar	–	13462	9680	–	51419	1500000	1574561	1574561
Himachal Pradesh	–	–	–	–	–	2560	2560	2560
Karnataka	–	–	–	–	–	3000	3000	3000
Rajasthan	–	13667	22917	9590	26310	18392	90876	90876
Tamil Nadu	–	–	–	–	–	24	24	24
West Bengal	–	–	–	–	–	2500	2500	2500

Figures rounded off.

Table – 2 : Reserves/Resources of Sulphur (Native) as on 1.4.2020 (P)
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves	Remaining Resources						Total (A+B)
	Total	Feasibility	Pre-feasibility	Measured	Indicated	Inferred	Total	
	(A)	STD211	STD222	STD331	STD332	STD333	(B)	
All India : Total	–	–	–	–	–	210	210	
By Grades								
Sulphur (Native)	–	–	–	–	–	210	210	
By States								
Jammu & Kashmir	–	–	–	–	–	210	210	

Figures rounded off.

PRODUCTION

Sulphur (By-product)

The production of sulphur recovered as by-product from fertilizer plants and oil refineries were 737 thousand tonnes in 2020-21 as against 901 thousand tonnes in the preceding year.

The oil refineries in Public Sector reported production of sulphur. During the year 2020-21, Indian Oil Corp. Ltd contributed about 74.5% of the total production during the year. Among the States, Odisha accounted for 28% of the total sulphur production and it was followed by Kerala (19%), Haryana (19%), Gujarat (11%), West Bengal (8%), Uttar Pradesh (7%) and Maharashtra (6%) and the remaining production was contributed by Assam and Bihar (Fig-1).

In addition, refineries of Hindustan Petroleum Corp. Ltd, RIL and Essar Oil also reported recovering of by-product sulphur which in turn is used as feedstock in manufacturing fertilizers and pharmaceuticals. The Vadinar refinery of Essar Oil Ltd is also reported to produce by-product sulphur. In Fertilizer Industry, the sulphuric acid is further used for manufacturing phosphoric acid and single superphosphate (SSP) from rock phosphate (Tables - 3 to 5).

Pyrites

Pyrites Phosphates and Chemicals Ltd (PPCL) had two pyrites production units located at Amjhore (Bihar) and Saladipura (Rajasthan) besides phosphorite division in Dehradun. The Government approved closure and hiving off of these two units in July 2002 and Amjhore unit in June 2003 and since then no activity is reported.

Petroleum Refining

In fossil fuels, sulphur is naturally present as an impurity when fuel is burnt, the sulphur is released as sulphur dioxide an air pollutant. Hydrodesulfurisation (HDS) is a catalytic chemical process widely used to remove sulphur from natural gas and from refined petroleum products, such as, gasoline or petrol, jet, fuel, kerosene, diesel and fuel oils. Sulphur is a by-product produced in various refineries processing high sulphur crude oil. Sulphur is produced from the sulphur-rich fuel gas as a process to reduce the emission level of sulphur in the atmosphere along with flue gases from the furnaces. Mathura refinery started production of sulphur from beginning itself and sulphur recovery units have been provided in Haldia, Koyali, Panipat, Mathura and Guwahati refineries.

Refinery-wise Sulphur (by-product) production capacity of Indian Oil Corporation Ltd is as under:

Unit	Production Capacity ('000 MTPA
Mathura	48.0
Haldia	24.0
Koyali	18.0
Panipat	144.0
Barauni	12.0
Guwahati	0.6

Specification of sulphur at Mathura, Panipat, Koyali, Haldia, Barauni & Guwahati refineries is as under:

Property	
Purity	99.9
Colour	Yellow
Shape	Lump

Table-3: Principal Producers of By-product Sulphur, 2020-21

Name & address of producers	Location of plant/refinery	
	State	District
Indian oil Corporation Ltd,	Assam	Kamrup Metro,
(Refineries Division),		Tinsukia
Scope Complex, Core-II,		Chirang
7, Institutional Area,	Bihar	Begusarai
Lodhi Road,	Gujarat	Vadodara
New Delhi -110 003.	Haryana	Panipat
	Odisha	Jagatsinghpur
	Uttar Pradesh	Mathura
	West Bengal	Purba Medinipur
Numaligarh Refinery	Assam	Golaghat
Limited,		
122S, G. S. Road,		
Christanbasti,		
Distt- Guwahati,		
Assam - 781 005.		
Bharat Petroleum	Maharashtra	Mumbai
Corporation Ltd,	Kerala	Ernakulam
Bharat Bhavan, 4 & 6,		
Currimbhoy Road,		
Ballard Estate,		
Mumbai-400 001,		
Maharashtra		

Note: Sulphur is recovered as by-product from fertilizer plants and oil refineries (excluding units working under Private Sector)

Table-4: Production of Sulphur (By-product) 2018-19 to 2020-21
(By States)

(In tonnes)

State	2018-19	2019-20	2020-21 (P)
India	890400	900942	737337
Assam	7100	5955	6447
Bihar	7050	6843	7135
Gujarat	91962	97107	82450
Haryana	176755	170907	138025
Kerala	225857	227253	142166
Maharashtra	46967	55659	41375
Odisha	239344	253697	209387
Uttar Pradesh	51738	47955	54234
West Bengal	43627	35566	56118

(In tonnes)

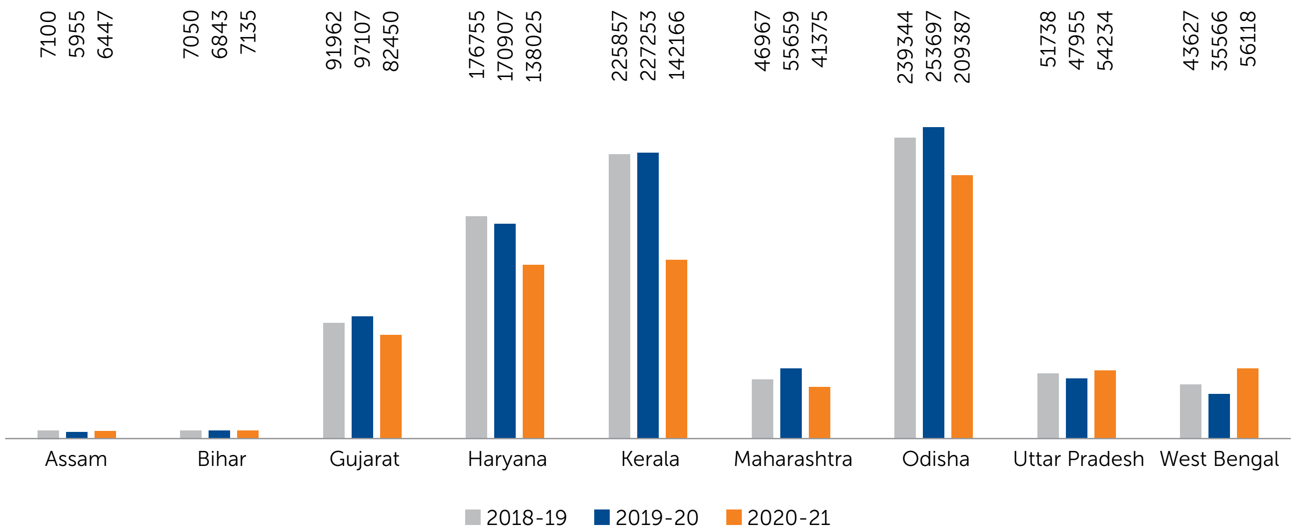


Fig 1: Statewise Production of Sulphur

Table-5: Production of Sulphur (By-product) 2018-19 and 2019-20

(By Sectors/States/Districts)

(In tonnes)

State/District	2019-20		2020-21 (P)	
	No. of units	Quantity	No. of units	Quantity
India/ Public sector	12	900942	12	737337
Assam	4	5955	4	6447
Chirang	1	1218	1	1523
Tinsukia	1	340	1	246
Kamrup Metro	1	694	1	218
Golaghat	1	3703	1	4460
Bihar/ Begusarai	1	6843	1	7135
Gujarat/ Vadodara	1	97107	1	82450
Haryana/ Panipat	1	170907	1	138025
Kerala/ Ernakulam	1	227253	1	142166
Maharashtra/ Mumbai	1	55659	1	41375
Odisha/ Jagatsinghpur	1	253697	1	209387
Uttar Pradesh/ Mathura	1	47955	1	54234
W. Bengal/ Purba Medinipur	1	35566	1	56118

USES

Flowers of Sulphur (sublimed sulphur)

Powdered form of sulphur produced by sublimation process that which may contain up to 30% of the amorphous allotrope are generally used in rubber vulcanisation, agricultural dusts, pharmaceutical products and stock feeds.

Sulphur dioxide (SO_2)

Sulphur dioxide is a by-product gas generated during processing of sulphide ores as well from other industries. It is used in many industrial processes such as, chemical preparation, refining, pulp-making and solvent extraction and also is the feed stock to manufacture sulphuric acid. Sulphur dioxide is also used in the preparation and preservation of food because it prevents bacterial growth and browning of fruit.

Sulphuric Acid

Sulphuric acid is a strong mineral acid with the formula H_2SO_4. It is soluble in water at all concentrations. Sulphuric acid has many applications and is produced in greater amounts than any other chemical besides water. Principal uses include ore processing, fertilizer manufacturing, oil refining, waste water processing and chemical synthesis.

Miscellaneous

One of the direct uses of sulphur is in vulcanisation of rubber. Sulphur is a component of gunpowder. It reacts directly with methane to give carbon disulphide, which is used in the manufacturing of cellophane and rayon.

Elemental sulphur is mainly used as a precursor to other chemicals. Most of the sulphur is converted to sulphuric acid (H_2SO_4), which is of prime importance to the world economy.

The production and consumption of sulphuric acid are an indicator of a nation's industrial development. The principal use of sulphuric acid is in the manufacture of phosphatic fertilizer.

Other applications of sulphuric acid include oil refining, waste water processing and mineral extraction. Sulphur compounds are also used in detergents, fungicides, dyestuffs and agrichemicals. In silver based photography, sodium and ammonium thio-sulphate are used as "fixing agents". Sulphites, derived from burning sulphur, are used to bleach paper. They are also used as preservatives in dried fruit and processed fruit products.

Sulphur is used as a light-generating medium in the rare lighting fixtures known as "sulphur lamps". The sulphur lamp is a highly efficient full-spectrum electrodeless lighting system whose light is generated by sulphur plasma that has been excited by microwave radiation.

Nitrogen (N), phosphorus (P) and potassium (K) are critical components of a well-fertilized crop. But to achieve yields and more nutritious foods, crops need sulphur (S). It improves protein and oil percentage in seeds, cereal quality for milling and baking, marketability of dry coconut kernel (copra), quality of tobacco, nutritive value of forages, etc. It is associated with special metabolisms in plant and the structural characteristics of protoplasm. Judicious application in sulphur-deficient soils is a cost-effective way to produce more food and feed.

Concrete binder made with sulphur is an eco-efficient alternative to conventional Portland cement for paving stones, sidewalks and building foundations. In road construction, sulphur technology can replace up to 30 per cent of asphalt binder, a high energy-intensive input in blacktop roads. Sulphur-enhanced roads and parking lots offer a longer life cycle.

INDUSTRY

Coromandel International Ltd, formerly Coromandal Fertilizers Limited (CFL), is a leading manufacturer of a wide range of fertilizers & pesticides. Manufacturing units are located at Vizag, Kakinada and Ennore. The plants have the flexibility to produce 13 products from multiple rock and acid combinations. As per Annual report 2020-21 of Coromandel International Ltd, the company is revamping Ranipet Sulphuric Acid plant for improvement in energy conservation. The environmental concerns have been incorporated in the development of its products and produces Sulphur enhanced fertilizer grades, 24-24-0-8S & 20-20- 0-13S are manufactured.

The present production facility of the Fertilizers and Chemicals Travancore Limited (FACT) includes manufacture of 3,30,000 metric tonnes per annum of sulphuric acid of Cochin Division. During the financial year 2020-21, FACT has started trading of Chemicals including Sulphuric Acid. Civil foundation work is in progress for construction of two Sulphuric Acid storage tank (5000 metric tonnes) at FACT Cochin Division. The Annual production of Sulphuric Acid for the year 2020-21 was 263932 metric tonnes,which is all time highest production surpassing the previous record of 258004 metric tonnes in financial year 2019-20 in the Udyogamandal Complex. In Cochin Division, during the year 2020-21, the division produced 298620 metric tonnes of Sulphuric Acid as compared to 307245 metric tonnes of Sulphuric Acid in the year 2019-20. Sulphur,a raw Material for Sulphuric Acid production, used in fertilizer production is sourced from refineries, is a by-product from crude processing. At present Company has a tie-up with BPCL-Kochi Refinery for sourcing about 60% of its annual requirement minimising import. Company also import Sulphuric Acid to meet its requirement for fertilizer production, mainly from metallurgical industry, where it is a waste / by-product during processing.

As per the Annual Report 2020-21 of Gujarat State Fertilizers & Chemical Limited, Company is considering to set up 600 metric tonnes per day Sulphuric Acid Plant on LSTK basis at Vadodara Unit. The company has carried out Detailed Project Report (DPR) through M/s tkIS for the plant capacity of 3000 metric tonnes per day Sulphuric Acid Plant at Sikka Unit. To expand Agro-product portfolio, company has successfully commissioned 22 metric tonnes per day Sulphur 90 Plant in the month of December, 2020.

HZL produce 98 % concentrated Sulphuric Acid at Chanderia, Debari and Dariba plants in the state of Rajasthan. The production capacity of Dariba plant and Chanderia plant is 0.6 million tonnes annually, while production capacity of Debari plant is 0.3 million tonnes annually. Sulphuric Acid is used in production of Single Super Phosphate Fertilizers/Zinc Sulphate/Phosphoric Acid/LABSA for detergent/Chemical Gypsum for Cement Industries/Metal Industry/Speciality Chemicals/ Dyes etc. for all spectrum of Industries.

TRADE POLICY

Imports of sulphur of all kinds other than sublimed sulphur, precipitated sulphur and colloidal sulphur under Heading No. 2503 are allowed free under the Foreign Trade Policy (FTP), 2015-20. Similarly, the imports of unroasted iron pyrites under Heading No. 2502 are allowed free.

WORLD REVIEW

Of the 14 countries that produced more than 1 million tonnes of sulphur, 12 obtained the majority of their production as recovered elemental sulphur. These 14 countries produced 88% of the total sulphur produced worldwide.

The world sulphur industry was composed of two sectors—discretionary and nondiscretionary. In the discretionary sector, the mining of sulphur or pyrites is the sole objective; this voluntary production of either sulphur or pyrites (mostly naturally occurring iron sulphide) is based on the mining of discrete deposits, with the objective of obtaining as nearly a complete recovery of the resource as economic conditions permit. In the non-discretionary sector, sulphur or sulphuric acid is recovered as an involuntary byproduct; the quantity of output is subject to demand for the primary product and environmental regulations that limit atmospheric emissions of sulphur compounds irrespective of sulphur demand. Discretionary sources (Frasch, native, and pyrites), once the primary sources of sulphur in all forms, represented only 8% of the sulphur produced worldwide in 2018.

The Frasch process is the term for hot-water mining of native sulphur associated with the caprock of salt domes and in sedimentary deposits; in this mining method, the native sulphur is melted underground with superheated water and brought to the surface by compressed air. The United States, where the Frasch process was developed early in the 20th century, was the leading producer of Frasch sulphur until 2000. Poland, with 660,000 tonnes, was the only country that produced more than 300,000 tonnes of native sulphur by using either the Frasch process or conventional mining methods. Small quantities of native sulphur were produced in Asia, Europe, and South America. The importance of pyrites to the world sulphur supply has significantly decreased; China and Finland were the top producers of sulphur from pyrites with China accounting for 86% of the world pyrite production.

Native sulphur production, including production of Frasch sulphur at Poland's last operating mine, was estimated to be about the same as that in 2017. Recovered elemental sulphur production and byproduct from metallurgy was slightly higher than that in 2017. Globally, production of sulphur from pyrites was estimated to have been the same as that in 2017. Pyrites is a less attractive alternative to elemental sulphur for sulphuric acid production, primarily because the environmental remediation cost of mining pyrites is high.

Canada

Ranked fifth in the world in sulphur production, Canada was one of the leading sulphur and sulphuric acid exporters. In 2018, sulphur production, in all forms, in Canada was slightly lower than that in 2017. About 80% of Canada's sulphur was recovered at natural gas and oil sands operations in Alberta; some sulphur was recovered from oil sands operations in Saskatchewan, petroleum refineries in other parts of the country, and as byproduct sulphuric acid from metallurgy. Canada's sulphur production was expected to remain stable over the medium term and may increase during the long term as a result of expanded oil sands production.

Environment and Climate Change Canada (2019) published information on Canada's sulphur emissions in 2017, which indicated a 9% decrease from those in 2016 and a 69% decrease from those in 1990. Sulphur emissions in Canada have declined as the result of improved sulphur recovery technology at nonferrous metal smelters but also as a result of reduced emissions from coal-fired, electric-power-generating utilities and plant closures, as well as a reduction in emissions from the petroleum-refining sector. Further decreases in sulphur emissions were achieved through the implementation of low-sulphur fuel standards.

China

China was the leading global producer of sulphur in all forms and the leading producer of pyrites, with about 25% of its sulphur in all forms coming from that source. The country was the leading sulphur importer with a total of about 11 millions tonnes, which was about one-third of global trade. Imports represented 55% to 60% of elemental sulphur consumption in China, the bulk of which was used to manufacture sulphuric acid.

China's Ministry of Transport announced the expansion of its coastal Emission Control Areas to encompass China's entire coastline. Beginning January 1, 2020, all large vessels would be required to burn bunker fuels with 0.5% sulphur content and smaller vessels would be required to use bunker fuels with 10 parts per million sulphur when the vessels were inland waterways. The policy also required seagoing vessels to use bunker fuels with 0.1% sulphur when entering inland waterway areas in China.

Table-6: World Production of Sulphur & Pyrites
(By Principal Countries)

In tonnes (sulphur content)

Country	2018	2019	2020
World: Total (Pyrites)	**6300000**	**6400000**	**5900000**
World: Total (Frash)	**600000**	**600000**	**400000**
World: Total (Recovered)	**77800000**	**78500000**	**72600000**
World: Total (Sulphur ore)	**100000**	**100000**	**50000**
Austria			
Recovered (a)	*44000	*44000	*44000
Belarus			
Recovered (a)	72718	65043	64336
Belgium(Recovered)(b)(a)	*400000	*400000	*400000
Bosnia & Herzegovina			
Recovered	3702	*3700	*3700
Bulgaria			
Recovered (b)	463393	414503	*420000
Recovered (a)	*60000	*60000	*60000
Croatia			
(Recovered)(a)	23406	12640	8618
Czech Republic			
(Recovered)(a)	*30000	*22000	*25000
Denmark			
(Recovered)(a)	4194	3554	4140
Finland			
Pyrites	271000	233000	194000
(Recovered)(b)	343377	327300	358700
(Recovered)(a)	*130000	*130000	*120000
France			
(Recovered)(a)	*370000	*370000	*370000
(Recovered)(c)	54592	*55000	*55000
Germany			
(Recovered)(a)	419597	460012	353293
(Recovered)(c)	254400	280660	213398
Greece			
(Recovered)(a)	*330000	*330000	*330000
Hungary			
(Recovered)(a)	*54000	*54000	*54000
Italy			
(Recovered)(d)	550000	550000	*550000
Lithuania			
(Recovered)(a)	93958	86041	71247
Netherlands			
(Recovered)(b)	*96000	*86000	*90000
(Recovered)(a)	*520000	510000	*510000
Norway			
(Recovered)(b)	69998	72900	73187
(Recovered)(a)	*22000	*22000	*22000
Poland			
Frasch	617370	568240	422380
(Recovered)(b)	*280000	*280000	*280000
(Recovered)(a)	23770	25200	24740

(Contd.)

Table-6 *(Contd.)*

In tonnes (sulphur content)

Country	2018	2019	2020
Portugal			
(Recovered)	*21000	*21000	*21000
Romania			
(Recovered)	*42000	*42000	*42000
Russia			
Pyrites	*71000	*71000	*71000
(Recovered)(a)	*6700000	*6700000	*6100000
(Recovered)(c)	*954000	*954000	*954000
Sulphur ore	83707	57427	*28000
Serbia			
(Recovered)(b)	*29400	*29400	*29400
Slovakia			
(Recovered)(b)	*4900	*4900	*4900
(Recovered)(a)	*85300	*85300	*85300
Sweden			
(Recovered)(b)	200122	178401	165500
(Recovered)(a)	86967	50021	39085
Turkey			
Pyrites	9142	173731	46408
(Recovered)(a)(c)	*72900	*72900	*72900
Sulphur ore	900	-	-
United Kingdom			
(Recovered)(a)	129000	130000	106000
Algeria	328247	254400	280660
(Recovered)(a)	*10000	*10000	*10000
Egypt			
(Recovered)(a)	*80000	*80000	*80000
Libya			
(Recovered)(a)	-	-	-
Morocco			
(Recovered)	*60000	*60000	*60000
Namibia			
(Recovered)	78612	72923	81500
South Africa			
(Recovered)(b)(a)	239405	919624	575491
Zambia			
(Recovered) (b)	947800	960200	*1000000
Canada			
(Recovered) (b)	505000	520000	554746
(Recovered)(a)	4828000	6418000	4349262
Cuba			
(Recovered)	3154	3234	3176
(Recovered)(a)	*20000	*20000	*20000
Mexico			
(Recovered) (b)	*556000	*556000	*556000
(Recovered)(a)	442657	364967	264078
Trinidad & Tobago			
(Recovered)(a)	*10000	*10000	*10000

(Contd.)

Table-6 *(Contd.)*

In tonnes (sulphur content)

Country	2018	2019	2020
USA			
(Recovered) (b)	672000	596000	*520000
(Recovered) (a)	9000000	8110000	*7600000
Argentina			
(Recoverd) (b)	*20000	*20000	*20000
Brazil			
Pyrites	*20000	*20000	*20000
Recoverd (b)	*292000	*292000	*292000
Recovered (a)	*239000	*239000	*239000
Chile			
(Recovered) (b)	1476456	1263119	1476154
Colombia			
(Recovered) (a)	*7000	*7000	*7000
Sulphur ore	-	-	-
Ecuador			
(Recovered) (a)(e)	*5000	*5000	*5000
Peru			
(Recovered) (d)	*556000	*556000	*556000
Venezuela			
(Recovered) (a)	*250000	*155000	*100000
Bahrain			
(Recovered) (a)	*100000	*120000	*120000
China			
Pyrites	*5900000	*5900000	*5610000
(Recovered)	*11600000	*11600000	*11390000
India			
(Recovered) (b)(f)	*1200000	*1200000	*1200000
(Recovered) (a)(f)	890400	900942	737337
Indonesia			
(Recovered) (b)	*160000	*160000	*160000
(Recovered) (a)	*120000	*120000	*120000
Iran			
(Recovered) (d)	2200000	*2200000	*2200000
Iraq			
(Recovered) (a)	*6583000	*6792000	*5858000
Israel			
(Recovered) (a)	75934	70973	45184
Japan			
(Recovered) (b)	1710961	1629656	1728654
(Recovered) (a)	1697355	1629365	1411860
Jordan			
(Recovered) (a)	*490000	*490000	*490000
Kazakhstan			
(Recovered) (b)	*604000	*604000	*604000
(Recovered) (a)	*2620000	*2625000	*2484000
Korea, Rep. of			
(Recovered) (b)	*1078000	*1078000	*1078000
(Recovered) (a)	2000000	1999000	2000000
Kuwait			
(Recovered) (a)	*880000	*860000	*780000

(Contd.)

Table-6 *(Concld)*

In tonnes (sulphur content)

Country	2018	2019	2020
Oman			
(Recovered) (a)	*49000	*48000	*48000
Pakistan			
(Sulphur ore)(g)	22040	20715	*20000
Philippines			
(Recovered) (b)	*169000	*169000	*169000
(Recovered) (a)	*2500	*2000	*2000
Qatar			
(Recovered) (a)	*1669500	*1648500	*1593900
Saudi Arabia			
(Recovered) (a)	*3900000	*3700000	*3500000
Singapore			
(Recovered) (a)	*300000	*300000	*300000
Syria			
(Recovered) (a)	*1500	*1500	*1500
Taiwan			
(Recovered)	169698	195358	167336
Thailand			
(Recovered) (b)	*-	*-	*-
(Recovered) (a)	*205000	*205000	168526
Turkmenistan			
(Recovered) (a)	*365000	*363000	*299000
UAE			
(Recovered) (a)	*2474000	*2523000	*2318000
Uzbekistan			
(Recovered) (b)	*131000	*131000	*131000
(Recovered) (a)	*84000	*81000	*61000
Australia			
(Recovered) (b)	*810000	*810000	*810000
(Recovered) (a)	*90000	*90000	*90000
New Zealand			
(Recovered) (a)	*35000	*35000	*35000

Source: BGS, World Mineral Production, 2016-2020

a: From petroleum refining and/or natural gas

b: From metal sulphide processing

c: Other; d: Sulphur, all forms

e: Including Frasch

f: Years ended 31st March following that stated.

** India's production of Sulphur (by-product) during 2018-19, 2019-20 and 2020-21,was 8,90,400 tonnes, 9,00,942 tonnes and 7,37,337 tonnes respectively.

* Estimated

FOREIGN TRADE

Exports

Exports of sulphur (excluding sublimed, precipitated and colloidal) increased marginally to 8,02,713 tonnes in 2020-21 as compared to 8,02,175 tonnes in the preceding year. Exports were mainly to China (97%), Jordan and Papua New Guinea (1% each) (Fig-2). On the other hand, exports of sulphur (sublimed, precipitated and colloidal) decreased marginally by 6% to 15,756 tonnes in 2020-21 as compared to 16,811 tonnes in the preceding year. Exports were mainly to Netherlands (21%), USA (16%), Indonesia (9%), Russia, Thailand & Brazil (8% each) and South Africa & Italy (4% each) (Tables-7 to 11). Exports of sulphur (sublimed) & precipitated were at 15,754 tonnes & 2 tonnes, respectively.

Imports

Imports of sulphur (excluding sublimed, precipitated and colloidal) increased by 18% to 1.46 million tonnes in 2020-21 from 1.24 million tonnes in the previous year. Imports were mainly from UAE (16%), Qatar (53%), Oman (10%), Kuwait (6%), Saudi Arabia (5%), Singapore & Bahrain (3% each) (Fig-3). Imports of sulphur (sublimed, precipitated and colloidal) increased by 15% to 862 tonnes in 2020-21 from 752 tonnes in the previous year. Imports were mainly from Taiwan (40%), Slovenia (37%), Republic of Korea (11%), China (6%) and Malaysia (3% each) (Tables -12 to 16). Imports of sulphur (sublimed) & precipitated were at 814 tonnes & 9 tonnes, respectively.

Table-7: Exports of Sulphur (Excl. Sublimed, Precipitated & Colloidal) :Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**802175**	**3872834**	**802713**	**4328627**
China	718977	3385473	777803	4142691
Jordan	38501	160610	10000	37541
Papua N Gna	38500	111763	11000	33471
UAE	2731	129029	620	28779
Sri Lanka	1187	20479	1069	18026
Nepal	1091	14117	836	12303
Turkey	120	7666	126	9396
Azerbaijan	-	-	92	8562
Mexico	20	1961	40	4373
Djibouti	-	-	169	3452
Other countries	1048	41736	958	30033

Figures rounded off.

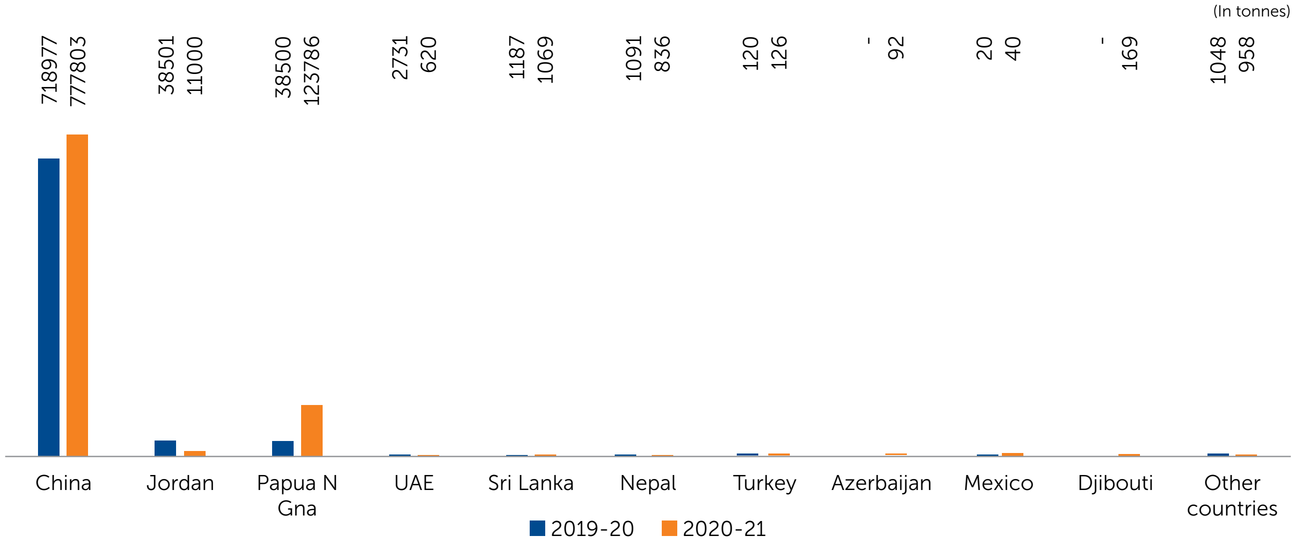


Fig 2: Countrywise Export of Sulphur

Table-8: Exports of Sulphur (Sublimed, Precipitated & Colloidal) : Total

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**16811**	**1917964**	**15756**	**1777105**
Netherlands	3353	406857	3367	413979
USA	2826	310857	2475	260094
Brazil	1248	139495	1317	143832
Indonesia	1383	150631	1378	141906
Russia	1242	140581	1237	136992
Thailand	1240	138243	1308	133794
Italy	704	83192	789	97743
South Africa	1007	124705	757	95890
Spain	720	77855	605	68631
Portugal	624	72713	528	62421
Other countries	2464	272835	1995	221823

Figures rounded off.

Table-9: Exports of Sulphur (Colloidal)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	24	++	9
Spain	-	-	++	4
Singapore	-	-	++	3
China	-	-	++	1
Taiwan	-	-	++	1
UAE	++	19	-	-
Kenya	++	3	-	-
Saudi Arabia	++	1	-	-
USA	1		-	-

Figures rounded off.

Table-10: Exports of Sulphur (Sublimed)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	16810	1917785	15754	1776553
Netherlands	3353	406857	3367	413979
USA	2826	310856	2475	260094
Brazil	1248	139495	1317	143832
Indonesia	1383	150631	1378	141906
Russia	1242	140581	1237	136992
Thailand	1240	138243	1308	133794
Italy	704	83192	789	97743
South Africa	1007	124705	757	95890
Spain	720	77855	605	68627
Portugal	624	72713	528	62421
Other countries	2463	272657	1993	221275

Figures rounded off.

Table-11: Exports of Sulphur (Precipitated)
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1	155	2	543
Sri Lanka	++	++	++	302
Haiti	-	-	2	239
Swaziland	-	-	++	2
Ecuador	-	-	++	++
Sudan	1	87	-	-
Kenya	++	21	-	-
Malaysia	++	20	-	-
Ethiopia	++	10	-	-
UAE	++	10	-	-
Kuwait	++	3	-	-
Other countries	++	4	-	-

Figures rounded off.

Table-12: Imports of Sulphur (Excl. Sublimed, Precipitated & Colloidal): Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1235102	8239656	1463291	10948268
Qatar	354407	2236044	781580	5767576
UAE	595442	4074207	227627	1436414
Oman	90240	507493	150573	1417055
Kuwait	-	-	93341	654667
Saudi Arabia	17132	154202	71251	519179
Singapore	37729	217065	38195	363098
Bahrain	36798	201149	44943	354667
Japan	63939	466787	44899	319478
Korea	19081	156622	8837	78779
Taiwan	203	24189	33	9196
Other countries	20131	201898	2012	28159

Figures rounded off.

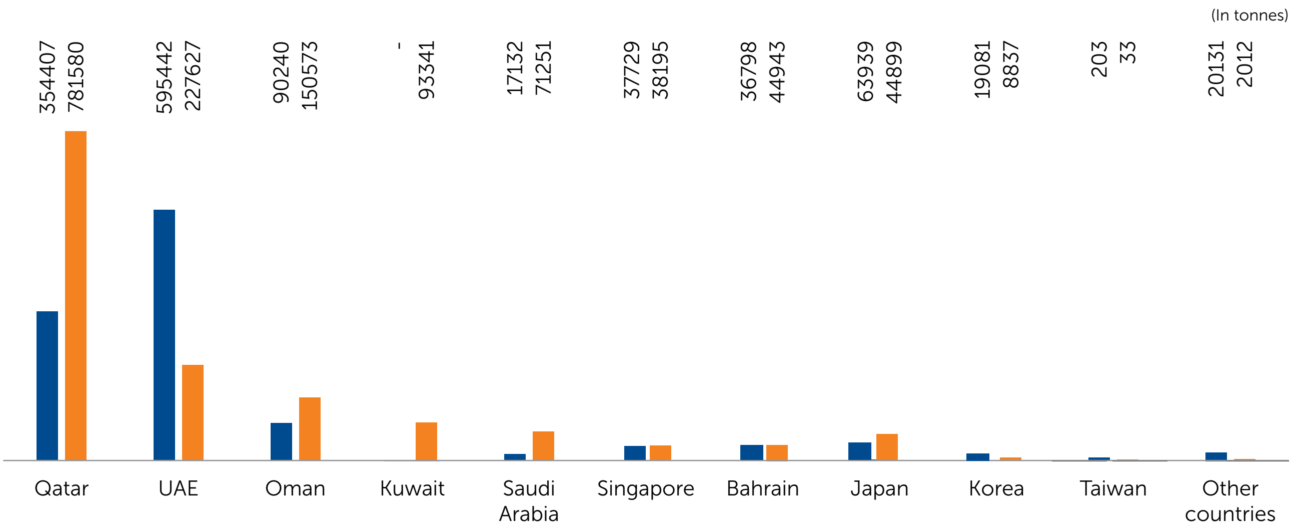


Fig 3: Countrywise Imports of Sulphur

Table – 13: Imports of Sulphur (Sublimed, Precipitated & Colloidal): Total

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
All Countries	752	42667	862	191861
Taiwan	8	2711	345	104365
Slovenia	-	-	321	53018
Korea	73	7353	95	13776
China	115	15443	50	6633
Germany	16	6361	15	5309
Belgium	++	2	9	3541
Malaysia	17	2105	22	2744
Japan	4	958	4	1036
Vietnam	++	160	1	793
USA	19	3207	++	584
Other countries	500	4367	++	62

Figures rounded off.

Table – 14: Imports of Sulphur (Precipitated)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
All Countries	528	9533	9	1568
Japan	3	804	4	990
Germany	++	35	5	578
Saudi Arabia	500	4091	-	-
Malaysia	16	2064	-	-
China	5	1400	-	-
Taiwan	4	1121	-	-
USA	++	18	-	-

Figures rounded off.

Table – 15: Imports of Sulphur (Colloidal)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
All Countries	54	8729	39	8477
Germany	16	6063	9	3764
Belgium	++	2	9	3541
Korea, Rep. of	37	2210	21	905
USA	++	126	++	159
UK	++	166	++	62
Japan	1	154	++	46
Netherlands	++	5	-	-
France	++	2	-	-
Thailand	++	1	-	-

Figures rounded off.

Table – 16: Imports of Sulphur (Sublimed)

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Quantity (t)	Value (₹'000)	Quantity (t)	Value (₹'000)
All Countries	170	24405	814	181816
Taiwan	4	1590	345	104365
Slovenia	-	-	321	53018
Korea, Rep. of	36	5143	74	12871
China, P Rp	110	14043	50	6633
Malaysia	1	41	22	2744
Germany	++	263	1	967
Vietnam, Soc Rep	++	160	1	793
USA	19	3063	++	425
Netherlands	++	100	-	-
UK	++	2	-	-

Figures rounded off.

FUTURE OUTLOOK

Country is deficient in sulphur and pyrites which are essential for Fertilizer Industry. Recovered sulphur output was expected to increase significantly worldwide. Refineries in developing countries are expected to improve environmental protection measures and eventually compare with the environmental standards of plants in Japan, North America and Western Europe in future. Higher sulphur recovery is likely to result from several factors, viz, higher refining rates, higher sulphur content in crude oil, lower allowable sulphur content in finished fuels and reduced sulphur emissions mandated by regulations.

World consumption of natural gas is expected to maintain strong growth, and sulphur recovery from that sector is likely to maintain an increasing trend. Some of the future gas production is expected to come from unconventional natural gas resources, such as, shale gas and coal-bed methane.

In the near term, increased global production and continued demand will keep the sulphur market balanced, which is expected to be followed in the long term by a surplus worldwide. International sulphur trade is expected to increase significantly, driven by demand for sulphuric acid in industrial sectors (particularly new ore-leaching operations) and a modest increase in demand for fertilizers.

27. Vermiculite

2.36

(million tonnes) Total reserves/ resources of vermiculite have been estimated as on 1st April 2020

1,260

(tonnes) Production of vermiculite were reported in 2020-21

853

(tonnes) of vermiculite were exported in 2020-21

696

(tonnes) of vermiculite were imported in 2020-21

Vermiculite is a term applied commercially to micaceous minerals (essentially hydrated silicates of Al, Mg and Fe), usually alteration products of biotite or phlogopite micas, formed by the removal of much alkalies and addition of water. Vermiculite differs from mica in its characteristic property, i.e., exfoliation. Crude vermiculite is always exfoliated before use.

RESERVES/RESOURCES

The total reserves/resources of vermiculite as on 1.4.2020 as per NMI data, based on UNFC system has been placed at 2.36 million tonnes of which about 1.60 million tonnes (68%) are placed under Reserves category and balance 0.77 million tonnes (32%) are placed under Remaining Resources category. Reserves/resources are mainly located in Tamil Nadu that reported 1.86 million tonnes (79%) followed by Andhra Pradesh with 0.20 million tonnes (8%), Karnataka 0.16 million tonnes (7%), Rajasthan 0.01 million tonnes (4%) and Jharkhand 0.03 million tonnes (1%). Nominal resources are located in Gujarat, Madhya Pradesh and West Bengal (Table-1).

