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2022 Minerals Yearbook

BISMUTH [ADVANCE RELEASE]

U.S. Department of the Interior
U.S. Geological Survey

June 2025

U.S. Geological Survey, Reston, Virginia: 2025

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Bismuth

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In 2022, reported consumption of bismuth in the United States was 724 metric tons (t), 21% more than the quantity in 2021 (tables 1, 2). There was no primary refinery production of bismuth in the United States in 2022. 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. Although some domestic firms continued to recycle bismuth alloy scrap, the United States was heavily reliant on imports to meet its domestic consumption requirements. Bismuth was imported principally from China and the Republic of Korea in 2022 (table 4).

In 2022, estimated world refinery production of bismuth was 19,000 t, 5% less than the revised quantity in 2021 (tables 1, 5). China was the world's leading producer of refined bismuth as a byproduct of fluorspar, lead, tin, and tungsten-ore processing, accounting for 82% of the estimated world total, followed by Laos and the Republic of Korea, accounting for 10% and 4%, respectively (table 5).

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.

Government Actions and Legislation

In May 2018, the U.S. Department of the Interior, in coordination with other executive branch agencies, published a list of 35 critical mineral commodities, including bismuth. The list was developed pursuant to Executive Order 13817, "A Federal Strategy To Ensure Secure and Reliable Supplies of Critical Minerals." The list was to be updated periodically to reflect current data on supply, demand, concentration of production, and current policy priorities (U.S. Department of the Interior, 2018). In November 2021, the U.S. Geological Survey (USGS) proposed a new draft list of 50 mineral commodities, including bismuth, for public comment. The mineral commodities were identified based on an updated methodology developed by the USGS with interagency input. The new methodology was published by the USGS in May 2021 in, "Methodology and Technical Input for the 2021 Review and Revision of the U.S. Critical Minerals List" (U.S. Geological Survey, 2021). In February 2022, the final critical minerals list was published, which included bismuth (U.S. Department of the Interior, 2021, 2022). More information on legislation and Government programs related to critical minerals in 2022 can be found in the "United States Critical Minerals Update" in the Mineral Commodity Summaries 2023 (U.S. Geological Survey, 2023).

Consumption

Consumption data were derived by the USGS from voluntary surveys of 25 companies in 2022. Responses were received from 13 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 2022, reported consumption was 724 t, a 21% increase from that in 2021 (table 1).

The leading use of bismuth in the United States was in chemicals. Within chemicals, the leading use of bismuth was for pharmaceuticals, including bismuth subsalicylate (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 for bismuth chemicals included superconductors, pearlescent pigments for cosmetics and paints, and high-performance pigments in coatings and plastics for architectural and industrial uses.

Bismuth metal also was used as a major constituent of various alloys accounting for 30% of reported consumption (table 2). One class of bismuth-base alloys, fusible alloys (characterized as having a low melting point), 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 is substituted for lead in certain steel products to provide greater machinability, and in lead-free glass, pigment, shot for waterfowl hunting, and solder. Although bismuth has been used successfully to replace lead in various applications, tin and tungsten may also substitute for lead in some applications.

Prices

The Fastmarkets annual average price for 99.99%-pure bismuth (in-warehouse, Rotterdam) was $3.90 per pound in 2022, 4% more that the annual average price of $3.74 per pound in 2021 (table 1). The average price, published twice weekly, was on a slight downward trend for most of the year, beginning 2022 at $4.08 per pound and decreasing to an annual low of $3.65 per pound in mid-September. The price then increased for the next few months to an annual high of $4.20 per pound in early November. The price then generally decreased for the rest of the year to $3.85 per pound at yearend.

Foreign Trade

The United States exported 502 t of bismuth metal, alloys, and waste and scrap in 2022, a 50% decrease from 1,010 t in 2021 (tables 1, 3). Bismuth was exported principally to Canada, Mexico, and Vietnam (19% each). The United States imported 3,090 t of bismuth metal, alloys, and waste and scrap in 2022, a 56% increase from 1,980 t in 2021 (tables 1, 4). Imported bismuth was sourced principally from China (74%) and the Republic of Korea (16%), which were the same leading sources in 2021 (table 4). Net imports of bismuth metal, alloys, and waste and scrap increased for the second year in a row to 2,590 t in 2022 from 973 t in 2021. Net imports previously decreased between 2018 and 2020 from 1,820 t to 955 t (table 1).

