



# 2019 Minerals Yearbook

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## BISMUTH [ADVANCE RELEASE]

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# BISMUTH

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In 2019, reported consumption of bismuth in the United States was 548 metric tons (t), 4% less than that in 2018 (tables 1, 2). The estimated value of bismuth consumed domestically decreased to \$3.85 million in 2019, 34% less than the value for 2018 owing to a 4% decrease in reported consumption and a 31% decrease in the average U.S. dealer price. In 2019, all primary bismuth consumed in the United States was imported, principally from China, which accounted for 55% of total imported bismuth. Other leading suppliers to the United States were, in descending order by quantity, the Republic of Korea (23%), Mexico (8%), and Belgium (5%) (table 4). In 2019, world refinery production of bismuth was 21,100 t, 10% more than that in 2018 (table 5). China was the world's leading producer of refined bismuth as a byproduct of processing ores of fluorspar, lead, tin, tungsten, and zinc, accounting for 76% of the estimated world total, followed by Laos with 14%.

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. Some domestic firms continued to recycle bismuth alloy scrap; however, data were unavailable to make estimates of secondary production for 2019.

Bismuth is one of the rarest elements on Earth, constituting less than an estimated 0.001% of the Earth's continental crust and ranking 65th in abundance among the elements. It occurs in association with lead and, consequently, is most often recovered as a byproduct of lead refining.

## Legislation and Government Programs

In 2018, the U.S. Department of the Interior, in coordination with other executive branch agencies, published a list of 35 mineral commodities, including bismuth. The list was developed to serve as an initial focus, pursuant to Executive Order 13817, "A Federal Strategy To Ensure Secure and Reliable Supplies of Critical Minerals" (U.S. Department of the Interior, 2018).

Under section 301(b) of the Trade Act of 1974, as amended, the Office of the U.S. Trade Representative (USTR) determined that acts, policies, and practices of China related to technology transfer, intellectual property, and innovation were discriminatory or unreasonable and those actions burdened or restricted United States commerce. The USTR formally sought public comments on imposing a 25% duty on certain Chinese products (Office of the U.S. Trade Representative, 2018a). In September 2018, the United States imposed a 10% import tariff on approximately \$200 billion worth of Chinese goods. Bismuth-containing products subject to the section 301 actions included the following Harmonized Tariff Schedule (HTS) codes: 2834.29.05 (bismuth nitrate), 2836.99.20 (bismuth carbonate), 3815.90.10 [reaction initiators, reaction accelerators, and catalytic preparations, not elsewhere specified or included

(n.e.s.o.i.), consisting wholly of bismuth, of tungsten, or of vanadium], 3824.99.31 (mixtures of bismuth), and 8106.00.00 [bismuth (including waste and scrap) and articles thereof, n.e.s.o.i.] (Office of the U.S. Trade Representative, 2018b). On May 10, 2019, the tariff on these goods was increased to 25% (Office of the U.S. Trade Representative, 2019).

## Consumption

Consumption data were derived by the U.S. Geological Survey from voluntary surveys of 33 companies in 2019. Responses were received from 20 of these companies. The amount of bismuth consumed by the companies that did not respond to the survey was estimated based on prior reports or on information from other sources. In 2019, reported consumption was 548 t, a decrease of 4% as compared with that in 2018 (table 1).

The leading use of bismuth metal in the United States was in chemicals, accounting for 56% of reported consumption (table 2). Within the chemicals-use category, the leading use of bismuth was for pharmaceuticals, including 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. Other applications of bismuth included superconductors and pearlescent pigments for cosmetics and paints.

Bismuth metal also was used as a major constituent of various alloys accounting for 21% of reported consumption, an increase of 22% from 2018 (table 2). One class of bismuth-base alloys, fusible alloys (characterized as having a low melting point, as low as 20 degrees Celsius (°C)), consists of combinations of bismuth with other metals, such as antimony, cadmium, gallium, indium, lead, and tin. Applications for those alloys included fuel tank safety plugs, holders for optical lenses, and other articles for machining or grinding, solders, and fire sprinkler triggering mechanisms.

As a metallurgical additive, bismuth was added in small amounts to aluminum and copper alloys to improve machinability and to malleable iron to prevent formation of graphite flakes. Bismuth was substituted for lead in certain steel products to provide greater machinability and in lead-free glasses, pigments, shot for waterfowl hunting, and solder. Although bismuth has been used successfully to replace lead in various applications, tin and tungsten also have been substituted for lead in some applications.

