

20 Cadmium

Cadmium is present generally in zinc ore deposits as greenockite (CdS). The principal source of cadmium is zinc ore, sphalerite (ZnS) which may contain up to 5% cadmium. Other sulphides and sulphosalts may also carry small amounts of the metal.

In India, cadmium is recovered as a by-product in zinc smelting and refining. The concentration of cadmium in sphalerite, the principal ore of zinc, ranges from 0.03 to 9.0 wt%. In zinc concentrate at Rampura Agucha, cadmium is 0.18% while in lead concentrate, it is 150 ppm. There are no separate resources of cadmium

INDUSTRY

The total installed capacity for recovering cadmium was 913 tonnes of which HZL accounted for 833 tonnes. Binani Zinc Ltd reported the remaining 80 tonnes capacity (Table-1).

Table - 1 : Installed Capacity for Recovery of Cadmium

Unit	Location	Installed capacity (tpy)
Total		913
1. HZL, Debari Zinc Smelter	Debari, Dist. Udaipur, Rajasthan.	250
2. HZL, Vizag Zinc Smelter	Visakhapatnam, Andhra Pradesh.	115
3. HZL, Chanderiya Lead-Zinc Smelter	Chanderiya, Dist. Chittorgarh, Rajasthan.	468
4. Binani Zinc Ltd	Binanipuram, Dist. Ernakulam, Kerala.	80

USES

Cadmium-base-bearing alloys are used in high-speed internal combustion engines. Copper-cadmium alloys possess high strength, high conductivity and high resistance to abrasion and, therefore, the alloys are used in electric transmission wires. Cadmium is used along with nickel in electrical storage batteries. The main use of cadmium is in electroplating wherein it can be applied as a very thin coating to protect iron, steel, copper alloys and other metals and alloys from corrosion. Cadmium sulphide forms brilliant golden yellow, orange-red, or reddish brown pigments used in paint, enamel, soap, rubber, glass and ceramic glazes. Some cadmium salts are also used in photographic films and in lithography. In nuclear physics, cadmium is used to control the fissionable elements in reactors.

PRODUCTION

Cadmium is recovered as a by-product of zinc smelting. Production of cadmium in 2007-08 at 589 tonnes increased by 22% as compared to that in the previous year (Tables - 2 and 3).

Table - 2 : Production of Cadmium, 2005-06 to 2007-08 (By States)

(Quantity in tonnes; value in Rs. '000)

State	2005-06		2006-07		2007-08 (p)	
	Qty.	Value	Qty.	Value	Qty.	Value
India	406	22852	481	28422	589	198345
Kerala	47	7791	63	10811	50	19939
Rajasthan	359	15061	418	17611	539	178406

CADMIUM

**Table - 3 : Production of Cadmium,
2006-07 and 2007-08
(By Sector/States/Districts)**

(Quantity in tonnes; value in Rs. '000)

State	2006-07		2007-08 (p)	
	Qty.	Value	Qty.	Value
India	481	28422	589	198345
Private Sector	481	28422	589	198345
Kerala	63	10811	50	19939
Ernakulam	63	10811	50	19939
Rajasthan	418	17611	539	178406
Udaipur	418	17611	539	178406

SUBSTITUTES

Suitable replacements of cadmium in all uses, especially in pigments and plating are being contemplated and enforced owing to the pollution hazards associated with the use of cadmium. Hitachi Maxwell, Sanyo Electric and Matsushita Battery Industrial are reportedly experimenting on nickel-hydrogen (Ni-H) batteries so as to replace nickel-cadmium (Ni-Cd) batteries, especially in view of the growing concern over cadmium pollution. Lately, Ni-Cd batteries, in some applications, are replaced with lithium ion and nickel metal hydride batteries. However, higher costs of these substitutes restrict their uses. Cadmium in plating applications can be substituted by coatings of zinc or vapour-deposited aluminium. Cerium sulphide is used as a replacement for cadmium pigments mostly for plastics.

In India, cadmium is consumed in industries like paint, glass and chemical.

HEALTH AND SAFETY

Cadmium in all its chemical forms is considered highly toxic to living species as it does not decompose and is ingested easily through food, water and air but cannot be excreted. It is both bioaccumulated and biomagnified. Ingested

cadmium accumulates in liver, kidney, pancreas and thyroid. Excessive exposure to cadmium has been linked with respiratory insufficiency (via occupational exposure) and renal disturbance (via environmental and occupational exposure). Itai-itai is the most severe stage of chronic cadmium poisoning. Cadmium has also been implicated in the development of cancer of various types.

