

Bismuth

By J. M. Hague ¹

After declining in the preceding 2 years, consumption of bismuth in the United States during 1972 increased about 40% to a level near the annual average of the 1961-70 period.

The price of bismuth was generally firm during the year but at a level substantially below the average of recent years. Sustained demand however, brought a price increase in the fourth quarter. Domestic production increased only slightly and the increased demand was met by increased imports and by sales from the Government stockpile. World production outside the United States increased slightly and reached a new record. World production and consumption of bismuth has grown at a faster rate during the last 30 years than U.S. production and consumption; the centers of production are shifting toward foreign mines and smelters.

Legislation and Government Programs.
—The General Services Administration (GSA) continued to sell surplus stocks of bismuth from the national stockpile during

the first three quarters of 1972. On October 10, announcement was made that all bismuth remaining in inventory was required in order to meet the stockpile objective at that time, 2.1 million pounds; the sales program was terminated under the authorization of Public Law 91-318 (approved July 10, 1970). Sales during 1972 were 235,100 pounds. The stockpile inventory at the end of the year was 2,204,733 pounds.

Bismuth remained on the list of commodities eligible for exploration assistance from the Office of Minerals Exploration (OME) covering 75% of the cost; but no contracts were in effect during 1972 and no applications were pending.

Federal income tax laws under the Tax Reform Act of 1969 provide a percentage depletion allowance of 22% for domestic production and 14% for U.S. companies producing from foreign sources.

¹ Mining engineer, Division of Nonferrous Metals.

Table 1.—Salient bismuth statistics

(Pounds)

	1968	1969	1970	1971	1972
United States:					
Consumption	2,347,768	2,531,959	2,209,641	1,648,718	2,315,534
Exports ¹	120,466	447,931	910,275	71,187	264,276
Imports, general	1,265,671	894,804	997,924	848,708	1,562,934
Price: New York, average ton lots	\$4.00	\$4.63	\$6.00	\$5.26	\$3.63
Stocks Dec. 31: Consumer and dealer	621,500	597,901	² 721,714	² 1,107,215	² 717,466
World: Production	8,312,000	8,289,000	8,192,000	8,442,000	8,794,000

¹ Includes bismuth, bismuth alloys, and waste and scrap.

² Consumer stocks only.

Table 2.—Historical bismuth statistics

(Thousand pounds)

Year	World production	United States			Average annual price (dollars per pound)
		Consumption	Exports	Imports	
1937	1,543	285	900	67	1.00
1938	2,205	1,000	226	92	1.05
1939	2,866	500	314	183	1.10
1940	3,086	500	600	124	1.25
1941	3,086	NA	434	223	1.25
1942	3,748	NA	15	NA	1.25
1943	3,086	2,004	16	431	1.25
1944	2,646	1,466	10	364	1.25
1945	2,425	1,635	116	333	1.25
1946	2,205	1,330	153	422	1.44
1947	3,307	NA	241	311	1.98
1948	3,307	NA	352	300	2.00
1949	3,307	NA	191	542	2.00
1950	3,100	NA	199	782	2.06
1951	3,900	1,737	147	527	2.25
1952	3,900	1,775	245	708	2.25
1953	4,600	1,568	127	641	2.25
1954	3,700	1,439	138	644	2.25
1955	4,200	1,548	204	596	2.25
1956	5,300	1,513	287	918	2.25
1957	5,000	1,615	158	848	2.25
1958	4,600	1,243	316	637	2.25
1959	5,000	1,598	180	457	2.25
1960	5,300	1,527	157	1,167	2.25
1961	5,700	1,478	318	799	2.25
1962	6,700	1,910	351	816	2.25
1963	5,566	2,175	36	1,123	2.25
1964	6,375	2,160	61	1,238	2.30
1965	6,526	2,932	342	1,378	3.43
1966	6,861	3,199	89	1,681	4.00
1967	7,441	2,514	153	1,380	4.00
1968	8,312	2,348	120	1,266	4.00
1969	8,289	2,532	448	895	4.63
1970	8,192	2,210	910	998	6.00
1971	8,442	1,649	71	849	5.26
1972	8,794	2,316	264	1,563	3.63

NA Not available.

