

SULPHUR AND PYRITES



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SULPHUR AND PYRITES

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**GOVERNMENT OF INDIA
MINISTRY OF MINES
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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 (H_2S), 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; H_2S 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 H_2S 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 SO_2 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

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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 and States)**

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources					Total (B)	Total (A+B)
		Feasibility STD211	Pre- feasibility STD222	Measured STD331	Indicated STD332	Inferred STD333		
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 and States)**

(In '000 tonnes)

Grade/State	Reserves Total (A)	Remaining Resources					Total (B)	Total (A+B)
		Feasibility STD211	Pre- feasibility STD222	Measured STD331	Indicated STD332	Inferred STD333		
All India : Total	–	–	–	–	–	210	210	210
By Grades								
Sulphur (Native)	–	–	–	–	–	210	210	210
By States								
Jammu & Kashmir	–	–	–	–	–	210	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.

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 producer	Location of plant/refinery	
	State	District(s)
Indian Oil Corporation Ltd, (Refineries Division), Scope Complex, Core-II, 7, Institutional Area, Lodhi Road, New Delhi -110 003.	Assam	Kamrup Metro, Tinsukia, Chirang
	Bihar	Begusarai
	Gujarat	Vadodara
	Haryana	Panipat
	Odisha	Jagatsinghpur
	Uttar Pradesh	Mathura
	West Bengal	Purba Medinipur
Numaligarh Refinery Limited, 122S, G. S. Road, Christianbasti, Distt- Guwahati, Assam - 781 005.	Assam	Golaghat
Bharat Petroleum Corporation Ltd, Bharat Bhavan, 4 & 6, Currimbhoy Road, Ballard Estate, Mumbai-400 001, Maharashtra	Maharashtra	Mumbai
	Kerala	Ernakulam

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

**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 (SO₂)

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 H₂SO₄. 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 (H₂SO₄), 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.

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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 Coromandel 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 fertiliser 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 fertiliser 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 nondiscretionary 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 sulfur 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.

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**Table – 6 : World Production of Sulphur & Pyrites
(By Principal Countries)**

Country	In tonnes (sulphur content)		
	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)

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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
USA			
(Recovered) (b)	672000	596000	*520000
(Recovered) (a)	9000000	8110000	*7600000

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Country	2018	2019	2020
Argentina			
(Recovered) (b)	*20000	*20000	*20000
Brazil			
Pyrites	*20000	*20000	*20000
Recovered (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
Oman			
(Recovered) (a)	*49000	*48000	*48000
Pakistan			
(Sulphur ore)(g)	22040	20715	*20000
Philippines			
(Recovered) (b)	*169000	*169000	*169000
(Recovered) (a)	*2500	*2000	*2000

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Country	2018	2019	2020
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

SULPHUR AND PYRITES

FOREIGN TRADE

Exports

Exports of sulphur (excluding sublimed, precipitated and colloidal) increased 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). 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). 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

Table –8 : Exports of Sulphur (Sublimed, Precipitated & Colloidal) : Total (By Countries)

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

SULPHUR AND PYRITES

**Table – 9: Exports of Sulphur (Colloidal)
(By Countries)**

Country	2019-20 (R)		2020-21 (P)	
	Quantity (t)	Value (₹'000)	Quantity (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)	
	Quantity (t)	Value (₹'000)	Quantity (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

SULPHUR AND PYRITES

**Table-11 : Exports of Sulphur (Precipitated)
(By Countries)**

Country	2019-20 (R)		2020-21 (P)	
	Quantity (t)	Value (₹'000)	Quantity (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)	
	Quantity (t)	Value (₹'000)	Quantity (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

SULPHUR AND PYRITES

**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

SULPHUR AND PYRITES

**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.

SULPHUR AND PYRITES

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.

