

SILVER



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SILVER

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

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Silver is one of the five noble metals. Its brilliant white colour, malleability and resistance to atmospheric oxidation, has enhanced its value as a highly desired precious metal which is used in many industrial applications. Apart from its monetary and decorative uses, its highest known electrical conductivity amongst all metals has increased its potential in modern age applications; viz, for printed electric circuits, coating for electronic conductors and in alloys of gold and copper for electrical contacts. Its chloride and iodide are light-sensitive and hence used in photographic material. These two major uses have contributed to increase supply of scrap of silver contained products.

In India, there are no native silver deposits except the small and unique Bharak deposit of silver in Rajasthan. It occurs generally with lead, zinc, copper and gold ores and is extracted as a by-product from electrolysis or chemical methods.

Silver is recovered as a co-product as well as a by-product in the country. Silver was recovered in the past as a co-product in gold refining at KGF Complex and Hutti Gold Mines in Karnataka, as a by-product in smelting and refining of lead, zinc and copper concentrates at Chanderiya and Debari smelters in Rajasthan, Tundoo and Moubandar (Ghatsila) smelters in Jharkhand and at Visakhapatnam smelter in Andhra Pradesh. The present production of silver comes from Chanderiya lead-zinc smelter of HZL and from gold refinery of HGML. In addition, Hindalco extracts silver as a by-product during smelting of imported copper concentrates at Dahej in Gujarat.

The installed capacity for recovery of silver at various plants are: HCL 9.9 tpy, HZL 168 tpy and Hindalco 150 tpy. HZL aims to produce 500 tpy silver through revamp of operations at their Sindesar Khurd Mine. The Company has commissioned a 1.5 million tpy concentrator at the

mine. The hundred thousand tpy lead smelter and 16 million oz per annum (about 497.6 tpy) of silver processing plant were scheduled for completion during the first quarter of 2011-12. The work on development of the greenfield Kayar lead-zinc mine also progressed as per schedule.

RESOURCES

As per the UNFC system, the total resources of silver ore in the country as on 1.4.2010 were estimated at about 466.98 million tonnes. Out of these, 187.56 million tonnes were placed under reserves category and 279.42 million tonnes under the 'remaining resources' category.

The total resources of silver in the country as on 1.4.2010 in terms of metal were estimated at 27,628.25 tonnes, of which 8,039.57 tonnes are under reserves and 19,588.68 tonnes are under of 'remaining resources'.

By States, Rajasthan accounted for about 87% resources in terms of ore, Jharkhand 5%, Andhra Pradesh 4% and Karnataka 2%. Madhya Pradesh, Uttarakhand, Odisha, Meghalaya, Sikkim, Tamil Nadu and Maharashtra together shared 2% ore resources (Table - 1).

PRODUCTION

Silver is recovered as a by-product from lead and zinc concentrates, copper slime and as a co-product of gold refining.

During the year 2011-12, the production of silver at 207,142 kg increased by 40% as compared to the previous year due to higher recovery of silver at Chanderiya. The production of silver from gold refining was 200 kg in 2011-12 as against 221 kg in 2010-11. One private sector & one public sector undertaking also reported production of silver during 2011-12.

In addition, Hindalco Industries Ltd reported recovery of 45,073 kg and 56,766 kg silver from imported copper concentrates in 2010-11 and 2011-12 respectively.

Table – 1 : Reserves/Resources of Silver as on 1.4.2010
(By Grades/States)

(In tonnes)

