

TELLURIUM

By a Special Contributor

Tellurium is a rare, semi-conductor that occurs in tellurium-bearing minerals such as sylvanite ((Au, Ag)₂Te₂) in copper and gold deposits. The chief source of tellurium is a by-product of electrolytic copper refining, where it preferentially concentrates into the anode slimes in concentrations of up to 5%. This source accounts for over 90% of supply, although tellurium is also recovered from the flue dusts and gases generated during the smelting of copper, bismuth and lead ores, and from lead refinery skimmings.

About half of world tellurium consumption is as an alloying agent with steel, where it improves machining characteristics. Tellurium is also alloyed with copper for the same reason, but without compromising copper's conductivity. A further important end-use of tellurium is in rubber manufacture, where it accelerates the vulcanising process. Industrially, tellurium is used in catalysts and in the manufacture of synthetic fibres. Finally, small quantities of tellurium are used in photoreceptors and in thermoelectric devices.

Estimated end-uses of tellurium in 2004 are:

Alloying agent with iron and steel	50%
Catalysts and chemical uses	25%
Alloyed with non-ferrous metals	10%
Electronic applications	8%
Other	7%

Production

Most companies do not publish figures on their tellurium production; therefore, the world production of tellurium is an estimate only.

Estimated world production of tellurium (tonnes)

Country	2000	2001	2002	2003	2004
Canada	64	53	51	45	42
USA	50	50	50	50	50
Peru	17	22	19	20	20
Japan	35	36	39	29	32
Russia	11	11	14	17	22

Estimated, rounded, world total 185 183 166 171 168

Source: USGS

Note: In addition to the countries listed above, Australia, Belgium, Chile, Germany and Zambia are all believed to produce minor quantities of tellurium. Estimates of their production are incorporated in the world total.

Prices

Tellurium prices are chiefly set by producers on a medium- to long-term contract basis, although there is a growing dealer market.

Average year-end tellurium price, 99.7% purity, quoted by sole US-based producer (US\$/lb)

1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
32	26	23	21	19	18	15	14	15	16	17	10

The value of tellurium production in 2003 is estimated at about US\$6.5 million. Because tellurium is mostly a by-product of copper refining, supply tends to depend on copper demand and supply. This can lead to short- to medium-term price volatility and a period of over-supply can be reasonably expected over the next few years as copper production increases in response to recent good price performance.

Recycling

Most of the major end-uses of tellurium are dissipative, thus there is very little secondary material processing. In Europe, the Waste Electronic and Electrical Equipment Directive (WEEE) may result in more secondary material entering the product-cycle in the form of electronic devices, photocopier drums and specialist ferrous and non-ferrous alloys.

Companies

Most companies do not report their production of tellurium. Copper refineries in Canada, Peru, the US, Japan, Russia and the Philippines account for much of the world's supply.

Asarco, a wholly-owned subsidiary of Grupo Mexico, is a major world producer from its Globe refinery in Denver, US. In Russia, the major producer is Uralelectromed, with reported production of about 22,000 kg of tellurium in 2004. In Peru, the main producer is the Oroya smelter (operated by Doe Run Co of the US), although production figures are not disclosed. The smelter was purchased from Centromin in 1997, and Doe Run is currently investing US\$100 million in reducing emissions from the plant. In the EU, the major producer is Belgium-based Umicore.

Market outlook

The market for tellurium is small and complex, and monitoring tellurium trade is hampered by its common inclusion in general 'minor metal' trade codes or trade in tellurium-compound and alloy forms. The supply of tellurium is closely linked to copper supply from refineries around the world. In its diverse applications tellurium consumption can vary from 50% of a product to only trace amounts, and this exerts a strong control on the price that consumers are willing to pay.

One common use of tellurium is with antimony and bismuth on DVD coatings. This isn't a major source of demand as only tiny quantities of tellurium are used. However, the development of a new bismuth-tellurium coating that

allows higher reading and writing speeds on DVDs may lead to a rise in world demand in the medium term.

One growth area for tellurium demand is a cadmium telluride that can be used in solar cells. Research into this application has produced some of the highest power conversion ratios so far obtained, and the use of solar cells for power generation in remote areas may be a significant source of future demand growth.

The growth in copper recovery by leaching processes (bio-, or SX/EW) is exerting a downward pressure on supply, as tellurium is not recovered by this copper production method. There is also limited scope to increase secondary tellurium production. With a combination of new markets, and falling primary supply, the tellurium price is predicted to increase significantly in the long term.

Tellurium can be substituted in most of its applications, which may happen if the price rises to a level that makes substitution attractive. However, this is usually accompanied by a loss of performance or production efficiency. In its major end-use, as an alloying agent with steel, tellurium can be substituted by bismuth, calcium, phosphorus, lead, sulphur or selenium. Other catalysts can replace tellurium-based catalysts in chemical processing, and selenium or sulphur can perform as vulcanising agents in rubber compounding.