

MANGANESE ORE



Indian Minerals Yearbook 2012

(Part- III : Mineral Reviews)

51st Edition

MANGANESE ORE

(FINAL RELEASE)

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

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Manganese in alloy form is an essential input in steel making and is one of the most important metals in an industrial economy. Manganese ores of major commercial importance are (i) pyrolusite (MnO_2 , Mn 63.2%); (ii) psilomelane (manganese oxide, containing water and varying amounts of oxides of Ba, K and Na as impurities; Mn commonly 45-60%); (iii) manganite ($Mn_2O_3 \cdot H_2O$, Mn 62.4%); and (iv) braunite ($3Mn_2O_3$, $MnSiO_3$, Mn about 62% and SiO_2 about 10%).

Indian manganese ore deposits occur mainly as metamorphosed bedded sedimentary deposits associated with Gondite Series (Archaeans) of Madhya Pradesh (Balaghat, Chhindwara & Jhabua districts), Maharashtra (Bhandara & Nagpur districts), Gujarat (Panchmahal district), Odisha (Sundergarh district) and with Kodurite Series (Archaeans) of Odisha (Ganjam & Koraput districts) and Andhra Pradesh (Srikakulam & Visakhapatnam districts).

RESOURCES

The total resources of manganese ore in the country as on 1.04.2010 are placed at 430 million tonnes as per UNFC system. Out of these, 142 million tonnes are categorised as reserves and the balance 288 million tonnes are in the remaining resources category. Gradewise, ferro-manganese grade accounts for 8%, medium grade 11%, BF grade 34% and the remaining 47% are of mixed, low, others, unclassified, and not-known grades including 0.35 million tonnes of battery/chemical grade.

Statewise, Odisha tops the total resources with 44% share followed by Karnataka 22%, Madhya Pradesh 13%, Maharashtra 8%, Andhra Pradesh 4% and Jharkhand & Goa 3% each. Rajasthan, Gujarat and West Bengal together shared the remaining about 3% resources (Table - 1).

EXPLORATION & DEVELOPMENT

Details of exploration carried out for manganese ore by various agencies during 2011-12 are given in Table - 2.

PRODUCTION, STOCKS AND PRICES

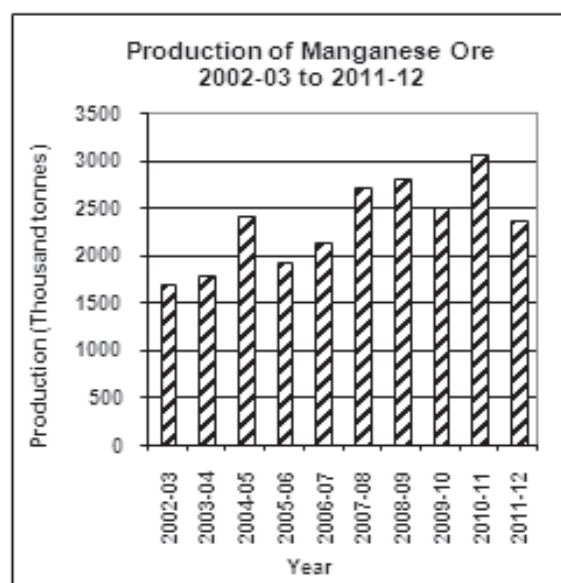
The production of manganese ore at 2349 thousand tonnes during 2011-12 decreased by 23% as compared to that in the previous year due

to temporary discontinuance of mining operations in Karnataka and Gujarat states.

There were 144 reporting mines during 2011-12 as against 149 in the previous year. Besides, manganese ore production was reported by seven mines of iron ore and one mine of quartz in 2011-12 whereas in 2010-11, seven mines of iron ore and one mine each of laterite, limestone and quartz reported production of manganese ore. In all 68 producers reported production of manganese ore in 2011-12. Five principal producers operating 27 mines contributed 74% production. About 70% of the total production was reported by 16 mines, each producing more than 40,000 tonnes per annum, while 13% was contributed by 9 mines (including two associate mines) each in the production range of 20,001 to 40,000 tonnes. The remaining 17% production was covered by 121 manganese and 6 associate mines each producing up to 20,000 tonnes.

In 2011-12, nineteen public sector mines including one associate mine jointly accounted for 47% of the total production. The contribution of captive mines was 15% of the total production.

As regards gradewise composition of production in 2011-12, 62% production was of lower grade (below 35% Mn), 25% of medium grade (35-46% Mn) and 11% was of high grade (46% Mn and above). Production of manganese dioxide was 42,633 tonnes (2%) during the year as against 48,068 tonnes (2%) in the previous year.



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**Table – 1 : Reserves/Resources of Manganese Ore as on 01.04.2010
(By Grades/States)**

State/Grade	Reserves										Remaining resources					Total resources (A+B)					
	Proved		Probable		Total		Feasibility		Pre-feasibility		Measured		Indicated		Inferred		Reconnaissance		Total		
	STD111	STD121	STD121	STD122	STD121	STD122	STD221	STD221	STD221	STD222	STD331	STD332	STD332	STD333	STD333		STD334	STD334	STD334	STD334	STD334
All India : Total	97427	11591	32961	141979	141979	23530	27593	51075	5732	23726	151703	4644	288003	429982							
By Grades																					
Battery/Chemical	67	-	45	112	112	-	8	-	4	26	202	-	240	352							
Ferro-manganese	9985	1053	1832	12870	12870	692	3349	2214	3703	3031	9267	330	22586	35456							
Medium	4736	194	3764	8694	8694	8482	1356	9595	388	1333	18382	498	40034	48728							
BF	33282	3076	13536	49894	49894	5680	8975	11338	360	10835	58109	664	95961	145855							
Mixed	1214	188	361	1763	1763	-	66	51	-	-	9400	2100	11617	13380							
Medium & BF mixed	6346	900	5017	12263	12263	101	1432	4665	548	1087	23441	750	32024	44287							
Ferro-manganese, medium & BF mixed	28879	1998	3665	34542	34542	5928	5751	11387	80	1862	6099	55	31162	65704							
Ferro-manganese & BF	1604	253	569	2426	2426	77	320	7678	189	1506	4132	-	13902	16328							
Low (-)25% Mn	1505	2	140	1647	1647	464	349	764	237	3713	1925	54	7506	9153							
Others	4763	1055	2053	7871	7871	1082	1767	384	223	14	2554	28	6052	13923							
Unclassified	3762	1617	1788	7167	7167	191	4212	2348	-	29	13271	165	20216	27383							
Not-Known	1284	1255	191	2730	2730	833	8	651	-	290	4921	-	6703	9433							
By States																					
Andhra Pradesh	1719	596	1841	4156	4156	412	130	251	188	4176	7877	410	13444	17600							
Goa	420	32	222	674	674	156	1674	3814	48	261	6968	-	12921	13595							
Gujarat	-	-	-	-	-	-	-	-	-	-	2954	-	2954	2954							
Jharkhand	1250	620	1586	3456	3456	396	211	3053	-	-	6594	-	10254	13710							
Karnataka	11455	1827	2820	16102	16102	6056	3730	7523	2227	7385	52893	270	80084	96186							
Madhya Pradesh	30094	1944	2954	34992	34992	7769	3934	1719	2179	943	4190	-	20734	55726							
Maharashtra	10000	2210	108	12318	12318	497	3010	12001	-	1589	4655	84	21836	34154							
Odisha	41354	4361	22784	68499	68499	8244	14906	22714	1090	9371	61343	3880	121548	190047							
Rajasthan	1134	-	647	1781	1781	-	-	-	-	-	4030	-	4030	5811							
West Bengal	-	-	-	-	-	-	-	-	-	-	200	-	200	200							

Figures rounded off.

