

ANTIMONY



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ANTIMONY

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**GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES**

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2 Antimony

Antimony is a strategic metal. The predominant ore of antimony is stibnite composed of antimony trisulphide, Sb_2S_3 (Sb 71.4%). The other important ores of antimony are jamesonite ($Pb_2Sb_2S_5$) and senarmonite/valentinite (Sb_2O_3). 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 exhibit unusual property of expansion 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. 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, such as, lead, copper and silver.

RESERVES/RESOURCES

As per the NMI database based on UNFC system, as on 1.4.2015, the total reserves/resources of antimony has been estimated at 10,588 thousands tonnes. The ore with metal content is placed at 174 thousand tonnes, all in Inferred category located in Lahaul & Spiti district, Himachal Pradesh (Table-1).

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, Jammu & Kashmir, Jharkhand, Karnataka and Uttarakhand.

USES

Antimony and its alloys find numerous applications in a wide range of high technology industries like electronic, space defence, photographic materials, electroplating, besides cosmetic, paint, plastics and textile industries. Traditionally, it is used in type metal in Printing Industry and other alloys. It is now used extensively

worldwide 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, including such markets, as children's clothing, toys as well as in manufacturing aircraft and automobile seat covers. Antimony sulphide is one of the ingredients used in safety matches. It is used in solar panels to improve stability of the solar performance of the glass upon exposure to UV radiations or sun-light and also as a decolourising and refining agent in Glass Industry. Antimony compounds also find use in pharmaceutical applications. It is also used in semiconductors for making infrared detectors, diodes and acoustic devices.

INDUSTRY

The metal is obtained commonly as a by-product in lead-zinc-silver smelting. As part of its R & D programme, HZL successfully implemented antimony dust treatment flow sheet at Ancillary Industry. Antimony dust at Pantnagar Metal Plant (PMP) was leached in controlled conditions to recover antimony as Potassium Antimony Tartarate (PAT) reagent which is used in Zinc Hydro plants purification section and enriched lead silver residue. 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. HZL is currently operating metal plant having 1,400 TPA (+400TPA proposed) antimony concentrate production capacity at SIDCUL, Pantnagar, Uttarakhand. As per pre-feasibility report of HZL, submitted to Ministry of Environment Forest & Climate Change (MoEF&CC) in April, 2018, it is proposed to increase annual capacity of antimony concentrates from 1,400 TPA to 1,800 TPA. Similarly, the Chanderiya Pb-Zn pyro smelter in Chittorgarh district Rajasthan produces 800 MT antimony slag (60% Pb + 20% antimony). There is a need to improve the antimony realisation from the slag.

**Table – 1 : Reserves/Resources of Antimony as on 1.4.2015
(By Grades/State)**

(In '000 tonnes)

Grade/State	Reserves			Remaining Resources						Total Resources (A+B)	
	Proved STD111	Probable STD121 STD122	Total (A)	Feasibility STD211	Pre-feasibility STD221 STD222	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334		Total (B)
All India : Total	-	-	-	-	-	-	-	10588	-	10588	10588
Ore	-	-	-	-	-	-	-	10588	-	10588	10588
Metal	-	-	-	-	-	-	-	174	-	174	174
By State											
Himachal Pradesh											
Ore	-	-	-	-	-	-	-	10588	-	10588	10588
Metal	-	-	-	-	-	-	-	174	-	174	174

Figures rounded off

SUBSTITUTES

Combination of tin, calcium, copper, selenium, cadmium, strontium and sulphur is among the substitutes used as hardeners for lead used in batteries. Low maintenance batteries have started using calcium as additive to substitute antimony. Antimony can be replaced by organic compounds or hydrated aluminium oxide in flame-retardants and by tellurium and selenium in rubber manufacturing. Compounds of titanium, zinc, chromium, tin and zirconium are substituted for antimony chemicals in paints, pigments and enamels.

