

75 Tin

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 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 (provisional) are placed at 83.73 million tonnes containing about 102,275 tonnes metal. About 7,131 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).

PRODUCTION & STOCKS

Concentrates

Chhattisgarh was the only producer of tin concentrates. The production of tin concentrates in 2009-10 was at 59,015 kg as against 59,778 kg in the preceding year. Five mines, one in public sector and four in private sector, all located in Dantewada district of Chhattisgarh reported production in 2009-10.

The mine-head stocks of tin concentrates were 11,335 kg at the end of the year as against 2,348 kg at the beginning 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 leased area. Hence, no labour was reported to have been employed in the mine owned by the CMDC, whereas Precious Minerals and Smelting Ltd, employed 44 workers in the mines during the year. Prices of tin concentrates are furnished in the General review on 'Prices'.

Metal

The plant owned by Precious Mineral and Smelting Limited reported production of 27,129 kg of tin metal in 2009-10 against 26,568 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
2009-10**

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 (p)
(By Grades/States)

(In tonnes)

Grade/State	Reserves				Remaining resources							Total Resources (A+B)
	Proved	Probable	Total (A)	Feasibility	Pre-feasibility	Measured	Indicated	Inferred	Total (B)	Total (A+B)		
	STD111	STD121	STD122	STD211	STD221	STD222	STD331	STD332	STD333			
All India : Total												
Ore	4404	1015	1713	22592692	2326	31330000	168622	561080	29064345	83719065	83726197	
Metal	925.75	189.76	16.92	32222.43	652.89	54032.08	894.91	231.63	13107.75	101142.41	102274.84	
By States												
Chhattisgarh												
Ore	4404	1015	1713	-	1690	-	168622	559914	29063345	29793571	29800703	
Metal	925.75	189.76	16.92	-	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.

TIN

**Table – 3 : Production of Tin Concentrates, 2007-08 to 2009-10
(By State)**

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

State	2007-08		2008-09		2009-10(P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	63218	14578	59778	21267	59015	21878
Chhattisgarh	63218	14578	59778	21267	59015	21878

**Table – 4 : Production of Tin Concentrates, 2008-09 and 2009-10
(By Sectors/State/District)**

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

State	2008-09			2009-10(P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	5	59778	21267	5	59015	21878
Public sector	1	48309	15957	1	34223	10399
Private sector	4	11469	5310	4	24792	11479
Chhattisgarh	5	59778	21267	5	59015	21878
Dantewada	5	59778	21267	5	59015	21878

**Table – 5 : Mine - head Stocks of Tin Concentrates, 2009-10(P)
(By State)**

(In kg)

State	Stocks at the	
	Beginning of the year	End of the year
India	2348	11335
Chhattisgarh	2348	11335

**Table – 6 : Production of Tin Metal in India
2007-08 to 2009-10**

(Qty. in kg; value in Rs. '000)

Year	Production	
	Quantity	Value
2007-08	27880	17079
2008-09	26568	18952
2009-10(P)	27129	15491

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

Metal production has not been reported from M/s Dravya Industrial Chemicals Ltd from its plant located in Raipur district since 1999-2000. Similarly, production has not been reported by the lone public sector plant of CMDC in Raipur district, Chhattisgarh.

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.

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 is to be carried out as per BIS specification IS:597-1978 (Second Revision) for pack-rolled tin plate and pack-rolled black plate. The minimum amount of pure tin per square metre shall be 105 g for Grade I, 85 g for Grade II and 55 g for BC grade. The specifications for tin ingot which is to be used for various purposes is as per IS: 26 - 1992 (Fourth Revision). There shall be two grades of tin ingot; viz, Sn 99.85% and 99.75%.

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 utilizes 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 which has a size of 3 lakh tonnes per annum is categorised broadly into three basic market segments: edible oil and cashew, processed food and non-food for packaging. Rourkela plant of SAIL consumed about 58 tonnes tin in 2008-09. Consumption of tin for 2009-10 is not available. Production of tin plates in 2009-10 was 18,024 tonnes and 20,343 tonnes in 2008-09 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 present installed capacity of the electrolytic tinning plant of the company is 179,000 tpy. The company produced 168,100 tonnes and 185,300 tonnes electrolytic tin plates in 2007-08 and 2008-09, respectively. Production for 2009-10 is not available.

Other industry which consumes tin in substantial quantities in the country is tin solder required by high-tech and electronic sectors which have a positive impact on tin industry. The consumption in IT industry and in food/beverages packaging industry is increasing day by day.

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

About 80% world's tin deposits occur as unconsolidated secondary or placer deposits in river beds and valleys or on the floor of sea and the remaining 20% as primary hard rock veins or lodes in close association with silicic granites. Tin is found allied closely with granite from which it originates. The world reserves of tin metal are estimated at 5.6 million tonnes, located mainly in China (30%), Indonesia (14%), Peru (13%), Brazil (10%), Bolivia (8%) and Malaysia (9%). The world reserves of tin by principal countries are given in Table-7.

