

Antimony

Antimony is a bluish-white, brittle metal with low thermal and electrical conductivity. It melts at 630.6°C and boils at 1,587°C. It is sited between arsenic and bismuth in the periodic table of elements. The origin of its name is not certain, but one theory says it is derived from the Greek words "anti" and "monos", meaning not found alone.

Stibnite or antimony sulphide (Sb_2S_3) was used in ancient times as a medicine and as a black cosmetic (kohl): the Latin stibium means mark or stain. A cast antimony object dating back to 3000 BC has been found in Chaldea (Iraq) and antimony-coated copper articles were in use in Egypt between 2500 and 2200 BC.

China is by far the biggest source of antimony, followed by Bolivia, South Africa, Tajikistan and Russia (see table). Total mine production was over 170,000 tonnes last year, according to the World Bureau of Metal Statistics (WBMS). The US Geological Survey (USGS) estimates that total world economic reserves are about 1.7m tonnes (with 0.79m tonnes in China) and total resources 3.9m tonnes.

EXTRACTION

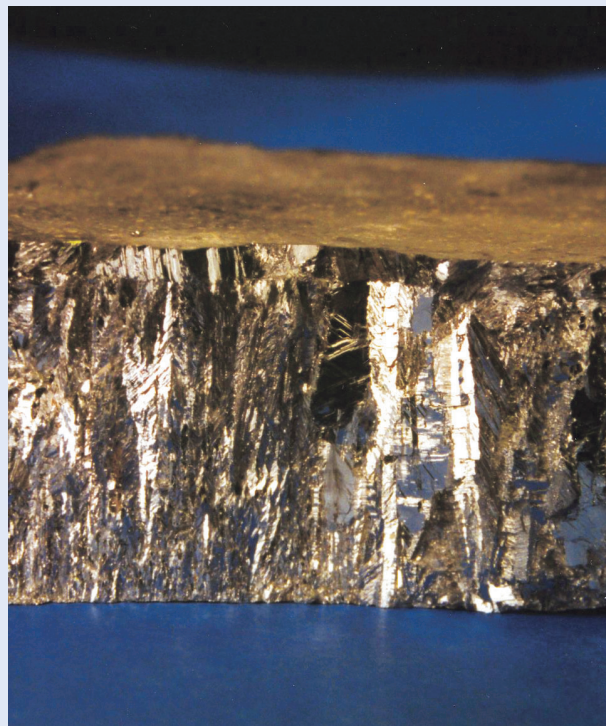
Antimony has an abundance of 0.2 to 0.5 ppm in the Earth's crust. It is sometimes found free in nature but its main source from the many minerals of antimony is black stibnite (Sb_2S_3). The element also occurs as white valentinite (Sb_2O_3), as well as antimonides and sulphoantimonides of metals like lead, copper and silver.

To obtain antimony metal, stibnite is reduced with iron, and the iron sulphide is then removed as slag. The metal can also be produced by roasting stibnite to the oxide, which is then reduced with carbon in the presence of a carbonate flux.

The principal impurities are lead and arsenic. The so-called technical metal (99.0-99.8% pure) is obtained by thermal refining or (rarely) electrorefining. The metal is converted into ingots, broken pieces, granules, cast cake, powder, shot or single crystals. The most common form of refined metal is called regulus, with minimum 99.65% Sb, maximum selenium 50 ppm and maximum bismuth 100 ppm.

Impure oxide from China is the major antimony intermediate raw material, because the oxide accounts for most of antimony's demand, namely for fire-retardants. For example, 7,290 tonnes of oxide, 1,530 tonnes of the metal and 89 tonnes of other forms of antimony (including sulphides) were consumed in the USA in 2005, according to the USGS. Impure oxide is converted into merchant oxide by thermal refining.

China itself consumed some 30,000 tonnes of antimony in 2005, of which half went into flame retardants, estimates Beijing Antaika Information Development.



Stephen Karpel

Antimony is not used in its pure form, but is a part of many alloys

USES

Because of its excessive brittleness and the difficulty of shaping it, pure antimony has no direct applications, but it is extensively used as an alloying element. For example,

hard lead may contain up to 25% antimony. Lead-antimony alloys are used in ammunition, antifriction bearings, cable sheaths, corrosion-resistant pumps and pipes, roof sheet solder and tank linings. Modern pewter contains up to 8% antimony.

