



# 2009 Minerals Yearbook

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BISMUTH

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Bismuth consumption in the United States was estimated to be 1,180 metric tons (t), an increase of 8% compared with that of 2008 (tables 1, 2). The estimated value of bismuth consumed domestically was \$19 million in 2009. The estimated domestic consumption breakdown for bismuth for 2009 was: 60% for chemical and pharmaceutical uses; 36% for metallurgical additives for casting and galvanizing; and 4% for bismuth alloys, fusible alloys, solder and ammunition (table 2).

Bismuth was last produced domestically, as a byproduct of lead refining, at a Nebraska refinery that closed in 1997. The last stocks of bismuth in the National Defense Stockpile were sold that same year. In 2009, all primary bismuth consumed in the United States was imported. Only a small amount of bismuth was obtained by recycling old scrap. The leading producers of refined bismuth in 2009 were, in descending order, China, Mexico, Belgium, and Peru. Belgium had no bismuth mine production, and its sole bismuth producer refined metal from anode slimes, concentrates, and smelter residues and flue dust, all of foreign origin. The principal suppliers to the United States were China, Belgium, the Republic of Korea, the United Kingdom, and Mexico, in descending order.

In recent years, new uses for bismuth as a nontoxic substitute for lead have been developed. These include the use of bismuth in shot for water fowl hunting, lubricating greases, pigments, and solders.

The annual average dealer price for bismuth in 2009 decreased to \$7.84 per pound, a 38% decrease from that of 2008. Industry observers attributed the price decline to the world economic slowdown.

## Production

Domestic production of primary refined bismuth ceased in 1997. Some domestic firms continued to recover secondary bismuth from fusible alloy scrap in 2009, but secondary production data were not available. Secondary production was estimated to be less than 5% of domestic supply during the year.

## Consumption

The U.S. Geological Survey surveys domestic bismuth consumption annually. The amount used by nonrespondents is estimated based on reports from prior years or on information from other sources. Accordingly, estimated bismuth consumption was about 1,180 t in 2009, an increase of 8% compared with that of 2008.

Consumption of bismuth in chemical uses (chemicals, cosmetics, and pharmaceuticals) in 2009 increased by 18% compared with that in 2008. The alloys category of use registered a 31% decline in consumption in 2009 compared with that in 2008. Metallurgical additives experienced a 13% increase

in consumption in 2009 compared with those in 2008. These substantial declines, especially for alloys and metallurgical additives, were attributed to the general economic slowdown, which especially affected industrial applications.

Bismuth pharmaceuticals include the well-known bismuth salicylate (the active ingredient in over-the-counter stomach remedies) and other bismuth medicinal compounds used to treat burns, intestinal disorders, and stomach ulcers in humans and animals. Bismuth nitrate is the initial material used for the production of most bismuth pharmaceutical compounds. Other applications of bismuth chemicals and compounds include uses in superconductors and pearlescent pigments for cosmetics and paints.

Bismuth metal is used primarily as a major constituent of various alloys and as a metallurgical additive (table 2). One class of bismuth alloys consists of fusible (low-melting-point, as low as 20° C) alloys, which are combinations of bismuth with other metals, such as antimony, cadmium, gallium, indium, lead, and tin. Applications for those alloys include fuel tank safety plugs, holders for optical lens grinding, and other articles for machining or grinding, solders, and fire sprinkler triggering mechanisms.

In addition to lead-free solder noted above, bismuth has been a substitute for lead added to certain steel products to provide greater machinability. A major domestic steel producer began to use a bismuth-containing substitute for the leaded alloy about 1982. Although bismuth has been used successfully to replace lead in various applications, it has been challenged as a lead substitute by tin and tungsten (Cusack, 1999).

Bismuth is also added in small amounts to aluminum (along with lead) and copper alloys to improve machinability. It is also added to malleable iron graphite flakes. These uses constitute the traditional metallurgical additives category.

## Prices

In 2009, the annual average Platts Metals Week New York dealer price for bismuth declined to \$7.84 per pound, a decrease of 38% from that in 2008. The annual average price had experienced a steady and substantial rise from 2003 to 2007.