Table-1: Reserves/Resources of Vermiculite as on 1.4.2020 (P)

(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon-naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	1562108	-	28888	1590996	76900	71397	25956	9800	20179	552279	8716	765227	2356223
By Grades													
Refractory	24514	-	14238	38752	-	-	-	-	-	807	-	807	39559
Unclassified	1537594	-	14650	1552244	76900	71397	25956	9800	20179	551472	8716	764420	2316664
By States													
Andhra Pradesh	45305	-	28888	74193	7349	917	5850	9800	5127	88865	-	117908	192101
Gujarat	-	-	-	-	-	-	-	-	-	1960	-	1960	1960
Jharkhand	-	-	-	-	-	-	-	-	-	30048	-	30048	30048
Karnataka	-	-	-	-	28000	50520	15500	-	1562	66658	-	162240	162240
Madhya Pradesh	-	-	-	-	197	-	66	-	-	66	-	329	329
Rajasthan	-	-	-	-	41354	19960	4540	-	13000	16555	8716	104125	104125
Tamil Nadu	1516803	-	-	1516803	-	-	-	-	-	343051	-	343051	1859854
West Bengal	-	-	-	-	-	-	-	-	490	5076	-	5566	5566

Figures rounded off.

PRODUCTION & STOCKS

Production of vermiculite at 1,260 tonnes in 2020-21 as compared to 2,774 in 2019-20 decreased by 120% as compared to that in the previous year. There were 3 reporting mines including one associate mine in 2020-21 and 5 reporting mines in the previous year.

Andhra Pradesh was the leading producer of vermiculite in 2020-21, which accounted for 60% of the total production and the remaining 40% was contributed from Tamil Nadu (Tables-2 to 4) (Fig-1).

Mine-head closing stocks of vermiculite at the end of the year 2020-21 were 7,650 tonnes as against 16,786 tonnes for the previous year (Table-5). The average daily employment of labour during the year was 35 as against 61 in the previous year.

Table-2: Principal Producers of Vermiculite, 2020-21
(By Grades/States)

Name & address of producers	Location of plant/refinery	
	State	District
T. Meenatchi Sundaram, Plot No. 2, Industrial Estate, Gudur P.O., (Mandal), SPSR Nellore - 524 101, Andhra Pradesh.	Andhra Pradesh	Nellore
Tamil Nadu Minerals Ltd, 31, Kamarajar Salaitwad House, Chepauk, Chennai-600 005, Tamil Nadu.	Tamil Nadu	Vellore

Table-3: Production of Vermiculite, 2018-19 to 2020-21
(By States)

(Qty in tonnes; Value in ₹'000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**2992**	**3709**	**2774**	**3347**	**1260**	**2157**
Andhra Pradesh	2286	1372	2190	1414	750	469
Karnataka	-	-	-	-	-	-
Tamil Nadu	706	2337	584	1933	510	1688

(In tonnes)

Fig 1: Statewise Production of Vermiculite

Table – 4 : Production of Vermiculite, 2019-20 & 2020-21
(By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/District	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	5(1)	2774	3347	3	1260	2157
Public sector	1	584	1933	1	510	1688
Private sector	4(1)	2190	1414	2	750	469
Andhra Pradesh	4(1)	2190	1414	1	750	469
Nellore	4(1)	2190	1414	1	750	469
Karnataka (Mysore)	-	-	-	1	-	-
Tamil Nadu	1	584	1933	1	510	1688
Vellore	1	584	1933	1	510	1688

Table–5: Mine-head Closing Stocks of Vermiculite 2019-20 & 2020-21
(By States)

(Qty in tonnes)

State	2019-20 (R)	2020-21 (P)
India	16786	7650
Andhra Pradesh	11563	2462
Karnataka	-	-
Tamil Nadu	5223	5188

MINING AND INDUSTRY

In Andhra Pradesh vermiculite is available in the district of Nellore, where one working mines have been reported during 2020-21. Vermiculite is mined and refined using a variety of techniques and supplied commercially in a range of particle size grades of vermiculite concentrate. In Tamil Nadu, good quality deposits of vermiculite are mostly found in the North Arcot district, where there are a few working mines. In Karnataka, vermiculite is found in the districts of Hassan, Mandya and Mysuru.

Vermiculite, when heated to a high degree of temperature exfoliates and expands 8 to 14 times in volume and yields exfoliated vermiculite by loss of water molecules. The chemical composition shows average moisture as 7.89%, loss on ignition 11.05%, SiO_2 30.52%, Fe_2O_3 16.32 % and TiO_2 2.63%. Exfoliation is observed at right angles to the strong basal cleavage. This property is the basis for its commercial use. Change in colour is observed during heating process and this depends upon the compositon of the vermiculite and furnace temperature.

USES

Vermiculite is known for its horticultural applications. It is a common component in potting soils. Unfoliated (unexpanded) vermiculite has only minor uses, such as, for circulation in drilling muds and in the annealing of steel. In order to convert raw vermiculite into a product suitable for industrial use, it must be exfoliated or expanded by heating, a process termed 'exfoliation'. Vermiculite is chemically inert, fireproof, non-conductor of electricity and a good insulator against heat (both radiant and conducted), cold and sound. Unlike cork and other organic lightweight insulating material, it neither rots nor is attacked by vermin and has a fair mechanical strength.

Vermiculite is added to soil for conditioning and lightening either alone or in conjunction with peat or compost. This will accelerate the growth by enabling the plant to absorb the NPK nutrients and promote anchorage for tender young root systems.

It is also used as a carrier in fertilizers, herbicides and insecticides. Cementing mixtures of exfoliated vermiculite and binding agents, such as, gypsum and plaster, have been important products and are applied to structural steel members in commercial buildings.

The mineral is used in various types of building boards and in pollution control applications. Finesized, untreated vermiculite concentrates are included in the preparation of fireproof plaster boards. The exfoliated product forms the basis of some lightweight plasterboard, whilst ground, exfoliated vermiculite is used in various refractory board products.

The principal uses of expanded vermiculite are based on its thermal insulating quality (due to presence of innumerable air cells), low-density, fireproof nature and granular form. Larger vermiculite granules are used as a loose fill for thermal insulation for homes, industrial structures, cold storage, refrigeration and high temperature & low temperature industrial equipment.

Vermiculite is also used for refractory and high temperature insulation as it can withstand hot face temperature of 1,000 °C, i.e., it can act as a thermal insulator.

The high absorbency and chemical inertness of exfoliated vermiculite have made it suitable for a wide range of absorbent packing materials as well as for packaged units for the containment of oil and similar liquids. Like perlite, vermiculite is a mined mineral that is heated to yield a soilless ingredient of potting mixes. Unlike perlite, vermiculite absorbs and retains water and nutrients. This quality is desirable especially in container gardens because of their quicker evaporation rates compared to in-ground plantings. On heating, vermiculite swells up and exfoliates into thin sheets the swellings may be twenty times or more. The swelled-up vermiculite is very light and thus may be used as an ingredient for the making of light cement or plaster. Vermiculite is also used in the Packing Industry and the making of insulator against heat and sound. Its colour may be yellow, brown or blue. It is very soft and slippery like soap. Pure vermiculite is also used for plaster aggregates as fireproof insulating material in steel/concrete structures. It is widely used in lightweight insulating material for roof/ floor deck system, insulation fill for homes and commercial building, packaging material, bitumen-coated vermiculite screens, acoustic insulation, etc.

SUBSTITUTES

Expanded perlite is a substitute for exfoliated vermiculite in lightweight concrete and plaster. Other denser but less costly substitutes in these applications are expanded clay, shale, slag and slate. Alternate materials for loose-fill fire-proofing insulation include fibreglass, perlite and slag wool. In agriculture, substitutes include bark and other plant materials, peat, perlite, sawdust and synthetic soil conditioners. Finely-ground pine bark also called "pine fines" is a principal ingredient of most potting mixes. As an alternative to vermiculite, pine fines also has water retentive qualities, especially with smaller particle sizes. Cotton gin waste includes gin leavings, such as, stems, leaves and hulls. Cotton gin compost renders these waste products into a viable alternative to vermiculite, also because of its ability to increase water-holding qualities in mixes. Resembling sphagnum peat moss, coir is the finish product of ground coconut husks. The University of Arkansas Co-operative Extension Service reports that coir can retain up to nine times its weight in water.

CONSUMPTION

The apparent consumption of vermiculite more than doubled in 2019-20 at 11,463 tonnes as against 4,410 tonnes in 2018-19.

POLICY

As per foreign trade policy 2015-20, the imports and exports of vermiculite (unexpanded) [ITC (HS) Code 25301010] and vermiculite insulation bricks [ITC (HS) Code 69029030] are allowed 'free'.

WORLD REVIEW

Significant deposits have been reported in Australia, China, Russia, Uganda and some other countries, but reserves and resources information come from many sources and in most cases, it is not clear whether the numbers refer to vermiculite alone or vermiculite plus other minerals and host rock and overburden and production data. The details of world reserves of vermiculite are reflected in Table 6 & 7. To provide a generalised view of the development in various countries, the countrywise description as sourced from the latest available publication of Minerals Yearbook 'USGS' 2018 is furnished below:

Brazil

In 2018, Brazil was estimated to have produced 50,000 tonnes of vermiculite, most of which was mined by Brasil Minérios Ltd., by far the leading vermiculite producer in Brazil. The company's largest mine was the Morro Pelado Mine in Sao Luis de Montes Belos municipality near Goiania in the State of Goias in central Brazil, and its primary processing plant was in Sao Luis. The mine had an estimated production capacity of 50,000 metric tonnes per year (tonnes/year) of vermiculite ore with reserves estimated in 2012 of 1.2 million metric tonnes (Mt) of vermiculite ore. With the expansion of its mining operations continuing, Brasil Minérios produced about 48,700 tonnes of vermiculite concentrate in 2017 (most recent year for which data were available). About 60% of Brazil's vermiculite products were exported, with sales in North America (50% of all exports), Europe (35%), and Asia (15%).

Near Brasilia in Catalao, Goias State, Brasil Minérios owned the mining rights to vermiculite deposits containing estimated vermiculite ore reserves of 3.3 million tonnes. Brasil Minérios' total production capacity was expected to increase to 200,000 tonnes/year when the Catalão Mine reached full capacity during the next several years. Brasil Minérios expected to meet Brazil's domestic demand for vermiculite for 50 years while continuing to be a significant exporter of the mineral. The company also expanded capacity by 15,000 tonnes/year of vermiculite at its exfoliation plants in Sanclerlandia, Goias State, and in Cosmopolis, Sao Paulo State.

Bulgeria

In 2018, Wolff & Müller Minerals Bulgaria OOD, a joint venture between companies from Bulgaria and Germany, mined vermiculite ore from its Belitza opencast mine and had limited production at, and continued development of, the nearby Verona vermiculite deposit in southwestern Bulgaria near the capital of Sofia. The company processed the crude vermiculite ore into a concentrate in superfine- and micron-sized products at its 20,000 tonnes/year vermiculite concentration plant.

China

Production levels of vermiculite in China were not available, but based on a 2016 estimate made by the Vermiculite Association that China annually exports 110,000 tonnes of vermiculite, the country's annual production likely was greater than 110,000 tonnes. Production increases in China continued to be constrained by increased enforcement of environmental regulations.

Xinjiang Yuli Xinlong Vermiculite Co., Ltd. mined vermiculite ore from its Xinlong Mine in the Bazhou area of Xinjiang Uyghur Autonomous Region. The 120,000tonnes/year vermiculite concentrate Xinlong Mine was the top-producing vermiculite mine in China, from which the company produced 30,000 cubic meters per year of exfoliated vermiculite. The company's leading product was a flake vermiculite concentrate ranging in size from 0.3 to 8.0 millimeters. The company exported most of its products, typically to developed countries and regions such as Europe, Australia, Hong Kong, Japan, the Republic of Korea, Russia, Taiwan, and the United States, but also sold products domestically.

South Africa

In 2018, South Africa continued to be the world's leading producer and exporter of vermiculite, accounting for about 43% of estimated world production In 2018, 180,000 tonnes was produced, most of which was mined by Palabora Mining Co. Ltd. Under the ownership of a consortium consisting of entities from South Africa and China led by the Industrial Development Corp. of South Africa Ltd. and China's Hebei Iron & Steel.

Group, Palabora Mining increased production in 2018 by more than 8% from that in 2017 from its mine in the Limpopo Provinc. Nearby, the company was preparing for the opencast mining of ore that was equally rich in high-purity vermiculite. The new mine was designed to produce 1.5 million metric tonnes per year of ore and yield 170,000 tonnes/year of vermiculite concentrate, extending the company's total mine life through 2031. Because of grade constraints and lower recovery rates from portions of the vermiculite ore body, the vermiculite product has continued to shift toward fine and superfine grades. Palabora Mining continued to face increased competition in the global vermiculite market, including from Brazil and Uganda, but it regained some of its market share lost in the past few years, in part through competitive pricing. Palabora Mining marketed its vermiculite products through the company's Singapore office to its three international subsidiaries in Australia, Europe, and North America.

Turkey

Organik Madencilik A.S., a 50–50 joint venture of Turkey's Yildirim Group and the Greek mining group S&B [a subsidiary of Imerys SA (Paris, France)] has completed plant construction and started producing from the country's first vermiculite mine at the Karakoc vermiculite deposit in Sivas in Central Turkey. The deposit, discovered by Turkey's Government Exploration Co. in the 1990s, is thought to hold resources of about 2.8 million tonnes of high-quality vermiculite and 2.5 million tonnesof lower quality vermiculite. The mine had a capacity of 10,000 million/year of vermiculite concentrate, which includes a significant quantity of coarse and medium grades. An unspecified portion of production was further processed by exfoliation. Sales of vermiculite concentrate and of exfoliated vermiculite were planned to go through Imerys' established network.

Uganda

In 2018, Black Mountain Resources Ltd. of Australia completed a company restructuring that included selling its interest in the Namekara Vermiculite Mine in the Manafwa district of eastern Uganda in exchange for debt relief. Black Mountain withdrew from the joint venture developing the Namekara Vermiculite Mine citing inconsistent vermiculite sales that resulted in reduced cash flow and the company's inability to service its debt obligations. Namekara Mining Co. Ltd. became the 100% owner of the Namekara Vermiculite Mine and continued mining operations. The large vermiculite deposit had almost 62 million tonnes of inferred resources with a grade of 18.2% vermiculite and containing 11 million tonnes of vermiculite. The mine had an estimated production capacity of 30,000 tonnes/year of vermiculite concentrate, which includes significant quantities of coarse and medium grades, and enough resources to operate for more than 50 years at previously announced rates of production. Black Mountain had considered a production expansion up to 80,000 tonnes/year, but Namekara Mining has not announced plans for expansion.

Zimbabwe.

Samrec Vermiculite (Pvt.) Ltd. [a subsidiary of Imerys SA (Paris, France)], the leading vermiculite producer in the country, produced vermiculite concentrate at the Shawa Mine, which is about 300 kilometers southeast of the capital of Harare. The surface mining operation with ore to a depth of 40 meters had a capacity of 40,000 tonnes/year of vermiculite concentrate and an expected mine life of more than 30 years in one of the largest vermiculite deposits in the world. The ore, which included a significant portion of large flake vermiculite, was processed into concentrates, the majority of which was exported to Asia, Europe, the Middle East, and the United States.

The Minerals Marketing Corp. of Zimbabwe, which was responsible for marketing and selling the country's industrial minerals, reported exports of 33,200 tonnes of vermiculite concentrate at a value of $3.79 million in 2018, representing a 42% increase in quantity with a 12% increase in value from about 23,300 tonnes at a value of $3.38 million in 2017. The company cited that the strong U.S. dollar and increased inland costs to sea ports had made the local product prices uncompetitive on the international market.

In 2018, the Government of Zimbabwe launched a Transitional Stabilisation Programme, set to run from October 2018 to December 2020, for economic recovery. The Zimbabwe-based Wickbury Investments (Pvt.) Ltd 's Dinhidza Vermiculite Mine in Buhera was listed with a nonoperational status and as available for investors. Wickbury Investments, which in 2015 had invested in its production facilities at the mine, marketed its product mainly to Zimbabwe's farming industry as a soil amendment to slow the leaching of fertilizers from soil after excessive rainfall while also promoting the mineral's slow release of fertilizer to the soils. In drier areas, farmers would benefit from the mineral's ability to swell and store water, increase soil aeration, and transport and store nutrients. In both instances, use of vermiculite would improve the long-term fertility of soils.

South Africa is the largest producer of vermiculite(118 thousand tonnes) in the world during 2020, followed by USA (100 thousand tonnes) and Brazil (50 thousand tonnes) (Table-7) (Fig-2).

Table-6: World Reserves of Vermiculite
(By Principal Countries)

(In '000 tonnes)

Country	Reserves
World: Total (rounded off)[a]	NA
Brazil	6,600
India*	1,600
South Africa	14,000
USA	25,000
Other countries	NA

Source: USGS, Mineral Commodity Summaries, 2022

a- Excludes China Production.

* India's total reserves/resources as per UNFC system as on 01.04.2020 were estimated at 2.36 million tonnes.

Table-7: World Production of Vermiculite
(By Principal Countries)

(In '000 tonnes)

Country	2018	2019	2020
USA[(a)*]	100	100	100
South Africa	141	158	118
Brazil	50	50	50
Zimbabwe[(a)]	33	30*	30*
Russia	26	29	9*
Turkey	18	1	19
China*	15	15	15
Bulgaria*	10	10	10
Uganda	10	10	14
Other countries	4	3	2

Source: BGS, World Mineral Production, 2016-20

** India's production of vermiculite during 2018-19, 2019-20 and 2020-21 was 3,636 tonnes, 3,322 tonnes and 1,808 tonnes, respectively.
* Estimated

(a): Sold or used by producers

(b): Including beneficiated and directly shipped material

(c) : Years ended 31 March following that stated

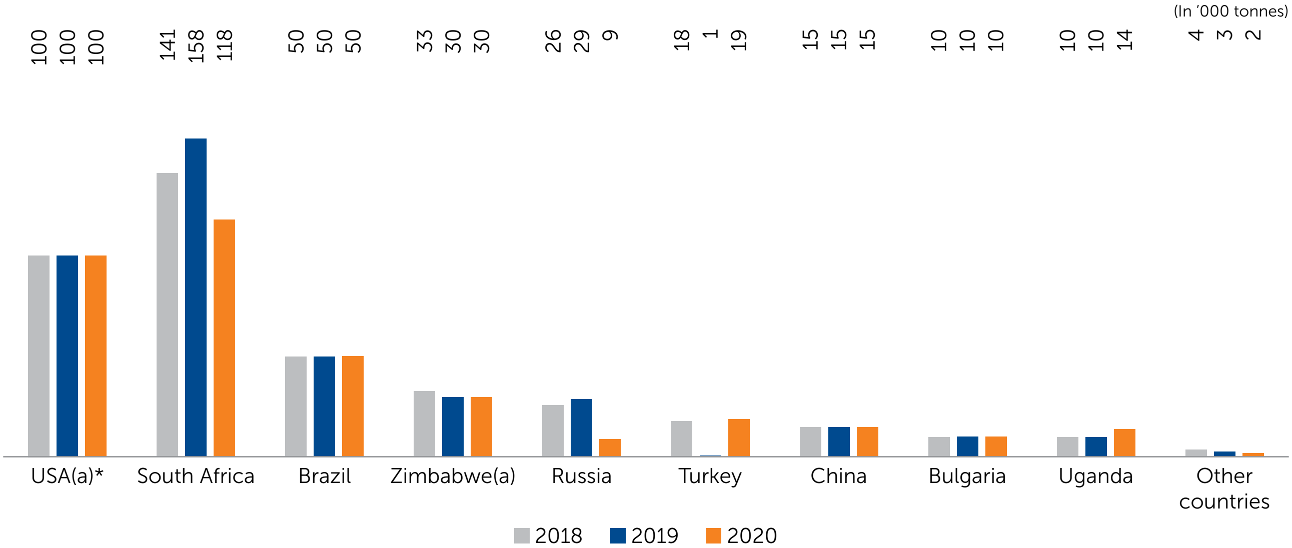


Fig 2: Countrywise Production of Vermiculite

FOREIGN TRADE

Exports

Exports of vermiculite increased marginally by 35% to 853 tonnes in 2020-21 as compared to 634 tonnes in 2019-20. Exports were mainly to Japan (35%), UAE (29%), Norway (14%), Saudi Arabia (10%), Jordan (7%) and Qatar (3%) (Table-8).

Imports

The imports of vermiculite also increased drastically by 67% to 696 tonnes in 2020-21 from 416 tonnes in 2019-20. Imports were mainly from Kenya (63%), South Africa (17%), Brazil (12%) and Japan (7%) (Table-9) (Fig-3).

Table – 8: Exports of Vermiculite

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value(₹'000)	Qty (t)	Value(₹'000)
All Countries	634	7902	853	11573
Japan	139	1916	300	4216
UAE	250	3002	250	2975
Saudi Arabia	120	1746	88	1749
Norway	96	916	120	1261
Qatar	-	-	22	467
Jordan	26	242	56	403
Nepal	++	4	5	187
Oman	-	-	5	165
Netherlands	-	-	7	124
Portugal	-	-	++	17
Other countries	3	76	++	9

Figures rounded off.

Table-9: Imports of Vermiculite

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value(₹'000)	Qty (t)	Value(₹'000)
All Countries	416	11024	696	17234
Kenya	242	5060	440	9627
South Africa	-	-	120	3638
Brazil	168	4780	84	2232
Japan	6	1184	5	905
Mozambique	-	-	20	613
Turkey	-	-	27	211
Oman	-	-	++	8

Figures rounded off.

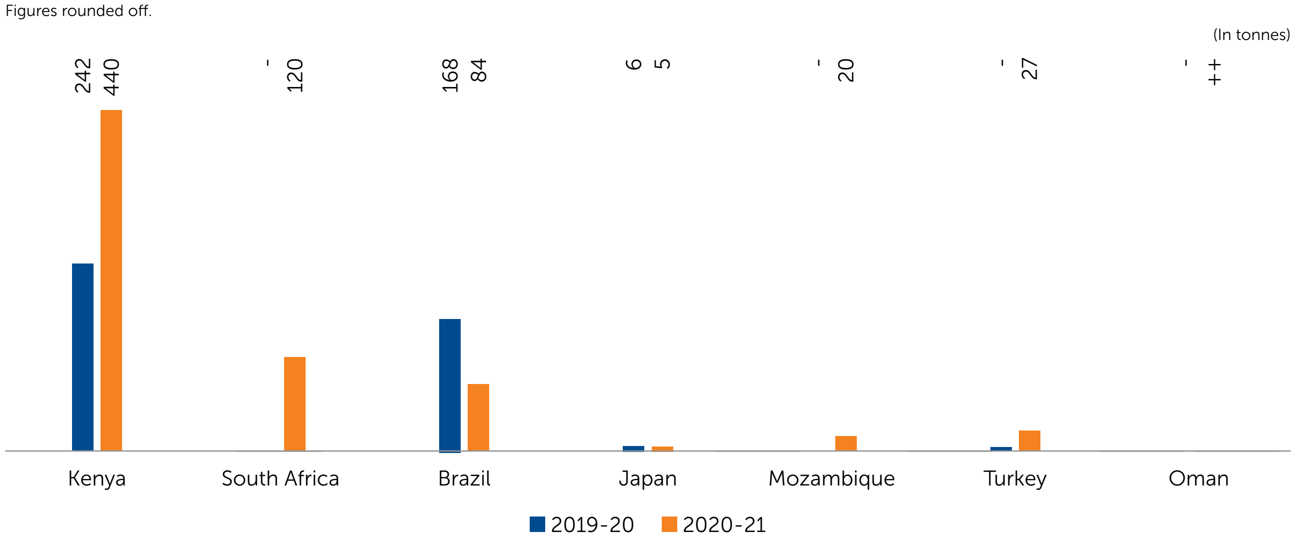


Fig 3: Countrywise Import of Vermiculite

FUTURE OUTLOOK

Exploration and development of vermiculite deposits containing medium, large and premium (coarser) grades (mostly in China and South Africa) are likely to continue because of the higher demand for these larger grades. During the next several years, operations in Brazil and the United States are expected to help maintain regional and global supplies of fine, superfine, and micron grades. Innovative applications continue to emerge including the use of fine-sized to micronsized grades of vermiculite to combat air pollution and absorb water in mines, replacing zeolites in ion-exchange columns, purifying waste water and containing or removing nuclear waste.

28. Wollastonite

25.11

(million tonnes) Total reserves/ resources of wollastonite have been estimated as on 1st April 2020

1,03,902

(tonnes) Production of wollastonite were reported in 2020-21

13,716

(tonnes) of wollastonite were exported in 2020-21

24,049

(tonnes) of wollastonite were imported in 2020-21

Wollastonite is a chemically simple mineral named in honour of English Mineralogist and Chemist Sir W.H.Wollaston. Wollastonite is composed of calcium and silica with a chemical formula $CaSiO_3$. Wollastonite may contain impurities like iron, potassium, manganese, etc. Though normally wollastonite is bright white in colour, the impurities can produce grey, cream, brown or red colour in wollastonite. Wollastonite is formed when limestone/ dolomite is subjected to high temperature and pressure in the presence of silica-bearing fluid as in skarn deposits or metamorphic rocks. It occurs as aggregates of bladed or needle-like crystals with hardness of 4.5 to 5 on Mohs scale. The uses of wollastonite in applications other than as filler include marine wallboard, paint, plastic, in refractory liners in steel mills and as a partial replacement for short-fibre asbestos in certain applications.

RESERVES/RESOURCES

Major deposits of wollastonite have been found in Ajmer, Dungarpur, Pali, Sirohi and Udaipur districts in Rajasthan. Besides, in Ghoda area, Banaskantha district in Gujarat and in Dharmapuri and Tirunelveli districts in Tamil Nadu, occurrences of a few deposits have been reported. As on 1.4.2020, the reserves/resources of wollastonite, as per NMI database, based on UNFC system are placed at 25.11 million tonnes of which Reserves under Proved and Probable categories together constitute 2.68 million tonnes (11%) and Remaining Resources constitute for the balance 22.43 million tonnes (89%). Out of the total resources, about 92% (23.11 million tonnes) including 2.68 million tonnes reserves are located in Rajasthan and the remaining about 8% resources (1.99 million tonnes) in Gujarat. Meagre resources are also located in Tamil Nadu (3,533 tonnes) (Table-1).

Table-1: Reserves/Resources of Wollastonite as on 1.4.2020 (P)
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	2388641	190739	101598	2680978	4563016	1245009	8559760	0	3325042	4597200	137461	22427488	25108466
By Grades													
Marketable	1790818	0	0	1790818	0	0	8194950	0	0	966850	0	9161800	10952618
Unclassified	449206 190739	0	639945		3680144	550276	322733	0	3325042	2647244	137461	10662900	11302845
Not-known	148617	0	101598	250215	882872	694733	42077	0	0	983106	0	2602788	2853003
By States													
Gujarat	0	0	0	0	0	0	0	0	0	1990000	0	1990000	1990000
Rajasthan	2388641	190739	101598	2680978	4563016	1245009	8559760	0	3325042	2603667	137461	20433955	23114933
Tamil Nadu	0	0	0	0	0	0	0	0	0	3533	0	3533	3533

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION & STOCKS

Production of wollastonite at 1,03,902 tonnes in 2020-21 decreased sharpely by 17% as compared to 1,24,757 tonnes in the preceding year (Fig-1). There were three reporting mines in 2020-21 as compared to four mines in the previous year. The entire production was reported only from Private Sector mines located in the State of Rajasthan (Tables-2 to 4).

Mine-head closing stocks of wollastonite at the end of the year 2020-21 were 1,18,311 tonnes as against 1,03,115 tonnes in the previous year (Table- 5).

The average daily employment of labour in wollastonite mines during 2020-21 was 215 as against 244 in the previous year.

Table-2: Principal Producers of Wollastonite, 2020-21

Name & address of producers	Location of mine	
	State	District
Wolkem Industries Ltd, P.B.21, E-101, Mewar Industrial Area, Madri, Distt Udaipur- 313 003, Rajasthan.	Rajasthan	Udaipur
Renu Atre, C-378, Pradhan Marg, Malviya Nagar, Jaipur- 302 017, Rajasthan.	Rajasthan	Ajmer

Table-3: Production of Wollastonite, 2018-19 to 2020-21
(By State)

(Quantity in tonnes; Value in ₹'000)

State	2018-19		2019-20		2020-21	
	Quantity	Value	Quantity	Value	Quantity	Value
India/Rajasthan	184063	172013	124757	139695	103902	96552

(In tonnes)

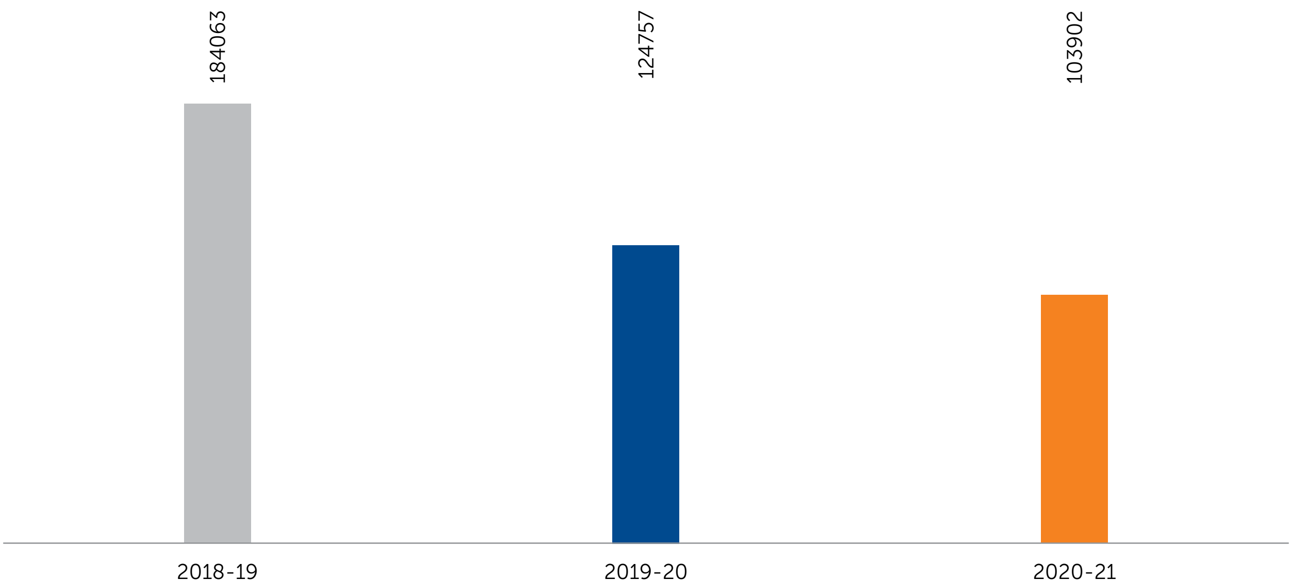


Fig 1: Production of Wollastonite in India

Table-4: Production of Wollastonite, 2019-20 and 2020-21
(By Sector/State/Districts)

(Quantity in tonnes; Value in ₹'000)

State/District	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India/Private sector	**4**	**124757**	**139695**	**3**	**103902**	**96552**
Rajasthan	4	124757	139695	3	103902	96552
Ajmer	3	3115	1510	1	312	190
Pali	-	-	-	1	-	-
Udaipur	1	121642	138185	1	103590	96362

Table-5: Mine-head Closing Stocks of Wollastonite, 2019-20 & 2020-21
(By State)

(Qty in tonnes)

State	2019-20	2020-21 (P)
India/Rajasthan	103115	118311

MINING, PROCESSING & MARKETING

Wollastonite is mined by opencast method essentially through manual and semi-mechanised method. In some of the mines viz. Belka Pahar mine of M/s Wolkem Industries Ltd in Sirohi district, Rajasthan, manual selection and manual sorting are practised for improving recovery of ore. The run-of-mine is selectively hand-sorted to the size of 30 cm to 50 cm to remove the associated minerals, such as, calcite, diopside, garnet, quartz and iron. Wollastonite, thus separated, is then crushed to various sizes at two crushing plants near Sirohi railway station with a capacity of 80,000 tonnes per year. Principal commercial grades produced are: White Kemolit (S1 to S5) and off-white Kemolit (H1 to H5 and LG 25) which are milled products in the size range of 100 to 500 mesh. Besides, micronised products are also marketed, i.e., Wolkron (1008, 1010, 1015, 1020, 1025 and 10825) in the low-aspect-ratio and Kemolit 1025 and 1020 in the high-aspect-ratio. In addition, speciality products and surface modified products are also marketed as Kemolit and Fillex, respectively. Wollastonite is processed to make it useful for various applications. The commonly associated minerals like garnet and diopside are removed by high intensity magnetic separators after grinding. Some of the other materials are chemically removed to improve binding in the resin-based products.

Processing improvements integral to new product development focus on the following:

(i) High-aspect-ratio, fine particle size grades used as reinforcements to compete against milled glass fibres, synthetic fibres and whiskers.

(ii) Fine particle size high aspect ratio grades to compete against other mineral reinforcements, such as, talcs and clays, in the thermoplastic compounds.

Hand-sorted wollastonite has few impurities and is of high-aspect-ratio.

USES & SPECIFICATIONS

The use of wollastonite depends on the acicularity or the aspect ratio, i.e., ratio between length and width of a crystal, chemical composition, brightness and fibre length. Wollastonite having aspect ratio in the range from 3:1 to 5:1 has little potential for reinforcing applications. Hence, market is primarily confined to ceramic, metallurgical fluxes and simple filler and coating applications. Wollastonite reduces the volume of the expensive plastic or resin medium and contributes to physical and chemical properties of the finished products. It improves tear strength, dielectric properties and retains mechanical properties at elevated temperatures.

Wollastonite is used primarily in automobile brakes, ceramics, metallurgical processing, paper, paint, plastic, cosmetics, adhesives and as a replacement of asbestos in asbestos-cement boards and sheets. Some of the properties that make it so useful are high brightness & whiteness, low moisture & oil absorption, low volatile content and the acicular nature of some wollastonite. A better compatibility between the polymer and the filler is achieved by chemical surface treatment of the mineral filler. Wollastonite results improved flexural modules in polypropylene and improved reinforcement in nylon. It is also used as performance additive in a wide range of construction material (concrete, stucco and adhesives).

Bulk of the demand for wollastonite in the country is in the Ceramic Industry for the manufacture of floor and wall tiles. In ceramics, wollastonite decreases shrinkage and gas evolution during firing. Small quantities are used in asbestos-cement products as a partial replacement for short fibre asbestos, paint, insecticide, marine wallboard and welding rod industries. In metallurgical applications, wollastonite serves as a flux for welding, a source for calcium oxide, as slag conditioners and to protect the source of molten metal during the continuous casting of steel. The addition of wollastonite to metallurgical fluxes provides ready fusibility, good insulating qualities and low viscosity.

A new development with very large potential is the use of wollastonite as a sequestration mineral for carbon dioxide, a major factor in global warming. Unlike other methods, sequestration by wollastonite is permanent and results in a mixture of precipitated calcium carbonate and silica that may have filler applications in paper, plastics & rubber.

SUBSTITUTE

The acicular nature of many wollastonite products allow it to compete with other acicular materials, such as, ceramic fibre, glass fibre, steel fibre and several organic fibres, such as, aramid, polyethylene, polypropylene, and polytetrafluoroethylene in products where improvements in dimensional stability, flexural modulus and heat deflection are sought. Wollastonite also competes with several non-fibrous minerals or rocks, such as, kaolin, mica and talc, which are added to plastics to increase flexural strength and such minerals as baryte, calcium carbonate, gypsum and talc, which impart dimensional stability to plastics. In ceramics, wollastonite competes with carbonates, feldspar, lime and silica as a source of calcium and silica. Its use in ceramics depends on the formulation of the ceramic body and the fixing method.

CONSUMPTION

The estimated consumption of wollastonite at 1,04,000 tonnes in 2019-20 decreased considerably by 18% as compared to 1,27,000 tonnes in 2018-19. The Ceramic

Industry is the sole consuming Industry in the entire quantity of wollastonite (Table-6).

Table-6: Estimated Consumption* of Wollastonite 2017-18 to 2019-20
(By State)

(In tonnes)

Industry	2017-18	2018-19 (R)	2019-20 (P)
All Industries	144300	127000	104000
Ceramic	144300	127000	104000

Figures rounded off.

* Includes actual reported consumption and / or estimates made from the dispatches, as reported in Form 'F' / 'H' under Rule-45 of MCDR, 2017/1988) whereever required due to paucity of data the coverage may not be complete.

WORLD REVIEW

World reserves of wollastonite exceed 100 millon tonnes. Many deposits, however, have not been surveyed, precluding accurate estimates of reserves. The large deposits of wollastonite have been identified in China, Finland, India, Mexico and the United States. Smaller but significant deposits were in Canada, Chile, Kenya, Namibia, South Africa, Spain, Sudan, Tajikistan, Turkey and Uzbekistan.

In 2018, global sales of refined wollastonite were thought to be in the range of 8,50,000 to 9,00,000 tonnes. China was the largest producer of wollastonite with a production of 890 thousand tonnes. India with 104 thousand tonnes, Mexico having 77 thousand tonnes and USA having 40 thousand tonnes were the other major producers. In addition to this countries, small quantities of wollastonite were also produced in Spain, Australia and Thailand.

The Ceramic Industry probably accounts for the major consumption of wollastonite worldwide, followed by polymers (plastic and rubber) and paint. The remaining were used in construction, friction products and metallurgical applications.

The countrywise production of wollastonite by principal countries from 2018 to 2020 is furnished in Table-7.

Table –7 : World Production of Wollastonite
(By Principal Countries)

(In tonnes)

Country	2018	2019	2020
China[e]	890000	890000	890000
India*[a]	184063	124657	103902
Mexico	145814	159498	77665
USA[e]	*60000	*50000	*40000
Finland[e]	*10000	*11000	*11000
Spain	12235	7165	17412
Australia[b]	2007	-	2426

Source: BGS, World Mineral Production, 2016-2020

* India's production of wollastonite during 2018-19, 2019-20 and 2020-21 was 184 thousand tonnes, 125 thousand tonnes and 104 thousand tonnes, respectively

a) Years ended 31st March following that stated

b) Years ended 30th June of that stated

c) In addition to the countries listed, Canada also produces wollastonite since 2014

FOREIGN TRADE

Exports

In 2020-21, exports of wollastonite decreased marginally by 6% to 13,716 tonnes from 14,582 tonnes in the previous year. Exports were mainly to Belgium (54%), Germany (11%), Hungary (16%), Japan (10%), France, UK & USA (2% each) (Table-8) (Fig-2).