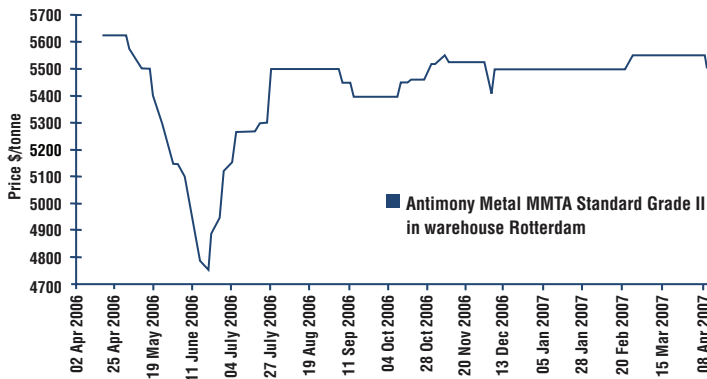
Most antimony metal is used as a hardener for the lead electrodes in lead-acid batteries. However, some of these alloys

US antimony consumption by end-use*

Metal products:	
Antimonial lead	1,200 [†]
Bearing metal and bearings	33
Solder	81
Other (includes ammunition, cable covering, castings, sheet and pipe)	2,830
Non-metal products:	
Ammunition primers	na
Ceramics and glass	421
Pigments	535
Plastics	na
Other (includes fireworks and rubber products)	1,410
Flame retardants:	
Adhesives	676 [†]
Plastics	2,650
Rubber	115
Textiles	184
Other (includes paper and pigments)	652
Total	10,787

*tonnes in 2005. [†]2004. na: not available
Source: USGS

Antimony metal price



Source: Metal Bulletin

World mine production*

Country	2005	2006
China	151,457	150,200
South Africa	6,098	4,383
Bolivia	5,225	4,877
Tajikistan	4,073	3,480
Russia	3,000	3,000
Kyrgyzstan	1,300	1,300
Mexico	604	600
Peru	566	773
Other	1,712	1,612
Total	174,035	170,225

*tonnes Sb. Source: World Bureau of Metal Statistics

promote the creation of hydrogen on recharging the battery, so water needs to be added at regular intervals to replace that lost – such batteries are not maintenance-free.

To manufacture maintenance-free batteries, the antimony content has to be significantly reduced and less than 0.1% selenium added; the antimony content of typical automotive battery alloys has fallen to 0.6% or lower.

These alloys have strong competition from alternative lead battery alloys containing calcium, aluminium and tin. The latter can be continuously cast and the cast strip then stamped into grids, which is not possible with antimonial alloys. Industry sources believe that the antimony content of lead-acid batteries could fall to zero by 2020.

Secondary antimony is recovered from used lead acid batteries, although the quantities are steadily falling as it is phased out of battery alloys. The USA produced 3,400 tonnes of secondary antimony in 2006, estimates the USGS.

But the main demand for antimony is as the trioxide for flame retardants. This consumes about 65% of the metal, estimates special metals producer Umicore. About 40% of the primary antimony consumed in the USA in 2005 went into flame retardants, reports the USGS, which notes that this application is expected to remain its principal use, in both US and global markets.

Antimony trioxide flame-proofing chemicals are used in a very wide range of materials (see table), usually in synergistic combination with halogenated organic compounds.

Antimony trioxide is also used as a catalyst in the production of the important plastic polyethylene terephthalate (PET), and in pigments and enamels.

Sodium antimonite is used in certain special glasses and antimony sulphide (Sb₂S₃) is one of the components of brake linings. The intermetallic compounds AsSb, GaSb and InSb have some applications in electronics. Germanium-antimony alloy is a promising semiconductor

for the next generation of “phase-change” computer chips.

For many traditional areas such as lead hardening, paints, pigments and enamels, antimony can be substituted by other metals. There are also alternative flame-retardants, so few antimony uses can be considered to be “fire-proof”.

DEVELOPMENTS

Antimony production in China is split between state and private companies. One of largest Chinese companies is state-owned Hsikwangshan Twinkling Star, based in Hunan province. It has two mines and two smelters, and produces 25,000 tpy of the metal and 25,000 tpy of the trioxide.

From the beginning of this year, the Chinese government has raised the minimum requirement for new and upgraded projects in the antimony industry in a bid to curb future expansions. All antimony smelting projects must now have a capacity of 5,000 tpy or more. The standards also include requirements for recycling of resources, power consumption, environmental protection and product quality.

The antimony market can be volatile because of China’s dominance as a producer. Continued production constraints (including a clampdown on illegal Chinese mines and smelters) and a decline in antimony use has caused a world supply deficit, helping to keep prices up.

China reduced its export quota for antimony and its products by 3% this year to 61,800 tonnes. It also introduced a 10% export tax on antimony ores and concentrates last November, and abolished the 5% export tax rebate on the metal last September. These are regarded as moves to promote domestic consumption, build up its strategic reserves and add value to its resources.

China’s antimony exports fell 62% year-on-year to 712.3 tonnes in the first two months of this year, according to the General Administration of Customs.

Since the end of last July, antimony prices have remained in the range \$5,400-5,550/tonne (MMTA standard grade II, in warehouse Rotterdam). ■