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GRAPHITE

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GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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25 Graphite

Graphite, also known as plumbago or black lead or mineral carbon is a stable form of naturally occurring carbon structurally, graphite. It crystalises in hexagonal system and is known to occur in layered & lamellar form with a 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 is dependent upon its physical qualities as well as carbon content. In addition to natural graphite, synthetic or artificial graphite is manufactured on a large-scale in electric furnaces, using anthracite or petroleum coke as raw feed.

RESOURCES

Graphite occurrences are reported from various states but the deposits of economic importance are located in Andhra Pradesh, Jharkhand, Karnataka, Kerala, Odisha, Rajasthan and Tamil Nadu.

As per the UNFC system, the total resources of graphite as on 1.4.2010 are placed at about 174.85 million tonnes, out of which 8.03 million tonnes are in the reserves category and 166.82 million tonnes are placed under remaining resources category. Resources containing +40% fixed carbon constitute about 1.11 million tonnes and resources analysing 10-40% fixed carbon constitute 22.69 million tonnes. The balance 151.05 million tonnes fall under 'others', 'unclassified' and 'not-known' grades. Arunachal Pradesh accounts for 42% of the total resources which is followed by Jammu & Kashmir (36%), Jharkhand (7%), Tamil Nadu and Odisha (5% each). However, in terms of reserves, Tamil Nadu has leading share of about 45% followed by Odisha (41%) and Jharkhand (14%) (Table-1).

EXPLORATION & DEVELOPMENT

During 2012-13 GSI carried out reconnaissance survey of Tikri, Gauthana, Chiklar in Betul district of Madhya Pradesh. Detailed mapping was carried out for one sq.km area on 1:2000 scale and large-scale mapping for 75 sq.km area on 1:12,500 scale. Samples collected and analysis showed that more than 50% of the chemical analytical data receipts indicated that the fixed carbon values ranged between 5% and 15.4% while remaining samples contain fixed carbon values between 1% and 5%. Graphite zones traced upto a length of 3.5 km in length with width range of above and 5 to 130 m. were found hosted in quartz mica schist.

PRODUCTION STOCKS & PRICES

Production of graphite at about 132 thousand tonnes in 2012-13 decreased by 14% as compared to that of the preceding year due to fall in demand. The output of graphite is reported in terms of run-of-mine (r.o.m.) which contains varying carbon content.

In all, there were 16 reporting mines in 2012-13 as against 21 in the previous year. Five principal producers accounted for 84% of the total output during the year. The share of public sector in the total output was 53% in 2012-13 as compared to 37% in the previous year.

About 84% of the total production in 2012-13 produced from five mines, each reported more than 5000 tonnes of annual production, while 13% was contributed by six mines, each in the production range of 2000 to 5000 tonnes per annum. The remaining output of 3 percent was reported by 5 mines, each of which produced below 2000 tonnes annually.

Tamil Nadu was the leading state that contributed about 52% of the total output during 2012-13 followed by Jharkhand, Odisha and Karnataka with share of 40%, 5% and 3 percent respectively (Tables- 2 to 5).

Mine-head stock at the end of the year 2012-13 was 110 thousand tonnes as against 88 thousand tonnes in the beginning of the year (Table- 6).

The average daily employment of labour during 2012-13 was 265 against 316 in the preceding year.

