Indian Minerals Yearbook 2019

(Part- III : MINERAL REVIEWS)

58th Edition

WOLLASTONITE

(ADVANCED RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
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April, 2020

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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.

RESERVES/RESOURCES

Major deposits of wollastonite have been found in Ajmer, 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, 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 balance14.23 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. Meagre resources are also located in Tamil Nadu (3,533 tonnes) (Table-1).

EXPLORATION & DEVELOPMENT

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

PRODUCTION & STOCKS

Production of wollastonite at 184 thousand tonnes in 2018-19 increased considerably by 20% as compared to 153 thousand tonnes in the preceding year. There were three reporting mines in 2018-19 as compared to four mines in the previous year. The entire production was reported only from Private Sector mines located in the State of Rajasthan only (Tables-2 to 4).

Mine-head closing stocks of wollastonite at the end of the year 2018-19 were 82,545 tonnes as against 25,518 tonnes in the previous year (Table- 5).

The average daily employment of labour during 2018-19 was 247 as against 279 in the previous year.

Table – 2: Principal Producers of Wollastonite, 2018-19

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

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

(In tonnes)

Grade\State	Reserves				Remaining Resources								Total
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	Resources
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	(A+B)
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	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 of.

Table-3: Production of Wollastonite, 2016-17 to 2018-19 (By State)

(Qty in tonnes; Value in `'000)

State	2016-17		2017-18		2018-19 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India/Rajasthan	**166186**	**158823**	**153049**	**126025**	**184063**	**173972**

Table-4: Production of Wollastonite, 2017-18 and 2018-19 (By Sector/State/Districts)

(Qty in tonnes; Value in `'000)

State/District	2017-18			2018-19 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India/Private sector	**4**	**153049**	**126025**	**3**	**184063**	**173972**
Rajasthan	**4**	**153049**	**126025**	**3**	**184063**	**173972**
Ajmer	2	12220	5194	2	4740	2015
Pali	1*	-	-	-	-	-
Udaipur	1	140829	120831	1	179323	171957

** Only labour reported.*

Table-5: Mine-head Closing Stocks of Wollastonite, 2017-18 & 2018-19 (By State)

(Qty in tonnes)

State	2017-18	2018-19 (P)
India/Rajasthan	**25518**	**82545**

MINING, PROCESSING & MARKETING

Wollastonite is mined by opencast method essentially through manual and semi-mechanised method. In some of the mines viz. Belka 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. The addition of wollastonite to metallurgical fluxes provides ready fusibility, good insulating qualities and low viscosity.

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. It is use in ceramics, depends on the formulation of the ceramic body and the fixing method.

CONSUMPTION

The estimated consumption of wollastonite at 1,27,000 tonnes in 2018-19 decreased marginally by 12% as compared to 1,44,300 tonnes in 2017-18. The Ceramic Industry is the sole consuming Industry in the entire quantity of wollastonite (Table-6).

Table-6 : Estimated Consumption* of Wollastonite 2016-17 to 2018-19 (By Industries)

(In tonnes)

Industry	2016-17	2017-18 (R)	2018-19 (P)
All Industries	**153000**	**144300**	**127000**
Ceramic	153000	144300	127000

Figures rounded off

** : Consumption estimated from the dispatches, as reported in Form-H, under Rule-45 of MCDR, 2017.*

WORLD REVIEW

World reserves of wollastonite exceed 100 millon tonnes. Many deposits, however, have not been surveyed, precluding accurate estimates of reserves. 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 2017, global sales of refined wollastonite were thought to be in the range of 825,000 to 875,000 tonnes China was the largest producer of wollastonite with a production of 0.53 million tonnes. India with 0.17 million tonnes, Mexico having 0.15 million tonnes and USA having 0.06 million tonnes were the other major producers. In addituion to this countries small quantities of wollastonite were also produced in Canada, Nambia, South Africa, and possibly other countries, however, output was not reported, and the available information was inadequate to make reliable estimates of output 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 countrywise production of wollastonite by principal countries from 2016 to 2018 is furnished in Table-7.

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

(In tonnes)

Country	2016	2017	2018
Finland[e]	10000	10000	11000
Spain	13553	19135	12235
Mexico	63683	98449	145814
USA[e]	60000	50000	60000
China[e]	500000	500000	530000
India*[(a)]	166186	153049	169000
Australia[(b)]	1797	1749	2007

Source: *World Mineral Production, 2014-2018.*

* *India's production of wollastonite during 2016-17, 2017-18 and 2018-19 was 166 thousand tonnes, 153 thousand tonnes and 184 thousand tonnes respectively.*

a) Years ended 31st March following that stated.

b) Years ended 30th June of that stated.

FOREIGN TRADE

Exports

In 2018-19, exports of wollastonite increased marginally by 10% to 13,786 tonnes from 12,479 tonnes in the previous year. Exports were mainly to Belgium (52%), Japan (21%), Germany (14%), France (4%) and Hungary (3%) (Table-8).

Imports

Imports of wollastonite increased drastically, which more than doubled to 26,483 tonnes in 2018-19 as compared to 11,461 tonnes in the previous year. Imports were almost from China (99%)(Table-9).

Table – 8 : Exports of Wollastonite (By Countries)

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**12479**	**224919**	**13786**	**279115**
Belgium	6688	123287	7149	149468
Japan	2880	43485	2940	50554
Germany	1674	32840	1898	40118
France	348	7851	528	13258
Hungary	3	49	434	7682
UK	231	4376	294	6309
USA	180	3446	120	2847
Malaysia	31	1891	16	1530
Australia	66	1641	44	1316
Indonesia	4	42	40	1242
Other countries	374	6011	323	4791

Table – 9 : Imports of Wollastonite (By Countries)

Country	2017-18 (P)		2018-19 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**11461**	**156397**	**26483**	**331612**
China	10872	131847	26187	314136
Canada	-	-	100	6531
Mexico	107	4654	70	4222
Thailand	-	-	85	1796
USA	255	13876	18	1482
Japan	2	492	4	1446
Germany	6	546	5	958
UAE	-	-	3	551
Belgium	-	-	10	403
Spain	192	4540	1	79
Other countries	27	442	++	8

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 127,000 tonnes.

The International Monetary Fund (2018) also projected that the global economy is likely to grow by 3.9% in 2018 and 2019. europe, China, India and Mexico are likely to experience growth of more than 2% in both 2018 and 2019.

The exports of processed wollastonite with high- aspect-ratio and powdered wollastonite may have to 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 end up being in a formidable position and would be in a position to cope with any futuristic demand.