

Sulfur

U.S. Geological Survey Sulfur Commodity Specialist Joyce A. Ober has prepared the following information on sulfur, global production of which minimizes the environmental effects of oil and natural gas production.

Since domestic sulfur production peaked at nearly 11 million metric tons in 1974, the sulfur industry has undergone dramatic change. In 1974, mined sulfur produced using the Frasch hot water method provided 8 million tons of sulfur, representing 75 percent of total elemental sulfur production. (In the Frasch process, hot water is injected directly into the sulfur-containing mineral strata, melting the crystalline sulfur, which then lifts to the surface with air.) The remaining 25 percent was produced as byproduct sulfur.

Byproduct sulfur — recovered to minimize the emission of sulfur dioxide at petroleum refineries and to eliminate poisonous hydrogen sulfide from natural gas supplies — now comprises 100 percent of domestic elemental sulfur production, which totals 8.5 million tons. Sulfur resources amenable to recovery through the Frasch method still exist in the United States; but the high energy requirement and cost of the method forced the closure of the last mine in 2000. Domestic sulfur supplies are insufficient to meet current demand, so the United States imports from Canada, Mexico and Venezuela.

In 2001 and 2002, the United States was the global leader in elemental sulfur production with production of nearly 8.5 million tons. Canada was the world's second largest producer of elemental sulfur, producing 8.3 million tons in 2001; preliminary 2002 reports estimate production at 7.8 million tons. [can cut if space a problem] Other major producers of elemental sulfur are, in descending order of production, Russia, Saudi Arabia, Japan, United Arab Emirates, Kazakhstan, Poland and Germany, each with more than 1 million tons of elemental sulfur production.

The vast majority of worldwide elemental sulfur production is recovered sulfur (byproduct). Poland is the only known significant producer of mined sulfur in the world, producing about 1.1 million tons in 2001. Iraq has produced Frasch sulfur in the past, but the status of its Frasch operations has been in question since Operation Desert Storm in 1991. Prior to 1991, Iraq had the capacity to produce about 1 million tons of sulfur annually at its Mishraq Mine. Recovered sulfur was produced at the petroleum refinery in Kirkuk. As the country begins to rebuild after Operation Iraqi Freedom, sulfur will again be produced at its refineries. It is not known whether Frasch production will resume.

Nonelemental sulfur forms are used to produce sulfuric acid. Byproduct sulfuric acid is produced at nonferrous metal smelter and pyrites are still used to produce sulfuric acid in a few countries. Leading producers of byproduct sulfuric acid are, in descending order, China, Japan, Chile and Canada, each with more than 1 million tons of sulfur contained in byproduct acid in 2001. China was the only country to use pyrites as the source of more than 1 million tons of sulfur in sulfuric acid.

Worldwide, more than 90 percent of all sulfur is converted to sulfuric acid before consumption, and nearly 50 percent of all sulfuric acid is used to produce phosphate fertilizers. Other end uses

include other agricultural chemicals, chemical production, copper ore leaching, petroleum refining, and pulp and paper products.

Although sulfur remains a widely used mineral commodity, production growth is outpacing consumption growth. Data complete through 2001 show that global production surpassed consumption for seven consecutive years beginning in 1995 — resulting in large stockpiles accumulating in a few countries, particularly Canada, with about 15 million tons, and Kazakhstan, with more than 4.6 million tons. Researchers are investigating techniques for disposing of excess sulfur to ease the storage concerns; but stockpile growth is expected to continue.

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Sample of sulfur crystal. Image from *Minerals in Your World*.