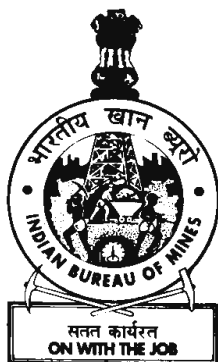


GRAPHITE



Indian Minerals Yearbook 2019

(Part- III : Mineral Reviews)

58th 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 1.4.2015 have been placed at about 194.89 million tonnes, out of which 7.96 million tonnes are in the Reserves category and 186.92 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 40.65 million tonnes. The balance 151.31 million tonnes fall under 'Others', 'Unclassified' and 'Not-known' grades. Arunachal Pradesh accounts for 37% of the total resources

which is followed by Jammu & Kashmir (32%), Odisha (9.7%), Jharkhand (9%) and Tamil Nadu (4%). However, in terms of reserves, Jharkhand has the leading share of about 52% followed by Tamil Nadu (42%) and Odisha (6%) (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 39,370 tonnes in 2018-19 increased by 17% as compared to that the preceding year.

There were nine 9 reporting mines in 2018-19 same as in the previous year. Five principal producers accounted for 97% during the year.

About 82% of the total production in 2018-19 was accrued from three mines, each producing more than 5,000 tonnes annually, while 18% was contributed by six mines in the production range of up to 5,000 tonnes per annum.

Odisha was the leading producing State contributing 59% to the total output during 2018-19, followed by Jharkhand (40%) and Kerala (1%).

Mine-head closing stock in the year 2018-19 was 1,74,270 tonnes as against 1,77,914 tonnes in the previous year.

The average daily employment of labour during 2018-19 was 190 against 249 in the preceding year (Tables 2 to 6).

**Table – 1 : Reserves/Resources of Graphite as on 1.4.2015
(By Grades/States)**

(In tonnes)

Grade/State	Reserves			Remaining Resources					Total Resources		
	Proved STD111	Probable STD121 STD122	Total (A)	Feasibility STD211	Pre-feasibility STD221 STD222	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	Total Resources (A+B)
All India : Total	4229675	1204423 2526694	7960793	9571933	3825575 3593404	741377	7368340	22361229	139464128	186925987	194886779
By Grades											
+ 40% F.C.	178846	1121513 502465	1802824	-	188968 79358	338686	263391	242528	-	1112931	2915755
10-40% F.C.	3621958	82910 1732350	5437219	9004058	3327566 3138724	353765	2703478	13586597	3106244	35220432	40657651
Others	258346	- 57000	315346	92188	117148 68752	-	3323906	3451194	-	7053188	7368534
Unclassified	170525	- 234879	405404	444415	191893 301706	9090	7253	3856995	63439569	68250921	68656325
Not-known	-	- -	-	31272	- 4864	39836	1070312	1223915	72918315	75288514	75288514
By States											
Andhra Pradesh	-	- -	-	-	1195 1135	-	1122	697575	-	701027	701027
Arunachal Pradesh	-	- -	-	-	- -	-	-	-	72758257	72758257	72758257
Chhattisgarh	6111	- -	6111	1230	- -	-	-	-	-	1230	7341
Gujarat	-	- -	-	-	- -	-	2520805	835000	-	3355805	3355805
Jammu & Kashmir	-	- -	-	-	- -	-	-	1059520	61681035	62740555	62740555
Jharkhand	1518581	1204423 1450350	4173555	39262	445703 1959747	5520	1856563	6639828	2440208	13386831	17560386
Karnataka	-	- 16518	16518	140827	18750 48821	-	41605	149403	-	399406	399406
Kerala	-	- -	-	-	8376 -	-	1088550	322606	-	1419532	1436050
Madhya Pradesh	-	- -	-	-	- -	-	-	3456660	2280000	5736660	5736660
Maharashtra	-	- -	-	-	- -	-	-	1160000	-	1160000	1160000
Odisha	209795	- 249176	458971	9314306	3312065 1415295	696021	838559	2628394	304628	18509268	18968239
Rajasthan	-	- -	-	47600	- 165920	-	250000	1450034	-	1913554	1913554
Tamil Nadu	2495188	- 810450	3305638	28708	39486 2486	29136	647500	3866390	-	4613707	7919345
Telangana	-	- -	-	-	- -	-	123636	95818	-	219455	219455
Uttarakhand	-	- -	-	-	- -	10700	-	-	-	10700	10700

