WOLLASTONITE

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(Part- III : Mineral Reviews)

55th Edition

WOLLASTONITE

(ADVANCE RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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Wollastonite, a metasilicate of calcium (CaSiO$_3$), theoretically contains 48.3% CaO and 51.7% SiO$_2$. It occurs as aggregates of bladed or needle-like crystals with hardness of 4.5 on Mohs’ scale. Ceramic Industry substantially uses the domestic production of wollastonite as a filler. 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, such as, brake-lining. Technical improvements in filler properties in plastic and rubber have reportedly 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, 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**

No exploration was carried out by any agency during 2015-16.

**PRODUCTION, STOCKS & PRICES**

Production of wollastonite at 175 thousand tonnes in 2015-16 decreased by 6 percent as compared to that in the preceding year. There were five reporting mines in 2015-16 as compared to six 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 2015-16 were 13,818 tonnes as against 3,418 tonnes in the previous year (Table-5).

The average daily employment of labour during 2015-16 was 295 as against 333 in the previous year. Prices of wollastonite are furnished in the General Review on ‘Prices’.

<table>
<thead>
<tr>
<th>Name &amp; address of producer</th>
<th>Location of mine</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location of mine</strong></td>
<td><strong>State</strong></td>
</tr>
<tr>
<td>Renu Atre 378,C Block, Malviya Nagar, Sanganer, Jaipur- 302 017, Rajasthan.</td>
<td>Rajasthan</td>
</tr>
</tbody>
</table>
### Table 1: Reserves/Resources of Wollastonite as on 1.4.2015

(Revised / Grades / States)

<table>
<thead>
<tr>
<th>Grade/State</th>
<th>Proved (A)</th>
<th>Probable (B)</th>
<th>Total (A+B)</th>
<th>Feasibility (STD11</th>
<th>Pre-feasibility (STD21)</th>
<th>Measured (STD31)</th>
<th>Indicated (STD32)</th>
<th>Inferred (STD33)</th>
<th>Reconnaissance (STD34)</th>
<th>Total Resources (A+B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All India: Total</td>
<td>1953384</td>
<td>48075</td>
<td>240003</td>
<td>2241462</td>
<td>3750118</td>
<td>12000</td>
<td>3748191</td>
<td>76088</td>
<td>3325042</td>
<td>3316385</td>
</tr>
<tr>
<td>By Grades</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gujarat</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rajasthan</td>
<td>1953384</td>
<td>48075</td>
<td>240003</td>
<td>2241462</td>
<td>3750118</td>
<td>12000</td>
<td>3748191</td>
<td>76088</td>
<td>3325042</td>
<td>1322852</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figures rounded off.
WOLLASTONITE

Table – 3: Production of Wollastonite, 2013-14 to 2015-16
(By State)

<table>
<thead>
<tr>
<th>State</th>
<th>2013-14 Quantity</th>
<th>2013-14 Value (L'000)</th>
<th>2014-15 Quantity</th>
<th>2014-15 Value (L'000)</th>
<th>2015-16 (P) Quantity</th>
<th>2015-16 (P) Value (L'000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>India/Rajasthan</td>
<td>192712</td>
<td>157090</td>
<td>186524</td>
<td>162113</td>
<td>175348</td>
<td>150364</td>
</tr>
</tbody>
</table>

Table – 4: Production of Wollastonite, 2014-15 & 2015-16
(By Sector/State/Districts)

<table>
<thead>
<tr>
<th>State/District</th>
<th>2014-15 No. of mines</th>
<th>2014-15 Quantity</th>
<th>2014-15 Value (L'000)</th>
<th>2015-16 (P) No. of mines</th>
<th>2015-16 (P) Quantity</th>
<th>2015-16 (P) Value (L'000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>India/Private sector</td>
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<td>186524</td>
<td>162113</td>
<td>5</td>
<td>175348</td>
<td>150364</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>6</td>
<td>186524</td>
<td>162113</td>
<td>5</td>
<td>175348</td>
<td>150364</td>
</tr>
<tr>
<td>Ajmer</td>
<td>3</td>
<td>18768</td>
<td>7507</td>
<td>2</td>
<td>15495</td>
<td>6334</td>
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<tr>
<td>Pali</td>
<td>1</td>
<td>36</td>
<td>13</td>
<td>1</td>
<td>589</td>
<td>324</td>
</tr>
<tr>
<td>Sirohi</td>
<td>1</td>
<td>20564</td>
<td>37015</td>
<td>1</td>
<td>14105</td>
<td>25389</td>
</tr>
<tr>
<td>Udaipur</td>
<td>1</td>
<td>147156</td>
<td>117578</td>
<td>1</td>
<td>145159</td>
<td>118317</td>
</tr>
</tbody>
</table>

Table – 5: Mine-head Closing Stocks of Wollastonite, 2014-15 & 2015-16
(By State)

<table>
<thead>
<tr>
<th>State</th>
<th>2014-15</th>
<th>2015-16 (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>India/Rajasthan</td>
<td>3418</td>
<td>13818</td>
</tr>
</tbody>
</table>

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. Wolcron (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.

