

Beryllium

By Benjamin Petkof¹

Bertrandite mined in Utah was the major source of beryllium used in the United States and was a significant part of the world beryllium mineral supply. A minor amount of beryl was produced domestically. Consumption of beryllium ore increased, imports declined, and exports of beryllium materials increased.

Legislation and Government Programs.—Strategic stockpile goals issued October 1, 1976 by the Federal Preparedness Agency of the General Services Administration remained unchanged dur-

ing 1977. There were no releases of beryllium materials from the strategic stockpile during the year.

Public hearings were held in August and September by the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor on proposed beryllium occupational safety and health standards as published in the Federal Register, October 17, 1975. Additional written statements were accepted for the record until December 12, 1977.

Table 1.—Salient beryllium mineral statistics

	1973	1974	1975	1976	1977
United States:					
Beryl, approximately 11% BeO:					
Shipped from mines ----- short tons..	W	W	W	W	W
Imports ----- do.-----	1,586	1,368	1,479	1,058	746
Consumption ¹ ----- do.-----	8,695	9,279	4,850	3,740	4,165
Price, approximate, per unit BeO, imported cobbed beryl at port of exportation -----	\$30	\$30	[†] \$32	[†] \$36	\$40
Bertrandite ore: Utah, low-grade, shipped from mines ----- short tons..	W	W	W	W	W
World production of beryl ----- do.-----	3,963	3,469	[†] 3,290	[†] 2,675	2,656

[†]Revised. W Withheld to avoid disclosing individual company confidential data.

¹Includes bertrandite ore, which was calculated as equivalent to beryl containing 11% BeO.

DOMESTIC PRODUCTION

Brush Wellman, Inc. (Brush) at its Spor Mountain operation in Millard County, Utah, was the only major domestic producer of beryllium concentrates. The company mined bertrandite for processing into beryllium hydroxide. A small quantity of beryl production was reported in South Dakota.

Brush converted its ore to beryllium hy-

droxide at a facility north of Delta, Utah, and shipped the hydroxide to its facility at Elmore, Ohio for conversion into various beryllium products.

During 1977 Brush closed its Elmore, Ohio beryl-processing plant and completed construction and startup of a facility to process imported beryl ore at its Delta,

Utah location. In addition, Brush announced that it expected to recover uranium oxide as a byproduct from its beryllium extraction operations.

Kawecki-Berylco Industries, Inc. (KBI) produced beryllium metal, alloys, and oxide at its plants in Hazelton and Reading, Pa. from imported beryl ore that was converted to beryllium hydroxide.

Domestic production of beryllium metal

and beryllium oxide declined significantly from that of the previous year. Beryllium-copper master alloy production declined slightly. Production of beryllia ceramic and beryllium-copper master alloy was expected to increase to meet the future demands of the electrical and electronic industries. Improved production of metal will occur with the inception of new space and nuclear energy programs specifying the use of beryllium metal.

CONSUMPTION AND USES

The domestic beryllium industry consumed beryllium ore equivalent to 4,165 tons of beryl containing a nominal 11% BeO, an increase of 11% from that of 1976.

Beryllium metal, with its high stiffness-to-weight ratio and excellent thermal properties was used in items such as inertial navigation systems, satellite structures, space optics, nuclear devices, and military aircraft brakes.

Products utilizing beryllium-copper alloys accounted for the greatest quantity of beryllium consumption. These alloys were used

by the business machine, appliance, transportation, and communications industries. Beryllium-copper alloys were also widely used in electrical and electronic systems for connectors, sockets, switches, and temperature- and pressure-sensing devices to provide reliability and long service life.

Beryllium oxide ceramics were used in lasers, microwave tubes, and semiconductors, primarily for heat dissipation. Beryllia was used as a substrate in various electronic devices and equipment.

STOCKS

Consumer stocks of beryllium minerals containing nominal 11% BeO totaled 3,557 tons at yearend 1977, a 10% decrease from

those of 1976. Dealer stocks of beryl were not reported.

PRICES AND SPECIFICATIONS

Metals Week quoted the price of imported beryl at \$40 to \$42 per short-ton unit of contained BeO throughout the year. At yearend, American Metal Market quoted the following prices for beryllium materials: Vacuum cast ingot, \$109 per pound; metal beads (1,000-pound lots), \$86.50 per pound; metal powder (5,000-pound lots), \$96 per pound; metal rod, \$166.90 per pound;

beryllium-copper master alloy, \$78 per pound of contained beryllium; beryllium-copper casting alloy, \$2.75 to \$3.15 per pound; beryllium copper in strip, rod, bar and wire, \$4.31 per pound; beryllium-aluminum alloy ingot (100,000-pound lots), \$78 per pound; and beryllium oxide powder, \$26 per pound. All beryllium metal quotations were for 97% purity metal.