	Reserves				Remaining resources				Total resources				
	Proved	Probable	Total	Feasibility	Pre-feasibility	Measured	Indicated	Inferred	Reconnaissance	Total			
	STD111	STD121	STD122	STD211	STD221	STD331	STD332	STD333	STD334	(A+B)			
All India : Total													
Ore	46109414	17655843	123793411	187558668	3375000	1048700	5404862	11140000	86286000	172171729	-	279426291	466984959
Metal	1591.85	1949.65	4498.07	8039.57	270.00	27.60	54.30	1045.40	6212.66	11978.72	-	19588.68	27628.25
Andhra Pradesh													
Ore	-	-	-	-	-	-	-	-	-	16950000	-	16950000	16950000
Metal	-	-	-	-	-	-	-	-	-	128.13	-	128.13	128.13
Jharkhand													
Ore	-	-	-	-	-	-	-	-	-	23840000	-	23840000	23840000
Metal	-	-	-	-	-	-	-	-	-	5.22	-	5.22	5.22
Karnataka													
Ore	8681065	-	-	8681065	-	-	69462	-	-	314150	-	383612	9064677
Metal	2.67	-	-	2.67	-	-	0.48	-	-	2.92	-	3.40	6.07
Madhya Pradesh													
Ore	-	-	-	-	-	-	-	-	2096000	1120000	-	3216000	3216000
Metal	-	-	-	-	-	-	-	-	150.61	9.25	-	159.86	159.86
Maharashtra													
Ore	-	-	-	-	-	-	-	-	-	235000	-	235000	235000
Metal	-	-	-	-	-	-	-	-	-	0.23	-	0.23	0.23
Meghalaya													
Ore	-	-	-	-	-	-	-	-	880000	-	-	880000	880000
Metal	-	-	-	-	-	-	-	-	19.80	-	-	19.80	19.80

(Contd.)

Table - 1 (Concl'd.)

	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 resources (B)		
SILVER													
Odisha													
Ore	-	-	-	-	960500	119000	-	-	670000	-	1749500	1749500	
Metal	-	-	-	-	27.34	3.40	-	-	34.17	-	64.91	64.91	
Rajasthan													
Ore	37428349	17220000	123729631	178377980	3375000	88200	5216400	9240000	81580000	128042579	-	227542179	405920159
Metal	1589.18	1934.40	4498.03	8021.61	270.00	0.26	50.42	883.80	6022.18	11757.93	-	18984.59	27006.20
Sikkim													
Ore	-	435843	63780	499623	-	-	-	300000	-	150000	-	450000	949623
Metal	-	15.25	0.04	15.29	-	-	-	27.60	-	13.80	-	41.40	56.69
Tamil Nadu													
Ore	-	-	-	-	-	-	-	-	330000	460000	-	790000	790000
Metal	-	-	-	-	-	-	-	-	15.87	26.68	-	42.55	42.55
Uttarakhand													
Ore	-	-	-	-	-	-	-	1600000	1400000	390000	-	3390000	3390000
Metal	-	-	-	-	-	-	-	134.00	4.20	0.39	-	138.59	138.59

Figures rounded off.

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Table – 2 : Principal Producers of Silver, 2011-12

Name & address of the producer	Name of Plant	Location of the plant	
		State	District
M/s Hindustan Zinc Ltd, Yashad Bhavan, Udaipur – 313 001.	Chanderiya	Rajasthan	Chittorgarh
The Hutti Gold Mines Co. Ltd, No. 6/13, Guruappa Avenue, Primrose Road Cross, Bengaluru – 560 025.	Hutti	Karnataka	Raichur

**Table – 3 : Production of Silver, 2009-10 to 2011-12
(By States*)**

(Qty in kg; value in ₹'000)

State	2009-10		2010-11		2011-2012(P)	
	Qty	Value	Qty	Value	Qty	Value
India	138780	3388694	148303	5438695	207142	11561651
Karnataka	230	5770	221	8627	200	11374
Rajasthan	138550	3382924	148082	5430068	206942	11550277

* According to location of final processing/extraction plant.

**Table – 4 : Production of Silver*, 2010-11 and 2011-12
(By Sectors/States/Districts)**

(Qty in kg; value in ₹'000)

State/District	2010-11		2011-12(P)	
	Quantity	Value	Quantity	Value
India	148303	5438695	207142	11561651
Public sector	221	8627	200	11374
Private sector	148082	5430068	206942	11550277
Karnataka	221	8627	200	11374
Raichur	221	8627	200	11374
Rajasthan	148082	5430068	206942	11550277
Chittorgarh	148082	5430068	206942	11550277

* Silver as a by-product:

(i) In Karnataka, it is recovered at Raichur while refining of gold at Hutti and Uti gold mines.

