

WOLLASTONITE



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WOLLASTONITE

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

Indira Bhavan, Civil Lines,
NAGPUR – 440 001

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

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Wollastonite, a metasilicate of calcium (CaSiO_3), contains theoretically 48.3% CaO and 51.7% SiO_2 with hardness of 4.5 on Mohs' scale. It occurs as aggregates of bladed or needle-like crystals. Ceramic industry uses substantially, domestic production of wollastonite, as a filler. Some other uses of wollastonite are as a filler in ceramic floor & wall tiles, marine wallboard, paint, plastic, in refractory liners in steel mills and as a partial replacement for short-fibre asbestos in certain applications such as brake-lining. Technical improvements in filler properties in plastic and rubber have been made in recent years. A better compatibility between the polymer and the filler is achieved by chemical surface treatment of the mineral filler. Wollastonite when treated in such a manner, results in improved flexural modules in polypropylene and improved reinforcement in nylon.

RESOURCES

Major deposits of wollastonite have been found in Dungarpur, Pali, Sirohi and Udaipur districts in Rajasthan. Besides, in Ghoda area, Banaskantha district in Gujarat and in Dharmapuri and Tirunelveli districts in Tamil Nadu, a few deposits also occur. As on 1.4.2010, the resources of wollastonite, as per UNFC system are placed at 16.57 million tonnes. Out of total resources, about 88% (14.58 million tonnes) including 2.49 million tonnes reserves are located in Rajasthan and the remaining about 12% resources (1.99 million tonnes) in Gujarat. Meagre resources are also located in Tamil Nadu (3,533 tonnes) (Table-1).

**Table – 1 : Reserves/Resources of Wollastonite as on 1.4.2010
(By Grades/States)**

(In tonnes)

Grade/State	Reserves			Remaining Resources						Total resources (A+B)
	Proved STD111	Probable STD122	Total (A)	Feasibility STD211	Pre- feasibility STD222	Measured STD 331	Indicated STD332	Inferred STD333	Total (B)	
All India (Total)	2289869	197253	2487122	3750545	3724191	76088	3325042	3206885	14082751	16569873
By Grades										
Marketable	2289869	197253	2487122	837864	3724191	76088	–	1083475	5721618	8208740
Unclassified	–	–	–	2912681	–	–	3325042	2044800	8282523	8282523
Not-known	–	–	–	–	–	–	–	78610	78610	78610
By States										
Gujarat	–	–	–	–	–	–	–	1990000	1990000	1990000
Rajasthan	2289869	197253	2487122	3750545	3724191	76088	3325042	1213352	12089218	14576340
Tamil Nadu	–	–	–	–	–	–	–	3533	3533	3533

Figures rounded off.

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EXPLORATION & DEVELOPMENT

In 2013-14, GSI conducted exploration for wollastonite in Ghoda-Dhanpura and Ghoda-Bhameriya area within Delhi fold belt in district Banaskantha, Gujarat. Details of exploration activities are furnished in Table- 2.

PRODUCTION, STOCKS & PRICES

Production of wollastonite at 193,000 tonnes in 2013-14 registered an increase by 32 percent as compared to that in the preceding year. There were

4 reporting mines as compared to 3 mines in the previous year. The entire production was reported from private sector mines located in Rajasthan. Wolkem Industries Ltd is the major contributor of the total production during the year (Tables-3 to 5).

Mine-head closing stocks for the year 2013-14 were 10,677 tonnes as against 2,248 tonnes in the previous year (Table- 6).

The average daily-employment of labour during 2013-14 was 397 as against 433 in the previous year. Prices of wollastonite are furnished in the General Review on 'Prices'.

Table – 2 : Details of Exploration Activities for Wollastonite, 2013-14

Agency/ State/District	Location	Mapping		Drilling		Sampling No.	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
GSI Gujarat Banaskantha	Dhanpura Ghoda, Bhameriya	1:10,000	50	72	-	10	Reconnaissance stage (G-4) investigation was carried out to assess the potentiality of wollastonite near Bhameriya, Ghoda & Dhanpura at the contact of granite & calc-silicate/gneiss terrain with intrusive granite. A number of skarn zones have been recorded near the contact and are characterised by the presence of wollastonite (CaSiO ₃) calcite, feldspar, amphiboles, tourmaline, diopside & quartz. A total of 799 thousand tonnes tentative resources have been estimated, out of which tentative reserves/ resources have also been estimated.
	i) 2.75 km WNW of Ghoda						About 14000 tonnes of reserves with Dimension 50x5x25 m, Sp.Gr. 2.8 and wollastonite content 80%.
	ii) 1.5 km SSE of Bhameriya						About 896 tonnes of reserves with Dimension 20x2x10 m, Sp.Gr. 2.8 and wollastonite content 80%.
	iii) 1 km North of Siyawa						About 784 thousand tonnes of reserves with Dimension 200x20x100 m, Sp.Gr. 2.8 and wollastonite content 70% (analytical result awaited).

