

WOLLASTONITE

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Wollastonite, a calcium metasilicate (CaSiO_3), has a theoretical composition of 48.3% calcium oxide and 51.7% silicon dioxide but may contain trace to minor amounts of aluminum, iron, magnesium, manganese, potassium, and sodium. It occurs as prismatic crystals that break into massive-to-acicular fragments. It is usually white but also may be gray, brown, or red depending on its composition.

Wollastonite forms when impure limestones are metamorphosed (subjected to heat and pressure) or silica-bearing fluids are introduced into calcareous sediments during metamorphism. In both cases, calcite reacts with silica to produce wollastonite and carbon dioxide. Wollastonite also can crystallize directly from a magma that has an unusually high carbon content, but this is a less common occurrence.

Deposits of wollastonite have been found in Arizona, California, Idaho, Nevada, New Mexico, New York, and Utah. These deposits also may contain calcite, diopside, garnet, idocrase, and quartz as minor components.

Wollastonite is used primarily in ceramics, friction products (brakes and clutches), metallurgy, paint, and plastics. Some of the properties that make it so useful are its high brightness and whiteness, low moisture and oil absorption, low volatile content, and the acicular nature of some wollastonite.

Production

Wollastonite has been mined commercially in California and New York. The California deposits, which are in Inyo, Kern, and Riverside Counties, were mined between 1930 and 1970. These operations were limited in size, producing only a few thousand metric tons per year for ceramics, decorative stone, paint, and mineral wool production.

Wollastonite deposits in New York have been mined for more than 50 years. Two companies currently are mining wollastonite—NYCO Minerals Inc. (a subsidiary of Fording Inc.) operates a mine in Essex County, and R.T. Vanderbilt Co. Inc. operates a mine in Lewis County. The NYCO deposit contains wollastonite, garnet, and diopside. Parts of the deposit comprise up to 60% wollastonite. The ore is processed at the Willsboro plant, where the garnet is removed by using high-intensity magnetic separators. NYCO also chemically modifies the surfaces of some of its wollastonite products to improve their performance. The R.T. Vanderbilt deposit in Lewis County consists primarily of wollastonite as well as minor amounts of calcite and prehnite and trace amounts of diopside. The ore is processed at R.T. Vanderbilt's Balmat plant, where it is milled and air classified.

In 2002, domestic wollastonite production was essentially unchanged from that of 2001. Data collected by the U.S. Geological Survey are withheld to avoid revealing proprietary information, but Hawley (2002) estimated U.S.

production to be between 115,000 metric tons per year (t/yr) and 127,000 t/yr.

Sherritt International Corp. initiated a hostile takeover of Fording, with a \$955 million purchase offer. Sherritt International was primarily interested in the coal assets of Fording, although NYCO was included in the deal. The company was joined in the purchase by the Ontario Teachers' Pension Plan Board, which has a 6.2% share in Fording (Jones, 2002). The purchase transaction was completed in February 2003 with the creation of the Fording Canadian Coal Trust. The trust is controlled by Sherritt International, the Ontario Teachers' Pension Plan Board, Teck Cominco Ltd., and Westshore Terminals Income Fund (Fording Inc., 2003).

Consumption

In 2002, domestic sales of wollastonite in the United States were essentially unchanged from those of 2001. Sales for plastics applications were strong, while those for ceramic, metallurgy, and low-value applications probably remained unchanged or declined slightly in 2002. Fording indicated that it had increased sales of high-value wollastonite products but had lower total sales. The company cited a slow domestic economy and foreign price competition for declining sales in the low-value markets (Fording Inc., 2002, p. 15).

In 1999, plastics accounted for an estimated 37% of U.S. sales, followed by ceramics (28%), metallurgical applications (10%), paint (10%), friction products (9%), and miscellaneous (6%) (Industrial Minerals, 1999). According to Hawley (2002), most of the fine-powder product market is used by the ceramics industry, although there is a trend toward finer high-aspect products for plastics applications. This trend is driven by the increased use of unpainted plastic parts in automobile and truck bodies, where finer particles provide a smoother finished surface. Wollastonite also was used in adhesives, joint compounds, refractory products, rubber, and wallboard applications.

In ceramics, wollastonite decreases shrinkage and gas evolution during firing, increases green and fired strength, maintains its brightness during firing, permits fast firing, and reduces crazing, cracking, and glaze defects. In metallurgical applications, wollastonite serves as a flux for welding, a source for calcium oxide, a slag conditioner, and a protectant for the surface of molten metal during the continuous casting of steel. As a filler in paint, it reinforces the paint film, acts as a pH buffer, improves its resistance to weathering, reduces gloss, reduces pigment consumption, and acts as a flattening and suspending agent. In plastics, it improves tensile and flexural strength, reduces resin consumption, and improves thermal and dimensional stability at elevated temperatures. Surface treatments are used to improve the adhesion between

the wollastonite and the polymers to which it is added. As a substitute for asbestos in floor tiles, friction products, insulating board and panels, paint, plastics, and roofing products, wollastonite is resistant to chemical attack, inert, stable at high temperatures, and a good reinforcer.

