

GARNET

By Ronald F. Balazik

Garnet is the name for a family of complex silicate minerals that have similar physical properties and contain one or more of the following metals in their crystalline structure: aluminum, calcium, chromium, iron, magnesium, manganese, and titanium. Industrial-grade garnet from the United States is a solid solution of almandite (iron-aluminum garnet) and pyrope (magnesium-aluminum garnet) that breaks into sharp chisel-edged plates. Industry uses this garnet as an abrasive powder and to manufacture coated abrasives. Low-quality industrial garnet primarily is utilized as airblasting or hydroblasting media and as filtration media.

Production

The United States is one of the world's largest producers of industrial garnet, accounting for an estimated 40% of global output. In 1995, five U.S. firms produced 53,000 tons of crude garnet concentrate valued at about \$10 million. The firms were Barton Mines Corp., Warren County, NY; NYCO Minerals, Inc., Essex County, NY; Patterson Materials Corp., Wingdale, NY; International Garnet Abrasive Inc., Clinton County, NY; and Emerald Creek Garnet Co., Benewah County, ID. All five firms were surveyed by the U.S. Geological Survey to determine U.S. production and sales of industrial garnet. Four of the five firms responded to the survey, accounting for about 90% of production.

At yearend 1995, a new garnet operation was set to open in southwestern Montana. The facility reportedly will begin producing about 9,000 tons of crude garnet per year and eventually will have a capacity of about 40,000 tons annually.

Consumption

The United States is the world's largest consumer of industrial garnet, accounting for almost 40% of estimated global consumption. Estimates of 1995 garnet consumption in the United States range from 45,000 to 60,000 tons. Major end uses in the United States and their estimated market share are as follows: Blasting media, 45%; water filtration, 15%; waterjet cutting and abrasive powders, 10% each; and other abrasive uses, 15%. Domestic industrial sectors that utilize garnet included the petroleum industry (40%), filtration plants (20%), transport manufacturing (20%), wood furniture finishing operations (10%), electronic component manufacturing (7%), and ceramics and glass production (3%).

Industrial garnet is used primarily as a loose-grain abrasive; some low-quality industrial garnet also is used as filtration media. High-quality, high-value garnet primarily has been used as a loose-grain abrasive for applications such as optical lens

grinding and plate-glass grinding for more than a century. In recent years, industrial garnet has been used for high-quality, scratch-free lapping of semiconductor materials and other metals. Other industrial applications include the manufacture of coated abrasives; air/water blasting; hydrocutting; nonskid surfaces; and the finishing of wood, leather, hard rubber, felt, and plastics.

Shipbuilding and aluminum aircraft industries use lower quality garnet for sandblasting. Similar uses include the cleaning and conditioning of aluminum and other soft metals as well as metals cleaning by structural steel fabrication shops. Mixed-media water filtration, using a mixture of sand, anthracite, and garnet, has displaced older filtration methods because it is more reliable and provide better water quality. Garnet entrained in high-pressure streams of water also is used to cut many different materials. In addition, the manufacturers of nonskid floor paint use alluvial and other low-cost garnets in their products.

Garnet has an intermediate place in the coated-abrasive field between low-cost quartz sand and more costly synthetic abrasives (silicon carbide and fused alumina). In addition, garnet reportedly is more efficient than quartz sand in similar applications. However, garnet, especially the lower grades, cannot compete with synthetic abrasives in most metalworking applications requiring substantial metal removal because of its friable nature and lower hardness.

Prices

Industrial garnet has a very wide range of values that are dependent on quality and use. Garnet ore values reportedly range from \$60 to \$85 per ton. Reported values for concentrates averaged \$175 per ton, but ranged from \$55 to \$205 per ton. Refined garnet values generally range from \$180 to \$550 per ton. However, prices for small quantities of highly processed garnet (e.g., powders) that are more than double the upper limit of this range have been reported.

Foreign Trade

The U.S. Department of Commerce, which is the major government source of U.S. trade data, does not provide import or export statistics on industrial garnet. However, the U.S. Geological Survey estimates that U.S. industrial garnet imports and exports in 1995 were at least 5,000 tons and 9,000 tons, respectively. Australia has accounted for about 85% of U.S. industrial garnet imports since 1990; India and China have been the remaining import sources.

World Review

Garnet occurs worldwide in many metamorphic rocks, particularly gneisses and schists. Moreover, garnet occurs as contact-metamorphic deposits in crystalline limestones, pegmatites, and serpentinites, and in high-temperature intrusive contacts and vein deposits. Alluvial garnet also is a coproduct with many heavy mineral sand and gravel deposits throughout the world. In addition to the United States, major garnet deposits exist in Australia, China, and India, where they are mined for foreign and domestic markets; deposits in Russia and Turkey also have been mined in recent years, primarily for internal markets.

Estimates of world industrial garnet production range from 110,000 to 155,000 tons. In addition to the United States, leading producers in recent years have been Australia, China, and India. It is estimated that Australia produced at least 30,000 tons of industrial garnet in 1995, while estimates for China and India indicate a minimum output of 15,000 tons each. Some reports more than double these estimates. At yearend 1995, new garnet operations were under development in southeastern India and in Ontario, Canada.

Outlook

Worldwide demand for industrial garnet has the potential to increase significantly. Forecasts indicate that global markets for industrial garnet may grow beyond 320,000 tons within the next 5 years. Specifically, world markets for garnet blasting media and waterjet cutting conceivably could more than double by the year 2000 if economic conditions permit. New production facilities currently planned worldwide to meet anticipated

demand would add more than 320,000 tons of capacity if constructed. Additional capacity would tend to restrain price increases.

According to industry plans, U.S. production capacity for garnet could increase by at least 20% before the end of this decade. However, the domestic garnet industry may be operating near capacity already. If so, new domestic markets for industrial garnet in the remaining 1990's largely will depend on imports if economic conditions and/or resource restrictions delay additional capacity.

If industrial garnet is not available to meet growing demand, other natural and synthetic abrasives could serve as substitutes to some extent for all major end uses. In many cases, however, the substitutes would entail sacrifices in quality or cost. Fused alumina and staurolite compete with garnet as a sandblasting material in the transportation equipment industries. Ilmenite and plastics compete as filtration media. Diamond, corundum, and fused alumina compete for lens grinding and for many lapping operations. Finally, sand, silicon carbide, and fused alumina compete for grinding and finishing of plastics, wood furniture, and other products.

OTHER SOURCES OF INFORMATION

U.S. Geological Survey Publications

Garnet Chapter of Mineral Commodity Summaries—1996
United States Mineral Resources: U.S. Geological Survey
Professional Paper 820, pp. 27-33.

Other Sources

Gorrill, Lindsay E., "World Garnet Review - Supply and Markets," 12th Industrial Minerals International Congress, 1996.

TABLE 1
SALIENT U.S. INDUSTRIAL GARNET STATISTICS 1/

Year	Crude production		Sold or used	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
1991	50,900	\$7,530	48,100	\$13,000
1992	54,100	4,840	46,100	13,000
1993	44,000	4,440	55,800	15,400
1994	51,000	6,100	40,600	15,000 r/
1995	53,000	10,000	34,900	17,900

r/ Revised.

1/ Data are rounded to three significant digits.