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Table – 2 : Details of Exploration Activities for Manganese Ore, 2011-12

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
GSI Madhya Pradesh Jhabua.	-	-	-	3	-	63	Reconnaissance stage investigation (G-4) was taken up in Aravalli belt in Meghnagar tehsil. Five Mn bands were traced in Nagnavat, Phuleri, Guvali, Patra and Doter areas. Out of these, three Mn bands are located in Mandali-Tunia block and one each in Rampura and Doter villages. The longest band is in Mandali & is 70 m in length with an average width of 5 m. Analysis of borehole samples indicated Mn values from 0.33 to 25.82%. The average Mn value in 45 surface samples was 14%.
Maharashtra Nagpur	Parseoni extn. Area	Detailed mapping	0.6	-	-	62 surface &38 pit	Prospecting (G-3) stage investigation was continued in this area in 2011-12. The area is occupied by Precambrian meta-sediments of Lohangi and Mansar formations with manganese horizons. Out of 62 surface samples Mn values ranged between 9.88 to 43.05% Mn in 19 samples and remaining samples showed <5.40% Mn. Out of 38 pit samples 2 samples showed 10 to 41.67% Mn and remaining samples showed <5.5% Mn.
	Savali and Mohgaon Blocks	-	-	2	-	-	The gravity and Magnetic survey conducted in both the blocks brought out some anomalies. Shallow drilling was recommended. DGM Maharashtra initiated drilling in collaborative work and completed 2 boreholes. Drilling did not intersect any encouraging mineralized zone. The item is completed.
Odisha Kendujhar	Damurda South Block, Bolani South Block & Bolani NE Block	-	-	-	-	-	Prospecting (G-3) stage investigation has been carried out. The manganese ore in the area occurs in three distinct litho associations. a) duricrusted laterite, b) brecciated chert and c) with ferruginous shale, saprotic clay and wady shale. The ore is mostly pyrolusite. The nature of ore is lumpy, friable and powdery psilomelane. Strike length is 300 m and width over 300 m. There are 6 ore bands. The thickness of ore bands vary from 0.20 m to 11.50 m. A total of inferred Manganese resource of 1.15 million tonnes (UNFC 333) has been estimated at 20% cut off and 0.608 million tonnes of marginal grade (10-20%) Mn resource has also been estimated. The item is completed.

(Contd.)

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Table - 2 (Contd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Odisha							
Kendujhar	Balagorha- Champausahi area	-	-	-	-	-	Reconnaissance stage investigation (G-4) was continued in the area. The area is mainly occupied by ferruginous, mangani-ferrous and aluminous laterites with lenses and small bands of chert. From surface indications and pits excavated, it is found that manganese mineralisation is in pockets over a zone of 300 x 300 m as manganiferous laterite. Based on chemical analysis and visual estimation, the manganese mineralisation is evaluated to be of low potentiality. The item is completed.
Directorate of Geology Chhattisgarh							
Gariaband	Chhura- Pursuli	1:50000 1:4000	151.0 0.56	-	-	28	The deposit is residual and not economic.
Directorate of Geology Maharashtra							
Nagpur	Parseoni Area	1:25000	37.0	-	-	-	Manganese exposures were noticed near Village Savali & Mohgaon. Trenching of 39.0 cu.m was carried out and samples were collected from surface and pits.
Directorate of Geology and Mining Odisha							
Kendujhar	Harmutu Gemlai Rugudihi Panduliposi	1:25,000	50.0	-	-	47 rock 10 manganese ore	Few manganese occurrences near Panduliposi, west of Harmutu and Chordiaburu Hill did not appear to be promising.
GMDC Gujarat							
Panchmahals	Shivrajpur	1:1000	424.20	10 ha	1200	-	Manganese occurred as lenticular deposit in metamorphic rocks belonging to Champaner series of Aravalli system. Deposits are of epigenetic origin. Pyrolusite and psilomelane are the principal minerals. The belt is 22 km long with 0.5 km width. Thickness of orebody varied from few cm to 5 m.
MOIL Madhya Pradesh							
Balaghat	Tirodi mine Teh - Katangi	1:1000	1.2 ha	01	76	-	As on 01.04.2011, 1.61 million tonnes of in situ reserves were estimated.
	Balaghat mine At Bharweli	-	-	02	1401	-	About 24.58 million tonnes manganese ore resources were estimated.

(Contd.)

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Table - 2 (Concl'd.)

Agency/ State/ District	Location Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
MOIL							
Madhya Pradesh							
Balaghat	Bharveli Mine	-	-	02	1391.60	-	As on 01.04.2012, 24.28 million tonnes reserves were estimated.
-do-	Sitapatore/ Sukli Mine	-	-	-	-	-	0.40 million tonnes of reserves were estimated as on 1.4.2012
-do-	Ukwa Mine	-	-	-	-	-	As on 01.04.2012, 8.70 million tonnes reserves were estimated.
-do-	Tirodi Mine	-	-	03	460	-	As on 01.04.2012, 8.70 million tonnes reserves were estimated.
Maharashtra							
Bhandara	Dongri Buzurg Mine Teh. Tumsar	-	-	03	600	-	As on 01.04.2012, 11.90 million tonnes of in situ reserves were estimated.
-do-	Chikla Mine Post - Sitasaongi Teh. Tumsar	-	-	08	1351	-	Estimated 5.10 million tonnes of manganese ore reserves as on 01.04.2012.
Nagpur	Gumgaon Mine Vill. Teghai Teh. Saoner	-	-	04	635	-	As on 01.04.2012, 4.34 million tonnes of manganese ore resources were estimated.
-do-	Kandri Mine/vill Teh. Ramtek	-	-	15	3561.70	-	Estimated 5.53 million tonnes of manganese ore reserves as on 01.04.2012.
-do-	Mansar Mine Teh. Ramtek	-	-	-	-	-	Estimated about 4.64 million tonnes of manganese ore resources.

Maharashtra & Madhya Pradesh being the leading producing states accounted for 28% each of the total production, in 2011-12. Next in the order of production were Odisha (24%), Andhra Pradesh (14%) and Karnataka (6%). Jharkhand and Rajasthan contributed negligible production (0.38%) during the year (Tables - 3 to 7).

The mine-head stocks increased to 863 thousand tonnes at the end of 2011-12 from 859 thousand tonnes at the beginning of the year (Tables - 8(A) and 8(B)).

The average daily employment of labour strength in manganese ore mines was 13,928 in 2011-12 as against 14,117 in the previous year. Prices of manganese ore are furnished in the General Review on "Prices".

