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(Part- III : Mineral Reviews)

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GRAPHITE

(FINAL RELEASE)

**GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES**

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25 Graphite

Graphite, also known as plumbago or black lead, is a variety of naturally occurring carbon. It crystallises in hexagonal system and has a lamellar form, a grey- to-black metallic lustre and greasy feel. Natural graphite is divisible into two commercial varieties: (i) crystalline (flaky) graphite and (ii) amorphous graphite. Both flaky and amorphous varieties of graphite are produced in the country. 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, comprising 8.03 million tonnes in the reserves category and 166.82 million tonnes 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. Balance resources of 151.05 million tonnes fall under 'others', 'unclassified' and 'not-known' grades. Arunachal Pradesh accounts for 42% of total resources, followed by Jammu & Kashmir (36%), Jharkhand (7%), Tamil Nadu & 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

Exploration work has not been reported from GSI or State Directorates of Geology & Mining during 2011-12.

PRODUCTION, STOCKS & PRICES

Production of graphite at about 149 thousand tonnes in 2011-12 increased by 29% as compared to that of the preceding year due to more demand in market. The output of graphite is reported in terms of run-of-mine(r.o.m.) which contains varying carbon content.

In all, there were 19 reporting mines in 2011-12 as against 24 in the previous year. Five principal producers accounted for 82% of the total output during the year. The share of public sector in the total output was 38% in 2011-12 as compared to 43% in the previous year.

About 92% of the total production in 2011-2012 accrued from five mines, each producing more than 5,000 tonnes annually while 5% was contributed by two mines, each in the production range of 2,000 to 5,000 tonnes per annum. The remaining 3% output was reported by 10 mines, each producing below 2,000 tonnes annually.

Jharkhand was the leading state contributing a major share of about 48% of the total output during 2011-12 followed by Tamil Nadu and Odisha contributing 39% and 17%, respectively (Tables - 2 to 5).

Mine-head stocks at the end of the year 2011-12 were 83 thousand tonnes as against 77 thousand tonnes at the beginning of the year (Table-6).

The average daily employment of labour during 2011-12 was 279 as against 313 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.

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**Table – 2 : Principal Producers of Graphite
2011-12**

Name & address of producer	Location of mine	
	State	District
Tamil Nadu Minerals Ltd, 31, Kamarajar Salai, Chepauk, Chennai-600 005, Tamil Nadu.	Tamil Nadu	Sivagangai
K. K. Poddar, Poddar Niket, Bariaju Road, Ranchi, Jharkhand.	Jharkhand	Palamau
Orissa Manganese & Minerals (P) Ltd, 2/1 A, Sarat Bose Road, Kolkata, West Bengal.	Jharkhand	Palamau

(Contd.)

Table - 2 : (Concl.)

Name & address of producer	Location of mine	
	State	District
T.P. Minerals Pvt. Ltd, Hospital Road, Sambalpur, Odisha.	Odisha	Rayagada
Singhania Commercial Co., M. S. Singhania, Jail Road, Daltonganj, Palamau, Jharkhand.	Jharkhand	Palamau

**Table – 3 : Production of Graphite, 2009-10 to 2011-12
(By States)**

(Qty in tonnes; value in ₹'000)

State	2009-10		2010-11(R)		2011-12(P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	124625	53830	115697	50380	148974	66451
Jharkhand	26714	9518	45146	14995	71810	29251
Odisha	46192	18636	20472	10394	18859	8497
Tamil Nadu	51719	25676	50079	24991	58305	28703

**Table – 4 : Production of Graphite, 2010-11 and 2011-12
(By Sectors/States/Districts)**

(Qty in tonnes; value in ₹'000)

State/District	2010-11(R)			2011-12(P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	24	115697	50380	19	148974	66451
Public sector	1	49329	24665	1	57205	28215
Private sector	23	66368	25715	18	91769	38236
Chhattisgarh	-	-	-	1	*	*
Surguja	-	-	-	1	*	*
Jharkhand	10	45146	14995	11	71810	29251
Latehar	1	1920	816	1	2885	1226
Palamau	9	43226	14179	10	68925	28025
Odisha	12	20472	10394	5	18859	8497
Bargarh	4	378	162	-	-	-
Bolangir	4	172	104	2	542	352
Nawapara	1	115522	4321	1	4338	1627
Rayagada	3	8400	5807	2	13979	6518
Tamil Nadu	2	50079	24991	2	58305	28703
Madurai	1	750	326	1	1100	488
Sivagangai	1	49329	24665	1	57205	28215

* : Only labour reported during the year.

