Selenium

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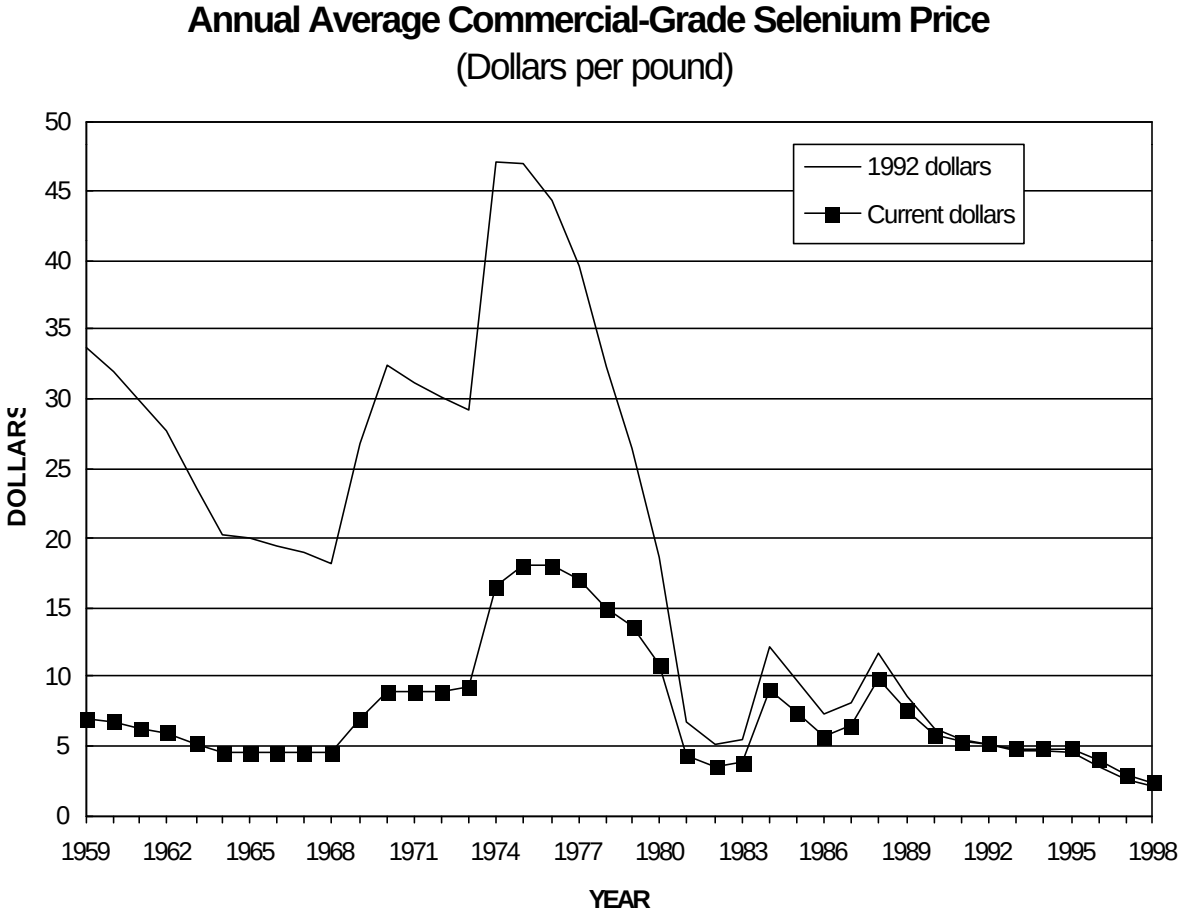

Significant events affecting selenium prices since 1958

1963-67	Commercial stocks rise to 1.3 million pounds before declining, U.S. Government stocks reach 400,000 pounds in 1963, imports increasing
1968-72	Vietnam War, production and demand surge to record highs of 1.2 million and 1.8 million pounds, respectively, in 1969, stocks decline rapidly, civilian demand growth from single-use bottles and xerography
1974-76	Government stocks liquidated by 1974, low commercial inventories, reduced domestic production from recession and copper industry strike, increased import dependence, continued growth in xerography
1977-80	Stock buildup and reduced demand following 1977 recession, production level is established at about one-half of 1969 peak
1981-83	Demand surges, stocks remain high, xerography and glass manufacturing dominate demand
1984-89	World stocks decline as demand outstrips production, speculation encourages price fluctuations, domestic demand averages 1.3 million pounds
1990-91	World production rises, demand slackens owing to recession, stock decline is reversed
1995-98	Increasing use in lead-free brasses
1996-98	Large-scale research on supplementation for cancer prevention in humans

The discovery of selenium is credited to J.J. Berzelius, who isolated it in 1817 from the red residue found in sulfuric acid prepared at the pyrite mining operation at Fahlun, Sweden (Carapella, 1984, p. 842). For almost a century, selenium was merely a scientific curiosity, until its use as a pigment in the manufacture of red glass, ceramics, and glazes was established by 1910 (Hess, 1911). Prices for selenium prior to that time are not generally available. Commercial quantities of selenium were and still are recovered as a byproduct of the electrolytic refining of copper where it accumulates in anode residues (Hoffman, 1984, p. 495-516).