TECHNICAL POSSIBILITIES

Antimony products can be used as stabilisers in specialised plastics. Development of electric vehicles could lead to the use of high antimonial lead batteries because of their deep cycling characteristics. Antimony semiconductors have possible use in aircraft night vision systems and in space-based astronomy. Antimony has also been found to be used in the manufacture of DVDs.

RECYCLING

Traditionally, the bulk of secondary antimony has been recovered at secondary lead smelters as antimonial lead, most of which was generated and then consumed by the Lead-acid Battery Industry.

Table – 2 : World Reserves of Antimony (By Principal Countries)

(In tonnes of metal content)

Country	Reserves
World : Total (rounded off)	150000
Australia	140000 ⁽⁸⁾
Bolivia	310000
Burma	NA
China	480000
Ecuador	NA
Guatemala	NA
Honduras	NA
Iran	NA
Kazakhstan	NA
Kyrgyzstan	NA
Laos	NA
Mexico	18000
Pakistan	26000
Russia (recoverable)	350000
Tajikistan	50000
Turkey	100000
USA	60000 ⁽⁷⁾
Vietnam	NA

Source: USGS Mineral Commodity Summaries, 2020.

Note : ⁽⁷⁾Company-reported probable reserves for the Stibnite Gold Project in Idaho.

⁽⁸⁾For Australia, Joint Ore Reserves committee-compliant reserves were 64,300 tonnes.

WORLD REVIEW

The world reserves of antimony were 1.5 million tonnes in terms of metal content. Antimony reserves are located mainly in China, which contribute about 32% of the total reserves followed by Russia (23%), Bolivia (21%), Australia (9%), Turkey (7%), USA (4%) and Tajikistan (3%) (Table-2).

The world mine production of antimony metal increased marginally by 4% to 1,65,000 tonnes in 2018 as against 1,58,000 tonnes in the previous year. China with (54%) production was the main producer of antimony in the world followed by Russia (18%), Tajikistan (17%) and Turkey (2%) (Table-3).

China continued to be the leading antimony producing country in the world. The Chinese Government considered antimony to be one of the protected and strategic minerals and therefore strictly controlled the exploitation and production of antimony. In Oman, a producer, which planned to construct an antimony smelter with 20,000 tonnes per year capacity of antimony metal and antimony oxide, acquired adequate funding and was proceeding with development. The Flame-retardant Sector was the leading consumer of antimony and accounted for about 50% of the total resources followed by battery alloys (17%), plastic stabilisers (15%), glass (10%) and others (8%).

Table – 3 : World Mine Production of Antimony (By Principal Countries)

(In tonnes of metal content)

Country	2016	2017	2018
World: Total (rounded off)	165000	158000	165000
China	107535	97683	89584
Russia	11900	14400	30000 ^e
Tajikistan	26970	26450	28881
Turkey	2700	4750	4000 ^e
Bolivia	2669	2881	3110
Australia(c)	5004	4294	2864
Myanmar(j)	2780	3060	2641
Iran(j)	1765	2489	2500 ^e
Kyrgyzstan ^e	1880	1100	620
Mexico	166	240	299
Vietnam	229	230	235
Kazakhstan ^e	900	200	100
Other countries	326	601	21

Source: BGS, World Mineral Production, 2014-18,

Note: c) Years ended 30 June of that stated.

j) Years ended 31 March following that stated

FOREIGN TRADE**Exports**

Exports of antimony ores & concentrates was negligible in 2018-19 as compared to only 4 tonnes in the previous year. Exports of antimony alloys and scrap increased to 2,282 tonnes in 2018-19 against 1,896 tonnes in the previous year. Exports were mainly to USA (76%), Pakistan (17%) and Netherlands (3%). Exports of antimony (Unwrought) powders increased to 2,270 tonnes in 2018-19 as against 1,889 tonnes in 2017-18. Exports of antimonial lead were 11,095 tonnes in 2018-19 as compared to 11,992 tonnes in 2017-18 (Tables- 4 to 8).