Prices

Prices for wollastonite ranged from \$50 per metric ton (lump) to \$1,700 per ton for ultrafine, surface-treated wollastonite (Hawley, 2002). Prices for domestically produced acicular wollastonite, ex works, were \$190 per ton for 200 mesh, \$234 per ton for 325 mesh, and \$258 per ton for 400 mesh. The price, ex works, for acicular, high-aspect-ratio wollastonite was \$318 per ton. Prices for wollastonite from China, free on board (f.o.b.), in bulk, were \$80 per ton to \$100 per ton for 200 mesh and \$90 per ton to \$110 per ton for 325 mesh (Industrial Minerals, 2002). Other price quotations, free on board, from China, powder grades, bulk or big bags, were \$50 per ton to \$60 per ton for up to 9.8-inch (250-millimeter) lump, \$65 per ton to \$80 per ton for 150 mesh, \$70 per ton to \$85 per ton for 200 mesh, and \$75 per ton to \$90 per ton for 325 mesh (Kendall, 2001). Prices for filler grades ranged from \$89 per ton to \$473 per ton and those for ceramic grades ranged from \$58 per ton to \$137 per ton, for wollastonite from Asia and Europe (Geo.net Commodities GmbH, 2003¹). Quoted prices should be used only as a guideline because actual prices depend on the terms of the contract between the seller and the buyer.

Foreign Trade

Comprehensive foreign trade data were not available for wollastonite. Imports were estimated to be between 2,500 metric tons (t) and 3,000 t in 2002. The United States imported 600 t to 800 t from China, 1,400 t to 1,500 t from India, and about 1,000 t from Mexico, based on data from the Journal of Commerce Port Import/Export Reporting Service. Imports from China and Mexico probably were in the form of lower value wollastonite grades. A small amount (about 115 t) of wollastonite was imported from Finland. Exports were estimated to be between 4,500 t and 5,000 t in 2002, with the greatest portion of exports being shipped to the Netherlands.

World Review

Worldwide production of wollastonite was estimated to be between 550,000 t and 600,000 t in 2002. As with many industrial minerals, the structure of the wollastonite mining industry is such that it is difficult to accurately determine production. Production in China was estimated to be between 300,000 t and 320,000 t.

In 2002, production for Finland, India, and Mexico was estimated to be 20,000 t (reported as 22,300 t in 1996), 100,000 t (reported as 95,700 t in 1998), and 40,000 t (reported as 39,800 t in 2001), respectively. Small tonnages probably also were

produced in Morocco, Namibia (estimated to be 450 t in 2002 and reported as 441 t in 2000), North Korea, Pakistan, and Turkey (less than 5,000 t/yr).

Outlook

The slow recovery of the U.S. economy probably will continue to hamper sales in the United States. Domestic demand for automobiles remains strong, so sales for friction products and automotive plastics probably will remain unchanged or increase slightly. Ceramics and paint markets probably will remain unchanged. The most promising market is in plastics, with sales anticipated to increase as plastics continue to substitute for metal components in products.

References Cited

- Fording Inc., 2002, 2002 annual report: Calgary, Alberta, Canada, Fording Inc., 72 p.
- Fording Inc., 2003, Fording completes transactions—Creates Fording Canadian Coal Trust: Calgary, Alberta, Canada, Fording Inc. press release, February 28, 3 p.
- Hawley, G.C., 2002, Wollastonite: *Mining Engineering*, v. 55, no. 6, June, p. 55-56.
- Industrial Minerals, 1999, Wollastonite: *Industrial Minerals*, no. 379, April, p. 19.
- Industrial Minerals, 2002, Prices: *Industrial Minerals*, no. 423, December, p. 71.
- Jones, Jeffrey, 2002, Sherritt in C\$1.5 billion hostile bid for Fording: Calgary, Alberta, Canada, Reuters, October 21, 2 p.
- Kendall, Tom, 2001, Wollastonite review: *Industrial Minerals*, no. 411, December, p. 63-67.

Internet Reference Cited

- Geo.net Commodities GmbH, 2003, Offers—Ceramic grade and filler grade, accessed May 29, 2003, via URL <http://geo.net>.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

- Pigments and Fillers. Ch. in *United States Mineral Resources*, Professional Paper 820, 1973.
- Wollastonite—A Versatile Industrial Mineral. Fact Sheet FS-002-01, 2001.

Other

- American Ceramic Society.
- Andrews, P.R.A., 1993, Wollastonite: Energy, Mines and Resources Canada Summary Report No. 18, 26 p.
- Ceramic Industry (monthly).
- Chemical Market Reporter (weekly).
- Economics of Wollastonite, The: Roskill Information Services Ltd., 1996.
- Minerals Pricewatch (monthly).
- Mining Engineering (monthly).
- Mining Journal (monthly).
- Paint and Coatings Industry (monthly).

¹A reference that includes a section mark (§) is found in the Internet References Cited section.