Table – 8 : Exports of Wollastonite
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	14582	298591	13716	311809
Belgium	6942	153037	7409	176460
Hungary	1892	33432	2200	43038
Germany	2484	48865	1458	33734
Japan	1782	30677	1406	27029
France	302	7610	300	8144
UK	294	6445	258	6447
USA	225	4776	230	4845
Australia	10	352	88	2664
Poland	52	1584	78	2643
China	10	2012	14	1458
Other countries	589	9801	275	5347

Figures rounded off.

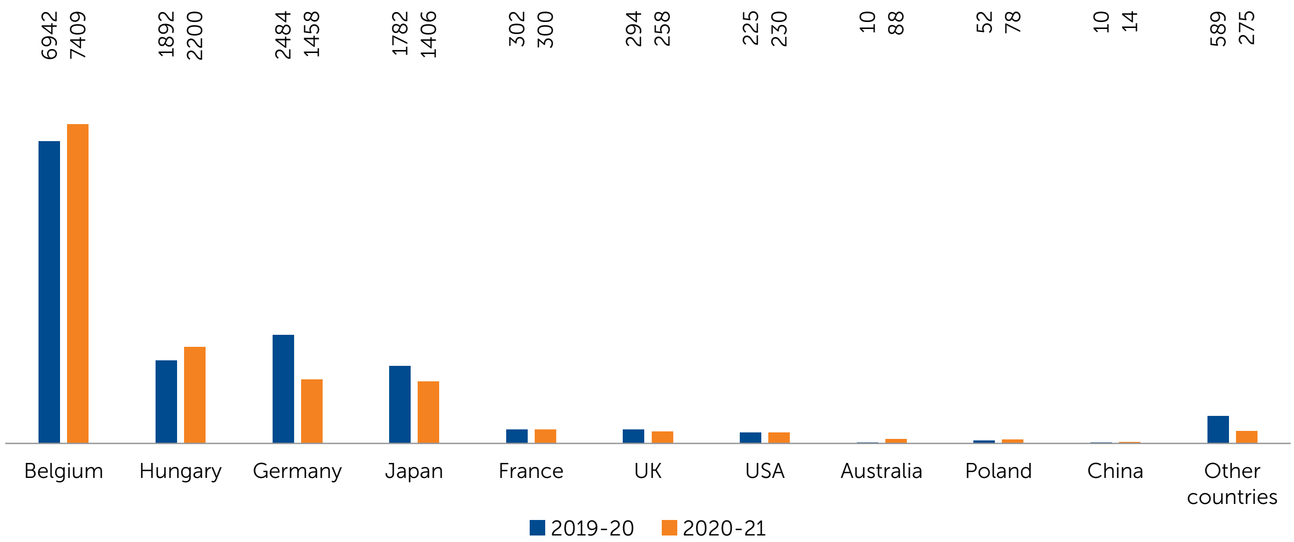


Fig 2: Countrywise Exports of Wollastonite

Imports

Unlike exports, imports of wollastonite increased marginally by 6% to 24,049 tonnes as compared to 22,616 tonnes in the previous year. Imports were almost entirely from China (99%) and the remaining 1% were from USA and other countries (Table-9) (Fig-3).

Table – 9 : Imports of Wollastonite
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	22616	294800	24049	370375
China	22330	266751	23739	347010
USA	36	2640	150	8951
Mexico	67	3560	75	5900
Japan	6	2078	9	2938
Canada	121	15211	40	2877
Denmark	++	194	2	1054
Belgium	-	-	8	1023
Vietnam	-	-	24	339
Germany	7	924	1	213
Italy	-	-	1	70
Other countries	49	3442	-	-

Figures rounded off.

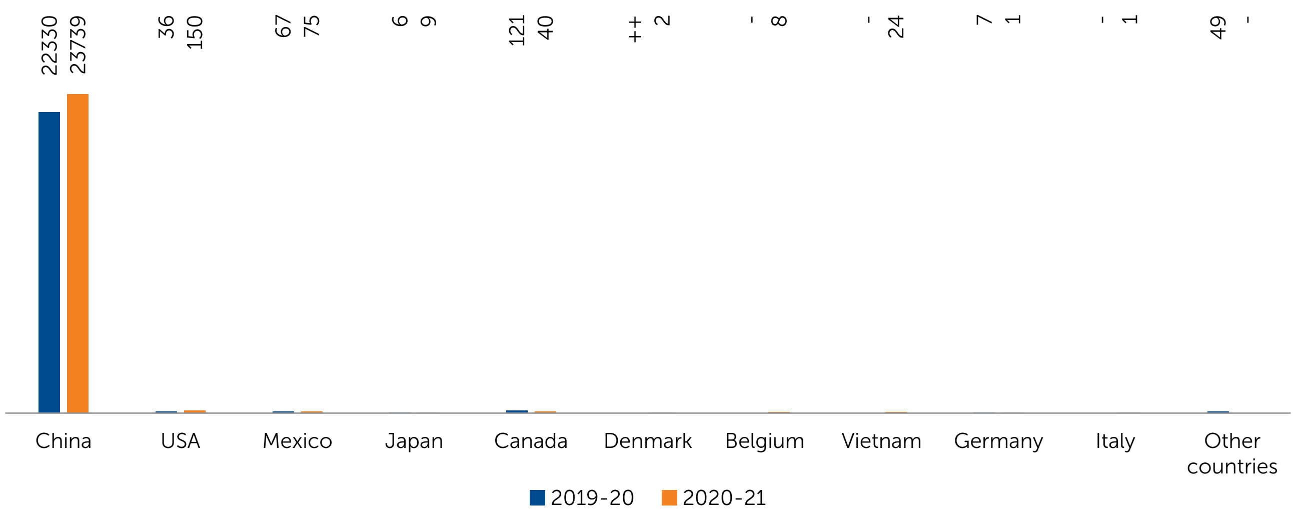


Fig 3: Countrywise Imports of Wollastonite

FUTURE OUTLOOK

Presently, India is world's second largest producer of wollastonite after China. The existing mines in the country are in a position to meet the domestic requirements of the Ceramic Industry as well as export demand. There is an increasing demand for wollastonite in the international markets, especially in ceramic, metallurgy, paint, construction and as asbestos substitute. Present consumption is around 1,04,000 tonnes.

The exports of processed wollastonite with high-aspect-ratio and powdered wollastonite may have to be encouraged for the betterment of export of value-added products. As a result of augmentation of resources of wollastonite in the States of Tamil Nadu and Gujarat, India would end up being in a formidable position and would be in a position to cope with any futuristic demand.

29. Zircon

15,600
(tonnes) Production of zircon were reported in 2019-20

<1
(tonne) of zircon ores and concentrates were exported in 2020-21

68,675
(tonnes) of zircon ores and concentrates were imported in 2020-21

Zircon is the twentieth most abundant element in the Earth's crust and occurs in a variety of rock types and geological environment but most often, in the form of zircon ($ZrSiO_4$) found usually as a constituent in heavy mineral sand assemblages, which include ilmenite, rutile, leucoxene, monazite and garnet in varying proportions. Zircon sand and baddeleyite (an oxide-ZrO_2) are used via their salts to extract zircon and hafnium. Normally, all zircon compounds contain between 1.4% and 3% hafnium. Zircon is very stable at high temperature and has excellent thermal shock resistance, low thermal conductivity and chemical inertness. It finds use chiefly in industries like ceramic, refractory, abrasive, foundry, chemical and speciality alloys. Gem variety of zircon is used in jewellery. Ministry of Mines vide Notification No.S.O.2356 (E) dated 11.07.2016, zircon covered under beach sand minerals was inserted as entry 12 of Part B of the First Schedule to the MMDR Act, 1957.

RESERVES/RESOURCES

Zircon occurs in close association with other heavy minerals, such as, ilmenite, rutile and monazite in beach sands, along the coastal tracts of the country. Its concentration in the deposits is about 0.6–18.7% of the total heavy minerals. Indian zircons analyse 63–66% ZrO_2. AMD has carried out reconnaissance investigation in parts of Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Odisha and West Bengal during 2008-14. The resource estimation in these areas have been carried out up to March 2020. The resources of zircon are placed at 36.56 million tonnes as per Department of Atomic Energy (DAE). However, the Statewise break-up as on March 2020 is not available, so far the breakup of 33.71 million tonnes resources up to 2016 is furnished in Table-1.

Table-1: Resources of Zircon

(In million tonnes)

State	Resources#
Total	33.71
Andhra Pradesh	11.94
Bihar/Jharkhand	0.08
Gujarat	0.01
Kerala	7.83
Maharashtra	0.01
Odisha	3.25
Tamil Nadu	10.2
West Bengal	0.39

Source:Department of Atomic Energy, Mumbai

:Inclusive of indicated, inferred and speculative categories.

As per letter received from Department of Atomic Energy dated 26.07.2018.

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

PRODUCTION AND PRICES

Production of zircon increased to 15,600 tonnes in 2019-20 from 11,906 tonnes in the preceding year (Fig-1). The production of zircon is provided in Table-2. Prices of zircon as furnished by IREL and KMML are detailed in Table- 3.

Table-2: Production of Zircon 2017-18 to 2019-20

(In tonnes)

Year	Production of Zircon*
2017-18	9107
2018-19	11906
2019-20	15600

*As reported by Indian Rare Earths Ltd.

(In tonnes)

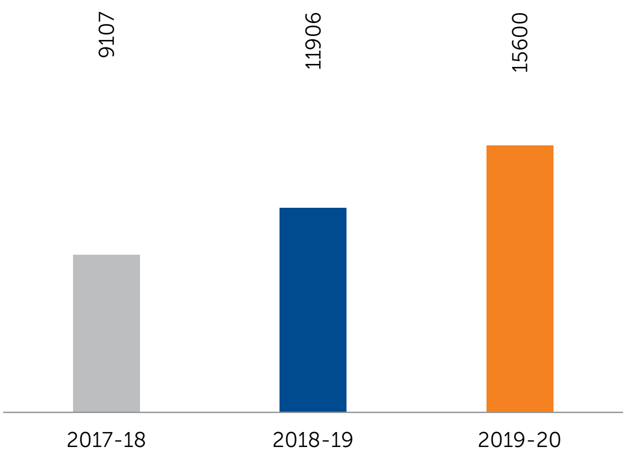


Fig 1: Production of Zircon in India

Table-3: Prices of Zircon, 2017-18 to 2019-20

(₹ per tonne)

Period	Grade	Price	Remarks
IREL			
2017-18	Q	70,215	-
	MK	-	-
	OR	61,638	-
2018-19	Q	1,05,245	-
	MK	1,03,099	-
	OR	90,149	-
2019-20	Q	1,06,790	-
	MK	1,07,032	-
	OR	95,297	-
KMML			
2017-18	Zircon Gr.I	85,167	Average
	Zircon Gr.II	80,167	Average
	Zircon Gr.III	76,167	Average
	Zircon Gr.IV	Nil	Average
2018-19	Zircon Gr.I	1,09,750	Average
	Zircon Gr.II	1,04,750	Average
	Zircon Gr.III	1,00,750	Average
	Zircon Gr.IV	98,500	Average
2019-20	Zircon Gr.I	1,15,000	Average
	Zircon Gr.II	1,10,000	Average
	Zircon Gr.III	1,06,000	Average
	Zircon Gr.IV	1,02,000	Average

Source: Department of Atomic Energy, Mumbai.

MINING AND PROCESSING

As per Gazette Notification No. S.O. 2685 dated 27.07.2019, grant of operating rights in any offshore in terms of any reconnaissance permit, exploration licence or production lease of atomic minerals as defined in Part B of the First Schedule of the Mines and Mineral (Development and Regulation Act, 1957 is prohibited to any person, except the Government or Government Company or a Corporation owned or controlled by the Government. The Indian Rare Earths Ltd (IREL), a Government of India Undertaking and Kerala Minerals and Metals Limited (KMML), a Kerala State Government Undertaking, are engaged actively in mining and processing of beach sands in India. Zircon is recovered by these companies as a co-product of mining/dredging of heavy mineral sands which include ilmenite, rutile, leucoxene, monazite, sillimanite and garnet. Beach sand deposits containing these minerals are obtained from coastal tracts of Manavalakurichi in Tamil Nadu, Chavara in Kerala and Gopalpur in Odisha. As such, no deposit is being worked exclusively for zircon alone. For details regarding mining and processing, etc., Review on 'Ilmenite and Rutile' may be referred. Plantwise capacity and production of zircon during 2017-18 to 2019-20 are given in (Table -4).

Table-4: Plantwise Capacity and Production of Zircon Ore, 2017-18 to 2019-20

(In tonnes)

Company	Location	Specification	Installed capacity** (tpy)	Production		
				2017-18	2018-19	2019-20
Total			39000	13951	-	
Indian Rare Earths Ltd	Manavalakurichi, Kanniyakumari distt., Tamil Nadu	65% ZrO_2+HfO_2 (min)	10000	*	2190	
	Chavara, Kollam distt., Kerala	65% ZrO_2+HfO_2 (min.)	17500	2649	3072	11490
	Orissa Sand Complex, Ganjam distt., Odisha	64.25% ZrO_2 (min.)	5000	6458	6694	
Kerala Minerals & Metals Ltd	Chavara, Kollam distt., Kerala	Zircon Gr.I 64.0% (min.) Zircon Gr.II 62% (min.)	6500	4844	4762	4110

Source: Respective Producers and Department of Atomic Energy, Mumbai.

* During 2017-18 plant was not operating from Jan. 17 because of non-availablity of environment clearance.

** Excluding the V.V.Mineral's installed capacity of 18000 tpy vide their letter and e-mail dated 09.09.2019 regarding non-operation of mining.

INDUSTRY

IREL has set up a dry grinding mill at Chavara, Kerala to produce Zirflour for its application in the Ceramic Industry. A wet grinding mill was also set up at Chavara to produce micro-zir for its specialised application as opacifier. Besides, IREL established a small chemical plant at Manavalakurichi, Tamil Nadu to produce zircon frit, zircon chloride, etc., primarily for supply of zircon frit to Department of Atomic Energy's Nuclear Fuel Complex (NFC), Hyderabad. A pilot plant (3.5 tpy capacity) was set up at Orissa Sand Complex (OSCOM) to produce a whole range of zirconia stabilised with CaO, MgO and rare earths.

The NFC manufactures and supplies fuel bundles for Pressurised Heavy Water Reactors (PHWRs) and Boiling Water Reactors (BWRs) of NPCIL. Highest ever production of PHWR fuel bundles, Zircon Oxide, Zircon sponge and Niobium metal was achieved during the period. The NFC, Hyderabad, has different types of production facilities which include the zircon oxide plant for processing of zircon to pure zircon oxide and zircon sponge plant for conversion of zircon oxide to pure sponge metal and Zircon Complex (ZC) at Pazhayakayal, near Thoothukudi, Tamil Nadu. NFC Hyderabad produced 424 tonnes, 585 tonnes and 470 tonnes of zircon oxide during 2018-19, 2019-20 and 2020-21, respectively. ZC, Pazhayakayal, produced 573 tonnes, 454 tonnes and 408 tonnes of ZrO_2 in 2018-19, 2019-20 and 2020-21, respectively. Besides, the Zircaloy Fabrication Plant produces various zircon alloy tubings and sheet, rod and wire products. The plant also has facilities for reclamation of zircaloy mill-scrap. Zircon sand is processed through caustic fusion, dissolution, solvent extraction (to remove hafnium), precipitation and calcination to obtain zircon oxide. The pure oxide is then subjected to high temperature chlorination, reactive metal reduction and vacuum distillation to obtain homogeneous zircon sponge. The sponge is briquetted with alloying ingredients and melted in vacuum to produce zircaloy ingots. The alloy ingots are extruded to convert into seamless tubes, sheets and bars. The total installed capacity and production of zircon oxide and zircon sponge plants at NFC and ZC are furnished in Table-5.

Besides, Bhalla Chemical Works Pvt. Ltd operates three plants—two of which are located in Gurgaon, Haryana to manufacture zircon derivatives (ZrO_2), based on imported zircon ore (capacity 10,000 tpy) and zircon silicate opacifiers (capacity 5,000 tpy). The third plant of the Company in Rajasthan manufactures zircon oxychloride crystals and special zirconias (capacity 10,000 tpy).

Table-5: Production of Zirconium Oxide and Sponge Plants of DAE at NFC and ZC, 2018-19 to 2020-21

(In tonnes)

Plant/Location	Installed capacity (tpy)	Production		
		2018-19	2019-20	2020-21
Zircon Oxide Plant, NFC, Hyderabad	600	424	585	470
Zircon Sponge Plant, NFC, Hyderabad	400	-	-	-
Zircon Oxide Plant, ZC, Pazhayakayal	500	573	454	408
Zircon Sponge Plant, ZC, Pazhayakayal	250	-	-	-

Source: Department of Atomic Energy, Mumbai.

USES & CONSUMPTION

Zircon's exceptional qualities of hardness and durability make it a must-use for the manufacture of ceramics and refractory tiles and also for a range of other high-tech applications, such as, armour plating on military aircraft, heat shield in space shuttles, potentially as solid oxide fuel cells in hydrogen- powered vehicles and in many industrial & chemical applications. Owing to its chemical inertness, very low heat conductivity, high specific gravity, low expansion, good resistance to abrasion, high melting point and no shrinkage on being heated up to 1,750 ^{0}C, zircon is found to be an outstanding refractory material. Zircon finds its application in ceramics, zirconia, chemicals, refractory and foundry & castings which accounts for zircon's total world estimated consumption. Zirconia and Zircon chemicals can be used for a variety of uses. Yttria-stablised zirconia (YSZ) is used in the manufacture of oxygen sensors that control combustion in automobile engines and furnaces. In Foundry Industry, zircon is used as facing for foundry moulds as it increases the resistance to metal penetration and accords a uniform finish to castings. Zircon sand is preferred to silica sand because of its uniform size, higher melting point, low thermal expansion and resistance to molten metal, acidic chemicals, slag, etc. Zircon containing 64% ZrO_2 is used generally for foundry applications. In Ceramic Industry, finely ground high-grade zircon and zircon dioxide are used as opacifier in melts for vitreous enamelling and as pigment in ceramic glazes. Zircon oxide is considered as a potential ceramic material for high temperature applications like engine components. Usually, zircon containing 65% ZrO_2 is preferred in ceramics. The toughened zirconia finds its use in ceramic coatings in jet aircraft engines and in other applications where strength and high temperature oxidation resistance are important. Zirconia ceramics are also used in automobile sensors for the microprocessor control of engines. In Chemical Industry, its property of high resistance to corrosion is used where dry chlorine, hydrochloric acid and caustic alkalies are involved. Abrasive and grinding wheels made from zircon sands are used for polishing optical glasses. Zircon powder is used as a medium in waterjet cutting machines.

Zircon and zircon powders are used in ammunition, primers, detonation caps, flashlight mixtures, radio tubes and in various heating elements. Hafnium-free zircon metal is used as cladding material in atomic reactors due to its low absorbing cross section for thermal neutron. Green, blue, indigo, red, orange coloured zircon is used as a natural gemstone and also processed to produce cubic zirconia — a synthetic gemstone resembling diamond. Zircon compounds have a very low toxicity and are not perceived as a potential environmental hazard. They are even said to have some medicinal properties and are now increasingly preferred in the manufacture of food products and pharmaceuticals too. It is also widely used in television and computer screens, resistance to corrosion and erosion makes zircon products ideal for use in the Chemical Industry and in desalination plants. Zircon flour is manufactured by milling zircon sand. It is used in ceramic frits, foundry mould coatings, ceramic shells for investment casting, refractories, friction products, insulating fibres and glass. Zircon opacifier are used in refractories and friction products. Zircon metal or sponge is used mainly in the Nuclear Industry with a requirement for minimum content of hafnium.

Consumption of zircon/zirflour decreased considerably by 17% to 13,829 tonnes in 2019-20 from 16,600 tonnes in 2018-19. The consumption of zircon during the year 2019-20 was reported only by IREL. Consumption of zircon/ zirflour during the year 2017-18 to 2019-20 is furnished in Table- 6.

Table-6: Estimated Consumption * of Zircon 2017-18 to 2019-20
(By Industries)

(In tonnes)

Industry	2017-18	2018-19 (R)	2019-20 (P)
All Industries	17500	16600	13829#
Ceramic	7200	6300	3963
Refractory	9700	9400	1153
Others (Alloy steel, iron & steel, Chemical, foundry, paint and cement)	600	900	8751

Figures rounded off.

* Includes actual reported consumtion and/or estimates made wherever required. Due to paucity of data, coverage may not be complete.

only reported by IREL.

RESEARCH & DEVELOPMENT

Various R&D studies have been conducted by R&D Laboratory, OSCOM, Department of Atomic Energy, to improve the metallurgical performance of mining and mineral separation plants. As a result throughput of the plants has increased and the grade and recovery of heavy minerals in concentrate has been enhanced. The two most outstanding contributions of this laboratory in the areas of value addition are development of new process flow sheets for the preparation of synthetic rutile from OSCOM ilmenite and zirconia from zircon.

IREL Technology Development Council (IRELTDC) has been formed with an objective of promoting industrial scale R & D that would be beneficial to the overall programme of DAE in both strategic and non-strategic fields utilizing mineral & value added products of IREL.

POLICY

Zircon was earlier classified as a 'prescribed substance', as per notifications issued under Atomic Energy Act, 1962. From the revised list notified vide S. O. No. 61(E), dated 20.1.2006, zircon has been deleted, subject to the condition that the mineral shall remain a prescribed substance till the policy on exploration of beach sand minerals notified on 6.10.1998, is adopted/revised/modified by Ministry of Mines or till 1.1.2007, whichever occurs earlier and shall cease to be so thereafter. Ministry of Mines, vide Notification No.S.O.2356(E) dated 11.07.2016, zircon covered under beach sand minerals was inserted as entry

12 after entry 11 of Part B of the First Schedule to the MMDR Act, 1957. As per the Foreign Trade Policy, 2015-20, the export and import of zircon ores and concentrates under ITC (HS) Code 26151000 are freely allowed. The notification reads:

S.O. 1592(E)—In pursuance of Clauses (f) and (g) of Sub-section (1) of Section 2 and Section 3 of the Atomic Energy Act,1962 (No. 33 of 1962) and in supersession of the notifications of the Government of India in the Department of Atomic Energy vide Number S.O. 61(E) dated 20th January 2006, the Central Government hereby notifies the substances, equipment and technology specified in the Schedule appended hereto as 'Prescribed Substances, Prescribed Equipment and Technology'.

Under Category 0A303 and under Heading Nuclear materials, nuclear-related other materials, equipment and technology—"Zircon with hafnium content of less than 1 part to 500 parts of zircon by weight (i.e. less than 2,000 ppm) in the form of metal, alloys containing more than 50% zircon by weight, compounds, manufactures thereof, waste or scrap of any of the foregoing".

G.S.R. 134(E) dated 20.02.2019 — In exercise of the powers conferred under Section 11B of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957) and Rule 36 of the Atomic Minerals Concession Rules, 2016, the Central Government hereby makes the following amendments further to amend the Atomic Minerals Concession Rules, 2016, namely—

2. (1) These rules may be called the Atomic Minerals Concession (Second Amendment) Rules, 2019.

   (2) They shall come into force on the date of their publication in the Official Gazette.

3. In the Atomic Minerals Concession Rules, 2016, for Schedule A, the following Schedule shall be substituted, namely—

PARTICULARS OF THRESHOLD VALUE FOR ATOMIC MINERALS

[See Rule 2 (1) (m) and Rule 36]

10.	Uranium bearing tailings left over from ores after extraction of copper and gold, ilmenite and other titanium ores.	60 ppm U_3O_8 and/or 250 ppm ThO_2.
11.	Zircon bearing minerals and ores including zircon.	All cases of zircon-bearing minerals occurring in Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e. the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade. In other cases, zircon containing less than 2,000 ppm of Hafnium.
12.	Beach Sand Minerals, i.e., economic heavy minerals found in the teri or beach sand, which include ilmenite, rutile, leucoxene, garnet, monazite, zircon and sillimanite.	All cases of Beach Sand Minerals and other placer deposits in association with monazite are notified as above threshold (i.e., the threshold is 0.00% monazite in Total Heavy Minerals), irrespective of monazite grade.

WORLD REVIEW

World reserves of zircon are placed at 70 million tonnes in terms of ZrO_2. The world's largest reserves are with Australia (71%), South Africa (8%) and Mozambique (3%) (Fig-2). The world production of zircon minerals was estimated at 1.20 million tonnes in 2020 which decreased by 12% as against 1.37 million tonnes in the previous year. Australia (36%), South Africa (27%), Mozambique (6%) are the principal producers of zircon minerals (Tables-7 & 8).

Table-7: World Reserves of Zirconium
(By Principal Countries)

(In '000 tonnes of Zro_2)

Country	Reserves
World: Total (rounded off)	70,000
Australia	50,000
China	500[a]
Indonesia	NA
Kenya	50
Mozambique	1,800
Senegal	NA
South Africa	5,900
USA	500
Other countries	11,000

Source: USGS, Mineral Commodity Summaries, 2022

[a] For Australia, Joint Ore Reserves Committee-compliant reserves were 22.1 million tonnes.

Table-8 : World Production of Zirconium Minerals
(By Principal Countries)

(In tonnes)

Country	2018-19	2019-20	2020-21
World: Total (rounded off)	1231000	1372000	1205000
Australia(i)	414672	499335	434339
South Africa*	350000	370000	320000
USA	100000	100000	90000
Mozambique	76550	87181	78138
Indonesia (d)*	54000	73000	64000
Senegal	64278	58432	59000
Kenya	36604	48356	32224
China*	33500	33500	33500
Madagascar	22757	28500	25300
Other countries	78145	73666	68676

Source: BGS, World Mineral Production, 2016-20.
Note: *Estimate
(i) Years ended 30 June of that stated.
(d) Conservative BGS estimates, based on exports.

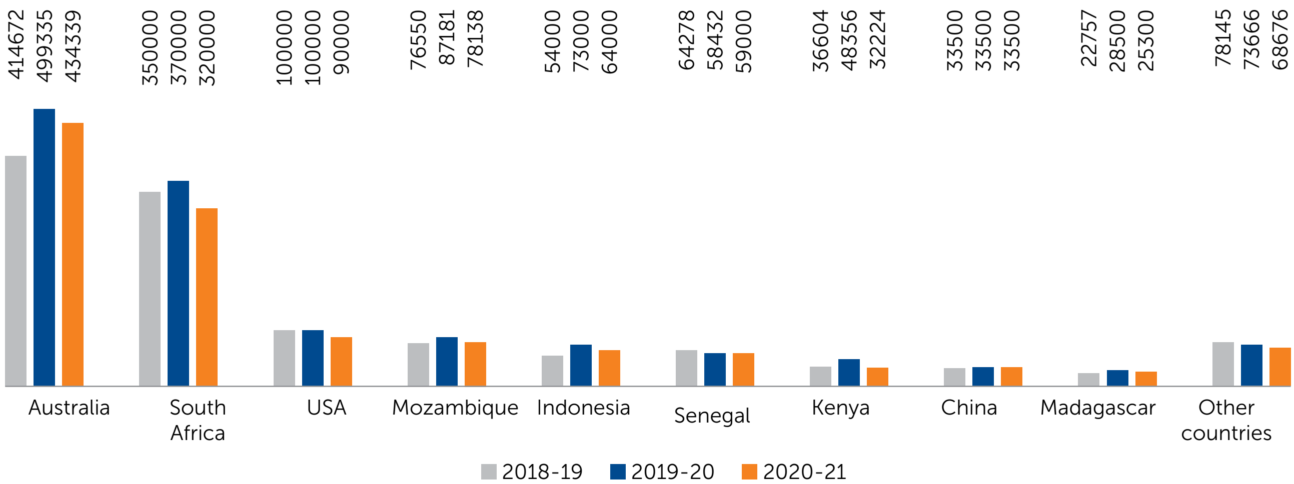


Fig 2: Production of Zircon ore

To provide a generalised view of the development in various countries, country-wise description as sourced from latest available publication of Minerals Yearbook 'USGS' -2018 is furnished below :

Australia

Iluka produced 328,000 tonnes of zircon from its operations in Australia, an increase of 12% from that in 2017. The majority of the Cataby project in Western Australia was constructed in 2018 and was expected to begin production in the first half of 2019. With a projected mine life of 8.5 years, zircon production was anticipated to average about 50,000 metric tonnes per year. Iluka completed the feasibility study for moving mining from the Jacinth deposit to the adjacent Ambrosia deposit and the decision was made to proceed with the move sooner than originally planned. By the end of 2018, work was initiated on the Ambrosia deposit.

Tronox Holdings plc produced 34,000 tonnes of zircon from its Cooljarloo Mine in Western Australia, unchanged from that in 2017.

Sheffield Resources Ltd. obtained offtake agreements to account for almost all zircon and zircon concentrate production during the first 4-year phase of its Thunderbird project. Production of zircon in the first year of production was expected to be about 80,000 tonnes, increasing to 110,000 tonnes in the fourth year of production. Contingent on financing, Sheffield was expecting to commence production at Thunderbird in 2020.

China

As the leading consumer of zircon mineral concentrates, China imported 1.05 million tonnes in 2018, an increase of 3% from 1.02 million tonnes imported in the previous year.

Kenya

Base Resources Ltd. produced 38,600 tonnes of zircon from its Kwale operation in the reporting year ending June 30, 2018, a decrease of 13% from that in the previous year. During the year, the Kwale Phase 2 mine project was ongoing. This work involved shutting down the mine and wet concentrator plant for the month of March to complete equipment installation and start a second hydraulic unit.

Madagascar

Base Resources acquired an 85% interest in the Toliara project in January and worked throughout the year to develop a labour plan and training programs in consultation with the Government and local communities. A prefeasibility study was expected to be completed in the first quarter of 2019, and the company projected production would begin in late 2021.

Mozambique

Kenmare Resources plc produced 74,700 tonnes of primary and secondary zircon at the Moma Mine in 2018. Increased production resulted from projects to increase recovery rates and capacity enhancement of the zircon recovery circuits. The company announced plans to expand capacity to increase ilmenite coproduct production by 20% by 2021.

Senegal

In July, Eramet Group acquired full ownership of the Grande Côte mineral sands operation operated by TiZir Ltd. Eramet reported zircon sales of 65,000 tonnes.

South Africa

Tronox produced 1,19,000 tonnes of zircon from its Namakwa Sands operation and 53,000 tonnes of zircon from its KZNSands operation in South Africa, for a total of 1,72,000 tonnes, an increase of 3% from that in 2017.

In 2018, Mineral Commodities Ltd. produced 17,000 tonnes of zircon-rutile concentrate, containing 68% zircon and 17% rutile, at its Tormin Mine in Western Cape Province. Although the amount of ore processed was greater than that in 2017, the zircon and rutile ore grades decreased from those in 2017.

Tanzania

Strandline Resources Ltd. continued to wait for mining licenses and seek funding for its Fungoni heavy-mineral-sands project. According to a definitive feasibility study completed in 2017, ore reserves were 12.3 million tonnes containing 3.9% heavy minerals.

FOREIGN TRADE

Exports

Exports of zircon ores and concentrates decreased to less than one tonne in 2020-21 from one tonne in the previous year. Exports were mostly to Austria and meagre quantity to China. Exports of zircon and scrap were negligible both the year 2019-20 and 2020-21. Exports of zircon waste & scraps was also negligible in the year 2019-20 and 2020-21 (Tables-9 to 12).

Imports

Imports of zircon ores and concentrates increased by 22% to 68,675 tonnes in 2020-21 from 56,166 tonnes in the previous year. Main suppliers were Australia (36%), Indonesia (19%), South Africa (15%) and Malaysia (11%) (Fig-3). Imports of zircon and scrap drastically decreased by 93% to 3 tonnes in 2020-21 as against 40 tonnes in 2019-20. Imports were mainly from China, USA & Italy (33% each). Similarly imports of zircon waste & scrap also decreased substantially by 92% to 3 tonnes in 2020-21 as compared to 38 tonnes in the preceding year. Imports were only from China, USA & Italy (33% each) (Tables-13 to 17).

Table-9: Exports of Zirconium Ores & Conc.
(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1	78	++	21
Austria	1	78	++	16
China	-	-	++	4
Venezuela	-	-	++	1
Latvia	-	-	++	++
Germany	++	++	-	-

Figures rounded off.

Table–10: Exports of Zirconium & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	21799	++	24791
USA	++	5834	++	13170
Iraq	++	3399	++	3963
Sweden	++	124	++	2330
Australia	++	2409	++	1994
UAE	-	-	++	984
Saudi Arabia	++	676	++	915
Taiwan	++	6510	++	707
Bahrain	-	-	++	158
Qatar	++	190	++	136
Singapore	++	++	++	132
Other countries	++	2657	++	302

Figures rounded off.

Table–11: Exports of Zirconium Waste & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	13253	++	14644
USA	++	5336	++	9601
Sweden	++	124	++	2330
Australia	++	2409	++	1994
UAE	-	-	++	227
Qatar	++	190	++	136
Singapore	-	-	++	132
France	-	-	++	120
Tanzania	-	-	++	49
Peru	-	-	++	45
Congo	-	-	++	7
Other countries	++	5194	++	3

Figures rounded off.

Table–12: Exports of Zirconium Unwrought Powder

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	++	8546	++	10147
Iraq	++	3399	++	3963
USA	++	498	++	3569
Saudi Arabia	++	676	++	915
UAE	-	-	++	757
Taiwan	++	2243	++	707
Bahrain	-	-	++	158
Canada	++	185	++	78
Israel	++	792	-	-
Ukraine	++	186	-	-
Korea Rep. of	++	184	-	-
Other countries	++	383	-	-

Figures rounded off.

Table– 13: Imports of Zirconium Ores & Conc.

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**56166**	**6073420**	**68675**	**6993378**
Australia	18325	1962060	24963	2547148
Indonesia	14289	1518753	13076	1351599
South Africa	8292	889071	10530	1035297
Malaysia	9096	1030308	7253	757539
USA	2624	308137	6179	632461
Senegal	764	82451	2235	226470
Vietnam	48	5112	1338	132319
Sri Lanka	1535	153831	1282	124796
Ukraine	802	82718	830	87831
China	204	19765	521	51378
Other countries	187	21124	468	46540

Figures rounded off.

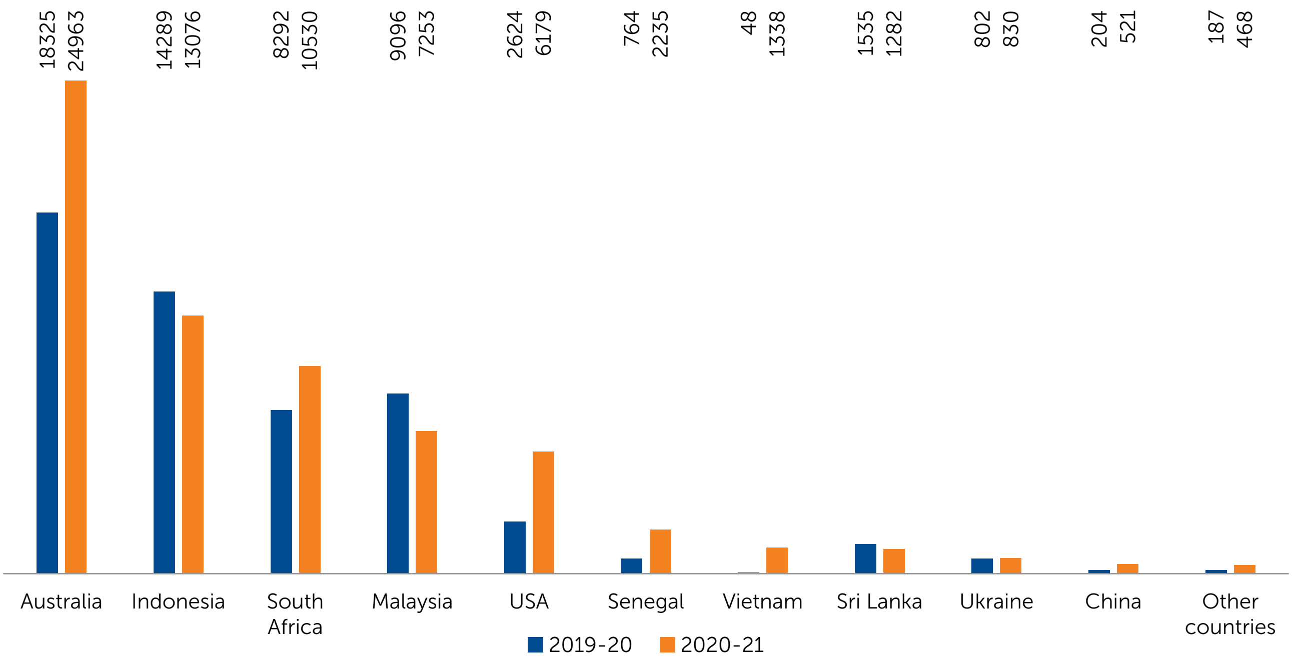


Fig 3: Countrywise Imports of Zircon Ores & Conc.

Table – 14: Imports of Zirconium & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**40**	**97660**	**3**	**23298**
China	28	7926	1	8723
USA	1	9405	1	5964
Italy	++	3073	++	3914
Germany	4	20507	1	1978
Malaysia	++	1435	++	1439
Japan	++	1716	++	710
Korea	-	-	++	464
Hong Kong	-	-	++	67
France	2	11487	++	24
Ukraine	-	-	++	15
Other countries	5	42111	++	++

Figures rounded off.

Table – 15: Imports of Zirconium Unwrought Powders

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2	10836	++	115
USA	-	-	++	100
Ukraine	-	-	++	15
France	2	10787	-	-
China	++	35	-	-
UK	++	14	-	-

Figures rounded off.

Table – 16: Imports of Zirconium Waste & Scrap

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	38	86824	3	23183
China	28	7891	1	8723
USA	1	9405	1	5864
Italy	++	3073	++	3914
Germany	4	20507	1	1978
Malaysia	++	1435	++	1439
Japan	++	1716	++	710
Korea	-	-	++	464
Hong Kong	-	-	++	67
Sweden	4	33689	-	-
France	++	700	++	24
Other countries	1	8408	-	-

Figures rounded off.

Table – 17: Imports of Ferrozirconium

(By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	342	41178	374	51237
China	342	41178	346	46248
Hong Kong	-	-	15	3395
UAE	-	-	8	1371
UK	-	-	5	223

Figures rounded off.

FUTURE OUTLOOK

The development of digital printing of ceramic tile pattern has the potential to increase demand since higher zircon content of the base tile is required to impart aesthitically appealing product and to optimise the cost of the digital printing process.