In early 2022, the U.S. import and export codes for bismuth metal were updated in the Harmonized Tariff Schedule of the United States and Schedule B, respectively, to match amendments adopted into the global Harmonized System (HS) of trade codes, as maintained by the World Customs Organization. HS code 8106 (bismuth and articles thereof, including waste and scrap) was subdivided into two new codes—HS code 8106.10 (bismuth and articles thereof, including waste and scrap, containing more than 99.99% of bismuth, by weight) and HS code 8106.90 (bismuth and articles thereof, including waste and scrap, other). The two new codes were adopted into the global HS to provide a separate category for bismuth scrap that was more than 99.99% bismuth (World Customs Organization, 2020, p. 20).

World Review

Bismuth was produced principally as a byproduct of the smelting of lead concentrates; however, it was also a byproduct of fluorspar, tin, and tungsten-ore processing in China, tungsten-polymetallic ore processing in Vietnam, copper smelter flue dust processing in Zambia, and zinc production in Japan. A world production total for mined bismuth ore was not available owing to it being a byproduct. World production data are available only once the bismuth is refined. Estimated world refinery production of bismuth was 19,000 t, a 5% decrease from 19,900 t (revised) in 2021. World production data excluded Belgium, Romania, or Russia, which may have produced refined bismuth, but available information was inadequate to make reliable estimates of output. China was the world's leading producer of refined bismuth, accounting for 82% of the estimated world total, followed by Laos and the Republic of Korea with 10% and 4%, respectively (table 5).

Belgium.—In December, Vital Materials Co. Ltd. (China) acquired 5N Plus Belgium SA, which was 5N Plus Inc.'s (Canada) bismuth production plant in Tilly, and planned to rename the operation Vital Materials Belgium. 5N Plus previously announced in May that it would halt production at Tilly and close the site because the plant was no longer economically viable. The Tilly plant mainly produced bismuth metal, and a range of metallic nitrates, including cobalt, copper, iron, and nickel nitrates. The nitrates were used in industrial applications, particularly in the petrochemical industry. The plant also produced lead nitrate, which was used in gold mining to increase gold recovery. Vital announced that it would diversify the products produced at Tilly to help the profitability of the operation, but details were not disclosed. Recently, Vital similarly acquired PPM Pure Metals GmbH's germanium production plant and equipment in Langelsheim, Germany, in 2020 after PPM ceased operations at the plant owing to financial difficulties. Most global bismuth and germanium production took place in China; there were few producers outside of China (Shabalala and Daly, 2020; Vital Materials Co. Ltd., 2021; Kurata, 2022; 5N Plus Inc., 2023, p. 9).

Canada.—Fortune Minerals Ltd. (Canada) continued to advance its NICO cobalt-gold-bismuth-copper project. The vertically integrated project included a proposed open pit and underground mine with a processing plant that would produce a bulk concentrate in the Northwest Territories and a hydrometallurgical refinery for processing the bulk concentrate into metal and chemical products, including bismuth metal and oxide. In January, Fortune Minerals entered into an option agreement to purchase a brownfield site for the refinery in Lamont County, Alberta Province (Fortune Minerals Ltd., 2023, p. 1, 3).

China.—China's exports of bismuth metal including waste and scrap (Harmonized Schedule codes 8106.10 and 8106.90) in 2022 were 6,130 t, 6% less than those in 2021 but 41% more than exports in 2020. Leading destinations were the United States (27%), Germany (26%), and the Netherlands (19%). About 95% of exports were traded under code 8106.10, bismuth articles containing more than 99.99% bismuth, by weight (Zen Innovations AG, 2023).

Outlook

Globally, most end uses of bismuth, especially its use as a metallurgical additive, are in the industrial sectors of the economy. An increase in global demand depends on economic growth and bismuth being used as a replacement for lead. Emerging uses in data transmission, medical treatment, and solar cells also could potentially increase the demand for bismuth, though these applications are still in the research and development stage.

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TABLE 1
SALIENT BISMUTH STATISTICS[1]

		2018	2019	2020	2021	2022
United States:						
Consumption, reported, bismuth metal	metric tons	570	548	513	597	724
Exports[2]	do.	653	636	699	1,010	502
Imports for consumption[2]	do.	2,470	2,340	1,650	1,980	3,090
Price, average[3]	dollars per pound	4.61	3.18	2.72	3.74	3.90
Stocks, December 31, consumer, bismuth metal	metric tons	346	443	271	297	356
World refinery production[4]	do.	20,400 r	18,300 r	18,400 r	19,900 r	19,000

rRevised. do. Ditto.
[1]Table includes data available through July 5, 2023. Data are rounded to no more than three significant digits, except prices.
[2]Consists of bismuth metal, alloys, and waste and scrap.
[3]Based on 99.99%-purity metal ingot at warehouse (Rotterdam) in minimum lots of 1 metric ton; source: Fastmarkets.
[4]May include estimated data.