Table - 3 : Principal Producers of Manganese Ore, 2011-12

Name & address of Producer	Location of mine	
	State	District
MOIL Ltd. (Manganese Ore (India) Ltd), MOIL Bhavan, 1A, Katol Road, Chhaoni, Nagpur-440013, Maharashtra.	Madhya Pradesh	Balaghat
Tata Steel Ltd, 24, Homi Mody Street, Fort, Mumbai-400001.	Odisha	1. Kendujhar 2. Sundergarh
RBSSD & FN DAS Garividi, Shreeramnagar, Dist. Vizianagaram Andhra Pradesh.	Andhra Pradesh	Vizianagaram
Mangilal Rungta, Main Road, Barbil, Dist. Kendujhar, Odisha-758035.	Odisha	Kendujhar
Sandur Manganese & Iron Ores Ltd, Manganese Project, Lakshimpur, Sandur, Dist. Bellary, Karnataka.	Karnataka	Bellary

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Table – 4 : Principal Producers of Manganese Dioxide, 2011-12

Name & address of Producer	Location of mine	
	State	District
Tata Steel Ltd, 24, Homi Mody Street, Fort, Mumbai – 400 001.	Odisha	Kendujhar
MOIL Ltd, MOIL Bhavan, 1A, Katol Road, Chhaoni, Nagpur – 440 013, Maharashtra.	Maharashtra	Bhandara
Orissa Manganese & Minerals (P) Ltd, P.O. Koira – 770 048, Dist. Sundergarh, Odisha.	Odisha	Sundergarh
Mangilal Rungta, P. O. Chaibasa – 833 201, Dist. West Singhbhum, Jharkhand.	Odisha	Kendujhar
*Devkabai Velji, Barajamda, Dist. Singhbhum(w)	Jharkhand	Singhbhum(w)
*Bhanja Minerals(P) Ltd., Park Road, Keonjhar Garh, Distt. Kendujhar, Odisha.	Odisha	Kendujhar
*R.B. Das, Choudhary Bazar, G.P.O. Baxi Bazar, Dist. Cuttack, Odisha.	Odisha	Kendujhar

* Associated with iron ore.

**Table – 5 : Production of Manganese Ore, 2009-10 to 2011-12(P)
(By States)**

(Quantity in tonnes; value in ₹'000)

State	2009-10		2010-11		2011-12(p)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	2491950	11905233	3056385	14684000	2349300	11712864
Andhra Pradesh	260628	332916	290785	526834	322087	535816
Goa	770	1047	440	1684	1550	2423
Gujarat	55090	27270	245240	121639	-	-
Jharkhand	39875	41472	44898	62094	18265	32766
Karnataka	301163	611165	413287	929734	136072	297422
Madhya Pradesh	607148	4094882	716285	4226787	648283	4030020
Maharashtra	613520	4618651	672828	4984603	649898	4347624
Odisha	605313	2165165	655984	3805668	565662	2451830
Rajasthan	8443	12665	16638	24957	7483	14963

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Table – 6 (A) : Gradewise Production of Manganese Ore, 2010-11
(By Sectors/States/Districts)

(Quantity in tonnes; value in ₹'000)

State/ District	No. of mines	MnO ₂	Production By Grades: Mn Content				Total	
			above 46%	35% - 46%	25% - 35%	below 25%	Quantity	Value
India	149(10)	48068	283916	614557	1510607	599237	3056385	14684000
Public sector	19(1)	4455	254608	261476	593583	347826	1461948	8698875
Private sector	130(9)	43613	29308	353081	917024	251411	1594437	5985125
Andhra Pradesh	38	-	-	5600	242299	42886	290785	526834
Adilabad	12	-	-	-	-	21971	21971	68504
Vizianagaram	26	-	-	5600	242299	20915	268814	458330
Goa	5	-	-	-	240	200	440	1684
South Goa	5	-	-	-	240	200	440	1684
Gujarat	1	-	-	-	-	245240	245240	121639
Panchmahal	1	-	-	-	-	245240	245240	121639
Jharkhand	2(2)	196	720	1889	41508	585	44898	62094
Singbhum West	2(2)	196	720	1889	41508	585	44898	62094
Karnataka	21(1)	-	-	64459	291327	57501	413287	929734
Bellary	10	-	-	64459	242638	-	307097	584397
Chitradurga	6(1)	-	-	-	-	3111	3111	5860
Davangere	2	-	-	-	36982	54390	91372	299854
Shimoga	1	-	-	-	174	-	174	122
Tumkur	2	-	-	-	11533	-	11533	39501
Madhya Pradesh	29(2)	-	198349	82979	249608	185349	716285	4226787
Balaghat	24(1)	-	198030	73298	148409	118382	538119	3747094
Chhindwara	3	-	319	9681	13424	14389	37813	195327
Jabalpur	1(1)	-	-	-	-	538	538	1076
Jhabua	1	-	-	-	87775	52040	139815	283290
Maharashtra	20	4455	57026	209115	397459	4773	672828	4984603
Bhandara	4	4455	13918	146712	285401	357	450843	3268145
Nagpur	16	-	43108	62403	112058	4416	221985	1716458
Odisha	32(5)	43417	27821	250515	271528	62703	655984	3805668
Kendujhar	16(4)	42202	27391	152166	147523	18577	387859	1803614
Sundergarh	16(1)	1215	430	98349	124005	44126	268125	2002054
Rajasthan	1	-	-	-	16638	-	16638	24957
Banswara	1	-	-	-	16638	-	16638	24957

Figures in parentheses indicate associated mines of iron ore, laterite, limestone, and quartz.

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Table – 6 (B) : Gradewise Production of Manganese Ore, 2011-12 (P)
(By Sectors/States/Districts)

(Quantity in tonnes; value in ₹'000)

State/ District	No. of mines	MnO ₂	Production By Grades: Mn Content				Total	
			above 46%	35% - 46%	25% - 35%	below 25%	Quantity	Value
India	144(8)	42633	268967	590124	1256850	190726	2349300	11712864
Public sector	18(1)	5281	212938	289506	588132	3386	1099243	7576224
Private sector	126(7)	37352	56029	300618	668718	187340	1250057	4136640
Andhra Pradesh	36	-	-	7650	241371	73066	322087	535816
Adilabad	10	-	-	-	1465	17908	19373	62301
Vizianagaram	26	-	-	7650	239906	55158	302714	473515
Goa	4	-	-	-	1550	-	1550	2423
South Goa	4	-	-	-	1550	-	1550	2423
Jharkhand	2(2)	170	150	1510	15128	1307	18265	32766
Singbhum West	2(2)	170	150	1510	15128	1307	18265	32766
Karnataka	19	-	-	26571	106600	2901	136072	297422
Bellary	8	-	-	25871	70720	-	96591	192989
Chitradurga	6	-	-	700	-	1610	2310	3634
Davangere	2	-	-	-	35880	1291	37171	100799
Shimoga*	1	-	-	-	-	-	-	-
Tumkur*	2	-	-	-	-	-	-	-
Madhya Pradesh	35(1)	-	179587	136916	261475	70305	648283	4030020
Balaghat	26(1)	-	174284	126627	217060	34190	552161	3666060
Chhindwara	5	-	5303	10289	10541	12929	39062	208730
Jabalpur	2	-	-	-	-	413	413	1173
Jhabua	2	-	-	-	33874	22773	56647	154057
Maharashtra	19	5281	48256	227810	365567	2984	649898	4347624
Bhandara	4	5281	13383	166052	256408	689	441813	2907993
Nagpur	15	-	34873	61758	109159	2295	208085	1439631
Odisha	28(5)	37182	40974	189667	257676	40163	565662	2451830
Kendujhar	13(4)	36451	40259	154172	214349	12408	457639	1804911
Sundergarh	15(1)	731	715	35495	43327	27755	108023	646919
Rajasthan	1	-	-	-	7483	-	7483	14963
Banswara	1	-	-	-	7483	-	7483	14963

Figures in parentheses indicate associated mines of iron ore, laterite, limestone, and quartz.

* Only labour reported.