As per the Zircon Market updated 2023 of Zircomet Limited, the global demand for zircon sand has been estimated at 1.2 million tonnes for both 2021 and 2022. This is a 20% increase over 2019 and 2020. The demand has been driven by India, China and Europe.

Current demand remains firm in China, particularly in the ceramics industry as they move out of covid restrictions and the construction industry picks up. It is expected supply will remain quite tight during 2023 and further mine development is needed to meet future demand. As zircon sand is the starting raw material for the majority of zircon chemicals and zircon oxides, prices of these materials are expected to remain firm with upward pressure during 2023.

Zircon and Zirflor are the key ingredients in ceramics, foundry and refraction and are likely to see growth path on account of Government of India's thrust for 'Housing for all'.

30. Minor Minerals

INTRODUCTION

The Government of India, in exercise of the powers conferred by Clause (e) of Section 3 of Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957), and by issue of Notification, vide Notification S.O.No. 423(E) dated 10th February, 2015; declared the below listed minerals to be Minor Minerals in addition to the earlier declared Minor Minerals, i.e., marble, granite, fuller's earth and bentonite. Most of these minerals were hitherto covered in Indian Minerals Yearbook as individual Reviews:

1. Agate
2. Ball clay
3. Barytes
4. Calcareous sand
5. Calcite
6. Chalk
7. China Clay
8. Clay (others)
9. Corundum
10. Diaspore
11. Dolomite
12. Dunite or pyroxenite
13. Felsite
14. Felspar
15. Fire clay
16. Fuschite Quartzite
17. Gypsum
18. Jasper
19. Kaolin
20. Laterite
21. Limekankar
22. Mica
23. Ochre
24. Pyrophyllite
25. Quartz
26. Quartzite
27. Sand (others)
28. Shale
29. Silica sand
30. Slate
31. Steatite or talc or soapstone

Since minor minerals come under the purview of respective State Governments, certain inadequacies in the flow of details with regard to their exploration and development, production, consumption, export/import details etc. have been experienced at IBM. Lack of promptness in receipt of information from various States has impeded the pace of updating of data regarding these minerals and this has caused limitations in the coverage of these minerals.

Efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or by visiting their websites. All possible information/data that could be gathered has been presented in the Review.

In the compilation of IMYB under the Review entitled 'Minor Minerals', the following sub-chapters on minor minerals have been alphabetically sequenced starting from Barytes to the final chapter on Steatite or Talc or Soapstone. Thus this compilation covers almost all Minor Minerals covered in the MM(DR) Act, 1957 as amended up to 2nd September, 2019.

1. Barytes
2. Bentonite
3. Calcite
4. Corundum (Minor) and Sapphire (Major)
5. Diaspore
6. Dolomite
7. Dunite and Pyroxenite
8. Felspar
9. Fireclay
10. Fuller's Earth
11. Granite
12. Gypsum (Minor) and Selenite (Major)
13. Kaolin, Ball Clay, Clay (Others) and Shale
14. Laterite
15. Marble
16. Mica
17. Ochre
18. Other Calcareous Materials
19. Pyrophyllite
20. Quartz and Other Silica Minerals

    [Moulding sand and Flint stone (Major)]
21. Slate, Sandstone and Other Dimension Stones
22. Talc, Soapstone and Steatite

30-1. Barytes

86.67

(million tonnes) Total reserves/ resources of barytes in the country as on 1st April 2015

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'barytes' has been declared as 'Minor Mineral'

The properties like non-corrosive, non-abrasive, insolubility in water, inertness and high specific gravity enable barytes application as a weighting agent in drilling operations

Baryte or barite is a moderately soft crystalline mineral form of barium sulphate ($BaSO_4$). Approximately, 80% barytes produced worldwide is used for oil and gas drilling as a weighting agent in the drill mud, primarily to prevent the explosive release of gas and oil during drilling. Its unique physical and chemical properties are heaviness, high specific gravity, chemical & physical inertness, very low solubility and magnetic neutrality. Barium compounds are utilised as filler, extender and aggregate. Baryte after converting to barium carbonate, is used in the manufacture of ceramic and glass. The Mangampet deposit in Kadapa district of Andhra Pradesh is the single largest barytes deposit in the world.

RESERVES/RESOURCES

The total reserves/resources of barytes in India as on 1.4.2015 as per NMI data based on UNFC system, has been placed at 86.67 million tonnes of which 59% constitute reserves and 41% Remaining Resources. By grades, 64% Resources are of Oil-well drilling grade followed by 6% of Chemical grade (Chemical-A & Chemical-B), 1% of Paint grade and 27% constitute low grade. About 3% resources are of Other, Unclassified and Not-known categories. Among the States Andhra Pradesh alone accounts for 92% of the country's barytes resources. As per the information available, National Data Sharing and Accessibility Policy (NDSAP), the deposits of barytes are located at Relpataliya (Rajasthan), Chimalapenta, Mangampeta and at Vemula (Andhra Pradesh & Telangana), Ghatihosahalli (Karnataka) and at Sukwari (Madhya Pradesh) (Table - 1).

Table-1: Reserves/Resources of Barytes as on 1.4.2015
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	50449000	49358	848467	51346825	410466	323345	1258521	205834	1284390	31735548	105721	35323825	86670650
By Grades													
Chemical-A	121417	13860	77696	212973	52409	53695	49790	-	140553	509819	-	806266	1019239
Chemical -B	1517785	23213	512919	2053917	231053	175630	180872	20167	508494	911750	12835	2040801	4094718
Oil-well Drilling	48615140	9185	174458	48798783	14154	57060	345584	48550	177407	5734783	-	6377538	55176321
Paint	1768	3100	1118	5986	83194	24348	149670	48904	21608	147135	-	474859	480845
Low	-	-	-	-	-	3068	388928	1210	361950	22876753	92886	23724795	23724795
Others	135331	-	73771	209102	28206	9544	122322	-	-	12599	-	172671	381773
Unclassified	57559	-	8505	66064	1450	-	20935	83195	69878	1494283	-	1669741	1735805
Not-known	-	-	-	-	-	-	420	3808	4500	48426	-	57154	57154
By States													
Andhra Pradesh	48990002	49358	372296	49411656	186544	94489	988514	104322	389630	28165637	105721	30034857	79446513
Haryana	-	-	-	-	-	-	-	-	-	440	-	440	440
Himachal Pradesh	-	-	-	-	27288	12846	12645	48904	12370	3000	-	117053	117053
Jharkhand	-	-	-	-	-	-	-	-	-	35900	-	35900	35900
Karnataka	-	-	-	-	78296	136220	14252	-	-	15175	-	243943	243943
Madhya Pradesh	-	-	-	-	-	18500	4472	-	35000	233940	-	291912	291912
Maharashtra	-	-	-	-	-	-	-	14800	89450	18610	-	122860	122860
Rajasthan	134416	-	72571	207167	6018	15890	108577	37808	311500	2304688	-	2784481	2991648
Tamil Nadu	-	-	-	-	-	-	-	-	500	221919	-	222419	222419
Telangana	1324582	-	403420	1728002	112320	45400	130061	-	12940	711239	-	1011960	2739962
Uttarakhand	-	-	-	-	-	-	-	-	-	25000	-	25000	25000
West Bengal	-	-	-	-	-	-	-	-	433000	-	-	433000	433000

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'barytes' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or by visiting their websites. But data of only a few States could be collected. All possible information/data that could be gathered has been presented in this Review.

Statewise production of barytes during 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Barytes

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Andhra Pradesh	2482736	2735439	1212038
Rajasthan	5000	3000	3287
Telangana	1020	150	-
Karnataka	-	345	1596

Source: As received from State DGMs and their websites.

USES AND SPECIFICATIONS

Oil and Gas Drilling

The properties like non-corrosive, non-abrasive, insolubility in water, inertness and high specific gravity enable barytes application as a weighting agent in drilling operations to remove the cutting from the bits, transport cutting to the surface to reduce the friction in the drilling string, control pressure, prevent blow-out and at the same time to provide lubrication. The most desirable characteristic of barytes is its high specific gravity which makes it the only mineral used in substantial tonnages to increase the density of water-based drilling. Barytes powder containing minimum 90% barium sulphate with 4.15 specific gravity is recommended for drilling. For offshore drilling, the specific gravity should be 4.2. At least 97% ground barytes should pass through 75-micron IS sieve and 95% through 53-micron IS sieve. BIS has prescribed IS:2881:1984 (Reaffirmed 2010) as specification of barytes for use in Chemical Industry and Oil-well Drilling Industry.

Chemical

Major barium chemicals obtained from barytes are carbonate, chloride, oxide, hydroxide, nitrate, peroxide and sulphate. Barium carbonate is used in Glass Industry as a flux to add brilliance & clarity in electro-ceramics and for removing inconvenient impurities in phosphoric acid. Barium hydroxide is used in the preparation of barium salts of organic acids which are utilised as additives for lubricating oils and as stabilisers for PVC. Barium sulphate is used as pigment, extender and filler in Rubber and Paper Industries.

Lithopone, a mixture of $BaSO_4$ and ZnS, is used in Paint and Lacquer Industries as white pigment, extenders and fillers. Barium nitrate is used in green signal flares, tracer bullets, primers and detonators. Barium oxide is known for its use in electric furnace. Barium titanate finds its use in miniature electronic and communication equipment. Barytes is also used in explosive manufacture.

For Chemical Industry, purity is the prime criterion, with ferric oxide and strontium sulphate limited to a maximum 1% and fluorine to traces. The mesh size is also important in manufacturing chemicals. Barytes used in explosive manufacture may be bleached or unbleached. It should be in dry powder form free from extraneous matter.

Paint

Barytes is used as filler and extender in Paint Industry. White pigment is manufactured from barytes. Barytes should be free from mud, clay or siliceous minerals. Presence of iron oxide is undesirable. The material should be in the form of dry powder.

Glass

In glass manufacturing, barytes is added to the glass melt for making the glass more workable and enhancing its brilliance. Iron is the most undesirable impurity in barytes.

Rubber

Barytes is used as a filler and extender in rubber products. It is added to rubber compounds to impart resiliency and durability. Barytes containing minimum 99.5% $BaSO_4$ is usually preferred. Since such pure form of barytes is not found in nature, barytes is normally bleached before use. The form of barytes called 'blanc fixe' is known best for its acid resistance properties. The sieve residue through 75-micron and 150-micron should be 4% and 0.01% max., respectively. BIS has prescribed IS:1683-1994 (Reaffirmed 2008) as specification of barytes for use in Rubber Industry.

Other Uses

Barytes is used in the manufacture of asbestos products required for autobrake lining and other frictional materials. It is used as a filler in Paper Industry, oil cloth, X-Ray proof plaster and rope finishes. Finely ground barytes and clay are used as suspension in Barvois system of coal washing. Barytes is also used in concrete aggregate as an absorber of gamma and X-Ray radiation required for reactor shielding. In medicine, it is used in radio diagnosis to highlight the abnormalities in internal body parts. Barytes also finds its use in explosives and pyrotechnics composition for which BIS has laid down specifications vide IS 7588-1992 (Reaffirmed 2011).

SUBSTITUTES AND TECHNICAL POSSIBILITIES

Drilling mud substitutes include Celestine, witherite calcium carbonate, synthetic haematite and ilmenite but the low cost and technical advantages of barytes deter substitution. Iron ore fines and ilmenite are substitutes used for deep drilling. Apart from calcium carbonate, none of the mineral substitutes has had a major impact on the Barytes Drilling Mud Industry. Reclamation and recycling of drilling muds have been increasingly hampering the requirement for new supplies. Further, new oil exploration techniques and drilling methods have reduced the need for new boreholes and wells, which have led to curtailment in the requirement for drilling muds. As a filler, barytes can be substituted by diatomite, felspar, kaolin, mica, talc and silica flour.

FUTURE OUTLOOK

Maximum quantity of the world's barytes is used in the Petroleum Industry. The worldwide demand for barytes would continue till petroleum products are preferred as chief source of energy given their importance in the transportation and industrial end-use sectors. The future growth in petroleum usage suggests that petroleum exploration will continue to grow and along with it barytes consumption, especially as more drilling has to be done to establish hydrocarbon discoveries which increasingly have become marginal and would get less productive with time. In the domestic front, however, the much needed exploration to locate new deposits of barytes especially in Rajasthan, Himachal Pradesh, etc. would continue.

30-2. Bentonite

583

(million tonnes) Total reserves/ resources of bentonite in the country as on 1st April 2015

As defined in Clause (e) of the Section-3 of MM (DR) Act 1957, 'bentonite' has been declared as 'Minor Mineral'; hence the producers report the production data directly to the respective States and not to IBM

Bentonite has high swelling properties along with good viscosity and liquid limit. These properties are highly valued in most of the industrial applications. Sodium bentonite is well-suited as a binder in the preparation of pellets and in foundry and as oil-well drilling mud

Bentonite is essentially a highly plastic clay containing not less than 85% clay mineral, montmorillonite. It derives its name from the place where its presence and usages were first discovered, Fort Benton, America. Bentonite's commercial importance is due to its inherent bleaching properties similar to that of fuller's earth, hence, it is also known as bleaching clay. There are two types of bentonites, namely, swelling-type or sodium bentonite and non-swelling-type or calcium bentonite. Sodium bentonite is usually referred to as bentonite, whereas calcium bentonite is called fuller's earth. The commercial importance of bentonite depends more on its physico-chemical properties rather than its chemical composition. Excellent plasticity & lubricity, high dry-bonding strength, high shear & compressive strength, low permeability and low compressibility make bentonite commercially viable. Bentonite is valued in applications, such as, foundry sand binding, drilling mud, iron ore pelletisation and as a waterproofing & sealing agent in civil engineering works. Processing is a prerequisite for bentonite marketing. Bhavnagar and Kachchh districts of Gujarat and Barmer district of Rajasthan are the major producing areas of bentonite. The sodium bentonite mined in Rajasthan tends to be of lower quality and is used as foundry sand. Both activated and granular bentonite are produced in the country. Bentonite is exported both as unprocessed (crude) and processed (including activated) forms.

RESERVES/RESOURCES

The total reserves/resources of bentonite in the country as per NMI data based on UNFC system as on 1.4.2015 has been estimated at 583 million tonnes out of which 15 million tonnes are categorised as Reserves. The bulk of the resources, i.e., 428 million tonnes (73%) are in Rajasthan, 144 million tonnes (25%) in Gujarat and the remaining in Tamil Nadu, Jharkhand and Jammu & Kashmir. Substantial quantity of 501 million tonnes (86%) of the total resources are placed under Unclassified and Notknown categories while 60 million tonnes (10%) are under Foundry grade and 19 million tonnes (3%) under Poor/Blendable grades. About 3 million tonnes resources are placed under Drilling Fluid grade. The reserves/resources of bentonite as per the UNFC system as on 1.4.2015 are furnished in Table - 1.

Table-1: Reserves/Resources of Bentonite as on 1.4.2015
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	13926227	50000	609406	14585633	6838864	2721697	68632472	26519818	225744237	212115692	25730000	568302781	582888414
By Grades													
Drilling Fluid	69109	-	-	69109	-	-	-	-	-	3009437	-	3009437	3078546
Foundry	4705000	50000	-	4755000	-	592570	3565120	420000	-	50468524	-	55046214	59801214
Poor/Blendable	-	-	-	-	-	-	-	-	-	18530969	-	18530969	18530969
Unclassified	9152118	-	609406	9761524	6838864	2129127	-	13583818	5302333	52583197	-	80437339	90198863
Not-known	-	-	-	-	-	-	65067352	12516000	220441904	87523565	25730000	411278821	411278821
By States													
Gujarat	9221227	-	-	9221227	6838864	-	12460170	2163813	1904	113259150	-	134723901	143945128
Jammu & Kashmir	-	-	-	-	-	-	-	-	-	147400	-	147400	147400
Jharkhand	-	-	609406	609406	-	3067	-	-	-	367527	-	370594	980000
Rajasthan	4705000	50000	-	4755000	-	2718630	56172302	24356005	222017000	92523096	25730000	423517033	428272033
Tamil Nadu	-	-	-	-	-	-	-	-	3725333	5818519	-	9543852	9543852

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

As defined in Clause (e) of the Section-3 of MM(DR) Act 1957, 'bentonite' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or by visiting their websites. All possible information/data that could be gathered has been presented in this Review.

Statewise production of bentonite during 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Bentonite

(By Principal Countries)

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Gujarat	3385450	-	-
Rajasthan	276000	305000	446075.2

Source: As received from State DGMs and their websites.

Note : " - " NA

USES & SPECIFICATIONS

Bentonite has high swelling properties along with good viscosity and liquid limit. These properties are highly valued in most of the industrial applications. Sodium bentonite is well-suited as a binder in the preparation of pellets and in foundry and as oil-well drilling mud. Bentonite also acts as a suspending agent in oil-well drilling fluids and is abundantly used in horizontal drilling for shale production. Bentonite exhibits good green strength along with high hot and dry strength which helps in preventing moulds from breaking or cracking during the pouring or cooling process in the Foundry Industry. Owing to high green strength resulting from its property to absorb and then release moisture, bentonite is used in iron ore pelletisation. Sodium-based bentonite of 75 micron size finds suitability in iron ore pelletisation for bonding by user industries. Bentonite clay is also used in pyrotechnics to make end plugs and rocket engine nozzles. Bentonite has remarkable colloidal and waterproofing properties. Bentonite gels are used as a carrier for a number of cosmetic preparations, toothpastes, creams, etc. Bentonite is also used in Chemical, Rubber, Insecticide & Pesticide Industries and in civil construction works. Bentonite in the form of fine powder free from dirt and other foreign matter and of least swelling property is used in Ceramic Industry. Bentonite which is the active mineral in clays with medicinal properties is also prescribed as a bulk laxative and it is also used as a base for many dermatological formulations. Bentonite is also used to prepare sulphur bentonite fertilizer (90:10) which is useful to impart better productivity.

The specifications of bentonite for Chemical & Rubber and Oil-well drilling Industries have been published vide BIS Specification IS:6186-1986 (Second Revision Reaffirmed 2010). The specifications for Ceramic Industry have been published vide IS:12621-1988 (Reaffirmed 2011). BIS has revised the specifications of bentonite for use in foundries, the new specifications are prescribed vide IS : 12446 - 2007 (First Revision, Reaffirmed 2012).

FUTURE OUTLOOK

The biggest market for bentonite in both North America and European countries are foundry, cat litter, iron ore pelletising and drilling. Civil engineering and environmental applications, such as, land fills require bentonite for use as a sealant and lubricant. The global market of bentonite and fuller's earth is likely to witness a healthy growth owing to strong demand expected in Foundry and Iron Ore Pelletisation Industry. This is mainly due to strong growth in the automotive production (>100 M vehicles) as well as increase in iron & steel production. Increase in civil construction activity in Asian countries and traditional edible oil refining in Asia will also boost bentonite consumption in near future. Bentonite is among the exportable mineral commodities in India. Since Indian resources of bentonite are of high grades, India has excellent opportunity to cater to diverse industries worldwide. Bentonite is exported both in unprocessed (crude) and processed (including activated) forms. Though, export of crude bentonite accounts for a higher quantity, the exports of processed bentonite fetch higher value than the crude bentonite. There is a pressing need to develop different processing techniques that suit our available resources, in order to make our products match the international standards. There is scope to establish bentonite processing, granulation and paint grade processed bentonite units in the country to meet the indigenous demand as well as demand in the international market. More and more Indian companies are entering into joint ventures with multinationals in order to meet the challenge of the strong global competition.

30-3. Calcite

23

(million tonnes) Total reserves/ resources of calcite in the country as on 1st April 2015

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'calcite' has been declared as 'Minor Mineral'.

The use of calcite is dictated by its level of purity. The highest purity of $CaCO_3$, which is as high as (+) 98%, has minimum inclusions and highest brightness

Calcite is a rock forming mineral with chemical formula $CaCO_3$ that contains 56% CaO and 44% CO_2. It is extremely common and found throughout the world in igneous, sedimentary and metamorphic rocks. It is one of the important industrial minerals also known as 'Calc Spar'. Pure crystallised transparent variety of calcite known as 'Iceland Spar' is used for optical purposes.

Calcite is one of the most abundantly available minerals in the world. It occurs in various shapes, colours and forms. Chemically, it is Calcium Carbonate and has varied uses in different fields. Calcite being easily available has been in use in various aspects of importance in the human life since ancient times. Though, its demand is continously on the rise its availability world over will not affect its price.

RESERVES/RESOURCES

Calcite occurs in abundance in India. As per NMI data, based on UNFC system as on 01.04.2015, the total reserves/resources of calcite has been estimated at about 23 million tonnes of which about 3.45 million tonnes (15%) are under 'Reserves' category and the rest are under 'Remaining Resources' category. Of the total resources, Chemical grade accounts for 22% and Glass & Ceramic grade about 3%. The remaining 75% resources fall under Unclassified/Not-known and Other grades etc. Rajasthan has the largest share (53%) of calcite resources, followed by Andhra Pradesh (40%) and Madhya Pradesh (5%). The remaining resources (2%) are located in Gujarat, Haryana, Karnataka, Tamil Nadu and Uttar Pradesh (Table-1).

Table-1: Reserves/Resources of Calcite as on 1.4.2015
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	928119	798170	1722578	3448867	1332076	217790	3339239	9122696	1246494	4204311	97476	19555082	23003949
By Grades													
Chemical	449149	-	19581	468730	753222	170359	1881020	-	-	1750993	-	4555594	5024324
Glass & Ceramic	-	8098	5175	13273	92767	47423	90993	20250	67395	451704	-	770532	783805
Poor/Low	-	-	-	-	-	-	-	-	70310	134220	-	204530	204530
Others	313094	-	963270	1276364	27656	8	827193	500	-	22813	-	878170	2154534
Unclassified	165876	790072	734552	1690500	236446	-	247670	8557000	66551	1391088	-	10493756	12184256
Not-known	-	-	-	-	221985	-	292363	544946	1042238	453493	97476	2652501	2652501
By States													
Andhra Pradesh	16522	8098	119526	144146	8538	-	105470	8562700	5200	282204	-	8964112	9108258
Gujarat	-	-	-	-	-	-	-	-	-	12380	-	12380	12380
Haryana	-	-	-	-	166900	-	183900	-	-	-	-	350800	350800
Karnataka	-	-	-	-	31800	-	15900	-	14400	51547	-	113647	113647
Madhya Pradesh	-	-	5175	5175	215327	35077	160421	20250	180226	358636	97476	1067412	1072587
Rajasthan	911597	790072	1597877	3299546	909511	182713	2873548	539746	1041668	3371912	-	8919099	12218645
Tamil Nadu	-	-	-	-	-	-	-	-	-	116632	-	116632	116632
Uttar Pradesh	-	-	-	-	-	-	-	-	-	11000	-	11000	11000

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reveiws"

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'calcite' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or by visiting their websites. But data of only a few States could be collected. All possible information/data that could be gathered has been presented in this Review.

Statewise production of calcite during 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Calcite

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Rajasthan	54000	23000	19693
Andhra Pradesh	31200	6500	1003

Source: As received from State DGMs and their websites.

USES AND SPECIFICATIONS

The use of calcite is dictated by its level of purity. The highest purity of $CaCO_3$, which is as high as (+) 98%, has minimum inclusions and highest brightness. Its applications are in varying sizes from coarse to as fine as 10 to 2 microns. Various grades of calcite products marketed by Wolkem India Ltd contain $CaCO_3$ at 95–98.5%, MgO at 0.2–0.4%, SiO_2 0.3% and Fe_2O_3 0.03–0.15%. Calcite is one of the important ingredients required in Glass and Ceramic Industries for imparting glaze and it is also used as a flux. In pulverised form, it is used as a filler in rubber goods, textile and as an extender in paints and as a carrier in insecticides. Other uses are in the manufacture of mortar, cement, bleaching powder, abrasive, for agricultural soil treatment, pharmaceuticals, etc. It is also used in the preparation of fat lime, soaps, detergents, plastics, polymers, etc. The $CaCO_3$ content in calcite used in Glass Industry is 95% (min.) and in Ceramic Industry is 95%. Calcium oxide is a mild flux and makes the glass stick to the articles shaped by its hardening nature. Generally, 54% (min.) CaO is used. In Ceramic Industry, generally, super-white calcite of 30 mesh is used while in Glass Industry, powder size ranging from 20 to 80 mesh is used.

Calcite as GCC finds extensive use as a filler in Plastics, Paper, Rubber and Paint industry. According to Global Industry Analysis, strong consumption in paper and plastic production may drive the calcite market upwards. In Paper Industry, calcite is used as filler to produce high quality, water proof anti-smudge papers and in plastics it is used as an additive to improve surface opacity, gloss and impact strength.

The transparent crystal of calcite (Iceland Spar) free from flaw is most valued in the Optical Industry for the manufacture of Nicol prism.

BIS has prescribed IS : 15751-2007 (reaffirmed in March-2012) as specification for use of calcite in Ceramic Industry.

30-4. Corundum and Sapphire

The reserves/resources of corundum in India are found in association with kyanite and sillimanite in Assam, Meghalaya and Maharashtra. It occurs in syenites and ultrabasic rocks in Telangana

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'Corundum' has been declared as 'Minor Mineral'.

Corundum is valued mostly for its abrasive and refractory properties. Its melting point is 2,010 oC and hence it is used in a sintered form for the manufacture of special refractory crucibles, rods and other materials

Corundum is a natural oxide of alumina with 52.9% alumina and 47.1% oxygen. It is very hard (9 on Mohs scale) next only to diamond. Corundum is found in rocks containing a high percentage of alkalies, deficient in silica and excess of alumina. It is generally found in association with rocks like syenite, nepheline syenite and anorthosite. Described to be formed as a result of metamorphism of high aluminous clay, corundum is often found associated with andalusite, kyanite and sillimanite. Corundum also occurs as masses adjacent to ultramafic intrusives, associated with lamprophyre dykes and as large crystals in pegmatites. The most common occurrence of corundum is as a detrital mineral in streams and beach sands because of its hardness and resistance to weathering. Pure corundum is colourless and clear if transparent, or pale white if opaque. The vivid colours of corundum gem varieties, such as, ruby and sapphire arise primarily from elemental substitution in the Al site by transition metal elements. The most common cations found as substitute are Fe^{+2}, Fe^{+3}, Ti^{+4}, Cr^{+3} and V^{+3}. Pink and red colour corundum are called ruby while blue coloured corundum is called sapphire and all other colours are called fancy sapphires. Usually rubies will have more or less 1 wt% of Cr_2O_3 while blue sapphires primarily have Fe^{+2} and Ti^{+4} substituting into the crystal structure. Some corundum gemstones show "asterism" or a star effect due to inclusion of rutile needles within the crystal of corundum.

RESERVES/RESOURCES

The reserves/resources of corundum in India are found in association with kyanite and sillimanite in Assam, Meghalaya and Maharashtra. It occurs in syenites and ultrabasic rocks in Telangana. A few outcrops of pegmatites containing corundum occur in Bastar district, Chhattisgarh and Morena district, Madhya Pradesh. Translucent to opaque ruby, sometimes with asterism is known to be abundant in Mysuru district in Karnataka.

Precious and semi-precious varieties of corundum have been reported from Tamil Nadu in Kangeyam belt stretching over Karur and Kulithalai tehsils in Tiruchirapalli district and Vedachandur tehsil in Dindigul district.

As per NMI data as on 1.4.2015 based on UNFC System, the total reserves/resources of corundum was estimated at 294 thousand tonnes of which 200 tonnes were placed under Reserves category and the bulk of over 293 thousand tonnes under 'Remaining Resources' category. The resources of corundum are located in Karnataka (68%), Telangana (26%) and Rajasthan (4%), besides a share of the Remaining Resources was contributed by Tamil Nadu, Chhattisgarh and Andhra Pradesh.

The total reserves/resources of ruby as on 1.4.2015 was estimated at 5,349 kg and the entire resources are placed under 'Remaining Resources' category and are located in Odisha. The total reserves/resources of sapphire was estimated at 450 kg, all of which is placed under 'Remaining Resources' category and is located in Jammu & Kashmir [Tables - 1(A) to 1(C)].

Table-1(A): Reserves/Resources of Corundum as on 1.4.2015

(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	200	-	-	200	70844	1073	63060	13	38	105794	52675	293497	293697
By Grades													
Semi-precious	-	-	-	-	-	34	-	-	1	895	-	930	930
Industrial	-	-	-	-	65020	1039	53767	-	28	90479	52675	263007	263007
Others	-	-	-	-	-	-	-	-	-	4	-	4	4
Unclassified	200	-	-	200	-	-	11	13	1	2533	-	2558	2758
Not-known	-	-	-	-	5824	-	9282	-	8	11883	-	26997	26997
By States													
Andhra Pradesh	200	-	-	200	-	7	-	-	-	-	-	7	207
Chhattisgarh	-	-	-	-	100	310	188	-	-	288	-	885	885
Karnataka	-	-	-	-	64920	756	53590	13	38	27575	52675	199566	199566
Rajasthan	-	-	-	-	-	-	-	-	-	11925	-	11925	11925
Tamil Nadu	-	-	-	-	-	-	-	-	-	4000	-	4000	4000
Telangana	-	-	-	-	5824	-	9282	-	-	62007	-	77113	77113

Figures rounded off.

Table-1(B): Reserves/Resources of Ruby as on 1.4.2015
(By Grades/States)

(In kg)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	-	-	-	-	-	429	3296	-	-	1623	-	5349	5349
By Grades													
Unclassified	-	-	-	-	-	429	3296	-	-	1623	-	5349	5349
By State													
Odisha	-	-	-	-	-	429	3296	-	-	1623	-	5349	5349

Figures rounded off.

Table-1(C): Reserves/Resources of Sapphire as on 1.4.2015
(By Grades/States)

(In kg)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	-	-	-	-	-	-	-	-	-	450	-	450	450
By Grades													
Unclassified	-	-	-	-	-	-	-	-	-	450	-	450	450
By State													
Jammu & Kashmir	-	-	-	-	-	-	-	-	-	450	-	450	450

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

Corundum

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'Corundum' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, 'Sapphire' has been retained as Major Mineral. Statewise production of corundum and sapphire is not available.

Ruby

There was no production of ruby reported since the year 2015-16.

CONSUMPTION & USES

Corundum is valued mostly for its abrasive and refractory properties. Its melting point is 2,010 °C and hence it is used in a sintered form for the manufacture of special refractory crucibles, rods and other materials.

Corundum's bright and glassy lustre, splintery property as it is devoid of cleavage plane and inclusions makes it preferred substance by industry for the manufacture of superior grade abrasives. After processing, it is used in grinding and polishing wheels, grinding belts, emery papers and cloth & grinding pastes. High-grade corundum with low iron finds use as ramming mass in the electric arc furnace. It is also used in mortars, wire drawing dies, thread guides and gauge blocks. Gem varieties are sometimes used for pivot supporters in delicate scientific instruments, as jewel in watches. Sapphire has emerged as a versatile material useful to a range of industries in many varied applications including LEDs, optical and Radio Frequency Integrated Circuits (RFICS).

FUTURE OUTLOOK

Corundum has been produced synthetically since 1837 and gem quality of synthetic corundum entered the market place in the early 1990s. Very large sizes of crystals can be made by Czochralski's Drawing Method. Another method is Verneuil process — but synthetic gem variety can be recognised by trained gemologist. The market for synthetic corundum is mainly driven by industrial abrasion applications. The natural occurring corundum has tremendous value in the gemstone market and is the most desirable precious stone after diamond. Owing to its uncommon colours, corundum's demand in the Jewellery Segment is increasingly on the rise. Apart from rubies and sapphire, rare gemstones, such as, padparadscha sapphire, witnessed expanding market demands.

In India, the gemstone market has been expanding and is expected to ramp-up in the coming years.

30-5. Diaspore

Diaspore occurs as thin veins, stringers and geode like bodies in association with pyrophyllite in Uttar Pradesh and Madhya Pradesh. The host rock mainly comprises granite, quartz and pyrophyllite of Bundelkhand Supergroup, and as a common constituent of bauxite in Jammu & Kashmir

As per Govt. of India Notification S.O. 423 (E), dated 10th February 2015, 'Diaspore' has been declared as 'Minor Mineral'

Diaspore mainly finds application in the manufacture of high alumina refractories either on its own or by bonding with flint or plastic clay as per content of alumina needed in the finished product.

Diaspore is a dimorphous form of boehmite, with chemical formula AlO(OH) (beta monohydrate of aluminium). It is an important constituent of bauxite. It is used chiefly for making high-alumina refractory bricks. It is also used as a filler in Plastic Industry and in jewellery as a gemstone.

RESERVES/RESOURCES

Diaspore occurs as thin veins, stringers and geode like bodies in association with pyrophyllite in Uttar Pradesh and Madhya Pradesh. The host rock mainly comprises granite, quartz and pyrophyllite of Bundelkhand Supergroup, and as a common constituent of bauxite in Jammu & Kashmir.

As per NMI database, based on UNFC System of resource classification, the total reserves/resources of diaspore as on 1.4.2015 has been placed at 10.19 million tonnes of which about 7.56 million tonnes (74%) are located in Madhya Pradesh, 2.63 million tonnes (26%) in Uttar Pradesh and a nominal quantity in Jammu & Kashmir. About 7.88 million tonnes (77%) of these resources are placed under Reserves category & the remaining 2.31 million tonnes (23%) are placed under Remaining Resources. Out of the total reserves/resources, 8.85 million tonnes (87%) are grouped under Refractory grade I & II, while 1.3 million tonnes (13%) resources fall under Unclassified, Not-known, Others and Ceramic grades (Table- 1).

Table-1: Reserves/Resources of Diaspore as on 1.4.2015

(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	3242363	884525	3755546	7882434	114789	498756	480663	14241	110358	1045944	46068	2310817	10193251
By Grades													
Ceramic	5646	6274	3137	15057	-	55	-	-	-	252	-	307	15364
Refractory-I	3040191	716408	2763636	6520235	68546	145566	177894	545	-	391151	-	783701	7303936
Refractory-II	105310	129983	973195	1208488	37833	140249	43345	693	31542	86238	-	339900	1548388
Unclassified	45918	-	13917	59835	-	6628	32392	-	67205	5453	46068	157746	217581
Not-known	-	-	-	-	-	4522	3290	-	9950	10966	-	28728	28728
Others	45298	31860	1661	78819	8410	201736	223742	13003	1661	551884	-	1000436	1079255
By States													
Jammu & Kashmir	-	-	-	-	-	-	-	-	566	711	-	1277	1277
Madhya Pradesh	2380710	341047	2814601	5536358	96241	488094	460808	13696	109792	810667	46068	2025365	7561723
Uttar Pradesh	861653	543478	940945	2346076	18548	10662	19855	545	-	234566	-	284175	2630251

Figures rounded off.

PRODUCTION

As per Govt. of India Notification S.O. 423(E), dated 10th February 2015, 'Diaspore' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, no production data was reported from any of the States.

USES & SPECIFICATIONS

Diaspore mainly finds application in the manufacture of high alumina refractories either on its own or by bonding with flint or plastic clay as per content of alumina needed in the finished product. The domestic refractory manufacturers use indigenous diaspore, that analyses Al_2O_3 of 56 to 62%, Fe_2O_3 of 1 to 4% , TiO_2 of 0.8 to 1.5%, with Pyrometric Cone Equivalent (PCE) of 36 (min.) and of size between 75 and 150 mm.

In addition to its industrial applications, diaspore is also used for making decorative items, such as, small figurines, lampshades, flower-vase, etc.

It is commonly used in refractories, cosmetic & soaps, ceramics, paper, rubber, potteries, insecticides, toys and statues.

FUTURE OUTLOOK

Diaspore (aluminium oxide hydroxide) is one of the three mineral constituents of bauxite ore of aluminium. Principally, it is used in the manufacture of high alumina refractories. India has large reserves of diaspore for its indigenous supply and has adequate resources to meet its future requirements. Gem variety of diaspore called zultanite is not found in indian reserves.

30-6. Dolomite

8,415
(million tonnes) Total reserves/ resources of dolomite in the country as on 1st April 2015

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'dolomite' has been declared as 'Minor Mineral'

Dolomite after calcination is used for refractory purposes (as a substitute of magnesite refractories) in linings of furnaces like basic open-hearth steel furnaces and basic Bessemer converters

Dolomite ($CaCO_3.MgCO_3$) theoretically contains $CaCO_3$ (54.35%) and $MgCO_3$ (45.65%) or CaO (30.4%), MgO (21.9%) and CO_2 (47.7%). However, in nature, dolomite is not available in this exact proportion. Hence, in commercial parlance, the rock containing 40–45% $MgCO_3$ is usually called dolomite. Dolomite rock that contains either calcite or a mixture of calcite & magnesite in addition to dolomite is called "Dolomitic Limestone". It is grouped under flux & construction minerals and is important for Iron & Steel and Ferroalloys industries. Dolomite occurrences are widespread in almost all parts of the country.

Removal of overburden is imperative in a mining activity, which leads to cutting of trees and deforestation. The statute provides directives for reclamation of the mined out areas and plantation of trees to regain the aesthetics of the degraded land. A study in this regard was undertaken to get an idea of afforestation efforts and success rate.

Mineral dolomite is found in almost all States and it is mostly mined by opencast method of mining.

RESERVES/RESOURCES

Dolomite occurrences are widespread in the country. As per NMI data, based on UNFC system, as on 1.4.2015, the total reserves/resources of dolomite has been placed at 8,415 million tonnes, out of which 677.8 million tonnes are placed under Reserves category and the balance 7,737 million tonnes under Remaining Resources category. Gradewise, BF/sintering grade alone accounted for 24% resources followed by S.M.S. (OH), S.M.S. (L.D.) & S.M.S. (O.H. & L.D. Mixed) (25%); refractory (8%), B.F. & S.M.S. mixed (5%); and glass (3%). Others, Unclassified, Not-known, B.F., S.M.S. & refractory grades together accounted for the remaining 35% resources. Major share of about 88% resources is found distributed in eight States, namely, Madhya Pradesh (27%), Andhra Pradesh (15%), Chhattisgarh (11%), Odisha (10%), Karnataka & Rajasthan (7% each), Gujarat (6%) and Maharashtra (5%). The remaining 12% resources are distributed in Arunachal Pradesh, Jharkhand, Haryana, Sikkim, Tamil Nadu, Telangana, Uttarakhand, Uttar Pradesh and West Bengal. Gradewise and Statewise reserves/resources of dolomite are furnished in Table-1.

