

BISMUTH

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

Domestic Production and Use: The United States ceased production of primary refined bismuth in 1997 and is thus highly import dependent for its supply. A small amount of bismuth is recycled by some domestic firms. Bismuth is contained in some lead ores mined domestically, but the bismuth-containing residues are not processed domestically and may be exported. The value of bismuth consumed was approximately \$64 million. About 47% of the bismuth was used for metallurgical additives; 34% in fusible alloys, solders, and ammunition cartridges; 18% in pharmaceuticals and chemicals; and 1% in other uses.

The Safe Drinking Water Act Amendment of 1996 required that all new and repaired fixtures and pipes for potable water supply be lead free after August 1998. Bismuth use in water meters and fixtures is one particular application that has increased in recent years. An application with major growth potential is the use of zinc-bismuth alloys to achieve thinner and more uniform galvanization. Bismuth was also used domestically in the manufacture of ceramic glazes, crystal ware, and pigments; as an additive to free-machining steels; and as an additive to malleable iron castings.

Salient Statistics—United States:	<u>2003</u>	<u>2004</u>	<u>2005</u>	<u>2006</u>	<u>2007^e</u>
Production, refinery	—	—	—	—	—
Imports for consumption, metal	2,320	1,980	2,530	2,300	2,700
Exports, metal, alloys, and scrap	108	109	142	311	670
Consumption:					
Reported	2,120	2,420	2,340	2,050	2,100
Apparent	2,040	2,130	2,490	2,070	2,125
Price, average, domestic dealer, dollars per pound	2.87	3.35	3.91	5.04	13.75
Stocks, yearend, consumer	279	134	136	155	160
Net import reliance ¹ as a percentage of apparent consumption	95	95	96	95	95

Recycling: All types of bismuth-containing alloy scrap were recycled and contributed about 10% of U.S. bismuth consumption, or 250 tons.

Import Sources (2003-06): Belgium, 38%; Mexico, 23%; China, 19%; United Kingdom, 12%; and other, 8%.

<u>Tariff:</u> Item	Number	Normal Trade Relations <u>12-31-07</u>
Bismuth and articles thereof, including waste and scrap	8106.00.0000	Free.

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

Government Stockpile: None.

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Events, Trends, and Issues: Owing to its unique properties, bismuth has a wide variety of applications, including use in free-machining steels, brass, pigments, and solders, as nontoxic replacements for lead; in pharmaceuticals, including bismuth subsalicylate, the active ingredient in over-the-counter stomach remedies; in the foundry industry, as an additive to enhance metallurgical quality; in the construction field, as a triggering mechanism for fire sprinklers; and in holding devices for grinding optical lenses. Currently, researchers in the European Union, Japan, and the United States are investigating the possibilities for the use of bismuth in lead-free solders. Researchers are looking at liquid lead-bismuth coolants for use in nuclear reactors. Work is proceeding toward developing a bismuth-containing metal polymer bullet.

The price of bismuth started 2007 at \$7.30 per pound and slowly rose throughout the first quarter. In early April, the price rise accelerated from \$10.50 per pound to \$15.00 per pound in late April, to \$18.00 per pound in late May, and reached a peak of \$18.50 per pound in late June. Then by early July, the price began to subside gradually, reaching \$14.50 per pound in mid-October. The estimated average price for 2007 was about 173% above that for 2006. Industry sources attributed the substantial price increases to a moderate increase in world demand combined with flat world production and speculative investing activity.

Around the world, there were a couple of bismuth exploration activities that seemed promising. In Canada, an exploration firm announced that its cobalt-gold-bismuth deposit in the Northwest Territories was undergoing a feasibility study and that an agreement was reached to sell all of its eventual bismuth production to a European bismuth refiner. Another Canadian exploration firm announced increased expenditures to develop its property in Vietnam that contains bismuth, fluor spar, and tungsten.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves ²	Reserve base ²
	<u>2006</u>	<u>2007^e</u>		
United States	—	—	—	14,000
Bolivia	70	70	10,000	20,000
Canada	190	190	5,000	30,000
China	3,000	3,000	240,000	470,000
Kazakhstan	140	140	5,000	10,000
Mexico	1,180	1,200	10,000	20,000
Peru	950	960	11,000	42,000
Other countries	<u>170</u>	<u>160</u>	<u>39,000</u>	<u>74,000</u>
World total (rounded)	5,700	5,700	320,000	680,000

World Resources: Bismuth, at an estimated 8 parts per billion by weight, is the 69th element in order of abundance in the Earth's crust and is about twice as abundant as gold. World reserves of bismuth are usually based on bismuth content of lead resources because bismuth production is most often a byproduct of processing lead ores; in China, bismuth production is a byproduct of tungsten and other metal ore processing. Bismuth minerals rarely occur in sufficient quantities to be mined as principal products; the Tasna Mine in Bolivia and a mine in China are the only mines that produced bismuth from a bismuth ore. The Tasna Mine has been on standby status since the mid-1990s awaiting a significant and sustained rise in the metal price. Several bismuth-containing deposits are in varying stages of mining feasibility review. These polymetallic deposits include Bonfim in Brazil, NICO in Canada, and Nui Phao in Vietnam.

Substitutes: Bismuth can be replaced in pharmaceutical applications by alumina, antibiotics, and magnesia. 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 alloys for holding metal shapes during machining, and glycerine-filled glass bulbs can replace bismuth alloys in triggering devices for fire sprinklers. Free-machining alloys can contain lead, selenium, or tellurium as a replacement for bismuth.

Bismuth, on the other hand, is an environmentally friendly substitute for lead in plumbing and many other applications, including fishing weights, hunting ammunition, lubricating greases, and soldering alloys.

^eEstimated. — Zero.

¹Defined as imports – exports + adjustments for Government and industry stock changes.

²See Appendix C for definitions.