

# GERMANIUM

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Germanium is a grayish-white, metallic element with the physical properties of a semiconductor, i.e.-electrical characteristics between those of a metal and an insulator. It is commercially available as a tetrachloride, a high-purity oxide, and in the form of zone-refined ingots, single-crystal bars, castings, doped semiconductors, optical materials, optical blanks, and other specialty products.

Domestic refinery production and consumption for germanium are estimated by the U.S. Bureau of Mines (USBM) on the basis of discussions with domestic producers. Estimated domestic refinery production of germanium in 1994 remained at approximately the same level as reported for 1993, while U.S. consumption was estimated to have dropped by approximately 14% in 1994. This lower consumption level was chiefly attributed to a continuing reduction in the U.S. defense establishment's requirements for infrared systems.

The importance of germanium as a strategic and critical material has been recognized by the Federal Emergency Management Agency. On July 6, 1984, it was included in the National Defense Stockpile (NDS) with an initial goal of 30,000 kilograms of germanium metal. On July 24, 1987, a new NDS goal of 146,000 kilograms was established. This goal was later adjusted downward and, as of December 31, 1994, the NDS inventory was 68,207 kilograms of germanium metal with 7 kilograms authorized for future disposal.

In a related matter, the American Mining Congress, through a series of letters to U.S. legislators, recommended that several materials in the NDS, including germanium, be considered as candidates for upgrading or additional processing to provide the highest purity materials suitable for stockpile storage. Despite this request, there were no metal upgrades included in the Defense Department's Annual Materials Plan for fiscal year 1995.

## Production

The USBM estimated domestic refinery production from primary and secondary materials in 1994 to be 10,000 kilograms, about

the same as in 1993.

In 1994, Eagle-Picher Industries Inc.'s Quapaw, OK, Specialty Materials Div. remained the only producer in the United States that recovered primary germanium from zinc smelter residues. Eagle-Picher also reprocessed germanium scrap. Cabot Corp., Revere, PA, and Atomergic Chemetals Corp., Plainview, NY, produced germanium from reprocessed scrap and semirefined foreign material. Early in 1994, Union Minière of Belgium sold its zinc mining and refining operations in the United States to the Australian group, Savage Resources Ltd. Under the new management, the Clarksville, TN, zinc refinery continued to produce germanium-rich residues as a byproduct of processing zinc ores from the new group's associated Elmwood-Gordonville Mine. In addition the new operating company, Savage Zinc, Inc., continued the established procedure of shipping these residues to Union Minière's Germanium Business Unit in Belgium for germanium recovery and refining.

## Consumption

The USBM estimated consumption of germanium in 1994 at 25,000 kilograms, compared with about 29,000 kilograms in 1993. The estimated consumption pattern in 1994 was as follows: fiber optics, 35%; infrared systems, 20%; gamma-ray, X-ray, and infrared detectors, 10%; semiconductors (including transistors, diodes, and rectifiers), 10%; and other applications (catalysts, phosphors, metallurgy, and chemotherapy), 25%.

Fiber optics and infrared optical systems continued to be the dominant end uses for germanium. In the fiber optics sector, germanium was employed as a dopant within the core of many optical fibers used by the telecommunications industry. In addition, germanium-containing lenses and windows are transparent to infrared radiation, a property that has led to their use in infrared optical systems. These optics are employed principally for military guidance and weapon-sighting applications. Germanium glass also was used for nonmilitary surveillance and monitoring systems in fields such as satellite systems and fire alarms.

## Prices

In 1994, domestic producer prices for germanium metal and dioxide were estimated to have remained at the levels established in late 1981 (\$1,060 and \$660 per kilogram, respectively). However, discounting by producers because of competition from imported materials was evident.

Free market prices, published by Metal Bulletin (London), remained in a low range of \$340 to \$350 per kilogram. The price for Belgian-produced germanium metal, published by Metal Bulletin (London), started the year at about \$860 per kilogram and dropped to the \$600-\$660 range from August 24, 1994, onward.<sup>1</sup>

## Foreign Trade

In 1994, the estimated germanium content of imports was approximately 14,000 kilograms. Total imports of germanium materials decreased modestly compared with those of 1993. China, Russia, Ukraine, Estonia, Germany, and Belgium, in descending order of shipments, accounted for approximately 87% of the total U.S. germanium imports for 1994. (See table I.)