DOMESTIC PRODUCTION

Bismuth produced by domestic smelters or refineries is obtained principally as a byproduct from treatment of domestic and foreign lead concentrates, and from processing leady flue dusts from copper converting processes. The principal producers were American Smelting and Refining Co. (Asarco), Omaha, Neb., and UV Industries (formerly U.S. Smelting Refining & Mining Co.), East Chicago, Ind. UV Industries closed its Tooele, Utah, lead smelter in January 1972, thus shutting off the supply of western bismuth-bearing products formerly refined at the East Chicago plant. Production from UV Industries in 1972 was mostly from inventory material, and its future operations will depend on a supply of secondary lead. A small amount of metallic bismuth, about 1% of domestic production in 1972, was recovered from secondary material by United Refining & Smelting Co. at Franklin Park, Ill.

Domestic refinery production statistics are withheld to avoid disclosing individual company confidential data. Total refinery production at the three plants increased a little more than 1% above the 1971 level. Although domestic production is not revealed in tabulated world production, the U.S. usually ranks among the first six producing countries. The proportion of domestic production that comes from imported concentrates, bullion, and dusts can be estimated only roughly; it is probably no more than half.

Cerro Corp., New York, is the principal U.S.-owned foreign producer and importer. It also owns a substantial domestic consuming subsidiary, Cerro Metal Products Division. Cerro refines in Peru a large part of the bismuth-bearing ores produced from the surrounding Andean region.

CONSUMPTION AND USES

The domestic consumption of bismuth in 1972 recovered from the low usage reported for 1971 to a rate more consistent with long-range trends. Current annual consumption of 2,315,500 pounds is only slightly below the average annual consumption for 1961-70 (2,346,000 pounds).

The pharmaceutical group, including therapeutic agents, cosmetics, and industrial and laboratory chemicals continued to be the largest consuming market for bismuth products. The licensing of new plants to produce acrylic acid using a bismuth catalyst may have revived the consumption of bismuth for catalytic chemicals.

The use of bismuth in fusible alloys increased 47% over 1971 consumption as a result of increased industrial activity and a relatively low price for bismuth during the first three quarters of 1972.

Bismuth used in metallurgical applications, as an alloy to improve machinability of aluminum, steel, and malleable iron, showed a 52% increase, probably due mainly to increased production in the automotive industry.

Table 3.—Bismuth metal consumed in the United States, by use
(Pounds)

Use	1971	1972
Fusible alloys ¹	514,208	754,432
Metallurgical additives....	362,527	549,973
Other alloys.....	17,439	18,004
Pharmaceuticals ²	724,592	983,877
Experimental uses.....	26,175	1,105
Other uses.....	3,782	8,143
Total.....	1,648,718	2,315,534

¹ Includes bismuth contained in bismuth-lead bullion used directly in the production of an end product.

² Includes industrial and laboratory chemicals and cosmetics.

STOCKS

Stocks of bismuth metal held by domestic consumers decreased during 1972 from 1,107,200 to 717,500 pounds. Sales of Government surplus stocks during the year by GSA amounted to 235,100 pounds. During the last quarter of 1972, sales of bismuth

from the Government stockpile were discontinued because the remaining inventory was required to meet the stockpile objective. If the objective is reduced in 1973, the stockpile may again become a domestic source of bismuth.

PRICES

The price of refined bismuth as quoted by the American Metal Market remained at \$3.50 per pound until October 1. An increase to \$4 per pound was announced as of October 2 by Cerro Corp. and Asarco. The London Metal Exchange price for bismuth in ton lots, c.i.f., as reported by Metal Bulletin of London, was \$3.20 per pound in January, \$3.60 in April, \$3.25 in

July, \$4 in October, and \$4.05 on December 29. The reason given by U.S.-based producers for the price increase in October was that stocks were getting low and production was limited. Producer and dealer prices were firm at the end of the year, and the outlook was for a possible increase in price during 1973.

FOREIGN TRADE

Exports of bismuth metal, alloys, and waste and scrap went to 15 countries for a total shipment of 264,000 pounds. This was more in line with exports in previous years after the surge in 1970. Belgium received 36% of the total, United Kingdom 24%, Canada 14%, and other countries 26%.