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Table – 5 : Production of Graphite, 2010-11& 2011-12(P)
(By Frequency Groups)

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage In total production		Cumulative percentage	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
India	24	19	115697	148974	100.00	100.00	-	-
Up to 500	13	5	622	80	0.54	0.05	0.54	0.05
501-1000	2	2	1454	1316	1.25	0.88	1.79	0.93
1001-2000	1	3	1920	3359	1.66	2.26	3.45	3.19
2001-3000	-	1	-	2885	-	1.94	3.45	5.13
3001-4000	2	-	6914	-	5.98	-	9.43	5.13
4001-5000	1	1	4910	4338	4.24	2.91	13.67	8.04
Above 5001	5	7	99877	136996	86.33	91.96	100.00	100.00

Table – 6 : Mine-head Stocks of Graphite, 2011-12(P)
(By States)

(In tonnes)

State	At the beginning of the year	At the end of the year
India	76640	82733
Chhattisgarh	-	3747
Jharkhand	8425	9489
Karnataka	-	13108
Odisha	32695	9260
Tamil Nadu	35520	47129

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 and Palamau districts in Jharkhand; Bargarh, Nuapada, Rayagada and Bolangir districts in Odisha and Madurai and Sivagangai districts in Tamil Nadu. In Jharkhand, mining activities are concentrated mostly around Sokara village in Palamau 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 being used in producing 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., on an average, containing 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. Few plant owners 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 Sivagainga area, Sivagangai 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 and Graphite Products, Daltonganj; Agrawal Graphite

Industries, Gandhamardhan Graphite Udyog and T. P. Minerals Private Limited, Sambalpur; Tamil Nadu Minerals Ltd (TAMIN), Sivagangai, 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. Graphite is used in bulk for producing certain products. It is also used in a minor amounts as a vital additive for producing other products. Foundry coatings are used to prevent fusion of liquid metal with the sand at the mould or core face. They are applied as coating by spraying or painting in the form of suspension or by dusting or rubbing as dry powders. Good quality graphite which is one of the materials for this purpose, does not peel off in flakes. On drying, it imparts a smooth surface to the casting.

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 by the industry for some uses are as follows:

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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	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
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 2009-10 to 2011-12 ranged from 14,600 tonnes to 45,500 tonnes. Out of total reported consumption in 2011-12, the crucible industry accounted for 34,700 tonnes (76%), refractory 7,600 tonnes (17%) and foundry industry 1,000 tonnes (2%). Industry-wise consumption data are given in Table - 7.

Table – 7 : Reported Consumption of Graphite 2009-10 to 2011-12 (By Industries)

Industry	(In tonnes)		
	2009-10	2010-11(R)	2011-12(P)
All Industries	14600	40700	45500
Dry cell battery	400(3)	400(3)	400(3)
Electrode	600(5)	600(6)	600(7)
Foundry(e)+	1000(6)	1000(6)	1000(6)
Graphite products (Crucible)(e) ++	4600(3)	30100(4)	34700(4)
Graphite products (pencil)	500(1)	500(1)	500(1)
Refractory	6800(23)	7400(25)	7600(25)
Others (asbestos products, chemicals, paint, paper, pesticide, pharmaceuticals, and rubber)	700(17)	700(17)	700(17)

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).

(e)+ Estimated consumption taken from Market Survey conducted by IBM.

Excludes consumption of graphite for beneficiation purposes estimated at 140,000 tonnes approximately.

(e)++Based on the information supplied by The All India Graphite Crucible Manufacturers Association, Rajahmundry (Andhra Pradesh) and field survey to Samalkot/Rajahmundry area by Mineral Economics Division, IBM, in March, 2007 and data received through non-statutory returns.