(ii) In Rajasthan, it is recovered at Chanderiya lead-zinc smelter of HZL.

(iii) Excludes by-product recovery of 45,073 kg and 56,766 kg silver from imported copper concentrates in 2010-11 and 2011-12, respectively.

WORLD REVIEW

The total reserves of silver is estimated at 540,000 tonnes. Peru, Poland, Chile, Australia, China and Mexico are the main countries having silver reserves (Table-5). Major part of the reserves is associated with base metals, such as copper, lead and zinc.

Mexico, Peru, China, Australia, Chile, Bolivia and Poland are the main producers of silver. The global primary as well as by-product mine output marginally decreased to 23,294 tonnes of contained metal in 2011 from 23,406 tonnes in the previous year. World mine production of silver is given in Table-6.

Australia

Silver production in Australia was 8% less than that in 2010, mainly as a result of decline in production at BHP Billiton Ltd's Cannington Mine which reported nearly 17% less production than that reported in 2010 due to excessive rainfall caused by cyclones which led to flooding and consequent disruption in the mining activities in the first quarter. Slump production was also due to lower average ore grades. Coeur d'Alene's Endeavor Mine, though there was an increase in tonnage milled the production of silver was partially offset by a decrease in ore grade.

Bolivia

Silver production decreased by 3% in 2011 from that in 2010 due to production decreases at several operations. Most notably at Sumitomo Corp.'s San Cristóbal Mine which reported 20% less production. A new area in the deposit, known as Huacajchi Sur, was opened for mining and its higher grade material led to increase in production and lowering of costs.

Chile

Silver production was more or less same as that in 2010, although production at BHP Billiton's Escondida mine decreased by 30%, mainly because of lower ore grade and labour strike.

China

Silver production from China, the world's second ranked silver producer, increased by 6% in 2011. Silver was produced mainly as a by-product of copper or lead and zinc mining. Silvercorp Metals Inc., the leading silver producer in China, operated several silver-lead-zinc.

Guatemala

Silver production from Goldcorp Inc.'s Marlin Mine, the country's only silver-producing mine, increased by 40% from that in 2010 mainly because of a 26% increase in head grade. The Company also began shifting to underground mining from open pit mining.

Mexico

In 2011, Mexico was the world's leading producer of silver, but silver production was about 8% higher than that in 2010. Fresnillo's newest mine, Saucito Mine, began operation in the first half of 2011. The mine was adjacent to the company's Fresnillo Mine, the world's leading primary silver mine, near Zacatecas. The mine was projected to achieve an annual production capacity of 310 tonnes of silver by 2014, and produce gold, lead and zinc as well. The Company's proven and probable reserves of silver were estimated at 12,500 tonnes. Gold Resource Corp.'s El Aguila project commenced implementation of improvements in its mill, which included installation of additional cleaner cells in the flotation circuit and installation of a third filter press.

Peru

Peru was the world's second ranked silver producer in 2011, however production was about 6% less over the previous years production. Three of the country's mines namely, Cia. de Minas Buenaventura S.A.A.'s Uchucchacua, Hochschild's Pallancanta and Hochschild's Arcata, are among the 15 leading silver mines in the world.

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Russia

Silver production at Polymetal International plc's mines in Russia increased in 2011. Production at the Company's Dukat mining complex, was 17% more than that produced in 2010 as a result of increased ore mining, although the silver grade declined.

**Table – 5 : World Reserves of Silver
(By Principal Countries)**

(In tonnes of silver content)

Country	Reserves
World Total (rounded)	540000
Australia	69000
Bolivia	22000
Canada	7000
Chile	77000
China	43000
Mexico	37000
Peru	120000
Poland	85000
USA	25000
Other countries	50000

Source: Mineral Commodity Summaries, 2013.

