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GARNET

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GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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13 Garnet

Garnet is the collective name for a group of minerals which crystalise in cubic system with different chemical composition. The principal members of the Garnet group are Almandine (Fe-Al), Pyrope (Mg-Al), Spessartine (Mn-Al), Grossularite (Ca-Al), Andradite (Ca-Fe) and Uvarovite (Ca-Cr). Almandine is hardest amongst all varieties and is often used for abrasive purpose. Garnet is dense & hard with sharp angular chisel-edged fracture, containing small amounts of free silica and exhibits high resistance to physical and chemical attacks. It is used both as semi-precious stone and as an abrasive. The hardness of garnet varies from 6.5 to 7.5 on Mohs scale. This allows it to be used as an effective abrasive.

RESERVES / RESOURCES

In India, garnet deposits suitable for use in Abrasive Industry occur in Andhra Pradesh, Chhattisgarh, Jharkhand, Kerala, Odisha, Rajasthan, Tamil Nadu and Telangana. Gem variety of garnet occurs in Ajmer, Bhilwara, Jhunjhunu, Sikar and Tonk districts, Rajasthan; Nellore and Srikakulam districts, Andhra Pradesh; Khammam district, Telangana and Coimbatore, Ramanathapuram, Tirunelveli, Kanyakumari, Tiruchirappalli and Tiruvarur districts, Tamil Nadu. Garnet is found to occur in beach sands along with ilmenite, rutile, sillimanite, etc. in the States of Kerala, Odisha and Tamil Nadu.

The total reserves/resources of garnet in India as on 1.4.2020, as per UNFC system has been placed at 56.01 million tonnes of which Reserves under Proved and Probable categories together constituted 8.60 million tonnes. Of the total resources, about 20.87 million tonnes are of Abrasive grade, whereas resources of Semi-precious grade are mere 8,468 tonnes. Tamil Nadu alone accounted for about 46% of the total resources followed by Andhra Pradesh (31%), Odisha (17%) and Telangana (3%). The remaining States together shared less than 3% (Table- 1).

EXPLORATION & DEVELOPMENT

The details about the exploration and development, if any, are covered in the Review on "Exploration and Development" under "General Reviews".

PRODUCTION AND STOCKS

Garnet (Abrasive)

Production of garnet (abrasive) is at 8,182 tonnes during 2021-22 compared to 7,114 tonnes in the preceeding year. Similarly, there were only 6 reporting mines during 2021-22 as against 9 mines reported in the year 2020-21. Three principal producer accounted for about 87% of the total production during the year.

Like previous year the share of Public Sector in the total output was nil in 2021-22 as same in the previous year. Similarly, the share of Private Sector in the total output was cent per cent in 2021-22 as same in the preceding year.

In 2021-22,like that of previous year, production was reported only from the State of Rajasthan, i.e.,five principal producers from Rajasthan accounted for about cent per cent of the total output during the current year (Tables-2 to 4).

Mine-head closing stocks of garnet (abrasive) for the year 2021-22 were 2,682 tonnes as against 3832 tonnes in the previous year (Table -5).The average daily employment of labour during 2021-22 was 42 as against 66 in the previous year.

Table – 1 : Reserves/Resources of Garnet as on 1.4.2020 (P)
(By Grades/States)

(Unit: tonnes)

