

TIN



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(Part- II : Metals & Alloys)

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TIN

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GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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Tin is one of the earliest metals known and used mainly in bronze implements. It is a scarce element having an incidence of about 2 ppm in the earth's crust. Its unique combination of properties like non-toxic nature, high malleability, chemical inertness and ease with which it can form an amalgam and alloy with other metals has given it a special status among non-ferrous metals. Pure tin is a silvery-white metal which is soft and malleable. It does not occur naturally as metal. By far, the most important tin mineral is cassiterite (SnO_2), which, in its purest form contains 78.6% tin. The less common tin ore is stannite ($\text{Cu}_2\text{SnFeS}_4$). Tin is now used mostly for tin plating, soldering special alloys and in making bronze.

RESOURCES

Tin occurs in primary as well as secondary (alluvial or placer) forms. Occurrences of tin in primary as well as secondary forms have been reported from Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Odisha, Rajasthan and West Bengal. However, the only workable economic deposits in the form of alluvial or placer deposits occur in Bastar and Dantewada districts of Chhattisgarh. Tin in primary form as disseminations in the gneisses and schists of Koraput district, Odisha is another source of economic importance.

The total resources of tin ore in the country as per UNFC system, as on 1.4.2010 are placed at 83.73 million tonnes containing about 102,275 tonnes metal. About 7,132 tonnes ore containing 1,132 tonnes metal are placed under 'reserves' category and the bulk i.e. about 83.72 million tonnes containing about 101,142 tonnes metal are placed under 'remaining resources' category. The entire ore reserves are located in Chhattisgarh. About, 64% of total ore resources are located in Haryana and 36% in Chhattisgarh, while nominal resources are estimated in Odisha (Table-1).

EXPLORATION & DEVELOPMENT

During 2011-12, DMG, Rajasthan carried out exploration for tin, tungsten, gold and other economic minerals around Hemardai, Karnos Odas villages, in tehsil Pisangan, Ajmer district by mapping - 1:50,000-100 sq km. About 3 km NW of Hemardai village, within calc-silicate, feruginous quartzite body having dimension about 50 x 3-5 m was mapped. It is magnetic in nature and gives black streak. Chemical analysis of 29 samples have been done.

PRODUCTION & STOCKS

Concentrates

Chhattisgarh was the only state producing tin concentrates. The production of tin concentrates in 2011-12 was 48,971 kg as against 60,643 kg in the preceding year. Six mines, one in public sector and five in private sector reported production in 2011-12. All these mines are located in Dantewada district of Chhattisgarh.

The mine-head stocks of tin concentrates were 10,984 kg at the beginning of the year as against 23,733 kg at the end of the year (Tables - 2 to 5).

The Chhattisgarh Mineral Development Corporation Limited (CMDC) purchases tin concentrates from local tribals, allowing them to collect it from the lease area. Hence, no labour was reported to have been employed in the mine owned by the CMDC Ltd, whereas Precious Minerals and Smelting Ltd employed 53 workers on average daily basis in the mines during the year as against 44 in the previous year. Prices of tin concentrates are furnished in the General review on 'Prices'.

Tin Metal

The plant owned by Precious Mineral and Smelting Limited reported production of 23,451 kg of tin metal in 2011-12 against 24,013 kg in the preceding year. The plant is located at Jagdalpur in Chhattisgarh. Production of tin metal is furnished in Table - 6.

**Table - 2 : Producers of Tin Concentrates
2011-12**

Name & address of the producer	Location of the mine	
	State	District
Chhattisgarh State Mineral Dev. Corp. Ltd, 27/520, New Shanti Nagar, Shankar Nagar Road, Raipur, Chhattisgarh.	Chhattisgarh	Dantewada
Precious Minerals and Smelting Ltd, Semi Urban Industrial Estate, Frezerpur, Jagdalpur-494 001, Chhattisgarh.	Chhattisgarh	Dantewada

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

(In tonnes)

