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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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28 Wollastonite

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 1.4.2020, the reserves/resources of wollastonite, as per NMI database, based on UNFC system are placed at 25.11 million tonnes of which Reserves under Proved and Probable categories together constitute 2.68 million tonnes (11%) and Remaining Resources constitute for the balance 22.43 million tonnes (89%). Out of the total resources, about 92% (23.11 million tonnes) including 2.68 million tonnes reserves are located in Rajasthan and the remaining about 8% 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" under "General Reviews".

PRODUCTION & STOCKS

Production of wollastonite at 1,03,902 tonnes in 2020-21 decreased sharpely by 17% as compared to 1,24,757 tonnes in the preceding year. There were three reporting mines in 2020-21 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 (Tables-2 to 4).

Mine-head closing stocks of wollastonite at the end of the year 2020-21 were 1,18,311 tonnes as against 1,03,115 tonnes in the previous year (Table- 5).

The average daily employment of labour in wollastonite mines during 2020-21 was 215 as against 244 in the previous year.

Table – 2: Principal Producers of Wollastonite, 2020-21

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 1.4.2020 (P)

(By Grades / States)

(Unit tonnes)

Grade\State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved	Probable		Total	Feasibility	Pre-feasibility		Measured	Indicated	Inferred	Reconnaissance	Total	
	STD111	STD121	STD122	(A)	STD211	STD221	STD222	STD331	STD332	STD333	STD334	(B)	
All India : Total	**2388641**	**190739**	**101598**	**2680978**	**4563016**	**1245009**	**8559760**	**0**	**3325042**	**4597200**	**137461**	**22427488**	**25108466**
By Grades													
Marketable	1790818	0	0	1790818	0	0	8194950	0	0	966850	0	9161800	10952618
Unclassified	449206	190739	0	639945	3680144	550276	322733	0	3325042	2647244	137461	10662900	11302845
Not-known	148617	0	101598	250215	882872	694733	42077	0	0	983106	0	2602788	2853003
By States													
Gujarat	0	0	0	0	0	0	0	0	0	1990000	0	1990000	1990000
Rajasthan	2388641	190739	101598	2680978	4563016	1245009	8559760	0	3325042	2603667	137461	20433955	23114933
Tamil Nadu	0	0	0	0	0	0	0	0	0	3533	0	3533	3533

Figures rounded off.

Table-3: Production of Wollastonite, 2018-19 to 2020-21
(By State)

(Qty in tonnes; Value in ₹'000)

State	2018-19		2019-20		2020-21 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India/Rajasthan	**184063**	**172013**	**124757**	**139695**	**103902**	**96552**

Table-4: Production of Wollastonite, 2019-20 and 2020-21
(By Sector/State/Districts)

(Qty in tonnes; Value in ₹'000)

State/District	2019-20			2020-21 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India/Private sector	**4**	**124757**	**139695**	**3**	**103902**	**96552**
Rajasthan	**4**	**124757**	**139695**	**3**	**103902**	**96552**
Ajmer	3	3115	1510	1	312	190
Pali	-	-	-	1	-	-
Udaipur	1	121642	138185	1	103590	96362

Table-5: Mine-head Closing Stocks of Wollastonite, 2019-20 & 2020-21
(By State)

(Qty in tonnes)

State	2019-20	2020-21 (P)
India/Rajasthan	**103115**	**118311**

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 non-fibrous 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. Its use in ceramics depends on the formulation of the ceramic body and the fixing method.

CONSUMPTION

The estimated consumption of wollastonite at 1,04,000 tonnes in 2019-20 decreased considerably by 18% as compared to 1,27,000 tonnes in 2018-19. The Ceramic Industry is the sole consuming Industry in the entire quantity of wollastonite (Table-6).

Table-6 : Estimated Consumption* of Wollastonite 2017-18 to 2019-20 (By Industries)

(In tonnes)

Industry	2017-18	2018-19 (R)	2019-20 (P)
All Industries	**144300**	**127000**	**104000**
Ceramic	144300	127000	**104000**

Figures rounded off

** Includes actual reported consumption and / or estimates made from the dispatches, as reported in Form 'F' / 'H' under Rule-45 of MCDR, 2017/1988) whereever required due to paucity of data the coverage may not be complete.*

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 have been identified 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 2018, global sales of refined wollastonite were thought to be in the range of 8,50,000 to 9,00,000 tonnes China was the largest producer of wollastonite with a production of 890 thousand tonnes. India with 104 thousand tonnes, Mexico having 77 thousand tonnes and USA having 40 thousand tonnes were the other major producers. In addition to this countries, small quantities of wollastonite were also produced in Spain, Australia and Thailand.

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 2018 to 2020 is furnished in Table-7.

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

(In tonnes)

Country	2018	2019	2020
China[e]	890000	890000	890000
India*[(a)]	184063	124657	103902
Mexico	145814	159498	77665
USA[e]	*60000	*50000	*40000
Finland[e]	*10000	*11000	*11000
Spain	12235	7165	17412
Australia[(b)]	2007	-	2426

Source: *BGS, World Mineral Production, 2016-2020*
* India's production of wollastonite during 2018-19, 2019-20 and 2020-21 was 184 thousand tonnes, 125 thousand tonnes and 104 thousand tonnes, respectively
a) Years ended 31st March following that stated
b) Years ended 30th June of that stated
c) In addition to the countries listed, Canada also produces wollastonite since 2014

FOREIGN TRADE

Exports

In 2020-21, exports of wollastonite decreased marginally by 6% to 13,716 tonnes from 14,582 tonnes in the previous year. Exports were mainly to Belgium (54%), Germany (11%), Hungary (16%), Japan (10%), France, UK & USA (2% each) (Table-8).

Imports

Unlike exports, imports of wollastonite increased marginally by 6% to 24,049 tonnes as compared to 22,616 tonnes in the previous year. Imports were almost entirely from China (99%) and the remaining 1% were from USA and other countries (Table-9).

Table – 8 : Exports of Wollastonite (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**14582**	**298591**	**13716**	**311809**
Belgium	6942	153037	7409	176460
Hungary	1892	33432	2200	43038
Germany	2484	48865	1458	33734
Japan	1782	30677	1406	27029
France	302	7610	300	8144
UK	294	6445	258	6447
USA	225	4776	230	4845
Australia	10	352	88	2664
Poland	52	1584	78	2643
China	10	2012	14	1458
Other countries	589	9801	275	5347

Figures rounded off

Table – 9 : Imports of Wollastonite (By Countries)

Country	2019-20 (R)		2020-21 (P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	**22616**	**294800**	**24049**	**370375**
China	22330	266751	23739	347010
USA	36	2640	150	8951
Mexico	67	3560	75	5900
Japan	6	2078	9	2938
Canada	121	15211	40	2877
Denmark	++	194	2	1054
Belgium	-	-	8	1023
Vietnam	-	-	24	339
Germany	7	924	1	213
Italy	-	-	1	70
Other countries	49	3442	-	-

Figures rounded off

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 104,000 tonnes.

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 augmentation of 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.