**Table – 6 : Mine Production of Silver
(By Principal Countries)**

(In tonnes of metal content)

Country	2009	2010	2011
World Total	22281	23406	23294
Argentina	415	693	702
Australia	1631	1880	1725
Bolivia	1326	1259	1216
Canada	618	591	572
Chile	1301	1287	1291
China	2900*	3085	3232
Kazakhstan*	614	549	647
Mexico	3554	4411	4778
Peru	3923	3640	3414
Poland	1206	1183	1167
Russia*	1313	1145	1134
USA	1245	1270	1120
Other countries	2235	2413	2096

Source: World Mineral Production, 2007-11.

* - Smelted and / or refinery production.

FOREIGN TRADE

Exports

In 2011-12, there were no exports of silver ores and concentrate. Exports of silver in 2011-12 decreased to 41 tonnes from 50 tonnes in the preceding year. Exports were mainly to Belgium and the USA. Besides, 12,055 kg silver-clad base metals were also exported during 2011-12 (Tables-7 and 8).

Imports

Imports of silver were 4,661 tonnes in 2011-12 against 2,656 tonnes in the previous year. Imports were mainly from the UK (19%), Switzerland (14%), Russia (12%), Chinese Taipei/Taiwan (11%) and China (9%) and Imports of silver-clad base metals were 1,174 kg in 2011-12 as against 5 kg in the previous year. The USA, Indonesia, the Republic of Korea and Switzerland were major importers (Tables-9 and 10).

**Table – 7 : Exports of Silver
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	50	1063414	41	1296694
USA	32	728766	11	474803
Belgium	8	114882	15	327006
Australia	1	35538	4	248885
Hong Kong	++	2477	1	52778
Canada	1	22485	2	44034
Iran	++	11543	1	41088
Italy	4	62387	2	27076
Sweden	1	9274	1	24187
Germany	1	26259	4	17486
Slovenia	++	5194	++	8281
Other countries	2	44609	++	31070

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**Table – 8 : Exports of Silver-clad Base Metals
(By Countries)**

Country	2010-11		2011-12	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	13953	224466	12055	33044
USA	118	1120	1781	20361
Malaysia	-	-	9400	12174
UK	14	1040	610	243
Oman	-	-	2	97
Mexico	-	-	2	57
Denmark	-	-	8	39
Libya	-	-	1	27
Thailand	-	-	1	23
Yemen Rep.	251	38	250	22
Other countries	13570	222268	++	1

**Table – 9 : Imports of Silver
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2656	89531561	4661	247042322
UK	245	8620110	891	47114906
Switzerland	174	6072896	631	34028287
Chinese Taipei/Taiwan	676	22944791	533	29207476
Russia	227	7886124	550	28779979
China	656	21510010	435	2335361
Hong Kong	281	10109970	289	15835142
Korea, Rep.of	39	1484929	196	9921121
Germany	51	1893083	179	9340705
UAE	49	1740477	151	8139763
Japan	47	1271041	124	6422248
Other countries	211	5998130	682	34899079

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**Table – 10 : Imports of Silver-clad Base Metals
(By Countries)**

Country	2010-11		2011-12	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	5	148	1174	32270
Switzerland	-	-	80	5726
Indonesia	-	-	166	3999
USA	-	-	454	2931
Rep. of Korea	-	-	110	1647
Germany	5	148	39	501
Italy	-	-	15	456
Hong Kong	-	-	1	45
Unspecified	-	-	309	16965
Other countries	-	-	-	-

FUTURE OUTLOOK

India is the largest importer and largest consumer of silver in the world. The average domestic consumption of silver in the country on an average is about 3,000 tonnes per annum. Considering the current pattern of utilisation of silver in the country and the anticipated

increase in the GDP, the future demand for silver is likely to exceed 6,000 tonnes per annum by 2017 as per the report of the Working Group on Mineral Exploration and Development (Other than Coal & Lignite) for the XII Five Year Plan (2012-2017).