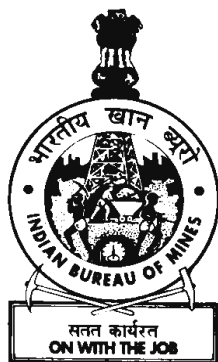


GRAPHITE



# Indian Minerals Yearbook 2014

(Part- III : Mineral Reviews)

**53<sup>rd</sup> Edition**

**GRAPHITE**

**(FINAL RELEASE)**

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**July, 2016**

# 25 Graphite

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**G**raphite, also known as plumbago or black lead 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.

## 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 is 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%), and Tamil Nadu & Odisha (5% each). However, in terms of reserves, Tamil Nadu has the leading share of about 45% followed by Odisha (41%) and Jharkhand (14%) (Table-1).

## EXPLORATION & DEVELOPMENT

During 2013-14, GSI carried out prospecting stage investigation (G-3) in Tikri, Gauthana, Chiklar in Betul district of Madhya Pradesh. Detailed mapping was carried out on 1:2000 scale.

A total of 464.40 m of drilling has been carried out in four boreholes on the southern band which has proved graphite mineralisation for a strike length of 700 m. Thickness of the mineralised zones varies from 6.85 m to 29.69 m, with up to 45 m vertical depth and fixed carbon content varies from 3.30% to 15.71%. The investigation has been completed.

## PRODUCTION STOCKS & PRICES

Production of graphite at about 146 thousand tonnes in 2013-14 increased by 8% as compared to that of the preceding year. The output of graphite is reported in terms of run-of-mine (r.o.m.) which contains varying carbon content.

In all, there were 11 reporting mines in 2013-14 as against 16 in the previous year. Five principal producers accounted for 93% of the total output during the year. The share of the Public Sector in the total output was 60% in 2013-14 as compared to 52% in the previous year.

About 91% of the total production in 2013-14 was produced from four mines, each reported more than 5000 tonnes of annual production, while 8% was contributed by four mines, each in the production range of 2,000 to 5,000 tonnes per annum. The remaining output of one percent was reported by 3 mines, each of which produced below 2,000 tonnes annually.

Tamil Nadu was the leading producing State that contributed a major share of about 61% to the total output during 2013-14 followed by Jharkhand, Odisha, Karnataka and Chhattisgarh with share of 30%, 7%, 2% and 1 percent each respectively (Tables- 2 to 5).

Mine-head closing stock for the year 2013-14 was 116 thousand tonnes as against 111 thousand tonnes in the previous year (Table- 6).

The average daily employment of labour during 2013-14 was 180 against 346 in the preceding year.

Domestic prices of graphite are furnished in the General review on 'Prices'.

**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						
<b>All India : Total</b>	<b>3685172</b>	<b>2266174</b>	<b>2080518</b>	<b>8031864</b>	<b>102173</b>	<b>1409511</b>	<b>3078665</b>	<b>224859</b>	<b>6603670</b>	<b>19736371</b>	<b>135662532</b>	<b>166817781</b>	<b>174849645</b>
<b>By Grades</b>													
+ 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
<b>By States</b>													
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  
2013-14**

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, 3 P. Shree Gopal Complex, Court Road, Ranchi-834 001, Jharkhand.	Jharkhand	Palamu
Shishir Kumar Poddar, Tirupati Carbons & Chemicals Pvt. Ltd. 4L, Shree Gopal Complex, Court Road, Ranchi-834 001 Jharkhand.	Jharkhand	Palamu

Table - 2 (Concl'd.)

Name & address of producer	Location of mine	
	State	District
T.P. Minerals Pvt. Ltd, Hospital Road, Sambalpur-768 002 Odisha.	Odisha	Rayagada
Orissa Manganese & Minerals, (P) Ltd, Lansdowne Towers, 6 <sup>th</sup> floor, 2/1 A, Sarat Chandra Bose Road, Kolkata West Bengal.	Jharkhand	Palamu

(Contd.)

