

## BISMUTH

(Data in metric tons of bismuth content, unless otherwise noted)

**Domestic Production and Use:** There is no domestic refinery production of primary bismuth. One refinery in Nebraska formerly produced bismuth as a byproduct of lead refining, but bismuth operations there ceased in 1997. Bismuth is contained in some domestically mined lead ores, but no byproduct bismuth was produced. Forty companies, mostly in the eastern United States, accounted for an estimated three-fourths of the bismuth consumed in 2002. The value of bismuth consumed was estimated at more than \$14 million. About 42% of the bismuth was used in fusible alloys, solders, and cartridges; 37% in pharmaceuticals and chemicals; 19% in metallurgical additives; and 2% in other uses.

<b>Salient Statistics—United States:</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002<sup>e</sup></b>
Production, refinery	—	—	—	—	—
Imports for consumption, metal	2,720	2,110	2,410	2,220	1,600
Exports, metal, alloys, scrap	245	257	491	541	200
Shipments from Government stockpile excesses	—	—	—	—	—
Consumption, reported	1,990	2,050	2,130	2,200	2,000
Price, average, domestic dealer, dollars per pound	3.60	3.85	3.70	3.74	3.20
Stocks, yearend, consumer	175	121	118	95	80
Employment, refinery, number of workers	—	—	—	—	—
Net import reliance <sup>1</sup> as a percentage of apparent consumption <sup>e</sup>	95	95	95	95	95

**Recycling:** Bismuth was recovered from fusible alloy scrap, but contributes less than 5% of the U.S. supply.

**Import Sources (1998-2001):** Belgium, 32%; Mexico, 23%; China, 18%; United Kingdom, 16%; and other, 11%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12/31/02</b>
Articles thereof, including waste and scrap	8106.00.0000	Free.

**Depletion Allowance:** 22% (Domestic), 14% (Foreign).

**Government Stockpile:** The final 85 tons of bismuth in the National Defense Stockpile was sold in 1997.

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**Events, Trends, and Issues:** Bismuth was used in several applications designed to provide nontoxic substitutes for lead. The Safe Drinking Water Act Amendment of 1996 required that all new and repaired fixtures and pipes for potable water be lead-free after August 1998. Bismuth use in water meters was one particular application that increased. Other major areas of development included bismuth shot for waterfowl hunting, bismuth-containing solders, and lubricating greases, especially extreme pressure lubricants. The use of new zinc-bismuth alloys in galvanizing to achieve better processing continued to grow. Bismuth was also used in ceramic glazes, crystal ware, and pigments. A bismuth-strontium-calcium-copper-oxide superconducting ceramic was installed in part of an electric power transmission system in Detroit, MI. Denmark and Spain have banned the use of lead in certain applications; bismuth could substitute in these cases.

World lead mine production and world primary lead refinery production has not increased significantly in recent years, limiting the amount of bismuth that can be produced as a lead byproduct. But bismuth was also recovered from some copper ores and from tungsten ores, especially in Asia. The dealer price remained fairly steady, about 15% lower than in 2001, throughout the year.

The Bismuth Institute, based in Brussels, Belgium, discontinued all operations and ceased to exist in 2002. For nearly 30 years, the Institute provided bismuth statistics and encouraged research and development as well as new uses for the metal. The Institute helped open trade with China, which is now the world leader in bismuth reserves and production. Moreover, the Institute consistently promoted the environmental advantages offered by bismuth as a substitute for lead in various applications.

**World Mine Production, Reserves, and Reserve Base:** Reserves and reserve base estimates have been revised for China and Japan based on new information from those countries. Significant fluctuations in annual Bolivian bismuth production were caused by withholding of production, shifts in government policy, and work stoppages.

	Mine production		Reserves <sup>2</sup>	Reserve base <sup>2</sup>
	2001	2002 <sup>e</sup>		
United States	—	—	9,000	14,000
Australia	—	—	18,000	27,000
Bolivia	5	10	10,000	20,000
Canada	200	300	5,000	30,000
China	1,500	1,500	240,000	470,000
Japan	28	25	6,000	12,000
Kazakhstan	130	130	5,000	10,000
Mexico	1,000	1,000	10,000	20,000
Peru	1,000	800	11,000	42,000
Other countries	137	150	15,000	35,000
World total (may be rounded)	4,000	3,900	330,000	680,000

**World Resources:** World reserves of bismuth are usually associated with lead deposits, except in China, North Korea, and Vietnam (where economically recoverable bismuth is found with tungsten ores and some copper ores) and in Australia (where bismuth is found with copper-gold ores). Bismuth minerals rarely occur in sufficient quantities to be mined as principal products, except in Bolivia and China. Bismuth is potentially recoverable as a byproduct of the processing of molybdenum and non-Asian tungsten ores, although extraction of bismuth from these ores usually is not economic.

**Substitutes:** Antibiotics, magnesia, and alumina can replace bismuth in pharmaceutical applications. Titanium dioxide-coated mica flakes and fish scale extracts are substitutes in pigment uses. Indium can replace bismuth in low-temperature solders. Resins can replace bismuth alloy jigs used for holding metal shapes during machining. Glycerine-filled glass bulbs can replace bismuth alloys as a triggering device for fire sprinklers. Selenium, tellurium, and lead could replace bismuth in free-machining alloys.

<sup>e</sup>Estimated. — Zero.

<sup>1</sup>Defined as imports - exports + adjustments for Government and industry stock changes.

<sup>2</sup>See Appendix C for definitions.