Grade/State	Proved			Reserves Probable			Total			Feasibility			Pre-feasibility			Measured			Remaining resources			Total Resources (A+B)
	STD111	STD121	STD122	STD121	STD122	STD122	STD211	STD221	STD222	STD331	STD332	STD333	Inferred	Total	Indicated	Inferred	Total	Resources				
All India : Total																						
Ore	4404	1015	1713	1015	1713	7132	22592692	2326	31330000	168622	561080	29064345	83719065	83726197								
Metal	925.75	189.76	16.92	189.76	16.92	1132.43	32222.43	652.89	54032.08	894.91	231.63	13107.75	101142.41	102274.84								
By States																						
Chhattisgarh																						
Ore	4404	1015	1713	1015	1713	7132	-	1690	-	168622	559914	29063345	29793571	29800703								
Metal	925.75	189.76	16.92	189.76	16.92	1132.43	-	152.11	-	894.91	209.43	13097.75	14354.2	15486.63								
Haryana																						
Ore	-	-	-	-	-	-	22580000	-	31330000	-	-	-	53910000	53910000								
Metal	-	-	-	-	-	-	32187.8	-	54032.8	-	-	-	86220.6	86220.6								
Odisha																						
Ore	-	-	-	-	-	-	12692	636	-	-	1166	1000	15494	15494								
Metal	-	-	-	-	-	-	34.63	500.78	-	-	22.2	10	567.61	567.61								

Figures rounded off.

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**Table – 3 : Production of Tin Concentrates, 2009-10 to 2011-12
(By State)**

(Quantity in kg; value in ₹'000)

State	2009-10		2010-11		2011-12(P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	59016	22895	60643	27799	48971	26742
Chhattisgarh	59016	22895	60643	27799	48971	26742

**Table – 4 : Production of Tin Concentrates, 2010-11 and 2011-12
(By Sectors/State/District)**

(Quantity in kg; value in ₹'000)

State	2010-11			2011-12(P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	6	60643	27799	6	48971	26742
Public sector	1	50179	23114	1	34534	20505
Private sector	5	10464	4685	5	14437	6237
Chhattisgarh	6	60643	27799	6	48971	26742
Dantewada	6	60643	27799	6	48971	26742

**Table – 5 : Mine-head Stocks of Tin Concentrates, 2011-12(P)
(By State)**

(In kg)

State	Stocks at the	
	beginning of the year	end of the year
India	10984	23733
Chhattisgarh	10984	23733

**Table – 6 : Production of Tin Metal in India
2009-10 to 2011-12**

(Qty in kg; value in ₹'000)

Year	Production	
	Quantity	Value
2009-10	27129	15491
2010-11	24013	25086
2011-12(P)	23451	26968

MINING

In Govindpal-Tongpal area in Dantewada district, Chhattisgarh, tin in the form of cassiterite is being mined from the sediments deposited in the streams. The stream sediments are dug up

manually with conventional implements. Subsequent panning of these sediments helps in separating the lighter gangue minerals while the heavier part is recovered as cassiterite. The CMDC purchases cassiterite concentrate at mutually agreed rates.

INDUSTRY

Precious Minerals and Smelting Ltd is a joint sector company promoted by Lunia group with CMDC Ltd. It has the only working plant producing tin ingots at present.

Under private sector, HAMCO Mining and Smelting Ltd, Mumbai, has a tin plant at Silvassa, Dadra & Nagar Haveli. The plant uses imported concentrates. It has a production capacity of 3,000 tpy. However, the plant has not reported production. The other plant at Choudhwar, Cuttack district, Odisha owned by Sartin Alloys Private Ltd has 300 tpy capacity for unwrought tin and 1,000 tpy capacity for lead and tin alloys. This plant is designed to process domestic as well as imported ores. This plant has also not reported any production since 2002-03.

TIN

Hindustan Tin Works Ltd is contemplating setting up a 350 million cans per annum capacity plant at Taloja in Maharashtra which will substitute the imports of cans meant mainly for beer and beverage/soft drinks.

USES & SPECIFICATIONS

Tin, as a metal, is the most preferred and environment-friendly packing material. Tin plates are used both in packaging food products like processed food, vanaspati ghee, etc. and in battery jackets and pesticide cans. The tin plate is manufactured by depositing tin on iron plate of thickness ranging from 0.17 mm to 0.60 mm. The amount of tin coating on tin plate was earlier as per BIS specification IS:597-1978 for pack-rolled tin plate and pack-rolled black plate which is now inactive. The specifications for tin ingot which is to be used for various purposes is as per IS: 26 - 1992 (Fourth Revision, Reaffirmed 2008). There shall be two grades of tin ingot; viz, Sn 99.85% and 99.75%. BIS has prescribed IS : 4280-1992 (Reaffirmed 2008) for refined secondary ingots.