## World Review

World refinery production was estimated at 50,000 kilograms in 1994, the same as in 1993. This sluggishness in world production was attributed to an oversupply and to a lower level of demand for the metal. The total world germanium refinery capacity for 1994 was estimated at 270 metric tons.

**Belgium.**—Metal Bulletin reported at the end of 1994 that Union Minière had decided to discontinue quoting a market price for 50 ohm-cm germanium metal ingot. The company, however, intended to continue to carry a quote for the price of germanium dioxide.

**Germany.**—Researchers at Siemens reported the development of a new photovoltaic light-stable semiconductor material based on amorphous germanium. The germanium/silicon-based material does not age under the action of light. In addition, it is

highly photosensitive and is particularly suitable for red-sensitive photovoltaic components.

**Japan.**—Roskill's Letter from Japan reports that Japanese demand for germanium dioxide used in catalysts for the production of polyethylene terephthalate (PET) resin was firm in 1994, because of a 5% increase in the output of PET. The production of PET resin accounts for over one-half of Japanese consumption of germanium dioxide. Japanese regulatory authorities reportedly approved Sanwa Kagaku Kenkyusho's new organic germanium (propagermanium) medication for the treatment of chronic hepatitis B infection. While this orally active agent has no direct antiviral activity, it appears to act by stimulating killer T cells and macrophages to produce interleukins and interferons, which thereby inhibit the growth and spread of the virus.

Plans were released in June by Japan's Ministry of Posts and Telecommunications (MPT) for a multibillion dollar effort to rewire every home and business in Japan with state-of-the-art fiber optics by the year 2010.

**Russia.**—As reported in Photonics Spectra, plans are under consideration by the Russian Ministry of Posts and Telecommunications for a major telecommunications expansion program in Russia that will entail laying some 76,000 kilometers of new fiber optic lines over the next 10 years.

In addition, it was reported by Haznews that the Gai Mining and Dressing Works near Orsk, in the Orenburg region of Russia, was seeking Western partners to process some 40 million tons of mine and concentrator tailings containing copper, zinc, and germanium.

## Outlook

In 1994, for the sixth consecutive year, the supply of germanium exceeded the demand for this specialty metal. Nevertheless, it is possible that future germanium supplies may become tight if the expanded demand for the fiber optics sector develops as has been projected and if sources of supply in the newly independent republics of the former Soviet Union encounter substantial disruption. If this supply-demand situation develops, prices of processed germanium may be expected to increase in the near term.

## OTHER SOURCES OF INFORMATION

### U.S. Bureau of Mines Publications

Germanium. Ch. in Mineral Commodity Summaries, annual.

Germanium. Ch. in Mineral Facts & Problems, 1985 ed.

### Other Sources

American Metal Market.

Chemical Abstracts.

Metal Bulletin (London).

Metals Week.

Mining Journal (London).

Roskill's Letter from Japan.

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<sup>1</sup>Where necessary, values have been converted from Belgian francs (BF) to U.S. dollars at the average exchange rate of BF33.5=US\$1.00.

TABLE 1  
U.S. IMPORTS OF GERMANIUM MATERIALS 1/, BY COUNTRY 2/

Country	1993		1994	
	Gross weight (kilograms)	Value	Gross weight (kilograms)	Value
Belgium	1,400	\$2,430,000	1,400	\$1,850,000
Canada	--	--	22	2,200
China	2,780	565,000	2,950	672,000
Czech Republic	202	36,400	--	--
Estonia	--	--	1,930	362,000
Finland	248	50,800	--	--
France	207	108,000	305	117,000
Germany	1,630	518,000	1,900	686,000
Hong Kong	982	313,000	--	--
Israel	216	110,000	273	158,000
Italy	--	--	70	11,300
Japan	1	4,690	--	--
Netherlands	--	--	139	23,600
Russia	1,960	275,000	2,370	439,000
Switzerland	--	--	5	1,750
Ukraine	5,030	649,000	2,340	545,000
United Kingdom	839	239,000	1,020	270,000
Total 2/	15,500	5,300,000	14,700	5,140,000

1/ Unwrought and waste and scrap.

2/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals show.

Source: Bureau of the Census.