



# 2010 Minerals Yearbook

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## WOLLASTONITE

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Wollastonite was mined by two companies in the United States in 2010. U.S. production data collected by the U.S. Geological Survey (USGS) are withheld to avoid disclosing company proprietary data, but U.S. production and sales increased with the recovery of the global economy from the 2008–09 recession. Exports of wollastonite were estimated to be less than 10,000 metric tons (t), but greater than those of 2009. Imports of wollastonite were estimated to be less than 4,000 t in 2010, unchanged from those of 2009. World sales of refined wollastonite products were estimated to be in the range of 460,000 to 500,000 t in 2010 compared with 430,000 to 470,000 t in 2009.

Wollastonite, a calcium metasilicate ( $\text{CaSiO}_3$ ), has an ideal composition of 51.7% silicon dioxide and 48.3% calcium oxide but can also contain trace to minor amounts of aluminum, iron, magnesium, manganese, potassium, sodium or strontium substituting for calcium. Wollastonite occurs in the form of prismatic crystals that break into tabular-to-acicular fragments. It is usually white but also may be gray, cream, brown, pale-green, or red depending on the impurities and grain size. Wollastonite is used primarily in automobile brakes, ceramics, metallurgical processing, paint, and plastics. Some of the properties that make it so useful are high brightness and whiteness, low moisture and oil absorption, low volatile content, and the acicular nature of some wollastonite.

## Production

In 2010, domestic wollastonite production increased from that of 2009. Data collected by the USGS are withheld to avoid disclosing proprietary information. Average annual U.S. wollastonite production was reported in the trade literature to be about 65,000 tons per year (t/yr) in 2009 (Ellen, 2009; Feytis, 2009).

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 each year for ceramics, decorative stone, paint, and mineral wool production before closing.

Wollastonite deposits in New York have been mined for more than 50 years. Two companies mined wollastonite in 2010—NYCO Minerals, Inc. [a subsidiary of Resource Capital Fund IV L.P. (RCF), Denver, CO], which operated a mine in Essex County, and R.T. Vanderbilt Co., Inc., through its Gouverneur Mineral Division, which operated a mine in Lewis County. The NYCO deposit contains diopside, garnet, and wollastonite. Parts of the deposit contain up to 60% wollastonite. The ore was processed at the Willsboro, NY, plant, where the garnet was removed using high-intensity magnetic separators. NYCO also chemically modified the surfaces of some of its wollastonite

products to improve their performance. R.T. Vanderbilt's deposit consists primarily of wollastonite with minor amounts of calcite and prehnite and trace amounts of diopside. The ore was processed at the company's St. Lawrence County plant, where it was milled and air classified. R.T. Vanderbilt also produced surface-treated products.

## Consumption

The USGS does not collect end-use data on wollastonite. Based on company press releases, general overview articles, U.S. manufacturing trends, and previously published consumption estimates, plastics and rubber applications were estimated to account for 30% to 35% of U.S. sales in 2010, followed by ceramics with 20% to 25%; metallurgical applications, 10% to 20%; paint, 10% to 15%; friction products, 10% to 15%; and miscellaneous, 10% to 15%.

Ceramic applications probably account for 30% to 40% of wollastonite sales worldwide, followed by polymers (plastics and rubber) with 30% to 35% of sales, and paint with 10% to 15% of sales. The remaining sales were for construction, friction products, and metallurgical applications (Kendall, 2001; Robinson, 2006).

The distribution of sales among domestic markets may have shifted slightly towards plastics and metallurgical applications in 2010 compared with those of 2009 because automobile manufacturing and steel demand began to recover from the global recession earlier than other wollastonite markets. Commercial and residential construction activity, where wollastonite may be used in products such as adhesives, caulks, ceramics, paints, stucco, and roof coatings, did not increase significantly from levels in 2009. The trend in wollastonite sales in Europe in 2010 probably was similar to that in the United States. In Asia, growth was likely more uniform across all markets.

In ceramics, wollastonite decreases shrinkage and gas evolution during firing, increases green and fired strength, maintains 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 to protect the surface of molten metal during the continuous casting of steel. As an additive in paint, it improves the durability of 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, wollastonite 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 improves flexural and tensile strength (Roskill Information Services Ltd., 1996, p. 58–59, 78–81, 104–107, 119, 123–128).