TABLE 2
BISMUTH METAL CONSUMED
IN THE UNITED STATES, BY ESTIMATED USE[1]

(Kilograms)

Use	2021	2022
Chemicals[2]	384,000	W
Bismuth alloys	65,200	182,000
Metallurgical additives	W	W
Other	W	W
Total	597,000	724,000

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Table includes data available through July 5, 2023. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes industrial and laboratory chemicals, cosmetics, and pharmaceuticals.

TABLE 3
U.S. EXPORTS OF BISMUTH METAL, ALLOYS, AND WASTE AND SCRAP,
BY COUNTRY OR LOCALITY[1, 2]

	2021		2022	
Country or locality	Quantity (kilograms)	Value (thousands)	Quantity (kilograms)	Value (thousands)
Argentina	2,140 r	$56 r	20	$3
Belgium	--	--	1,940	19
Brazil	11,000	281	29,700	839
Canada	38,000	561	96,800	1,640
China	15,100	188	16,900	177
Colombia	97	8	4,190	47
Costa Rica	3,070	30	87	6
France	3,970	146	2,510	147
Germany	6,790	136	19,700	531
Hong Kong	23,500	306	13,000	236
Hungary	17,000	314	324	11
India	7,020	223	16,700	309
Ireland	--	--	1,740	16
Italy	1,340	22	14,700	136
Japan	3,100	51	1,190	36
Korea, Republic of	50	4	1,320	37
Mexico	70,400	923	93,300	1,390
Netherlands	394	4	20,700	164
Philippines	12,600	114	28,800	272
Singapore	8,630	78	3,080	28
Taiwan	1,560	23	1,620	18
Thailand	26,700	275	26,300	246
Turkey	1,660	18	284	11
United Kingdom	20,900 r	190 r	5,970	127
Vietnam	734,000	12,300	97,400	886
Other	1,050 r	50 r	4,230	90
Total	1,010,000	16,300	502,000	7,430

rRevised. -- Zero.
[1]Table includes data available through June 5, 2023. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes data for the Schedule B numbers 8106.00.0000, 8106.10.0000, and 8106.90.0000.

Source: U.S. Census Bureau.

TABLE 4
U.S. IMPORTS FOR CONSUMPTION OF BISMUTH METAL, ALLOYS, AND WASTE AND SCRAP
BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2021		2022	
	Quantity (kilograms)	Value (thousands)	Quantity (kilograms)	Value (thousands)
Austria	--	--	1,400	$8
Belgium	10,800	$170	71,700	788
Bolivia	17,900	128	22,900	198
Brazil	134	3	--	--
Canada	23,200	360	20,900	490
China	1,530,000	10,900	2,300,000	17,700
Germany	4,300	199	59,300	1,230
Hungary	3,580	63	5	3
India	--	--	7,870	103
Italy	--	--	1	3
Japan	25,200	435	44,400	689
Korea, Republic of	300,000	2,210	500,000	4,260
Laos	30,000	243	17,000	144
Luxembourg	--	--	13,100	129
Mexico	7,350	458	14,200	943
Poland	22,300	490	--	--
Spain	--	--	44	3
Taiwan	3,520	58	2,780	142
Thailand	--	--	17,200	147
United Kingdom	15	3	457	19
Total	1,980,000	15,700	3,090,000	27,000

-- Zero.
[1]Table includes data available through June 5, 2023. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes data for Harmonized Tariff Schedule of the United States codes 8106.00.0000, 8106.10.0000, and 8106.90.0000.

Source: U.S. Census Bureau.

TABLE 5
BISMUTH: WORLD REFINERY PRODUCTION, BY COUNTRY OR LOCALITY[1]

(Metric tons)

Country or locality[2]	2018	2019	2020	2021	2022
Bolivia	39	-- [r]	55	64 [r]	-- [e]
Bulgaria[e]	47	47	50	50	50
Canada	27	20	35	-- [r]	--
China	15,537	15,450 [r]	15,500 [r, e]	16,000 [e]	15,500 [e]
Japan	571	570	570 [e]	500 [e]	490 [e]
Kazakhstan[e]	280	230	230	200 [r]	190
Korea, Republic of	880	930 [e]	940 [r, e]	1,000 [e]	810 [e]
Laos	3,009	1,062	993	2,067	1,938
Mexico	(3) [r]	(3) [r]	-- [r]	-- [r]	--
Total	20,400 [r]	18,300 [r]	18,400 [r]	19,900 [r]	19,000

[e]Estimated. [r]Revised. -- Zero.
[1]Table includes data available through May 17, 2023. All data are reported unless otherwise noted, totals may include estimated data. Totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.
[2]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.
[3]Less than ½ unit.