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Table – 3 : Principal Producers of Wollastonite, 2013-14

Name & address of producer	Location of mine	
	State	District
Wolkem Industries Ltd, P.B.21, E-101, Mewar Industrial Area, Madri, Dist. Udaipur- 313 003, Rajasthan.	Rajasthan	Sirohi Udaipur
Renu Atre 378,C Block, Malviya Nagar, Sanganer, Jaipur- 302 017, Rajasthan.	Rajasthan	Ajmer

**Table – 4 : Production of Wollastonite, 2011-12 to 2013-14 (P)
(By State)**

(Qty in tonnes; value in ₹'000)

State	2011-12		2012-13		2013-14 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India/Rajasthan	184445	159974	145667	127468	192642	157047

**Table – 5: Production of Wollastonite, 2012-13 & 2013-14 (P)
(By Sector/State/Districts)**

(Qty in tonnes; value in ₹'000)

State/District	2012-13			2013-14 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India/Private sector	3	145667	127468	4	192642	157047
Rajasthan	3	145667	127468	4	192642	157047
Ajmer	1	8499	2116	2	10753	4461
Sirohi	1	23203	31672	1	24660	32058
Udaipur	1	113965	93680	1	157229	120528

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

(Qty in tonnes)

State	2012-13	2013-14 (P)
India/Rajasthan	2248	10677

MINING, PROCESSING & MARKETING

Wollastonite is being mined by opencast by manual and semi-mechanised methods. In some of the mines viz. Chaura Nimberi mine in Ajmer district, Rajasthan, manual selective and manual sorting being carried out followed by magnetic separation for improving recovery of ore. Working along the strike of mineralised zone with bench height 2 to 6 metres. The run-of-mine is selectively hand-sorted to the size of 30 cm to 50 cm to remove the associated minerals, such as calcite, diopside, garnet, quartz and iron. Wollastonite, thus separated, is then crushed to various sizes at two crushing plants near Sirohi railway station. Principal commercial grades produced are: White Kemolit (S1 to S5) and off-white Kemolit (H1 to H5 and LG 25) which are milled products in the size range of 100 to 500 mesh. Besides, micronised products being marketed are Wolkron (1008, 1010, 1015, 1020, 1025 and 10825) in the low aspect ratio and Kemolit 1025 and 1020 in the high aspect ratio. In addition, speciality products and surface modified products are also marketed as Kemolit and Fillex, respectively. Wolkem's grinding technology and its automated process control system, which is duly supported with the latest instrumentation enables it to achieve a highly acicular wollastonite.

Processing improvements integral to new product development focus on the following :

(i) High aspect ratio, fine particle size grades used as reinforcements to compete against milled glass fibres, synthetic fibres and whiskers.

(ii) Fine particle size high aspect ratio grades to compete against other mineral reinforcements, such as talcs and clays, in the thermoplastic compounds.

(iii) Incorporation of new coupling agents to expand the usefulness of wollastonite into emerging markets, such as wood composites.

Hand sorted wollastonite has few impurities and is of high aspect ratio.

USES & SPECIFICATIONS

The use of wollastonite depends on the acicularity or the aspect ratio; i.e., ratio between length and width of a crystal, chemical

composition, brightness and fibre length. Wollastonite having aspect ratio in the range from 3:1 to 5:1 has little potential for reinforcing applications. Hence, market is primarily confined to ceramic, metallurgical fluxes and simple filler and coating applications. Wollastonites acicular nature allows it to compete with other acicular materials, such as ceramic fibre, glass fibre, steel fibre, and several organic fibres such as aramid and polyethylene, etc. It reduces the volume of the expensive plastic or resin medium and contributes to physical and chemical properties of the finished products. It improves tear strength, dielectric properties and retains mechanical properties at elevated temperatures.

Wollastonite is used primarily in automobile brakes, ceramics, metallurgical processing, paper, paint, plastic, cosmetics, adhesives and as a replacement of asbestos in asbestos cement boards and sheets. Some of the properties that make it so useful are high brightness and whiteness, low moisture and oil absorption, low volatile content, and the acicular nature of some wollastonite. A better compatibility between the polymer and the filler is achieved by chemical surface treatment of the mineral filler. Wollastonite results improved flexural modules in polypropylene and improved reinforcement in nylon.

Bulk demand for wollastonite in the country is in the ceramic industry for the manufacture of floor and wall tiles. In ceramics, wollastonite decreases shrinkage and gas evolution during firing. Small quantities are used in asbestos-cement products as a partial replacement for short fibre asbestos, paint, insecticide, marine wallboard and welding rod industries. In metallurgical applications, wollastonite serves as a flux for welding, a source for calcium oxide, as slag conditioners and to protect the source of molten metal during the continuous casting of steel.

A new development with very large potential is the use of wollastonite as a sequestration mineral for carbon dioxide, a major factor in global warming. Unlike other methods, sequestration by wollastonite is permanent and results in a mixture of precipitated calcium carbonate and silica that may have filler applications in paper, plastics & rubber.

