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GRAPHITE

(FINAL RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

Indira Bhavan, Civil Lines,
NAGPUR – 440 001

PHONE/FAX NO. (0712) 2565471
PBX : (0712) 2562649, 2560544, 2560648
E-MAIL : cme@ibm.gov.in
Website: www.ibm.gov.in

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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 crystalise in hexagonal system and occurs in layered & lamellar form with grey-to-black metallic lustre and a greasy feel. Natural graphite is categorised into two commercial varieties (i) crystalline (flaky) graphite and (ii) amorphous graphite. Both flaky and amorphous varieties of graphite are produced in India. The quality of graphite depends upon its physical qualities and carbon content. Besides natural graphite, there is synthetic or artificial graphite which is manufactured on a large-scale in electric furnaces, using anthracite or petroleum coke as raw feed.

RESERVES/RESOURCES

Graphite occurrences are reported from various States but the deposits of economic importance are located in Chhattisgarh, Jharkhand, Odisha and Tamil Nadu.

As per NMI database, based on the UNFC system, the total reserves/resources of graphite as on 1.4.2015 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 given in the review on Exploration & Development in "General Review".

PRODUCTION & STOCKS

Production of graphite at about 33558 tonnes in 2017-18 decreased by 73% as compared to that in the preceding year.

There were 9 reporting mines in 2017-18 and in the previous year also. Five principal producers accounted for 100% during the year.

About 70% of the total production in 2017-18 was accrued from two mines, each producing more than 5000 tonnes annually, while 30% was contributed by seven mines in the production range of 100 to 5000 tonnes per annum.

Jharkhand was the leading producing state contributing 56% to the total output during 2017-18, followed by Odisha and Kerala.

Mine-head closing stock in the year 2017-18 was 173784 tonnes as against 186603 tonnes in the previous year.

The average daily employment of labour during 2017-18 was 384 against 162 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 (A+B)
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
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	1450550	4173555	39262	445703	1959747	5520	1856563	6639828	2440208	13386831	17560386
Karnataka	-	-	-	-	140827	18750	48821	-	41605	149403	-	399406	399406
Kerala	-	-	16518	16518	-	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

Table – 2: Principal Producers of Graphite, 2017-18

Name & address of producer	Location of mine	
	State	District
Sishir Kumar Poddar, 4L, Shree Gopal Complex, Court Road, Ranchi - 834001, 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
Thomson Graphite & Crucible Works, Rajbhavan, Company Mukku Vellanad, P.O. Nedumangad Thiruvananthapuram -695 543, Kerala.	Kerala	Ernakulam

Table – 3: Production of Graphite, 2015-16 to 2017-18
(By States)

(Qty in tonnes; Value in `'000)

State	2015-16		2016-17		2017-18 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**135528**	**106487**	**122438**	**94158**	**33558**	**25656**
Jharkhand	36270	22914	10343	11450	18734	17094
Kerala	650	5200	660	5280	150	1200
Odisha	7783	4865	16374	10684	14674	7362
Tamil Nadu	90825	73508	95061	66744	-	-

Table – 4: Production of Graphite, 2016-17 and 2017-18 (By Sectors/States/Districts)

(Qty in tonnes;Value in ` '000)

State/District	2016-17			2017-18 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**9**	**122438**	**94158**	**9**	**33558**	**25656**
Public Sector	1	92901	65125	1*	-	-
Private Sector	8	29537	29033	8	33558	25656
Jharkhand	**1**	**10343**	**11450**	**2**	**18734**	**17094**
Latehar	-	-	-	1	4644	2624
Palamu	1	10343	11450	1	14090	14470
Karnataka	**1***	**-**	**-**	**-**	**-**	**-**
Mysuru	1*	-	-	-	-	-
Kerala	**1**	**660**	**5280**	**1**	**150**	**1200**
Ernakulam	1	660	5280	1	150	1200
Odisha	**4**	**16374**	**10684**	**5**	**14674**	**7362**
Nawapara	4	16374	10684	4	14674	7362
Raygada	-	-	-	1	-	-
Tamil Nadu	**2**	**95061**	**66744**	**1***	**-**	**-**
Madurai	1	2160	1620	-	-	-
Sivaganga	1	92901	65124	1*	-	-

** : Only labour reported during the year*

Table – 5 : Production of Graphite, 2016-17 & 2017-18 (By Frequency Groups)

(Qty in tonnes)

Production group	No.of mines		Production for the group		Percentage in total production		Cumulative percentage	
	2016-17	2017-18 (P)	2016-17	2017-18 (P)	2016-17	2017-18 (P)	2016-17	2017-18 (P)
India	**9**	**9**	**122438**	**33558**	**100.00**	**100.00**	**-**	**-**
Up to 1000	3	5	660	992	0.54	2.96	0.54	2.96
1001 to 2000	1	-	1806	-	1.48	-	2.02	-
2001 to 5000	1	2	2160	9022	1.76	26.88	3.78	29.84
5001 to 10000	2	1	14568	9454	11.90	28.17	15.68	58.01
Above 10000	2	1	103244	14090	84.32	41.99	100.00	100.00

Table – 6: Mine-head Closing Stocks of Graphite, 2016-17 & 2017-18 (By States)

(In tonnes)

State	2016-17	2017-18
India	**186603**	**173784**
Chhattisgarh	3942	-
Jharkhand	7318	9636
Karnataka	8186	1742
Kerala	110	130
Odisha	4567	192
Tamil Nadu	162480	162084

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 Senthiudayanathapuram 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.