In 2009, the weekly bismuth price started the year at \$8.50 to \$9.50 per pound. The price reached a low for the year in early August, at \$5.50 to \$6.50 per pound, then rose later in the third and fourth quarters to finish the year at \$7.35 to \$8.00 per pound.

## Foreign Trade

U.S. exports of bismuth metal, alloys, and waste and scrap rose by 6% compared with those in 2008. Notable increases were recorded for exports to Belgium, China, France, and

Vietnam. Substantial decreases were noted for exports to Canada, Mexico, Thailand, and the United Kingdom.

U.S. imports of metallic bismuth decreased by 35% compared with the 2008 figures (table 4). Bismuth imports were about three times greater (by weight) than bismuth exports. The leading import source for the United States was China, which supplied 44% of imports. Considerable increases in imports were observed for those from the Republic of Korea and Mexico. There were sizable decreases in imports from China, Hong Kong, Peru, and the United Kingdom.

## World Review

In much of the world, bismuth is produced as a byproduct of smelting lead ores. In China, it is also a byproduct of fluor spar, tin, and tungsten ore processing. In Bolivia, the Tasma Mine, the only mine that produces bismuth from bismuth ore, has been on standby since the mid-1990s, awaiting a sufficient and substantial rise in the metal price.

World refinery production of bismuth was 15,000 t, the same as that in 2008. China was the world's leading producer of refined bismuth with 80% of the world total, followed by Mexico with 6%, and Belgium with 5%.

**Bolivia.**—The Mining and Metallurgy Ministry announced that exports of bismuth from the Telamayo smelter in Potosi Department would begin in June 2009. The smelter, which was restarted in late 2008 following an investment of \$1 million, refined minerals, such as antimony, arsenic, bismuth, copper, tin, and tungsten. Telamayo produced 1 metric ton per day of bismuth, which was a byproduct of refined copper, lead, and tin production (Metal-Pages, 2009).

**Canada.**—Fortune Minerals Ltd. (London, Ontario) announced further progress with its NICO gold-cobalt-bismuth-copper project. NICO is a planned vertically integrated project to mine and concentrate ores from Fortune's deposit in the Northwest Territories. Fortune entered into an agreement to purchase land near Saskatoon, Saskatchewan, on which it proposes to construct its southern hydrometallurgical facility. Bulk concentrates would be transported by truck and rail to the facility for processing to high-value metal products, including bismuth cathodes, cobalt, copper, and gold dore. Beginning in 2012, the Saskatoon refinery would process 80,000 metric tons per year (t/yr) of NICO sulfide concentrates each year, yielding average production of 1,800 t/yr of 99.8% cobalt cathode, 1,900 t/yr of 99.8% bismuth cathode, as well as 2,500 kilograms per year (kg/yr) of gold in the first 2 years of mine life, followed by 840 kg/yr of gold production in subsequent years (Fortune Minerals Ltd., 2009).

**Mexico.**—Met-Mex Penoles S.A. de C.V. (Torreon), a significant bismuth refiner, declared force majeure on its lead and precious metals processing in March owing to a strike that began in February over a wage dispute. Because of an oversupplied world bismuth market, the force majeure did not materially affect prices. The 60-day strike ended in April (Metal Bulletin, 2009).

**Peru.**—Doe Run Peru (Lima) encountered financial difficulties and furloughed its workers from August 1 through yearend (American Metal Market, 2009). Doe Run Peru announced that it had signed a letter of intent with Glencore

International AG (Baar, Switzerland) for a credit line that could be used as working capital to restart its La Oroya polymetallic smelter, which has been idle since June 2009. The funds also could be partially used to finance part of its environmental cleanup program at La Oroya, which was estimated to cost \$156 million. La Oroya refined bismuth as well as several other metals (American Metal Market, 2010).

## Outlook

Over much of the past decade, worldwide bismuth demand has been increasing at about 3% to 5% per year. However, the global economic slowdown that began in late 2008 and extended through 2009 led to a substantial contraction in consumption. World consumption of bismuth in the steel sector decreased, although it was relatively minor compared with that in other use sectors. World consumption in the chemical industry seemed to be rising, especially in Japan, as bismuth began to replace lead in pigments.