Grade/State	Reserves				Remaining Resources								
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	Total Resources (A+B)
		STD121	STD122			STD221	STD222						
All India : Total	**8539521**	**50946**	**5**	**8590472**	**1835546**	**1624128**	**4622014**	**138905**	**10226601**	**28066885**	**902574**	**47416654**	**56007126**
By Grades													
Gem	-	-	1	1	5847	16279	23919	0	0	110	4	46158	46160
Abrasive	8486371	50920	4	8537296	1705715	1526269	4568321	102866	15602	3514907	902570	12336249	20873545
Semi-precious	612	26	-	637	2093	132	1630	39	1249	2688	-	7831	8468
Others	-	-	-	-	9051	36358	-	-	-	215573	-	260982	260982
Unclassified	52538	-	-	52538	85485	43806	394	36000	10208995	23951287	-	34325967	34378505
Not-known	-	-	-	-	27355	1284	27750	-	756	382321	-	439466	439466
By States													
Andhra Pradesh	-	-	-	-	1196087	237025	1359988	18	8800000	5674011	-	17267129	17267129
Chhattisgarh	-	-	-	-	-	-	-	-	-	28800	-	28800	28800
Jharkhand	-	-	-	-	-	-	88303	-	-	21768	-	110071	110071
Kerala	-	-	-	-	-	-	45797	100874	-	52190	-	198861	198861
Odisha	8330045	-	1	8330046	5	-	1	-	-	348001	-	1177318	9507364
Rajasthan	156938	50946	4	207888	310712	191094	33115	2013	17606	215120	73263	842923	1050811
Tamil Nadu	52538	-	-	52538	266555	1153976	3094811	36000	1408995	19871019	-	25831356	25883894
Telangana	-	-	-	-	62187	42033	-	-	-	1855976	-	1960196	1960196

Figures rounded off

Table – 2 : Principal Producers of Garnet (Abrasive), 2021-22

Name & address of producer	Location of mine	
	State	District
AKD Gem Garnet Mines, F-203, Near Mahapragya Circle, Azad Nagar, Bhilwara - 311 001, Rajasthan.	Rajasthan	Bhilwara
Arun Bagdiya,C/o,Shri Ramdev Bagdiya,Resi No-110,Kendriya Vihar, Sector-8,Bidyadhar Nagar, Jaipur-302039, Rajasthan.	Rajasthan	Ajmer
Ummed Singh Ranawat, Vill-Basda,P.O.Gundali Bhilwara-311001 Rajasthan.	Rajasthan	Bhilwara

**Producing as an associated mineral with sillimanite.*

Table – 3 : Production of Garnet (Abrasive) 2019-20 to 2021-22 (By States)

(Qty in tonnes; Value in ₹'000)

State	2019-20		2020-21		2021-22 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	**568**	**1775**	**7114**	**26378**	**8182**	**29880**
Andhra Pradesh	-	-	-	-	-	-
Odisha	-	-	-	-	-	
Rajasthan	568	1775	7114	26378	8182	29880
Tamil Nadu	-	-	-	-	-	-

Table – 4 : Production of Garnet (Abrasive), 2020-21 & 2021-22 (By Sectors/States/Districts)

(Qty in tonnes; Value in ₹'000)

State/District	2020-21			2021-22 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**9**	**7114**	**26378**	**6**	**8182**	**29880**
Public sector	-	-	-	-	-	-
Private sector	9	7114	26378	6	8182	29880
Rajasthan	**7**	**7114**	**26378**	**5**	**8182**	**29880**
Ajmer	3	2367	7017	2	2316	6783
Bhilwara	3	4741	19332	2	5850	23042
Tonk	1	06	29	1	16	55
Tamil Nadu	**2**	**-**	**-**	**1**	**-**	**-**
Tiruchirapalli	2	-	-	1	-	-

Note-*The main reason for decrease in number of mines is classification of some Garnet producing mines, such as BSM mines in Andhra Pradesh, Odisha and Tamil Nadu. Earlier, these mines were considered under Garnet (Abrasive) as a part of MCDR mineral as there was no seperate classification of Beach Sand Minerals (BSM) and Non-Beach Sand Minerals (Non-BSM).*

Table – 5 : Mine-head Closing Stocks of Garnet (Abrasive) 2020-21 & 2021-22 (By States)

(In tonnes)

State	2020-21	2021-22 (P)
India	**3832**	**2682**
Andhra Pradesh	326	-
Odisha	-	-
Rajasthan	2864	2616
Tamil Nadu	642	66

Garnet (Gem)

No production of garnet (gem) was reported since 2018-19.

