

WOLLASTONITE



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WOLLASTONITE

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

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Wollastonite is a chemically simple mineral named in honour of English mineralogist and chemist Sir W.H. Wollaston. Wollastonite is composed of calcium and silica with a chemical formula CaSiO_3 . Wollastonite may contain impurities like iron, potassium, manganese etc. Though normally wollastonite is bright white in colour, the impurities can produce grey, cream, brown or red colour in wollastonite. Wollastonite is formed when limestone/dolomite is subjected to high temperature and pressure in the presence of silica bearing fluid as in skarn deposits or metamorphic rocks. It occurs as aggregates of bladed or needle-like crystals with hardness of 4.5 to 5 on Mohs' scale. The uses of wollastonite in applications other than as filler include marine wallboard, paint, plastic, in refractory liners in steel mills and as a partial replacement for short-fibre asbestos in certain applications.

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, occurrences of a few deposits have been reported. As on 1.4.2015 (P), the reserves/resources of wollastonite, as per NMI database, based on UNFC system are placed at 16.47 million tonnes of which reserves under proved and probable categories together constitute 2.24 million tonnes

(14%) and remaining resources constitute for the balance 14.23 million tonnes (86%). Out of the total resources, about 88% (14.47 million tonnes) including 2.24 million tonnes reserves are located in Rajasthan and the remaining about 12% resources (1.99 million tonnes) in Gujarat. Meager resources are also located in Tamil Nadu (3,533 tonnes) (Table-1).

EXPLORATION & DEVELOPMENT

The exploration and development details are given in the review on "EXPLORATION & DEVELOPMENT" in "General Reviews".

PRODUCTION & STOCKS

Production of wollastonite at 166 thousand tonnes in 2016-17 decreased by 5% as compared to that in the preceding year. There were four reporting mines in 2016-17 as compared to five mines in the previous year. The entire production was reported from Private Sector mines located in Rajasthan (Tables-2 to 4).

Mine-head closing stocks of wollastonite for the year 2016-17 were 17,580 tonnes as against 13,896 tonnes in the previous year (Table- 5).

The average daily employment of labour during 2016-17 was 292 as against 309 in the previous year.

Table – 2: Principal Producers of Wollastonite, 2016-17

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 C-378, pradhan Marg, Malviya Nagar, Sanganer, Jaipur- 302 017, Rajasthan.	Rajasthan	Ajmer

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Table 1: Reserves/Resources of Wollastonite as on 1.4.2015
(By Grades / States)

Grade/State	Reserves			Remaining Resources					Total Resources (A+B)	
	Proved STD111	Probable STD121 STD122	Total (A)	Feasibility STD211	Pre-feasibility STD221	Measured STD331	Indicated STD332	Inferred STD333		Reconnaissance STD334
All India : Total	1953384	48075 240003	2241462	3750118 12000	3748191	76088	3325042	3316385	-	14227824 16469286
By Grades										
Marketable	1953384	- 197253	2150637	837864 -	3724191	76088	-	1083475	-	5721618 7872255
Unclassified	-	48075 42750	90825	2912254 12000	24000	-	3325042	2154300	-	8427596 8518421
Not-known	-	-	-	-	-	-	-	78610	-	78610
By States										
Gujarat	-	-	-	-	-	-	-	1990000	-	1990000 1990000
Rajasthan	1953384	48075 240003	2241462	3750118 12000	3748191	76088	3325042	1322852	-	12234291 14475753
Tamil Nadu	-	-	-	-	-	-	-	3533	-	3533 3533

Figures rounded off.

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**Table-3: Production of Wollastonite, 2014-15 to 2016-17
(By State)**

(Qty in tonnes; Value in ₹'000)

State	2014-15		2015-16 (R)		2016-17 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India/Rajasthan	186524	162113	175348	150313	166186	158935

**Table-4: Production of Wollastonite, 2015-16 & 2016-17
(By Sector/State/Districts)**

(Qty in tonnes; Value in ₹'000)

State/District	2015-16			2016-17 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India/Private sector	5	175348	150313	6	166186	158935
Rajasthan	5	175348	150313	6	166186	158935
Ajmer	2	15495	6585	4	11385	4839
Pali	1	589	324	-	-	-
Sirohi	1	14105	25389	1	15246	31225
Udaipur	1	145159	118015	1	139555	122871

**Table-5: Mine-head Closing Stocks of
Wollastonite, 2015-16 & 2016-17
(By State)**

(Qty in tonnes)

State	2015-16	2016-17 (P)
India/Rajasthan	13896	17580

MINING, PROCESSING & MARKETING

Wollastonite is mined by opencast method essentially through manual and semi-mechanised method. In some of the mines viz. Bel ka Pahar mine of M/s Wolkem Industries Ltd in Sirohi district, Rajasthan, manual selection and manual sorting are practised for improving recovery of ore. 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 with a capacity of 80,000 tonnes per year. 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 are also marketed i.e. 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. Wollastonite is processed to make it useful for various applications. The commonly associated minerals like garnet and diopside are removed by high intensity magnetic separators after grinding. Some of the other materials are chemically removed to improve binding in the resin-based products.