**Table – 3 : Production of Graphite, 2011-12 to 2013-14 (P)  
(By States)**

(Qty in tonnes; value in ₹'000)

State	2011-12		2012-13		2013-14(P)	
	Quantity	Value	Quantity	Value	Quantity	Value
<b>India</b>	<b>153339</b>	<b>69449</b>	<b>134735</b>	<b>84133</b>	<b>146009</b>	<b>81651</b>
Chhattisgarh	-	-	-	-	1403	631
Jharkhand	76175	31565	55855	26636	43717	19494
Karnataka	-	-	3241	3889	2205	2646
Odisha	18859	8793	6530	3816	10139	6308
Tamil Nadu	58305	29091	69109	49792	88545	52572

**Table – 4 : Production of Graphite, 2012-13 and 2013-14 (P)  
(By Sectors/States/Districts)**

(Qty in tonnes; value in ₹'000)

State/District	2012-13			2013-14 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
<b>India</b>	<b>16</b>	<b>134735</b>	<b>84133</b>	<b>11</b>	<b>146009</b>	<b>81651</b>
Public sector	2	69477	50251	2	87995	52279
Private sector	14	65258	33882	9	58014	29372
<b>Chhattisgarh</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1</b>	<b>1403</b>	<b>631</b>
Surguja	-	-	-	1	1403	631
<b>Jharkhand</b>	<b>10</b>	<b>55855</b>	<b>26636</b>	<b>5</b>	<b>43717</b>	<b>19494</b>
Latehar	1	2120	901	-	-	-
Palamu	9	53735	25735	5	43717	19494
<b>Karnataka</b>	<b>1</b>	<b>3241</b>	<b>3889</b>	<b>1</b>	<b>2205</b>	<b>2646</b>
Mysore	1	3241	3889	1	2205	2646
<b>Odisha</b>	<b>3</b>	<b>6530</b>	<b>3816</b>	<b>2</b>	<b>10139</b>	<b>6308</b>
Balangir	1*	-	-	-	-	-
Nuapada	1	810	304	1	3039	1854
Rayagada	1	5720	3512	1	7100	4454
<b>Tamil Nadu</b>	<b>2</b>	<b>69109</b>	<b>49792</b>	<b>2</b>	<b>88545</b>	<b>52572</b>
Madurai	1	1150	522	1	550	292
Sivagangai	1	67959	49270	1	87995	52280

\*: Only labour reported during the year.

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**Table – 5 : Production of Graphite, 2012-13 & 2013-14 (P)**  
(By Frequency Groups)

(Qty in tonnes)

Production group	No. of mines		Production for the group		Percentage In total production		Cumulative percentage	
	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14
<b>India</b>	<b>16</b>	<b>11</b>	<b>134735</b>	<b>146009</b>	<b>100.00</b>	<b>100.00</b>	–	–
Up to 1000	2	2	810	550	0.60	0.38	0.60	0.38
1001-2000	3	1	4502	1403	3.34	0.96	3.94	1.34
2001-5000	6	4	19465	11642	14.45	7.97	18.39	9.31
5001-10000	3	2	17091	16361	12.68	11.21	31.07	20.52
Above 10000	2	2	92867	116053	68.93	79.48	100.00	100.00

**Table – 6 : Mine-head Stocks of Graphite, 2012-13 & 2013-14 (P)**  
(By States)

(In tonnes)

State	2012-13	2013-14 (P)
<b>India</b>	<b>111297</b>	<b>115820</b>
Chhattisgarh	4449	5687
Jharkhand	8741	4430
Karnataka	5912	-
Kerala	-	67
Odisha	26268	4503
Tamil Nadu	65927	101133

## MINING & MARKETING

Graphite mines, barring a few underground mines are mostly small and opencast.

Active mining centres of graphite are in Latehar & Palamu districts in Jharkhand; Bargarh, Nuapada, Rayagada & Balangir districts in Odisha; and Madurai & Sivagangai 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% Fixed Carbon (F.C.). 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, 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 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 claybinded graphite crucibles.

## 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 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), Sivagangai etc.

The r.o.m., containing an 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 Sivagangai district in Tamil Nadu. The beneficiation plant located adjacent to the mine site is designed to produce 8,400 tpy of natural graphite concentrate containing 96% F.C. with 92% recovery from r.o.m.

## 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 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.

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

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End product	Percentage of graphite used	Quality of the graphite used	
		Fixed Carbon (F.C.)	Size (micron)
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 2011-12 to 2013-14 ranged from 45,700 tonnes to 52,800 tonnes. Out of the total reported consumption in 2013-14, the Crucible Industry accounted for 34,800 tonnes (66%), Chemical Industry (14%), the Refractory Industry for 7,100 tonnes (13%) and Foundry Industry 1,000 tonnes (2%). Industrywise consumption data are provided in Table- 7.

