Th

Thorium

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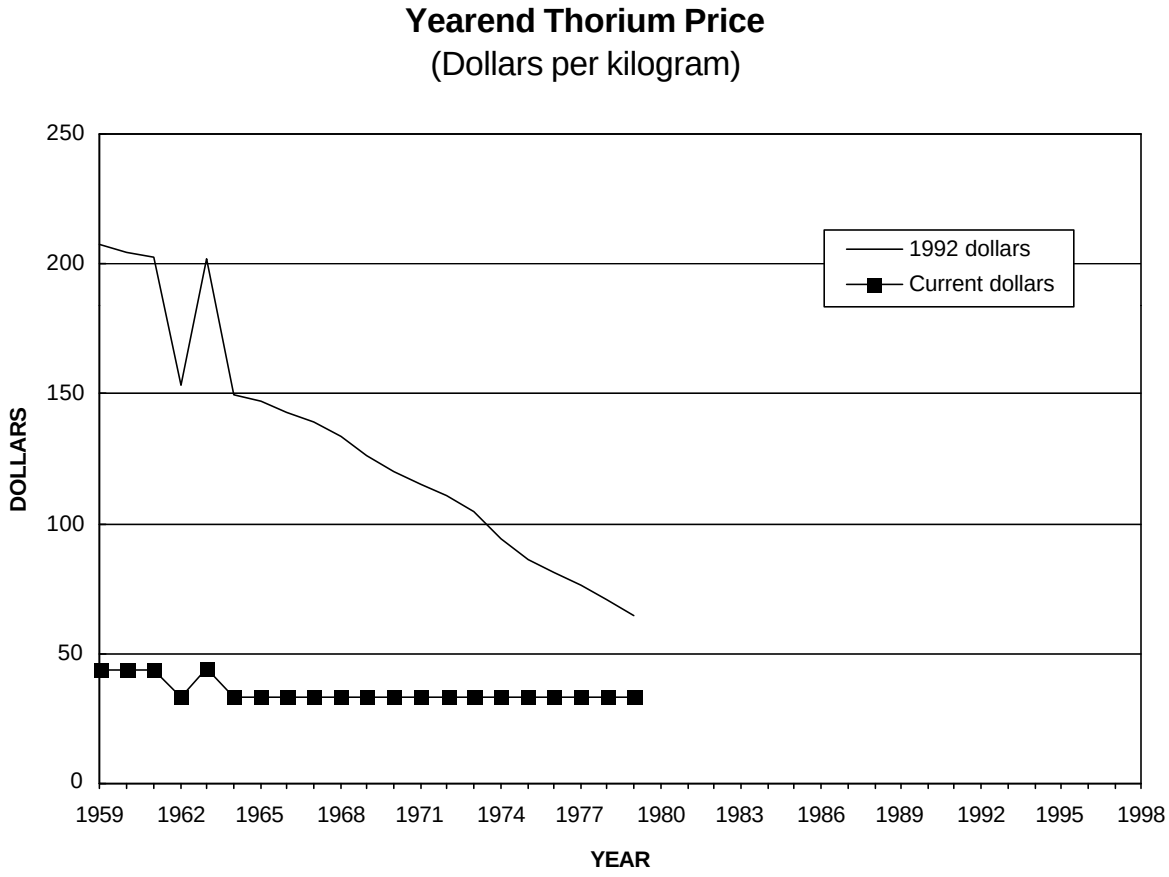

Significant events affecting thorium prices since 1958

1958	Technology improved
1977	Vietnam War increased demand
1980	Decrease in demand, prices for commercial quantities of pure thorium no longer quoted

In 1828, Jöns Jakob Berzelius, a Swedish chemist and mineralogist, discovered thorium in the mineral thorite (Söderbaum, 1929-31), which had been collected by the Reverend Hans M.T. Esmark from a syenite on the island of Lövö, Norway (Weeks and Leicester, 1968, p. 532). Berzelius prepared the impure metal by reducing potassium thorium fluoride with potassium in a glass tube (Weeks and Leicester, 1968, p. 534). In 1884, commercial use of thorium began with the invention and development of the incandescent gas light "Welsbach mantle," or "Auerlicht," by Austrian chemist Carl Auer von Welsbach. Patented the following year, the mantle used the luminescent properties of a thorium nitrate mixture containing small amounts of cerium, beryllium, and magnesium nitrates to adjust the brightness and strength of the lamp mantle (Auer von Welsbach, 1902). World production initially came from Sweden and Norway, but the United States (1893), Brazil (1895), and India (1911) followed, as larger and more-economic deposits were developed (Parker and Baroch, 1971, p. 17).