Table – 7 : Production of Manganese Ore, 2010-11 and 2011-12(P)
(By Frequency Groups)

(Quantity in tonnes)

Production Group	No. of mines		Production		Percentage in total Production		Cumulative %	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Total	149(10)	144(8)	3056385	2349300	100.00	100.00	-	-
Up to 1000	67(3)	68(1)	13645	13421	0.45	0.57	0.45	0.57
1001 - 5000	27(3)	31(2)	63936	79008	2.09	3.36	2.54	3.93
5001 - 10000	10	7(1)	70534	61185	2.31	2.60	4.85	6.53
10001 - 20,000	18(2)	15(2)	283473	256056	9.27	10.90	14.12	17.43
20,001 - 30,000	2	2(1)	56200	74888	1.84	3.19	15.96	20.62
30,001 - 40,000	6(1)	5(1)	243206	219429	7.96	9.34	23.92	29.96
40,001 - 50,000	2(1)	2	127545	89978	4.17	3.83	28.09	33.79
50,001 & above	17	14	2197846	1555335	71.91	66.21	100.00	100.00

Figures in parentheses indicate associated mines of iron ore, laterite, limestone, and quartz.

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**Table – 8 (A) : Mine-head Stocks of Manganese Ore at the beginning of 2011-12
(By States and Grades)**

(In tonnes)

State	Grades : Mn content					Total
	MnO ₂	above 46%	35% - 46%	25% - 35%	Below 25%	
India	3769	32723	149011	441982	231268	858753
Andhra Pradesh	–	–	257	38871	11647	50775
Goa	–	-	-	3590	150	3740
Jharkhand	7	233	29	1519	208	1996
Karnataka	–	-	84	22963	96323	119370
Madhya Pradesh	–	18149	17367	88374	81682	205572
Maharashtra	828	6857	63018	72852	11404	154959
Odisha	2934	7484	68256	213813	29854	322341

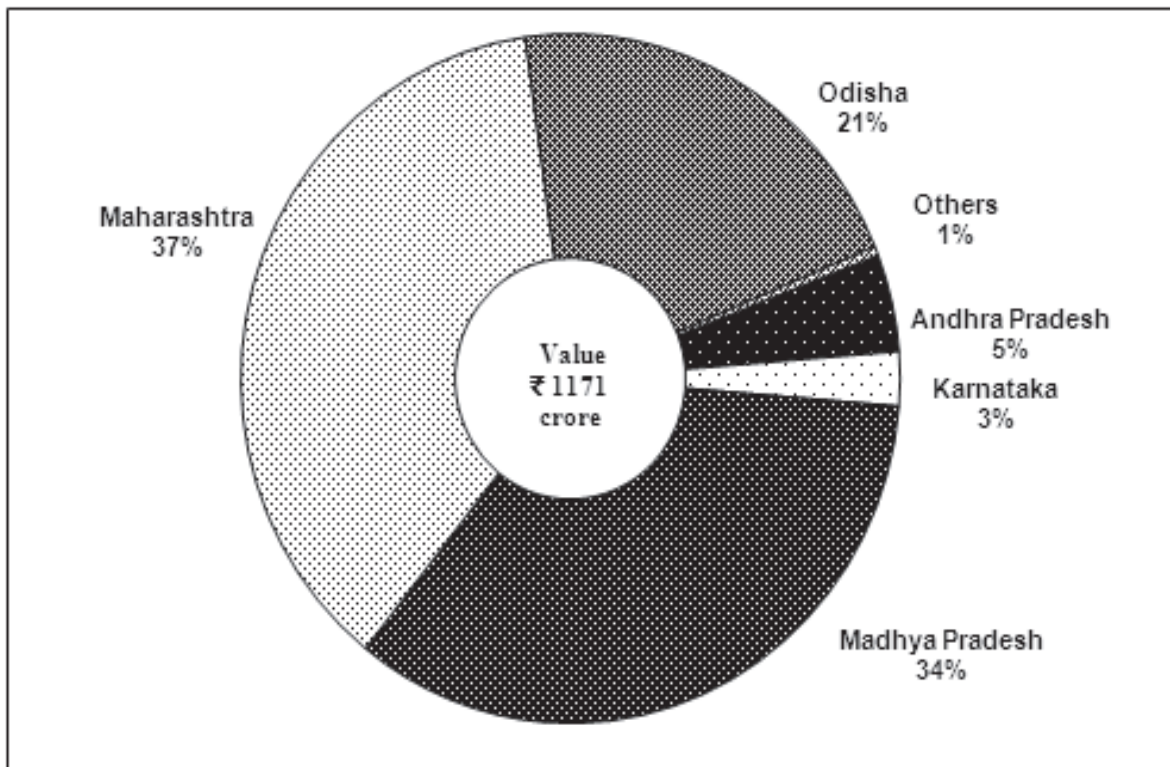
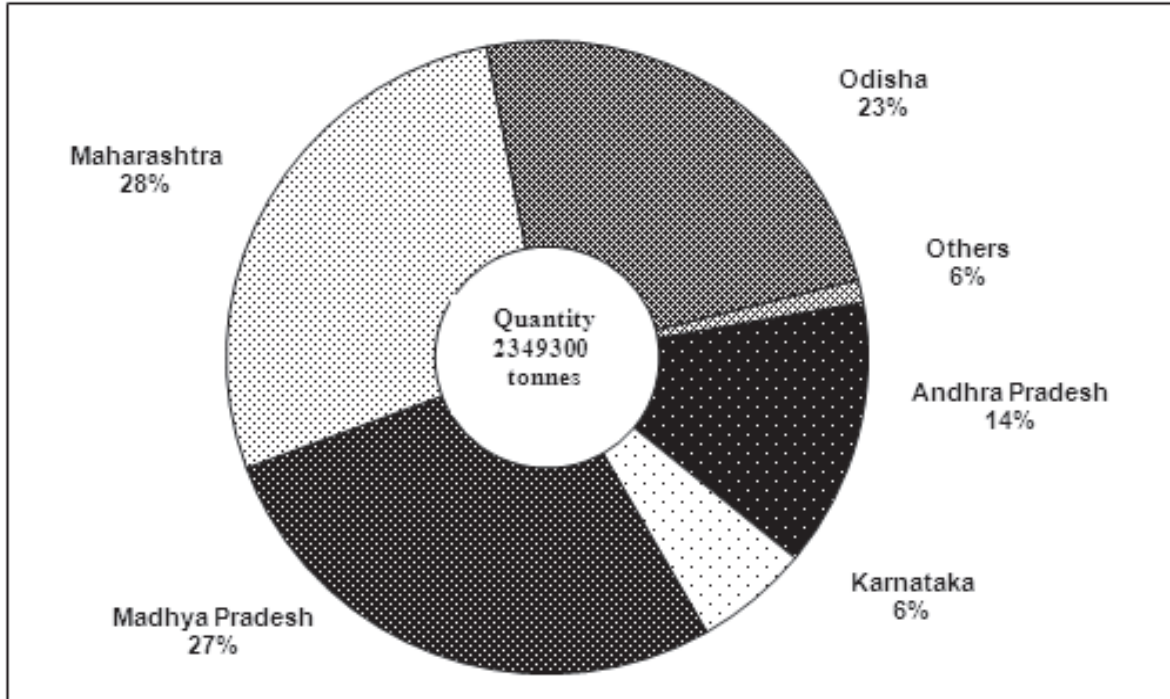
**Table – 8 (B) : Mine-head Stocks of Manganese Ore at the end of 2011-12(P)
(By States and Grades)**

(In tonnes)