USES & CONSUMPTION

The most important industrial use of garnet in the form of garnet sand is as an abrasive. About 90% production of abrasive garnet is used for manufacturing of garnet-coated papers, clothes and discs. Garnet-coated abrasives are used in the form of belts, covers for drums, discs or as small sheets. It is used for cleaning spark plugs, paints, polishing and grinding of plate-glass. The remaining 10% output is used in the form of loose grains for surfacing and polishing soft stones (marble, slate, soapstone, etc.). Clear, flawless and rich-coloured crystals of garnet are used as semi-precious stones. The principal variety among them are pyrope, deep-crimson almandine, orange-yellow grossularite, etc. Other uses are in Electronic and Television Industry for polishing glass and TV tubes. Garnet granules are used in 'abrasive blasting'commonly called 'sand blasting'in order to smoothen, clean and remove oxidation products from metals, stone and other material. MMTC's specifications of garnet sand used for sand blasting/jet cutting/other uses for exports to USA, Europe, Middle East and Taiwan are as follows: Al_2O_3: 20.8 to 21.2%, Bulk density; 2.17 kg/m^3, Hardness in Mohs scale should be 7.5 to 8.

Water jet cutting machines generally use finely-ground 80-120 mesh size garnet as cutting medium with high pressure water. Owing to its inertness to a wide range of chemicals and relatively high specific gravity, it is used as filter medium for water and other liquids.

SUBSTITUTES

Other natural and manufactured abrasives can substitute to some extent for all major end uses of garnet. In many cases, however, using the substitutes would entail sacrifices in quality or cost. Fused aluminum oxide and staurolite compete with garnet as a sandblasting material. Ilmenite, magnetite and plastics compete as filtration media. Corundum, diamond and fused aluminum oxide compete for lens grinding and for many lapping operations. Emery is a substitute in nonskid surfaces. Fused aluminum oxide, quartz sand and silicon carbide compete for the finishing of plastics, wood furniture and other products.

WORLD REVIEW

Garnet group of minerals are found throughout the world in metamorphic, igneous and sedimentary rocks.

World resources of garnet are large and occur in a wide variety of rocks, particularly, gneisses and schists. Garnet also occurs in contact-metamorphic deposits in crystalline limestones, pegmatites, serpentinites and in vein deposits. In addition, alluvial garnet is present in many heavy-mineral sand and gravel deposits throughout the world. Large domestic resources of garnet also are concentrated in coarsely-crystalline gneiss near North Creek, NY; other significant domestic resources of garnet occur in Idaho, Maine, Montana, New Hampshire, North Carolina, and Oregon. In addition to those in the United States, major garnet deposits exist in Australia, Canada, China, India and South Africa, where they are mined for foreign and domestic markets; deposits in Russia and Turkey also have been mined in recent years, primarily for internal markets. Additional garnet resources are in Chile, Czechia, Pakistan, Spain, Thailand and Ukraine; small mining operations have been reported in most of these countries.

In 2022, Australia produced about 38% of total global production of garnet (Industrial), followed by China (31%), South Africa (15%), USA (8%) and the remaining 8 % was contributed by other countries. Russia and Turkey are also mining garnet for domestic markets. Garnet is also mined in Canada, Chile, Czech Republic, Pakistan, South Africa, Spain, Thailand and Ukraine.

Worldwide the end uses of garnet and market shares are: abrasive blasting media 30%, abrasive grains for water jet cutting 35%, water filtration 20%, abrasive powder 10% and other end uses 5 per cent.

The world reserves/resources and production of industrial garnet are furnished in (Tables- 6 and 7).