Table – 1 : Reserves/Resources of Graphite as on 1.4.2010 (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	**3685172**	**2266174**	**2080518**	**8031864**	**102173**	**1409511**	**3078665**	**224859**	**6603670**	**19736371**	**135662532**	**166817781**	**174849645**
By Grades													
+ 40% F.C.	58050	88770	67950	214770	7811	48157	604891	-	951	237190	-	899000	1113770
10-40% F.C.	3621687	598758	1988468	6208913	86237	477760	2361072	178703	2226024	10512356	636497	16478649	22687562
Others	5435	-	23452	28887	7500	18750	-	-	3300501	3297811	-	6624562	6653449
Unclassified	-	1549549	648	1550197	-	860223	112702	6320	5882	4467502	62107720	67560349	69110546
Not-known	-	29097	-	29097	625	4621	-	39836	1070312	1221512	72918315	75255221	75284318
By States													
Andhra Pradesh	-	-	-	-	-	-	1135	-	124759	301306	-	427200	427200
Arunachal Pradesh	-	-	-	-	-	-	-	-	-	-	72758257	72758257	72758257
Gujarat	-	-	-	-	-	-	-	-	2520805	835000	-	3355805	3355805
Jammu & Kashmir	-	-	-	-	-	-	-	-	-	1059520	61681035	62740555	62740555
Jharkhand	382036	72670	645823	1100529	47073	236783	1666551	2750	1855192	6798641	1203350	11810340	12910869
Karnataka	727	20820	1312	22859	7500	18750	-	-	18200	-	-	44450	67309
Kerala	-	-	-	-	-	8300	17762	134900	1088550	335818	-	1585330	1585330
Madhya Pradesh	-	-	-	-	-	-	-	-	-	1006660	-	1006660	1006660
Maharashtra	-	-	-	-	-	-	-	-	-	1160000	-	1160000	1160000
Odisha	495296	2172684	622933	3290913	-	1106192	1224811	11179	98665	2923002	19890	5383739	8674652
Rajasthan	-	-	-	-	47600	-	165920	-	250000	1450034	-	1913554	1913554
Tamil Nadu	2807113	-	810450	3617563	-	39486	2486	65330	647500	3866390	-	4621192	8238755
Uttarakhand	-	-	-	-	-	-	-	10700	-	-	-	10700	10700

Figures rounded off.

Table – 2 : Principal Producers of Graphite 2012-13

Name & address of producer	Location of mine	
	State	District
Tamil Nadu Minerals Ltd, 31, Kamarajar Salai, Chepauk, Chennai-600 005, Tamil Nadu.	Tamil Nadu	Sivaganga
K. K. Poddar, 3 P, Shree Gopal Complex, Court Road, Ranchi-834 001, Jharkhand.	Jharkhand	Palamu
Orissa Manganese & Minerals, (P) Ltd, Lansdowne Towers, 6th floor, 2/1 A, Sarat Chandra Bose Road, Kolkata,West Bengal.	Jharkhand	Palamu

(Contd.)

Table - 2 : (Concld.)

Name & address of producer	Location of mine	
	State	District
Hemant Kumar Poddar, 4L, Shree Gopal Complex, Court Road, Ranchi-834 001, Jharkhand.	Jharkhand	Palamu
T.P. Minerals Pvt. Ltd, Hospital Road, Sambalpur, Odisha.	Odisha	Rayagada

Table – 3 : Production of Graphite, 2010-11 to 2012-13 (By States)

(Qty in tonnes; value in ₹'000)

State	2010-11		2011-12(R)		2012-13(P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**115697**	**50380**	**153339**	**69449**	**132156**	**68052**
Jharkhand	45146	14995	76175	31565	53276	24129
Karnataka	-	-	-	-	3241	3889
Odisha	20472	10394	18859	8793	6530	3719
Tamil Nadu	50079	24991	58305	29091	69109	36315

Table – 4 : Production of Graphite, 2011-12 and 2012-13 (By Sectors/States/Districts)

(Qty in tonnes; value in ₹ '000)

State/District	2011-12 (R)			2012-13 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**21**	**153339**	**69449**	**16**	**132156**	**68052**
Public sector	1	57205	28603	2	69477	36775
Private sector	20	96134	40846	14	62679	31277
Chhattisgarh	**1***	-	-	-	-	-
Surguja	1*	-	-	-	-	-
Jharkhand	**12**	**76175**	**31565**	**10**	**53276**	**24129**
Latehar	1	2885	1226	1	2120	901
Palamu	11	73290	30339	9	51156	23228
Karnataka	-	-	-	**1**	**3241**	**3889**
Mysore	-	-	-	1	3241	3889
Odisha	**6**	**18859**	**8793**	**3**	**6530**	**3719**
Bolangir	3	542	352	1*	-	-
Nawapara	1	4338	1627	1	810	304
Rayagada	2	13979	6814	1	5720	3415
Tamil Nadu	**2**	**58305**	**29091**	**2**	**69109**	**36315**
Madurai	1	1100	488	1	1150	522
Sivaganga	1	57205	28603	1	67959	35793

** : Only labour reported during the year.*

Table – 5 : Production of Graphite, 2011-12 & 2012-13 (p)
(By Frequency Groups)

(Qty in tonnes)