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 77 million tonnes of which China alone holds 55 million tonnes; i.e., over 71%, followed by India (14%) and Mexico (4%) (Table-8).

World production of graphite was 2.1 million tonnes in 2011. China continued to be the leading producer, having a share of about 86%, followed by India (5%) and Brazil (4%) (Table-9).

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

(In '000 tonnes)	
Country	Reserves
World : Total (rounded)	77000
Brazil	360
China	55000
India*	11000
Madagascar	940
Mexico	3100
Other countries	6600

*Source: Mineral Commodity Summaries, 2013. Figures of Canada, North Korea, Norway, Sri Lanka, Ukraine are included with 'Other countries. *India's total resources of graphite as per National Mineral Inventory as on 1.4.2010 are 175 million tonnes of which 8 million tonnes are categorised as reserves.*

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

(In '000 tonnes)			
Country	2009	2010	2011
World : Total	2223	2145	2135
Brazil @	59	84	90
Bosnia & Herzegovina	134	45	NA
Canada ^(e)	7	20	20
China ^{(e) #}	1800	1800	1800
India *	125	115	143
Korea, Dem. P. R. of	30	30	30
Madagascar	3	4	4
Mexico	5	7	7
Norway	5	6	8
Russia ^(e)	14	14	14
Sri Lanka	3	3	3
Ukraine ^(e)	8	8	8
Zimbabwe	2	1	7
Other countries	28	8	1

*Source: World Mineral Production, 2007-2011
@ Including beneficiated and directly shipped material.
Including flake graphite.
* Crude.*

FOREIGN TRADE

Exports

In 2011-12, exports of graphite (natural) were 1,683 tonnes as compared to 1,205 tonnes in the previous year. Graphite (natural) was exported mainly to Germany (26%), UK (16%), Bangladesh and Kenya (6% each). The exports of graphite (artificial) increased to 29,154 tonnes in 2011-12 from 10,170 tonnes in the previous year. Graphite (artificial) was exported mainly to Germany (35%), USA (24%) and Iran (11%).

The exports of graphite crucibles decreased to 699 tonnes in 2011-12 from 1532 tonnes in the preceding year, while those of silicon carbide crucibles increased to 21,897 tonnes from 18,649 tonnes in the previous year. Syria and Indonesia were main buyers of Graphite crucibles. Silicon carbide crucibles were exported mainly to Germany, Iran, South Africa, UK and Egypt. Exports of graphite bricks and shapes were at 149 tonnes in 2011-12 as compared to 195 tonnes in the preceding year. Graphite bricks and shapes were mainly exported to Nigeria, Angola and Uganda. (Tables - 10 to 14).

Imports

Imports of graphite (natural) increased to 19,287 tonnes in 2011-12 from 14,348 tonnes in the preceding year. Imports of graphite (artificial) also doubled at 31,415 tonnes in 2011-12 from 15,903 tonnes in the previous year. Graphite (natural) was mainly imported from China (86%). Imports of graphite (artificial) were mainly from China (76%), Norway (7%) and France (6%).

Imports of graphite bricks and shapes increased to 389 tonnes in 2011-12 from 215 tonnes in the preceding year. Imports were mainly from Netherlands and Austria. Imports of graphite crucibles decreased to 5,348 tonnes in 2011-12 from 5,743 tonnes in the preceding year. China was the main supplier with 94% share. Imports of silicon carbide crucibles were 2,074 tonnes in 2011-12 as compared to 1,262 tonnes in the previous year. Imports were mainly from China (53%), Germany (17%) and the USA (10%) (Tables - 15 to 19).