State	Grades : Mn content					Total
	MnO ₂	above 46%	35% - 46%	25%-35%	Below 25%	
India	8276	16956	142500	474838	220230	862800
Andhra Pradesh	–	–	107	45551	5396	51054
Goa	–	–	-	1600	-	1600
Jharkhand	7	26	45	3890	1281	5249
Karnataka	–	–	434	53751	87166	141351
Madhya Pradesh	–	5480	20346	47512	65437	138775
Maharashtra	3130	5102	36245	70235	9515	124227
Odisha	5139	6348	85323	251299	51435	399544
Rajasthan	–	–	–	1000	–	1000

MANGANESE ORE

Quantity and Value of Manganese Ore
Production in Different States, 2011-12



MINING, PROCESSING, MARKETING & TRANSPORT

Manganese ore mining in the country is carried out by opencast as well as by underground methods. Of the 149 mines, 8 are underground (3 in Madhya Pradesh and 5 in Maharashtra). Seven underground mines were operated by MOIL, a public sector company, and one by M/s J.K. Minerals, Balaghat (Madhya Pradesh), a private company. All the underground mines are mechanised or semi-mechanised and adopt cut and fill method of stoping. In Kandri mine, hydraulic sand stowing is introduced in place of manual filling system. The system is faster, cheaper and requires less manpower. Conventional timber supports are replaced by cable bolting pre-mining support to increase safety and productivity. In Balaghat underground mechanised mine, overhand flat back cut and fill method with rock bolting support and sand stowing to fill up the voids is being practised with a level interval of 30 m and size of stope block as 30 m x 30 m to 60 m x 30 m. Side Dump Loaders (SDL) of 0.66 cu m bucket capacity were also deployed in underground levels for mechanised loading of run of mine (r.o.m.) in stopes. Tyre mounted Rocker shovel was also introduced in Balaghat mine for mechanised loading of ore from ore drive at stripping area. Deepening of vertical shaft was completed in Balaghat and Beldongri mines of MOIL. Sinking of vertical shafts is in progress at Mansar and Ukwa mines.

The open-pits are worked manually by benching method, using portable compressors, jackhammers and dumper trucks. Tirodi mine of MOIL is worked by opencast mechanised method. Height of the benches in overburden is kept at 7.5 m and that in the ore at 6 m. Drills of 100 mm dia with 0.9 to 1.7 m³ capacity of shovels and 20-25 tonnes dumpers are used for production, loading & transport.

The workings vary from shallow depth in lateritoid-type deposits in Odisha, Karnataka and Goa to deep operations in deposits of a more

regular nature found in Madhya Pradesh, Maharashtra and Andhra Pradesh. Bulldozers are used where the overburden is soft. In a few cases, tramways are laid up to the working face and loaded tubs pushed manually to the dumping ground. In Odisha, Goa and Karnataka, ore is worked by loosening the ground either with crowbars or by blastings. After picking up manganese ore, the waste is removed to the dumping ground. Mining of bedded ore in Madhya Pradesh and Maharashtra is generally carried out by drilling and blasting.

Hand sorting and visual grading are adopted widely to upgrade the ore. Scrubber is also used for washing the ore at some mines. Manual as well as mechanised jigging is done in a few mines.

MOIL has set up an integrated manganese ore beneficiation plant at Dongri Buzurg mine in Bhandara district, Maharashtra, with 4 lakh tonnes annual capacity to process r.o.m. The plant is equipped with handling, crushing, wet screening, drying and magnetic separation facilities in one complex. MOIL has installed a manganese ore beneficiation plant of 500,000 tonnes per annum capacity at Balaghat mine in order to conserve mineral and profitably utilise low/medium grade ore. The plant facilities include crushing, wet screening, classification and jigging operations.

The plant upgrades the low/medium fines into high grade and the value addition is around 3-4 times, in case of low grade fines. The company is planning to set up a sintering plant for agglomeration of these fines. After agglomeration these fines will be utilised in ferro-alloys production.

Most of the producers market manganese ore directly to the industrial units. In a few cases, especially in case of supplies of special type of ore or a semi-processed product, middlemen are found to be involved in marketing. Ore from mines is usually sold to the domestic consumers, either at the rail-head or ex-plant. In case of integrated iron and steel and ferro-manganese industry, the

units draw their supplies largely from captive mines. However, special ore types for specific purposes are obtained from other producers. In case of ore meant for export, producers other than MOIL supply it to MMTC, the canalising agency, either at rail-head or at the port. MOIL exports its own ore.

Transport of manganese ore from mines to rail-head is generally done by trucks from where it is transported to ports by rail wagons. From the mine of MOIL in Balaghat district, Madhya Pradesh, the ore is transported by aerial ropeways to the loading bins at the rail-heads. Battery loco was introduced for underground transport of r.o.m. tub from ore pass chute to skip bunker. In Goa, ore, in bulk, is carried by road-cum-river routes up to Marmugao harbour and in a few cases by rail where the mines are close to the railways. The ore loading at river-head into barges is carried out both manually and mechanically.

ENVIRONMENTAL PROTECTION

MOIL carried out mass afforestation work to maintain ecological balance at mines. R&D work was taken up by them for reclamation of old mined out areas and to ascertain the impact of manganese mining on ecology including air and water pollution. At Gumgaon mine, a sericulture project has been established as a part of socio-economic programme and even on waste debris dumps, a forest has been developed.

Chandrapur ferro-alloys plant of SAIL (formerly Maharashtra Electros melt Ltd) has continuously taken steps towards gainful utilisation of high MnO slag in silico-manganese production, lumpy silico-manganese slag as rail ballast and for road construction as a step towards solid waste management.

Manganism - a health condition attributed to manganese poisoning - has been reported to be detected in case of five persons working with BHP Billiton's Metalloys manganese alloys plant in South Africa. Manganism shows symptoms similar

to Parkinson's disease and psychotic behaviour but conditions of development of the disease are not properly understood.

USES & SPECIFICATIONS

Classification of manganese ore, ferruginous manganese ore, silicious manganese ore, dioxide manganese ore, and manganiferous iron ore is laid down by BIS vide specification no. IS : 11895- 2006 (Reaffirmed 2008). Manganese ore is an important material in iron and steel metallurgy where it is used both in the ore form as such and as ferro-manganese. Manganese improves strength, toughness, hardness and workability of steel, acts as a deoxidiser and desulphuriser and also helps in getting ingots free from blowholes. About 90 to 95% world production of manganese ore is used in metallurgy of iron and steel. Manganese has no satisfactory substitute in its major applications. The specifications of manganese ore by different industries are detailed below:

In iron and steel industry, the BIS:11281-2005(Reaffirmed 2008) specification is laid down for manganese ore. However, specifications based on the user industry indicate that normally manganese ore containing 28 to 35% Mn is used. Ore size generally varies from 10 to 40 mm. For other constituents general stipulations are Fe: 16 to 22%, SiO₂: 2 to 8%, Al₂O₃: 5 to 8% and P: 0.3% maximum.

For manganese ore used in ferro-manganese industry, besides manganese content, other important considerations are high manganese to iron ratio and a very low content of deleterious phosphorus. Specifications of manganese ore for ferro-manganese, are prescribed by the Bureau of Indian Standards vide IS: 4763-2006, Second Revision, Reaffirmed 2010. BIS has also laid down the specifications of manganese ore sinters for blending for ferro manganese production vide IS:12596-1989 (Reaffirmed 2009). User's specifications of manganese ore for ferro-manganese/silico-manganese industries are furnished in Table- 9.