Tin readily forms alloys with other metals to create useful materials, such as solders, bronzes, and fusible alloys. Tin with lead forms an excellent alloy which melts at very low temperature and is used as solders in electronics or as a seal in plumbing. Tin is used in making fusible alloys to be used in safety devices such as fire sprinklers, pressure cookers, boiler plugs and electrical fuses.

Powder containing 60% silver, 27% tin and 13% copper when mixed with appropriate quantity of mercury forms excellent dental amalgam to be used for filling dental cavities.

Tin is used in cast iron to improve the microstructure and it results in higher uniform hardness. Tin bronzes are used for making gears, tubing, springs and plumbing fittings and for making bearings. Tin is also used in making high tech alloys such as zirconium-tin, used for cladding the fuel elements in thermal nuclear reactors and a niobium-tin-intermetallic compound

used in certain high-performance superconducting fields such as in high-energy physics.

Tin oxide-based catalysts are used in air purification system, gas sensors and CO₂ lasers. Organotin compounds are used in agrochemicals and antifouling paints in seafaring vessels. Float glass industry is an important user of tin; it utilises a method of floating molten glass over a huge vat of molten tin. Pure tin in molten form is used to provide a flat surface as well as fire-polish on both sides of float glass which solidifies on it. It is also used in the production of lead crystal glass. Tin oxide films thicker than 1 mm on glass, produce a transparent, yet electrically conductive layer. This layer is used in de-icing windscreen, antistatic glassware, security alarm, etc.

POLICY

As per the Foreign Trade Policy, 2009-14, there are no restrictions on the export and import of tin ores and concentrates.

CONSUMPTION

The main consumers in India are the tin plate industry and solder industry. The latter advancing to become the biggest single end-use sector, over the last decade. The fastest growth rate is also expected in future. Tin plate companies; namely, Tin Plate Company of India Ltd and SAIL's Rourkela Steel Plant use tin metal in appreciable quantities for the manufacture of tin plate.

The domestic tin plate market is categorised broadly into three basic packaging market segments: edible oil and cashew, processed food and non-processed food. Production of tin plates in 2010-11 was 7,193 tonnes and 12,005 tonnes in 2011-12 against an installed capacity of 85,000 tpy of tin plates. The Tin Plate Company of India Ltd consumes tin at its Golmuri Works, Jamshedpur in East Singhbhum, Jharkhand. The installed capacity of the electrolytic tinning plant of the company is 379,000 tpy. The consumption in IT industry and in food/beverages packaging industry has increased in the recent years.

SUBSTITUTES

The most important use of tin is in making packing materials, as it is environment-friendly. A number of materials can replace tin in its various applications; such as tetrapack for liquid food items, plastic/polycontainers for solid, semi-solid food; aluminium, glass, tin-free steel can be used in place of tin cans and containers. For tin solders, new epoxy resins, for bronze-aluminium alloys, copper-base alloys, plastic for bearing metals, compounds of lead and sodium for some tin chemicals are the other substitutes now in use in place of tin.

WORLD REVIEW

The world reserves of tin metal are estimated at 4.9 million tonnes, located mainly in China (31%), Indonesia (16%), Brazil (14%), Bolivia (8%) and Russia (7%). The world reserves of tin by principal countries are given in Table-7.

The world production of tin in 2011 decreased marginally to 300,000 tonnes from 320,000 tonnes in the previous year. China (42%), Indonesia (26%), Peru (10%), Bolivia (7%) and Australia (5%) were the principal producing countries (Table-8).

Yunnan Tin Group Co. Ltd (China), PT Timah Tbk (Indonesia), Malaysia Smelting Corp. (Malaysia), Minsur SA (Peru), Thailand Smelting and Refining Co. Ltd (Thailand), Liuzhou China Tin Group Co. Ltd (China), Yunnan Chengfeng Non-ferrous Metals Co. Ltd (China), Empresa Metalurgica Vinto (Bolivia), Metallo Chimique NV (Belgium) and Geijiu Zi-Li Ltd (China) were the world's top 10 producers of refined tin, as per the ITRI in 2010.

According to a survey conducted by the Tin Industry Organisation (TRI Ltd) preliminary estimates for 2011 indicates a marginal decline in usage from 2010.

Bolivia

Sinchi Wayra owned by a subsidiary of Glencore International AG operated five tin mines in Bolivia that produce about 6,000 tonnes per year of tin concentrates.