Selected segments of the bismuth use markets, such as metallurgical additives in particular, were very much involved in the industrial sectors of the economy, and any improvement there will likely depend on how quickly the world's industrialized nations can rebound from the 2008–09 economic slowdown.

Commercial and research organizations in Europe, Japan, and North America agreed to a framework to eliminate lead from solders in manufacturing. This agreement would tend to increase the demand for bismuth during the 2010 through 2012 period because bismuth is used in some solders. Many Japanese manufacturers were using lead-free solders in some or all of their soldering applications, and studies on how best to develop lead-free solders were being performed independently by the European Union, Japan, the Republic of Korea, and the United States. Although world lead consumption was expected to be reduced by only 0.8% by these moves, world bismuth consumption may increase by about 25% by this trend.

A significant, near-term increase in supplies of lead byproduct bismuth was unlikely because world production of lead from mine sources was expected to be relatively stable, and an increasing portion of lead demand was expected to be met by recycling. A global shortage of bismuth, however, was not anticipated. In China, new technologies have increased world bismuth reserves. Therefore, despite large increases in world demand, supplies from China can be expected to help keep the bismuth market stable.

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## GENERAL SOURCES OF INFORMATION

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Bismuth. Ch. in United States Mineral Resources, Professional Paper 820, 1973.

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### Other

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TABLE 1  
SALIENT BISMUTH STATISTICS<sup>1</sup>

		2005	2006	2007	2008	2009
United States:						
Consumption <sup>e, 2</sup>	metric tons	2,390	1,960	2,630	1,090	1,180
Exports <sup>3</sup>	do.	142	311	421	375	397
Imports for consumption	do.	2,530	2,300	3,070	1,930	1,250
Price, average, domestic dealer	dollars per pound	3.91	5.04	14.07	12.73	7.84
Stocks, December 31, consumer	metric tons	175	120 <sup>r</sup>	139 <sup>r</sup>	228	134
World production: <sup>e, 4</sup>						
Mine, metal content <sup>5</sup>	do.	5,400	5,800	6,200	7,600 <sup>r</sup>	8,200
Refinery	do.	14,000	15,000	16,000	15,000	15,000

<sup>e</sup>Estimated. <sup>r</sup>Revised. do. Ditto.

<sup>1</sup>Data are rounded to no more than three significant digits.

<sup>2</sup>Estimated based on net imports.

<sup>3</sup>Comprises bismuth metal and the bismuth content of alloys and waste and scrap.

<sup>4</sup>Data are rounded to no more than two significant digits.

<sup>5</sup>Excludes the United States.

TABLE 2  
ESTIMATED BISMUTH METAL CONSUMED  
IN THE UNITED STATES, BY USE<sup>1, 2</sup>

(Metric tons)

Use	2008	2009
Chemicals <sup>3</sup>	597	706
Bismuth alloys	75	52
Metallurgical additives	375	422
Other	38	3
Total	1,090	1,180

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Estimated based on net imports.

<sup>3</sup>Includes industrial and laboratory chemicals, cosmetics, and pharmaceuticals.

TABLE 3  
 U.S. EXPORTS OF BISMUTH METAL, ALLOYS, AND WASTE AND SCRAP,  
 BY COUNTRY<sup>1</sup>

Country	2008		2009	
	Quantity (kilograms, metal content)	Value (thousands)	Quantity (kilograms, metal content)	Value (thousands)
Argentina	8,340	\$78	220	\$17
Australia	319	3	--	--
Austria	140	4	--	--
Belgium	--	--	56,600	820
Belize	21	3	--	--
Bolivia	--	--	136	3
Brazil	28,400	264	13,400	121
Canada	55,100	866	32,900	701
China	3,210	79	28,800	261
Colombia	3,120	82	1,230	29
Costa Rica	2,130	19	--	--
Cyprus	51	7	34	4
Czech Republic	3,400	31	99	9
Dominican Republic	8,950	81	6,550	60
Egypt	1,020	38	97	6
France	13,600	791	121,000	1,450
Germany	3,380	39	2,420	37
Hong Kong	1,730	30	2,410	26
India	770	14	121	3
Ireland	124	4	--	--
Israel	3,490	33	--	--
Japan	4,460	117	11,000	309
Korea, Republic of	54	5	--	--
Mexico	76,400	998	59,300	1,350
Paraguay	--	--	106	4
Saudi Arabia	1,470	13	27	3
Singapore	8,680	103	445	30
Slovenia	--	--	316	3
South Africa	50	7	30	3
Spain	163	9	283	3
Sweden	794	12	83	7
Taiwan	55	9	219	16
Thailand	25,500	446	8,590	78
Turkey	--	--	361	11
United Arab Emirates	20	4	--	--
United Kingdom	101,000	2,370	4,710	50
Vietnam	18,400	174	45,200	411
Total	375,000	6,730	397,000	5,820

