

GRAPHITE



Indian Minerals Yearbook 2021

(Part- III : Mineral Reviews)

60th Edition

GRAPHITE

(ADVANCE RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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14 Graphite

Graphite, also known as plumbago or blacklead or mineral carbon, is a stable form of naturally occurring carbon. Structurally, graphite is known to crystallise 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 Beneficial '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).

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 30168 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.

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 – 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 STD111	Probable STD121 STD122	Total (A)	Feasibility STD211	Pre-feasibility STD221 STD222	Measured STD331	Indicated STD332	Inferred STD333		Reconnaissance STD334	Total (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
Beneficial	-	-	-	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

GRAPHITE

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

Name & address of producer	Location of mine	
	State	District
Krishna Kumar Poddar, 3P, Shree Gopal Complex, Court Road, Ranchi - 834 001, Jharkhand.	Jharkhand	Palamu
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
Tamil Nadu Minerals Limited, 31, Kamarajar Salaitwad House, Chepauk, Chennai-600 005, Tamil Nadu.	Jharkhand	Palamau

**Table – 3: Production of Graphite, 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	39030	36233	34674	55908	30168	60054
Chhatisgarh	-	-	908	409	1701	1765
Jharkhand	15831	17974	21202	20661	5674	5795
Odhis	23199	18259	12564	34838	12767	41633
Tamil Nadu	-	-	-	-	10026	10861

GRAPHITE

**Table – 4: Production of Graphite, 2019-20 and 2020-21
(By Sectors/States/Districts)**

(Qty in tonnes; Value in ₹ '000)

State/District	No. of Mines	2019-20					2020-21 (P)					
		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)**

(Qty in tonnes)

Production group	No. of mines		Production for the group		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)
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	37.40	31.14	43.67	41.09
5001 to 10000	1	1	7915	7744	22.83	25.67	66.50	66.76
Above 10000	1	1	11618	10026	33.51	33.23	100	100

GRAPHITE

**Table – 6: Mine-head Closing Stocks of Graphite, 2019-20 & 2020-21
(By States)**

(In tonnes)

State	2019-20				2020-21 (P)			
	Grade: Fixed Carbon content			Total	Grade: Fixed Carbon content			Total
	80% or more	40% or more but less than 80%	Less than 40%		80% or more	40% or more but less than 80%	Less than 40%	
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

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 Senthudayanathapuram 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) alumina refractories	8-1085%	min.	150-500
Clay-bonded crucibles	60-65	+80%	-20 to +100 mesh
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
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%), Foundry 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)

Industry	(In tonnes)		
	2017-18	2018-19 (P)	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 consumption 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 & Uzbekistan (2% each) and Mexico & Dem. P. R. of Korea (1% each) (Table-8).

GRAPHITE

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)**

Country	Reserves (In '000 tonnes)
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
Mozambique	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.

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

**Table – 9 : World Production of Graphite
(By Principal Countries)**

Country	(In tonnes)		
	2018	2019	2020
World Total (Rounded off)	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 30 June of that stated

h: Export

j: Sales

India's production of graphite during 2017-18, 2018-19 and 2019-20 was at 34 thousand tonnes, 39 thousand tonnes and 31 thousand tonnes, respectively.

Tanzania (25%), Nepal (15%), Malaysia (11%), U A E (10.1%)

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%),

GRAPHITE

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).

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%).

Imports of graphite (artificial) increased by 14% to 54,327 tonnes in 2020-21 from 47,511 tonnes in

**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
U A E	16	1236	77	4379
Sudan	72	3748	60	3930
Bangladesh	35	1760	40	2389
Baharain	++	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

**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 Arab	41	7726	231	54641
Bangladesh	1265	51072	1548	54222
Belgium	124	62903	75	40903
Other countries	4016	447669	2362	380787

Figures rounded off

GRAPHITE

**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
Netherland	-	-	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
U S A	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

GRAPHITE

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

**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
Netherland	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

GRAPHITE

**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.