## Prices

The Fastmarkets annual average free market price for 99.99%-pure bismuth (Rotterdam) was \$3.19 per pound in 2019, a 31% decrease from the 2018 annual average price of \$4.64 per pound (table 1). The average daily price began 2019 at \$3.60 per pound and fluctuated between \$3.55 per pound

and \$3.95 per pound throughout the first quarter. In the second through the fourth quarters, the price generally decreased from \$3.55 per pound to \$2.63 per pound, where it ended the year. The price experienced an overall decrease of 27% from January to December 2019 largely as a result of oversupply in China, the successful sale at auction of approximately 19,200 t of Fanya Metal Exchange inventory, and the United States import tariff on Chinese bismuth, which slowed market demand (Belda, 2019a; Rakes, 2019).

Figure 1 illustrates the relation between price and apparent consumption, defined in this report as imports for consumption minus exports plus adjustments for industry stock changes, over the past 20 years.

## Foreign Trade

The United States imported 2,300 t of bismuth metal, alloys, and waste and scrap in 2019, an 8% decrease from 2,510 t in 2018 (tables 1, 4). The imported bismuth was principally sourced from China (55%), the Republic of Korea (23%), Mexico (8%), and Belgium (5%) (table 4). The United States exported 636 t of bismuth metal, alloys, and waste and scrap in 2019, a 3% decrease from 653 t in 2018 (tables 1, 3). United States bismuth was principally exported to Vietnam (52%), Canada (12%), Mexico (7%), and Hong Kong (5%).

## World Review

Bismuth was produced principally as a byproduct of the smelting of lead concentrates; however, it was also a byproduct of processing ores of fluor spar, tin, and tungsten in China, tungsten-polymetallic ore processing in Vietnam, copper smelter flue dust processing in Zambia, and zinc production in Japan and the Republic of Korea. A world production total for mined bismuth ore was not available owing to it being a byproduct. World production data are only available once the bismuth is refined. World refinery production of bismuth was 21,100 t in 2019, a 10% increase from 19,200 t produced in 2018. China was the world's leading producer of refined bismuth, accounting for 76% of the estimated world total, followed by Laos (14%), the Republic of Korea (4%), Japan (3%), and others (3%) (table 5).

**Canada.**—On July 22, 2019, 5N Plus Inc. (Montreal, Quebec, Canada), producer of engineered materials and specialty chemicals, announced that it would increase its purchases of commercial-grade bismuth metal owing to residue shortages from its suppliers. The residues were purchased by 5N Plus from producers of other metals that generated the residues as a byproduct. The residues were used in 5N Plus's refining and recycling facilities to extract bismuth for use in its products. Low bismuth prices were affecting suppliers' ability to provide residues at a profitable margin (5N Plus Inc., 2019). The company typically produced 3,000 to 3,500 metric tons per year of bismuth. Since July, the company reportedly purchased 100 to 200 metric tons per month (t/mo) of bismuth (Belda, 2019b).

**China.**—On June 1, China imposed a 25% import tariff on more than 5,000 items including bismuth oxide from the United States. China's action appears to have been a response to the United States-imposed tariffs on Chinese goods which increased from 10% to 25% on May 10 (Manthey, 2019).

Trade tensions with China may diminish demand from the manufacturing sector for raw material such as bismuth and continue to affect bismuth prices.

In September, China's Hunan Yongxing Zhongde Environmental Protection Technology Co., Ltd. suspended bismuth metal production to perform equipment maintenance and upgrade work. Once production resumed, capacity was expected to increase to 600 to 700 t/mo. As planned, production resumed in October; however, plans to increase production were not implemented owing to low bismuth prices (Argus Metals International, 2019a, b).

On November 22, the Kunming Intermediate People's Court sold by auction the bismuth metal bar inventory previously held by the failed Fanya Metal Exchange. Kunming Rongke New Materials Company purchased 19,228.05 t of bismuth for \$87.8 million<sup>1</sup> (Xu and Daly, 2019). The total inventory purchased by Kunming Rongke New Materials Co. was estimated to equal 1 to 2 years' worth of global supply and would contribute to global stocks of bismuth being larger than consumer demand at 2019 production rates (Rakes, 2019).

China's exports of bismuth metal including waste and scrap (HTS code 8106.00.00) in the first half of 2019 were 1,830 t, a 17% decrease from 2,200 t in the same period of 2018. Bismuth exports in the second half of 2019 were 2,170 t, a 20% increase from 1,810 t in the same period of 2018. Full-year exports of bismuth in 2019 were 4,000 t in 2019, unchanged from those in 2018 (Zen Innovations AG, 2020).

## Outlook

Globally, most end uses of bismuth are in the industrial sectors of the economy. An increase in global bismuth demand depends on economic growth and bismuth being used as a replacement for lead. Emerging uses in data transmission, medical treatment, and solar cells potentially could increase the demand for bismuth though these applications are still in the research and development stage. In the short term, supplies of bismuth exceed consumption because of the release of the Fanya Metal Exchange's bismuth stock and China's overproduction. These factors are expected to affect the market through 2020.

