

# 13 Antimony

Antimony is a strategic metal. Stibnite, composed of antimony trisulphide,  $Sb_2S_3$ , (Sb 71.4%) is the predominant ore of antimony. Antimony in its elemental form is a silvery white, brittle, fusible, crystalline solid that exhibits poor electrical and heat conductivity properties and vaporises at low temperatures. Antimony and some of its alloys are unusual in nature that they expand on cooling. Commercial forms of antimony are generally traded in the form of ingots, broken pieces, granules or cast cake. Other forms are powder, shots, and single crystals. The occurrence of antimony in the earth crust ranges from 0.2 to 0.5 parts per million. Antimony is geochemically categorised as a chalcophile, occurring with sulphur and associated

with heavy metals, lead, copper and silver. The metal is obtained commonly as a by-product in lead-zinc-silver smelting.

Presently, there is no production of antimony in India. The entire requirement of antimony in the country is met through imports of its ore and concentrates.

## RESOURCES

As per the UNFC system, as on 1.4.2005, total resources of 10,588 tonnes ore with metal content of 174 tonnes are estimated all in inferred category in Lahul & Spiti district, Himachal Pradesh (Table-1).

**Table - 1 : Reserves/Resources of Antimony as on 1.4.2005  
(By States/Grades)**

India/State		Reserves Total (A)	Remaining resources		Total resources (A+B)
			Inferred (STD 333)	Total (B)	
<b>India</b>					
	<b>Ore</b>	-	<b>10588</b>	<b>10588</b>	<b>10588</b>
	<b>Metal</b>	-	<b>174</b>	<b>174</b>	<b>174</b>
Himachal Pradesh					
	Ore	-	10588	10588	10588
	Metal	-	174	174	174

The stibnite and its decomposition products, cervantite and kermesite occur as veins, stringers and specks. Occurrences of antimony ores are also reported from the states of Andhra Pradesh, Bihar, Jammu and Kashmir, Karnataka and Uttar Pradesh.

## USES

Antimony and its alloys find numerous applications in a wide range of high technology industries like electronic, space and defence, photographic materials, electroplating, besides cosmetic, paint, plastics and textile industries. Traditionally, it is used in type metal and other alloys. It is now used extensively world-wide to harden and increase the mechanical strength of lead, particularly in battery industry. Antimony

trioxide is the most important of the antimony compounds and is primarily used in flame-retardant applications include such markets as children's clothing, toys, aircraft and automobile seat covers. Antimony sulphide is one of the ingredients of safety matches. It is also used as a decolourising and refining agent in glass industry.

## SUBSTITUTES

Combination of tin, calcium, copper, selenium, cadmium, strontium and sulphur are among the substitutes used as hardeners for lead used in batteries. Low maintenance batteries have shifted to use of calcium as additive to substitute for antimony. Antimony can be replaced by organic

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compounds or hydrated aluminium oxide in flame-retardants and by tellurium and selenium in rubber manufacturing. Compounds of titanium, zinc, chromium, tin and zirconium may be substituted for antimony chemicals in paints, pigments and enamels.

### TECHNICAL POSSIBILITIES

Antimony products can be used as stabilizers in specialised plastics. Development of electric vehicles could lead to the use of high antimony batteries because of their deep cycling characteristics. Antimony semiconductors have possible use in aircraft night vision systems and in space-based astronomy. The antimonial lead scrap extracted from the spent lead acid storage batteries is recycled largely from and for storage battery industry.

### WORLD REVIEW

The world resources of antimony are 4.3 million tonnes in terms of metal content. Antimony resources are located mainly in China, which contributes about 56% to the total reserve base followed by Thailand (10%), Russia (9%), Bolivia (7%), South Africa (5%) and Tajikistan (3%) (Table-2).

The world production of antimony metal decreased to 174,000 tonnes in 2007 as against 181,000 tonnes in the previous year. China was the main producer of antimony accounting for about 88% of world production. South Africa, Bolivia, Tajikistan, Russia, Guatemala, and Kyrgyzstan were the other important producers (Table-3).

**Table - 2 : World Resources of Antimony  
(By Principal Countries)**

(In tonnes of metal content)	
Country	Reserve base
<b>World : Total (rounded)</b>	<b>4300000</b>
Bolivia	320000
China	2400000
Guatemala	NA
Russia (Recoverable)	370000
South Africa	200000
Tajikistan	150000
Thailand	450000
USA	90000
Other countries	330000

*Source: Mineral Commodity Summaries, 2008.*

**Table - 3 : World Production of Antimony  
(By Principal Countries)**

(In tonnes of metal content)			
Country	2005	2006	2007
<b>World : Total</b>	<b>175000</b>	<b>181000</b>	<b>174000</b>
Bolivia	5204	5460	3881
China	151457	156200	152900
Guatemala	1007	1000 <sup>(e)</sup>	1000 <sup>(e)</sup>
Kyrgyzstan <sup>(e)</sup>	1500	1500	1500
Peru	807	691	590
Russia <sup>(e)</sup>	3000 <sup>(e)</sup>	3000 <sup>(e)</sup>	3000 <sup>(e)</sup>
South Africa	5979	4500 <sup>(e)</sup>	3500 <sup>(e)</sup>
Tajikistan	4073	3480	3500 <sup>(e)</sup>
Other countries	1973	5169	4129

*Source: World Mineral Production, 2003-2007.*

### Australia

In Australia, antimony mining restarted in mid 2006 at AGD Mining Ltd's Augusta antimony gold deposit in Central Victoria. Production at the mine now owned by AIM-listed Cambrian Mining Plc. has fallen behind schedule owing to poor ground condition and lack of experienced personnel and equipment. AGD's initial target was to treat 60,000 t/p of antimony ore. Ore is being treated at AGD's Casterfield concentrator. The plant became operational in late March 2007 but was only treating 2000-3000 t/mth of ore, which is less than half of the company's initial target. Straits Resources Ltd is reviving the Hillgrove antimony gold mine in New South Wales. Operations, scheduled to restart during August or September 2007, are expected to yield around 10,000 t/y of antimony metal.