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 4  
U.S. IMPORTS FOR CONSUMPTION OF METALLIC BISMUTH, BY COUNTRY<sup>1</sup>

Country	2008		2009	
	Quantity (kilograms)	Value (thousands)	Quantity (kilograms)	Value (thousands)
Belgium	509,000	\$10,500	450,000	\$8,350
Canada	18,500	229	5,740	88
China	998,000	24,200	554,000	8,180
France	23,100	533	--	--
Germany	696	41	1,600	94
Hong Kong	93,500	1,980	--	--
Italy	50	7	50	8
Japan	104	15	--	--
Kazakhstan	--	--	9,850	185
Korea, Republic of	--	--	75,100	1,170
Mexico	40,000	1,080	59,400	758
Netherlands	416	91	124	22
Peru	55,700	1,100	29,400	386
Poland	80	17	--	--
Russia	--	--	3,320	239
Spain	825	29	--	--
Switzerland	6	5	--	--
United Kingdom	186,000	4,890	62,400	1,110
Total	1,930,000	44,700	1,250,000	20,600

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 5  
BISMUTH: ESTIMATED WORLD MINE AND REFINERY PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Metric tons)

Country	Mine					Refinery				
	2005	2006	2007	2008	2009	2005	2006	2007	2008	2009
Belgium	--	--	--	--	--	800	800	800	800	800
Bolivia	44 <sup>3</sup>	155 <sup>r,3</sup>	147 <sup>3</sup>	28 <sup>r,3</sup>	50	-- <sup>3</sup>	1 <sup>r,3</sup>	-- <sup>3</sup>	92 <sup>r,p</sup>	100
Bulgaria	40	45	45	45	NA	35 <sup>3</sup>	30	30	30	NA
Canada <sup>4</sup>	185	177 <sup>r,3</sup>	137 <sup>3</sup>	71	86 <sup>3</sup>	250	250	200	150 <sup>f</sup>	150
China	3,000	3,000	3,500	5,000	6,000	10,600	11,800	12,100	12,000	12,000
Italy	--	--	--	--	--	5	5	5	5	5
Japan <sup>5</sup>	23	21	20	20	21	463 <sup>3</sup>	425 <sup>3</sup>	408	410 <sup>f</sup>	420
Kazakhstan	140	140	145	150	150	120	115	120	125	125
Mexico	970 <sup>3</sup>	1,186 <sup>3</sup>	1,200	1,170	854	970 <sup>3</sup>	1,186 <sup>3</sup>	1,200	1,170	854
Peru	952 <sup>3</sup>	950	950	960	960 <sup>p</sup>	600	600	600	600	600
Romania	40	40	40	40	40	35	30	30	30	NA
Russia	50	55	55	70	65	10	11	12	13	12
Total <sup>6</sup>	5,400	5,800	6,200	7,600 <sup>f</sup>	8,200	14,000	15,000	16,000	15,000	15,000

<sup>p</sup>Preliminary. <sup>f</sup>Revised. NA Not available. -- Zero.

<sup>1</sup>Estimated data are rounded to no more than three significant digits.

<sup>2</sup>Table includes data available through April 1, 2010. Bismuth is produced primarily as a byproduct of other metals, mainly lead and tungsten.

<sup>3</sup>Reported figure.

<sup>4</sup>Figures listed under mine output are the metal content of concentrates produced, according to Natural Resources Canada, 2005–06.

<sup>5</sup>Mine output figures have been estimated to be 5% of reported metal output figures.

<sup>6</sup>World totals are rounded to no more than two significant digits.