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ANTIMONY

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GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

Indira Bhavan, Civil Lines,
NAGPUR – 440 001

PHONE/FAX NO. (0712) 2565471
PBX : (0712) 2562649, 2560544, 2560648
E-MAIL : cme@ibm.gov.in
Website: www.ibm.gov.in

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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. 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 flowsheet 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 1400 TPA 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 1400 TPA to 1800 TPA.

RESOURCES

As per the NMI database based on UNFC system, as on 1.4.2015, total reserves/ resources of antimony have been estimated at 10,588 tonnes, ore with metal content of 174 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 of safety matches. It is also used as a decolourising and refining agent in Glass Industry. Antimony compounds also find use in pharmaceutical applications. It is also used in semi-conductors for making infrared detectors, diodes and acoustic devices.

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.

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		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
All India : Total													
Ore	-	-	-	-	-	-	-	-	-	**10588**	-	**10588**	**10588**
Metal	-	-	-	-	-	-	-	-	-	174	-	174	174
By State													
Himachal Pradesh													
Ore	-	-	-	-	-	-	-	-	-	10588	-	10588	10588
Metal	-	-	-	-	-	-	-	-	-	174	-	174	174

Figures rounded off

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 semi-conductors 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.

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%), USA (4%),Turkey (7%) & Tajikistan (3%) (Table-2).

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

(In tonnes of metal content)

Country	Reserves
World : Total (*rounded off*)	**1500000**
USA	60000
Australia	140000
Bolivia	310000
Burma	NA
China	480000
Guatemala	NA
Iran	NA
Kazakhstan	NA
Laos	NA
Mexico	18000
Pakistan	NA
Russia (recoverable)	350000
Tajikistan	50000
Turkey	10000
Vietnam	NA

Source: *Mineral Commodity Summaries, 2019.*

The world mine production of antimony metal decreased to 139065 tonnes in 2017 as against 145268 tonnes in the previous year. China with (75%) production was the main producer of antimony in the world followed by Tajikistan (9%), Russia (4%), Turkey (3%), Bolivia & Myanmar (2% each) (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 percent.

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

(In tonnes of metal content)

Country	2015	2016	2017
World: Total (*rounded off*)	**156039**	**145268**	**139065**
Australia	3926	5004	4294
Bolivia	3843	2669	2844
Myanmar	5777	2780	3060
Canada	1	-	-
China	120732	107535	101000[e]
Ecuador	-	-	579
Guatemala	-	25	-
Honduras	14	-	-
Iran	1020	1765	1800
Kazakhstan[e]	700	900	200
Kyrgystan[e]	1200	1880	1100
Laos	1166	242	320
Mexico	90	166	240
Pakistan	114	21	15
Russia	7420	6620	6120
South Africa	400	-	-
Tajikistan[e]	6800	12700	12500
Thailand	700	32	-
Turkey	1917	2700	4750
Vietnam	219	229	243

Source: *World Mineral Production, 2012-17,* ***BGS.***

FOREIGN TRADE

Exports

Exports of antimony ores & concentrates sharply declined to 4 tonnes in 2017-2018 as compared to 46 tonnes in the previous year. Exports of antimony alloys and scrap increased to 1,899 tonnes in 2017-18 against 1,668 tonnes in the previous year. Exports were mainly to USA (74%), Pakistan (19%) and Netherlands (1%). Exports of antimony (Unwrought) powders increased to 1892 tonnes in 2017-18 as against 1,667 tonnes in 2016-17. Exports of antimonial lead were 11992 tonnes in 2017-18 as compared to 12231 tonnes in 2016-17 (Tables-4 to 8).

Imports

Imports of antimony ores and concentrates increased to 5,257 tonnes in 2017-18 as compared to 4,756 tonnes in the previous year. Imports were mainly from Tajikistan (63%),Russia (31%) and Italy (2%) .

Imports of antimony alloys and scrap increased considerably to 1,344 tonnes in 2017-18 from 864 tonnes in the previous year. Imports of alloys and scrap were mainly from China (81%), Vietnam (10%) and Russia (3%) (Tables-9 to 13).