The world production of tin in 2009 increased to 279,000 tonnes from 273,000 tonnes in the previous year. China (46%), Indonesia (17%), Peru (13%) and Bolivia (7%) were the principal producing countries (Table - 8).

Argentina

Silver standard Resources Inc.'s Pirquitas silver-tin project in Jujuy began concentrate production in December 2009.

Bolivia

The state owned Vinto tin smelter is installing a new Ausmelt furnace with Government assistance by 2010-11. The furnace would expand the smelter capacity from 11,000 tpy to 17,000 tpy with treatment of 38,000 tpy concentrates.

China

A new tin smelter was commissioned by Nanshan Tin Co. Ltd in Nankang Industrial Zone. Capacity of this plant is 10,000 tonne per annum of refined tin. Liuzhou China Tin Group Co. Ltd is to install a new 20,000 tpy capacity tin smelter with Ausmelt tin smelting technology at the existing facility at Liabing.

Indonesia

PT Latinusa Tbk has plans to double its tin plate production capacity to 250,000 tpy by 2013-14. Its present capacity is 130,000 tpy.

Japan

Nippon Mining completed first phase of Hitachi Metal Recycling Complex in September 2009 with capacity to produce 500 tpy tin besides antimony (150 tpy), bismuth (200 tpy) and nickel (500 tpy).

Morocco

Kasbah Resources Ltd is drilling in 15,000 sq m area in Meknes Zone to complete feasibility study of the project by June 2011.

UK

Western United Mines Ltd announced plans to return the South Crofty Tin Mine into production within two years. The mine has produced tin for over 300 years and is a polymetallic mine containing copper, lithium, precious metals and zinc.

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

(In '000 tonnes of tin content)

Country	Reserves
World : Total (rounded)	5600
Australia	150
Bolivia	450
Brazil	540
China	1700
Congo (Kinshasa)	NA
Indonesia	800
Malaysia	500
Peru	710
Portugal	70
Russia	300
Thailand	170
USA	-
Vietnam	NA
Other countries	180

Source: Mineral Commodity Summaries, 2010.

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

Country	(In tonnes of metal content)		
	2007	2008	2009
World: Total	307000	273000	279000
Australia	2071	1783	13269
Bolivia	15972	17320	19581
Brazil	11835	13000	10000
China	145900	121500	128000
Congo, Dem. People's Rep.of	8900	11800	9400
Indonesia	66137	53228	46078
Malaysia	2263	2605	2412
Nigeria	2500	1800	1800
Peru [#]	39019	39037	37530
Russia [#]	2500	1500	1200
Vietnam ^e	5400	5400	5400
Other countries	4503	4027	4330

Source : World Mineral Production, 2005-2009.

[#] Recoverable.

FOREIGN TRADE

Exports

About 7 tonnes of tin ores & conc. were exported to Sri Lanka and Nepal in 2009-10. Exports of tin & alloys including scrap were 2,315 tonnes as compared to 2,243 tonnes in the preceding year. Out of total exports in 2009-10, tin and alloys comprised 764 tonnes, tin and alloys worked (NES) 1,435 tonnes and tin scrap 116 tonnes. Exports were mainly to Malaysia (18%), Tunisia (11%), UAE and USA (8% each) (Tables -9 to 13).

Imports

Imports of tin ores and concentrates decreased to 487 tonnes in 2009-10 from 979 tonnes in the previous year. Imports were mainly from People's Rep. of Congo (50%), South Africa (40%) and Tanzania (10%). Imports of tin and alloys including scrap were 7,672 tonnes in 2009-10 and 7,689 tonnes in the previous year. Out of the total imports in 2009-10, tin and alloys comprised 7,367 tonnes, tin and alloys (worked, NES) 292 tonnes and tin (scrap) 13 tonnes. Major suppliers were Malaysia (38%), Indonesia (25%), Thailand (12%) and Belgium 10%) (Tables - 14 to 19).

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

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	2	21	7	371
Sri Lanka	-	-	3	325
Nepal	-	-	4	46
Germany	1	18	-	-
Spain	1	3	-	-

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

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	2243	1296515	2315	598850
Malaysia	37	20428	407	271874
USA	38	7252	190	57167
Singapore	59	17346	156	40525
Sri Lanka	66	10528	166	24219
UK	103	18613	25	20377
UAE	1355	1124065	191	19867
Tanzania	37	3618	148	18435
Iran	7	386	24	17211
Tunisia	-	-	253	13900
Australia	36	19680	3	1276
Other countries	505	74599	752	113999

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

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	1607	1216288	764	450443
Malaysia	35	19961	394	270915
USA	3	1519	70	43184
Singapore	52	16463	148	39757
UK	89	17392	21	19896
Iran	-	-	24	17197
Japan	-	-	21	12762
Nigeria	-	-	10	9965
Germany	21	3263	17	5111
UAE	1287	1107906	2	2134
Australia	20	18752	++	243
Other countries	100	31032	57	29279