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.

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. Wollastonite 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 & whiteness, low moisture & 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. It is also used as performance additive in a wide range of construction material (concrete, stucco and adhesives).

Bulk of the 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 allow it to compete with other acicular materials, such as, ceramic fibre, glass fibre, steel fibre and several organic fibres, such 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. America Selenite has developed a very high-aspect-ratio synthetic whiskers which can replace the higher-end wollastonite.

CONSUMPTION

The estimated consumption of wollastonite is at 153,000 tonnes in 2016-17. The Ceramic Industry solely consumed the entire quantity of wollastonite (Table-6).

Table-6: Estimated Consumption* of Wollastonite 2014-15 to 2016-17 (By Industries)

Industry	(In tonnes)		
	2014-15	2015-16 (R)	2016-17 (P)
All Industries	196700	164200	153000
Ceramic	196700	177900#	153000#

Figures rounded off.

*(*Includes reported consumption and/or estimates wherever required and due to paucity of data, coverage not be completed).*

: Consumption taken from the despatches of 2016-17.

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

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Africa, Spain, Sudan, Tajikistan, Turkey and Uzbekistan.

In 2015, the world production of wollastonite was 1.34 million tonnes which decreased by 7% as against previous year. China (75%), India (13%) & USA (5%) were the major producers. Small quantities of wollastonite were produced in many other countries as well.

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. China (75%), India (13%) & USA (5%) were the major producers. Small quantities of wollastonite were produced in many other countries as well.

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 by principal countries from 2013 to 2015 is furnished in Table-7.

**Table –7 : World Production of Wollastonite
(By Principal Countries)**

(In tonnes)			
Country	2013	2014	2015
World Total	1098252	1439401	1338427
China ^c	750000	1100000	1000000
Finland ^c	11500	10000	10000
India [*]	192712	186524	175348
Mexico	57302	54579	57451
Spain	16738	15298	17700
USA ^c	70000	70000	70000
Other countries	-	3000	7928

Source: World Mineral Production, 2011-2015.

** India's production of wollastonite during 2013-14, 2014-15 and 2015-16 was 193 thousand tonnes, 187 thousand tonnes and 175 thousand tonnes respectively.*

FOREIGN TRADE

Exports

The exports of wollastonite during 2016-17 were 16,699 tonnes. Exports were mainly to

Belgium (53%), Japan (25%), Germany (12%) and Turkey (3%) (Table-8).

In 2015-16, exports of wollastonite decreased by 7% to 16,616 tonnes from 17,864 tonnes in the previous year. Exports were mainly to Belgium (54%), Japan (27%), Germany (7%) and Saudi Arabia (3%) (Table-9).

**Table – 8 : Exports of Wollastonite
(By Countries)**

Country	2016-17	
	Qty (t)	Value (₹'000)
All Countries	16699	293525
Belgium	8823	163212
Japan	4203	65244
Germany	1987	36905
Turkey	506	5572
France	336	7473
UK	316	6325
USA	180	2911
Saudi Arabia	105	792
Iran	65	1493
UAE	64	1271
Other countries	114	2327

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

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	17864	288087	16616	279263
Belgium	7989	133579	8899	160416
Japan	4737	64254	4420	65394
Germany	1787	36565	1217	24186
Netherlands	520	6806	521	6208
France	315	6415	294	5968
Saudi Arabia	481	3128	562	3842
USA	256	4324	217	3429
UK	1	28	81	1638
Turkey	5	78	83	1407
Singapore	23	1064	35	1098
Other countries	1750	31846	287	5677

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Imports

Imports of wollastonite were 3,483 tonnes during 2016-17. Imports were mainly from China (62%), Spain (30%), USA(6%) and Mexico (2%) (Table-10). Imports of wollastonite increased by 45% to 2,818 tonnes in 2015-16 as compared to 1,948 tonnes in the previous year. Imports were mainly from China (90%), USA(7%), Mexico (2%) and Germany (1%) (Table-11).

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

Country	2016-17	
	Qty (t)	Value (₹'000)
All Countries	3483	73052
China	2169	31454
Spain	1032	22767
USA	195	12921
Mexico	65	2751
Germany	16	2135
Other countries	6	1024

**Table – 11 : Imports of Wollastonite
(By Countries)**

Country	2014-15		2015-16 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1948	32549	2818	53216
China	1641	19672	2525	35972
USA	58	3740	189	11870
Germany	11	1523	37	2661
Mexico	50	2046	43	1684
Netherlands	-	-	15	478
Belgium	-	-	1	163
Finland	8	964	2	144
Spain	168	4191	6	137
Japan	-	-	++	89
Denmark	++	6	++	13
Other countries	12	407	++	5

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 around 1.5 lac tonnes. It is expected that the apparent domestic demand will be about 220,000 tonnes by 2017-18 at an

expected growth rate of 9% .

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 the betterment of export of value added products. As a result of augmenting of the resources of wollastonite in the States of Tamil Nadu and Gujarat, India would be in a formidable position to cope with futuristic demand.