Imports of metallic bismuth increased to 1,563,000 pounds, second only to the 1966 record amount, in order to satisfy the increased demand that grew with a relatively static domestic production and a reduced amount sold from the national stockpile. The imports of metallic bismuth were augmented by 233,000 pounds gross weight of

bismuth-lead alloys from Mexico and 35,000 pounds gross weight of alloys from Peru. Bismuth compounds and mixtures were imported in the amount of 7,400 pounds from European countries, half from West Germany.

Table 4.—U.S. exports of bismuth ¹

Year	Gross weight (pounds)	Value
1969	447,931	\$1,515,363
1970	910,275	2,332,423
1971	71,187	199,084
1972	264,276	492,585

¹ Includes bismuth, bismuth alloys, and waste and scrap.

Table 5.—U.S. general imports of metallic bismuth, by country

Country	1971		1972	
	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)
Belgium-Luxembourg	40,579	\$171	8,030	\$32
Bolivia	--	--	1,164	4
Canada	87,985	374	47,446	163
Ecuador	--	--	20,000	94
France	--	--	6,631	19
Germany, West	--	--	42,046	141
Italy	2,216	8	--	--
Japan	228,491	1,047	191,029	596
Korea, Republic of	28,675	153	111,650	339
Mexico	251,591	1,135	238,660	666
Netherlands	15,400	78	24,280	78
Peru	191,732	1,074	478,885	1,733
South Africa, Republic of	--	--	8,000	18
United Kingdom	2,039	10	383,934	1,349
Yugoslavia	--	--	1,129	3
Total	848,708	4,050	1,562,934	5,235

WORLD REVIEW

Market conditions for bismuth improved during 1972 from the oversupply situation in 1971. World production, excluding U.S. production, increased to an estimated record high of 8.8 million pounds. Consumption in the United States increased more markedly than that in the rest of the world. Most bismuth continued to be produced as a byproduct from smelting copper, lead, molybdenum or zinc ores and concentrates and from treatment of smelter residues; however, two new smelting plants have been designed to produce bismuth as a major product, one in Bolivia, now in operation, and one in Australia, scheduled to start in 1973.

Australia.—Mine production in 1972 exceeded 830,000 pounds, produced mainly by Peko-Wallsend Ltd. from the Juno mine near Tennant Creek, Northern Territory. Ore reserves at the Juno mine are given as 170,000 tons assaying 1.95 ounces of gold per ton, 0.8% bismuth, and 0.4% copper. The Peko, Warrego, and Orlando mines of the same company were in production, but not on bismuth-bearing ores. Ore reserves at Peko are 750,000 tons as-

saying 0.1 ounce of gold per ton, 3.2% copper, and 0.15% bismuth; ore reserves at Warrego are 5,000,000 tons assaying 0.1 ounce of gold per ton, 2.6% copper, and 0.3% bismuth; and ore reserves at Orlando are 100,000 tons assaying 0.035 ounce of gold per ton, 5% copper, and 0.1% bismuth. Peko-Wallsend Metals Ltd., a subsidiary, has made good progress in the construction of a smelter at Tennant Creek designed to produce low-bismuth blister copper and crude-bismuth bullion. The initial operation of the plant was scheduled for March 1973 with a planned capacity of over 2,000,000 pounds of bismuth annually. Current bismuth production is shipped as concentrates to Japan at the rate of about 500,000 pounds of bismuth metal per year. The completion of the Tennant Creek smelter will probably be accompanied by an increase in mine production and will make Australia a major world source of bismuth.

Bolivia.—COMIBOL (Corporación Minera de Bolivia) opened its new bismuth smelter at Telamayu in May 1972. The plant is designed to handle 440 short tons

Table 6.—Bismuth: World mine production, by country
(Thousand pounds)

Country ¹	1970	1971	1972 ²
Argentina (in ore).....	(³)	• 1	• 1
Australia (in concentrates).....	422	537	• 830
Bolivia.....	• 1,340	• 1,470	• 1,058
Canada ⁴	590	267	402
China, People's Republic of (in ore) ⁵	550	550	550
France (metal).....	159	170	• 176
Germany, West (in ore) ⁵	29	29	27
Japan (metal).....	1,495	1,790	1,974
Korea, Republic of (metal).....	234	214	• 210
Mexico ⁵	1,259	1,257	1,387
Mozambique (in ore).....	3	3	• 3
Peru ⁵	1,593	1,591	1,609
Romania (in ore) ⁵	180	180	180
South Africa, Republic of.....	---	(²)	---
Spain (metal).....	• 27	• 26	• 25
Sweden (in ore) ⁵	33	33	33
Uganda (in ore).....	2	2	• 2
U.S.S.R. (metal) ⁵	110	120	130
United States.....	W	W	W
Yugoslavia (metal).....	166	202	196
Total.....	• 8,192	8,442	8,794

¹ Estimate. ² Preliminary. ³ Revised. W Withheld to avoid disclosing individual company confidential data.