During the last decade, regulatory pressure to reduce or even eliminate the use of cadmium has gained momentum in many developed countries. The world recommended target guidelines for cadmium as a residual heavy metal below which no major risk is expected which could have significant or adverse impact on aquatic biota or human use, is 0.1 mg/l. In the USA, Federal and State agencies regulate cadmium content in the environment. In the European Union, despite the directives such as, Restriction of Hazardous Substances in Electrical and Electronic Equipment Directive and others, aimed at eliminating use of cadmium in products, the regulatory emphasis is shifting from elimination and prohibition to proper management of risks present.

WORLD REVIEW

Cadmium is extracted from zinc ores and concentrates, and other materials like scrap. The world reserve base of cadmium is estimated at 1.2 million tonnes in terms of metal content, located mainly in China (23%), Australia (22%), Peru, Canada and Kazakhstan (7% each) and USA (6%). The world resources of cadmium by principal countries are given in Table - 4.

The world production of cadmium was estimated at 18,800 tonnes in 2007. China, Republic of Korea, Japan, Canada, Mexico, Kazakhstan and USA were the important producers. China and Republic of Korea are by far the world's largest consumers of cadmium and almost all cadmium is utilised in the production of Ni-Cd batteries. The world production of cadmium during 2005 to 2007 by principal countries is given in Table - 5.

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**Table - 4 : World Reserve Base of Cadmium
(By Principal Countries)**

(In tonnes of metal content)

Country	Reserve base
World : Total (rounded)	1200000
Australia	260000
Canada	84000
China	280000
Germany	8000
India	49000
Kazakhstan	89000
Mexico	39000
Peru	87000
Russia	37000
USA	67000
Other countries	200000

Source: Mineral Commodity Summaries, 2008.

**Table - 5 : World Production of Cadmium
(By Principal Countries)**

(In tonnes)

Country	2005	2006	2007
World : Total	19500	20800	18800
Australia	429	425	425 ^e
Canada	1727	2090	1388
China	4080	3791	3800 ^e
Germany ^e	640	640	640
Japan	2297	2286	1939
Kazakhstan	1624	1700 ^e	1700 ^e
Korea, Republic of	2582	3320	2846
Mexico	1627	1399	1605
Netherlands	494	524	495
Peru	481	416	347
Russia	621	690	810
USA	1070	700	700 ^e
Other countries	1828	2819	2105

Source: World Mineral Production, 2003-2007

FOREIGN TRADE

Exports

In 2007-08, exports of cadmium (including waste & scrap) increased to 174 tonnes from 155 tonnes in the previous year. Exports were mainly to Netherlands, China and Belgium (Table - 6).

**Table - 6 : Exports of Cadmium
(Including Waste & Scrap)
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	155	30624	174	57029
Netherlands	75	16255	113	34033
China	75	10142	36	10113
Belgium	2	672	25	7210
UK	1	2014	++	4855
Israel	-	-	++	818
Djibouti	++	6	-	-
Nigeria	1	1109	-	-
Pakistan	1	171	-	-
UAE	++	255	-	-

Imports

Imports of cadmium (including waste & scrap) decreased in 2007-08 to 115 tonnes from 121 tonnes in the previous year. Imports were mostly from Republic of Korea, China, Japan and Peru (Table - 7).

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**Table - 7 : Imports of Cadmium (Including Waste & Scrap)
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	121	18443	115	23136
Korea, Republic of	-	-	34	7546
China	20	2977	31	5308
Japan	10	1804	22	4648
Peru	-	-	22	3372
USA	++	239	4	1915
Germany	8	1085	++	82
UK	11	1632	++	9
Algeria	10	1555	-	-
Canada	20	2521	-	-
Mexico	40	6243	-	-
Other countries	2	387	2	256

FUTURE OUTLOOK

The cadmium market in the world is in a state of uncertainty. While the primary cadmium supply is on decrease, there is a modest rise in production through recycling. Though cadmium consumption in various applications is clamoured with concerns over its toxicity and hazardous effect on human health and environment, the production of

cadmium as a by-product will however continue as long as lead and zinc are produced. Primary cadmium metal production is expected to grow in Asian countries while it is expected to decline in European countries. Decreased primary production is expected to be replaced by secondary production from recycling of Ni-Cd batteries.