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.

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	8-10	85% 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.	Amorph-ous 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 2017-18 was 41,200 tonnes which was decreased by about 39% as compared to preceding year. Out of the total consumption in 2017-18, graphite products (Crucible/Pencil Industry) accounted for 22,900 tonnes (56%), Chemical Industry 13,800 tonnes (33%), Refractory Industry for 1,200 tonnes (3%) and remaining by Alloy Steel & Foundry Industry. Industry wise consumption data are provided in Table - 7.

Table - 7 : Consumption* of Graphite 2015-16 to 2017-18 (By Industries)

(In tonnes)

Industry	2015-16	2016-17 (R)	2017-18(P)
All Industries	**58000**	**67600**	**41200**
Chemicals	17800	9700	13800
Foundry	1300	4800	2600
Graphite products (Crucible, Pencil, etc.)	29300	48500	22900
Refractory	7000	3000	1200
Others (Dry cell battery, cement, Iron & steel, paint, paper, etc.)	2600	1600	700

Figures rounded off

**Includes actual reported consumption and/or estimates made wherever required and due to paucity of data, consumption may not be complete*

Apparent consumption of Graphite is about 71,200 tonnes during 2017-18

SUBSTITUTION

In principle, it is possible to substitute graphite by either its 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.

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 Brazil 24%, China 24%, Mozambique & Tanzania (6% each) and India 1% (Table-8).

World production of graphite was 1.21 million tonnes in 2017. China continued to be the leading producer, with a share of about 88% which is followed by Brazil (8%) and India (3%) (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.

Brazil was the second leading country providing new natural graphite supply with a new mine producing 40,000 tonnes per year.

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

(In '000 tonnes)

Country	Reserves
World : Total *(rounded off)*	**300000**
Brazil	72000
China	73000
India*	8000
Madagascar	1600
Mexico	3100
Mozambique	17000
Tanzania	17000
Turkey	90000

Source: *Mineral Commodity Summaries, 2019*
Reserves in Canada, Korea, Dem P.R., Russia, Norway, Sri Lanka, Ukraine, Vietnam and Zimbabwe, etc, are included in the World total

**India's reserves of graphite as per NMI database, based on UNFC system as on 1.4.2015 have been placed at about 7960 thousand tonnes*

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

(In '000 tonnes)

Country	2015	2016	2017
World Total (rounded)	**1026**	**1197**	**1217**
Austria[ae]	21e	22	21[e]
Brazil[c]	82e	75	82
Canada[e]	30	30	30
China[ed]	900	860	900
India[ac]	34	136	122
Korea, Dem. P.R.[e]	10	10	10
Mexico	10	7	10
Russia	14[e]	16	19
Ukraine	14	15	15
Zimbabwe	2	6	6
Other countries	43	35	25

Source: *World Mineral Production, 2013-17, BGS*
e: Estimated
a: Crude
c: Including beneficiated and directly shipped material
d:Including flake graphite

FOREIGN TRADE

Exports

In 2017-18, exports of graphite (natural) drastically increased to 910 tonnes as compared to 402 tonnes in the previous year. Graphite (natural) was exported mainly to Bangladesh (48%), Tanzania (13%), Kuwait (7%), Canada (5%), Saudi Arabia (4%) and Sudan (3%).

The exports of graphite (artificial) increased to 23,693 tonnes in 2017-18 from 18,181 tonnes in the previous year. Graphite (artificial) was exported mainly to Germany (23%), USA (21%), Bhutan (17%), Kuwait (7%), Iran (6%), Saudi Arabia and Oman (5% each).

The exports of graphite crucibles drastically increased to 118 tonnes in 2017-18 from 12 tonnes in the preceding year, while those of silicon carbide crucibles decreased to 3,556 tonnes in 2017-18 from 5,083 tonnes in the previous year. Silicon carbide crucibles were exported mainly to Iran (16%), UK & Turkey (8% each) and Germany, USA, Egypt & UAE (6% each). Exports of Graphite Bricks and Shapes increased to 295 tonnes in 2017-18 from 88 tonnes in the preceding year. Graphite Bricks and Shapes were mainly exported to Cameroon (34), Kenya (24%), Nigeria (16%) and Tanzania (12%) (Tables - 10 to 14).

Imports

Imports of graphite (natural) increased marginally to 39,863 tonnes in 2017-18 from 37,046 tonnes in the preceding year. Graphite (natural) was imported mainly from China (86%), Brazil (6%) and Madagascar (5%).