### Canada

Moves have continued to re-open the Beaver Brook mine in Newfoundland, reputedly based on one of the largest undeveloped antimony deposits in the world. As world antimony prices are now much improved there is political pressure to re-start the mine. The mine would be back in operation by the end of the year producing some 5000 to 10,000 tpy of antimony.

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### China

China dominates the world antimony production. Hsikwangshen Twinkling Star Antimony Co. is China's largest antimony metal and trioxide producer. The company has two smelters, both with a capacity of 1000 t/mth. There are known to be more than 100 small antimony producers in Human accounting for 10,000 to 20,000 t/y. The surge in non-ferrous metal prices in recent years has aggregated the problem of illegal mining in China and after a fatal accident at a mine in Lengshuijiang in December 2006, the Human provincial Government ordered a temporary halt to all mining operations and announced plans to bring projects in the province involving mining, concentrating and converting of metals into line with Central Government guidelines on environmental protection and mining safety by October 2007. One river of the Human Province was found to contain a high concentration of antimony. All mines and smelters were shut down for checks and many of the small and illegal mines and plants were closed permanently.

### South Africa

Outside China the only antimony mine of any significance that has continued its operation, is consolidated Murchison mine, in South Africa. The mine has an estimated life of about 7-8 years and in 2006 it produced 5,763 tonnes antimony contained in crude trioxide, all of which was shipped to the Reynosa smelter in Mexico operated by Chentura, the world's largest plastic additives company.

### Kyrgyzstan

Prior to closure in 2004, the Kadamjas antimony smelter in Kyrgyzstan has been struggling to obtain sufficient antimony concentrates for some years and production had dropped to an all time low of around 320 tonnes mainly because China was buying ore from Kyrgyzstan's traditional suppliers - Kazakhstan, Russia and Tajikistan. In 2005, ATF-Invest, a unit of Kazakhstan's fourth largest bank took a 70% stake in the Kadamjai plant, with the intention of

restrating operation in July 2006, albeit at a slightly reduced capacity of 18,000 t/y of ore. This would make it once again the most significant producer outside China.

### Peru

The Peruvian Mining Company, Minera Falcon de Gorgar is planning to start production of antimony concentrates in Cajatambo Province to produce 2,000 tpy of antimony metal for export.

## FOREIGN TRADE

### Exports

Exports of antimony alloys and scrap dropped sharply to 24 tonnes in 2007-08 from 2,159 tonnes in the previous year. Exports were mainly to Jordan, Pakistan, Switzerland and Nepal (Table - 4).

### Imports

Imports of antimony ores and concentrates increased to 693 tonnes in 2006-07 from 478 tonnes in the previous year. Imports were mainly from China, Mexico and Peru. Imports of antimony alloys and scrap increased in 2007-08 to 2,144 tonnes from 2,107 tonnes in the previous year. Imports were mainly from China (94%) (Tables - 5 and 6).

**Table - 4 : Exports of Antimony Alloys and Scrap  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>2159</b>	<b>418875</b>	<b>24</b>	<b>6466</b>
Switzerland	3	3203	2	1998
Jordan	-	-	14	1885
Pakistan	-	-	5	1484
Thailand	-	-	1	603
Nepal	-	-	2	425
UK	++	73	++	21
Afghanistan	1	473	-	-
Italy	4	3783	-	-
Malaysia	1	1080	-	-
Saudi Arabia	2150	410165	-	-
Other countries	++	98	++	50

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**Table - 5 : Imports of Antimony Ores & Conc.  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>478</b>	<b>51084</b>	<b>693</b>	<b>63692</b>
China	52	9700	120	20780
Mexico	40	3176	180	12147
Peru	79	6454	97	5706
Austria	10	2054	24	4743
Canada	-	-	58	4530
Thailand	-	-	50	4189
Germany	58	7391	15	3377
UK	-	-	23	2764
Bolivia	150	15876	-	-
Chile	22	2625	-	-
Other countries	67	3808	126	5456

**Tble - 6 : Imports of Antimony Alloys & Scrap  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>2107</b>	<b>511906</b>	<b>2144</b>	<b>391539</b>
China	2011	487221	2005	364453
Vietnam	40	11244	76	13255
Japan	-	-	40	8629
Hong Kong	20	5306	20	4409
Nigeria	-	-	2	550
Germany	4	381	1	239
Bolivia	3	547	-	-
Singapore	6	1565	-	-
Switzerland	2	312	-	-
Thailand	20	5038	-	-
Other countries	1	292	++	4

## FUTURE OUTLOOK

Continued mining restrictions in China may result in higher market prices of antimony. The future growth in demand for antimony will be much dependent on the level of requirement from the flame-retardant sector which accounts for 55% primary antimony consumption worldwide and for about 90% global antimony trioxide consumption. In the flame-retardant sector, antimony trioxide is used as a synergist normally with bromine and chlorine. In flame-retardant sector, 4% annual growth is predicted for the next five years and the future of antimony will depend on this sector alone.

Currently, antimony-based catalysts account for around 90% usage worldwide in polyethylene terephthalate (PET) production.

A new chip based on germanium-antimony-telluride was developed abroad for 'Phase-change' Random Access Memory chips (PRAMS) which can process data faster than flash memory chips and, unlike silicon, are non-flammable. The chips are commercialised and expected to find applications in mobile telephones and digital cameras. In contrast, little or no growth is anticipated for antimony metal in metallurgical and battery markets.