Table-1: Reserves/Resources of Dolomite as on 1.4.2015
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	431750	107364	138770	677884	372515	323183	537932	307103	757005	5215075	224194	7737007	8414891
By Grades													
B.F./Sintering	114238	7657	55233	177128	82335	77121	139875	185566	412641	863924	34946	1796407	1979535
S.M.S.(O.H.)	64004	26454	13147	103605	87822	27618	36350	32509	123316	863484	76707	1247806	1351411
S.M.S.(L.D.)	39244	4317	12740	56300	27207	9680	159913	8697	5464	136145	80	347186	403487
S.M.S.(O.H.& L.D mixed)	50417	328	2539	53284	7142	44258	9977	30718	4000	184470	969	281534	334818
B.F. & S.M.S. mixed	43316	670	10031	54017	32665	14474	2811	18140	35000	226370	-	329461	383478
Refractory	8305	6457	4097	18859	34984	68817	51803	-	271	515375	2994	674244	693103
B.F., S.M.S.& Refractory	-	-	-	-	-	1797	1258	-	-	5387	-	8441	8441
Glass	285	25792	369	26446	4392	22136	44773	2093	1297	127978	-	202668	229114
Others	70539	17960	16122	104622	68632	33909	41387	28073	47783	124737	4969	349490	454112
Unclassified	40599	17609	23720	81928	21639	21593	25698	1099	58954	591618	7674	728276	810203
Not-known	803	122	770	1695	5697	1780	24087	207	68279	1575587	95856	1771493	1773188
By States													
Andhra Pradesh	86134	11371	17539	115045	176477	31908	38234	22373	77	910217	4301	1183677	1298722
Arunachal Pradesh	-	-	-	-	-	-	-	-	204	77633	-	77837	77837
Chhattisgarh	34465	48130	11623	94218	29294	80865	24512	150795	24412	511610	1950	823439	917657
Gujarat	34862	15934	20829	71625	11947	27064	68785	20263	63780	280592	-	472431	544056
Haryana	-	-	-	-	1692	6037	3722	-	-	16183	-	27633	27633
Jharkhand	4510	-	6720	11230	10620	350	860	-	-	1857	-	13686	24916
Karnataka	28609	5910	6093	40612	16264	6684	9202	8519	76244	455337	13482	585731	626344
Madhya Pradesh	23765	10078	18714	52557	33798	94599	102857	33030	295222	1584534	114799	2258839	2311395
Maharashtra	8301	4346	7768	20416	13986	16036	7371	-	18050	339141	2994	397578	417994
Odisha	109551	6421	34839	150811	42521	33896	110904	48535	46683	330660	85884	699082	849892
Rajasthan	57910	4579	13994	76483	20483	10807	121082	16132	25480	327838	784	522607	599089
Sikkim	-	-	-	-	-	-	-	-	-	2756	-	2756	2756
Tamil Nadu	-	-	-	-	-	-	-	2010	135	-	-	2145	2145
Telangana	42072	-	651	42723	2869	1594	1944	-	132511	6380	-	145298	188021
Uttar Pradesh	-	-	-	-	-	12622	-	3500	-	66230	-	82352	82352
Uttarakhand	1570	594	-	2165	36	721	371	1946	981	199834	-	203888	206053
West Bengal	-	-	-	-	12528	-	48000	-	73226	104275	-	238029	238029

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'dolomite' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or by visiting their websites. But data of only a few States could be collected. All possible information/data that could be gathered has been presented in this Review.

Statewise production of dolomite during 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Dolomite

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Andhra Pradesh	2034682	2039342	2128467
Gujarat	1455352	-	-
Telangana	653025	518052	-
Maharashtra	468890	465667	-
Rajasthan	285000	177000	117875
Karnataka	628114	913373	923669

Source: As received from State DGMs and their websites.

Note : " - " NA

USES & SPECIFICATIONS

Dolomite after calcination is used for refractory purposes (as a substitute of magnesite refractories) in linings of furnaces like basic open-hearth steel furnaces and basic Bessemer converters.

High purity dead-burnt dolomite bricks are required for lining LD furnaces, while mini-steel plants generally require dolomite for fettling and refractory purposes. Like limestone, dolomite is used as a flux in iron & steel, ferroalloys and glass works. Few steel plants have dispensed with the use of dolomite in blast furnaces and its use in the preparation of self-fluxing sinters is found adequate for blast-furnace charge.

It is useful in the recovery of magnesia and also in the manufacture of magnesium metal; it finds important application in the manufacture of basic magnesium carbonate (termed 'technical carbonate', 'block magnesia' or 'magnesia alba') used in pipe and boiler coverings as heat insulation, in pharmaceutical, rubber, chemical Industries, paper, leather, glass, potteries and high-magnesium limes. In agriculture, it is used as a soil conditioner to neutralise acidity. Regular application of dolomite improves crop yields owing to its neutralisation potential. It finds use as a filler in fertilizers, paints & varnishes and for suppression of dust in coal mines. It is also used as a building stone and in the making of flooring tiles as chips & powder.

Generally, insolubles like SiO_2, Fe_2O_3 and Al_2O_3 are considered deleterious constituents of dolomite for any industrial use. It is essential that these insolubles should be as low as possible. High purity dolomite with less than one per cent insolubles is preferred for making refractory bricks which are used in the lining of LD furnaces.

Similarly, high-grade dolomite containing low iron (less than 0.15%) is required in Glass Industry. BIS has prescribed the specifications of dolomite used in Glass Industry vide IS: 997-1973; (First Revision; Reaffirmed 2008). Specifications for flux grade dolomite for use in Iron & Steel Industry have been revised and are prescribed in IS: 10346 - 2004 (Second revision, Reaffirmed 2009), while specifications of dolomite for Refractory Industry are prescribed in IS: 14296 - 1995 (Reaffirmed 2010). IS: 15366 - 2003 (Reaffirmed 2009) lays down the specifications of dolomite for Paint Industry.

FUTURE OUTLOOK

Over 95% of the total production of dolomite finds outlet mainly in Iron & Steel and allied industries. The importance of high purity dead-burnt dolomite bricks for lining LD furnaces has gained ground due to LD process of steel making. At the same time, a few of the steel plants have dispensed with the use of dolomite pin blast furnace. Mini-steel plants generally require dolomite for fettling and refractory purpose only.

The resources of the Refractory grade dolomite in the country are meagre and this type of material is in short supply though the demand for it is very high especially for producing tar-bonded dolomite bricks.Therefore, intensive search is needed in non-Himalayan regions for locating deposits of massive non-crystalline dolomite, containing less than 2.5% R_2O_3 for use in tar-dolomite bricks required for lining of LD steel furnaces.

30-7. Dunite & Pyroxenite

187.82

(million tonnes) Total reserves/resources of dunite & pyroxenite in the country as on 1st April 2015

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'Dunite & Pyroxenite' have been declared as 'Minor Mineral'

Dunite and pyroxenite are preferred as flux to dolomite as a source of MgO in sintering and also in Iron & Steel Industry. Main benefits of olivine over dolomite in slag conditioning are higher MgO content, no requirement of preheat treatment, low LOI, reduced energy consumption, lower coke consumption, reduced slag volume and lower CO_2 emissions

Dunite is a monomineralic ultrabasic rock that consists of more or less pure olivine. Dunite typically contains 36 to 42% MgO and 36 to 39% SiO_2. Olivine is a commercial source of magnesia combined with silica that is mainly used in metallurgy, fertilizer, etc. Pyroxenite is also an ultrabasic rock that consists of pyroxenes, i.e., predominantly ferromagnesian minerals other than olivine. There is a rising trend in use of dunite and pyroxenite in sintering and as a fluxing agent in blast furnace in place of dolomite.

RESERVES/RESOURCES

In India, occurrences of dunite are reported in association with other ultrabasic rocks in chrysotile-bearing areas of Jharkhand and Karnataka; chromite-bearing areas in Odisha, Karnataka, Jharkhand & Nagaland; and magnesite-bearing areas in Karnataka & Tamil Nadu. As per the NMI database, based on UNFC system, the total reserves/resources of dunite in the country as on 1.4.2015 has been estimated at about 187.82 million tonnes of which 12.77 million tonnes constitute Reserves (about 10.85 million tonnes Proved Reserves and 1.92 million tonnes Probable Reserves) and 175.05 million tonnes Remaining Resources. Dunite resources are located mainly in Tamil Nadu (65%) and Karnataka (17%). The remaining 18% resources are in Jharkhand (9%), Odisha (6%) and Nagaland (3%). Reserves/Resources of dunite are furnished in Table-1.

The occurrences and production of pyroxenite are reported from Jajpur district in Odisha and Singhbhum (East) district in Jharkhand. However, no production data is available.

Table-1: Reserves/Resources of Dunite as on 1.4.2015

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	10848	18	1901	12768	436	1925	108887	25202	1087	23832	13680	175049	187818
By Grades													
Grade - I	4969	-	984	5953	264	-	37910	24516	780	11464	2328	77263	83216
Grade-II	5535	-	917	6452	172	1351	70976	686	307	7268	11352	92113	98565
Unclassified	345	18	-	363	-	574	-	-	-	5100	-	5674	6037
By States													
Jharkhand	123	-	262	385	264	-	448	607	780	6121	8637	16857	17242
Karnataka	3074	18	189	3282	-	-	34	23909	-	4606	-	28549	31831
Odisha	308	-	-	308	172	1925	6215	686	307	2531	-	11837	12145
Tamil Nadu	7343	-	1450	8793	-	-	102190	-	-	5773	5044	113007	121800
Nagaland	-	-	-	-	-	-	-	-	-	4800	-	4800	4800

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'Dunite & Pyroxenite' have been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. Production data for 'dunite & pyroxenite' is presently not available. However, 87,395 tonnes of dunite production was reported during the year 2020-21 as compared to that 49,634 tonnes produced last year i.e. 2019-20 predominantly by Karnataka state.

USES & SPECIFICATIONS

Dunite and pyroxenite are preferred as flux to dolomite as a source of MgO in sintering and also in Iron & Steel Industry. Main benefits of olivine over dolomite in slag conditioning are higher MgO content, no requirement of preheat treatment, low LOI, reduced energy consumption, lower coke consumption, reduced slag volume and lower CO_2 emissions. Presence of higher amount of silica in dolomite leads to lower sinter basicity (i.e. CaO/SiO_2) at around 2.5 than 3.5 of dolomite and the phases in sinter change to those having better reducibility. The net result is a reduction in the resistance of the cohesive zone to gas flow in the blast furnace leading to drop in fuel rate and higher productivity. In addition, the magnesium silicates do not call for calcination (unlike the carbonates) and thus lowers energy requirement in the blast furnace.

Olivine helps to condition the slag as well as to control the basicity through reduction of alkali recirculation. Its higher reaction temperature reduces low temperature breakdown and swelling of burden, thus, maintaining permeability and reducing coke consumption. Olivine could be added directly to the blast furnace charge as lump (10 to 40 mm), sinter feed (3 to 6 mm), or mixed with low silica iron ore fines and pressed into pellets.When lump is added directly to the furnace, olivine can replace limestone partly and dolomite flux in the reduction of iron ore. In comparison with dolomite, olivine has higher MgO content (requires less material for a given MgO level), amenable MgO: SiO_2 ratio (allows MgO levels to be raised without changing the basicity of the slag) and lower LOI, i.e., 0.3–0.7% (conserves the energy required to drive off unwanted carbon dioxide). As a sinter feed, olivine reduces the sintering temperature as much as100 °C, thus, producing harder sinter which in turn generates less fines. Olivine is added directly to the iron ore as flux during the production of pellets so that the fluxed pellets swell less, reduce more quickly and have narrower melting range. However, on the other side, high silica content in olivine restricts its use in low silica iron ores because high silica content creates excessive slag formation in the furnace.

Dunite is well-suited as a refractory material due to its low and uniform coefficient of thermal expansion. Besides, dunite exhibits properties, such as, good resistance to thermal shock; spalling and slag attack; high green strength; and resistance to metal attack. Dunite, calcined in rotary kilns at 1,650 °C increases its refractory and foundry applications. Other uses of olivine are as loose-grainshot blasting abrasive, filtration media, in mineral wool production, filler in speciality paints, asphalt, mastics and weighing agent in concrete oil production platforms. Olivine also contributes magnesia and iron as nutrients to the soil.

Olivine should contain 45 to 51% MgO, 40 to 43% SiO_2, 7 to 8% Fe_2O_3, 0.2 to 0.8% CaO and 1.8 to 2% Al_2O_3 and TiO_2, MnO, Cr_2O_3, NiO & CaO for various uses. For blast furnace use, olivine should contain 47 to 48% MgO with 10 to 40 mm lump size. For foundry use, the size should be AFS 20, 30, 60, 90, 120 and for Flour, Filler and Fertilizer grades, size recommended is up to 0.8 mm, up to 0.02 mm and less than 0.1 mm, respectively.

As per the end-use grade classification, the reserves of 'fresh' and 'weathered' dunite have been classified as Gr. I and Gr. II, respectively. However, recommendations to assign chemical specification to these grade based on the experience of Tata Steel Ltd and GSI have been incorporated.

FUTURE OUTLOOK

The importance of dunite as a fluxing agent is increasing in the low silica iron ores. It is also used as a refractory material. India has adequate resources of dunite and pyroxenite to meet all its future industrial applications. With increasing need to augment steel production, requirement of fluxes as well as refractories are bound to increase and India is self-sufficient as far as these minerals are concerned.

30-8. Felspar

634
(million tonnes) Total reserves/ resources of felspar in the country as on 1st April 2015

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'felspar' has been declared as 'Minor Mineral'

Traditionally, potassium felspar obtained from labradorite are used as semi-precious stones.In Ceramic Industry, felspar is used as fluxing agents and the commonly used ceramic flux contains potash felspar and sodium felspar

Felspars are one of the most abundant rock- forming minerals in the earth's crust, comprising a complex series of aluminosilicates with varying amounts of potassium, sodium, calcium and, though rarely, barium. Common amongst these are the potash felspars called orthoclase and microcline ($K_2O.Al_2O_3.6SiO_2$), sodium felspar called albite ($Na_2O.Al_2O_3.6SiO_2$) and calcium felspar called anorthite ($CaO.Al_2O_3.2SiO_2$). The sodium and calcium felspars form a continuous series of solid solutions and are together termed plagioclase felspars. Though felspars occur in a variety of colours, pink, brown and grey felspars are known to be common.

Several varieties of felspar minerals are used as gemstones. Three of them, moonstone, sunstone and labradorite are known for their unique optical phenomena. The phenomenal properties of moonstone, sunstone and labradorite are that they almost always cut as dome-shaped cabochons. The uniqueness in their properties is observed when light strikes the microscopic structures within a polished stone at just the right angle. To make that happen, skilled craftmen who understand the optical phenomena of these gems cut the stone in such a way that the planes where the optical phenomena are produced occur parallel to the bottom of the cut gemstone.

RESERVES/RESOURCES

As per NMI database, based on UNFC system, the total reserves/resources of felspar as on 1.4.2015 has been placed at 634 million tonnes of which 320 million tonnes (50.48%) constitute as "Reserves" and 314 million tonnes (49.52%) as "Remaining Resources". In terms of grades, Unclassified grade accounts for 57%, Pottery/Ceramic grade 19%, Glass grade 13% and Not-known & Others grades (6% each) of the total resources. By States, Rajasthan alone accounts for about 90% of the total reserves/resources followed by Telangana (4%) and Andhra Pradesh & Tamil Nadu (2% each) (Table - 1).

Table-1: Reserves/Resources of Felspar as on 1.4.2015
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	173383004	103054634	43403974	319841612	45903221	42467787	40160373	13882441	17928113	150012330	3371567	313725831	633567443
By Grades													
Glass	31101917	18964826	1116975	51183718	8069246	4155097	4088590	238133	181140	15735742	318842	32786790	83970507
Pottery/Ceramic	25598581	11659828	9048026	46306435	17946394	7997021	13703037	2462573	2417929	25265494	1238089	71030537	117336972
Others	9078676	888220	1552793	11519689	2480626	10933380	4250318	342147	100474	6621536	33048	24761530	36281219
Unclassified	106501350	71098791	31198970	208799110	16935671	19338463	17924472	634831	3195686	91436219	1762983	151228326	360027436
Not-known	1102480	442970	487210	2032660	471284	43825	193956	10204757	12032883	10953339	18605	33918649	35951309
By States													
Andhra Pradesh	2295253	150795	556263	3002311	4427537	50911	2379650	361444	1819937	1571271	442950	11053700	14056011
Bihar	-	-	-	-	-	-	35147	-	4195	4871499	-	4910841	4910841
Haryana	-	-	-	-	-	-	-	-	-	72164	-	72164	72164
Jharkhand	68789	15402	191913	276104	-	40766	348792	32510	120388	836061	-	1378517	1654621
Karnataka	-	-	-	-	103675	73613	107055	25000	135133	177300	3900	625676	625676
Madhya Pradesh	-	-	-	-	10330	-	6610	-	-	339851	-	356791	356791
Maharashtra	-	-	-	-	651835	-	323337	-	-	253731	-	1228903	1228903
Meghalaya	-	-	-	-	-	-	-	-	-	37449	-	37449	37449
Rajasthan	161965311	102283772	41417085	305666168	35514780	40938362	33919764	12410200	8488066	132329070	2866777	266467018	572133186
Tamil Nadu	738656	23386	7134	769176	1896213	620530	1101842	18870	69822	5465465	-	9172741	9941916
Telangana	8244089	526905	1231579	10002573	3163212	543605	1938177	134417	3890572	3657219	57940	13385142	23387715
Uttar Pradesh	-	-	-	-	-	-	-	-	-	200000	-	200000	200000
West Bengal	70906	54375	-	125281	135639	200000	-	900000	3400000	201250	-	4836889	4962170

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'felspar' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few State could be collected. All possible information/data that could be gathered has been presented in this Review.

Statewise production of felspar during 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Felspar

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Rajasthan	7415000	5171000	3818825
Telangana	922611	780653	-
Andhra Pradesh	144239	211719	219712
Gujarat	2122	-	-
Karnataka	2290	9915	-

Source: As received from State DGMs and their websites.

USES & SPECIFICATIONS

Traditionally, potassium felspar obtained from labradorite are used as semi-precious stones.

In Ceramic Industry, felspar is used as fluxing agents and the commonly used ceramic flux contains potash felspar and sodium felspar. After clay, felspar is the biggest ingredient in the raw material batch for ceramic bodies. Typical felspar contents are < 25% in earthenware, 25–35% in sanitaryware, 15–30% in whiteware and 10–55% in floor & wall tiles.

In the Abrasive Industry, plagioclase felspar is used in the manufacture of acid-proof refractories. In Welding Electrode Industry, felspar is used as a flux which acts as an arc stabiliser and helps in protecting the molten metal from aerial oxidation.

Physical properties like good dispersability, chemical inertness, stable pH, low free silica content and brightness of 89–95% improve the filler properties of finely ground felspar material.

Ceramic Industry in India is about a century old and has formed a sizeable industrial base. The products generally comprise ceramic tiles, sanitaryware and crockery items. The Industry has wide variance in type, size, quality and standard. Manufacturing units are spread all-over India. The state-of-the-art ceramic goods are manufactured in the country. The domestic technology is at par with international standard. During the last two decades, there has been a phenomenal growth in the field of high-end technical ceramics to meet specific demands of industries like high alumina ceramic, cutting tools and other structural ceramics.

WORLD SCENARIO

World resources of felspar are large. The major producers of felspar are Turkey, Italy and China. Substantial production also comes from India, Thailand and Iran.

30-9. Fireclay

India possesses substantial reserves of fireclay. The best deposits occur in association with the coal seams in the Lower Gondwana Coalfields of Andhra Pradesh, Jharkhand, West Bengal, Madhya Pradesh and Neyveli lignite fields in Tamil Nadu

As per Govt. of India Notification S.O. 423 (E), dated 10th February 2015, 'fireclay' has been declared as 'Minor Mineral'

Fireclays are used in the manufacture of cement, bricks, blocks, retorts, crucibles, mortars, masses, pottery, floor tiles, etc. Low-grade material is used for manufacturing heavy sanitaryware, such as, pipes and bath tubs. Firebricks manufactured are used where heat generation is involved, such as, in furnaces, kilns and ovens. Firebricks are extensively used in metallurgical industries

The name fireclay is given to a group of refractory clays which can withstand temperatures above Pyrometric Cone Equivalent (PCE) value of 19. Refractoriness and plasticity are the two main properties needed in fireclay for its suitability in the manufacture of refractory bricks. A good fireclay should have a high fusion point (>1,580 °C) and good plasticity. Fireclay containing high alumina and low iron oxide, lime, magnesia and alkalies is preferred by refractory manufacturers. The aluminous (kaolinitic) variety of fireclay is more refractory because of its hardness and density and absence of iron, giving it a white-burning colour. The absence of alkalies gives it a very high fusion temperature.

RESERVES/RESOURCES

India possesses substantial reserves of fireclay. The best deposits occur in association with the coal seams in the Lower Gondwana Coalfields of Andhra Pradesh, Jharkhand, West Bengal, Madhya Pradesh and Neyveli lignite fields in Tamil Nadu. Notable occurrences of fireclay, not associated with coal measures, are reported in Gujarat, Jabalpur region of Madhya Pradesh and Belpahar–Sundargarh areas of Odisha. The reserves of fireclay are substantial but reserves of high-grade (non-plastic) fireclay containing more than 37% alumina are limited.

Reserves/Resources of fireclay as per NMI data, based on UNFC system as on 1.4.2015, have been estimated at 722.83 million tonnes. Out of these, 27 million tonnes are grouped under Reserves category while the bulk, i.e., 695.79 million tonnes are classified under Remaining Resources category. Out of 27 million tonnes Reserves, 13.29 million tonnes are Proved Reserves and 13.74 million tonnes are Probable Reserves. Out of the total Reserves/Resources, Odisha accounts for 24% followed by Madhya Pradesh (18%), Tamil Nadu (16%), Jharkhand (9%) and Gujarat & Rajasthan (8% each). Gradewise, Refractory-plastic grade accounts for 37% followed by Refractory-non-plastic/semi-plastic (16%) and Refractory-unspecified (14%). The remaining 33% are of Others, Unclassified and Not-known grades (Table-1).

Table-1: Reserves/Resources of Fireclay as on 1.4.2015
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon-naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	13295	5035	8707	27037	13878	30155	18260	49290	54093	524011	6104	695791	722829
By Grades													
Refractory-non-plastic/semi-plastic	2069	782	813	3663	4099	15234	3231	2607	1397	86980	-	113548	117211
Refractory-plastic	2271	1113	2076	5460	2492	4835	3074	4076	4674	238564	5146	262861	268321
Refractory-unspecified	7493	2088	4666	14248	5552	5983	6625	945	2010	69444	-	90558	104806
Others	641	302	772	1715	1384	2394	3420	7251	4137	44935	125	63647	65362
Unclassified	821	749	381	1951	194	1382	823	205	30	10020	-	12653	14604
Not-known	-	-	-	-	157	327	1087	34206	41845	74070	833	152525	152525
By States													
Andhra Pradesh	1252	40	642	1934	771	1400	1574	56	417	10211	132	14562	16496
Assam	-	-	-	-	-	-	-	-	-	3161	-	3161	3161
Bihar	-	-	-	-	-	-	-	-	-	44	-	44	44
Chhattisgarh	315	23	94	433	68	27	17	7180	3400	10435	-	21126	21558
Delhi	-	-	-	-	-	-	-	6	13	45	-	64	64
Gujarat	231	-	56	287	1193	664	966	2120	1053	53526	-	59522	59809
Jammu & Kashmir	-	-	-	-	-	-	-	-	-	-	4914	4914	4914
Jharkhand	-	-	3	3	-	1125	309	139	122	64755	-	66450	66454
Karnataka	146	-	-	146	247	340	2003	-	226	8832	-	11648	11794
Kerala	-	-	-	-	-	-	-	8200	51	9929	-	18181	18181
Madhya Pradesh	390	4192	3020	7603	2139	7164	4975	1551	2129	100977	100	119036	126639
Maharashtra	-	322	388	709	17	44	32	-	-	6652	-	6746	7455
Meghalaya	-	-	-	-	-	-	-	-	-	10999	-	10999	10999
Odisha	133	-	40	173	3074	12376	4495	26219	42925	83662	-	172751	172924
Rajasthan	6561	-	3932	10493	1548	1718	697	2256	2580	35363	-	44163	54656
Tamil Nadu	2523	458	155	3136	3952	3971	1842	1561	-	102202	-	113528	116663
Telangana	762	-	-	762	667	746	-	-	758	8514	-	10684	11446
Tripura	-	-	-	-	-	-	-	1	-	369	-	370	370
Uttar Pradesh	-	-	-	-	-	-	-	-	-	3221	-	3221	3221
West Bengal	981	-	377	1359	201	580	1349	-	419	11114	958	14622	15981

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details if any are covered in the Review on Exploration & Development under "General Reviews".

PRODUCTION

As per Govt. of India Notification S.O. 423(E), dated 10th February 2015, 'fireclay' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few states could be collected. All possible information/data that could be gathered has been presented in this Review. Statewise production of fireclay during 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Fire clay

(In tonnes)

State	2018-19	2019-20	2020-21
Gujarat	638145	-	-
Andhra Pradesh	47011	55254	27090

Source: As received from State DGMs and their websites.

Note : " - " NA

USES AND SPECIFICATIONS

Fireclays are used in the manufacture of cement, bricks, blocks, retorts, crucibles, mortars, masses, pottery, floor tiles, etc. Low-grade material is used for manufacturing heavy sanitaryware, such as, pipes and bath tubs. Firebricks manufactured are used where heat generation is involved, such as, in furnaces, kilns and ovens. Firebricks are extensively used in metallurgical industries.

Fireclays are usually graded into: i) Low duty ii) Intermediate duty iii) High duty and iv)Super duty, depending upon their capacity to withstand temperature before melting. The Low duty fireclay can withstand temperatures between 1,515 and 1,615 °C (PCE 19–28); Intermediate duty fireclay up to 1,650 °C (PCE 30), High duty fireclay up to 1,700 °C (PCE 32); and Super duty beyond 1,775 °C (PCE 35).

Crude fireclay and other clays including kaolin (china clay) are also used in a few cement manufacturing plants to increase the alumina content in the raw meal and its plasticity. Cement Industry has been the major consumer of crude fireclay followed by Refractory, Ceramic and Iron & Steel industries and other industries, such as, pesticide, alloy steel, graphite products, foundry, sugar, etc.

FUTURE OUTLOOK

Fireclay is one of the most important minerals used in the Refractory Industry. India has huge reserves of fireclay and there does not seem to be any problem in respect of supplies to the Refractory Industry in the near future. However, a serious dearth is being felt in the availability of high-grade fireclay analysing 37% & above Al_2O_3 with Fe_2O_3 and fluxing impurities less than 2% for supply to the refractories. To fulfil the increasing demand of the Refractory Industry, it is imperative that deposits of high-grade fireclay be explored and delineated. The export prospect of fireclay is relatively less as it is considered as low-value high bulk mineral. However, fireclay bricks as a commodity could have high export potential and therefore must be encouraged.

30-10. Fuller's Earth

261.38

(million tonnes) Total reserves/resources of fuller's earth have been established in the country as on 1st April 2015

74%

The total resources of Fuller's Earth located in Rajasthan

Fuller's earth, like bentonite, is also known as 'bleaching clay' because of its inherent bleaching properties. Fuller's earth is non-plastic clay that can be used to decolourise, filter and purify animal, mineral & vegetable oils and greases. It has great commercial importance like bentonite. Bentonite is swelling-type clay but fuller's earth is a non-swelling-type clay. This property difference is because of their chemical composition. Bentonite contains sodium, whereas fuller's earth contains calcium. Calcium bentonite, more commonly called fuller's earth, can be converted into sodium bentonite by cation exchange process or acid activation.

RESERVES/RESOURCES

The total reserves/resources of fuller's earth in India as on 1.4.2015 as per NMI database, based on UNFC system has been estimated at 261.38 million tonnes. Out of these, only 3.94 million tonnes are placed under 'Reserves' category while 257.4 million tonnes (98.49%) are placed under 'Remaining Resources' category. About 74% of the total resources are located in Rajasthan while the remaining resources are in Telangana (10%), Arunachal Pradesh (8%) and Assam (7%). Negligible quantities are also reported from Karnataka and Madhya Pradesh. The Statewise reserves/resources of fuller's earth are furnished in Table 1.

Table-1: Reserves/Resources of Fuller's Earth as on 1.4.2015
(By States)

(In tonnes)

Grade/State	Reserves		Remaining Resources				Total Resources (A+B)
	Proved	Total	Pre-feasibility	Indicated	Inferred	Total	
	STD111	(A)	STD222	STD332	STD333	(B)	
All India : Total	3941000	3941000	58200	912340	256467419	257437959	261378959
Unclassified Grade : Total	3941000	3941000	58200	912340	256467419	257437959	261378959
By States							
Arunachal Pradesh	–	–	–	10700	20000000	20010700	20010700
Assam	–	–	–	–	18860000	18860000	18860000
Karnataka	–	–	58200	551640	1557156	2166996	2166996
Madhya Pradesh	–	–	–	–	117200	117200	117200
Rajasthan	3941000	3941000	–	350000	190409080	190759080	194700080
Telangana	–	–	–	–	25523983	25523983	25523983

Figures rounded off.

Note : " - " Nil

PRODUCTION

As defined in Clause (e) of the Section-3 of MM (DR) Act 1957, 'fuller's earth' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few States could be collected. All possible information/ data that could be gathered has been presented in this Review. Statewise production of fuller's earth during 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Fuller's Earth

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Telangana	547096	597205	-
Rajasthan	64000	22000	28297
Karnataka	6198	3299	32958

Source: As received from State DGMs and their websites.

Note : " - " NA

USES & SPECIFICATIONS

Fuller's earth is used to decolourise, deodorise, dehydrate and neutralise various minerals, vegetable/ animal oils, etc. It is also used in the manufacture of No Carbon Required (NCR) papers. Of late, the growth in consumption in these sectors has been affected because of the advent of more sophisticated techniques in refining and due to availability of effective substitutes like activated bauxite and magnesium silicate. Fuller's earth is generally used in Fertilizer Industry as a carrier. In animal feed, fuller's earth is used as binders for pelletised feeds, carriers of supplement free flowing additives for feed in flour and lubricants to reduce dye friction. Consumption, however, is expected to rise in other unconventional uses as absorbent, for cleaning oil spillage on factory floors; as carrier for insecticides, fungicides; and as a mineral filler & extender.

WORLD SCENARIO

World resources of clays including fuller's earth are quite large, hence country specific data is not available. USA is the major producer. Other major producers are Spain, Mexico and Senegal.

30-11. Granite

46,320

(million cubic metres) Total reserves/resources of granite have been established in the country as on 1st April 2015

The granite being building stone comes under 'Minor Mineral' as defined in Clause (e) of Section 3 of MM(DR) Act,1957, hence the producers report the production data directly to the respective States and not to IBM

Granite is the most sought-after among all building stones. In ancient times, granite pillars and beams were a preferred material to support the huge structures of temples and palaces and for making protective walls around them

Granite technically refers to a light-coloured granulose plutonic rock composed of felspars, plagioclase, quartz (35% approx.) and minor amounts of mafic minerals (45% approx.), such as, biotite, hornblende, pyroxene, iron oxides, etc. But, in commercial parlance, the term granite has become synonymous with all those crystalline rocks which have pleasing colours, strength to bear the processes of quarrying and cutting & polishing and which are used commonly for decorative purposes. Being more resistant to wear and tear as well as weathering, granite is most sought-after stone for building as well as has uses as decorative stone. The fascination for granite is due to its amenability for taking mirror-like polish, high compressive strength, longevity and aesthetics. India possesses enormous deposits of all types of dimension stones and is considered as one of the prominent producers of dimension stones in the world. The Dimension Stone Industry employs a workforce of over one million at its various sectors in the country. This Industry plays a vital role in the economy of the States like Tamil Nadu, Andhra Pradesh, Telangana, Karnataka and Rajasthan. Granite Industry is valued at $40 billion and has a potential to generate semi-skilled employment, especially in rural areas.

Within the country, granite used for decorative purposes is considered costly when compared with other materials, hence, its utilisation and trade in the domestic front has been relatively low when compared to its export potential.

RESERVES/RESOURCES

India is endowed with abundant resources of wide variety of granite comprising over 200 shades. As per NMI data, based on UNFC system (as on 1.4.2015) reserves/resources of granite dimension stone of all types have been estimated at 46,320 million cubic metres. Of these resources, 264 million cubic metres (less than 1%) fall under Reserves category, while the remaining 46,056 million cubic metres (about 99%) fall under Remaining Resources category.

Of the total granite reserves, about 36 million cubic metres of all grades fall under Proved category while 228 million cubic metres fall under Probable category.

Statewise break-up of total resources reveals that Karnataka & Rajasthan share about 20% each of the resources which are followed by Jharkhand (19%), Gujarat (18%), Andhra Pradesh (5%) and Madhya Pradesh & Odisha (4% each). These States together account for 90% of the total resources. Gradewise classification reveals that about 7% of the total resources fall under Black granite while 92% under Coloured granite. About 1% resources are of Unclassified grade.

The details of Reserves/Resources as on 1.4.2015 are furnished in Table-1.

Table-1: Reserves/Resources of Granite (Dimension Stone) as on 1.4.2015

(By Grades/States)

(In thousand' cubic metres)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	35741	201377	26574	263692	38462	51990	8234	837325	2063964	42543908	512216	46056098	46319790
By Grades													
Black Granite	6936	6060	3909	16906	-	45690	1	50934	466039	2572581	23538	3158783	3175688
Coloured Granite	28805	195316	22665	246786	38462	6300	8233	786391	1276125	39843847	448438	42407795	42654581
Unclassified	-	-	-	-	-	-	-	-	321800	127481	40240	489521	489521
By States													
Andhra Pradesh	-	-	-	-	-	-	-	-	-	2360396	-	2360396	2360396
Assam	-	-	-	-	-	-	-	-	800	583150	-	583950	583950
Bihar	-	-	-	-	-	-	-	-	179000	698612	-	877612	877612
Chhattisgarh	-	-	-	-	-	-	-	-	-	50057	-	50057	50057
Gujarat	-	-	-	-	-	-	-	-	-	8501947	-	8501947	8501947
Haryana	-	-	-	-	-	-	-	-	-	34000	-	34000	34000
Jammu & Kashmir	-	-	-	-	-	-	-	-	-	44570	40000	84570	84570
Jharkhand	-	-	-	-	-	-	-	-	651300	8197110	26930	8875340	8875340
Karnataka	26363	19389	21836	67587	-	-	-	238	1231625	8012784	25659	9270306	9337893
Kerala	140	-	-	140	-	-	-	-	99	2570	-	2669	2808
Madhya Pradesh	-	160	-	160	-	-	-	-	-	1885924	108000	1993924	1994084
Maharashtra	-	-	-	-	-	6300	-	486925	-	665622	-	1158847	1158847
Meghalaya	-	-	-	-	-	-	-	-	-	-	286467	286467	286467
Odisha	-	80000	-	80000	-	-	-	330328	-	1432492	5160	1767980	1847980
Rajasthan	5581	100380	4500	110461	38462	-	-	-	-	9021742	20000	9080204	9190665
Tamil Nadu	-	1448	238	1686	-	45690	8234	7	-	503818	-	557749	559435
Telangana	-	-	-	-	-	-	-	-	-	45494	-	45494	45494
Uttar Pradesh	-	-	-	-	-	-	-	-	-	494819	-	494819	494819
West Bengal	3658	-	-	3658	-	-	-	19827	1140	8802	-	29768	33426

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on Exploration & Development under "General Reviews".

PRODUCTION

The granite being building stone comes under 'Minor Mineral' as defined in Clause (e) of Section 3 of MM(DR) Act,1957, hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few States could be collected. All possible information/data that could be gathered has been presented in this Review.

Major production of granite in raw as well as processed form is generally from Andhra Pradesh, Telangana, Rajasthan, Karnataka, Tamil Nadu and Gujarat. Statewise production of granite during 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Black/ Coloured Granite

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Rajasthan#	5612000	5665000	6561139
Telangana	1109743	1143633	-
Andhra Pradesh	1226958	1498695	748851
Gujarat#	537965	-	-
Karnataka@	39532	42130	202964
Kerala*#	1000	-	-
Goa**	417242	-	-

Source: As received from State DGMs and their websites.

Note : " - " NA

Quantity in tonnes

@ Karnataka also produced green granite about 11,908 cu. m during 2018-19 & 14,728 cu. m during 2019-20

* Dimension stone

** Basalt

USES & SPECIFICATIONS

Uses

Granite is the most sought-after among all building stones. In ancient times, granite pillars and beams were a preferred material to support the huge structures of temples and palaces and for making protective walls around them. With the invention of modern tools of greater hardness and polishing ability, the use of granite has rather increased on account of its aesthetic value. The modern motorised tools of tungsten carbide and brazed diamond have enabled the user to cut & polish granite as per the specifications of the Building Sector. Presently, cut and polished granite slabs of 20 mm thickness are preferred for flooring, while tiles of 10 or 12 mm thickness are used for cladding. In addition, gravestones and monuments of various shapes and sizes are also in vogue. The flexibility of the cutting tools has engendered creation of many artifacts of granite for decorative purposes.

Granite also finds its application in making garden furniture, such as, benches, fountains and many other articles which are used for landscaping and/or decorative purposes. The cut-to-size small blocks are used as cobblestone, kerbstone, road sidings and for many other innovative purposes.

Crude granites are utilised for structural purpose after little dressing & sizing, whereas processed granites are used mostly in the construction of buildings and monuments and for interiors and exterior facing. Granites, because of its superior wear resistance and non-denting quality are used as parts in various meteorological and engineering instruments, such as, surface plates, straight edges, parallels, cubes, V' blocks and work-mounting tables of co-ordinate measuring machines.

The surface plates are used as flat datum surface whenever precise measurements of dimensions and geometrical relationships are to be carried out. For this purpose, harder varieties of granite are preferred as they can bear the high-degree of grinding, polishing and calibration required for achieving flat surfaces. For its use as surface plates, granites should have properties, such as, close grain size, homogeneity, high density & hardness, uniform colour, low moisture absorption and should be free from flaws.

Specifications

The properties of granite which are normally valued for exploitation are compressive strength, tensile strength, density, p-wave velocity, etc. For marketability, other requirements like colour, texture, granularity, size, water absorption, porosity, hardness, moisture content, etc. are also essential. Raw blocks should be free from normal defects like fractures, joints, shears, hairline cracks, segregation, veins, etc.

POLICY

Granite is a 'Minor Mineral' under the MM(DR) Act, 1957. The grant of various mineral concessions for granite is, therefore, administered under the Minor Mineral Concession Rules of the respective State Governments. However, the Granite Conservation and Development Rules, 1999 aims at uniform rules for conservation, systematic development and scientific exploitation of granite resources.

WORLD SCENARIO

The top five granite producing countries in descending order were China, Brazil, India, Saudi Arabia and Italy. Currently, the USA is the world's biggest consumer of granite and its demand is largely fulfilled by imports from Brazil, China and India.