Production group	No.of mines		Production for the group		Percentage In total production		Cumulative percentage	
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
India	**21**	**16**	**153339**	**132156**	**100.00**	**100.00**	–	–
Up to 1000	8	3	1396	1177	0.91	0.89	0.91	0.89
1001-2000	3	2	3359	2668	2.19	2.02	3.10	2.91
2001-5000	3	6	11579	17888	7.55	13.54	10.65	16.45
5001-10000	3	3	23889	17556	15.58	13.28	26.23	29.73
Above 10000	4	2	113116	92867	73.77	70.27	100.00	100.00

Table – 6 : Mine-head Stocks of Graphite, 2012-13 (P)
(By States)

(In tonnes)

State	At the beginning of the year	At the end of the year
India	**87722**	**110345**
Chhattisgarh	3747	4449
Jharkhand	13442	8462
Karnataka	13108	5912
Odisha	10296	25596
Tamil Nadu	47129	65926

MINING & MARKETING

Graphite mines are mostly small and opencast barring a few underground mines. Water seepage beyond 6 m depth is the main problem faced by almost all mine owners in Odisha.

Active mining centres of graphite are in Latehar & Palamu districts in Jharkhand; Bargarh, Nuapada, Rayagada & Bolangir districts in Odisha; and Madurai & Sivaganga districts in Tamil Nadu. In Jharkhand, mining activities are concentrated mostly around village Sokara in Palamu district. It is a disseminated deposit of flaky graphite containing 5 to 20% F.C. In Odisha, areas in and around Bolangir are the chief mining centres where several graphite grades are produced. At Bolangir, 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, analysing up to 40% F.C. in the past.

Graphite of Bolangir and Sambalpur districts 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.

BENEFICIATION

Graphite occurs generally admixed with the 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.

The r.o.m. containing and average of about 10% F.C. has to be invariably beneficiated before marketing. Indigenously fabricated equipment is used generally to upgrade the r.o.m. 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 (r.o.m.). 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. is also used.

Tamil Nadu Minerals Ltd (TAMIN) produced flaky graphite from a mine in Sivaganga district in Tamil Nadu. The beneficiation plant located adjacent to the mine site is designed to produce 9,240 tpy of natural graphite concentrate containing 96% F.C. with 92% recovery from r.o.m. Some of the beneficiation plants are Chhota 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.

USES & SPECIFICATIONS

Traditional uses of graphite are in crucibles, foundries, pencils, etc. More sophisticated applications of graphite are in refractories, expanded graphite-based sealing gaskets, graphitised grease, braid, brushes, brake lining, etc. It is also used in a 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. It does not peel off as flakes and on drying, it 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, thermol conductor, electircal conductor, UV shield, electromagnetic pulse shield, corrosion shield and pigment. It is also used as moderator in nuclear reactors.

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
Recarburisation of steel	100	99%	Micronised
Colloidal graphite	100	99.9%	Colloidal

CONSUMPTION

Consumption data on beneficiated graphite concentrates are not available. As per the information received from various graphite consuming units and estimates, the consumption of various grades of graphite during 2010-11 to 2012-13 ranged from 40,700 tonnes to 52,700 tonnes. Out of the total reported consumption in 2012-13, the Crucible Industry accounted for 34,700 tonnes (66%), the Refractory industry for 7,300 tonnes,(14%) and Foundry industry 1,000 tonnes (2%). Industry wise consumption data are reflected in Table- 7.

Table - 7 : Consumption of Graphite 2010-11 to 2012-13 (By Industries)

(In tonnes)

Industry	2010-11	2011-12(R)	2012-13(P)
All Industries	**40700**	**45700**	**52700**
Dry cell battery	400(3)	400(3)	400(3)
Electrode	600(6)	600(8)	600(10)
Foundry (e)++	1000(6)	1000(6)	1000(6)
Graphite products (Crucible) (e) ++	30100(4)	34700(4)	34700(6)
Graphite products (pencil)	500(1)	500(1)	500(1)
Refractory	7400(25)	7800(25)	7300(27)
Others (asbestos products, chemicals, paint, paper, pesticide, pharmaceuticals, and rubber)	700(17)	700(17)	8200(18)

Figures rounded off.

Figures in parentheses denote the number of units in organised sector reporting consumption.*

*(*Includes actual reported consumption and/or estimates made wherever required).*

Excludes consumption of graphite for beneficiation purposes estimated at 1,40,100 tonnes approximately.