China

Nippon Steel Corporation (Tokyo, Japan) announced a new joint venture in China which would boost its global tin plate production capacity to 2 million tonnes per year.

Morocco

Kasbah Resources Ltd (South Perth, Western Australia, Australia) announced it had signed an agreement with Moroccan Government to assign 100% of two mining permits for the Achmmach Tin project to Kasbah's wholly owned Moroccan subsidiary. This project was expected to start up in 2013 with a planned annual capacity of about 5,600 tonnes per year of tin-in-concentrate.

Indonesia

PT Timah (Jakarta) one of the world's leading tin producer, announced that it planned to produce 50,000 tonnes of refined tin in 2012, an increase of 19% from its output of 42,000 tonnes in 2011. The production was expected to come mostly from offshore mining. Tin producers on Indonesia's Bangka Island announced plans to establish a tin market to gain greater control of supply and prices.

**Table – 7 : World Reserves of Tin
(By Principal Countries)**

(In '000 tonnes of tin content)

Country	Reserves
World : Total (rounded)	4900
Australia	240
Bolivia	400
Brazil	710
China	1500
Congo (Kinshasa)	NA
Indonesia	800
Malaysia	250
Peru	310
Russia	350
Thailand	170
USA	-
Vietnam	NA
Other countries	180

Source: Mineral Commodity Summaries, 2013.

**Table – 8 : World Production of Tin
(By Principal Countries)**

(In tonnes of metal content)			
Country	2009	2010	2011
World: Total	317000	320000	300000
Australia	13269	18646	15400
Bolivia	19575	20190	20373
Brazil	9500	9600	9546
China	128000 ^e	129600	127400
Congo, Dem. Peoples Rep. of	10083	8720	3549
Indonesia ^e	84000	84000	78000
Malaysia	2410	2668	3346
Nigeria	1800	1300	1800
Peru ^e	37503	33848	28882
Russia [#]	1200	1000	600
Rwanda	3154	3970	4508
Vietnam ^e	5400	5400	5400
Other countries	1106	1058	1196

Source: World Mineral Production, 2007-2011.

^e - Recoverable

[#] - Metal

FOREIGN TRADE

Exports

About 2 tonnes of tin ores & concentrates was exported during 2011-12 as compared to 33 tonnes of exports during the previous year. Exports of tin & alloys including scrap were 1,673 tonnes as compared to 1,900 tonnes in the preceding year. Out of total exports in 2011-12, tin and alloys comprised 344 tonnes, tin and alloys (worked) 1,317 tonnes, tin & alloys (NES) 146 tonnes and tin waste & scrap 12 tonnes. Exports were mainly to Zambia (18%), UAE (16%) and Nepal and Egypt (11%) each (Tables -9 to 14).

Imports

Imports of tin ores and concentrates decreased drastically to negligible quantity in 2011-12 from 195 tonnes in the previous year. Imports was only from Uganda. Imports of tin and alloys including scrap were 8,055 tonnes in 2011-12 and 7,494 tonnes in the previous year. Out of the total imports in 2011-12, tin and alloys comprised 7,792 tonnes, tin and alloys (worked, NES) 263 tonnes and tin (scrap) negligible quantity. Major suppliers were Malaysia (50%), Indonesia (16%), China (9%) and Thailand (6%) (Tables - 15 to 20).

**Table – 9 : Exports of Tin Ores & Conc.
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	33	9219	2	454
Nepal	-	-	2	454
Other countries	33	9219	-	-

**Table – 10 : Exports of Tin and Alloys
Incl. Scrap
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1900	403662	1673	413908
UAE	132	16620	273	78662
Singapore	76	47377	55	48491
Nepal	34	4229	188	35077
UK	52	38084	36	32341
Egypt	149	8416	184	22572
Netherlands	18	11727	13	21045
USA	136	9972	82	19658
Zambia	76	7358	305	19001
South Africa	53	4703	26	18593
Sri Lanka	63	13452	30	13730
Other countries	1111	241724	481	104738

**Table – 11 : Exports of Tin and Alloys
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	274	195481	344	277913
UAE	9	5659	114	62251
Singapore	66	45825	51	47707
UK	42	30740	21	29972
Nepal	2	163	47	25566
Netherlands	7	9696	13	21045
South Africa	2	745	9	13749
Egypt	-	4	9	11112
Sri Lanka	9	6831	6	9573
USA	1	2376	5	9279
Germany	21	11509	27	9244
Other countries	115	81933	42	38415