MANGANESE ORE

Table – 9 : User's Specifications of Manganese Ore in different Ferro-manganese/Silico-manganese Units

Name and location of plant	Specifications of ore consumed
Andhra Pradesh Ferro-Alloys Corp. Ltd, Shreeram Nagar, Dist. Vizianagram.	Mn: 70-75% C: 6-8%
Nav Bharat Ferro-Alloys Ltd, Paloncha, Khammam.	Mn: 28-50%, P: 0.1-0.3%, SiO ₂ : 8-30% Fe :5-8%
Chhattisgarh Sarda Energy & Minerals Ltd. Raipur.	Mn: 28-30% (Low P) Mn: 37-40%, 42-44%, 46% (High P)
Monnet Ispat & Energy Ltd, Raipur	Mn: 46 - 28% Fe : 16 - 05% SiO ₂ : 34 - 06% S & P: 0.05 - 0.28% Size: 0 - 100% (lumps & fines)
Hira Power & Steel Ltd., Raipur i) Jain Carbides & Chemicals Ltd, Raipur (Unit-I). ii) Jain Carbides & Chemicals Ltd, Raipur (Unit-II).	Mn: 32-35% Mn: 32-35%
Karnataka S.R. Chemicals & Ferro Alloys, Belgaum. Thermit Alloys Ltd, Shimoga.	Mn: 38-40%, Fe: 18-23% Mn: 48-54%
Kerala INDSIL Hydro Power and Manganese Ltd, Pallatheri Palakkad.	Fe-Mn ratio 1:3 to 5% (50%) 1:5 to 8% (50%) P: 0.05% max Al ₂ O ₃ : 3 to 5% max
Madhya Pradesh MOIL, Ferro-manganese Plant, Bharveli, Dist. Balaghat.	Mn: 46-48%
Maharashtra Chandrapur Ferro Alloys Ltd, (Formerly Maharashtra Electro-Smelt Ltd.) Chandrapur.	Mn: 38-46%, Fe: 6-17% SiO ₂ +Al ₂ O ₃ : 10-16% P: 0.5-0.25% max +100 mm 10% max +10-100 mm, 80-85% min +5-10 mm 10% max
Nagpur Power & Industries Ltd, Nagpur.	Mn: 42-46%, Fe: 7-8%, SiO ₂ : 3.6%, Al ₂ O ₃ : 6-7%, P: 0.10-0.12% Size: 5-25 mm
Natural Sugar & Allied Ind. Ltd, Sai Nagar Ranjani, Dist. Osmanabad	Size: 10-80 mm
Odisha Tata Steel Ltd, Joda, Kendujhar.	Mn: 43%, min. (for FeMn) 36% min. (for SiMn), Size: 10-75 mm (for FeMn & SiMn)
	Captive Mn Ore Size (mm) Below 35% (10-75) + 5% 35% to 46% (10-75) + 5% 46% to 49% (10-75) + 5% Dioxide + 49% (10-75) + 5%
	MOIL, Mn Ore Below 35% (10-75) + 5% Imported Mn 46 to 49% (10-75) + 5%
Tamil Nadu Silcal Metallurgical Ltd, Ramanujanagar, Coimbatore.	Mn: 35-40% & above Size: 35 mm
West Bengal Cosmic Ferro Alloys Ltd, Bankura.	Size: 75 mm

MANGANESE ORE

Manganese dioxide is used for manufacturing dry cell batteries in which it functions as a depolariser of hydrogen. For use in dry cell battery, BIS has prescribed Specification No. IS:11153-1996 (First Revision, Reaffirmed 2010) for manganese dioxide. Suitability of ore depends not only on manganese dioxide content but also on its crystallographic structure. Ore having predominant gamma structure is required. The ore must have high manganese dioxide and low iron contents, a certain degree of porosity and moderate hardness. It should be free from metallic compounds such as copper, nickel, cobalt, arsenic, lead and antimony which are electronegative to zinc (container). The user industry specifications are MnO₂ 70% (min), Fe 6% (max), moisture 4% (max), Cu 0.02% (max) and Ni 0.02% (max). The size requirement lays down that 90% material should pass through 300 mesh and 100% through 100 mesh. User industry specifications for electrolytic manganese dioxide (EMD) used in dry cell battery are MnO₂ 90% (min), Fe (as oxide) 0.05% (max), moisture 4% (max), Pb 0.15% (max) and pH 4.5 to 5.6. The size requirements are same as those for manganese dioxide ore.

In chemical industry, generally high-grade material is used for potassium permanganate. Ore containing MnO₂ 80% (min), SiO₂ 5% (max), Fe₂O₃ 5% (max) and 200 to 250 mesh ore size is used. In glass industry, ore analysing MnO₂ 80% (preferably 86% min), Fe₂O₃ 5% (preferably 0.75% max), SiO₂ 2.8% (max), Al₂O₃ 1.1% (max), BaO 1.3% (max), CaO 0.4% (max) and MgO 0.4% (max) is consumed.

Requirement of manganese dioxide for explosive and pyrotechnic industries as laid down in IS : 5713-1981 (First Revision, Reaffirmed 2011) by BIS is as follows: MnO₂ 80% by mass (min), moisture 1% (max), matter soluble in water 0.2%

(max) and water soluble chlorides (as NaCl) 0.05% (max). There are three types of material with above composition depending upon the particle size: Type A, Type B and Type C. Particle size (max) is 600 micron for Type A, 150 micron for Type B and 74 micron for Type C ore. In addition, grit content should be 1% (max) for Type A ore. For match industry, the MnO₂ content shall be 50% (min).

Pyrolusite is used generally to impart glaze to the pottery and to make coloured bricks. It also finds use as driers for oils, varnishes and paints. Manganese sulphide is used in the manufacture of salts and in calico printing. Manganese chloride is used in cotton textile as a bronze dye. Manganese salts are used in photography and in leather and matchbox industries.

CONSUMPTION

The reported consumption of manganese ore in all industries was about 4 million tonnes in 2011-12 as against 3.37 million tonnes in 2010-11. Silico-manganese (66%) and ferro-manganese (27%) industries together accounted for about 93% consumption followed by iron & steel (6%). The remaining (1%) was shared by battery, chemical, zinc smelter, alloy steel and glass industries (Table-10).

The reported consumption of ferro-manganese in 2011-12 increased to 126 thousand tonnes from 117 thousand tonnes in the previous year. Iron & steel industry was the bulk consumer of ferro-manganese accounting for about 94% consumption in 2011-12. The remaining 6% was consumed in alloy steel, foundry and electrode industries. Consumption of silico-manganese which was 192,356 tonnes in 2010-11 has increased to 216,490 tonnes in 2011-12 (Tables - 11 & 12).

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**Table – 10 : Reported Consumption of Manganese Ore^{1/}, 2009-10 to 2011-12
(By Industries)**

(In tonnes)			
Industry	2009-10	2010-11(R)	2011-12(P)
All Industries	2927500	3370100	4006500
Alloy steel	100(1)	100(1)	100(1)
Battery ^{2/}	14900(6)	14600(6)	14600(6)
Chemical	1600(2)	1600(2)	1600(2)
Ferro-manganese	854700 ^(e)	964800 ^(e)	1072200 ^(e)
Glass	200(3)	200(1)	200(1)
Silico-Manganese	1919700 ^(e)	2235900 ^(e)	2661100 ^(e)
Iron & steel (incl.pelletisation)	134600(17)	151200(20)	255000(21)
Zinc smelters	1700(2)	1700(2)	1700(2)

Figures rounded off.

Figures in parentheses denote the number of units in organised sector reporting* consumption.