**Table - 7 : Consumption\* of Graphite  
2011-12 to 2013-14  
(By Industries)**

Industry	(In tonnes)		
	2011-12	2012-13(R)	2013-14(P)
<b>All Industries</b>	<b>45700</b>	<b>52900</b>	<b>52800</b>
Chemicals	300(2)	7700(3)	7700(3)
Dry cell battery	400(3)	400(3)	400(3)
Electrode	600(8)	600(10)	600(10)
Foundry	1000(6)	1000(6)	1000(6)
Graphite products (Crucible)	34700(4)	34700(4)	34800(4)
Graphite products (pencil)	500(1)	500(1)	500(1)
Refractory	7800(27)	7300(27)	7100(27)
Others (asbestos products, chemicals, paint, paper, pesticide, pharmaceuticals, and rubber)	400(15)	700(16)	700(16)

*Figures rounded off.*

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

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

## SUBSTITUTION

In principle, it is possible to substitute graphite by either its synthetic alternative (e.g. in batteries or for increasing the carbon content of 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 inferred resources of graphite are believed to exceed 800 million tonnes of recoverable reserves. However, world reserves of graphite have been placed at 110 million tonnes of which China accounts for 50% followed by Brazil 36% and India 10% (Table-8).

World production of graphite was 2.2 million tonnes in 2013. China continued to be the leading producer, with a share of about 82% which is followed by India (6%) and Brazil (4%) (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 40,000 tonnes per year mine being considered by Magnesite Refractorios SA.

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

(In '000 tonnes)	
Country	Reserves
<b>World: Total (rounded)</b>	<b>110000</b>
Brazil	40000
China	55000
India*	11000
Madagascar	940
Mexico	3100
USA	-

*Source: Mineral Commodity Summaries, 2015. Reserves in Canada, Korea, Dem P.R., Russia, Norway, Sri Lanka, Turkey, Ukraine and Zimbabwe are included with World total. India's resources of graphite as per UNFC system are place at about 1,74,850 thousand tonnes.*

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

(In '000 tonnes)			
Country	2011	2012	2013
<b>World: Total</b>	<b>2200</b>	<b>2147</b>	<b>2200</b>
Brazil @	105	88	84
Canada <sup>(e)</sup>	20	20	20
China <sup>(e) #</sup>	1800	1800	1800
India *	153	135	146
Korea, Dem. P.R. of	30	30	30
Madagascar	4	3 <sup>e</sup>	5 <sup>e</sup>
Mexico	7	7	7
Norway	8	7	6
Russia <sup>(e)</sup>	14	14	14
Sri Lanka	3	3	3 <sup>e</sup>
Turkey	5	31	32 <sup>e</sup>
Ukraine <sup>(e)</sup>	1	5	5 <sup>e</sup>
Zimbabwe	7	4	4 <sup>e</sup>
Other countries	43	-	44

*Source: World Mineral Production, 2009-2013.  
@ Including beneficiated and directly shipped material.  
# Including flake graphite.  
\* Crude.*

*India's production of graphite in 2011-12, 2012-13 and 2013-14 was 153 thousand tonnes, 135 thousand tonnes and 146 thousand tonnes respectively.*

## FOREIGN TRADE

### Exports

In 2013-14, exports of graphite (natural) drastically decreased to 820 tonnes as compared to 2,304 tonnes in the previous year. Graphite (natural) was exported mainly to Japan (20%), Germany (18%), Netherlands (14%) and UK (8%). The exports of graphite (artificial) decreased to 17,415 tonnes in 2013-14 from 23,666 tonnes in the previous year. Graphite (artificial) was exported mainly to Iran (27%), USA (19%), Germany (11%) and UK & France (9% each).

The exports of graphite crucibles decreased drastically to 85 tonnes in 2013-14 from 2,290 tonnes in the preceding year, while those of silicon carbide crucibles decreased marginally to 3,240 tonnes from 4,024 tonnes in the previous year. Silicon carbide crucibles were exported mainly to Iran (13%), UK (10%), Rep. of Korea (9%) and Germany, USA & Egypt (8% each). Exports of graphite bricks and shapes were at 100 tonnes in 2013-14 compared to 37 tonnes in the preceding year. Graphite bricks and shapes were mainly exported to Rep. of Tanzania (98%) (Tables- 10 to 14).

### Imports

Imports of graphite (natural) increased marginally to 22,916 tonnes in 2013-14 from 19,485 tonnes in the preceding year. Imports of graphite (artificial) decreased to 18,317 tonnes in 2013-14 from 27,218 tonnes in the previous year. Graphite (natural) was mainly imported from China (87%). Imports of graphite (artificial) were mainly from China (52%), Poland (11%) and Norway & France (8% each).