(e)++ Based on the information by The All India Graphite Crucible Manufacturers Association, Rajahmundry (Andhra Pradesh) and field survey data of Samalkot/ Rajahmundry area.

WORLD REVIEW

The world inferred resources of graphite are believed to exceed 800 million tonnes of recoverable reserves. However, world reserves of graphite have been placed at 130 million tonnes of which Brazil accounts for 45% followed by China (42%) and India (8%) (Table-8).

World production of graphite was 2.1 million tonnes in 2012. China continued to be the leading producer, with a share of about 86% which is followed by India (6%) and Brazil (4%) (Table-9).

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

Brazil was the second leading country providing new natural graphite supply with a new new 40,000 metric per year mine being considered by Magnesite Refractarios SA.

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

(In '000 tonnes)

Country	Reserves
World : Total (rounded)	**130000**
Brazil	58000
China	55000
India*	11000
Madagascar	940
Mexico	3100
USA	-

Source: *Mineral Commodity Summaries, 2014. Reserves in Canada, Korea, Dem P.R., Russia, Norway, Sri Lanka, Turkey, Ukraine and Zimbabwe are included with World total.*

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

(In '000 tonnes)

Country	2010	2011	2012
World : Total	**2150**	**2150**	**2101**
Brazil @	92	105	80
Bosnia & Herzegovina	145	NA	NA
Canada[(e)]	20	20	20
China[(e) #]	1800	1800	1800
India *	116	149	129
Korea, Dem. P.R. of	30	30	30
Madagascar	4	4	3
Mexico	7	7	7
Norway	6	8	7
Russia[(e)]	14	14	14
Sri Lanka	3	3	3
Ukraine[(e)]	3	1	4
Zimbabwe	1	7	4
Other countries	9	2	-

Source: *World Mineral Production, 2008-2012*
@ Including beneficiated and directly shipped material.
 # Including flake graphite.
** Crude.*

FOREIGN TRADE

Exports

In 2012-13, exports of graphite (natural) were at 2,304 tonnes as compared to 1,683 tonnes in the previous year. Graphite (natural) was exported mainly to Bangladesh (36%), Japan (19%), Germany (10%), UK (8%) and Netherlands (7%). The exports of graphite (artificial) decreased marginally to 23,631 tonnes in 2012-13 from 26,154 tonnes in the previous year. Graphite (artificial) was exported mainly to USA (27%), Germany (26%) and Iran (13%).

The exports of graphite crucibles increased considerably to 2,290 tonnes in 2012-13 from 699 tonnes in the preceding year, while those of silicon carbide crucibles decreased drastically to 4,029 tonnes from 21,897 tonnes in the previous year. Italy was the main buyer of graphite crucibles followed by Uganda and Bangladesh. Silicon carbide crucibles were exported mainly to Iran, UK, Rep. of Korea, Germany, USA and Egypt. Exports of graphite bricks and shapes were at 37 tonnes in 2012-13 compared to 149 tonnes in the preceding year. Graphite bricks and shapes were mainly exported to Sri Lanka, Rep. of Yemen and Chile (Tables - 10 to 14).

Imports

Imports of graphite (natural) increased marginally to 19,871 tonnes in 2012-13 from 19,287 tonnes in the preceding year. Imports of graphite (artificial) decreased marginally to 27,212 tonnes in 2012-13 from 31,415 tonnes in the previous year. Graphite (natural) was mainly imported from China (83%). Imports of graphite (artificial) were mainly from China (61%), France (11%) and Norway (9%).

Imports of graphite bricks and shapes decreased to 109 tonnes in 2012-13 from 389 tonnes in the preceding year. Imports were mainly from Japan and China. Imports of graphite crucibles decreased considerably to 3,554 tonnes in 2012-13 from 5,348 tonnes in the preceding year. China was the main supplier with 97% share. Imports of silicon carbide crucibles decreased substantially to 476 tonnes in 2012-13 as compared to 2,074 tonnes in the previous year. Imports were mainly from UK (30%), Germany (27%) and USA (17%) (Tables - 15 to 19).