Table – 6 : World Reserves of Garnet (Industrial) (By Principal Countries)

(In 000' tonnes)

Country	Reserves
World: Total (rounded)	**Moderate to Large**
India	13,000,000
United Stated	5,000,000
China	2,200,000
Australia	Moderate to Large
South Africa	NA
Other countries	6,500,000

***Source**:USGS Mineral Commodity Summaries, 2023*

** In India as per NMI data based on UNFC system the total reserves/resources of garnet as on 1.4.2020 are estimated at 56.01 million tonnes.*

Table – 7 : World Production of Garnet (Industrial) (By Principal Countries)

(In tonnes)

Country	2021	2022
World:Total (rounded)	**925000**	**980000**
Australia	321000	370000
China	310000	310000
South Africa	140000	150000
United States	81700	76000
India	12000	15000
Other countries	60000	60000

***Source**: USGS, Mineral Commodity Summaries 2023,*

***Note :** Figures are rounded off*

** India's production of garnet (abrasive) during 2019-20, 2020-21, and 2021-22 was at 568 tonnes,and 8182 tonnes respectively.*

FOREIGN TRADE

Exports

In 2021-22, exports of abrasive garnet increased drastically by 3% to 81,270 tonnes from 76,799 tonnes in the previous year. Exports were mainly to UAE (35%), USA (19%), Malaysia (6%) Thailand (5%) and Saudi Arabia (5%). Exports in terms of value in respect of cut & uncut garnet variety increased drastically by 35% to 37.84 crore in 2021-22 from 28.08 crore in the previous year. In terms of value, exports were mainly to Thailand (30%), Hong Kong (18%), USA (15%), Japan (6%) and Armenia (5%).

Out of the total exports in terms of value of cut & uncut garnet in 2021-22, cut variety of garnet accounted for 95% share and the remaining 5% was contributed by the uncut garnet. In terms of value exports of cut variety were mainly to Thailand (31%),USA (16%), Hong Kong (15%), Japan (6%) & Armenia(6%). Similarly, exports of uncut garnet were mainly to Hong Kong (100%), (Tables- 8 to 11).

Imports

In 2021-22, imports of abrasive garnet decreased marginally by 60% to 140 tonnes from 345 tonnes in the previous year. Imports were from UAE (82%). and Kenya (18%). Imports in terms of value in respect of cut & uncut garnet variety increased drastically by 88% to 18.35 crore in 2021-22 from 9.73 crore in the previous year. In terms of value, imports were mainly from Kenya (24%), Thailand (21%), Hong Kong (18%),Tanzania (15%) Sri Lanka (6%), & USA (5%).

Out of the total imports in terms of value of cut & uncut garnet in 2021-22, uncut variety of garnet accounted for 77% share and the remaining 23% was contributed by the cut garnet. In terms of quantity, imports of uncut variety were mainly from Madagascar (43%) and Tanzania (21%). Similarly, imports of cut garnet were mainly from Sri Lanka (57%) and USA (15%) (Tables-12 to 15).

Table -8 : Exports of Garnet (Abrasive) (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**76799**	**1265586**	**81270**	**1433741**
UAE	9184	157482	28448	490465
USA	19989	308885	15383	317258
Malaysia	7057	113156	5005	80339
Thailand	1618	29610	4116	71145
Saudi Arabia	6540	116809	4050	70796
Qatar	2986	52016	2931	50204
Kuwait	3472	53941	2904	47549
Italy	5208	91648	2380	44063
Canada	3325	57665	2119	37611
Oman	2688	46263	2156	36806
Other countries	14732	238111	11778	187505

Figures rounded off

Table- 9 : Exports of Garnet (Cut & Uncut) (By Countries)

Country	2020-21(R)		2021-22 (P)	
	Qty (**)	Value (₹'000)	Qty (**)	Value (₹'000)
All Countries	**	**280824**	**	**378455**
Thailand	**	79120	**	112575
Hong Kong	**	69715	**	69441
USA	**	47384	**	58670
Japan	**	13710	**	24271
Armenia	**	7682	**	20890
Russia	**	4015	**	14862
Italy	**	4082	**	14754
UK	**	18439	**	12531
Germany	**	6396	**	11356
Australia	**	3772	**	10060
Other countries	**	26509	**	29045