Imports of graphite bricks and shapes drastically decreased to 19 tonnes in 2013-14 from 109 tonnes in the preceding year. Imports were mainly from China (95%). Imports of graphite crucibles increased considerably to 6,431 tonnes in 2013-14 from 3,554 tonnes in the preceding year. China was the main supplier with 99% share. Imports of silicon carbide crucibles also decreased to 181 tonnes in 2013-14 as compared to 476 tonnes in the previous year. Imports were mainly from USA (46%), China (19%) and Germany & Japan (8% each) (Tables- 15 to 19).



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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>2304</b>	<b>155353</b>	<b>820</b>	<b>112370</b>
Germany	228	32233	145	26898
Netherlands	156	25373	112	23144
UK	176	28356	69	12866
Japan	442	25742	163	9422
Turkey	54	11365	36	8006
Poland	-	-	32	7061
France	16	2241	32	4806
New Zealand	14	2921	19	4480
Belgium	-	-	10	2553
Bangladesh	821	3887	10	1886
Other countries	397	23235	192	11248

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>23666</b>	<b>2354355</b>	<b>17415</b>	<b>1453521</b>
Germany	6196	1214162	1857	430292
USA	6327	352393	3283	166376
Iran	3089	184587	4767	240031
France	1626	96012	1533	111075
UK	1277	60341	1652	96496
Japan	506	44484	332	30519
Belgium	69	25320	80	32416
Sweden	77	23512	103	34604
Oman	118	4013	1188	45962
Spain	291	20834	570	34491
Other countries	4090	328697	2050	231259

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>37</b>	<b>1626</b>	<b>100</b>	<b>1011</b>
Tanzania	-	-	98	902
Congo	-	-	2	109
Other countries	37	1626	-	-

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>2290</b>	<b>4644</b>	<b>85</b>	<b>4745</b>
UAE	-	-	10	2257
Sudan	-	-	48	1926
Bangladesh	13	451	20	292
Jordan	1	46	2	73
Nepal	1	24	1	74
Malaysia	-	-	2	60
Kenya	-	-	1	51
Nigeria	-	-	1	12
Other countries	2275	4123	-	-

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>4024</b>	<b>561122</b>	<b>3240</b>	<b>595567</b>
Korea, Rep. of	379	81165	305	70142
Egypt	272	50257	252	48708
South Africa	205	46435	138	40601
Germany	332	39220	250	38957
USA	298	39117	248	50547
UK	388	37048	336	38716
Turkey	144	26695	181	34077
Iran	424	64282	434	80746
Spain	104	21853	87	21628
UAE	107	18740	139	23237
Other countries	1371	136310	870	148208

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>19485</b>	<b>1193505</b>	<b>22916</b>	<b>1235588</b>
China	16961	952730	19955	939918
Madagascar	1178	84950	1164	99777
Brazil	614	54955	1041	91619
Germany	188	34723	97	25150
USA	235	26047	401	48452
Japan	7	3650	13	5230
Italy	103	11846	34	4151
Slovenia	-	-	54	4065
Sri Lanka	46	5658	31	3632
Belgium	6	1440	18	3590
Other countries	147	17506	108	10004

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>27218</b>	<b>2844472</b>	<b>18317</b>	<b>1886075</b>
China	17011	1213344	9498	554238
Japan	1673	562006	782	186392
France	2993	313388	1434	217404
Germany	519	245920	979	364359
Norway	2530	131633	1529	87347
USA	226	64666	324	66828
UK	263	66576	357	47789
Netherlands	481	61277	536	76620
Poland	619	47078	2092	171262
Italy	78	30182	76	21049
Other countries	825	108402	710	92787

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>109</b>	<b>20974</b>	<b>19</b>	<b>1934</b>
China	35	6657	18	1922
Belgium	-	-	1	12
Other countries	74	14317	-	-

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>3554</b>	<b>172963</b>	<b>6431</b>	<b>260107</b>
China	3423	164568	6347	253916
USA	86	5673	57	4664
Germany	27	1673	20	1029
France	7	401	5	228
Japan	7	374	1	231
Jamaica	-	-	1	39
Other countries	4	274	-	-

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

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
<b>All Countries</b>	<b>476</b>	<b>29799</b>	<b>181</b>	<b>17985</b>
UK	166	9627	3	601
Germany	122	6906	14	1374
USA	70	4723	83	7319
Italy	50	2319	7	1048
China	20	1729	35	4501
Japan	14	639	14	1202
Spain	15	784	12	1005
Singapore	3	159	1	133
Australia	-	-	12	802
Other countries	16	2913	-	-

### 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, electrification of vehicles 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. 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 12<sup>th</sup> 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 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.