SUBSTITUTE

The acicular nature of many wollastonite products allows it to compete with other acicular materials, such as ceramic fibre, glass fibre, steel fibre, and several organic fibres, such

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as aramid, polyethylene, polypropylene, and polytetrafluoroethylene in products where improvements in dimensional stability, flexural modulus and heat deflection are sought. Wollastonite also competes with several nonfibrous minerals or rocks, such as kaolin, mica and talc, which are added to plastics to increase flexural strength and such minerals as baryte, calcium carbonate, gypsum and talc, which impart dimensional stability to plastics. In ceramics, wollastonite competes with carbonates, feldspar, lime and silica as a source of calcium and silica.

CONSUMPTION

The estimated consumption of wollastonite is at 187,300 tonnes in 2013-14. The ceramic industry consumed almost the entire quantity of wollastonite (Table-7).

Table- 7 : Estimated Consumption* of Wollastonite 2011-12 to 2013-14 (P) (By Industries)

(In tonnes)			
Industry	2011-12	2012-13(R)	2013-14(P)
All Industries	102990	140300	187300
Asbestos products	++ (2)	++ (2)	++ (2)
Ceramic	102990 ^(e)	140300	187300 ^(e)

Figures rounded off.

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

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

WORLD REVIEW

World resources have not been estimated for wollastonite. The large deposits of wollastonite were in China, Finland, India, Mexico and the United States. Smaller but significant deposits were in Canada, Chile, Kenya, Namibia, South Africa, Spain, Sudan, Tajikistan, Turkey and Uzbekistan.

In 2013, the world production of wollastonite was 1.1 million tonnes which increased by 1% as against previous year. China (68%) and India (18%) were the major producers. The United States ranked third in wollastonite production. Small

quantities of wollastonite may have been produced in other countries.

Canadian Wollastonite, a private held company, after receiving approval, has started production on their St. Lawrence Wollastonite Project.

The ceramic industry probably accounts for the major consumption of wollastonite worldwide, followed by polymers (plastic and rubber) and paint. The remaining were used in construction, friction products and metallurgical applications. The countrywise production of wollastonite from 2011 to 2013 is furnished in Table-8.

Table – 8 : World Production of Wollastonite (By Principal Countries)

(In tonnes)			
Country	2011	2012	2013
China	745000	750000 ^e	750000 ^e
Finland	11500	11500 ^e	11500 ^e
India [*]	184445	145667	192642
Mexico	47523	55204	57302
Spain	7417	10918	16738
USA ^e	70000	70000	70000

Source: World Mineral Production, 2009-2013.

**India's production of wollastonite during 2011-12, 2012-13 and 2013-14 was 0.18 million tonnes, 0.15 million tonnes and 0.19 million tonnes, respectively.*

FOREIGN TRADE

Exports

In 2013-14, exports of wollastonite increased by only 1% to 19,033 tonnes from 18,765 tonnes in the previous year. Exports were mainly to Belgium (41%), Japan (28%), Australia (14%) and Germany (7%) (Table- 9).

Imports

Imports of wollastonite also increased by 1% to 1,305 tonnes in 2013-14 as compared to 1,288 tonnes in the previous year. Imports were mainly from China (56%), USA (14%) and Mexico (9%) (Table- 10).

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**Table – 9 : Exports of Wollastonite
(By Countries)**

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	18765	281471	19033	310240
Belgium	8448	119664	7725	126648
Japan	4683	53472	5405	68782
Australia	2265	43498	2649	54183
Germany	1625	35492	1404	33093
Netherlands	412	5329	492	5613
USA	282	6078	200	4517
UK	102	1859	153	3065
Saudi Arabia	361	2161	460	2884
Iran	87	1583	88	1898
Italy	78	1198	104	1782
Other countries	422	11137	353	7775

**Table – 10 : Imports of Wollastonite
(By Countries)**

Country	2012-13		2013-14	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1288	24233	1305	30479
China	729	7982	734	8409
USA	24	1236	187	7564
Mexico	45	2336	120	6419
Spain	414	9631	110	2733
Germany	15	1027	14	1947
Finland	28	691	54	1521
Korea, Rep. of	11	379	50	1352
Canada	-	-	35	467
Japan	16	683	1	66
Other countries	6	268	++	1

FUTURE OUTLOOK

Presently, India is world's second largest producer of wollastonite after China. The existing mines in the country are in a position to meet the domestic requirements of the ceramic industry as well as export demand. There is an increasing demand for wollastonite in the international markets, especially in ceramic, metallurgy, paint, construction and as asbestos substitute. Present consumption is 140,300 tonnes and as per Sub-Group Report for 12th Plan Period, the apparent domestic demand was estimated as 203,000 tonnes by 2016-17 at 9% growth rate.

The Sub-Group Report for 12th Plan Period has recommended that the exports of processed wollastonite with high aspect ratio and powdered wollastonite may be encouraged for better unit value realisation. The Sub-Group Report recommended that to augment the reserves of wollastonite in the country by further, exploration in the states of Tamil Nadu and Gujarat is needed.

Wolkem India Ltd a leading wollastonite producer has planned to increase capacity to 30,000 tpy by 2013-14 to meet future demand.

As per USGS Mineral Yearbook 2012, the United States and world production and sales of wollastonite may increase by several percentages in 2013, considering the predictions of the International Monetary Fund for U.S. economic growth and global economic growth in 2013.