## Prices

Quoted prices for domestically produced acicular wollastonite, ex-works, were \$200 to \$230 per metric ton for 200-mesh, \$210 to \$240 per ton for 325-mesh, and \$444 for high-aspect-ratio wollastonite. Prices for wollastonite from China, free on board, in bulk, were \$80 to \$90 per ton for 200-mesh and \$90 to \$100 per ton for 325-mesh (Industrial Minerals, 2010). Hawley (2010) indicated that wollastonite sold for plastics applications was \$600 to \$1,800 per ton, and prices for ceramic grades of wollastonite were \$200 to \$450 per ton from a major U.S. producer. 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 trade data were not available for wollastonite because it is included under generic U.S. Census Bureau Harmonized Tariff Schedule (HTS) code 2530.90.8060 (mineral substances not elsewhere specified or included). Some wollastonite also may be exported under HTS code 2121.00.0000 (limestone flux; limestone and other calcareous stone). With the global economy showing signs of recovery from the 2008–09 economic recession, U.S. exports were likely to have increased from those of 2009. Documented exports were in the range of 1,500 to 2,000 t. These exports were moved by ship to Argentina, Australia, Belgium, Brazil, China, Colombia, the Dominican Republic, Germany, Hong Kong, India, Japan, the Netherlands, Nicaragua, the Republic of Korea, South Africa, and the United Kingdom (United Business Media Global Trade, undated). Additional quantities probably were transported by truck or train to Canada.

U.S. imports were estimated to be less than 4,000 t in 2010, about the same as in 2009. Imports transported by ship were received from China, Finland, Germany, and India. India was reported to be the leading source of wollastonite imported into the United States by ship, followed by Finland, China, and Germany (United Business Media Global Trade, undated). Imports from Germany were thought to be transshipments because there is no mining of wollastonite in Germany. Small additional quantities of wollastonite may have been imported by rail or truck from Canada and Mexico.

## World Review

World production of crude wollastonite ore probably increased by 5% to 10% in 2010 compared with that of 2009 as many countries began to recover from the recent global recession, and the Asian economy continued to remain strong. Estimated crude ore production increased and was in the range of 550,000 to 575,000 t in 2010 compared with 520,000 to 540,000 t in 2009. Sales of refined wollastonite products

probably were in the range of 460,000 to 500,000 t in 2010, an increase from 430,000 to 470,000 t in 2009.

In 2010, wollastonite production in China was estimated to be 300,000 to 320,000 t (300,000 t in 2009), and production in India was probably 145,000 t (132,000 t in 2009). The United States ranked third in wollastonite production (about 65,000 t in 2009). Production in Mexico was estimated to have increased to 40,000 t in 2010 (29,700 t in 2009). Following Mexico in ranking were Finland (16,000 t in 2009), Spain (7,000 t in 2009), and Namibia (55 t in 2009) (Brown and others, 2011, p. 103). Small quantities of wollastonite may have been produced in other countries. Data for 2010 were not available for most countries.

**Finland.**—Rettig Group acquired full ownership of Nordkalk Corp., which produced limestone and wollastonite. Rettig became a shareholder of Nordkalk in 2002 and gradually increased its holdings over time. Nordkalk was one of the top five world wollastonite producers (Feytis, 2010a).

**India.**—Wolkem India Ltd. increased production capacity at its mine in the Sirohi district of Rajasthan by 15% to 175,000 t/yr (Feytis, 2011).

**South Africa.**—Namaqua Wollastonite (Pty.) Ltd. announced plans to begin wollastonite mining at its Magata project near Garies, Namaqualand. The wollastonite had a high aspect ratio but also had a high iron content. Namaqua planned to market their wollastonite as an asbestos substitute and for construction applications, friction products, and plastics (Feytis, 2010b).

## Outlook

Demand for and production of wollastonite increased in 2010 as countries began to slowly recover from the global recession. U.S. manufacturing began to increase in 2010, resulting in increased demand for wollastonite for such applications as powder coatings for consumer appliances, surface conditioners for steel casting, ingredients for manufacturing technical ceramic bodies, and reinforcements for plastics products. Commercial and residential construction remained almost unchanged in 2010. Consequently, demand for wollastonite for architectural paints, caulks, ceramic tile glazes and bodies, roof coatings, sanitaryware, sealants, stucco, and wallboard did not increase significantly. Use of wollastonite in structural clay products, such as brick and quarry tile, also did not increase significantly because of the continued slow construction markets. The automotive industry increased its output in 2010, increasing demand for wollastonite for the manufacture of such items as friction products and wollastonite-reinforced plastic automotive components.

Economic growth was expected to be greatest in countries with developing and emerging economies, where the average economic growth rate was expected to be 6.5% in 2011 and 2012. For countries with advanced economies, the average growth rate was expected to be 2.5% in 2011 and 2012 (International Monetary Fund, 2011). The slower growth in countries with advanced economies probably will prompt European and North American wollastonite producers to continue to direct their marketing attention towards Asian markets.

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## GENERAL SOURCES OF INFORMATION

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