Imports

Imports of antimony ores and concentrates increased drastically by 43% to 7,496 tonnes in 2018-19 as compared to 5,257 tonnes in the previous year. Imports were mainly from Russia (61%), Tajikistan (17%), Br. Virgin Islands (13%) and China (5%).

Imports of antimony alloys and scrap decreased by 12% to 1,176 tonnes in 2018-19 from 1,343 tonnes in the previous year. Imports of alloys and scrap were mainly from Singapore (31%), Vietnam & China (24% each) and Sweden (9%). Imports of antimony (Unwrought) powders decreased by 13% to 1,174 tonnes in 2018-19 as compared to 1,342 tonnes in the preceding year. Imports were mainly from Singapore (31%), Vietnam & China (24% each) and Sweden (9%). (Tables-9 to 13).

**Table – 4 : Exports of Antimony Ores & Conc.
(By Countries)**

Country	2017-18(R)		2018-19(P)	
	Qty (t)	Value (` 000)	Qty (t)	Value (` 000)
All Countries	4	290	++	7
Nepal	4	290	-	-
UK	++	++	-	-
Japan	-	-	++	4
Canada	-	-	++	2

Figures rounded off

**Table – 5 : Exports of Antimony (Unwrought) Powders
(By Countries)**

Country	2017-18(R)		2018-18(P)	
	Qty (t)	Value (` 000)	Qty (t)	Value (` 000)
All Countries	1889	965764	2270	1234685
USA	1418	711438	1726	925819
Pakistan	363	193143	393	221333
Netherlands	23	14259	72	43099
South Africa	-	-	25	13143
Canada	-	-	20	10428
Bangladesh	-	-	10	5295
Egypt	-	-	7	4063
UAE	1	433	6	3269
Sri Lanka	-	-	4	2459
Denmark	2	1482	2	1537
Other countries	82	45008	6	4239

Figures rounded off

**Table – 6 : Exports of Antimony & Articles, NES
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (` 000)	Qty (t)	Value (` 000)
All Countries	7	4924	12	8189
Nepal	5	3188	11	6956
Germany	++	387	1	1032
Uganda	++	76	++	78
Kenya	-	-	++	54
UK	-	-	++	41
Sri Lanka	-	-	++	24
Afghanistan	-	-	++	3
Nigeria	1	771	-	-
Sudan	1	381	-	-
Malaysia	++	81	-	-
Other countries	++	40	++	++

Figures rounded off

**Table – 7: Exports of Antimony Alloys & Scrap
(By Countries)**

Country	2017-18 (R)		2018-19 (P)	
	Qty (t)	Value (` 000)	Qty (t)	Value (` 000)
All Countries	1896	970687	2282	1242874
USA	1418	711455	1726	925819
Pakistan	363	193143	393	221333
Netherlands	23	14259	72	43099
South Africa	-	-	25	13143
Canada	-	-	20	10428
Nepal	7	4066	11	6956
Bangladesh	-	-	10	5295
Egypt	-	-	7	4063
UAE	1	448	6	3269
Sri Lanka	-	-	4	2483
Other countries	84	47316	8	6985

Figures rounded off

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**Table – 8 : Exports of Antimonial Lead
(By Countries)**

Country	2017-18(R)		2018-19(P)	
	Qty (t)	Value (` 000)	Qty (t)	Value (` 000)
All Countries	11992	1916848	11095	1805326
UAE	2505	384404	2650	423626
Korea, Rep. of	2982	478837	2476	407410
Vietnam	1495	243141	1525	255338
Indonesia	1280	207746	1298	204934
Japan	659	112108	1239	204053
Oman	170	27906	695	102730
Bangladesh	1893	299379	551	95098
Nepal	192	32156	297	51029
USA	-	-	221	36549
Bulgaria	25	4428	50	8514
Other countries	791	126745	94	16043

*Figures rounded off***Table – 9 : Imports of Antimony Ores & Conc.
(By Countries)**