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

Country	2016-17		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**46**	**9646**	**4**	**290**
Nepal	-	-	4	290
UK	++	1	-	-
Bangladesh	++	9	-	0
Austria	46	9636	0	-

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

Country	2016-17		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**1667**	**746682**	**1892**	**965763**
USA	1037	465758	1418	711438
Pakistan	405	178487	363	193143
Netherlands	63	26627	23	14259
Spain	-	-	25	13333
Japan	30	13264	21	11478
Israel	10	4813	21	10305
Russia	-	-	12	7006
Nigeria	-	-	3	1604
Denmark	2	1253	2	1482
Nepal	-	-	2	879
Other countries	120	56480	2	836

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

Country	2016-17		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**1**	**3377**	**7**	**4924**
Nepal	++	24	5	3188
Nigeria	-	-	1	771
Germany	1	3047	++	387
Sudan	-	-	1	381
Malaysia	++	273	++	81
Uganda	-	-	++	76
USA	-	-	++	16
UAE	-	-	++	15
Philippines	-	-	++	5
Bhutan	-	-	++	4
Other countries	++	33	-	-

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

Country	2016-17		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**1668**	**750059**	**1899**	**970687**
USA	1037	465758	1418	711454
Pakistan	405	178487	363	193143
Netherlands	63	26627	23	14259
Spain	-	-	25	13333
Japan	30	13264	21	11478
Israel	10	4813	21	10305
Russia	-	-	12	7006
Nepal	-	24	7	4067
Nigeria	-	-	4	2375
Denmark	2	1253	2	1482
Other countries	121	59833	3	1785

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

Country	2016-17		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**12231**	**1734253**	**11992**	**1916848**
Korea, Rep. of	3579	511259	2982	478837
UAE	2083	307225	2505	384404
Bangladesh	657	92491	1893	299379
Vietnam	353	58443	1495	243141
Indonesia	448	63625	1280	207746
Japan	100	16037	659	112108
Sri Lanka	-	-	251	41778
Turkey	25	3563	251	37834
Cuba	336	44979	202	32240
Nepal	321	43866	192	32156
Other countries	4329	592765	282	47225

Table – 9 : Imports of Antimony Ores & Conc. (By Countries)

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**4756**	**752103**	**5257**	**1093067**
Tajikistan	2612	483535	3347	707295
Russia	286	41470	1672	319154
Italy	90	36440	100	44664
Bolivia	-	-	74	11517
Myanmar	-	-	20	3815
Thailand	70	9592	13	2902
Netherlands	-	-	22	2064
Japan	-	-	9	1474
Turkey	80	15186	++	182
Kazakhstan	1618	165880	-	-
Other countries	-	-	-	-

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**7626**	**1069821**	**3782**	**597264**
UAE	780	100204	1695	265215
Malaysia	531	72335	1236	194549
South Africa	-	-	208	35329
Burundi	-	-	182	29615
Korea, Rep. of	4773	664518	164	24927
Japan	-	-	97	17176
Nigeria	99	12130	102	15214
Myanmar	-	-	50	7776
Thailand	-	-	25	4098
Mexico	75	9090	22	3269
Other countries	1368	211544	1	96

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**22**	**8067**	**++**	**54**
USA	++	12	++	24
Germany	++	7	++	15
UK	++	5	++	15
China	22	8037	-	-
Italy	++	6	-	-
Other countries	++	-	-	-

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

Country	2016-17 (R)		2017-18 (P)	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**842**	**388642**	**1342**	**735826**
China	691	316418	1095	599047
Vietnam	31	15046	131	72728
Russia	11	5423	40	22423
Turkey	24	8418	25	13904
Thailand	-	-	21	10449
Japan	60	32985	20	10039
Canada	-	-	8	3646
UK	20	6924	2	3587
Belgium	++	26	++	2
USA	2	2229	++	1
Other countries	3	1173	-	-

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

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**864**	**396709**	**1344**	**737084**
China	713	324455	1095	599047
Vietnam	31	15046	131	72728
Russia	11	5423	40	22423
Turkey	24	8418	25	13904
Thailand	-	-	21	10449
Japan	60	32985	20	10039
UK	20	6929	4	4806
Canada	-	-	8	3646
USA	2	2241	++	25
Germany	++	7	++	15
Other countries	3	1205	++	2

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.

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, little growth is anticipated for antimony metal in metallurgical and battery markets. 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.