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

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**1683**	**101327**	**2304**	**155340**
Germany	444	29643	228	32233
UK	277	22982	176	28356
Japan	88	6194	442	25742
Netherlands	49	7133	156	25373
Turkey	-	-	54	11365
Australia	16	2572	24	4857
China	10	691	56	4372
Nepal	114	336	6	4298
Bangladesh	100	6391	821	3887
New Zealand	-	-	14	2921
Other countries	585	25385	327	11936

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

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value ('₹ 000)
All Countries	**26154**	**2601571**	**23631**	**2352371**
Germany	9054	1407821	6196	1214162
USA	6202	475691	6327	352393
Iran	2917	125615	3089	184587
UAE	1581	62120	1243	96275
France	1214	69867	1626	96012
UK	1048	45166	1277	60341
Japan	586	35586	506	44484
Belgium	62	17062	69	25320
Bangladesh	411	14801	947	25244
Sweden	3441	114356	77	23512
Other countries	2638	233486	2274	230041

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

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**149**	**2689**	**37**	**1626**
Chile	-	-	3	1200
UAE	5	92	1	185
Sri Lanka	12	88	25	93
Nepal	-	-	2	91
Yemen, Rep. of	-	-	6	57
Other countries	132	2509	-	-

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

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**699**	**8450**	**2290**	**4644**
Italy	1	52	2248	2683
UK	-	-	6	1408
Bangladesh	2	19	13	451
Jordan	-	-	1	46
Uganda	-	-	21	32
Nepal	8	837	1	24
Other countries	688	7542	-	-

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

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**21897**	**534043**	**4029**	**561122**
Korea, Rep. of	828	60855	379	81165
Iran	2728	70083	424	64282
Egypt	1255	31407	272	50257
South Africa	1573	46289	205	46435
Germany	3077	53418	332	39220
USA	687	39642	298	39117
UK	1465	32201	388	37048
Turkey	338	22248	144	26695
Thailand	166	12125	229	24643
Spain	248	21531	104	21853
Other countries	9532	144244	1254	130407

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

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**19287**	**944259**	**19871**	**1200532**
China	16495	744146	16465	928264
Madagascar	797	50742	1098	78686
Brazil	359	26251	534	47843
Germany	144	18602	256	37523
USA	91	9031	375	31688
Italy	266	30514	234	21067
France	42	1476	119	8725
Angola	--	--	386	7026
Sri Lanka	65	5901	46	5658
Japan	2	1094	27	4641
Other countries	1026	56502	331	29411

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

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**31415**	**2809833**	**27212**	**2844538**
China	23871	1698566	16489	1190131
Japan	488	231099	1668	563228
France	1963	154708	2973	309941
Germany	580	201016	509	208233
Norway	2184	111129	2534	131984
USA	671	96456	238	72263
UK	293	66900	249	66199
Netherlands	420	52735	417	52872
Poland	6	350	619	47078
Italy	156	34600	102	33714
Other countries	783	162274	1414	168895

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

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**389**	**187616**	**109**	**20974**
Japan	2	457	54	13710
China	2	772	35	6657
USA	-	-	20	607
Other countries	385	186387	-	-

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

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**5348**	**238320**	**3554**	**172963**
China	5040	220083	3432	165328
USA	1	306	76	4890
Germany	8	5082	22	1383
France	4	293	7	401
Japan	--	--	7	374
Singapore	--	--	6	313
Korea, Rep. of	80	4930	3	231
Italy	6	144	1	43
Other countries	209	7482	++	1

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

Country	2011-12		2012-13	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**2074**	**97566**	**476**	**29799**
UK	99	5865	142	9016
Germany	344	17086	127	6714
USA	213	7624	81	4636
Italy	39	1010	54	2510
China	1104	54161	22	1946
Japan	31	1028	11	1589
France	1	78	10	1359
Singapore	59	2775	6	774
Spain	3	130	13	601
Czech Rep.	58	2216	4	367
Other countries	123	5593	6	287

FUTURE OUTLOOK

Worldwide demand for combined natural and synthetic graphite is expected to raise along with improvements in the global economic conditions. Demand is also expected to augment further with the development of non-carbon energy applications 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. Consumption of various grades of graphite in the organised sector was in the range of 40,000 to 53,000 tonnes during the last three years. Out of the total consumption, the Refractory Industry accounted for 17% and crucible industries accounted for 76%. The domestic demand of graphite ROM was estimated at 1,35,000 tonnes by 2011-12 and at 2,08,000 tonnes by 2016-17 at 9% growth rate by the Working Group for the 12th Plan, Planning Commission of India.

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. Carbon-composite materials are used in very high technology areas. In the world scenario there rapid diversification in respect of a 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 carrying away 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.