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<sup>1</sup>Where necessary, values have been converted from Chinese Yuan Renminbi (CNY) to U.S. dollars (US\$) at the 2019 average annual exchange rate of CNY6.9066=US\$1.00.

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

		2015	2016	2017	2018	2019
United States:						
Consumption, reported, bismuth metal	metric tons	566	651	694	570	548
Exports <sup>2</sup>	do.	519	431	392	653	636
Imports for consumption <sup>2</sup>	do.	1,950	2,190	2,820	2,510	2,300
Price, average, domestic dealer <sup>3</sup>	dollars per pound	6.43	4.53	4.93	4.64	3.19
Stocks, December 31, consumer, bismuth metal	metric tons	457	513	489	346	443
World refinery production	do.	19,400	19,700	19,800 <sup>r</sup>	19,200	21,100

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

<sup>1</sup>Table includes data available through June 3, 2020. Data are rounded to no more than three significant digits; except prices.

<sup>2</sup>Consists of bismuth metal, alloys, and waste and scrap.

<sup>3</sup>Price in 2015 is based on New York dealer price for 99.99%-purity metal in minimum lots of 1 ton; source: S&P Global Platts Metal Week. Prices in 2016–19 are based on 99.99%-purity metal at warehouse (Rotterdam) in minimum lots of 1 ton; source: American Metal Market (Fastmarkets AMM).

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

(Kilograms)

Use	2018	2019
Chemicals <sup>2</sup>	314,000	305,000
Bismuth alloys	96,200	118,000
Metallurgical additives	W	W
Other	W	W
Total	570,000	548,000

W Withheld to avoid disclosing company proprietary data; included in "Total."

<sup>1</sup>Table includes data available through June 3, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes cosmetics, industrial and laboratory chemicals, and pharmaceuticals.

TABLE 3  
U.S. EXPORTS OF BISMUTH METAL, ALLOYS, AND WASTE AND SCRAP,  
BY COUNTRY OR LOCALITY<sup>1,2</sup>

Country or locality	2018		2019	
	Quantity (kilograms)	Value (thousands)	Quantity (kilograms)	Value (thousands)
Argentina	60	\$8 <sup>r</sup>	398	\$26
Australia	--	--	9,550	132
Austria	--	--	1,150	44
Belgium	--	--	3,050	28
Bolivia	20	4	--	--
Brazil	2,910	64	22,200	461
Canada	128,000	1,860	73,400	1,160
Chile	1,560	15	2,100	23
China	31,000	394	8,780	112
Colombia	104	10	68	3
Costa Rica	2,000	18	655	6
Dominican Republic	887	14	119	7
Egypt	93	4	70	5
El Salvador	--	--	35	4
Finland	--	--	150	3
France	10,500	180	2,970	104
French Guiana	--	--	1,870	17
Germany	14,500	172	855	41
Greece	5,430	120	--	--
Honduras	110	8	--	--
Hong Kong	39,100	377	29,700	364
Hungary	--	--	4,010	70
India	15,300	178	5,450	193
Israel	1,740	63	4,650	50
Italy	1,020	27	1,970	52
Japan	5,950	53	5,700	105
Korea, Republic of	--	--	2,770	25
Laos	--	--	22,900	176
Lithuania	--	--	394	4
Malaysia	713	6	--	--
Mexico	33,200	493	46,800	670
Netherlands	--	--	1,100	10
Nicaragua	--	--	330	3
Peru	23	4	--	--
Philippines	347	3	1,130	28
Poland	45	5	--	--
Russia	34	3	--	--
Singapore	28,500	275	3,740	34
South Africa	1,850	94	914	43
Taiwan	1,870	29	2,970	27
Thailand	62,400	553	21,600	204
United Kingdom	10,200	96	19,500	184
Uruguay	--	--	40	5
Vietnam	254,000	2,320	332,000	3,030
Total	653,000	7,450	636,000	7,460

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through June 3, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Export data are reported by Schedule B number 8106.00.0000.

Source: U.S. Census Bureau.