FOREIGN TRADE

Exports of wrought and unwrought beryllium alloys and of waste and scrap increased 41% in quantity over those of 1976. Total value of exports increased 9%, but average value declined from \$15.38 per pound to \$11.91 per pound. On the basis of quantity, 53% of total material exported went to Japan, 28% to Canada, and 8% to France.

Beryl ore imports decreased 29% in quantity and 22% in value from those of

1976. The average value of imported material was \$399 per ton compared with \$359 per ton in 1976. Major sources of imports were Brazil (63%) and Argentina (24%). In addition, 9,174 pounds of wrought, unwrought, and waste and scrap beryllium metal valued at \$35,598 were imported primarily from Mexico and the United Kingdom.

Table 2.—U.S. exports of beryllium alloys, wrought or unwrought, and waste and scrap¹

Country	1976		1977	
	Quantity (pounds)	Value (thousands)	Quantity (pounds)	Value (thousands)
Argentina	--	--	967	\$21
Australia	--	--	797	3
Austria	32	\$1	--	--
Belgium	4	2	549	5
Canada	3,204	63	44,472	28
France	4,718	325	13,414	571
Germany, West	701	92	855	65
Hong Kong	3,000	8	--	--
Italy	2,419	49	56	1
Jamaica	--	--	832	4
Japan	12,591	255	84,410	624
Mexico	73,960	61	4,000	9
Netherlands	1,407	63	1,356	38
Switzerland	2,374	89	30	11
United Kingdom	9,568	742	7,912	521
Other	165	6	855	10
Total	114,148	1,756	160,505	1,911

¹Consisting of beryllium lumps, single crystals, powder; beryllium-base alloy powder; beryllium rods, sheets, and wire.

Table 3.—U.S. imports for consumption of beryl, by customs district and country

Customs district and country	1976		1977	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Philadelphia district:				
Argentina	--	--	66	\$22
Australia	103	\$38	15	3
Bolivia	11	3	--	--
Brazil	512	201	370	162
France	103	35	--	--
India	120	46	--	--
Rwanda	66	14	--	--
South Africa, Republic of	97	34	32	12
Spain	--	--	9	4
Uganda	44	9	--	--
Total	1,056	380	492	203
Los Angeles district:				
Argentina	--	--	111	38
Brazil	--	--	99	42
Mozambique	--	--	22	6
Rwanda	--	--	22	9
Total	--	--	254	95
New York City district: Mozambique	2	(¹)	--	--
Grand total	1,058	380	746	298

¹Less than 1/2 unit.

WORLD REVIEW

In 1977, world production of beryl continued its downward trend of recent years. Only one major producing nation had any significant increase in production. Production in all other producing nations remained at the same level or declined.

The capability to mine and process low-

grade bertrandite ore has maintained the position of the United States as a significant source of commercial beryllium minerals. In addition, the United States and the U.S.S.R. are the major consumers of world beryllium mineral production.

Table 4.—Beryl: World production, by country

(Short tons)

Country ¹	1975	1976	1977 ^P
Angola ^e	35	(²)	--
Argentina	308	123	^e 110
Brazil ^e	⁷ 770	500	470
Madagascar	17	19	^e 15
Mozambique	⁹	^e 10	^e 10
Portugal	^r 23	--	--
Rhodesia, Southern ^e	70	70	70
Rwanda	20	^e 70	^e 60
South Africa, Republic of	³	3	^e 1
Uganda ^e	60	60	50
U.S.S.R. ^e	1,760	1,820	1,870
United States	W	W	W
Zambia ²	220	--	--
Total	^r 3,290	2,675	2,656

^eEstimate. ^PPreliminary. ^rRevised. W Withheld to avoid disclosing individual company confidential data.¹In addition to the countries listed, Bolivia and the Territory of South-West Africa (Namibia) may also have produced beryl, but available information is inadequate to formulate reliable estimates of output levels.²Revised to zero.

TECHNOLOGY

Studies relating to the formation of beryllium deposits in western Utah have been reviewed to develop favorable indicators of the presence of epithermal beryllium and associated deposits.²

A method was devised for manufacturing a thin-walled beryllium metal structure. The process required beryllium powder that was mixed with a minor quantity of silicon powder. The mix was plasma-sprayed on to a substrate, removed, exposed to a wet atmosphere to pick up moisture, placed in a sizing die with a coefficient of expansion similar to that of beryllium, out-gassed in a vacuum at high temperature, and finally sintered in an inert atmosphere.³

A method to measure beryllium concen-

trations in particulate matter using chelation gas chromatography was developed. This technique was used to observe beryllium levels in suspended particulate matter in ambient air conditions over rural, suburban, and industrial environments. A description of experimental data and techniques was presented.⁴

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