THORIUM

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Worldwide demand for thorium is small. There was no domestic production of thorium in 2004. Domestic imports for consumption of refined thorium products increased by 29% in 2004 according to data collected by the U.S. International Trade Commission. The value of thorium metal and compounds used by the domestic industry in 2004 was estimated to be about $170,000, an increase from $149,000 in 2003. Only minor amounts of thorium are used annually (less than 10 metric tons per year). However, large fluctuations in demand are caused by intermittent use, especially for catalytic applications that do not require annual replenishment.

Thorium and its compounds were produced primarily from the mineral monazite, which was recovered as a byproduct of processing heavy-mineral sands for tin, titanium, or zirconium minerals. Monazite was recovered primarily for its rare-earth content, and only a small portion of the byproduct thorium produced was consumed. Monazite-producing countries were Brazil, India, Malaysia, and Sri Lanka. In 2004, all thorium compounds, metal, and alloys used by the domestic industry were derived from imports, company stocks, or material previously acquired from the U.S. Government stockpile.

Problems associated with thorium's natural radioactivity represented a significant cost to those companies involved in its mining, processing, manufacture, and use. The costs to comply with environmental regulations and potential legal liabilities and the excessive costs to purchase storage and waste disposal space were the principal deterrents to its commercial use. Health concerns associated with thorium's natural radioactivity have not been a significant factor in switching to alternative nonradioactive materials (Ed Loughlin, Grace-Davison division of W.R. Grace & Co., oral commun., 1997; Don Whitesell, The Coleman Company, Inc., oral commun., 2002).

Limited demand for thorium, relative to the rare earths, continued to create a worldwide oversupply of thorium compounds and residues. Most major rare-earth processors have switched feed materials to thorium-free intermediate compounds, such as rare-earth chlorides, hydroxides, or nitrates. Excess thorium not designated for commercial use was either disposed of as a radioactive waste or stored for potential use as a nuclear fuel or other application. Principal nonenergy uses have shifted from refractory applications to chemical catalysts, lighting, and welding electrodes.

Legislation and Government Programs

The National Defense Authorization Act for Fiscal Year 2004 (Public Law 108-136) was enacted on November 24, 2003. The law authorized the National Defense Stockpile (NDS) manager to obligate up to $69.7 million for the uses under section 9(b)(2) of the Strategic and Critical Materials Stock Piling Act, including the disposal of hazardous materials that are environmentally sensitive, which would include thorium nitrate.

The Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (Public Law 108-375) was enacted on October 28, 2004. The Act authorized the NDS manager to obligate up to $59.7 million from the NDS Transaction Fund for authorized uses under the Strategic and Critical Materials Stock Piling Act (50 U.S.C. 98h), including disposal of hazardous materials that are environmentally sensitive. Fiscal year 2005 funding decreased by $10 million from that of the previous fiscal year. The Annual Materials Plan for fiscal year 2005, released February 1, 2005, authorized the disposal of 3,220,506 kilograms (kg) (7,100,000 pounds) of thorium nitrate from the NDS classified as excess to goal.

Based on the legislated funding, studies were conducted in 2003 on the disposal of thorium nitrate in the NDS. As required under the National Environmental Policy Act (42 U.S.C. 4321 et seq.), an environmental assessment was prepared to assess the potential environmental impacts associated with the proposed action to transfer the Defense National Stockpile Center's (DNSC) thorium nitrate to the Nevada Test Site (NTS) for disposal. The thorium nitrate is stored at DNSC depots at Curtis Bay, MD, and Hammond, IN. Approximately 21,000 drums containing thorium nitrate and 10 drums containing converted thorium nitrate would be loaded into cargo containers and transported to the NTS, where the cargo containers would be placed in disposal cells. DNSC began the disposal of the entire NDS stockpile of thorium nitrate from its depots in Maryland and Indiana to the Nevada Test Site, about 105 kilometers (65 miles) northwest of Las Vegas, NV. Shipments of thorium nitrate began from the Curtis Bay NDS depot in 2004. Shipments of the stockpile at the Hammond NDS depot were expected to begin by mid-year 2005 with shipments to Nevada from both depots expected to be completed by the end of fiscal year 2005.

Production

Domestic mine production data for thorium-bearing minerals were developed by the U.S. Geological Survey from a voluntary canvass of U.S. thorium operations. The one mine to which a canvass form was sent responded. Although thorium was not produced in the United States in 2004, the mine that had previously produced thorium-bearing monazite continued to maintain capacity on standby. Monazite was last produced in the United States in 1994.

Spectrulite Consortium, Inc. of Madison, IL, which filed for protection under Chapter 11 of the U.S. Bankruptcy Code in January 2003, was in the process of having its assets liquidated during 2004 (Aluminum Association, Inc., The, 2003§[1]). The company previously produced high-strength lightweight thorium-magnesium alloys for aerospace applications.

[1]A reference that includes a section mark (§) is found in the Internet Reference Cited section.