The European Union (EU) is one of the biggest markets for the worldwide Natural Stone Industry. India has also been one of the key players in the global export of natural stones, with substantial share in global exports.

FUTURE OUTLOOK

India possesses one of the best granite deposits in the world having excellent varieties comprising over 200 shades. India accounts for over 20% of the world resources in granite. The total granite resources in India as on 1.4.2015 is estimated at 46,320 million cubic meters.

The current environment for Granite Industry remains challenging. There are multiple headwinds like competition from engineered stone, closure of granite quaries and change in demand trends. Dimension stone market is said to grow at a fervent pace as the demand for granite, marble, sandstone and other dimension stones and stone products is on the rise as the residential consumption and private spending on home are increasing. In addition to this, residential remodelling activity is expected to rise as home owners continue to opt for larger kitchens and multiple bathroom, expending the space devoted to countertops. A similar rate of growth in exports can also be achieved with the help of suitable policy framework, infrastructure and other facilities which the Industry expects to consolidate for augmentation of prospects. A well-planned, concerted and dedicated efforts are essentially needed for promotion of Indian stones to galvanise their export prospects.

There is a need to integrate environmental concern and social & economic development of regions into mineral development programmes for achieving sustainable development. Granite mining adversely impacts the environment due to removal of top soil and overburden, which results in degradation of land. The recovery of saleable granite blocks is very low and the waste is mostly in the form of granite rocks having defects of colour, cracks, grain size etc. and these wastes could be used in manufacturing M-sands. The basic objective of sustainable development in mining is to meet the needs of the present without compromising the ability of future generations to meet their own needs.

30-12. Gypsum and Selenite

1,330

(million tonnes) Total reserves/resources of gypsum and selenite in the country as on 1st April 2015

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'gypsum' has been declared as 'Minor Mineral'

Cement, fertilizer (ammonium sulphate) and plaster of Paris are the three important industries in which gypsum is utilised. Gypsum of less purity in crushed form is utilised in portland cement manufacturing for controlling the setting time of portland cement (i.e., as a retarder to prevent quick set)

Gypsum ($CaSO_4.2H_2O$) is a hydrated calcium sulphate used widely in various industries because of its special property of losing three-fourth of the combined water of crystallisation when moderately heated (calcined) to about 130^{0}C. Besides, calcined gypsum when cooled, finely ground and made plastic with water can be spread out, cast or moulded to any desired surface or form. On drying, it sets into a hard rock-like form. Selenite is a colourless, transparent, naturally occurring crystalline variety of gypsum and is used extensively in Ceramic Industry and for manufacturing surgical grade plaster of Paris, whereas alabaster is a fine-grained, massive variety, white or shaded in colour. Silky and fibrous variety of gypsum is called satin spar. Anhydrite ($CaSO_4$) is a calcium sulphate mineral found associated with gypsum commonly as a massive or fibrous mineral.

Gypsum that occurs in nature is called mineral gypsum. In addition to mineral gypsum, seawater and some chemical and fertilizer plants are sources of by-product marine gypsum and by-product chemical gypsum, respectively. The latter is obtained as by-product phospho-gypsum or fluoro-gypsum or boro-gypsum, depending upon the source. Phosphoric acid plants are important sources of by-product phospho-gypsum.

Marine gypsum is recovered from salt pans during production of common salt in coastal region, particularly, in Gujarat and Tamil Nadu. The recovery of by-product gypsum and marine gypsum together is substantial and is comparable with the production of mineral gypsum.

FGD Gypsum is a unique synthetic product derived from flue gas desulphurisation (FGD) systems at electric power plants. Sulphur dioxide emission control systems used by coal-fired power plants remove sulphur from combustion gases using 'scrubbers'. In addition to FGD gypsum, synthetic gypsum includes materials, such as, phospho-gypsum, titano-gypsum, fluoro-gypsum and citro-gypsum.

Various grades of gypsum (as per $CaSO_4.2H_2O$ content) are produced and consumed by industries like cement, fertilizer plants, plaster of Paris, etc. Gypsum also acts as a neutralising agent and helps in improving soil permeability.

In gypsum, calcium or magnesium carbonate, chlorides, other sulphate minerals, clay minerals or silica are considered as deleterious constituents. As a result, mostly mine production of gypsum possess purity ranging between 70 and 95%.

RESERVES/RESOURCES

As per NMI database, based on UNFC system, the total reserves/resources of mineral gypsum in India as on 1.4.2015 has been estimated at 1,330 million tonnes of which 37 million tonnes have been placed under 'Reserves' and 1,293 million tonnes under 'Remaining Resources' category.

Of the total reserves/resources, Fertilizer/Pottery grade accounts for about 80% and Cement/Paint grade 13%. The Unclassified and Not-known grades together account for 5% resources. The remaining two per cent of resources is shared by Surgical Plaster and Soil Reclamation grades. By States, Rajasthan alone accounts for 81% resources, Jammu & Kashmir 14% and Tamil Nadu 2% resources. The remaining 3% resources are in Gujarat, Himachal Pradesh, Karnataka, Uttarakhand, Andhra Pradesh and Madhya Pradesh (Table-1).

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

GYPSUM

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'gypsum' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few States could be collected. All possible information/data that could be gathered has been presented in this Review. Statewise production of gypsum during 2018-19 to 2020-21 is furnished in Table-2.

SELENITE

M/s RSMML, a Public Sector company, is a leading producer of natural gypsum and selenite variety, producing from Thar desert areas of Rajasthan. Gypsum with (+)70% $CaSO_4.2H_2O$ purity produced by RSMML fulfils the demands of the cement industries and powder gypsum is used by farmers as a direct fertilizer for re-conditioning of alkaline soils for reducing alkanity and improving crop production.

The production of selenite was 2,200 tonnes in the year 2020-21 as against 1,167 tonnes during the previous year. The entire production of selenite was reported by Rajasthan State Mines & Minerals Ltd (RSMML), a Public Sector Undertaking, that operates two mines, one each in Barmer and Bikaner district of Rajasthan.

The mine-head closing stocks of selenite were 23 tonnes at the end of the year 2020-21 as against 24 tonnes at the end of the year 2018-19.

The average daily labour employed in selenite mines during 2019-20 was 14 as against 12 in the previous year.

As selenite is not listed under minor minerals, its production details are covered in this Review (Tables 3 to 5).

USES AND SPECIFICATIONS

Cement, fertilizer (ammonium sulphate) and plaster of Paris are the three important industries in which gypsum is utilised. Gypsum of less purity in crushed form is utilised in portland cement manufacturing for controlling the setting time of portland cement (i.e., as a retarder to prevent quick set). It is added to the clinker just before final grinding to finished cement. Proportion of gypsum in Cement Industry is 4-5% of the cement produced. Both mineral and by-product gypsum are used in cement manufacture. Calcined gypsum finds use in manufacturing Plaster of Paris. It is also used in manufacturing partition blocks, sheets & tiles, insulation boards for stucco and lattice works. Gypsum board is primarily used as a finish for walls and ceilings. It is also used as a binder in fast dry tennis court clay. Low-grade gypsum is calcined and used as gypsum plaster after preparation of mortar. It is used for internal plastering and masonry work. Requirement of low-grade gypsum for use in Building Industry as per IS:12654-1989 (Reaffirmed 2010) is: $CaSO_4.2H_2O$ not less than 60%. In pottery, calcined gypsum is used for preparation of moulds in the production of sanitarywares. The used and discarded moulds are in turn again used as source of gypsum in cement and other industries. Low-grade gypsum is used in conditioning of alkaline soil and as manure in agriculture mainly for correcting black alkali soils. BIS has also prescribed IS: 6046-1982 (First Revision; Reaffirmed 2008) for gypsum for agricultural use.

Table-1: Reserves/Resources of Gypsum as on 1.4.2015

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnais-sance STD334	Total (B)	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222						
All India : Total	35141	311	1169	36621	10826	93127	33419	9071	713834	428097	4518	1292892	1329513
By Grades													
Surgical Plaster	621	-	-	621	-	1039	82	-	-	3773	-	4894	5515
Fertilizer/Pottery	18933	-	45	18978	2296	9266	270	7680	703244	320454	-	1043211	1062189
Cement/Paint	11547	311	691	12549	7980	82430	30372	1148	3184	39191	10	164315	176864
Soil Reclamation	-	-	-	-	185	392	2573	100	206	7939	2180	13576	13576
Unclassified	367	-	46	413	3	-	116	78	5548	33548	2328	41621	42034
Not-known	3670	-	387	4057	356	-	-	66	1652	23191	-	25265	29322
Others	3	-	-	3	5	-	5	-	-	-	-	11	14
By States													
Andhra Pradesh	-	-	-	-	-	-	-	-	-	404	-	404	404
Gujarat	4	5	24	33	4	-	-	616	308	15446	-	16374	16407
Haryana	-	-	-	-	-	-	-	-	-	-	2180	2180	2180
Himachal Pradesh	-	-	-	-	-	-	1365	-	-	3081	-	4446	4446
Jammu & Kashmir	11383	153	442	11977	4602	9844	6570	7680	2673	146914	2328	180610	192588
Karnataka	-	-	-	-	-	-	-	-	-	3784	-	3784	3784
Madhya Pradesh	-	-	-	-	-	-	-	-	-	69	-	69	69
Rajasthan	23617	153	658	24428	6201	82814	18663	750	710604	236847	-	1055878	1080306
Tamil Nadu	137	-	46	183	19	469	6786	25	249	19540	10	27099	27282
Uttarakhand	-	-	-	-	-	-	35	-	-	2012	-	2047	2047

Figures rounded off.

Table-2: Statewise Production of Gypsum

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Rajasthan	4664000	3006000	6788194
Gujarat	46	50	-

Source: As received from State DGMs and their website.

Table-3 : Principal Producer of Selenite, 2019-20

Name & Address of Producer	Location of Mines	
	State	District
Rajasthan State Mines & Minerals Ltd, C 89-90, Janpath, Lal Kothi Scheme, Jaipur – 302 015, Rajasthan.	Rajasthan	Barmer Bikaner

Table-4: Production of Selenite, 2018-19 to 2020-21

(By States)

(Quantity in tonnes; Value in ₹'000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	2906	5812	1167	2353	2200	41269
Uttarakhand	2906	5812	1167	2353	2200	41269

Selenite, a crystalline variety is used to a limited extent for gypsum plate for petrological microscopes, known as Sensitive Tint. It is also used in the Ceramic Industry for making moulds to manufacture surgical grade plaster of paris and also for producing white cement. Plaster of Paris Industry requires high purity gypsum. Different grades of plaster of Paris are manufactured depending upon the period for setting. For surgical plaster, a minimum 96% $CaSO_4.2H_2O$ grade gypsum is required.

High-purity gypsum can be utilised for manufacturing of ammonium sulphate fertilizer. Ground pure white gypsum is also used as a filler in paper, paints and textile goods. Ground low-grade gypsum is used in mine dusting, manufacture of black board chalks and as a filler in insecticides. Besides, gypsum is also used in other industries like pharmaceutical, textile and asbestos products.

Alabaster, a dense, massive, granular and translucent variety, is employed as ornamental stone in statuary and interior decoration.

BIS specification for by-product gypsum (IS:10170-1982, reaffirmed 2008) lays down a minimum 70% content of $CaSO_4.2H_2O$ and maximum limit of 0.75% Na, 1.0% F and 15% free moisture on dry basis. The material should pass through 2 mm sieve, but 50% of material should also pass through 0.25 mm (60 mesh) sieve. The specifications of by-product gypsum for use in plaster, blocks and boards are as per IS:12679-1989 (reaffirmed 2010). Besides, BIS has prescribed IS:1290-1973 (Second Revision; reaffirmed 2011) for mineral gypsum.

Substantial quantity of mineral gypsum as well as phospho-gypsum was used in Agricultural Sector for conditioning of alkaline soil and in Cement Industry. The remaining nominal consumption was in plaster of Paris, asbestos products, ceramic, fertilizer, refractories, textile, pharmaceutical and paint industries. The entire quantity of marine gypsum and gypsum moulds was also consumed in cement and ceramic industries respectively.

WORLD SCENARIO

The world reserves of gypsum are large. China was the largest producer of gypsum followed by Iran, Thailand, USA, Iraq, Turkey, Spain, Mexico, Oman, Japan, Russia, Germany and Australia.

TRADE POLICY

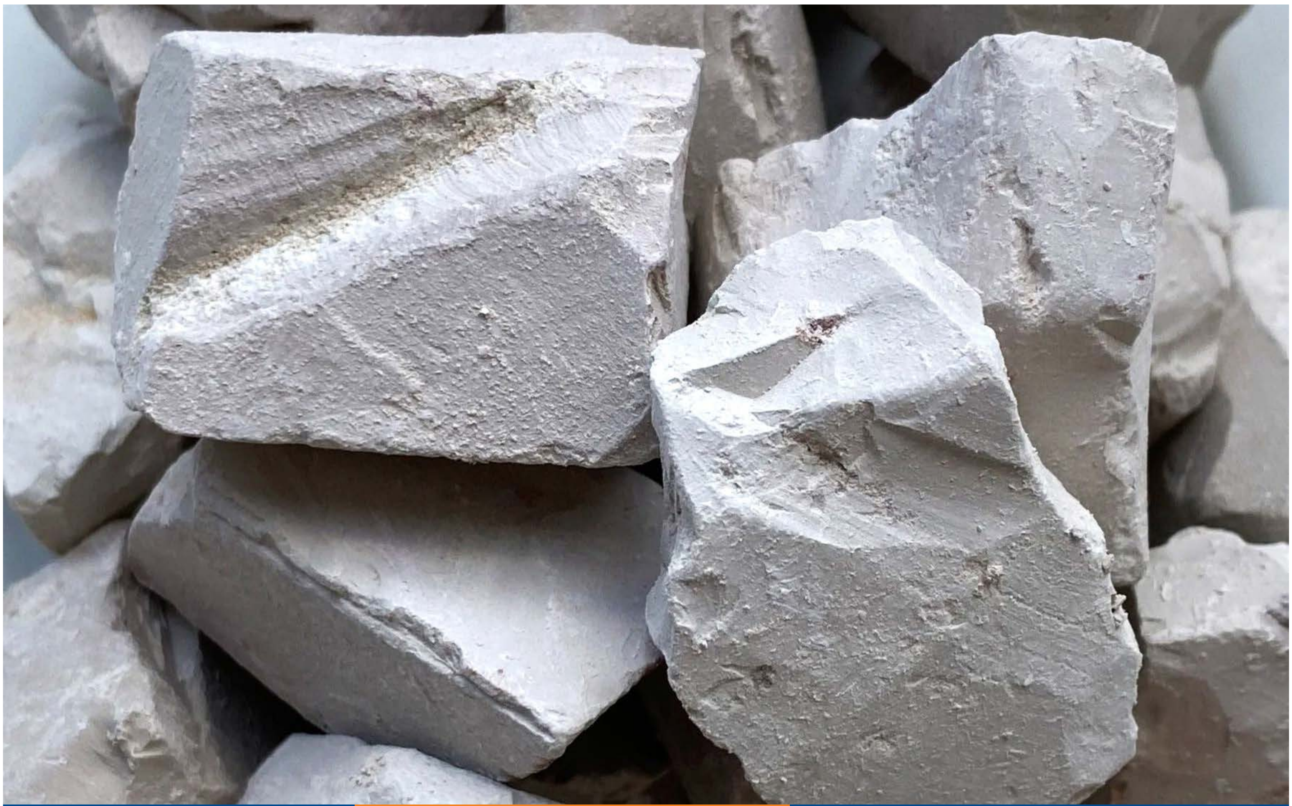
As per 'Export-Import Policy, 2015-2020, gypsum, anhydrite, plasters (consisting of calcined gypsum or calcium sulphate) whether or not coloured, with or without small quantities of accelerators or retarders are free under heading 2,520 of import policy.

FUTURE OUTLOOK

India's domestic resources of gypsum are large enough to meet increased demand. With renewed focus on improving the economy and upscaling industrial developments, India lays greater emphasis on creation of infrastructure. As per the Working Group report, augmentation of infrastructural activities will endanger further growth of the Cement Industry which concomitantly will raise the consumption of gypsum and thereby its demand, with consequence, leading to increased dependence on imports and synthetic gypsum to meet cement demand. Further, as per the report, steps would be necessary to find out suitable mining technology to exploit deep-seated gypsum resources in Bhadvasi deposit, Nagaur district Rajasthan. State-of-the-art technology needs to be adopted for the exploitation of deep-seated gypsum.

Other segments that would attract attention would be production of gypsum wallboard which is currently negligible in India. It could find better prospects because of its light weight and other special characteristics. It being an excellent partition material could facilitate its utility in high rise building constructions. In view of the environmental problem arising from huge accumulation of phospho-gypsum at different fertilizer plants, possibilities of finding other possible means for its utilisation has become a necessity. Low-grade gypsum being cheaper could find better prospects in its application more as a soil conditioner for reclamation of alkaline soils.

30-13. Kaolin, Ball Clay, Clay (Others) and Shale



2,941.24

(million tonnes) Total reserves/resources of china clay in the country as on 1st April 2015

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'china clay' has been declared as 'Minor Mineral'.

China clay (kaolin) is used in a number of industries in both crude and processed forms. The major use for crude china clay in India is in the Cement Industry, whereas Ceramic Industry accounts for consumption of a major share of processed form of china clay

1. Kaolin (China Clay)

The name kaolin is derived from the village of Gaoling in Jiangxi province, China, where the white clay was mined. Kaolin also known as china clay, is a white commercial clay consisting predominantly of the mineral kaolinite, a hydrated aluminosilicate formed by chemical weathering of aluminium silicate minerals like felspars through a complex sequence of events. It is relatively pure clay predominantly consisting of kaolinite ($Al_2Si_2O_5(OH)_4$), associated with other clay minerals like dickite, halloysite, nacrite and anauxite. Kaolinite and halloysite are the most commonly found members of the kaolin group whilst nacrite and dickite are considered rare but with the progress made in infrared spectroscopy techniques, nacrite and dickite are now found in association with kaolinite in many deposits. As the levels of nacrite and dickite increase with the higher temperatures and pressures at depth, these two minerals are used as a guide by the Oil Industry as an indicator of depth of sediments burial.

Kaolin is commercially valued for its whiteness and fine particle size which distinguish it from other clays, such as, ball clay and fireclay. Other physical characteristics that influence commercial utility include brightness, glossiness, abrasiveness and viscosity. It often contains small amounts of impurities in the form of rock fragments, hydrous oxides and colloidal materials. Kaolin is produced and consumed by the country in crude & processed forms. The major use of crude china clay is in Cement Industry and that of processed china clay in Ceramic Industry. The in situ clay deposits in India are often soft and can be easily extracted without blasting.

RESERVES/RESOURCES

China clay reserves/resources in the country as per NMI data based on UNFC system as on 1.4.2015 have been placed at 2,941.24 million tonnes. The reserves constitute only about 8% of the resources at 229.47 million tonnes. Out of the total reserves, 61% (about 140.46 million tonnes) reserves are under Proved category whereas 39% (about 89 million tonnes) reserves fall under Probable category.

The reserves/resources are spread over in a number of States of which Kerala holds about 23%, followed by Rajasthan (19%),West Bengal (14%), Odisha (10%) and Karnataka (9%). Out of the total reserves/ resources, about 26% or 771.42 million tonnes fall under Ceramic/Pottery grade, about 4% is classified under Chemical, filler and cement grades and about 70% or 2,039 million tonnes resources fall under Mixed Grade, Others, Unclassified & Not-known categories. The details of reserves/resources are furnished in Table- 1.

Table-1: Reserves/Resources of China Clay as on 1.4.2015
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon-naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	140456	36144	52869	229469	107176	42220	98627	289723	415703	1685730	72599	2711777	2941247
By Grades													
Textile/Paper Coating	-	-	-	-	65	-	-	-	-	-	-	65	65
Insecticide	-	-	-	-	-	-	-	-	-	113	-	113	113
Chemical	-	-	-	-	-	600	-	-	-	33945	-	34545	34545
Ceramic/Pottery	77668	15765	30250	123683	47145	26047	47784	103887	25753	362781	34340	647736	771419
Rubber	-	136	-	136	-	81	-	-	-	125	138	345	481
Mixed Grade	356	200	80	636	7748	1846	4335	884	607	199355	18002	232778	233414
Filler	9564	1118	3070	13752	11606	1406	8144	621	684	32909	621	55990	69742
Cement	4955	1230	2399	8584	6749	1160	6070	25	423	2902	-	17330	25914
Others	28168	17183	13174	58525	13889	8206	17395	180397	1649	53406	6983	281925	340450
Unclassified	12210	42	1940	14192	15913	1342	6792	720	68626	31882	1421	126694	140886
Not-known	7535	472	1954	9961	4061	1533	8107	3189	317961	968311	11094	1314257	1324218
By States													
Andhra Pradesh	2494	953	1889	5337	1508	989	2071	511	688	51427	362	57556	62893
Assam	-	-	-	-	-	131	-	392	-	3520	-	4043	4043

Table 1-*(Concld)*

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Recon-naissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
Bihar	-	-	-	-	-	-	-	104	39	1296	-	1438	1438
Chhattisgarh	107	-	22	130	1272	765	1412	-	-	11422	-	14871	15001
Delhi	-	-	-	-	-	-	-	857	630	3802	-	5289	5289
Goa	-	-	-	-	-	-	16	-	-	-	-	16	16
Gujarat	54111	3486	19671	77268	25378	4790	28542	1663	4198	49337	4114	118021	195289
Haryana	-	-	-	-	2367	789	3377	13	34	5485	-	12065	12065
Jammu & Kashmir	-	-	-	-	-	-	-	-	2	28122	-	28124	28124
Jharkhand	427	-	6412	6838	9338	2093	4738	3962	7363	149892	18019	195405	202244
Karnataka	330	472	-	802	1768	747	2683	220360	443	24803	6030	256834	257636
Kerala	7097	200	725	8022	4573	463	4112	43930	20439	571644	20200	665360	673383
Madhya Pradesh	357	474	902	1733	2882	406	3774	621	415	12017	-	20115	21848
Maharashtra	-	-	-	-	418	81	831	-	184	5735	-	7248	7248
Manipur	-	-	-	-	-	-	-	2520	-	-	-	2520	2520
Meghalaya	-	-	-	-	-	-	-	1200	6266	76242	5167	88875	88875
Odisha	-	-	-	-	3600	3503	5018	368	35770	236546	1354	286157	286157
Puducherry	-	-	-	-	-	-	-	-	-	2940	-	2940	2940
Rajasthan	73434	29510	22493	125437	47554	26157	40542	1584	3221	294386	11428	424874	550311
Tamil Nadu	-	-	-	-	-	-	-	-	327	56570	-	56897	56897
Telangana	623	322	-	945	2902	1059	655	-	-	10602	132	15350	16295
Uttar Pradesh	-	-	-	-	-	-	-	11600	3447	10018	-	25065	25065
West Bengal	1476	727	754	2957	3617	248	857	38	332236	79923	5793	422712	425669

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'china clay' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few states could be collected. All possible information/data that could be gathered has been presented in this Review.

Statewise production of china clay from 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of China Clay/ White Clay

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Gujarat	3883199	-	-
Rajasthan	3775000	1345000	3604724
Andhra Pradesh	88369	82485	70080
Telangana	50009	44410	-
Kerala	399978	-	-
Karnataka	5391	27863	2975
Maharashtra*	7168639	734096	-
Himachal Pradesh*	58060	32843	-

Source: As received from State DGMs and their websites.

Note : " - " NA

*Ordinary clay

USES AND SPECIFICATIONS

China clay (kaolin) is used in a number of industries in both crude and processed forms. The major use for crude china clay in India is in the Cement Industry, whereas Ceramic Industry accounts for consumption of a major share of processed form of china clay. Besides ceramics, processed china clay finds use in other industries in the country, such as, sealants, paper coatings, as extender in fibre glass, paint and as a filler for paper, rubber, plastic, cosmetics, pharmaceuticals and textiles. Crude china clay also finds use in Insecticide and Refractory Industries. Other uses of china clay are in ink, ultramarine, synthetic zeolite, catalyst, water filter candles, soaps & detergents and explosives & pyrotechnic industries. Some of the areas where use of china clay is gaining importance are in the manufacture of plastic film, video and audio tapes where clays are used as anti-blocking agents, and in the field of biotechnology, where ceramics are widely in use for its light weight & high strength properties. EICL has been producing Metakaolin which increases the durability of concrete by lime fixation and arresting of deterioration of concrete by weathering. Himacem has high chemical resistance which makes the product suitable for construction of high span bridges, underwater structures and chemical plants.

The Bureau of Indian Standards (BIS) has prescribed specifications for china clay to be used in different industries. They are IS:505-1995 (Third Revision, Reaffirmed 2011) for paper coating and filler for paper, rubber, textile industries, IS:1463-1983 (Third Revision, Reaffirmed 2000) for cosmetics and IS:7589-1974 (Reaffirmed 2011) for Explosive & Pyrotechnic Industry. BIS has revised the specifications for china clay for Ceramic Industry to IS:2840-2002 (Second Revision, Reaffirmed 2008) and for Paint Industry to IS:68-2006. The whiteness, particle size, plasticity, contents of alumina, iron and titanium are some important factors which control the specifications of china clay for different end-uses. China clay for ceramic and refractory applications is analysed for grit, brightness, green and dry strength, fixed colour, iron and alumina contents. For filler and extender applications, it must meet very rigid specifications, such as, particle size, colour, brightness and viscosity. The replacement of kaolin as a filler with Precipitated Calcium Carbonate (PCC) and Ground Calcium Carbonate (GCC) results in lowering consumption of kaolin in Paper Industry. Now they are using GCC due to a switch over by paper makers from an acid-based processing route to an alkali-based route for production.

The main consumption of raw china clay is in the china clay process/refining plants industry. The china clay processed by these plants in turn is consumed by various industries except cement, refractory and pesticide industries. The major consumer industries of raw china clay, are pesticide, paint, refractory, paper, cosmetic, rubber, abrasive, asbestos products, chemical, dry cell batteries, textile, electrical, electrode and glass.

TRADE POLICY

As per Import Policy under schedule of ITC (HS) 2022 and export policy under schedule of ITC (HS) 2022 there are no restriction no exports and imports china clay (kaolin).

WORLD SCENARIO

World production of kaolin is increasing steadily. Two-third of the world production comes from USA, China, Turkey, Ukraine, Brazil, Iran and Germany.

FUTURE OUTLOOK

India has abundant resources of kaolin which can easily meet both the internal and the external demands. The processing of kaolin in the country is done mostly by conventional methods like levigation and washing. New capacities for High-tech processing have to be established and existing capacities in the country have to be augmented to meet the demand of processed kaolin in the future.

In the Indian kaolin market, good growth is expected both for hydrous and calcined clay particularly in paint, cables, plastics, rubber and ceramics.

2. Ball Clay

Ball clay commonly consists of 20–80% kaolinite, 10–25% mica & 6–65% quartz. Ball clay and china clay differ only in the degree of plasticity. China clay is less plastic than ball clay. Ball clay is a highly plastic variety of kaolin having high binding power, tensile strength and shrinkage. It is utilised generally after mixing with non-plastic clay to impart the desired plasticity in pottery, porcelain and refractory materials. It also helps in the preparation of glaze, enamels and for imparting a dense vitrified body.

RESERVES/RESOURCES

Deposits of ball clays are relatively scarce due to the combination of geological factors needed for their formation.The total resources of ball clay as per NMI data based on UNFC system as on 1.4.2015 in the country is placed at 134.74 million tonnes. Out of these resources, the reserves are about 49.49 million tonnes and the remaining resources are 85.25 million tonnes. About more than 57% resources are in Rajasthan followed by Andhra Pradesh with 42%. Resources in Gujarat are nominal. Out of the total reserves/resources, Ceramic/Pottery grade constitutes 58%. All India reserves/resources of ball clay are furnished in Table- 3.

Table-3: Reserves/Resources of Ball Clay as on 1.4.2015
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources							Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	(B)	
All India : Total	33526297	11182801	4784522	49493621	11045214	4286560	13437994	624977	2497880	53357091	85249716	134743337
By Grades												
Ceramic/Pottery	12164675	1733326	3894361	17792361	4582521	4223342	11445891	470986	2279330	37898024	60900094	78692455
Refractory	1411104	202950	54	1614108	3363353	-	763135	-	-	512760	4639248	6253356
Others	17857250	8534551	890108	27281909	342169	46134	67320	153991	-	9457635	10067249	37349158
Unclassified	2093268	711975	-	2805243	2757171	17084	1161648	-	218550	5488672	9643125	12448368
By States												
Andhra Pradesh	6700417	202950	1049025	7952392	5622514	2842702	10275648	-	2279330	28044529	49064723	57017115
Gujarat	20900	-	-	20900	342169	-	-	403801	-	49670	795640	816540
Rajasthan	26804980	10979851	3735497	41520329	5080531	1443858	3162346	221176	218550	25262892	35389353	76909682

Figures rounded off

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'ball clay' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few States could be collected. All possible information/data that could be gathered has been presented in this Review.

Statewise production of ball clay during 2018-19 to 2020-21 is furnished in Table-4.

Table-4: Statewise Production of Ball Clay

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Rajasthan	4743000	3014000	4094522
Andhra Pradesh	164039	186145	139116
Gujarat	60645	-	-

Source: As received from State DGMs and their websites.

SPECIFICATIONS

The specifications for plastic clay and washed plastic clay for use in Ceramic Industry are prescribed vide IS:4589-2002 (Third Revision, reaffirmed 2008). About 95% consumption was accounted for by the Ceramic Industry. The remaining consumption (5%) was reported by the Refractory and Abrasive Industries.

3. Clay (Others)

As per Govt. of India Notification S.O. 423(E), dated 10th February 2015, 'Clay (Others)' has been declared as 'Minor Mineral', hence the production data is not available with IBM. Clay (Others) may contain all types of clays used as brick clay, ordinary clay/earth mitti, chhui mitti, reh mitti, etc. Almost all States produce one or other type of clay. However, no authentic production data is available.

4. Shale

Shale is a fine-grained, plastic sedimentary rock comprised of mud that is a mixture of flakes of clay minerals and tiny fragments of minerals like quartz and calcite. The ratio of clay to other minerals is variable.

Shale which occurs with limestones as parting is rich in alumina content. Hitherto, shale was considered as implacable substance that reduced the quality of limestone due to presence of clay minerals. Now, with advancements and better knowledge, it is utilised as a source of alumina in cement making.

RESERVES/RESOURCES

The reserves/resources of shale were placed at 19.25 million tonnes as per NMI data , based on UNFC system, as on 1.4.2015. Of the total resources, Reserves comprise 15.47 million tonnes and Remaining Resources 3.78 million tonnes. About 72% resources are located in Telangana followed by Andhra Pradesh (18%) and Madhya Pradesh (10%) (Table-5).

Table-5: Reserves/Resources of Shale as on 1.4.2015
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	15027	171	274	15472	495	-	2022	-	-	1175	90	3781	19253
By Grades													
Unclassified	15027	171	274	15472	495	-	2022	-	-	1175	90	3781	19253
By States													
Andhra Pradesh	1120	162	272	1554	199	-	563	-	-	1142	90	1994	3548
Madhya Pradesh	55	9	2	66	295	-	1459	-	-	33	-	1787	1853
Telangana	13852	-	-	13852	-	-	-	-	-	-	-	-	13852

Figures rounded off.

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'shale' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. Considering white shale as a type of shale, the Statewise production of white shale during 2018-19 to 2020-21 is furnished in Table-6.

Table-6: Statewise Production of White Shale/Shale

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Andhra Pradesh	83350	-	-
Telangana	53522	18323	-
Himachal Pradesh	1138222	1276429	-
Karnataka	3984	-	35205
Maharashtra*	-	44234	-

Source: As received from State DGMs and their websites.

* : Other than that for building material.

30-14. Laterite

Laterite occurrences are widespread in the country. Almost all Indian bauxite deposits are associated with laterite, except those in Jammu & Kashmir	As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'laterite' has been declared as 'Minor Mineral'	Indian Standards code IS 3620-1979 provides specifications and standards for laterite masonry construction in India

Laterite (from the Latin word later, meaning "brick" or "tile") is a surface formation that is enriched in iron and aluminium. Found mainly in hot, wet tropical areas, it develops by intensive and long-lasting weathering of the underlying parent rock. The mineralogical & chemical composition of laterite depends on their parent rock. Due to the presence of iron oxides, lateritic soils are red in colour ranging from light bright to brown shades. The term 'laterite' was originally used for highly ferruginous deposits, first observed in Malabar Region of coastal Kerala and Dakshina Kannada & other parts of Karnataka. It is a highly weathered material, rich in secondary oxides of iron, aluminium or both. It is either hard or capable of hardening on exposure to moisture and drying.

Laterite and bauxite show a tendency to occur together. Aluminous laterites and ferruginous bauxites are quite common. The most common impurity in both is silica. Laterite gradually passes into bauxite with decrease in iron oxide and increase in aluminium oxide. The laterite deposits may be described on the basis of the dominant extractable minerals in it: (i) aluminous laterite (bauxite), (ii) ferruginous laterite (iron ore), (iii) manganiferous laterite (manganese ore), (iv) nickeliferous laterite (nickel ore) and (v) chromiferous laterite (chrome ore). Laterite with Fe_2O_3:Al_2O_3 ratio more than one, and SiO_2:Fe_2O_3 ratio less than 1.33 is termed as ferruginous laterite, while that having Fe_2O_3:Al_2O_3 ratio less than one and SiO_2:Al_2O_3 ratio less than 1.33 is termed as aluminous laterite.

Laterite can be considered as polymetallic ore as it is not only the essential repository for aluminium, but also a source of iron, manganese, cobalt, nickel and chromium. Furthermore, it is the home for several trace elements like gallium and vanadium which can be extracted as by-products.

RESERVES/RESOURCES

Laterite occurrences are widespread in the country. Almost all Indian bauxite deposits are associated with laterite, except those in Jammu & Kashmir. Laterite generally occurs as capping on the hills and plateaus of Madhya Pradesh and in some States of the Deccan peninsula at altitudes ranging from coastal to 2,000 m with thickness up to 60 m.

As per the NMI database based on UNFC System as on 1.04.2015, the total reserves/resources of laterite were estimated at 706 million tonnes. Out of these, 124 million tonnes are placed under Reserves category and 581 million tonnes are under Remaining Resources category. Major share of about 73% resources is located in two States, namely, Madhya Pradesh (56%) and Rajasthan (17%). The remaining 27% of resources are spread over in the States of Andhra Pradesh, Kerala, Gujarat, Maharashtra and Jharkhand. Gradewise and Statewise reserves/resources are furnished in Table- 1.

Table-1: Reserves/Resources of Laterite as on 1.4.2015
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	98598	12527	13608	124733	49655	8960	22724	3532	2626	243535	250787	581819	706552
By Grade													
Unclassified	98598	12527	13608	124733	49655	8960	22724	3532	2626	243535	250787	581819	706552
By States													
Andhra Pradesh	13574	680	1710	15964	23238	5107	2244	24	1107	889	-	32608	48572
Gujarat	36019	-	399	36418	8095	-	1467	-	-	-	-	9562	45981
Jharkhand	-	-	-	-	-	-	-	-	-	570	-	570	570
Kerala	-	-	1156	1156	953	-	-	-	-	-	16717	17670	18826
Madhya Pradesh	12534	3355	7917	23807	8715	1631	16077	3189	1519	167527	169678	368336	392143
Maharashtra	-	278	-	278	2215	1393	400	319	-	7577	-	11903	12181
Odisha	-	-	-	-	-	-	-	-	-	-	1227	1227	1227
Rajasthan	-	-	-	-	-	-	-	-	-	60490	62860	123350	123350
Telangana	36471	8213	2426	47110	6439	828	2536	-	-	6483	305	16591	63701

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'laterite' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few states could be collected. All possible information/data that could be gathered has been presented in this Review.

Statewise production of laterite from 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Laterite

(In tonnes)

State	2018-19	2019-20	2020-21
Andhra Pradesh	2260896	707730	71866
Telangana	3837982	3471995	-
Maharashtra	1809659	2252671	-
Gujarat	14670	-	-
Goa	930*	-	-
Kerala*	3007297	-	-
Karnataka	108468	327842	295060

Source: As received from State DGMs and their websites.

Note : " - " NA, *in cu. m

* : Figure relates to laterite (building) only.

USES & SPECIFICATIONS

Indian Standards code IS 3620-1979 provides specifications and standards for laterite masonry construction in India. Unique material properties and regional variations have rendered laterite stone as subject of controversy. The engineering characteristics of laterite from Malabar region of western India have been reflected in research studies conducted and were established in several other published studies.

The compact and ferruginous variety of laterite is used widely as a building stone and road metal. It cannot withstand heavy pressure hence, laterite is used in construction of light structures, partition walls, boundary walls, etc. Laterite as a building stone possesses one advantage that it is soft when quarried and can be easily cut and dressed into blocks and bricks which on exposure to air become hard.

The industrial use of laterite is in the Cement Industry. It is used as an additive for lowering the clinkerisation temperature and supplementing aluminous and iron contents required in the manufacture of cement. It is also reported that laterite is capable of removal of phosphorus from solutions and percolating columns of laterite remove cadmium, chromium and lead to very low concentrations.

FUTURE OUTLOOK

In India, though the resources of laterite are vast and are available in abundance, the work in respect of systematic exploration and estimation of resources have been restricted. There seems to be no major change in the end-use pattern of laterite.

Laterite is widely used as a building stone and road metal. Laterite is a weak stone, but can be used for masonry construction. The property of laterite can be enhanced by suitable water proofing treatments. Long-term study is required to find an optimum size for its varied masonry applications.

The consumption of laterite in cement has risen due to increased demand of cement in the country. The plausibility of diverse application of laterite in future could be in the realm as a viable source for metallic minerals like iron, aluminium, chromite and of trace elements like gallium and vanadium.

30-15. Marble

On the basis of available data, IBM has prepared a mineral inventory of marble reserves/ resources as per NMI database, based on UNFC system as on 1.4.2015

Marble being building stone, comes under 'Minor Mineral', as defined in Clause (e) of Section 3 of MM(DR) Act, 1957

Marble is used widely in buildings, monuments and sculptures. Its utility value lies in its beauty, strength and resistance to fire and erosion. Marble has its application in interior and exterior wall cladding, interior and exterior paving, fireplace facing and hearth, lavatory tops, residential and commercial counter tops, table tops, statues and novelty items

Marble is a 'Minor Mineral' as defined under Clause (e) of Section 3 of Mines and Minerals (Development & Regulation) Act, 1957. The term "marble" is derived from the Latin word Murmur which in turn is said to have been coined from the Greek word Marmorous, meaning shining stone. It is known for its pleasant colours, smooth and uniform texture, moderate hardness, amenability to be quarried into big blocks, smooth & shiny polished surface and silky feel. Marble occupies a unique position among other dimension stones because of its aesthetic value.

