SELENIUM

(Data in metric tons of selenium content, unless otherwise noted)

Domestic Production and Use: Primary selenium was recovered from anode slimes generated in the electrolytic refining of copper. One copper refinery in Texas reported domestic production of primary selenium. One producer exported semirefined selenium for toll-refining in Asia and three other companies generated selenium-containing slimes, which were exported for processing.

The estimated consumption of selenium by end use was as follows: glass manufacturing, 35%; chemicals and pigments, 20%; electronics, 12%; and other, including agriculture and metallurgy, 33%. In glass manufacturing, selenium is used to decolorize the green tint caused by iron impurities in glass containers and other soda-lime silica glass and is used in architectural plate glass to reduce solar heat transmission. It is also used, as cadmium sulfoselenide, in plastics, ceramics, art glass, and other glasses, such as that used in traffic lights to produce a ruby red color. Selenium is used in catalysts to enhance selective oxidation; in plating solutions, where it improves appearance and durability; in blasting caps and gun bluing; in rubber compounding chemicals; and to increase yields in the electrolytic production of manganese.

Selenium is used as a human dietary supplement and in antidandruff shampoos. The largest agricultural uses are as a dietary supplement for livestock and as a fertilizer additive to enrich selenium-poor soils. It is used as a metallurgical additive to improve machinability of copper, lead, and steel alloys. Its primary electronic use was as a photoreceptor on the drums of copiers, but now it is only used for replacement parts for older copiers, which are gradually being replaced by newer models that do not use selenium in the reproduction process.

Salient Statistics—United States:	**1999**	**2000**	**2001**	**2002**	**2003[e]**
Production, refinery	W	W	W	W	W
Imports for consumption, metal and dioxide	326	476	483	422	431
Exports, metal, waste and scrap	233	82	41	85	226
Consumption, apparent[1]	W	W	W	W	W
Price, dealers, average, dollars per pound, 100-pound lots, refined	2.50	3.84	3.80	4.27	5.00
Stocks, producer, refined, yearend	W	W	W	W	W
Employment, number	NA	NA	NA	NA	NA
Net import reliance[2] as a percentage of apparent consumption	W	W	W	W	W

Recycling: There was no domestic production of secondary selenium. Scrap xerographic materials were exported for recovery of the contained selenium. An estimated 25 tons of selenium metal was recovered from imported scrap in 2003.

Import Sources (1999-2002): Canada, 50%; Philippines, 23%; Belgium, 8%; Germany, 5%; and other, 14%.

Tariff: **Item**	**Number**	**Normal Trade Relations 12/31/03**
Selenium metal	2804.90.0000	Free.
Selenium dioxide	2811.29.2000	Free.

Depletion Allowance:[3] 14% (Domestic and foreign).

Government Stockpile: None.

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Events, Trends, and Issues: The supply of selenium is directly affected by the supply of the materials from which it is a byproduct—copper, nickel, and cobalt. In 2003, domestic consumption of selenium increased slightly when compared with that of 2002. The average annual global consumption of selenium over the past 4 years is estimated to have been about 2,000 tons per year. Production of selenium did not decrease in 2003 in spite of the idling of high-cost copper capacity and the use of solvent extraction instead of older slime-producing technology. Continued concern over selenium supply saw the price increase from $3.75-$4.25 per pound in the last quarter of 2002 to $5.80-$6.40 by late in the third quarter of 2003. Owing to higher prices, the production drop was more than offset by the increase of selenium-bearing anode slimes and other selenium scrap sent to refineries.

The use of selenium in China rose significantly with continued interest in selenium as a fertilizer supplement, as an ingredient in glassmaking, and as selenium dioxide to increase the yield in the manganese smelting process, where selenium is substituting for nickel in a portion of the Chinese stainless steel market.

The use of selenium in glass remained strong, while use in copiers continued to decline. The use of selenium as a substitute for lead in free-machining brasses continued to increase as more stringent regulations on the use of lead were implemented. The use of selenium supplements in the plant-animal-human food chain increased as its health benefits were confirmed. Increased selenium supplementation in fertilizer has been used to achieve this public health benefit—both as improved feed for livestock and as produce for human consumption.

World Refinery Production, Reserves, and Reserve Base:

	Refinery production		Reserves[4]	Reserve base[4]
	2002	2003[e]		
United States	W	W	10,000	19,000
Belgium	200	200	—	—
Canada	226	230	6,400	10,000
Chile	40	40	16,000	37,000
Finland	39	39	—	—
Germany	100	100	—	—
India	12	12	—	—
Japan	740	760	—	—
Peru	16	20	5,000	8,000
Philippines	40	118	2,000	3,000
Serbia and Montenegro	20	30	1,000	2,000
Sweden	20	20	—	—
Other countries[5]	60	90	42,000	90,000
World total (rounded)	[6]1,510	[6]1,660	82,000	170,000

World Resources: The reserve base for selenium is based on identified economic copper deposits. An additional 2.5 times this reserve base is estimated to exist in copper and other metal deposits that have not yet been developed. Coal generally contains between 0.5 and 12 parts per million of selenium, or about 80 to 90 times the average for copper deposits. The recovery of selenium from coal does not appear likely in the foreseeable future.

Substitutes: High-purity silicon has replaced selenium in high-voltage rectifiers. Silicon is also the major substitute for selenium in low- and medium-voltage rectifiers and solar photovoltaic cells. Amorphous silicon and organic photoreceptors are substitutes in xerographic document copiers. Organic pigments have been developed as substitutes for cadmium sulfoselenide pigments. Other substitutes include cerium oxide as either a colorant or decolorant in glass; tellurium in pigments and rubber; bismuth, lead, and tellurium in free-machining alloys; and bismuth and tellurium in lead-free brasses.

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data. — Zero.
[1]Defined as reported shipments + imports of selenium metal – estimated exports of selenium metal, excluding scrap.
[2]Defined as imports – exports + adjustments for Government and industry stock changes.
[3]See Appendix B for definitions.
[4]See Appendix C for definitions.
[5]In addition to the countries listed, Australia, China, Kazakhstan, Russia, and the United Kingdom are known to produce refined selenium.
[6]Excludes U.S. production.