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 modulus 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 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 modulus 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).

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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 151,200 tonnes in 2015-16. The Ceramic Industry solely consumed the entire quantity of wollastonite (Table-6). In addition to this, as per the annual returns, about 13,000 tonnes of wollastonite was dispatched to various end uses consumers.

Table-6: Estimated Consumption* of Wollastonite

<table>
<thead>
<tr>
<th>Industry</th>
<th>2013-14</th>
<th>2014-15 (R)</th>
<th>2015-16 (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Industries</td>
<td>187300</td>
<td>177900</td>
<td>151200</td>
</tr>
<tr>
<td>Ceramic</td>
<td>187300</td>
<td>177900**</td>
<td>151200**</td>
</tr>
<tr>
<td>Others</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
</tbody>
</table>

Figures rounded off.

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

<table>
<thead>
<tr>
<th>Country</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Total</td>
<td>1098252</td>
<td>1439401</td>
<td>1338427</td>
</tr>
<tr>
<td>China</td>
<td>750000</td>
<td>1100000</td>
<td>1000000</td>
</tr>
<tr>
<td>Finland'</td>
<td>11500</td>
<td>10000</td>
<td>10000</td>
</tr>
<tr>
<td>India'</td>
<td>192712</td>
<td>186524</td>
<td>175348</td>
</tr>
<tr>
<td>Mexico</td>
<td>57302</td>
<td>54579</td>
<td>57451</td>
</tr>
<tr>
<td>Spain</td>
<td>16738</td>
<td>15298</td>
<td>17700</td>
</tr>
<tr>
<td>USA'</td>
<td>70000</td>
<td>70000</td>
<td>70000</td>
</tr>
<tr>
<td>Other countries</td>
<td>-</td>
<td>3000</td>
<td>7928</td>
</tr>
</tbody>
</table>

* 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

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-8).

Imports

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-9).

Table –8 : Exports of Wollastonite (By Countries)

<table>
<thead>
<tr>
<th>Country</th>
<th>2014-15 Qty (t)</th>
<th>2014-15 Value (‘000)</th>
<th>2015-16 Qty (t)</th>
<th>2015-16 Value (‘000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Countries</td>
<td>17864</td>
<td>288087</td>
<td>16616</td>
<td>279263</td>
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<tr>
<td>Belgium</td>
<td>7989</td>
<td>133579</td>
<td>8899</td>
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<tr>
<td>Japan</td>
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<td>Germany</td>
<td>1787</td>
<td>36565</td>
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<td>24186</td>
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<td>315</td>
<td>6415</td>
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<td>5968</td>
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<td>Saudi Arabia</td>
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<td>23</td>
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<td>1098</td>
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<tr>
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<td>31846</td>
<td>287</td>
<td>5677</td>
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</table>

Table –9 : Imports of Wollastonite (By Countries)

<table>
<thead>
<tr>
<th>Country</th>
<th>2014-15 Qty (t)</th>
<th>2014-15 Value (‘000)</th>
<th>2015-16 Qty (t)</th>
<th>2015-16 Value (‘000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Countries</td>
<td>1948</td>
<td>32549</td>
<td>2818</td>
<td>53216</td>
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<td>China</td>
<td>1641</td>
<td>19672</td>
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<td>USA</td>
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<td>3740</td>
<td>189</td>
<td>11870</td>
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<tr>
<td>Germany</td>
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<td>2661</td>
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<tr>
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<td>-</td>
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<td>++</td>
<td>13</td>
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<tr>
<td>Other countries</td>
<td>12</td>
<td>407</td>
<td>++</td>
<td>5</td>
</tr>
</tbody>
</table>
WOLLASTONITE

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 151,200 tonnes and as per Sub-Group Report for 12th Plan Period, the apparent domestic demand is estimated at 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 by augmenting the reserves of wollastonite in the States of Tamil Nadu and Gujarat, India would be in a formidable position to cope with futuristic demands.