Figures rounded off

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Table – 2: Principal Producers of Graphite, 2018-19

Name & address of producer	Location of mine	
	State	District
Pramod Kumar Agrawal, Shantikunj Farm Road Modipara, Sambalpur – 768 002, Odisha.	Odisha	Nuapada
Sishir Kumar Poddar, 4L,Shree Gopal Complex, Court Road, Ranchi - 834 001, Jharkhand.	Jharkhand	Palamu
Prabhas Chandra Agrawal, Shantikunj Farm Road Modipara, Sambalpur – 768 002, Odisha.	Odisha	Nuapada
Parijat Mining Industries (India) Pvt. Ltd, Town Hall Road, Opp. Shiavajee Maidan, Daltonganj, Palamu – 822 101, Jharkhand.	Jharkhand	Latehar
Krishna Kumar Poddar, 3P, Shree Gopal Complex, Court Road, Ranchi - 834 001, Jharkhand.	Jharkhand	Palamu

**Table – 3: Production of Graphite, 2016-17 to 2018-19
(By States)**

(Qty in tonnes; Value in `'000)

State	2016-17		2017-18		2018-19 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	122438	94158	33649	28229	39370	37711
Jharkhand	10343	11450	18735	19120	15830	17491
Kerala	660	5280	240	1937	340	2720
Odisha	16374	10684	14674	7172	23200	17500
Tamil Nadu	95061	66744	-	-	-	-

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**Table – 4: Production of Graphite, 2017-18 and 2018-19
(By Sectors/States/Districts)**

(Qty in tonnes; Value in ` '000)

State/District	No. of Mines	2017-18					2018-19					
		Grade: Fixed Carbon content			Total		No. of Mines	Grade: Fixed Carbon content			Total	
		80% or more	40% or more but less than 40%	Less than 40%	Qty.	Value		80% or more	40% or more but less than 40%	Less than 40%	Qty.	Value
India	9	-	842	32807	33649	28229	9	-	954	38416	39370	37711
Public Sector	1*	-	-	-	-	-	-	-	-	-	-	-
Private Sector	8	-	842	32807	33649	28229	9	-	954	38416	39370	37711
Jharkhand	2	-	-	18735	18735	19120	3	-	-	15830	15830	17491
Latehar	1	-	-	4645	4645	4636	1	-	-	3251	3251	2427
Palamau	1	-	-	14090	14090	14484	2	-	-	12579	12579	15064
Karnataka	-	-	-	-	-	-	2*	-	-	-	-	-
Mysore	-	-	-	-	-	-	2*	-	-	-	-	-
Kerala	1	-	-	240	240	1937	1	-	-	340	340	2720
Ernakulam	1	-	-	240	240	1937	1	-	-	340	340	2720
Odisha	5	-	842	13832	14674	7172	3	-	954	22246	23200	17500
Nawapara	4	-	842	13832	14674	7172	2	-	-	22246	22246	14447
Raygada	1	-	-	-	-	-	1	-	954	-	954	3053
Tamil Nadu	1*	-	-	-	-	-	-	-	-	-	-	-
Madurai	-	-	-	-	-	-	-	-	-	-	-	-
Sivaganga	1*	-	-	-	-	-	-	-	-	-	-	-

* : Only labour reported during the year

**Table – 5 : Production of Graphite, 2017-18 & 2018-19
(By Frequency Groups)**

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage in total production		Cumulative percentage	
	2017-18	2018-19 (P)	2017-18	2018-19 (P)	2017-18	2018-19 (P)	2017-18	2018-19 (P)
	India	9	9	33649	39370	100.00	100.00	-
Up to 1000	5	4	1082	1294	3.22	3.29	3.22	3.29
1001 to 2000	-	-	-	-	-	-	-	-
2001 to 5000	2	2	9023	5951	26.82	15.12	30.04	18.41
5001 to 10000	1	2	9454	15272	28.09	38.79	58.13	57.2
Above 10000	1	1	14090	16853	41.87	42.80	100.00	100.00