**Table – 12 : Exports of Tin and Alloys: Worked
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1535	189388	1317	130331
Zambia	76	7358	305	19001
UAE	123	10961	159	16412
Tunisia	92	11818	114	11120
Egypt	149	8412	174	10613
USA	135	7596	77	10338
Nepal	4	2079	140	9431
Oman	5	849	56	9203
Syria	-	-	44	4798
Sri Lanka	53	6538	24	4157
Kuwait	8	1268	19	3161
Other countries	890	132509	205	32097

**Table – 13 : Exports of Tin : Waste & Scrap
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	91	18793	12	5664
South Africa	-	-	1	2690
Egypt	-	-	1	847
China	15	14160	1	605
Vietnam	20	306	5	340
Angola	-	-	1	238
Saudi Arabia	5	387	1	201
Australia	++	24	1	173
Uganda	-	-	++	148
France	-	-	++	81
Nepal	28	1987	1	81
Other countries	23	1929	++	260

**Table – 15 : Imports of Tin Ores & Conc.
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	195	86167	++	32
Uganda	-	-	++	32
Other countries	195	86167	-	-

**Table - 14 : Exports of Tin & Alloys: NES
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	57	42046	146	120184
UAE	6	2294	87	59976
UK	24	28957	21	29972
Netherlands	-	-	5	6496
Egypt	-	-	6	5929
Chinese Taipei/Taiwan	-	-	3	3873
Sri Lanka	7	5261	2	3765
USA	-	-	2	3503
Malaysia	12	2407	2	2927
Germany	1	1246	7	2030
Vietnam	-	-	1	696
Other countries	7	1881	10	1017

**Table – 16 : Imports of Tin and Alloys, Incl. Scrap
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	7494	7258073	8055	8789035
Malaysia	3460	3531029	3999	4466733
Indonesia	1289	1351742	1319	1561159
China	597	434778	703	660899
Thailand	385	381699	493	613058
Singapore	612	516591	246	304053
Belgium	754	652205	254	286216
Germany	67	66788	155	199314
Korea, Rep.of	23	37736	95	143195
Japan	6	7880	54	77396
USA	53	40616	63	43071
Other countries	248	237009	674	433941

**Table – 17 : Imports of Tin & Alloys
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	7104	7114189	7792	8664921
Malaysia	3446	3522535	3957	4444731
Indonesia	1289	1351742	1319	1561159
China	356	370245	540	610369
Thailand	385	381691	489	609384
Singapore	606	513479	246	303969
Belgium	754	652205	254	286216
Germany	59	59123	146	189601
Korea, Rep. of	23	37007	95	142539
Japan	1	867	48	68975
Australia	20	29442	26	38113
Other countries	165	195853	672	409865

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**Table – 18 : Imports of Tin & Alloys : Worked, NES
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	347	142890	263	123900
China	241	64533	163	50508
Malaysia	14	8494	42	22002
Chinese Taipei/ Taiwan	7	20980	6	13879
Germany	8	7665	9	9713
Japan	5	7013	6	8420
Italy	24	14840	9	6046
USA	23	7296	19	5205
Thailand	++	8	4	3675
Hong Kong	3	2856	3	1334
Kenya	++	461	1	1225
Other countries	22	8744	1	1893

**Table – 19 : Imports of Tin (Scrap)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	43	994	++	214
UK	-	-	++	191
China	-	-	++	22
Italy	-	-	++	1
Other countries	43	994	-	-

**Table – 20 : Imports of Tin
(By Items)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Items	7494	7258073	8055	8789035
Tin & alloys	7104	7114189	7792	8664921
Block tin	563	486229	105	131795
Anode, cathode, etc. of tin unwrought	6250	6307581	7259	8004652
Tin base alloys, NES	76	104911	102	132552
Tin & alloys: worked	215	215468	326	395922
Tin & alloys: worked, NES	347	142890	263	123900
Tin scrap	43	994	++	214

FUTURE OUTLOOK

Worldwide demand for primary tin was expected to increase at moderate annual rate. The rate of increase, however, could balloon or go up in a few years if new applications continue to find acceptance in the market place, especially in the electronics (solder) field.

ITRI estimated that global tin demand in 2015 would be about 400,000 tonnes per year during coming decades technological changes likely would affect tin consumption in its main application of electronics, solder and tin plate.