Essentially all thorium alloys and compounds used by the domestic industry were derived from imports, company stocks, or materials sold from the NDS. Domestic companies processed or fabricated various forms of thorium for nonenergy uses, such as chemical catalysts, lighting, and welding electrodes.

Consumption

Statistics on domestic thorium consumption were developed by surveying various processors and manufacturers, evaluating import-export data, and analyzing Government stockpile shipments. Domestic thorium producers and processors that were surveyed in 2004 reported no consumption of thorium oxide equivalent in 2004. Additional information on domestic consumption was not available (table 1).

Stocks

Government stocks of thorium nitrate in the NDS were 3,218,697 kg (7,096,012 pounds) on December 31, 2004. At yearend 2004, all stocks of thorium nitrate in the NDS were uncommitted (not previously sold) and authorized for disposal. NDS stocks were scheduled for shipment to the NTS.

Prices

Thorium oxide prices in 2004, quoted by Rhodia Electronics and Catalysis, Inc., were unchanged from the previous year (table 1). At yearend, thorium oxide prices delivered duty paid were $82.50 per kilogram for 99.9% purity and $107.25 per kilogram for 99.99% purity. Thorium nitrate prices from Rhodia were $27.00 per kilogram for mantle-grade material.

World Review

Thorium demand remained depressed because industrial consumers expressed concerns with the potential liabilities, the cost of complying with environmental monitoring and regulations, and the costs of disposal at approved waste burial sites.

Outlook

Thorium use in the United States has decreased substantially during the past decade. Domestic demand is expected to remain at recent depressed levels unless low-cost technology is developed to dispose of residues or its use as a nonproliferative nuclear fuel gains widespread commercialization. In the long term, high-disposal costs, increasingly stringent regulations, and public concerns related to thorium's natural radioactivity are expected to continue to depress its use in nonenergy applications, especially in the United States.

Internet Reference Cited

Aluminum Association, Inc., The, 2003, Spectrulite Consortium Inc. files for chapter 11 bankruptcy protection, accessed August 16, 2004, at URL http://www.aluminum.org/Template.cfm?Section=Home&template=/ContentManagement/ContentDisplay.cfm&ContentID=4671.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Nuclear Fuels. Ch. in United States Mineral Resources, Professional Paper 820, 1973.
Thorium. Ch. in Mineral Commodity Summaries, annual.

Other

Thorium. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.
Uranium Industry Annual 2002, U.S. Department of Energy.

TABLE 1
SALIENT U.S. REFINED THORIUM STATISTICS[1]

(Kilograms and dollars)

	2000	2001	2002	2003	2004
Exports, gross weight:					
Thorium ore, including monazite	--	--	--	23,000	--
Compounds	4,640	7,300	880 r	590 r	731
Imports, compounds, gross weight	11,100	1,850	650	4,140	5,320
Consumption, reported nonenergy applications, gross weight[2]	6,000	NA	NA	NA	NA
Prices, yearend:					
Nitrate, gross weight[3, 4]	27.00	27.00	27.00	27.00	27.00
Oxide, 99.9% purity[4]	82.50	82.50	82.50	82.50	82.50

rRevised. NA Not available. -- Zero.
[1]Data are rounded to no more than three significant digits, except prices.
[2]All domestically consumed thorium was derived from imported metals, alloys, and compounds.
[3]Source: Rhodia Canada, Inc., free on board port of entry, duty paid, thorium oxide basis.
[4]Source: Rhodia Electronics and Catalysis, Inc.

TABLE 2
U.S. FOREIGN TRADE IN THORIUM AND THORIUM-BEARING MATERIALS[1]

(Kilograms and dollars)

	2003		2004		
	Quantity	Value	Quantity	Value	Principal destinations/sources and quantities, 2004
Exports:					
Thorium ore, monazite concentrate	23,000	2,610	--	--	--
Compounds	590 r	168,000 r	731	298,000	Mexico 421; Singapore 217; United Kingdom 34; Japan 21; United Arab Emirates 18; Equatorial Guinea 7.
Imports, compounds	4,140	149,000	5,320	170,000	France 5,320; Germany 5.

rRevised. -- Zero.
[1]Data are rounded to no more than three significant digits.

Source: U.S. Census Bureau.

TABLE 3
MONAZITE CONCENTRATE: ESTIMATED WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons, gross weight)

Country[3]	2000	2001	2002	2003	2004
Brazil	200	200	200	200	200
India	5,000	5,000	5,000	5,000	5,000
Malaysia	818 4	643 4	441 r, 4	795 r, 4	500
Total	6,020	5,840	5,640 r	6,000 r	5,700

rRevised.
[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.
[2]Table includes data available through April 18, 2005.
[3]In addition to the countries listed, China, Indonesia, Nigeria, North Korea, the Republic of Korea, and countries of the Commonwealth of Independent States may produce monazite; available general information is inadequate for formulation of reliable estimates of output levels.
[4]Reported figure.