During World War I, selenium production and demand grew rapidly owing to the increased demand for red glass and the development of selenium as a replacement for manganese dioxide as a decolorizer in clear glass. Domestic production rose rapidly from about 5 metric tons in 1910 to about 50 tons in 1918. Although the production of selenium fluctuated markedly from year to year, it continued to increase, reaching a peak of 565 tons in 1969, during the Vietnam War. Disruptions to copper production, changing technology, and variable demand contributed to year-to-year fluctuations in production. From 1970 through 1980, domestic production fell markedly, with imports accounting for an increasing share of domestic demand. Domestic production of selenium was about 140 tons in 1980 and increased to roughly 250 tons in 1985, 275 tons in 1990, 375 tons in 1995, and 380 tons in 1996.

As calculated from domestic shipments plus net imports, apparent consumption also fluctuated markedly from year to year owing to economic cycles, military engagements, technical developments, and consumer stockpiling. Growth in consumption was driven by the development of new uses, including applications in rubber compounding, steel alloying, and selenium rectifiers. Consumption generally increased through 1969 when it peaked at almost 900 tons owing mainly to defense requirements. By 1970, selenium in rectifiers had largely been replaced by silicon, but its use as a photoconductor in plain paper copiers had become its leading application. By 1974, U.S. Government stocks, which had reached a peak of 400,000 pounds in 1963, were liquidated. Apparent consumption fell to less than 350 tons in 1980 but rose to a fairly stable range just above or below 500 tons from 1990 through 1996. During the 1980's, the photoconductor application declined (although it was still a large end use) as more and more copiers using organic photoconductors were produced. In the late 1980's, demand outstripped supply, thus causing an increase in price and a decrease in stocks. Since 1990, worldwide production has exceeded or matched demand. When demand has increased, so has production, but when demand has decreased, production has remained about the same. This fairly constant oversupply situation has kept prices low (Brown, 1998, p. 13-17). In 1996, continuing research showed a positive correlation between selenium supplementation and cancer prevention in humans (Clark, 1996, p. 1957-1963). Although this could be very important from a public health viewpoint, direct application of this finding would not add significantly to demand owing to the small doses required. In the late 1990's, the use of selenium (usually with bismuth) as an additive to plumbing brasses to meet no-lead standards became important (King and Li, 1997); this application could add significantly to demand. In 1996, total domestic consumption was about 500 tons. Demand data from 1997 and 1998 are withheld to prevent publication of proprietary information.

References Cited

Brown, R.D., Jr., 1998, Selenium and tellurium—Supply demand relationship: International Symposium on the Uses of Selenium and Tellurium, 6th, Scottsdale, AZ, May 10-12, 1998, Proceedings, 314 p.

Carapella, S.C., Jr., 1984, Selenium (4th ed.): New York, Van Nostrand Reinhold Encyclopedia of Chemistry, 1082 p.

Clark, L.C., and others, 1996, Effect of selenium supplementation for cancer prevention: Journal of the American Medical Association, v. 276, no. 24, December 25, 129 p.

Hess, F.L., 1911, Selenium, *in* Mineral resources of the United States 1910: U.S. Geological Survey, pt. I, Metals, p. 731.

Hoffman, J.E., 1984, Recovery of selenium from electrolytic copper refinery slimes, *in* Precious metals—Mining, extraction, and processing: Warrendale, PA, Mining, Minerals, and Materials Society, 621 p.

King, M.G., and Li, Taie, 1997, Method for making machinable lead-free copper alloys with additive: U.S. Patent 5,614,038, assigned to ASARCO Incorporated, 4 p.

Annual Average Commercial-Grade Selenium Price[1]

(Dollars per pound[2])

Year	Price	Year	Price	Year	Price	Year	Price
1911	3.00	1933	1.90	1955	7.50	1977	17.12
1912	2.50	1934	1.90	1956	11.25	1978	15.00
1913	1.68	1935	2.00	1957	9.75	1979	13.65
1914	1.50	1936	1.88	1958	7.25	1980	10.95
1915	NA	1937	1.88	1959	7.00	1981	4.38
1916	1.35	1938	1.80	1960	6.75	1982	3.53
1917	2.15	1939	1.80	1961	6.38	1983	3.87
1918	3.00	1940	1.75	1962	6.00	1984	9.02
1919	2.38	1941	1.75	1963	5.13	1985	7.44
1920	2.00	1942	1.75	1964	4.50	1986	5.70
1921	2.13	1943	1.75	1965	4.50	1987	6.51
1922	1.96	1944	1.75	1966	4.50	1988	9.84
1923	1.86	1945	1.75	1967	4.50	1989	7.61
1924	1.86	1946	1.75	1968	4.50	1990	5.82
1925	1.70	1947	1.88	1969	7.00	1991	5.41
1926	1.95	1948	2.00	1970	9.00	1992	5.13
1927	1.95	1949	2.00	1971	9.00	1993	4.90
1928	2.13	1950	2.75	1972	9.00	1994	4.90
1929	1.65	1951	3.25	1973	9.25	1995	4.89
1930	1.90	1952	3.25	1974	16.53	1996	4.00
1931	1.90	1953	3.63	1975	18.00	1997	2.94
1932	1.90	1954	4.63	1976	18.00	1998	2.50

NA Not available

[1] 99.5%-pure selenium powder.

[2] To convert to dollars per kilogram, multiply by 2.20462.

Note:

1911-20, Domestic price, *in* U.S. Geological Survey, Mineral Resources of the United States.

1921-36, Domestic price, *in* Engineering & Mining Journal.

1937-66, Domestic price, *in* E&MJ Metal and Mineral Markets.

1967-93, New York dealer price, *in* Metals Week [through June 14, 1993].

1993-98, New York dealer price, *in* Platt's Metals Week.