(* Includes actual reported consumption and/or estimates made wherever required).

^{1/} Besides, there are a number of SSI units manufacturing ferro-manganese and silico-manganese, data for which are not available. Excludes consumption of manganese ore fines which are used in making sinters which are in turn used in the manufacture of ferro-manganese, data for which are not available.

^{2/} Excludes consumption of indigenous and imported electrolytic manganese dioxide (EMD) which was estimated at about 6,335 tonnes, 6681 tonnes and 6,681 tonnes during 2009-10, 2010-11 and 2011-12, respectively. Also excludes consumption of natural manganese dioxide in the manufacture of EMD.

**Table – 11 : Reported Consumption of Ferro-manganese, 2009-10 to 2011-12
(By Industries)**

(In tonnes)			
Industry	2009-10	2010-11(R)	2011-12(P)
All Industries	118800	117000	125600
Alloy steel	7900(10)	6400(11)	6400(11)
Electrode	500(9)	900(15)	700(17)
Foundry	700(19)	600(18)	600(18)
Iron & steel	109700(14)	109100(15)	117900(15)

Figures rounded off.

Figures in parentheses denote the number of units in organised sector reporting* consumption.

(* Includes actual reported consumption and/or estimates made wherever required).

Table – 12 : Reported Consumption of Silico-manganese, 2009-10 to 2011-12 (By Industries)

Industry	(In tonnes)		
	2009-10	2010-11(R)	2011-12(P)
All Industries	194600	192356	216490
Alloy steel	3100(5)	1909(3)	1965(3)
Foundry	200(3)	150(3)	150(3)
Iron & steel	191300(21)	190297(24)	214375(27)

Figures rounded off.

Figures in parentheses denote the number of units in organised sector reporting consumption.*

(Includes actual reported consumption and/or estimates made wherever required).*

INDUSTRY

Manganese alloy is the largest produced ferro-alloy in the world with a share of about 41% of the global production of ferro-alloys. Manganese is an essential requisite for iron and steel production owing to its capability for sulphur fixing, de-oxidising and good alloying properties. For production of one tonne of ferro-manganese, about 2.6 tonnes of manganese ore, 0.5 tonne of reductant and 3 MWh of electricity inputs are required. As per Indian Ferro Alloys Producers' Association (IFAPA), the total installed capacity of manganese alloys including ferro-manganese/silico-manganese in the country was estimated to be around 2.75 million tonnes per annum.

MOIL had set up a High Intensity Magnetic Separation Plant and 1,000 tpy Electrolytic Manganese Dioxide (EMD) Plant at Dongri Buzurg mine. The plant is under expansion to 1,500 tpy capacity. In 2011-12 about 714 tonnes of EMD was produced as against 805 tonnes in 2010-11. Ferro-manganese plant of 10,000 tonnes per annum capacity has been set up at Bharveli, Balaghat.

Ferro-manganese

The total production of various types of manganese alloys (high carbon ferro-manganese, medium carbon ferro-manganese and low carbon ferro-manganese) in 2011-12, as per Indian Ferro Alloys Producers' Association was about 4.47 lakh tonnes as against 4.02 lakh tonnes in 2010-11.

Silico-manganese

Silico-manganese is a combination of 60-70% Mn, 10-20% silica and about 20% carbon. As per the IFAPA, production of silico-manganese increased to 14.78 lakh tonnes in 2011-12 from 12.42 lakh tonnes in 2010-11. MOIL is considering setting up ferro-manganese and silico-manganese plants through joint venture companies with RINL and SAIL. SAIL & MOIL Ltd will set up 31,000 tpy ferro-manganese and 75,000 tpy silico-manganese plants at Nandini near Bhilai, Chhattisgarh. The other joint venture company RINL and MOIL Ltd will set up a 20,000 tpy ferro manganese and 37,500 tpy silico-manganese plants at Bobbili, Vizianagaram district, Andhra Pradesh.

The major factor driving the production of manganese alloys is high production growth of low nickel austenitic stainless steel with India emerging as the largest producer of this steel where manganese is added substituting the expensive nickel.

Iron & Steel

Iron & steel industry was the second major consumer of manganese ore wherein manganese ore is used directly as a blast furnace feed. Details on consumption, specifications and source of supply of manganese ore to major iron & steel plants in the country in 2010-11 and 2011-12 are given in Table-13.

MANGANESE ORE

Table – 13 : Consumption, Specifications and Source of Supply of Manganese Ore in Different Iron and Steel Plants, 2010-11 and 2011-12

Plant	Production of pig iron/hot metal (tonnes)		Consumption of Mn-ore (tonnes)		Specifications of ore consumed	Source
	2010-11	2011-12	2010-11	2011-12		
Bhilai Steel Plant, Bhilai Nagar, Durg, Chhattisgarh.	Hot metal 5707852	Hot metal 5126000	25656	NA	Size: 25 to 85 mm Mn: 30% min SiO ₂ : 30% max Al ₂ O ₃ : 5% max	MOIL/ Ramtek Goberwahi, Gua Mines SAIL, RMD P: 0.3% max
Bokaro Steel Plant, Bokaro, Jharkhand.	Hot metal 4107760	Hot metal 4012263	NA	NA	Mn: 30% max SiO ₂ +Al ₂ O ₃ : 20.5% max -10 mm -15% max +40 mm -10% max	-
Durgapur Steel Plant, Durgapur, West Bengal.	Hot metal 2143000	Hot metal 2099000	NA	NA	Mn: 30.0% min Fe: 15-28% SiO ₂ : 3.3% max Al ₂ O ₃ : 7.5% max	-
Rourkela Steel Plant, Rourkela, Odisha.	Hot metal 2303000	Hot metal 2309000	NA	NA	-	-
IISCO Steel Plant, Burnpur, Dist. Burdwan, West Bengal.	Hot metal 495000	Hot metal 451000	NA	NA	Mn (dry) 30% (min.) -10 mm - 10.0% max +40 mm - 15% max	-
Visvesvaraya Iron and Steel Ltd, Bhadravati, Shimoga, Karnataka.	Hot metal 131000	Hot metal 118373	NA	NA	-	-
KIOCL Ltd. Pellet Plant, Mangalore, Dakshin Kannad, Karnataka.	Hot metal NA	Hot metal NA	NA	NA	Fe: 25-50% min MnO ₂ : 44% min SiO ₂ +Al ₂ O ₃ : 12% max	Milan Minerals, Karnataka
Visakhapatnam Steel Plant, Visakhapatnam, A.P.	3830000	3778000	6700	11400	Mn: 28%, (min) Fe: 16% SiO ₂ : 25% max Size: 10-60 mm(BF) (-) 10 mm (SP)	Garividi, Andhra Pradesh
IDCOL, Kalinga Iron Works Ltd, Barbil, Kendujhar, Odisha.	Hot metal 15522	Hot metal 18740	518	386	Size: 10-40 mm	From own/ local mines

(Contd.)

MANGANESE ORE

Table - 13 (Concl'd.)