⁴ In addition to the countries listed, Brazil, Bulgaria, East Germany, and South-West Africa are believed to produce bismuth, but information is inadequate to make reliable estimates of output levels.

⁵ Less than 1/2 unit.

⁶ Production by COMIBOL and exports by medium and small mines.

⁷ Exports by all producers.

⁸ Bismuth content of refined metal and bullion, plus recoverable content of concentrates exported.

per month of concentrates to produce 150,000 pounds per month of bismuth metal or about 1,800,000 pounds per year. In the past, concentrates have been sent to Peru or Europe for smelting and refining at the rate of about 1,400,000 pounds per year; the new installation, if operated at design capacity, will increase Bolivia's contribution to world production of bismuth metal.

In November, COMIBOL announced that meetings would be held in La Paz with other international bismuth interests to establish lines of communication among producers and to form a Bismuth Institute to investigate new uses, promote growth, and keep statistics on consumption.

Canada.—Bismuth production as a by-product of molybdenum ores in western Quebec has been curtailed by the closing of several molybdenum mines. However, increased bismuth production from lead concentrates by Cominco, Ltd., at Trail, British Columbia, and by Brunswick Mining and Smelting Corp. Ltd. at Belle-dune, New Brunswick, partially offset this loss so that the total bismuth production for Canada increased about 50% from the 1971 production level, although it was still below the 1970 output.

Japan.—According to preliminary estimates, Japan led the world in the produc-

tion of bismuth metal in 1972. Production from its eight metallurgical plants is a by-product of the treatment of copper, lead, and zinc ores and concentrates. Much of the Japanese production is thought to come from imported concentrates and residues, so its mine production may be only part of the reported output. The rate of production reported for several consecutive months in 1972 was about 165,000 pounds per month.

Mexico.—Most bismuth metal production in Mexico is exported after recovery from impure lead bars or bullion. The two principal producers are Asarco Mexicana, S.A., at its Monterrey refinery and Metalurgica Mexicana Peñoles, S.A., also at Monterrey. Bismuth-bearing lead bullion is also exported to the United States and the United Kingdom for further refining; roughly one-fifth of total Mexican bismuth production is sent to the United States for extraction from bullion by U.S. refiners.

Peru.—Cerro Corp. is one of the principal world suppliers of bismuth from products made by its metallurgical works at La Oroya. A major part of its production is exported and consumed in the United States. Smaller producers in Peru, as well as a few small producers in Bolivia, may ship ore and concentrates to Cerro or export them to foreign refiners.

TECHNOLOGY

A new microfilm process using a thin layer of bismuth on film was announced by Bell Laboratories.² A centrifugation process for removing bismuth from lead was developed by the Federal Bureau of Mines.³ Australian research laboratories developed an electrometallurgical method for debismuthing lead.⁴ The thermodynamic, thermoelectric, electrochemical and alloying behavior of bismuth was studied and reported on in several papers.⁵

² American Metal Market. Bismuth is Key Material in New Microfilm Process. V. 79, No. 191. Oct. 18, 1972, p. 9.

³ Montagna, D., and J. A. Ruppert. Removing Bismuth From Lead With a Submersible Centrifuge. BuMines RI 7602, 1972, 10 pp.

⁴ Commonwealth Scientific & Industrial Research Organization, Minerals Research Laboratories (Melbourne, Australia). Annual Report 1971-72. P. 22.

⁵ Cadle, S. H., and S. Bruckenstein. Ring-Disk Electrode Study of the Reduction and Oxidation of Bismuth on Gold. J. Electrochem Soc., v. 119, No. 9, 1972, pp. 1166-1169.

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