**Table – 6: Mine-head Closing Stocks of Graphite, 2017-18 & 2018-19
(By States)**

(In tonnes)

State	2017-18				2018-19(P)			
	Grade: Fixed Carbon content			Total	Grade: Fixed Carbon content			Total
	80% or more	40% or more but less than 40%	Less than 40%		80% or more	40% or more but less than 40%	Less than 40%	
India	-	44	177870	177914	-	330	173940	174270
Chattisgarh	-	-	3797	3797	-	-	-	-
Jharkhand	-	-	9636	9636	-	-	9543	9543
Karnataka	-	-	1742	1742	-	-	1742	1742
Kerala	-	-	220	220	-	-	--180	180
Odisha	-	44	148	192	-	330	148	478
Tamil Nadu	-	-	162327	162327	-	-	162327	162327

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; Nuapada & Balangir districts in Odisha; and Madurai & Sivaganga 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 Sivaganga 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 Sivaganga district, Tamil Nadu.

BENEFICIATION

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), Sivaganga, 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 Sivaganga 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.

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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. (+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 2018-19 was 23,000 tonnes which showed a decline of about 68 % as compared to preceding year. Out of the total consumption in 2018-19, Chemical Industry accounted for 13,800 tonnes (60%), Foundry Industry 5,600 tonnes (24%), Graphite products (Crucible, Pencil etc.) 2000 tonnes (9%), Others (Dry Cell battery, cement, Iron & Steel, Paint, paper etc.) 1100 tonnes (5%) and Refractory Industry 500 tonnes (2%). Industrywise consumption data are provided in Table - 7.

**Table - 7 : Consumption* of Graphite
2016-17 to 2018-19
(By Industries)**

Industry	(In tonnes)		
	2016-17	2017-18 (R)	2018-19(P)
All Industries	67600	71700	23000
Chemicals	9700	13800	13800
Foundry	4800	4800	5600
Graphite products (Crucible, Pencil, etc.)	48500	50400	2000
Refractory	3000	1200	500
Others (Dry cell battery, cement, Iron & steel, paint, paper, etc.)	1600	1500	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

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 reserves. However, world reserves of graphite have been placed at 300 million tonnes of which Turkey accounts for 30% followed by China & Brazil 24%, Mozambique 8%, Tanzania 6%, India & Vietnam (3% each) and Mexico, Dem. P. R. of Korea & Madagascar (1% each) (Table-8).

World production of graphite was 1.0 million tonnes in 2018 same as in the preceding year. China continued to be the leading producer, with a share of about 63% which is followed by Mozambique (11%), Brazil (10%) and India & Dem. P.R of Korea (4% each) (Table-9).

Canada was the leading country for natural graphite development with a favourable outlook for new mines. Eight companies reportedly were exploring for graphite.

Mozambique was second leading producing country followed by Brazil which provided new natural graphite supply with a new mine producing 40,000 tonnes per year.

**Table – 8 : World Reserves of Graphite (Natural)
(By Principal Countries)**

Country	Reserves
World : Total (rounded off)	300000
Brazil	72000
China	73000
India*	8000
Korea, Dem. P.R	2000
Madagascar	1600
Mexico	3100
Mozambique	25000
Norway	600
Tanzania	18000
Turkey	90000
Vietnam	7600

Source: USGS Mineral Commodity Summaries, 2020

*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

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

(In '000 tonnes)

Country	2016	2017	2018
World Total	900	1000	1000
China ^{de}	550	625	630
Mozambique	1	1	107
Brazil ^b	62	80	97
Korea, Dem. P.R. ^c	50	140	40
*India ^{ac}	122	34	39 ^e
Austria ^{ai}	23	24	25
Russia	19	25	18
Ukraine	15	15	15 ^e
Canada	16 ^e	14	13
Norway	10	10 ^e	10 ^e
Other countries	30	26	20

