

## 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. Two copper refineries in Texas accounted for domestic production of primary selenium. Anode slimes from other primary electrolytic refiners were exported for processing. The estimated consumption of selenium by end use was as follows: glass manufacturing, 35%; chemicals and pigments, 20%; electronics, 13%; and other, including agriculture and metallurgy, 32%. In glass manufacturing, selenium was used to decolor container glass and other soda-lime silica glasses and to reduce solar heat transmission in architectural plate glass. Cadmium sulfoselenide red pigments, which have good heat stability, were used in ceramics and plastics. Chemical uses included rubber compounding chemicals, gun bluing, catalysts, human dietary supplements, and antidandruff shampoos. Dietary supplementation for livestock was the largest agricultural use. Combinations of bismuth and selenium were added to brasses to replace lead in plumbing applications. Selenium was added to copper, lead, and steel alloys to improve their machinability. In electronics, high-purity selenium was used primarily as a photoreceptor on the drums of plain paper copiers; but this application has reached the replacement-only stage as selenium has been supplanted by newer materials in currently manufactured copiers.

<b>Salient Statistics—United States:</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000<sup>e</sup></b>
Production, refinery	379	W	W	W	W
Imports for consumption, metal and dioxide	428	346	339	326	452
Exports, metal, waste and scrap	322	127	151	233	89
Consumption, apparent <sup>1</sup>	564	W	W	W	W
Price, dealers, average, dollars per pound, 100-pound lots, refined	4.00	2.94	2.49	2.55	3.82
Stocks, producer, refined, yearend	W	W	W	W	W
Employment, number	NA	NA	NA	NA	NA
Net import reliance <sup>2</sup> as a percent of apparent consumption	38	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 70 tons of selenium metal recovered from scrap was imported in 2000.

**Import Sources (1996-99):** Philippines, 35%; Canada, 31%; Belgium, 13%; Japan, 6%; and other, 15%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations</b>
		<b><u>12/31/00</u></b>
Selenium metal	2804.90.0000	Free.
Selenium dioxide	2811.29.2000	Free.

**Depletion Allowance:** 14% (Domestic and foreign).

**Government Stockpile:** None.

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**Events, Trends, and Issues:** Domestic selenium consumption increased moderately when compared to that of 1999. World selenium demand and production were steady, so the oversupply situation that already existed was eased only slightly in 2000. The price of selenium rose from \$2.78 per pound to \$3.35 per pound during the first week of 2000. The price increase that began in 1999 continued until March 2000, when the price reached \$4.30 per pound. It declined slowly to \$3.95 per pound over a period of 2 months and remained steady until October, when it began to fall again. The price reached \$3.25 per pound by yearend.

The use of selenium in glass remained strong. The use in copiers continued to decline, while the use in metallurgical additives increased. The use of selenium as an additive to no-lead, free-machining brasses for plumbing applications continued to increase as more stringent regulations on lead in drinking water took effect (ordinary free-machining brass contains up to 7% lead). Alloys with bismuth/selenium additions are dominating this market. Selenium reduces the quantity of bismuth needed, without adverse effects on alloy properties.

Research continued to confirm the effectiveness of dietary selenium supplementation for human cancer prevention. However, even if proven safe and effective, the dosage requirement for direct supplementation would be small, 200 to 400 micrograms per day per person; consequently, selenium demand would not change dramatically. Supplementation of fertilizer would be another way to achieve this public health benefit. Selenium already is added to fertilizer used to improve feed for livestock.

### World Refinery Production, Reserves, and Reserve Base:

	Refinery production		Reserves <sup>3</sup>	Reserve base <sup>3</sup>
	1999	2000 <sup>e</sup>		
United States	W	W	10,000	19,000
Belgium	200	200	—	—
Canada	438	400	7,000	15,000
Chile	49	50	19,000	30,000
Finland	26	25	—	—
Germany	100	100	—	—
Japan	548	550	—	—
Peru	21	20	2,000	5,000
Philippines	40	40	2,000	3,000
Serbia and Montenegro	10	10	1,000	1,000
Sweden	20	20	—	—
Zambia	13	10	3,000	6,000
Other countries <sup>4</sup>	12	10	27,000	55,000
World total (rounded)	<sup>5</sup> 1,480	<sup>5</sup> 1,400	70,000	130,000

**World Resources:** In addition to the reserve base of selenium, which is contained in identified economic copper deposits, 2.5 times this quantity of selenium was estimated to exist in copper or other metal deposits that were undeveloped, of uneconomic grade, or as yet undiscovered. Coal contains an average of 1.5 parts per million of selenium, which is about 80 times the average for copper deposits, but recovery of selenium from coal appears unlikely in the foreseeable future.

**Substitutes:** High-purity silicon has replaced selenium in high-voltage rectifiers and is the major substitute for selenium in low- and medium-voltage rectifiers. Other inorganic semiconductor materials, such as silicon, cadmium, tellurium, gallium, and arsenic, as well as organic photoconductors, substitute for selenium in photoelectric applications. Other substitutes include cerium oxide in glass manufacturing; tellurium in pigment and rubber compounding; bismuth, lead, and tellurium in free-machining alloys; and bismuth and tellurium in lead-free brasses.

<sup>e</sup>Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>Calculated using reported shipments, imports of selenium metal, and estimated exports of selenium metal, excluding scrap.

<sup>2</sup>Defined as imports - exports + adjustments for Government and industry stock changes.

<sup>3</sup>See Appendix C for definitions.

<sup>4</sup>In addition to the countries listed, Australia, China, India, Kazakhstan, Russia, the United Kingdom, and Zimbabwe are known to produce refined selenium.

<sup>5</sup>Excludes the United States.