Imports of Graphite (artificial) increased substantially to 67,225 tonnes in 2017-18 from 43,768 tonnes in the previous year. Imports of graphite (artificial) were mainly from China (48%), Poland (17%), Malaysia (16%), Norway (6%), Germany (4%) and France (3%).

Imports of Graphite Bricks and Shapes drastically increased to 811 tonnes in 2017-18 from 46 tonnes in the preceding year. Imports of Graphite Bricks and Shapes were mainly from Japan (87%) and Turkey (12%). Imports of graphite crucibles decreased to 26 tonnes in 2017-18 from 71 tonnes in the preceding year. Italy was the main supplier with 54% share followed by Japan (19%), Germany (12%) and China (8%). Imports of silicon carbide crucibles decreased marginally to 126 tonnes in 2017-18 from 161 tonnes in the previous year. Imports were mainly from USA (33%), Germany & Japan (21% each) and China (10%) (Tables - 15 to 19).

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**402**	**30315**	**910**	**77567**
UAE	101	8255	++	40628
Bangladesh	8	770	441	9426
Tanzania	95	3754	120	5294
Qatar	21	1748	15	3262
Kuwait	88	6089	63	2971
Canada	3	1753	45	2419
Germany	++	208	20	2121
Sudan	22	992	28	1557
Saudi Arabia	-	-	35	1082
Indonesia	4	855	5	990
Other countries	60	5891	138	7817

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**88**	**4713**	**295**	**7746**
Italy	-	-	1	1516
China	-	-	6	1065
Bangladesh	-	-	2	973
Cameroon	-	-	100	970
Kenya	-	-	70	892
Tanzania	52	274	35	683
Nigeria	5	80	46	459
Vietnam	-	-	7	335
Mexico	-	-	1	229
Zimbabwe	-	-	7	177
Other countries	31	4359	20	447

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**18181**	**1600571**	**23693**	**2135591**
Germany	4125	528758	5465	710177
USA	2106	292010	5018	557569
Bhutan	2653	68676	3931	146151
UAE	55	7598	177	135896
Iran	2440	79177	1408	61748
Kuwait	924	32050	1566	60620
UK	179	30049	602	56078
Saudi Arabia	1275	135486	1153	48275
Oman	1637	51799	1072	40793
Belgium	215	75969	108	32205
Other countries	2572	298999	3193	286079

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**12**	**1478**	**118**	**5495**
USA	-	-	32	3048
UAE	-	-	20	1049
Cameroon	-	-	45	861
Bangladesh	9	1082	4	163
Nepal	1	77	7	131
Ethiopia	-	-	5	86
Italy	-	-	1	77
Uganda	-	-	1	31
Ghana	-	-	1	31
Baharain	-	-	1	13
Other countries	2	319	1	5

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**5083**	**639444**	**3556**	**595149**
Iran	600	91527	580	92073
USA	179	49485	225	57643
Egypt	186	42434	213	47410
Turkey	472	53161	294	40176
Germany	220	41102	230	36545
UAE	160	31634	200	35643
South Africa	211	58936	116	33315
Korea, Rep. of	196	52655	102	26015
UK	195	23246	302	19988
Thailand	140	28940	111	19234
Other countries	2524	166324	1183	187107

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**37046**	**1391091**	**39863**	**1487947**
China	31388	993095	34253	1106728
Brazil	2277	126442	2367	135891
Madagascar	2408	132084	1987	120688
USA	372	51073	272	42740
Germany	237	43229	151	25535
Zimbabwe	-	-	384	12950
Sri Lanka	54	7606	72	10845
Canada	21	5012	25	4703
Belgium	37	4802	36	4449
Other countries	252	27748	316	23418

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**43768**	**4137126**	**67225**	**6250259**
China	19581	1235071	31937	2868759
Poland	8978	1074443	11484	1478986
Germany	2172	409896	2541	517648
France	4553	612806	2080	293360
Japan	1034	268129	799	254989
Malaysia	2159	41926	10531	195230
Norway	3488	172072	3898	185284
USA	549	118696	679	132455
Netherlands	559	73500	685	113285
UK	363	31962	509	58441
Other countries	332	98625	2082	151822

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**46**	**17165**	**811**	**86383**
Japan	-	-	709	78145
Turkey	-	-	99	7125
USA	1	13	3	1113
China	44	17145	-	-
Belgium	1	7	-	-

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**71**	**2005**	**26**	**4024**
Italy	64	600	14	1742
Japan	2	627	5	742
China	-	-	2	708
Germany	2	426	3	628
Thailand	-	-	1	192
Bulgaria	1	17	1	12
UK	1	257	-	-
Belgium	1	78	-	-

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**161**	**10432**	**126**	**21681**
USA	78	3165	42	9333
Japan	-	-	26	4911
Germany	22	2244	27	2771
Korea, Rep. of	-	-	4	1893
UK	10	1849	5	1050
China	48	1921	13	897
Italy	-	-	8	627
Singapore	-	-	1	199
Spain	1	201	-	-
Switzerland	2	1052	-	-

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 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.