In terms of geological definition, it is a metamorphosed limestone produced by re-crystallisation under conditions of thermal and regional metamorphism. In commercial parlance, all calcareous rocks capable of taking polish are classed as marbles. Furthermore, serpentine rocks containing little calcium or magnesium carbonates, if attractive and capable of taking good polish are also classed as marbles. The calcareous stones like onyx, travertine and some limestone have also been classed as marbles. Marble's internal demand has always remained high and most of the production added with recent increase in imports is consumed within the country.

Marble is the most preferred stone in India among all dimension stones. Most of the units in the Marble Industry are in the small-scale sector.

RESERVES/RESOURCES

On the basis of available data, IBM has prepared a mineral inventory of marble reserves/ resources as per NMI database, based on UNFC system as on 1.4.2015 which is furnished in Table - 1. The total resources of all grades of marble have been estimated at 1,945 million tonnes. Of these, only about 4.5 million tonnes (0.23%) fall under 'Reserves' category and about 1,941.3 million tonnes (99.77%) under 'Remaining Resources' category. Gradewise, about 28% resources fall under Unclassified and Not-known grades, 55% under Off-colour grade and 17% under White Colour grade. The available data on marble resources reveal that about 63% resources are in Rajasthan, 21% in Jammu & Kashmir, 6% in Gujarat and 4% in Chhattisgarh. The remaining resources are distributed mainly in Maharashtra, Haryana, Uttarakhand and Sikkim in descending order.

Table-1: Reserves/Resources of Marble as on 1.04.2015

(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnais-sance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	-	-	4551	4551	104236	202003	72386	-	107129	1453386	2200	1941341	1945892
By Grades													
White Colour	-	-	-	-	72700	124504	81	-	-	133442	-	330727	330727
Off-Colour	-	-	-	-	31536	75364	48352	-	107129	809104	-	1071485	1071485
Unclassified	-	-	4551	4551	-	-	21870	-	-	505952	2200	530022	534573
Not-known	-	-	-	-	-	2136	2083	-	-	4888	-	9107	9107
By States													
Telangana	-	-	-	-	-	-	-	-	-	3	-	3	3
Chhattisgarh	-	-	-	-	-	-	-	-	-	83000	-	83000	83000
Gujarat	-	-	-	-	-	26571	45000	-	17129	34871	-	123571	123571
Haryana	-	-	-	-	-	1234	1602	-	-	19492	-	22328	22328
Jammu & Kashmir	-	-	-	-	-	-	-	-	-	412381	2200	414581	414581
Madhya Pradesh	-	-	4551	4551	-	-	-	-	-	-	-	-	4551
Maharashtra	-	-	-	-	-	324	81	-	-	57642	-	58047	58047
Rajasthan	-	-	-	-	104236	173875	25703	-	90000	837615	-	1231429	1231429
Sikkim	-	-	-	-	-	-	-	-	-	2382	-	2382	2382
Uttarakhand	-	-	-	-	-	-	-	-	-	6000	-	6000	6000

Figures rounded off.

PRODUCTION

Marble being building stone, comes under 'Minor Mineral', as defined in Clause (e) of Section 3 of MM(DR) Act, 1957; hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few States could be collected. All possible information/data that could be gathered has been presented in this Review.

Statewise production of marble from 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Marble

(In tonnes)

State	2018-19	2019-20	2020-21
Rajasthan	8252000	10621000	16159347
Gujarat	1086979	-	-
Andhra Pradesh	-	347	277

Source: As received from State DGMs and their websites.

Note : " - " NA

CLASSIFICATION

A variety of marbles are produced and marketed under various trade names on the basis of colour, shade and pattern. These are i) Plain white marble ii) Panther Marble iii) White-veined Marble iv) Plain Black Marble v) Black Zebra Marble vi) Green Marble vii) Pink Adanga Marble viii) Pink Marble ix) Grey Marble and x) Brown Marble.

In addition, many new varieties of marble have been brought into the folds of classification especially after opening of new mining areas. The important new types classified by BIS are given below:

1. Yellow marble from Jaisalmer.
2. Pista marble (amphibolite variety) from Andhi-Jhiri belt, Jaipur, Alwar and Dausa districts, Rajasthan.
3. Brown green and golden ultramafics from Dunkar, Churu district, Rajasthan.
4. Chocolate-brown and English teak wood marble from Jodhpur district, Rajasthan.
5. Parrot green marble from Jhilo, Sikar district, Rajasthan.
6. Chocolate-brown or wood-finish marble from Mandaldeh, Chittorgarh district, Rajasthan.
7. Purple marble from Tripura Sundari, Banswara district, Rajasthan.
8. Blue marble from Desuri, Pali district, Rajasthan.

POLICY

The Central Government has notified Marble Development and Conservation Rules, 2002 (notified on 15.5.2002) for conservation, systematic development and scientific mining of marble with a purpose to provide a uniform framework that would be applicable throughout the country. The maximum period for which a lease may be granted shall not exceed thirty years and minimum period shall not be less than twenty years. Further, no lease is to be granted unless there is mining plan duly approved by the State Government or any person authorised in this behalf by that Government.

As per the Export-Import Policy, 2015-20, and the Foreign Trade Policy thereunder, the imports of crude or roughly-trimmed, marble & travertine blocks, slabs and ecaussine & calcareous monumental or building stone are restricted while imports of alabaster are freely allowed under heading No. 2515. On the other hand, the imports of items that fall under ITC(HS) Code 68022110 to 68022190 are freely allowed. The Ministry of Commerce and Industry, Deptt. of Commerce, vide Notification No.27(RE-2015)/2015-20, dated 19.9.2015 has made amendment in the Schedule I (Imports) of the ITC(HS) Classification of Export and Import items. The amended entry is as below: "Import permitted freely provided if value is US$200 and above per square metre". Import of marble, classified under Chapter 25 and 68 from Bhutan shall be subjected to a combined annual quota of 10 lakh sq. ft (5,882 tonnes). The quota came into effect from the date of this Notification and shall operate on financial year basis. Monitoring and allocation of the quota shall be made by the Government of Bhutan. The combined annual quota for import of marble from Bhutan will be 5,882 tonnes as per Directorate General of Foreign Trade.

USES AND SPECIFICATIONS

Marble is used widely in buildings, monuments and sculptures. Its utility value lies in its beauty, strength and resistance to fire and erosion. Marble has its application in interior and exterior wall cladding, interior and exterior paving, fireplace facing and hearth, lavatory tops, residential and commercial counter tops, table tops, statues and novelty items. The other non-conventional uses of marble are in toothpaste, paint, whiting, agricultural lime, etc.

Different marble varieties are used basically as both interior and exterior vertical wall cladding and flooring. Their use as structural elements (masonry), statues, epitaphs, graves, etc. is quantitatively less with funeral art accounting for the largest percentage. In interior applications, such as, for floors, marble is used in the form of 20 mm thick cut-to-size slabs. The slabs are also used for interior and outer facings, stairs, table tops, kitchen platforms, etc. The tiles in sizes ranging from 10 x 10 cm to 60 x 60 cm are used for floors, dadoes and for skirting in thickness ranging from 10 to 20 mm. The selected marble blocks free from cracks and other inclusions are used for making artifacts, such as, carved figures, handrails and balustrade for staircases, jalis, fire places, flower vases and many other pieces of art.

The existing Indian standards for marbles (blocks, slabs and tiles) are covered under IS:1130-1969 (reaffirmed in 2008).

WORLD SCENARIO

Resources of natural stones are substantial in the world and almost every country produces dimension stones. Major exporting countries of marble in the world are Turkey, Italy, Greece, Spain and Iran.

The world famous Carrara deposits in Italy have been worked over 2,000 years, and according to the statements of experts who have examined the mountains of marble in this locality, the quality of high-grade material yet to be excavated is so great that Carrara promises to meet the present rate of demand for its marbles for centuries to come.

30-16. Mica

Most important mica-bearing pegmatites occur in Andhra Pradesh, Bihar, Jharkhand, Maharashtra, Odisha, Rajasthan and Telangana

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'mica' has been declared as 'Minor Mineral'

Natural sheet mica is used in Electrical and Electronic Industries in the form of blocks, splittings and films or built-up mica called "micanite"

Mica is widely distributed and occurs in igneous, metamorphic and sedimentary regimes. Mica group represents 34 phyllosilicate minerals that exhibits a layered or platy structure. Commercially important mica minerals are muscovite (potash or white mica) and phlogopite (magnesium or amber mica). Granitic pegmatites are the source of muscovite sheet, while phlogopite is found in areas of metamorphosed sedimentary rocks into which pegmatite-rich granite rocks have been intruded. It possesses highly perfect basal cleavage due to which it can easily and accurately split into very thin sheets or films of any specified thickness. It has a unique combination of elasticity, toughness, flexibility and transparency. It possesses resistance to heat and sudden change in temperature and high dielectric strength. It is chemically inert, stable and does not absorb water.

For over hundred years, India has enjoyed the monopoly in the production and export of sheet mica in the world. Of late, there has been a steady downfall in the production of mica. This declining trend could be attributed to fall in the demand of natural mica in the world market due to technological improvements that facilitate use of reconstituted mica and emergence of mica substitutes. However, there are sufficient resources in the country to meet the domestic requirement and export demand.

RESERVES/RESOURCES

Most important mica-bearing pegmatites occur in Andhra Pradesh, Bihar, Jharkhand, Maharashtra, Odisha, Rajasthan and Telangana. Occurrences of mica pegmatites are also reported from Gujarat, Haryana, Karnataka, Kerala, Tamil Nadu and West Bengal.

As per NMI database based on UNFC system, the total reserves/resources of mica in the country as on 1.4.2015 has been estimated at 6,35,302 tonnes out of which 1,14,433 tonnes are placed under Reserves category and 5,20,869 tonnes under Remaining Resources category. Andhra Pradesh leads with 41% share in country's total resources followed by Rajasthan (28%), Odisha (17%),

Maharashtra (13%), Bihar (2%) and a small quantity of resources is found in Jharkhand and Telangana (Table- 1).

Table-1: Reserves/Resources of Mica as on 1.4.2015
(By Grades/States)

(In kg)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnais-sance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	82187635	20035595	12209547	114432777	38252500	10605400	124089303	143353477	56528016	144446953	3593715	520869364	635302141
By Grade													
Unclassified	82187635	20035595	12209547	114432777	38252500	10605400	124089303	143353477	56528016	144446953	3593715	520869364	635302141
By States													
Andhra Pradesh	61942537	18293548	-	80236085	18960000	-	-	93830994	12894000	51668132	-	177353126	257589211
Bihar	-	-	-	-	-	-	-	-	-	13066667	7700	13074367	13074367
Jharkhand	-	-	-	-	-	-	-	-	-	1494430	170700	1665130	1665130
Maharashtra	-	-	-	-	-	-	65916000	-	-	15120000	-	81036000	81036000
Odisha	-	-	-	-	-	-	51856000	-	26712000	26712000	-	105280000	105280000
Rajasthan	20245098	1742047	12209547	34196692	19292500	10605400	5732418	49522483	16922016	36385724	3415315	141875856	176072548
Telangana	-	-	-	-	-	-	584885	-	-	-	-	584885	584885

Figures rounded off.

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'mica' has been declared as 'Minor Mineral'; hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few States could be collected. All possible information/ data that could be gathered has been presented in this Review.

Statewise production of mica from 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Marble

(In tonnes)

State	2018-19	2019-20	2020-21
Andhra Pradesh	16822	16822	16717
Rajasthan	17000	16000	17719

Source: As received from State DGMs and their websites.

USES & SPECIFICATIONS

Natural sheet mica is used in Electrical and Electronic Industries in the form of blocks, splittings and films or built-up mica called "micanite". Sheet mica is used in manufacturing fabricated and micanite products, such as, capacitors and commutator segments. Micanite or built-up mica is partly overlapped, irregular-shaped and arranged as splittings cemented together with either an organic or inorganic binder. Other uses of sheet mica include gauge glasses of high pressure steam boilers, diaphragms of oxygen-breathing equipment, marker dials of navigation compasses, quarterwave plates for optical instruments, window covers for radiation pyrometers & thermal regulators, stove window, chimneys for gas & petromax lamps, diaphragms in microwave transmitters and insulation wrappers for high tension radar coils. Besides, high quality natural mica sheets are used in helium-neon lasers where mica sheet works as retardation plate. Of late, mica washers are extensively used in Computer Industry.

Mica paper or reconstituted mica is a paper-like material made by depositing fine flakes of scrap mica as a continuous mat which is then dried. Mica paper is usually impregnated with organic binder. Primary end-uses of mica paper are the same as for micanite or built-up mica.

Micanite is used in electrical insulation mainly because natural mica sheet of sufficient thickness is not always available. This is used in copper commutator segments of DC universal motors and generators, moulding plates from which V-rings are cut and stripped for use in commutators. These moulding plates also find use in the form of tubes and rings as an insulator in transformers, armatures and motor starters. As flexible plates, micanite is also used in electric motors and generator-armatures, field coil insulators & magnet and commutator core insulation. Similarly, as heater plates, micanite is used where high insulation strength at high temperature is required.

In the Construction Sector, mica scrap/ground mica is used in jointing cement for gypsum boards, asphaltic roofings & damp-proof seal, and insulation boards. Ground mica acts as reinforcing filler in plaster for textured coatings. Mica is used in insulation bricks, slabs and tiles because of its excellent thermal and insulating properties. Dry-ground 50 mesh mica is used in the flux coating for arc welding electrodes, with flux containing 3 to 5% mica powder. In paints, mica in the form of powder is used as filler and as an extender because it provides a smoother consistency, improved workability and imparts increased resistance to water penetration and weathering. It also facilitates suspension due to its relatively low specific gravity and platy morphology. Mica is used mainly in four types of paints, such as, bituminous emulsions, exterior paints, fire-retardant paints and pearlescent pigments. Mica is added to drilling fluids to get off the lost circulation zones. The platy structure of mica facilitates the overlapping of particles to form a tight layer or wall, thereby preventing further fluid loss. Ground mica is used in the Rubber Industry as a dusting agent and as an inert filler in the production of rubber. Mica fillers increase the hardness, tensile strength and tear resistance of rubber articles. In Plastic Industry, mica is used as a filler and reinforcer in thermoplastics to improve the electrical properties, flexural strength & modulus, stiffness, heat deflection temperatures and resistance. Dry-ground mica powder is used in small quantities in cosmetic applications. The property of high resistance of mica to the effect of the sun rays, moisture, gases, water and other chemicals, enables the use of dry-ground mica powder in small quantity to improve the decorative coating and lustre of wallpaper, printing and ceiling papers, etc. Wet-ground mica powder is used in paints, cosmetics, rubber, etc. as a filler. Small quantities of scrap mica/ground mica are also used in industries like foundries as coating to foundry cores and moulds, as a dry lubricant to prevent hot bearings from seizing up.

SPECIFICATIONS

The Bureau of Indian Standards (BIS) has prepared standards for (a) processed mica, (b) fabricated mica and (c) mica-based products. BIS has brought out the following specifications for mica for various purposes:

IS:1175 – 1981(First Revision, Reaffirmed 2011): Deals with methods of grading and classification of muscovite mica blocks, thins and films according to visual size, visual qualities and presence of structural imperfections.

IS:1885 (Part-53)-1980 (Reaffirmed 2007): Deals with electro technical vocabulary, Part-53, Mica.

IS:2001-1968: Deals with specifications of fixed silvered mica capacitors.

IS:2464-1963 (Reaffirmed 2008): Deals with specifications of built-up mica for electrical purposes.

IS:9043-1979 (Reaffirmed 2011): Deals with grading (by size) of phlogopite mica blocks, thins, films and splittings.

IS:9044-1979 (Reaffirmed 2011): Deals with methods of measuring thickness of mica blocks, thins, films and splittings.

IS:9045-1979 (Reaffirmed 2011): Deals with thermal classification of phlogopite mica splittings.

IS :9299 (Part 3/Sec.1)- 1979 (Reaffirmed 2003): Deals with rigid mica material for commutator separators.

IS:9299 (Part3/Sec.2)-1982 (Reaffirmed 2003): Deals with moulding mica materials for electrical purposes.

IS:9299 (Part 3/Sec. 3)-1982 (Reaffirmed 2008): Deals with flexible mica flake tape for insulation of electrical machines.

IS:9299 (Part 3/Sec. 4) (Reaffirmed 2008): Deals with rigid mica materials for heating equipment.

IS:13357: Methods of grading and visual classification of muscovite mica splittings.

SUBSTITUTES

Mica and its products can be substituted to some extent by using alumina, ceramics, bentonite, glass, mylar polystyrene, fused quartz, silicon, talc, bakelite, teflon, nylon synthetic mica, acrylate polymers, cellulose acetate, fibre glass, etc.

Some lightweight aggregates, such as, diatomite, vermiculite and perlite may be substituted for ground mica when used as filler. Ground synthetic fluorophlogopite, fluorine-rich mica, may replace natural ground mica for uses that require thermal and electrical properties of mica.

Sheet mica is used in electrical components, electronics and atomic force microscopy. Many products can be substituted for mica in electrical and electronic uses. Substitutes include Acrylic, Benelex, Cellulose acetate, Delrin, Duranel N, Fibreglass, Fishpaper, Kel F, Kydex, Kapton Lexan, Lucite, Mylar, Nylon, Nylatron, Nomex, Noryl, Phenolics, Plexiglass, Polycarbonate, Polyester, Styrene, Teflon, Vinyl-pvc and Vulcanised Fibre.

TRADE POLICY

As per Import Policy under schedule of ITC (HS) 2022 and export policy under schdule of ITC (HS) 2022, Mica, inculding splittings, mica waste are allowed free without restrictions. The effective Export-Import Policy, exports and imports of varieties of mica blocks, splittings, powder, waste and scrap under Heading 2525 are allowed without restrictions.

WORLD SCENARIO

Resources of scrap and flake mica are available in clay deposits, granite, pegmetite and schist and are considered more than adequate to meet anticipated world demand in the foreseeable future. World resources of sheet mica have not been formally evaluated because of the sporadic occurrences of this material. Large deposits of mica-bearing rock are known to exist in countries, such as, Brazil, India and Madagascar. Limited resources of sheet mica are available in the United States.

30-17. Ochre

Deposits of red ochre are found chiefly in Bharatpur, Bhilwara, Bikaner, Chittorgarh & Udaipur districts in Rajasthan

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'ochre' has been declared as 'Minor Mineral'

Ochre is a natural mineral pigment known to mankind from ages. In ancient times it had been used in colouring earthen-ware, household utensils and for decorative purposes. Though its use dates back to prehistoric times, ochre's use only became widespread in the late 19th century, when Jean-Etienne Astier of Roussilon introduced the industrial process for making ochre pigment.

It occurs in various shades and colours generally ranging from yellow to deep orange or brown. The pigmentary strength of ochre is mainly due to the presence of oxides of iron. The presence of hydrated iron oxide imparts yellow colour and anhydrous iron oxide red. A mixture of ferrous and ferric oxide imparts mainly brown besides other shades.

Depending upon the colour, the ochres are called red ochre, yellow ochre, green earth, sienna, umber and various other names. In addition to red ochre, the red oxide of iron, commonly called 'red oxide' is an important natural pigment which results from alteration of haematite and ferruginous laterite.

Red ochre is mostly used in Cement Industry. The Cement Grade mix raw material requires a minimum quantum of iron and alumina. The red ochre mixed with limestone makes a perfect mix of constituents in the raw material fed to the cement manufacturing units.

Ochres are non-toxic and are used in manufacturing of paints that not only dries quickly but also covers surfaces thoroughly. Occurrences of ochre have been reported from several States in the country.

Reserves/Resources

Deposits of red ochre are found chiefly in Bharatpur, Bhilwara, Bikaner, Chittorgarh & Udaipur districts in Rajasthan; Gwalior, Katni and Rewa districts in Madhya Pradesh; Anantapur, Kadapa, Visakhapatnam districts in Andhra Pradesh; Bhavnagar, Kachchh & Patan districts in Gujarat; Ballari & Bidar districts in Karnataka and Chandrapur district in Maharashtra.

Deposits of yellow ochre are found in Guntur & Kurnool districts in Andhra Pradesh; Jabalpur, Mandla, Satna & Shahdol districts in Madhya Pradesh; and Nagpur district in Maharashtra.

The total reserves/resources of ochre as on 1.4.2015 as per the NMI data, based on UNFC system, has been estimated at 167.79 million tonnes. Out of these resources, about 36.93 million tonnes are under 'Reserves' category and 130.86 million tonnes are under 'Remaining Resources' category. Of the total, about 87% resources are of red ochre, 11% are of yellow ochre and the remaining 2% are of grades "Not-known". About 78% resources are concentrated in Rajasthan, followed by Madhya Pradesh 11%, Andhra Pradesh 7% and Gujarat about 2%. The remaining 2% resources are located in Karnataka, Maharashtra, Jharkhand and Uttar Pradesh (Table-1).

Table-1: Reserves/Resources of Ochre as on 1.4.2015
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnais-sance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	21959552	4448341	10525912	36933805	44924890	13936202	31896176	2559245	3560819	32369262	1612607	130859201	167793006
By Grades													
Red Ochre	16332257	4448341	9775941	30556539	43386327	12810591	28564110	1922633	1316886	25711807	1610486	115322840	145879380
Yellow Ochre	5626356	-	75802	5702158	1404292	912286	1796007	596612	2071612	5528926	2121	12311856	18014014
Not-known	939	-	674169	675108	134271	213324	1536059	40000	172321	1128529	-	3224505	3899613
By States													
Andhra Pradesh	5284990	-	64602	5349592	1404230	430231	1087353	347681	-	3596595	2121	6868210	12217802
Chhattisgarh	-	-	-	-	-	142	-	-	-	-	-	142	142
Gujarat	37862	-	75703	113565	-	32699	4303	-	-	3016066	-	3053068	3166633
Jharkhand	-	-	-	-	62	-	4	-	147	-	-	214	214
Karnataka	-	-	-	-	-	-	1766367	-	-	-	20000	1786367	1786367
Madhya Pradesh	1605342	194757	1895247	3695346	681904	1653225	5402710	356344	2577575	3732142	749250	15153150	18848495
Maharashtra	22260	-	16000	38260	-	-	156740	6010	6010	286000	-	454760	493020
Rajasthan	15009099	4253584	8474360	27737043	42838694	11819905	23478699	1824210	942087	21728459	841236	103473290	131210333
Uttar Pradesh	-	-	-	-	-	-	-	25000	35000	10000	-	70000	70000

Figures rounded off.

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'ochre' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few States could be collected. All possible information/ data that could be gathered has been presented in this Review.

Statewise production of ochre (Andhra Pradesh – yellow ochre, Gujarat – red ochre). during 2018-19 to 2020-21 is furnished in Table-2.

Table-2: State-wise Production of Ochre

(In tonnes)

State	2018-19	2019-20	2020-21
Rajasthan	3191000	2886000	-
Andhra Pradesh	89940	54000	46276
Gujarat	16	-	-

Source: As received from State DGMs and their websites.

Note : " - " NA

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

FUTURE OUTLOOK

Ochre is being used as natural pigment since ancient times and it is still being used for this purpose. India has huge resources of both yellow and red ochre. It is mostly produced in Andhra Pradesh, Rajasthan, Gujarat, Madhya Pradesh and Maharashtra. It is extensively used in Paint and Colour Industry and Indian resources are large enough to last for many years in future.

30-18. Other Calcareous Materials

6.75

(million tonnes) of chalk resources have been established as per NMI data based on UNFC system as on 1.4.2015

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'chalk' has been declared as 'Minor Mineral'

Other calcareous material used by industry is 'chalk', a white, extremely fine-grained, usually soft and friable variety of limestone, composed largely of microscopic small remains of foraminifera and broken shelly fragments; 'kankar', irregular nodules and concretions of impure calcium carbonate of all sizes found in the older surface alluvium or soils; and 'limeshell', the thick calcareous shells of molluscs deposited in the form of beds as well as present in ancient lakes and shallow seas. A limestone rock which separates well along the stratification into a few centimetres thick slab is termed 'flagstone'. The dimension limestone is used for buildings and as ornamental stones.

The total resources of chalk of all categories and grades as per NMI data based on UNFC system as on 1.4.2015 has been estimated in Gujarat at 6.75 million tonnes of which 5.06 million tonnes (75%) are under Reserves category and 1.69 million tonnes (25%) are under Remaining Resources category (Table-1).

Limekankar

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'limekankar' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. Production data of limekankar was not available.

Chalk

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'chalk' has been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual states or visiting their websites. All possible information/data that could be gathered has been presented in this Review. Production data of chalk was not available.

Table-1: Reserves/Resources of Chalk as on 01.04.2015
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	4215	529	319	5064	741	331	151	196	-	269	-	1687	6751
By State													
Gujarat	4215	529	319	5064	741	331	151	196	-	269	-	1687	6751

Figures rounded off.

USES

Chalk

This soft, friable, porous sedimentary carbonate rock is a form of limestone composed mainly of calcite. It forms under reasonably deep marine conditions from the gradual accumulation of minute shells shed by microorganisms. Chalk deposits are sedimentary types and it has greater resistance to weathering and slumping than the clays with which it is usually associated, thus forming steep cliffs where the chalk ridges meet the sea. Its well jointed nature holds large volume of ground water making it a natural reservoir. Chalk is mined from both above and underground.

Chalk is a common name given to blackboard chalk used for writing on the blackboard because of its property of crumble and easy to erase. Nowadays many substitutes have replaced the natural chalk. Apart from this primary use, it is extensively used as a filler as builder's putty. It is also used to increase pH of soils, in small doses as antacid, as mild abrasive in toothpastes and polishing of metals and also as a fingerprint powder.

Kankar

Kankar is a nodular variety of limestone which is of spongy nature, found in almost all parts of India containing some quantity of clayey and silicious matter. It is found either in layers or blocks, or in separate nodules. The block form occurs as solid deposits at various depths, and the nodular variety is generally found scattered on the surface or in small thicknesses about a metre or so below the surface in the low lying portions of the catchments of nallas and rivulets. The nodules are of varying sizes from 10 mm to 100 mm. Nodular kankar is superior to block kankar but is not available in large quantities. Shining or glittering particles in a fresh fracture indicate presence of sand. The proportions of clay and sand can be determined by dissolving the sample in powdered form in dilute hydrochloric acid and determining residue left. "Bichwa" kankar as known in Punjab and Uttar Pradesh in India is considered to be the best.

Kankar is extensively used for producing hydraulic lime. The nodules should have a blue grey fracture, free of any sand grains or mud sticking to them, and broken to pass a 12 mm gauge before being calcined.

Only Rajasthan State reported production for Kankar-Bajri of about 28,98,000 tonnes, 56,30,000 & 8709571 tonnes during 2018-19, 2019-20 & 2020-21 respectively.

FUTURE OUTLOOK

Calcareous materials other than limestone and dolomite produced in India are chalk and lime kankar. Chalk is produced in huge quantities from Gujarat state, whereas Limekankar is found and produced locally from many parts of India. Considering their availability in large quantity, low cost and domestic applications Indian deposits have the potential to last for many years.

30-19. Pyrophyllite

59.61
(million tonnes) total reserves/ resources of pyrophyllite have been established in India as on 1.4.2015

As per Government of India Notification S.O. 423(E), dated 10th February 2015, 'pyrophyllite' has been declared as 'Minor Mineral

Pyrophyllite is harder than talc. Unlike talc, pyrophyllite does not flux when subjected to fire and maintains its strength after heating

Pyrophyllite ($Al_2O_3.4SiO_2.H_2O$) is a hydrous silicate of aluminium. It resembles closely to talc in many physical and optical properties but differs in chemical composition. Pyrophyllite finds application in high-grade ceramics & refractories and also as a filler in Pesticide Industry. Production of pyrophyllite is mainly reported from Chhatarpur, Tikamgarh & Shivpuri districts of Madhya Pradesh; Mahoba, Hamirpur, Jhansi & Lalitpur districts of Uttar Pradesh; Bhandara district of Maharashtra; Bhilwara & Udaipur districts of Rajasthan; Anantapur & Kadapa districts of Andhra Pradesh; and Kendujhar district of Odisha.

RESERVES/RESOURCES

The total reserves/resources of pyrophyllite in India as per NMI data, based on UNFC system as on 1.4.2015 has been placed at 59.61 million tonnes of which about 42%, i.e., 24.93 million tonnes are in Reserves category. Among the States, Madhya Pradesh accounted for 48% resources, followed by Odisha (23%) and Uttar Pradesh (13%). The remaining (16%) resources are in Andhra Pradesh, Maharashtra, Jharkhand and Rajasthan. Gradewise, Refractory grade accounts for 28%, followed by Insecticide grade (22%), Ceramic grade (19%) and Insecticide & Ceramic mixed grade (14%). The remaining 17% belongs to Others, Unclassified and Not-known grades (Table-1).

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Review".

Table-1: Reserves/Resources of Pyrophyllite as on 1.4.2015
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnais-sance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	16575493	4322386	4035079	24932958	9539407	8301411	4240016	1118943	3589624	7533340	360006	34682745	59615703
By Grades													
Refractory	5839430	1835057	746404	8420890	1915721	5030576	204467	247568	49730	1084237	17161	8549460	16970350
Ceramic	2323554	1128868	1040529	4492951	2047247	819750	1286251	555850	48114	1803804	43200	6604215	11097166
Insecticide	2495205	644502	415394	3555101	249016	1865059	1990109	176400	3198926	1956786	51240	9487536	13042636
Insecticide & Ceramic Mixed	4960978	492259	1446327	6899564	52665	231942	260177	37563	77451	934862	-	1594660	8494224
Others	342379	221700	110850	674929	5022557	41841	-	-	60570	60585	-	5185553	5860482
Unclassified	435404	-	129956	565360	210351	309093	427599	94450	134360	1456906	248405	2881163	3446523
Not-Known	178544	-	145619	324163	41850	3150	71413	7112	20473	236160	-	380158	704321
By States													
Andhra Pradesh	39376	-	9441	48817	366494	75201	311209	-	108831	737855	-	1599590	1648407
Jharkhand	858	-	328	1185	-	-	-	-	-	-	-	-	1185
Madhya Pradesh	9786485	2242501	1907116	13936102	1860354	2976581	2738198	520801	3294772	2984100	248405	14623211	28559313
Maharashtra	-	-	705169	705169	45532	4780000	-	-	-	407160	-	5232692	5937861
Odisha	2781889	1094902	-	3876791	6978702	216661	766105	80	40	1782070	68401	9812058	13688848
Rajasthan	368774	214870	179514	763158	156136	38989	210982	219612	119469	551225	-	1296413	2059571
Uttar Pradesh	3598112	770113	1233511	5601736	132189	213979	213522	378450	66512	1070930	43200	2118782	7720518

Figures rounded off.

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'pyrophyllite' has been declared as 'Minor Mineral'; hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few States could be collected.

All possible information/data that could be gathered has been presented in this Review.

Statewise production of pyrophyllite during 2018-19 to 2020-21 is furnished in (Table-2).

Table-2: Statewise Production of Pyrophyllite
(By States)

(In tonnes)

State	2018-19	2019-20	2020-21
Andhra Pradesh	870	10610	14762
Rajasthan	40000	14300	19050

Source: As received from State DGMs and their websites.

USES AND SPECIFICATIONS

Pyrophyllite is harder than talc. Unlike talc, pyrophyllite does not flux when subjected to fire and maintains its strength after heating. It is, therefore, used in high-grade ceramic products, electric insulators and refractories. Pyrophyllite imparts thermal shock resistance to ceramic bodies. It is also used as filler and dusting powder in various industries. In Glass Industry, pyrophyllite is used as a source of aluminium instead of felspar. Owing to its softness and mode of occurrence in lumps, it is used extensively in handicraft industries for making various articles.

Low thermal expansion and shrinkage characteristics of pyrophyllite makes it a useful ingredient in ceramic blends and may substitute either pitcher (grog) or silica. Pyrophyllite allows faster firing cycles in the manufacture of whiteware.

In production of stoneware and chinaware, more mechanical strength as well as improved whiteness can be achieved at lower firing temperature. Pyrophyllite is quite stable up to 800 °C and hence, it is consumed in refractory as well as in wall tiles, sanitaryware, electrical porcelain and other ceramic and vitreous china products. Pyrophyllite is non-abrasive, inert with a neutral pH, as well as a good absorbent providing good flowability which allows it to be used as a diluent, extender, vehicle and carrier for liquids, such as, fungicide, insecticide, herbicide and fertilizer.

The BIS has prescribed the specifications for pyrophyllite for Ceramic Industry (IS:11477-2011 first revision) reaffirmed on March 2012.

The consumers in Refractory Industry generally prefer pyrophyllite containing 26 to 28% Al_2O_3 , 3 to 4% alkali and having 23 to 25 Pyrometric Cone Equivalent (PCE). For Insecticide Industry, the specifications of talc/steatite can also be applicable to pyrophyllite as given below:

Loss on Ignition : 7% max.

Matter soluble in HCl : 3% max.

Fe_2O_3 : 1.5% max.

FUTURE OUTLOOK

Globally, market demand for pyrophyllite is expected to increase over the next few years on account of steady growth witnessed in the Ceramic Industry and its other refractory applications. Increasing number of applications of pyrophyllite in various end-use industries including paints, electrical, porcelain, insecticides, machinery, rubbers and plastics are likely to aid market growth over the next few years. Pyrophyllite will continue to face competition from bentonite and attapulgite in carrier applications. However, use in filler applications appears to be stable.

30-20. Quartz & Other Silica Minerals

As per the NMI database, based on UNFC system as on 1.4.2015	As per Government of India Notification S.O. 423(E), dated 10th February 2015, 'quartz/silica sand/quartzite/ sand (others)/ agate/ jasper' have been declared as 'Minor Mineral'	Quartz, quartzite and silica sand are used in various industries like glass, refractory, foundry, ceramic, cosmetic, electrical, abrasives, paints

The term 'quartz' is often referred to as a synonym for silica. Silica is one of the ubiquitous materials in the earth's crust. Quartz, quartz crystals, quartzite, silica sand, sand (others) and moulding sand are all coined together in one generic name 'silica minerals'. This is because all these commodities are essentially crystalline silicon dioxide (SiO_2) with variations mostly related to their crystalline structure and presence of minor or trace impurities. Silica occurs in several forms giving rise to different varieties.

Crystalline Varieties

The important varieties of crystalline quartz are vein quartz (massive crystalline quartz); milky quartz (white, translucent to opaque); ferruginous quartz (containing brown limonite and red haematite and almost opaque); aventurine quartz (containing glistening flakes of mica or haematite); cat's eye (opalescent greenish quartz with fibrous structure); rock crystal (clear, colourless, well-crystallised transparent quartz); amethyst (clear-purple or violet-blue), transparent quartz; rose quartz; smoky quartz; etc. Occurrences of massive crystalline quartz in veins or pegmatites have been recorded in almost all the States.

Clastic or Granular Varieties

These varieties include sand consisting largely of unconsolidated quartzose grains (0.06 mm to 2 mm diameter), gravel consisting largely of unconsolidated coarse quartzose grains or pebbles (2 mm to 8 mm in diameter), sandstone and quartzite. Quartzite is a granulose metamorphic rock consisting essentially of quartz and sandstone cemented by silica which has grown in optical continuity around each grain. Occurrences are reported from Andhra Pradesh, Bihar, Delhi, Haryana, Karnataka, Kerala, Madhya Pradesh, Rajasthan,Tamil Nadu, Uttar Pradesh, etc. The silica sand from Naini area in Allahabad district, Uttar Pradesh is of a very high quality.

Cryptocrystalline Varieties

This group includes chalcedony, agate, jasper, onyx, flint and chert. These varieties appear non- crystalline (amorphous) in hand specimens, but under microscope show double refraction which reveals their concealed crystalline nature. These varieties are reported from Gujarat, Uttar Pradesh, Tamil Nadu, Andhra Pradesh, Maharashtra, Madhya Pradesh, Karnataka and Punjab. The most important occurrences of agate are in Ratnapur, Rajpipla area and further west between Rivers Tapi and Narmada in Bharuch district, Gujarat, where it is found as pebbles in varying sizes associated with clay washed down by the river flow. Other occurrences of economic importance are reported from Amravati, Aurangabad, Buldhana, Chandrapur, Nashik and Pune districts in Maharashtra; beds of Rivers Krishna and Godavari in Andhra Pradesh; Dumka district in Jharkhand; Dhar, Mandsaur, Sihore and Shahdol districts in Madhya Pradesh; and Kachchh district in Gujarat.

As per Govt of India Gazette Notification S.O. 423 (E), dated 10th February 2015, 31 minerals have been declared as minor minerals. Out of these 31 minor minerals, agate, fuschite quartzite, jasper, quartz, quartzite, sand (others) and silica sand come under the different variety of silica minerals. Minor minerals come under the purview of respective State Governments and they frame the rules for minor minerals.

RESERVES/RESOURCES

As per the NMI database, based on UNFC system as on 1.4.2015, the total reserves/resources of quartz and silica sand in the country has been estimated at 3,907.95 million tonnes out of which 647.53 million tonnes (17%) are placed under Reserves category and 3,260.42 million tonnes (83%) are placed under Remaining Resources category. Resources by grades reflect Foundry & Moulding grade at 735.59 million tonnes (19%), Glass at 649.71 million tonnes (17%), Ceramic & Pottery grade at 438.44 million tonnes (11%) and Ferro-silicon grade at 183.96 million tonnes (5%). The Abrasive, Sodium silicate, Others, Unclassified and Not-known grades account for 1,900.18 million tonnes (48%) of the total resources. Statewise, Haryana alone accounts for 1,653.65 million tonnes (42%) of the total resources, followed by Rajasthan at 740.46 million tonnes (19%), Andhra Pradesh 236.69 million tonnes (6%), Tamil Nadu 201.49 million tonnes (5%), Maharashtra 179.72 million tonnes (4.60%), Jharkhand 151.19 million tonnes (4%), Uttar Pradesh 140.72 million tonnes (3.60%), Gujarat 132.42 million tonnes (3.39%), Kerala 128.48 million tonnes (3.28%), Karnataka 95 million tonnes (2.43%), Telangana 80.07 million tonnes (2.05%) etc. (Table-1).