Recovered almost exclusively as a residue or waste during processing of the rare-earth-thorium phosphate mineral, monazite, thorium is used in small amounts in alloying

magnesium, emitting electrons at microwave frequencies, and welding electrodes to provide a stable and continuous arc (Hedrick, 1997).

Fluctuations in the price of thorium have been minimized by its byproduct status and a supply that far exceeds demand. Because of the small size of the thorium industry, quoted prices are those of individual companies. The thorium price, which is variable, depends on the material's purity and the quantity purchased. Its use as a pure metal has been limited, with essentially all thorium applications using either a thorium compound or a thorium-containing master alloy. Therefore, the price history of the individual metal is limited. The annual prices presented in the graph and table may not be comparable from year to year, owing to differences in purities, quantity of material to be purchased, and source of the price.

The price of thorium metal was quoted in dollars per pound beginning in 1958. The previous year, the Atomic Energy Commission (AEC) released information on an improved process for preparing high-purity (99.9% purity) thorium metal (U.S. Atomic Energy Commission, 1957). AEC's new technology reportedly reduced the per pound production cost of the metal from the $15 to $20 ($33 to $44 per kilogram) range to $2 ($4.41 per kilogram). Increased costs in the late 1960's and early 1970's were related to increased demand for aviation alloys during the Vietnam War (Baroch, 1968). After the war, demand for thorium-containing alloys declined about 50%, and only minor quantities have been used since (Kirk, 1981).

Environmental issues and concerns related to thorium's natural radioactivity have impeded its commercial development. The impact of these environmental concerns escalated in the 1980's, causing the principal consumers to seek nonradioactive substitutes. By the end of the decade, most thorium materials generated as a byproduct of rare-earth production were disposed of in tailing ponds or shipped to U.S. Government approved low-level radioactive disposal sites (Hedrick, 1990).

After 1979, thorium was primarily sold in small research quantities or alloyed as a master or finished alloy. As a result, prices for the pure metal were no longer quoted for commercial quantities. Research in the late 1980's led to the development of suitable substitutes for thorium alloys, and demand decreased. In the 1980's and 1990's, prices for commercial quantities were only available for a few thorium-containing alloys, including magnesium-thorium master alloy (80% magnesium-20% thorium), the magnesium alloy HZ-32, and the magnesium-zinc alloy ZH-62. During the mid-1990's, most domestic companies ceased using thorium-bearing metal and alloys in their products, the result of concerns and costs related to its natural radioactivity (Hedrick, 1996).

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Yearend Thorium Price

(Dollars per kilogram)

Year	Price	Year	Price	Year	Price	Year	Price
1959	43.10	1969	33.07	1979	33.07	1989	NA
1960	43.10	1970	33.07	1980	NA	1990	NA
1961	43.10	1971	33.07	1981	NA	1991	NA
1962	33.07	1972	33.07	1982	NA	1992	NA
1963	44.09	1973	33.07	1983	NA	1993	NA
1964	33.07	1974	33.07	1984	NA	1994	NA
1965	33.07	1975	33.07	1985	NA	1995	NA
1966	33.07	1976	33.07	1986	NA	1996	NA
1967	33.07	1977	33.07	1987	NA	1997	NA
1968	33.07	1978	33.07	1988	NA	1998	NA

NA Not available

Note:
1959-61, Nuclear grade from the U.S. Atomic Energy Commission.
1962, 1964-79, Commercial grade for pellets, *in* American Metal Market.
1963, 99.9+% purity, *in* Thorium, U.S. Bureau of Mines Minerals Yearbook 1963.
1980-98, Price no longer quoted because of decreased demand.