Note : *** - Not additive. The total may not tally.*
Figures rounded off

Table – 10 : Exports of Garnet (Cut) (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty ('000crt)	Value (₹'000)	Qty ('000crt)	Value (₹'000)
All Countries	**76049**	**260630**	**12258**	**359152**
Thailand	1473	74972	20811	111039
USA	2398	46737	4073	57467
Hong Kong	1502	55990	1573	53690
Japan	350	13673	437	24255
Armenia	109	7682	317	20890
Russia	92	4015	277	14862
Italy	104	4082	170	14754
UK	1647	18157	488	11979
Germany	277	6396	486	11321
Australia	66440	3715	9	10056
Other countries	1657	25211	2377	28839

Figures rounded off

Table – 11 : Exports of Garnet (Uncut) (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**111**	**20194**	**29**	19303
Hong Kong	84	13725	29	15751
Thailand	++	4118	-	1536
USA	++	612	-	1203
UK	++	282	-	552
China	27	1240	-	173
Germany	-	-	-	35
Ireland	-	-	-	27
Japan	++	32	-	16
Australia	++	52	-	4
Mexico	-	-	-	3
Other countries	++	58	-	3

Figures rounded off

Table – 12 : Imports of Garnet (Abrasive) (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**345**	**14712**	**140**	**1789**
UAE	104	1978	115	1545
Kenya	-	-	25	244
UK	241	12734	-	-

Figures rounded off

Table- 13: Imports of Garnet (Cut & Uncut) (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (**)	Value (₹'000)	Qty (**)	Value (₹'000)
All Countries	**	**97335**	**	**183591**
Kenya	**	10668	**	44520
Thailand	**	24582	**	38413
Hong Kong	**	22559	**	34614
Tanzania	**	6826	**	28232
Sri Lanka	**	9393	**	11559
USA	**	11447	**	8765
South Africa	**	-	**	8562
Nigeria	**	1330	**	2043
Germany	**	524	**	2039
Madagascar	**	165	**	1880
Other countries	**	9841	**	2964

Note : ** - *Not additive. The total may not tally.*

Figures rounded off

Table – 14 : Imports of Garnet (Cut) (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty ('000 crt)	Value (₹'000)	Qty ('000 crt)	Value (₹'000)
All Countries	**1437**	**32565**	**1299**	**42311**
Hong Kong	669	6260	175	13712
Sri Lanka	622	9393	749	11559
Thailand	105	7548	116	7519
USA	22	2809	188	6094
Germany	1	512	47	1186
Canada	++	36	12	1092
Japan	++	2	12	748
Switzerland	-	-	++	207
Madagascar	-	-	++	69
UAE	-	-	++	52
Other countries	18	6005	++	73

Figures rounded off

Table – 15 : Imports of Garnet (Uncut) (By Countries)

Country	2020-21 (R)		2021-22 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**11**	**64770**	**23**	**141280**
Kenya	++	10668	1	44483
Thailand	1	17034	1	30894
Tanzania	1	3773	5	28232
Hong Kong	1	16299	1	20902
South Africa	-	-	3	8562
USA	++	8638	++	2671
Nigeria	1	1330	1	2043
Madagascar	++	165	10	1811
Germany	++	12	++	853
Zambia	1	1351	++	296
Other countries	6	5500	1	533

Figures rounded off

FUTURE OUTLOOK

Garnet has a wide range of applications, such as, in production of abrasives, sand blasting, water filtration materials, abrasive blasting media and water-jet cutting. Garnet is expected to continue replacing silica sand blasting media, owing to latter's associated occupational health risks. Moreover, garnet is safer for the environment and cheaper to dispose of after recycling. Hence, the worldwide demand for garnet is expected to increase, especially for waterjet cutting and for abrasive blasting media. China and India are expected to steadily increase garnet production and will become significant garnet sources for other countries. The garnet market is very competitive. To increase profitability and remain competitive with imported material, production may be restricted to only high-grade garnet ores as a by-product of other saleable mineral products that occur with garnet, such as, kyanite, marble, metallic ores, mica minerals, sillimanite, staurolite or wollastonite.