**Table - 12 : Exports of Tin and Alloys: Worked, NES
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	579	71190	1435	140417
Sri Lanka	61	7977	160	19872
Tanzania	36	3168	146	18389
UAE	62	15086	169	16075
Tunisia	-	-	253	13900
USA	34	5570	100	13236
Oman	++	22	74	9770
Italy	8	543	182	9347
South Africa	24	2970	57	7884
France	17	1325	47	6785
Nepal	38	3333	88	5870
Other countries	299	31196	159	19289

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

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	57	9037	116	7990
Denmark	++	++	27	2588
UAE	6	1073	20	1658
Malawi	++	69	19	941
USA	1	163	20	747
Mauritius	2	412	3	603
Germany	7	686	4	337
Nepal	6	497	17	309
Colombia	7	1612	-	-
Kuwait	7	1401	-	-
Saudi Arabia	7	792	-	-
Other countries	14	2332	6	807

**Table - 14 : Imports of Tin Ores & Conc.
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	979	464371	487	168047
Congo, People's Rep. of	759	368255	243	79999
South Africa	-	-	195	69766
Tanzania	-	-	49	18045
Singapore	-	-	++	237
Hong Kong	++	120	-	-
Rwanda	220	95996	-	-

**Table - 15 : Imports of Tin and Alloys, Incl. Scrap
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	7689	4686282	7672	5148447
Malaysia	3085	2492424	2939	2083504
Indonesia	760	653802	1920	1256254
Thailand	40	24814	910	684110
Belgium	682	581511	756	530423
Singapore	653	479670	395	228782
Chinese Taipei/ Taiwan	85	131428	142	147757
China	1901	61720	333	80805
Germany	103	63455	37	30410
UK	83	34901	21	15655
Australia	128	83116	15	10414
Other countries	169	79441	204	80333

**Table - 16 : Imports of Tin & Alloys
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	5665	4604114	7367	5082623
Malaysia	3072	2485408	2937	2080956
Indonesia	760	653802	1920	1256254
Thailand	40	24814	910	684078
Belgium	682	581435	756	530423
Singapore	636	475775	382	225271
Chinese Taipei/ Taiwan	85	131168	142	147757
China	66	37049	186	55929
Germany	57	51429	30	25581
UK	81	34174	19	14718
Australia	128	83116	15	10374
Other countries	58	45944	70	51282

**Table - 17 : Imports of Tin & Alloys : Worked, NES
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	1983	66750	292	65631
China	1835	24660	147	24876
Italy	33	9385	77	18163
USA	24	7145	21	4917
Germany	10	4685	7	4829
Hong Kong	10	2028	18	3592
Singapore	17	3083	13	3511
Malaysia	8	1917	2	2548
Japan	3	752	1	1244
Canada	4	2280	-	-
South Africa	24	6363	-	-
Other countries	15	4452	6	1951

TIN

**Table – 18 : Imports of Tin (Scrap)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	41	15418	13	193
UAE	-	-	13	193
Chinese Taipei/Taiwan	++	23	-	-
Germany	36	7341	-	-
Hong Kong	++	72	-	-
Italy	++	350	-	-
Japan	++	118	-	-
Malaysia	5	5099	-	-
Singapore	++	812	-	-
UK	++	65	-	-
USA	++	1527	-	-
Other countries	++	11	-	-

**Table – 19 : Imports of Tin
(By Items)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Items	7689	4686282	7672	5148447
Tin & alloys	5665	4604114	7367	5082623
Block tin	830	544799	977	639640
Anode, cathode, etc. of tin unwrought	4542	3770856	6017	4104691
Tin base alloys, NES	121	154215	218	225887
Tin & alloys: worked (bars, rods, plates, etc.)	-	-	-	-
Tin & alloys: worked	172	134244	155	112405
Tin & alloys: worked, NES	1983	66750	292	65631
Tin scrap	41	15418	13	193

FUTURE OUTLOOK

According to the Indian Tin Plate Manufacturers' Association (ITMA), the demand of tin plate for packaging industry in the country is growing and the consumption is expected to grow at a moderate level of 5% per annum. The per capita consumption of tin plate in India is only 0.3 kg compared with 10 kg in USA, 8 kg in Japan and 0.8 kg in China. The consumption pattern of tin in the world is: solders 28%, tin plates 27%, alloys and alloy coating 16%, PVC stabilisers 7%, tinning 5% and others 17 percent.

The demand has historically been dominated by tin - plate and soldering industries, with latter advancing to become the biggest single end-use sector, over last decade. Demand is expected to continue to increase in all end-use sectors, but fastest growth rates will be in soldering industry.

In view of the likely enforcement of ban on the use of lead, lead-free solder will find market for soldering of electronic and electrical devices in the future. In other development, motor vehicle industry is showing interest in tin-zinc coatings for fuel tanks to replace lead-based fuel tank coatings.