TABLE 4  
U.S. IMPORTS FOR CONSUMPTION OF BISMUTH METAL, ALLOYS, AND WASTE AND SCRAP  
BY COUNTRY OR LOCALITY<sup>1,2</sup>

Country or locality	2018		2019	
	Quantity (kilograms)	Value (thousands)	Quantity (kilograms)	Value (thousands)
Belgium	143,000	\$1,370	116,000	\$763
Bolivia	20,100	194	--	--
Canada	8,640	152	5,670	100
China	1,510,000	15,900	1,260,000	8,530
Denmark	4	7 <sup>r</sup>	--	--
France	108	4	--	--
Germany	8,100	210	5,990	162
Hong Kong	120,000	1,350	97,500	1,140
Hungary	--	--	492	7
India	3,070	46	--	--
Indonesia	146	3	--	--
Italy	419	15	--	--
Japan	5	3	10,500	67
Korea, Republic of	313,000	2,720	533,000	3,220
Laos	42,900	481	--	--
Luxembourg	--	--	3,130	7
Mexico	205,000	1,970	195,000	1,260
Netherlands	1,060	9	--	--
Spain	37	5	--	--
Taiwan	1,210	38	1,410	44
Thailand	136,000	1,380	33,600	265
Uganda	--	--	923	5
United Kingdom	101	15	33,600	305
Total	2,510,000	25,800	2,300,000	15,900

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through June 3, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes data for Harmonized Tariff Schedule of the United States code 8106.00.0000.

Source: U.S. Census Bureau.

TABLE 5  
BISMUTH: WORLD REFINERY PRODUCTION<sup>1,2</sup>

(Metric tons)

Country or locality <sup>3</sup>	2015	2016	2017	2018	2019
Bolivia	--	8	8 <sup>r</sup>	39 <sup>r</sup>	15 <sup>e</sup>
Bulgaria <sup>c</sup>	42	47	50	50	50
Canada <sup>c</sup>	25	25	25	25	25
China	16,013	15,643	14,813 <sup>r</sup>	14,000 <sup>e</sup>	16,000 <sup>e</sup>
Japan <sup>4</sup>	632	428	525	571	540 <sup>e</sup>
Kazakhstan <sup>c</sup>	220	270	270	290	270
Korea, Republic of <sup>4</sup>	500	700	900	880 <sup>r</sup>	930 <sup>e</sup>
Laos	1,300 <sup>e</sup>	2,013	2,743	3,009	3,000 <sup>e</sup>
Mexico	603	539	513	333	300
Zambia <sup>5</sup>	40	--	--	--	--
Total	19,400	19,700	19,800 <sup>r</sup>	19,200	21,100

<sup>e</sup>Estimated. <sup>r</sup>Revised. -- Zero.

<sup>1</sup>Table includes data available through June 1, 2020. All data are reported unless otherwise noted. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Bismuth is produced as a byproduct of mining and processing other metals, mainly lead and tungsten. Not all mines that produce ores containing recoverable bismuth report their production. Therefore, some bismuth production may only be accounted for at the refinery level.

<sup>3</sup>In addition to the countries and (or) localities listed, Belgium, Romania, and Russia may have produced refined bismuth, but available information was inadequate to make reliable estimates of output.

<sup>4</sup>Refined bismuth was produced as a byproduct of zinc production.

<sup>5</sup>Bismuth recovered from smoke at the Chambishi copper smelter.

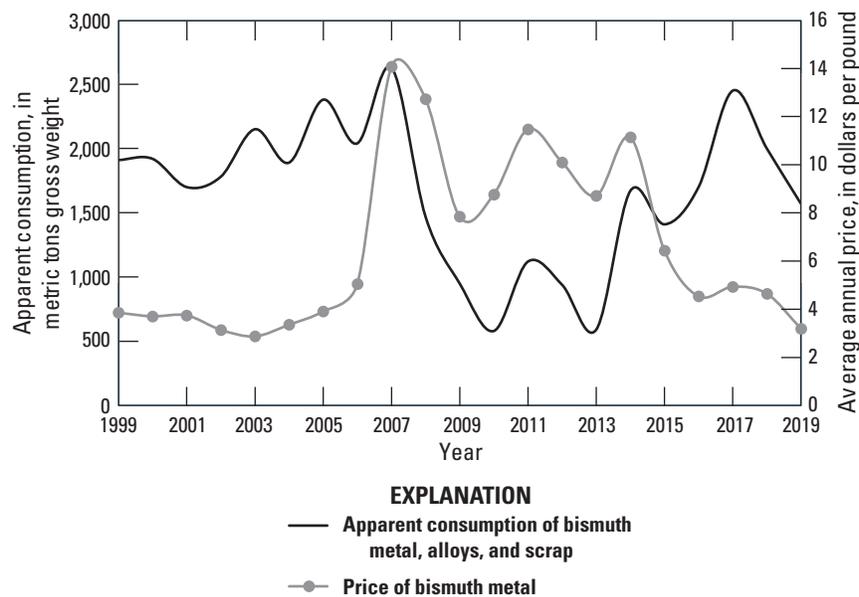


Figure 1. Bismuth metal apparent consumption and price for years 1999–2019.