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1205	79686	1683	101327
Germany	251	16813	444	29643
UK	218	20930	277	22982
Netherlands	33	4258	49	7133
Bangladesh	–	–	100	6391
Japan	58	2232	88	6194
Italy	127	8320	74	5781
Saudi Arabia	14	556	70	3550
USA	6	934	65	3339
Tanzania Rep.	54	1143	85	3001
Kenya	40	533	95	2629
Other countries	404	23967	336	10684

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	10170	586987	29154	2601571
Germany	272	74266	9054	1407821
USA	1732	90152	6202	475691
Iran	3896	108436	2917	125615
Sweden	328	74898	441	114356
France	246	23332	1214	69867
Netherlands	211	24034	384	62398
UAE	227	11611	1581	62120
UK	419	17450	1048	45166
Japan	94	5192	586	35586
Bhutan	1075	27693	701	21769
Other countries	1670	129923	2026	181182

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	195	4119	149	2689
Nigeria	–	–	48	1628
Argentina	20	181	10	290
Angola	–	–	43	282
Uganda	–	–	28	210
Kenya	–	–	3	99
UAE	20	395	5	92
Sri Lanka	–	–	12	88
Other countries	155	3543	–	–

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1532	36094	699	8450
Oman	–	–	47	2295
Turkey	–	–	19	1579
Indonesia	–	–	135	1376
Syria	–	–	477	1196
Egypt Arab Rep.	–	–	9	1053
Nepal	–	–	8	837
Italy	–	–	1	52
Portugal	–	–	1	43
Bangladesh	–	–	2	19
Other countries	1532	36094	–	–

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	18649	445940	21897	534043
Iran	1339	48485	2728	70083
Korea, Rep. of	882	38765	828	60855
Germany	4384	41241	3077	53418
South Africa	403	28658	1573	46289
USA	3056	31306	687	39642
UK	1243	23650	1465	32201
Egypt	1189	34620	1255	31407
Turkey	455	22756	338	22248
Spain	674	21696	248	21531
France	622	21774	508	21501
Other countries	4402	132989	9190	134868

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	14348	460015	19287	944259
China	12404	357456	16495	744146
Madagascar	720	29247	797	50742
Italy	18	1515	266	30514
Brazil	400	20417	359	26251
Germany	119	15459	144	18602
Ireland	–	–	235	13978
USA	121	10545	91	9031
UK	33	2821	137	8996
Thailand	36	959	180	7668
Sri Lanka	105	8023	65	5901
Other countries	392	13573	518	28430

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	15903	1548569	31415	2809833
China	7526	491808	23871	1698566
Japan	355	90258	488	231099
Germany	687	170299	580	201016
France	989	89025	1963	154708
Norway	1871	89105	2184	111129
USA	746	177767	671	96456
Singapore	48	12871	171	72685
UK	359	65495	293	66900
Netherlands	486	55312	420	52735
Italy	128	21400	156	34600
Other countries	2708	285229	618	89939

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	215	12535	389	187616
Netherlands	100	4911	367	182809
Poland	–	–	7	3055
China	71	1670	2	772
Austria	18	3136	10	502
Belgium	2	218	1	21
Japan	1	31	2	457
Other countries	23	2569	–	–

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	5743	142945	5348	238320
China	5394	138444	5040	220083
Hong Kong	–	–	209	7483
Germany	293	2166	8	5082
Korea Rep. of	–	–	80	4930
USA	13	215	1	3056
France	22	1283	4	292
Italy	–	–	6	144
Other countries	21	837	–	–

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

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1262	45109	2074	97566
China	56	2168	1104	54161
Germany	250	10346	344	17086
USA	185	5823	213	7624
UK	285	12875	99	5865
Mexico	4	216	64	3076
Singapore	16	1268	59	2775
Czech Rep.	127	3315	58	2216
Switzerland	–	–	45	1742
Japan	63	1234	31	1028
Italy	138	1184	39	1010
Other countries	138	6680	18	983

FUTURE OUTLOOK

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 14,000 to 45,500 tonnes during the last three years. Out of the total consumption, the refractory (17%) and crucible industries accounted for 75% of total consumption and foundry industry for 7%. The apparent domestic demand of graphite run of mine is estimated at 135,000 tonnes by 2011-12 and at 208,000 tonnes by 2016-17 at 9% growth rate by the Working Group for the 12th Plan, Planning Commission of India.

Some important higher applications have emerged in exfoliated graphite which are for making sealings, gaskets, braids and brushes. New products of synthetic graphite are graphite fibres/ropes and graphite insulation blankets. Carbon-composite materials are used in very high technology areas. On world scenario, a potential large-volume end-use for natural graphite has emerged in heat sinks, also called spreader shield, which is a graphite foil material conducting 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.