Similarly, the total reserves/resources of quartzite in the country as per NMI database, based on UNFC system as on 1.4.2015 has been estimated at 1,658.80 million tonnes out of which Reserves are placed at 83.47 million tonnes (5%) and the Remaining Resources at 1,575.32 million tonnes (95%). Statewise bulk resources of about 884.18 million tonnes are located in Haryana (53%) followed by Bihar 277.82 million tonnes (17%), Odisha 140.55 million tonnes (8.47%), Maharashtra 90.70 million tonnes (5.46%), Punjab 81.91 million tonnes (5%) and Jharkhand at 40.70 million tonnes (2.45%). Gradewise resources of Refractory grade-I & II are estimated at 579.45 million tonnes (35%), Ceramic & Pottery grade at 215.91 million tonnes (13%), BF grades at 66.50 million tonnes (4%) and the remaining resources of 796.92 million tonnes (48%) are of Ferro-Silicon, low, Unclassified, Others & Not-known grades (Table-2).

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on Exploration & Development under "General Review".

PRODUCTION

Quartz/Silica Sand/Quartzite/Sand (Others)/Agate

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'quartz/silica sand/quartzite/sand (others)/ agate/ jasper' have been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. But data of only a few States could be collected. All possible information/ data that could be gathered has been presented in this Review.

Statewise production of quartz, silica sand, quartzite during 2018-19 to 2020-21 is furnished in Tables-3 to 5.

Moulding sand

The production of moulding sand was 11,737 tonnes in 2020-21 as against 12,905 tonnes in the previous year.

There were four reporting mines in the year 2020-21 against three reporting mines in 2019-20. The production of moulding sand was reported only from Chhattisgarh State during the year (Table -6 to 8).

Flint Stone

The production of flint stone was not reported since last three years i.e. 2018-19 to 2020-21.

MINING

Mining for silica minerals is carried out by manual opencast method. Quartz produced in the form of lump along with other associated minerals is invariably hammered to pieces and manually sorted before it is despatched to the consuming industries. It is sometimes crushed and marketed. Glass sand is generally screened and washed to remove all the deleterious constituents for its use in Glass Industry.

APMDC owns two crushing plants located at Mahabubnagar district in Andhra Pradesh with crushing capacity of 45 tonnes and 1,000 tonnes a month, respectively. Besides, Maharashtra Minerals Corp. Ltd operates a 50,000 tonnes per year beneficiation plant at Phondaghat in Sindhudurg district. The plant uses advanced technology in washing both by water and chemicals and further grading it in required fractions.

Table-1: Reserves/Resources of Quartz & Silica Sand as on 1.4.2015

(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnais-sance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	433014	93339	121169	647522	354566	368217	362128	36872	219180	1897899	21436	3260297	3907819
By Grades													
Glass	205934	24780	19173	249886	83708	46000	54870	3268	5506	194962	11505	399820	649706
Ferro-silicon	10385	170	6729	17283	14199	15950	15194	106	65173	55878	179	166679	183963
Sodium silicate	2385	80	1911	4376	840	1422	5313	195	325	30869	11	38976	43351
Ceramic and Pottery	35142	8883	23348	67373	98139	24681	68351	7553	13022	159035	289	371070	438443
Foundry and Moulding	115324	4946	9898	130167	71962	47190	121130	19234	37977	300257	7672	605421	735589
Abrasive	48	-	-	48	2253	256	1984	22	21	3508	-	8043	8091
Others	20911	8067	2026	31004	44667	65197	27456	1185	873	866706	541	1006625	1037629
Unclassified	42010	45825	56370	144204	28474	161250	48346	4747	1976	150383	679	395855	540060
Not-known	875	590	1715	3180	10323	6270	19485	563	94307	136301	560	267808	270988
By States													
Andhra Pradesh	94483	3429	13687	111599	32690	4039	17329	7081	6691	45661	11599	125090	236690
Assam	-	-	-	-	-	-	-	-	-	1790	-	1790	1790
Bihar	-	-	-	-	-	-	-	-	-	25755	-	25755	25755
Chhattisgarh	501	479	800	1780	389	282	789	56	26	642	7672	9856	11636
Goa	-	-	-	-	-	20	1736	-	-	18248	-	20004	20004
Gujarat	27892	5617	15260	48769	26742	6681	17809	2932	3371	26099	21	83656	132425
Haryana	-	-	-	-	35553	247695	186475	886	642	1182400	-	1653650	1653650
Himachal Pradesh	1	-	7	8	99	-	-	-	-	2928	-	3027	3035
Jammu & Kashmir	-	-	-	-	-	-	-	-	-	3110	-	3110	3110
Jharkhand	-	-	1070	1070	534	985	4533	137	766	143053	112	150122	151192
Karnataka	7975	417	1807	101991	15904	6695	9448	94	52	52077	525	84794	94993
Kerala	221	33	136	389	179	1985	3588	14611	30241	77489	-	128092	128481
Madhya Pradesh	129	30	1781	1940	516	-	920	791	316	2717	-	5261	7201
Maharashtra	15188	93	9984	25265	33039	15455	48535	-	355	57077	-	154461	179726
Meghalaya	-	-	-	-	-	-	-	-	177	6906	-	7083	7083
Odisha	567	109	725	1401	344	2038	2918	93	63308	3944	179	72824	74225
Punjab	-	-	-	-	-	-	-	-	-	3927	-	3927	3927
Rajasthan	239131	58049	51713	348894	160210	34587	50216	5464	8001	131753	1098	391439	740333
Tamil Nadu	25086	3493	1199	29778	28196	15176	2191	3387	95837	26931	-	171718	201496
Telangana	18541	1367	6916	26824	10334	2414	8365	159	3107	28642	230	53250	80074
Tripura	-	-	-	-	-	-	-	225	-	264	-	490	490
Uttar Pradesh	445	19825	15144	35413	9415	30013	7048	957	6290	51590	-	105314	140727
West Bengal	2853	400	939	4193	310	151	229	-	-	4896	-	5586	9779

Figures rounded off.

Table-2 : Reserves/Resources of Quartzite as on 1.4.2015
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnais-sance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	47758	2016	33698	83472	120723	141437	160355	119953	152715	868850	11293	1575325	1658798
By Grades													
Refractory Grade-I	29574	831	19192	49597	50814	10512	31337	1032	1067	293813	2906	391482	441079
Refractory Grade-II	1038	303	42	1384	1666	3220	497	3183	21075	99849	7497	136987	138371
Ceramic / Pottery	112	49	16	177	18499	37356	58442	-	3599	97772	72	215741	215918
Low	249	35	-	284	2139	3764	73	-	23	8791	-	14789	15073
Ferro-silicon	-	-	-	-	169	8392	3034	-	376	461	523	12955	12955
B.F.	-	-	-	-	-	848	2067	197	275	62822	295	66503	66503
Others	9713	68	175	9956	35277	15920	2093	309	251	44895	-	98745	180701
Unclassified	5572	672	12938	19182	12158	55006	60718	94298	94799	226394	-	543373	562555
Not-known	1500	58	1334	2892	-	6418	2094	20935	31250	34053	-	94750	97642
By States													
Andhra Pradesh	16001	-	1389	17390	2103	8357	6418	-	3975	24797	1256	46905	64295
Arunachal Pradesh	-	-	-	-	-	-	-	-	-	5270	-	5270	5270
Bihar	-	282	12260	12542	390	959	8090	5490	22822	227531	-	265282	277824
Chhattisgarh	605	1524	1567	3696	575	7035	1856	-	-	15404	-	24870	28566
Haryana	-	-	-	-	50751	118056	116686	113902	124458	360335	-	884188	884188
Himachal Pradesh	25	-	16	41	16	-	-	-	-	-	-	16	57
Jammu & Kashmir	1500	58	-	1558	-	-	-	-	120	9100	7380	16600	18158
Jharkhand	181	-	-	181	763	49	390	197	275	38854	-	40527	40708
Karnataka	231	-	-	231	69	48	592	-	-	4914	1730	7353	7584
Madhya Pradesh	-	-	-	-	-	-	-	-	-	832	-	832	832
Maharashtra	9026	-	-	9026	49172	-	21156	-	-	11344	-	81671	90697
Odisha	20050	151	18381	38582	16861	6914	5128	364	274	71503	927	101971	140554
Punjab	-	-	-	-	-	-	-	-	116	81796	-	81912	81912
Rajasthan	140	-	86	226	-	18	18	-	-	706	-	742	968
Sikkim	-	-	-	-	-	-	-	-	675	16444	-	17119	17119
West Bengal	-	-	-	-	24	-	21	-	-	21	-	66	66

Figures rounded off.

Table-3: Statewise Production of Quartz

(In tonnes)

State	2018-19	2019-20	2020-21
Rajasthan	2683000	5744000	3037988
Andhra Pradesh	136794	878270	547390
Telangana	731952	813816	-
Gujarat	357193	-	-
Maharashtra	-	245050	-
Karnataka	108598	127064	71020

Source: As received from State DGMs and their websites.

Note:"-" NA.

Table-4: Statewise Production of Silica Sand

(In tonnes)

State	2018-19	2019-20	2020-21
Gujarat	86182776	-	-
Andhra Pradesh	3381270	2871070	1402110
Rajasthan	1920000	1329000	1306802
Maharashtra	-	879007	-
Himachal Pradesh	3000	1500	-

Source: As received from State DGMs and their websites.
Note:"-" NA.

Table-5: Statewise Production of Quartzite

(In tonnes)

State	2018-19	2019-20	2020-21
Andhra Pradesh	754959	525726	851897
Gujarat	392516	-	-
Rajasthan	26000	17000	120079
Odisha	-	-	175235

Source: As received from State DGMs and their websites.
Note:"-" NA.

Table-6: Principal Producers of Moulding Sand, 2020-21

Name & address of producers	Location of mine	
	State	District
Mahendra Kumar Seksaria, 271, Ramdev Mandir Ward-35, Ganjpara, Durg-491 001, Chhattisgarh.	Chhattisgarh	Durg
Smt. Sujata Dakaliya, House No: 19/132, Sahadeo Nagar, Rajnandgaon-491 441, Chhattisgarh.	Chhattisgarh	Rajnandgaon
Bimal Kumar Seksaria, 271, Ramdev Mandir, Ward-35, Ganj Para, Durg- 490 001, Chhattisgarh.	Chhattisgarh	Rajnandgaon

Table-7: Production of Moulding Sand, 2018-19 to 2020-21
(By State)

(Qty in tonnes; Value in ₹'000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**14805**	**4145**	**12805**	**3683**	**11737**	**3419**
Chhattisgarh	14805	4145	12805	3683	11737	3419

Table-8 : Production of Moulding Sand, 2019-20 & 2020-21
(By Sector/State/Districts)

(Qty in tonnes; Value in ₹'000)

Country	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**3**	**12805**	**3683**	**4**	**11737**	**-**
Private sector	3	12805	3683	-	-	-

HEALTH HAZARDS

Respirable silica is still a cause of major concern to miners and consumers since many minerals, especially industrial sand and gravel contain crystalline silica. There is a potential threat to workers of getting subjected to "silicosis" in quartz, silica sand and gravel mines. Occupational safety measures & regulations to monitor the levels of crystalline silica in these mines are mandatory. In the USA, the Occupational Safety and Health Administration (OSHA) listed "crystalline silica" as one of their top five priorities for formulation of necessary rules. The OSHA, on the basis of significant information put out by International Agency for Research on Evaluation of Cancer has declared that any material containing more than 0.1% crystalline silica should indicate its carcinogenic hazard.

USES & SPECIFICATIONS

Quartz, quartzite and silica sand are used in various industries like glass, refractory, foundry, ceramic, cosmetic, electrical, abrasives, paints, etc. The primary use of silica is in the manufacture of virtually all types of glasswares, ceramics and ceramic glazes. Other major uses are in metallurgy, (where silica is used as a refractory, foundry mould, fluxes and as a source of silicon for the production of silicon metal and ferro-silicon and other ferro-alloys), silicon carbide manufacture, chemical & construction sectors and as a natural abrasive. Known for its piezoelectric properties, high quality quartz crystal is used in electronic devices, multiple telephone lines, depth-sounding devices, range finders, chronometers, etc.

Sand is also used as a fireproofing material, for sandstowing in mines, soundproofing material and as a filler. Silica sand is also used to maintain or increase the permeability of oil and gas-bearing formations; its application as a filler in acid proof cements, putty, paints, epoxy & polyester resins is inevitable. Besides, it is widely used in horticulture as a filtration medium, and for ornamental purposes as well. Silica flour is used as a filler in plastic and rubber products.

Flint and chert are used in abrasives and tube-mill lining. Besides, chert is used in crushed form as aggregate for concrete and road surfacing. Rounded pebbles of chalcedony are used as balls in ball mill for finer crushing and grinding felspar, calcite & barytes. The different cryptocrystalline varieties of transparent and translucent chalcedony are valued as semi-precious stones and are carved out into a variety of ornaments and used for making different ornamental wares or articles of decoration. Agate pieces after cutting and polishing are sold as semi-precious stones. Big pieces are used in making mortars and pestles for laboratory use. Agate cut into requisite shapes is also used as fulcra of scientific balances and in making edges, planes and bearings of precision instruments.

In India, quartz, quartzite and silica sand are used mainly in glass, foundry, ferroalloys and refractory industries and also as building materials. According to its suitability for different purposes, it may be named as building sand, paving sand, moulding or foundry sand, refractory sand or furnace sand, filter sand, glass sand and grinding & polishing sand.

SUBSTITUTION

In order to reduce the potential threat of "silicosis", a variety of materials are used as substitutes for silica. Basic and neutral refractories (including magnesite, mag-chrome, dolomite and high alumina bricks) have replaced silica in a large number of applications. Chromite, olivine and zircon are alternatives to foundry sands. Garnet and to a lesser extent, olivine, are used in sand blasting to avoid the risk of silicosis. Wollastonite is more favoured than free silicon for use in the Ceramic Industry, again due to the risk of silicosis. In Electronic Industry, replacement of natural quartz crystal by cultured quartz crystal is increasing steadily. It has been estimated that about 10 billion quartz crystals and oscillators per year are manufactured and installed worldwide in all types of electronic devices.

FUTURE OUTLOOK

According to its suitability for different purposes, quartz & silica minerals are named as building sand, paving sand, moulding or foundry sand, refractory sand or furnace sand, glass sand, etc. The future market demand of quartz and silica minerals will depend on its application. However, the main use of silica minerals is in the manufacture of different types of glasses, natural silica sand being the preferred material in the Glass Industry. In India, quartz, quartzite and silica sand are used mainly in glass, foundry, ferroalloys, refractory industries and also as building materials. Silica sand is used in the Oil Industry for the hydraulic fracturing process as it helps in the extraction of gases. The market demand of silica minerals may get very high due to increased use in horizontal well drilling by oil companies.

The demand for quartz, silica sand, moulding sand and quartzite is increasing over the years to cater to the requirement of ferrosilicon, silico-manganese, silico-chrome, silica refractories, glass and for moulding & casting purposes. The requirements of these products are linked up directly with Iron & Steel Industry including alloy steel production. Further, setting up foundries and enhancing their capacities are also linked with Metallurgical Industry. There are very good prospects of increasing the production and also the export of quartz and silica minerals to the neighbouring countries.

30-21. Slate, Sandstone & Other Dimension Stones

Occurrences of sandstone in India are spread across Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Madhya Pradesh, Meghalaya, Mizoram, Karnataka, Odisha, Punjab, Rajasthan, Uttar Pradesh, Tamil Nadu and West Bengal

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'slate' has been declared as 'Minor Mineral'

Application of Kota Stone ranges from interior flooring, wall cladding to exterior use in paving and facades for building of all kinds and types

Slate, sandstone, limestone and quartzite are the principal rock types used as dimension stones other than granite and marble. India is endowed with abundant resources of these types of dimension stones which are increasingly used by domestic consumers. These stones are also important export commodities. India is one of the largest producers of dimension stones in the world.

1. SLATE

Slate is a fine-grained, very low-to-low metamorphic rock possessing well-developed fissility (splitting attitude) tendencies that are parallel to the planes of slaty cleavage. It is formed by the metamorphism of pre-existing clay rocks, such as, claystone, shale or siltstone. The most remarkable feature of this rock is that it has cleavage planes that are well-marked which enable it to be split manually or mechanically into relatively thin slabs. Slate is a low-cost decorative stone used for exterior and interior decoration of buildings. It is significantly used in roofing. It is also used as school slate and also as building dimension stone. The aesthetic value of slate matches that of other dimension stones, granite and marble. Slate has emerged as a low cost alternative to granite and marble which are comparatively expensive. The exports of slate have increased over the period and this has brought a sense of reckoning to Slate Mining Industry of the country. Micaceous and chlorite slates are generally preferred among many slate stone varieties.

OCCURRENCES

The Aravalli Mountain ranges in Rajasthan and Haryana; rock assemblages under Kadapa System in Andhra Pradesh and Tamil Nadu; and Himalayan region in Northern India are the regions where slate deposits along with other metamorphosed products are abundantly known to be present. The availability of slates has also been reported from Madhya Pradesh, Haryana, Himachal Pradesh, Jharkhand, Andhra Pradesh, Rajasthan, Uttarakhand, Bihar and Gujarat.

RESERVES/RESOURCES

Attempts to consolidate and prepare an authentic inventory of slate are underway. However, the total reserves resources of slate as per NMI database based on UNFC system (as on 01.04.2015) is placed at 22.9 million tonnes under Unclassified grade. Reserves/Resources are located in Andhra Pradesh & Haryana (Table- 1).

Table-1: Reserves/Resources of Slate as on 1.4.2015
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	19619	667	-	20286	-	-	1075	-	-	1511	-	2586	22872
By Grades													
Unclassified	19619	667	-	20286	-	-	1075	-	-	1511	-	2586	22872
By States													
Andhra Pradesh	109	667	-	776	-	-	1075	-	-	1511	-	2586	3362
Haryana	19510	-	-	19510	-	-	-	-	-	-	-	-	19510

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews - Volume - I".

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'slate' has been declared as 'Minor Mineral' hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. Data of only a few States could be collected. All possible information/data that could be gathered has been presented in this Review.

Statewise production of slate during 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Slate

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Andhra Pradesh	17560	12980	8810
Himachal Pradesh	2859	3451	-
Rajasthan	2000	1000	998

Source: As received from State DGMs and their websites.

Note : " - " NA

USES AND SPECIFICATIONS

There are two main uses of slate as a natural stone in building work: a) for roofing in the form of roofing tiles and b) for flooring in the form of tiles and for cladding purposes. For roofing tiles, the slate stone should be exfoliated easily and should be free from minerals like iron sulphides or carbonates which after a period of time could cause corrosion and staining. For cladding or flooring purposes, the slate stone should withstand the impact of the cutting processes involved for producing required sizes, polishing or smoothening process by machines and should not peel off during the process of fixing or laying. Bureau of Indian Standard has laid down Standard IS: 6250-1981 (First revision; reaffirmed 2008), namely, specification for roofing slate tiles with respect to requirement of dimensions, physical properties and workmanship of slate tiles used for sloped roof covering.

2. SANDSTONE

Sandstone is a sedimentary rock largely made up of sand grains in size ranging from 2 mm to 120 mm of varying compositions. The sand may consist of grains of quartz, felspar and other detrital minerals with interstitial cementing material. The composition of sand particles and the cementing material by and large defines the colour of sandstone while the mode of formation decides the thickness of bed which gives rise to various types of sandstones. The colour of sandstone may range from dark red to brown, earthy to buff, white, yellow and a number of other shades. The pattern of the sandstone depends upon the thickness of bed. Sandstone produced in the country is being marketed as Vindhyan Red, Rainbow, Teak, Modak, Bundi, Bansi Pink, Mandana, Dholpur Cream, etc. The sandstone may occur as massive, thick, non-splittable bands or thin beds or layers that can be split by applying slight pressure. Only the State of Rajasthan reported production of sandstone about 158.14 lakh tonnes & 274.50 lakh tonnes during 2018-19 & 2019-20 respectively.

RESERVES/RESOURCES

Occurrences of sandstone in India are spread across Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Madhya Pradesh, Meghalaya, Mizoram, Karnataka, Odisha, Punjab, Rajasthan, Uttar Pradesh, Tamil Nadu and West Bengal.

The reserve/resource estimation has not been considered important because of its abundance and easy availability. Hence, there is no comprehensive inventory of sandstone. However, the Centre for Development of Stones (CDOS), a 'Government of Rajasthan Undertaking' has reported estimated reserves of sandstone at over 1,000 million tonnes in the country. Huge deposits of sandstone in Rajasthan are associated with Vindhyan and Trans-Aravalli Formations, exposed over an area of nearly 35,000 sq. km covering districts of Dholpur, Bharatpur, Karauli, Sawai Madhopur, Tonk, Bundi, Jhalawar, Kota, Bhilwara and Chittorgarh. It is also found scattered in the districts of western desert plain in the districts of Jodhpur, Churu, Bikaner and Nagaur. Splittable sandstone deposits are confined to an area of 16,000 sq. km, out of which 10,000 sq. km lies in eastern and south-eastern Rajasthan and 6,000 sq. km in western Rajasthan.

In Gujarat, fine to medium-grained sandstone of varying colours ranging from white, light-purplish, reddish-brown, cream to yellow are found in the district of Kachchh. A brownish-yellow sandstone occurs near Chabari and Mainapara in Bhachau tehsil. The sandstone at Rampur, Katada-Roha and Rajoda Dungar near Mangwana in Nakhtrana tehsil is cream coloured and is fairly hard. Extensive deposits are found around Songir, Naswadi, Ghautoli, Namaria and Lachharas in District Vadodara.

The Vindhyan and Satpura Mountains in Madhya Pradesh have vast resources of sandstone. The red, cream and white sandstone are being quarried extensively in Panna and Shivpuri districts and in many areas near Jabalpur.

In Uttar Pradesh, sandstones suitable for making slabs and tiles are located in Agra, Mirzapur, Lalitpur, Allahabad and Sonbhadra districts. The sandstone of Lalitpur district is yellow, light green and maroon and takes good polish. The sandstone in Lalitpur occurs in Madanpur and Rampura (near Deogarh) areas and is traded under the commercial name Royal Gold, Beach Sand and U.P. Green. The sandstone of Agra occurring in Tatpur area is red and mottled and is used for interior as well as exterior flooring and cladding. In Mirzapur and Sonbhadra areas, good quality buff to pale and creamish sandstone is available.

The felspathic sandstone occurring with the coal seams as overburden is also used as building stone. The Kamthi Sandstone occurring in and around Tehsil Saoner, District Nagpur in Maharashtra is being quarried and is used as building stone.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews - Volume - I".

PRODUCTION

Sandstone being building stone comes under 'Minor Mineral' as defined in Clause (e) of the Section 3 of MM(DR) Act 1957, hence the producers report the production data directly to the respective States and not to IBM. Production data for sandstone is not available except for that of Rajasthan, Jammu & Kashmir and Karnataka. Karnataka produced about 569 tonnes during the year 2020-21 as compared to 272 tonnes in the previous year; Rajasthan produced 22.4 million tonnes during 2020-21 as compared to 10.26 million tonnes in the previous year; while J & K produced 3,109 cubic meter of sand stone during current year 2020-21.

3. DIMENSION LIMESTONE

The limestone which is used as dimension stone differs from the limestone used for cement making or for any other industrial purpose in two ways — firstly, chemical composition and secondly, the mode of occurrence. In both the types, the major constituent is calcium carbonate, but, very high silica content gives limestone sufficient hardness to be utilised as a dimension or building stone. The industrial limestone occurs as massive formation with less intercalations while in case of dimension limestone, thin-bedded deposits are preferred. Limestone which is compact and amorphous in texture is known as flaggy or splittable limestone and is quarried in the form of thin slabs ranging in thickness from 12 mm to 50 mm in ready-to-use form.

Statewise production of limestone slabs used as dimension stone during 2018-19 to 2020-21 is furnished in Table-3

Table-3: Statewise Production of Limestone Slabs

(In sq m)

State	Year		
	2018-19	2019-20	2020-21
Andhra Pradesh	23329720	21445258	19482975
Telangana	3674418	2926619	-
Rajasthan	4389000	9586000	5153067

Source: As received from State DGMs and their websites.
Note : " - " NA

Limestone has been used since ancient times for construction of houses, flooring and for various other building purposes. In recent times, the use of limestone has increased manifold mainly for interior flooring, as cobble stones and for decorative purposes in combination with other stones because of its availability in a range of colours and shades. Depending upon the place of origin of limestone and its colour, various types of nomenclatures have been used in the trade for limestone, such as, Kadapa Stone, Shahabad Stone, Kota Stone with different shades and colours (Kota Blue, Kota Brown, etc.), Kachchh Stone, Miliolitic Limestone, etc.

OCCURRENCES

Occurrences of dimension limestone have been reported from several regions across various States, such as, Shahabad Stone of Vijapura at Kalaburagi and Belagavi districts in Karnataka; and 'Kadapa Stone' of Kurnool at Anantapur and Guntur districts and 'Tandur Stone' of Kadapa district in Andhra Pradesh, etc. Other coloured well-known limestones are from Bethamcherla, Tadipatri & Macherla areas in Andhra Pradesh and Nereducherla & Muddimanikyam in Telangana. Occurrence of 'Milliolitic Limestone' from Saurashtra region, 'Yellow Limestone' in Kachchh district of Gujarat, 'Kota Limestone' in Kota district and 'Yellow Limestone' in Jaisalmer district, Rajasthan have also been reported from across the country.

Rajasthan is richly endowed with the occurrence of greenish-grey 'Kota' limestone. The Kota stone has gained tremendous popularity and is widely used for flooring and cladding purposes. The important deposits of limestone are in Kota, Jhalawar, Chittorgarh and Jaisalmer districts, Rajasthan. Kota, Jhalawar and Chittorgarh are the major districts that produce dimension limestone in the State. Extensive limestone deposits are found in the Upper Stage of the Lower Vindhyans and these limestone varieties have good potential to be used as cement-grade limestone as well as flooring stone. Certain portions of the limestone having splittable form are used extensively as flooring stones. Occurrences of limestone in the north-south belt from Dalla-ka-Khera to Nimbahera which extend into Madhya Pradesh covering a distance of about 70 km have been established. It is fine-grained, thinly bedded and has a total thickness of about 150 m. At a few places, the major portion of the limestone deposit is suitable for cement making but there are pockets, containing splittable forms that can be used for building and flooring purposes directly.

Occurrences of yellow limestone deposits in Jaisalmer is of Jurassic Age and is found in Bada Bag, Mool Sagar and Kanod villages of Jaisalmer. Ist contains 42 to 51% calcium oxide and has a thickness of about 3 m. It is quarried in the form of blocks and can be sawed into slabs and tiles. It is also termed as yellow marble as it takes reasonably good polish.

Flaggy limestone deposits of Jhalawar and Ramganjmandi, Kota area belong to Lower Vindhyan Group and are available in plenty at Sarola Kotri Chitawa and Khokhriya-Khurd areas. Extensive deposits are available near Ramganjmandi, Aroliya and Parolia areas. Ramganjmandi and Jhalawar Road are the main railway stations from where the splittable limestone produced is dispatched to various parts of the country. In the last few years, export market of this limestone which is popularly known as 'Kota Stone' has been vastly significant.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

USES & SPECIFICATIONS

Application of Kota Stone ranges from interior flooring, wall cladding to exterior use in paving and facades for building of all kinds and types.

The Kota Stone has a natural split non-slip surface. Massive, dense and fine-grained varieties are generally durable as these are not porous. These are tough and have a crushing strength of 17.8 kg/mm^2 and a high compressive strength of over 2,189 kg/cm^2. Abrasion value of Kota Stone is 18.12 to 18.32 and it has a high resistance to delamination and failure under freezing and thawing conditions.

Bureau of Indian Standards has prescribed Specification for Limestone (Slab & Tiles) as IS : 1128 - 1974 (First Revision, reaffirmed 2008).

4. OTHER DIMENSION STONES

In addition to the dimension stones already described, other dimension stones are also quarried and used for the construction of houses and other building purposes.

In Odisha, Karnataka, Goa and in parts of coastal States, laterite is quarried in huge quantities. It is utilised as bricks in the construction of houses and pavements. Huge deposits of basalt in Maharashtra, Karnataka and Gujarat are used as building stones since ancient times. Quartzite bands occurring along with phyllite schists are also utilised for building purposes.

In addition, stone aggregates, such as, broken and sized pieces of limestone, dolomite, quartzite and sandstone are mixed either with cement for building and road-making purposes or with asphalt for mending road. To utilise the huge waste generated during mining and processing, a new variety of man-made stone 'Terrazo" has been developed, which is composed of stone chips, set in cement, epoxy or polyacrylate and then polished. The Terrazo is an economical alternative to solid marble slabs or tiles.

5. FELSITE

Felsite is a fine evenly-grained acid or intermediate igneous rock, usually occurring as dykes and veins in country rocks and in the parent plutonic mass. BIS has prescribed the specification IS:10874-1983 (reaffirmed 2010) for felsite grinding media and liner stones. Felsite has architectural, industrial and antiquity uses. As per GOI Notification S.O.423(E), dated 10.2.2015, felsite has been declared as 'Minor Mineral', hence the production beyond January, 2015 is not available with IBM.

TRADE POLICY

As per the Export-Import Policy announced for the period 2015-20; and the Foreign Trade Policy thereunder, the imports of slate blocks or slabs whether or not roughly trimmed or merely cut are restricted under Heading no. 2514. As per Import policy under schedule of ITC (HS) 2022 and export policy under schedule of ITC (HS) 2022, the imports of slate, whether or not roughly trimmed or merely and, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape are restricted.

Import of crude or roughly trimmed/cut blocks or slabs of sandstone and other monumental or building stones, viz, pakur stone, stone boulders, and others, are restricted under Heading no. 2516. However, sets of curbstones and flagstones of natural stone (except slate) under Heading no. 6801 and worked monumental building stone (excluding slate), tiles, cubes and similar articles of natural stone including slate, under Heading No. 6802 can be imported freely. Worked slate and articles of slate or of agglomerated slate under Sub-heading 6803 can also be imported freely. Exports of stone aggregates which are restricted under Chapter 25 of ITC (HS), 2022, Schedule 2-Export policy, are permitted to be exported to Maldives subject to ceiling limits. The annual ceilings are monitored by CAPEXIL and is subject to exporters obtaining appropriate clearances.

FUTURE OUTLOOK

Slate is mostly used as a roofing material, but other uses like cladding and flooring tiles are also gaining momentum. Slate occurs widely in the country and detailed study has to be conducted to quantify the resources. The demand for dimension stones including sandstone & others and stone products is anticipated to grow at around 15%. A similar growth is also expected in exports.

The demand for artifacts, especially carved work is on the rise all over the world. India with its rich tradition of craftmanship and trained artisans can embark upon the world market.

Improved quarrying, finishing & hauling technology, availability of greater variety of stones and the rising cost of alternative construction materials are among the factors that suggest that the demand for dimension stones in future would see steady and consistant growth.

30-22. Talc, Soapstone and Steatite

316

(million tonnes) total reserves/ resources of talc/soapstone/steatite have been established as per NMI as on 1.4.2015

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'talc, soapstone and steatite' have been declared as 'Minor Mineral'

Talc in pulverised form is mostly used as a filler in paper, textile, rubber, insecticides and fertilizer industries

Talc is a hydrous magnesium silicate. In trade parlance, talc often includes: (i) the mineral talc in the form of flakes and fibres; (ii) steatite, the massive compact cryptocrystalline variety of high-grade talc; and (iii) soapstone, the massive talcose rock containing variable talc (usually 50%), which is soft and soapy in nature. Commercial talc may contain other minerals like quartz, calcite, dolomite, magnesite, serpentine, chlorite, tremolite and anthophyllite as impurities. The properties of talc that enable its use in a wide variety of applications are its extreme softness & smoothness, good lustre & sheen, high slip & lubricating property, low moisture content, ability to absorb oil & grease, chemical inertness, high fusion point, low electrical & heat conductivity, high dielectric strength, good retention for filler purposes, whiteness, good hiding power as pigment and high specific heat. In addition, it has the advantage of being relatively abundant. It can be easily mined and prepared for market. Rajasthan is the hub of activities related to talc mining, processing and trade. Talc, Soapstone and Steatite has been declared as 'Minor Mineral', vide Government of India Notification S.O. 423 (E) dated 10th February, 2015.

RESERVES/RESOURCES

As per NMI data, based on the UNFC system, the total reserves/resources of talc/soapstone/steatite as on 1.4.2015 has been estimated at 316 million tonnes of which Reserves and Remaining Resources are 106 million tonnes and 209 million tonnes, respectively. Substantial quantities of reserves/resources are established in Rajasthan (57%) and Uttarakhand (25%). The remaining 18% resources are in Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Odisha, Sikkim, Tamil Nadu and Telangana. By grades, Paper & Textile grade accounts for about 22% share in total resources followed by Insecticides (21%) and Cosmetics (9%). Resources of Ceramic and Paint grades are negligible. Others, Unclassified and Not-known grades account for about (48%) resources (Table-1).

Table-1: Reserves/Resources of Talc/Soapstone/Steatite as on 1.4.2015
(By Grades/States)

(In '000 tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	72172	8067	26251	106490	18178	13020	32221	2994	8126	128620	6275	209434	315924
By Grades													
Paper & textile	21398	4401	6088	31887	5947	818	7170	575	430	15452	5890	36283	68170
Cosmetics	9094	361	2912	12368	1575	991	4287	1102	844	5986	146	14932	27300
Insecticide	17258	2193	7307	26759	6002	3205	11850	956	217	17066	40	39336	66095
Ceramic	131	10	64	205	17	46	93	-	35	160	17	367	572
Paint	52	300	242	594	57	27	92	-	-	135	30	341	935
Others	544	-	267	811	1314	3603	3539	346	100	2219	-	11122	11933
Unclassified	23359	801	9302	33462	2004	4246	4509	11	6444	78213	147	95573	129035
Not-known	336	-	67	404	1263	84	680	2	56	9388	5	11479	11883
By States													
Andhra Pradesh	1875	482	1001	3358	197	725	1804	184	369	3611	248	7137	10495
Bihar	-	-	-	-	-	-	-	-	-	149	-	149	149
Chhattisgarh	22	-	8	29	-	-	-	-	70	8	-	78	107
Gujarat	-	-	4	4	-	20	9	-	-	4	-	33	37
Jharkhand	336	-	83	419	-	-	54	2	4	243	16	319	739
Karnataka	46	53	182	280	58	78	251	11	208	1196	-	1800	2081
Kerala	-	-	-	-	-	-	-	-	-	14390	-	14390	14390
Madhya Pradesh	185	20	79	283	179	378	1609	-	1679	6107	-	9952	10235
Maharashtra	-	-	-	-	-	-	-	-	2565	14262	-	16827	16827
Odisha	-	2	8	10	106	89	193	151	-	278	-	817	827
Rajasthan	52812	2989	22189	77990	11249	6167	17498	1640	858	63411	151	100975	178965
Sikkim	-	-	-	-	-	-	60	-	-	-	-	60	60
Tamil Nadu	-	-	-	-	559	210	1762	27	-	553	-	3110	3110
Telangana	-	-	-	-	-	-	-	-	-	20	-	20	20
Uttarakhand	16896	4521	2698	24115	5831	5353	8982	978	2372	24388	5860	53765	77881

Figures rounded off.

EXPLORATION & DEVELOPMENT

The exploration & development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

PRODUCTION

As per Govt of India Notification S.O. 423(E), dated 10th February 2015, 'talc, soapstone and steatite' have been declared as 'Minor Mineral', hence the producers report the production data directly to the respective States and not to IBM. However, efforts were made to collect this information through correspondence with the State Directorates of Mining and Geology of individual States or visiting their websites. Data of only a few States could be collected. All possible information/data that could be gathered has been presented in this Review.

Statewise production of talc, soapstone and steatite during 2018-19 to 2020-21 is furnished in Table-2.

Table-2: Statewise Production of Talc, Soapstone & Steatite

(In tonnes)

State	Year		
	2018-19	2019-20	2020-21
Rajasthan	1459000	1484000	1590395
Andhra Pradesh	107160	110921	102260
Karnataka	895	432	721

Source: As received from State DGMs and their websites.

Note : " - " NA.

USES & SPECIFICATIONS

Talc in pulverised form is mostly used as a filler in paper, textile, rubber, insecticides and fertilizer industries. Pure talc after calcining, called 'Lava', is used in the manufacture of low-loss ceramic materials essential for radio, radar, television, etc. In roofing products, such as, tar, paper, asphalt shingles and roll roofing, talc acts as a fire retardant increases weather resistance. Body and face powders (talcum powder) are prepared from the finest quality talc after adding deodorant and perfumes. Massive steatite when cut into panels is used for switchboards and acid proof tabletops in laboratory, laundry and kitchen sinks, in tubs and tanks as well as for lining alkali tanks in Paper Industry. Due to its high melting point (1,630 ^{0}C), soapstone can be used in refractories and fire places. It is also quite useful in sculpturing.

Indian talc, especially mined in Rajasthan and Andhra Pradesh is comparable with the best quality available in other countries. In the world market, talc, free from grit, having high whiteness and high degree of soapiness is very much sought after in cosmetic, filler and weighing applications. Talc having more than 92% brightness, less than 1% Fe_2O_3 and less than 1.5% $CaCO_3$ is preferred for exports.

Soapstone powder is also used as parting agent in Foundry Industry. Parting agents are used for easy release of moulds and cores from pattern equipment and core boxes. BIS specification IS 8250-1988 (First Revision Reaffirmed, February 2014) prescribes use of off-white or cream-coloured material having a very smooth and slippery feel, passing completely through 75 microns IS-sieve. The material shall be predominantly magnesium silicate and chemical composition as agreed to between buyer and purchaser compatible with naturally occurring soapstone. In Paint Industry, foliated, fibrous or lamellar material of 300 mesh and free from silica is used. Specifications of steatite (as French chalk) used in paper, textile, pyrotechnic and rubber industries are as per IS: 380-1978 (Second Revision, Reaffirmed 2003). Specifications for Ceramic Industry and actual user specifications for Insecticide Industry are as per IS : 10429-1982 (Reaffirmed 2001). BIS has prescribed specifications for use of talc in Cosmetic Industry vide IS: 1462-1985 (Third Revision, Reaffirmed 2006).

POLICY

As per Import Policy under Schedule I of ITC (HS) 2022 and Exports Policy under Schedule II of ITC (HS) 2022, Natrual Steatite whether or not roughly trimmed or merely cut by sawing or otherwise, into blocks or slabs of a rectangular (inculding square) shape is allowed; while for talc exports are allowed freely without restrictions.

FUTURE OUTLOOK

India is one of the principal sources of 'Lava' grade talc suited for specialised purposes like low ceramic materials and also of swan-shaped talc. Indian talc is considered to be the second best in the world next to Italian talc. India has large resource base and well-developed production facilities that utilises modern pulverising techniques. Concerted efforts through R & D advancements are necessary to make Indian talc suitable for world market.

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