Source: BGS World Mineral Production, 2014-18,

e: Estimated

a: Crude

b: Including beneficiated and directly shipped material

c: Years ended 31 March following that stated

d: Including flake graphite

i: Sales

** India's production of graphite during 2016-17, 2017-18 and 2018-19 was at 122 thousand tonnes, 34 thousand tonnes and 39 thousand tonnes respectively.*

FOREIGN TRADE

Exports

In 2018-19, exports of graphite (natural) drastically decreased by 55% to 405 tonnes as compared to 910 tonnes in the previous year. Graphite (natural) was exported mainly to Tanzania (47%), Bangladesh (10%), Iraq & Germany (4% each), Mauritius (3%) Malaysia & Nepal (2% each) and Egypt, Sri Lanka & Indonesia (1% each).

The exports of graphite (artificial) increased by 33% to 31,594 tonnes in 2018-19 from 23,693 tonnes in the previous year. Graphite (artificial) was exported mainly to Germany (29%), USA (20%), Bhutan (14%), Iran & Kuwait (6% each), UAE (5%), Oman & Bangladesh (4% each).

The exports of graphite crucibles drastically decreased by 5% to 56 tonnes in 2018-19 from 113 tonnes in the preceding year, while those of silicon carbide crucibles also decreased by 12% to 3,128 tonnes in 2018-19 from 3,549 tonnes in the previous year. Silicon carbide crucibles were exported mainly to UAE (12%), Iran (11%), USA, Egypt & Turkey (7% each), Germany (6%), Thailand, UK & South Africa (4% each) and Republic of Korea (3%). Exports of graphite bricks and shapes increased to 597 tonnes in 2018-19 from 292 tonnes in the preceding year. Graphite bricks and shapes were mainly exported to Bangladesh (85%), Ethiopia (9%) and Australia (3%) (Tables - 10 to 14).

Imports

Imports of graphite (natural) increased marginally by 18% to 47,053 tonnes in 2018-19 from 39,863 tonnes in the preceding year. Graphite (natural) was imported mainly from China (74%), Madagascar (11%), Mozambique (9%) and Brazil (3%).

Imports of graphite (artificial) also increased slightly by 2% to 68,289 tonnes in 2018-19 from 67,225 tonnes in the previous year. Imports of graphite (artificial) were mainly from China (47%), Malaysia (8%), Germany & UAE (7% each), Norway (6%), Japan (4%), France (3%), Poland & USA (2% each) and Republic of Korea (1%).

Imports of graphite bricks and shapes drastically decreased by 99% to 9 tonnes in 2018-19 from 811 tonnes in the preceding year. Imports of graphite bricks and shapes were mainly from China (89%) and remaining share was contributed by Germany. Imports of graphite crucibles increased more than threefold to 79 tonnes in 2018-19 from 25 tonnes in the preceding year. Baharian was the main supplier with 95% share. Imports of silicon carbide crucibles decreased by 62% to 48 tonnes in 2018-19 from 125 tonnes in the previous year. Imports were mainly from USA (54%) and Japan (17%). (Tables - 15 to 19).

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**Table – 10 : Exports of Graphite (Natural)
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	910	77567	405	22958
Tanzania	120	5294	190	8363
Bangladesh	441	9426	42	2083
Germany	20	2121	17	1530
Mauritius	++	12	12	1409
Malaysia	++	31	10	1207
Sri Lanka Dsr	6	937	5	1073
Egypt A Rp	-	-	6	933
Indonesia	5	990	4	836
Iraq	-	-	18	834
Nepal	14	596	9	787
Other countries	304	58161	91	3906

Figures rounded off

**Table – 11: Exports of Graphite (Artificial)
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	23693	2135615	31594	3745543
Germany	5465	710196	9301	1880231
USA	5018	557569	6338	728170
Bhutan	3931	146151	4431	214923
UAE	177	135896	1704	130022
Kuwait	1566	60620	1863	106600
Iran	1408	61748	1874	96211
Bangladesh	855	29297	1157	68299
Oman	1072	40793	1316	60800
UK	602	56078	413	50774
Spain	13	13684	43	42143
Other countries	3585	323582	3153	367370