Country	2017-18(R)		2018-19(P)	
	Qty (t)	Value (` 000)	Qty (t)	Value (` 000)
All Countries	5257	1093067	7496	1609649
Russia	1672	319154	4575	905400
Tajikistan	3347	707295	1289	298693
Br. Virgin Islands	-	-	965	217150
China	-	-	387	105991
Italy	100	44664	88	43039
Myanmar	20	3815	144	31551
Belgium	-	-	25	5124
Bolivia	74	11517	23	2686
UK	-	-	++	15
Thailand	13	2902	-	-
Other countries	31	3720	-	-

Figures rounded off

**Table – 10 : Imports of Antimonial Lead
(By Countries)**

Country	2017-18(R)		2018-19(P)	
	Qty (t)	Value (` 000)	Qty (t)	Value (` 000)
All Countries	3782	597264	10319	1628009
Korea, Rep. of	164	24927	3900	636385
UAE	1695	265215	3217	496476
USA	1	96	730	108454
Chile	-	-	662	97906
Malaysia	1236	194549	445	69526
Tanzania	-	-	420	67927
Singapore	-	-	412	62149
Australia	-	-	224	40339
Poland	-	-	99	15367
Japan	97	17176	66	10444
Other countries	589	95301	144	23036

Figures rounded off

**Table – 11 : Imports of Antimony & Articles, NES
(By Countries)**

Country	2017-18(R)		2018-19(P)	
	Qty (t)	Value (` 000)	Qty (t)	Value (` 000)
All Countries	++	54	++	375
USA	++	24	++	194
France	-	-	++	82
Germany	++	15	++	72
UK	++	15	++	27

Figures rounded off

**Table – 12 : Imports of Antimony (Unwrought), Powders
(By Countries)**

Country	2017-18(R)		2018-19(P)	
	Qty (t)	Value (` 000)	Qty (t)	Value (` 000)
All Countries	1342	735826	1174	670279
Singapore	-	-	369	215218
Vietnam	131	72728	277	158657
China	1095	599047	277	155275
Sweden	-	-	109	61814
Thailand	21	10449	45	27079
Hong Kong	-	-	41	22180
UK	2	3587	31	16208
Argentina	-	-	25	13820
USA	++	1	++	28
Russia	40	22423	-	-
Other countries	53	27591	-	-

Figures rounded off

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**Table – 13 : Imports of Antimony Alloys & Scrap
(By Countries)**

Country	2017-18(R)		2018-19 (P)	
	Qty (t)	Value (` 000)	Qty (t)	Value (` 000)
All Countries	1343	737085	1176	673155
Singapore	-	-	369	215218
Vietnam	131	72728	277	158657
China	1095	599047	277	155275
Sweden	-	-	109	61814
Thailand	21	10449	45	27079
Hong Kong	-	-	41	22180
UK	3	4807	33	18735
Argentina	-	-	25	13820
USA	++	25	++	223
France	-	-	++	82
Other countries	93	50029	++	72

Figures rounded off

FUTURE OUTLOOK

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.

Antimony is becoming an increasingly critical element as the supply-demand gap is expected to exceed 10% by the end of the year 2020. Research works are going on to recover antimony from lamp phosphor waste (which is considered as a source of rare-earth elements) as it contains significant amount of antimony.

In the Flame-retardant Sector, antimony trioxide is used as a synergist normally with bromine and chlorine. 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 have been commercialised and are expected to find applications in mobile phones and digital cameras. In contrast, antimony metal consumption in metallurgical and battery markets could show a declining trend. The recent research and development programmes initiated by lead-acid battery manufacturers have led to significant changes in lead-acid battery design that have yielded substantial performance improvement which is bound to make lead-acid batteries a better and viable option as compared to its counterparts. This would eventually result in reduced use of antimony in lead-acid batteries diminishing the prospect of use of antimony in Battery Markets. The world supplies of antimony are expected to rise to an extent sufficient enough to meet the prospective demand. However, as per USGS, global consumption of antimony is expected to increase owing to projected increase in the use of antimony in flame retardants, lead-acid batteries and plastics, primarily in Asia.