THALLIUM

(Data in kilograms of thallium content unless otherwise noted)

Domestic Production and Use: Thallium is a byproduct metal recovered in some countries from flue dusts and residues collected in the smelting of copper, zinc, and lead ores. Although thallium was contained in ores mined or processed in the United States, it has not been recovered domestically since 1981. Consumption of thallium metal and thallium compounds continued for most of its established end uses. These included the use of radioactive thallium isotope 201 for medical purposes in cardiovascular imaging; thallium as an activator (sodium iodide crystal doped with thallium) in gamma radiation detection equipment (scintillometer); thallium-barium-calcium-copper oxide high-temperature superconductor (HTS) used in filters for wireless communications; thallium in lenses, prisms and windows for infrared detection and transmission equipment; thallium-arsenic-selenium crystal filters for light diffraction in acousto-optical measuring devices; and thallium as an alloying component with mercury for low-temperature measurements. Other uses included an additive in glass to increase its refractive index and density, a catalyst for organic compound synthesis, and a component in high-density liquids for sink-float separation of minerals.

Salient Statistics—United States:	2002	2003	2004	2005	2006[e]
Production, mine	(1)	(1)	(1)	(1)	(1)
Imports for consumption (gross weight)					
Unwrought powders	49	36	117	23	30
Formed and articles	258	45	98	212	279
Waste and scrap	—	—	110	—	—
Total	307	81	325	235	309
Exports (gross weight)					
Unwrought powders	—	490	224	209	200
Formed and articles	463	1,560	965	43	1,090
Waste and scrap	188	39	—	—	—
Total	651	2,090	1,190	252	1,290
Consumption[e]	500	NA	900	300	NA
Price, metal, dollars per kilogram[2]	1,250	1,300	1,600	1,900	5,170
Net import reliance[e, 3] as a percentage of apparent consumption	100	100	100	100	100

Recycling: None.

Import Sources (2002-05): Russia, 90%; and Belgium, 10%.

Tariff: Item	Number	Normal Trade Relations 12-31-06
Unwrought and powders	8112.51.0000	4.0% ad val.
Waste and scrap	8112.52.0000	Free.
Other	8112.59.0000	4.0% ad val.

Depletion Allowance: 14% (Domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: The annual thallium consumption and trade numbers found in the "Salient Statistics—United States" table are relatively low in comparison with other mineral commodities, and their changes do not conform to the normal supply-demand economic model. A telephone survey of several chemical and specialty metal providers determined that there was a scarcity of thallium metal in stock and relatively high prices in 2006. The lowest price found was $1,164 for 225-gram rods or $5,173.33 per kilogram, and most prices were significantly higher—some more than $6,000 per kilogram.

Research and development activities of both a basic and applied nature were conducted during 2006 that could expand the use of thallium. Atomic property research of thallium has potential to make this element important in elementary particle physics. Other activities included the development of HTS materials for such applications as magnetic resonance imaging, storage of magnetic energy, magnetic propulsion, more efficient electrical motors, and electric power generation and transmission. Materials are considered HTS if they have a critical transition (to superconductivity) temperature (Tc) above 77 Kelvin (K), the boiling temperature of liquid nitrogen. Presently, the HTS material attaining the highest Tc, 138 K, is a mercury-thallium-barium-calcium-copper oxide mix. Improved methods for manufacturing high-temperature superconductor tapes and films were under development. Tapes and films could be significant energy savers if used in ultrafast computers and power transmission systems.

Prepared by **Xiaoyu Bi [(703) 648-7731, xbi@usgs.gov, fax: (703) 648-7757]**

THALLIUM

A broad range of commercial applications would become available if HTS materials could be fabricated on a large scale into wires having a certain degree of flexibility and strength. Currently, HTS materials are relatively brittle metal-oxide ceramics. There are now more than 50 known HTS materials, but only a few (nonthallium) have been used successfully to form long-length wires.

In medical applications, dipyridamole-thallium imaging continued to be a useful preoperative procedure for assessing long-term cardiac risks in patients with coronary artery disease or diabetes who are undergoing peripheral vascular surgery. Further uses of radioactive thallium in clinical diagnostic applications include cardiovascular and oncological imaging.

Thallium metal and its compounds are highly toxic materials and are strictly controlled to prevent a threat to humans and the environment. Thallium and its compounds can be absorbed into the human body by skin contact, ingestion, or inhalation of dust or fumes. Further information on thallium toxicity can be found in the U.S. Environmental Protection Agency (EPA) Integrated Risk Information System (IRIS) database. The EPA initiated studies at its National Risk Management Research Laboratory on thallium removal from mine wastewaters. The U.S. Department of Health and Human Services, Food and Drug Administration, issued a guidance document announcing an approved drug for treatment of internal bodily contamination by radioactive or nonradioactive thallium. The drug, a form of industrial and artists' pigment (Prussian blue), effectively increases the rate of elimination of thallium from the body by interrupting readsorption in the intestine by fixing the metal through ion exchange with the drug.

World Mine Production, Reserves, and Reserve Base:[4]

	Mine production		Reserves[5]	Reserve base[5]
	2005	2006[e]		
United States	([1])	([1])	32,000	120,000
Other countries	10,000	10,000	350,000	530,000
World total (rounded)	10,000	10,000	380,000	650,000

World Resources: World resources of thallium contained in zinc resources total about 17 million kilograms; most are located in Canada, Europe, and the United States. An additional 630 million kilograms is in world coal resources. The average thallium content of the Earth's crust has been estimated to be 0.7 part per million.

Substitutes: The apparent leading potential demand for thallium could be in the area of HTS materials but demand will be based on which HTS formulation has a combination of favorable electric and physical qualities and is best suited for fabrication. A firm presently using a thallium HTS material in filters for wireless communications is considering using a nonthallium HTS. While research in HTS continues, and thallium is part of that research effort, it is not guaranteed that HTS products will be a large user of thallium in the future.

While other materials and formulations can substitute for thallium in gamma radiation detection equipment and optics used for infrared detection and transmission, thallium materials are presently superior and more cost effective for these very specialized uses.

While thallium is still used in high-density liquids for sink-float separation of minerals, nonpoisonous substitutes like tungsten compounds are being marketed.

[e]Estimated. NA Not available. — Zero.

[1]No reported mine production; flue dust and residues from base-metal smelters, from which thallium metal and compounds may be recovered, are being exported to Canada, France, the United Kingdom, and other countries.

[2]Estimated price of 99.999%-pure granules or rods in 100- to 250-gram or larger lots.

[3]Defined as imports – exports + adjustments for Government and industry stock changes. Consumption and exports of unwrought thallium were from imported material or from a drawdown in unreported inventories.

[4]Estimates are based on thallium content of zinc ores.

[5]See Appendix C for definitions.