Figures rounded off

**Table– 12 : Exports of Graphite Bricks & Shapes
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	292	7745	597	5707
Bangladesh	2	973	510	3289
Australia	-	-	20	964
Jordan	++	128	4	666
Ethiopia	-	-	56	445
Argentina	-	-	5	243
Uganda	-	-	2	100
Indonesia	-	-	++	1
Italy	1	1516	-	-
China	6	1065	-	-
Cameroon	100	970	-	-
Other countries	183	3093	++	++

Figures rounded off

**Table – 13 : Exports of Graphite Crucibles
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	113	5496	56	6888
USA	32	3048	10	3645
Ethiopia	5	86	29	2198
Saudi Arabia	-	-	5	513
Iraq	-	-	10	381
UAE	20	1049	++	50
Mexico	-	-	++	30
Nepal	7	131	1	28
Hong Kong	-	-	++	21
Spain	-	-	1	20
Uganda	++	31	++	2
Other countries	49	1151	++	++

Figures rounded off

GRAPHITE

**Table – 14 : Exports of Silicon Carbide Crucibles
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	3549	595149	3128	671354
USA	225	57643	214	66770
Iran	580	92073	345	64994
UAE	200	35643	391	64722
Egypt	213	47410	208	58853
Turkey	294	40176	222	51117
South Africa	116	33315	130	49683
Germany	230	36545	176	42360
Korea, Rep. of	102	26015	106	34539
Thailand	111	19234	134	24896
UK	302	19988	134	19690
Other countries	1176	187105	1068	193729

Figures rounded off

**Table – 15 : Imports of Graphite (Natural)
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	39863	1487947	47053	2328882
China	34253	1106728	34742	1489400
Madagascar	1987	120688	4950	349377
Mozambique	-	-	4444	187986
Brazil	2367	135891	1476	104257
Germany	151	25535	179	64856
USA	272	42740	398	45654
UK	24	1989	215	17460
Sri Lanka	72	10845	82	12942
Italy	13	1991	70	10657
Japan	8	3279	16	8740
Other countries	716	38261	481	37283

Figures rounded off

**Table – 16 : Imports of Graphite (Artificial)
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	67225	6250259	68289	6739305
China	31937	2868759	31834	3116539
Germany	2541	517648	4542	1006832
Japan	799	254989	2989	848593
France	2080	293360	2311	324491
Norway	3898	185284	4409	255901
UAE	-	-	4580	234122
USA	679	132455	1147	193751
Poland	11484	1478986	1583	163002
Malaysia	10531	195230	5683	147026
Korea, Rep. of	276	29605	524	71341
Other countries	3000	293943	8687	377707

Figures rounded off

GRAPHITE

**Table – 17 : Imports of Graphite Bricks & Shapes
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	811	86383	9	10434
Germany	-	-	1	4960
China	-	-	8	4607
Japan	709	78145	++	867
Turkey	99	7125	-	-
USA	3	1113	-	-

Figures rounded off

**Table – 18 : Imports of Graphite Crucibles
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	25	4024	79	10195
China	2	708	3	7358
Italy	14	1742	++	1564
Baharain	-	-	75	645
Germany	3	628	1	346
Japan	5	742	++	222
Bulgaria	1	12	++	57
UAE	-	-	++	2
France	-	-	++	1
Thailand	++	192	-	-

Figures rounded off

**Table – 19 : Imports of Silicon Carbide Crucibles
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
All Countries	125	21681	48	8628
USA	42	9333	26	2930
Italy	8	627	++	1415
Germany	27	2771	3	1329
Japan	26	4911	8	588
UK	5	1050	++	530
China	13	897	4	421
Korea, Rep. of	4	1893	++	402
Spain	-	-	5	398
Vietnam	-	-	++	356
Canada	-	-	2	259
Other countries	++	199	-	-

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.

GRAPHITE

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 as well.

Global demand for natural graphite has been forecasted to increase by 37% by 2020. Demand for graphite in lithium-ion batteries for application in electric/hybrid vehicles, laptops, smartphones, home/business applications and traditional uses for expanded graphite foils, are the potential areas that are expected to be major drivers in the market. It represents 23% of global flake graphite demand. Battery demand for graphite is forecasted to double in the next six years.