

# Molybdenum

*U.S. Geological Survey Molybdenum Commodity Specialist Michael J. Magyar has prepared the following information on molybdenum — one of the most important ferrous metals and the only one for which the United States is a net exporter.*

Molybdenum is a metallic element that is most frequently used in alloy and stainless steels, which together represent the single largest market for molybdenum. Molybdenum has also proven invaluable in carbon steel, cast iron and superalloys. Its alloying versatility is unmatched because its addition enhances material performance under high-stress conditions in expanded temperature ranges and in highly corrosive environments. The metal is also used in catalysts, other chemicals, lubricants and many other applications.

Molybdenum does not occur in metallic form in nature. Although a number of molybdenum-bearing minerals have been identified, the only one of commercial significance is molybdenite — a natural molybdenum sulfide. Roasting plants convert molybdenite concentrate to molybdic oxide (generally known as “tech-oxide”), which produces intermediate products, such as ferromolybdenum, metal powder and various chemicals. A unique feature of molybdenum, in contrast to other heavy metals, is the low toxicity of its compounds.

In World War I, molybdenum was widely used in steel as a replacement for tungsten, which was in short supply. The increased use of molybdenum led to the development of flotation technology to concentrate the molybdenite ore from a massive, disseminated porphyry deposit in Climax, Colo., which became the site of the world’s premier molybdenum mine.

After the war ended, the Climax Molybdenum Company established a research laboratory to expand the uses of molybdenum. Initial successes included the introduction of low-alloy steels into the automobile industry and development of a line of molybdenum-bearing high-speed and tool steels. After World War II, additional research resulted in development of markets for molybdenum-containing structural steel.

About half of the world’s known reserves of molybdenum are found in the Western Cordillera of North America and South America. More than 95 percent of the world’s supply of molybdenum is mined from porphyry molybdenum or porphyry copper-molybdenum deposits in which primary copper sulfides and/or molybdenite occur as disseminated grains and in stockworks (mineral deposits) of quartz veins. About half of the molybdenum mined worldwide comes from mines where it is the primary mineral produced, and the rest is recovered as a byproduct from copper mining.

Metallurgical applications dominated molybdenum use in 2003, accounting for about 80 percent of total consumption. In 2003, ferromolybdenum accounted for 39 percent of the molybdenum-bearing forms used to make steel, a 3 percent increase from that of 2002. In 2003, exports of molybdenum contained in materials (molybdenum content of exported molybdates, oxides and hydroxides not included) were about 21,000 metric tons, valued at \$168 million. Imports for consumption of molybdenum contained in materials (products) were about 10,500 metric tons, valued at \$125 million.

In 2003, U.S. mine production (molybdenum contained in concentrate) was estimated to be 34,100 metric tons, a 5 percent increase from 32,600 metric tons in 2002. World mine production of molybdenum in 2003 increased to 127,000 metric tons, a 3 percent increase from 123,000 metric tons in 2002. In descending order of production, the United States, Chile, China, Peru, Canada, Armenia and Mexico provided almost 94 percent of the world production of molybdenum. The U.S. share of world production was 27 percent in 2003, the same as in 2002. Chile, China and the United States also possessed about 85 percent of the estimated 19 million metric tons of molybdenum in the world reserve base.

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Sample of molybdenite. Image from *Minerals in Your World*.