Plant	Production of pig iron/hot metal (tonnes)		Consumption of Mn-ore (tonnes)		Specifications of ore consumed	Source
	2010-11	2011-12	2010-11	2011-12		
Tata Steel Ltd, Jamshedpur, Bihar.	Hot Metal 7502688	Hot metal 7751000	NA	NA	NA	-
Kirloskar Ferrous Industries Ltd, Berinahalli, Koppal, Karnataka.	Pig iron 307265	Pig iron 240899	7666	3095	Mn: 28% min Fe: 20% min SiO ₂ : 8% max Alkalies: 1% max Size: 10 to 40 mm 90% min under & over size: 5% max each	SMIORE, Adarsha Mining Co., Omkaramma
LANCO Industries Ltd, Chittoor, Andhra Pradesh.	Pig iron+ molten metal 180026	NA	NA	NA	NA	NA
Visa Steel Ltd, Kalinganagar, Jajpur, Odisha.	Hot metal 46233	Hot metal NA	302	NA	below 35% Mn Mines	Siljoda
Sunflag Iron & Steel - Co.Ltd, Bhandara.	Hot metal 193992	Hot metal 208224	NA	NA		-
Jaiswal Neco Industries, Ltd, Raipur.	Hot metal 437108	Hot metal 503177	10620	10842	Mn:26-28% Size:10-60 mm	-
Tata Metalliks Ltd, Kharagpur, West Bengal.	Hot metal 306190	Hot metal 287241	8068	7243	NA	NA
JSW Steel Ltd, Salem, Tamil Nadu.	Hot metal 712000	Hot metal 756000	-	46	NA	NA
Rashmi Metaliks, Gokulpur, West Medinipur, West Bengal.	Hot metal 86386	Hot metal 115689	3702	2277	NA	NA
Sona Alloys P. Ltd,	Hot metal NA	Hot metal 231732	NA	3640	NA	NA
Aparent Iron & Steel Pvt.Ltd, Goa.	Pig Iron NA	Pig Iron 86870	1380	2555	NA	NA

Dry Battery

Consumption of manganese dioxide ore in this industry was reported by 6 units which together accounted for 14,600 tonnes in 2011-12, (excluding EMD). The demand was met through imports, supported by indigenous production of manganese dioxide and EMD.

Dry battery industry also consumes EMD along with natural manganese dioxide ore. There is only one plant producing EMD; owned by MOIL in Bhandara district with 1,000 tpy capacity (under expansion to 1,500 tpy capacity).

SUBSTITUTES

Cost and technology militate substitution in major applications. However, for economic reasons, there is only limited substitution in minor applications in chemical and battery industries. The steel industry has, however, made great strides in economising the use of manganese, largely through changes in steel-making techniques.

TECHNICAL POSSIBILITIES

The deep-sea nodules can be a potential resource of manganese in the next century. There is a trend towards using lower grades of ores in ferro-manganese production. New steel-making practices and techniques are reducing the amount of manganese consumed in the process. However, counterbalancing this to some extent is a trend towards higher manganese specifications for modern steels.

TRADE POLICY

Export Policy

The Foreign Trade Policy, 2009-14 and the policy on export puts restrictions on exports of manganese ore as follows:

HS Code	Item description	Policy	Nature of restriction
2602 0000	Manganese ores excluding the following: Lumpy/blended manganese ore with more than 46% Mn	State Trading Enterprise	Exports through (a) MMTC (b) MOIL for manganese ore produced in MOIL mines
2602 0010	Lumpy/blended manganese ore with more than 46% Mn	Restricted	Export permitted under licence

Import Policy

Imports of manganese ore and concentrates including ferruginous manganese ores and concentrates containing 20% or more manganese (calculated on dry weight basis), agglomerated manganese ore sinters, etc. are freely allowed.

WORLD REVIEW

The total world reserve of manganese ore is approximately 630 million tonnes of metal content which is unevenly distributed (Table-14). Reserves are located in South Africa (24%), Ukraine (22%), Brazil (17%), Australia (15%) and India (8%). Only a small fraction of global manganese reserves is clearly economic. This fact continues to support interest in deep-sea manganese nodules, which constitute an enormous untapped resource. Most nodules are found in areas of deep-sea floor at water depths of 5 to 7 km. The Pacific Ocean alone is estimated to contain about 2.5 billion tonnes nodules containing about 25% Mn, making them similar in abundance to low-grade land-based deposits. Most major steel-making nations lack manganese resources. North America had less than 1% world reserves. Besides, United States have lean grade reserves and potentially high extraction cost. This situation has created an active global trade in manganese ore and manganese alloys.

World production of manganese ore in 2011 was estimated to be around 47.3 million tonnes as compared to 41.9 million tonnes in 2010. China was the leading producer contributing about 30% followed by South Africa (18%), Australia (15%), Gabon (7%) and India (5%) (Table-15). The production of manganese ore is linked with the production of steel. The steel industry consumes it in the form of ore and manganese alloys.

China

China was the world's largest consumer of manganese and producer of manganese alloys and electrolytic manganese metal (EMM) in the world. In 2011, China also was leading producer of EMD in the world.

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Japan

Nippon Mining & Metals Co. Ltd started a recycling plant on demonstration scale for used lithium-ion batteries to extract value-bearing metals such as cobalt, lithium, manganese and nickel. The plant in Fukui was expected to recover about 6 tonnes per month of manganese.

Brazil

Vale S A was the leading manganese ore and ferro alloy producer which produced 2.6 million tonnes of manganese ore in 2011 (an increase of about 39%) from previous year.

FOREIGN TRADE

Exports

Exports of manganese ore decreased to about 75 thousand tonnes in 2011-12 from 99 thousand tonnes in 2010-11. Out of the total exports in 2011-12, exports of manganese ore having +46% Mn were 3,3051 tonnes, ore having 30 to 35% Mn were 8,099 tonnes and manganese ore (others) were 34,013 tonnes. Exports were mainly to China (94%) and Bhutan (4%). Exports of manganese oxide (total) increased to 8,972 tonnes in 2011-12, as against 2,885 tonnes in the previous year. Manganese oxide exports in 2011-12 comprised manganese dioxide 1,757 tonnes and other oxides 7,215 tonnes. Exports were mainly to Spain (14%) and Germany (11%). In 2011-12 exports of manganese and alloys (including waste & scrap) decreased to 57 tonnes compared to 143 tonnes in the previous year. Exports of wrought/unwrought manganese alloys in 2011-12 were at 29 tonnes (Tables - 16 to 26).

Imports

Imports of manganese ore increased considerably to about 1.96 million tonnes in 2011-12 from 1.3 million tonnes in 2010-11. South Africa (48%), Australia (29%), Gabon (9%) and Brazil (4%) were the main suppliers of manganese ore in 2011-12. Imports in 2011-12 comprised manganese ore having +46% Mn were 860,032 tonnes, manganese ore having 35 to 46% Mn were 1,070,827 tonnes, manganese ore having 30 to 35 % Mn were 10,253 tonnes and manganese

ore (others) were 20,284 tonnes. In 2011-12, imports of manganese oxides were 6,338 tonnes. Imports of manganese oxides comprised manganese oxide and other than manganese dioxides 941 tonnes. Imports were mainly from China (92%) and South Africa (2%). During 2011-12, imports of manganese & alloys (including waste and scrap) were 15,890 tonnes, out of which manganese alloys (unwrought) comprised 11,830 tonnes and NES 265 tonnes. Imports of manganese & alloys were mainly from China (87%) (Tables - 27 to 36).

Table – 14 : World Reserves of Manganese Ore (By Principal Countries)

(In '000 tonnes of contained metal)

Country	Reserves
World : Total (rounded)	630000
Australia	97000
Brazil	110000
China	44000
Gabon	27000
India*	49000
Kazakhstan	5000
Mexico	5000
South Africa	150000
Ukraine	140000
Other countries	Small

Source: Mineral Commodity Summaries, 2013.

** India's total UNFC resources of manganese ore as on 1.04.2010 are estimated at 430 million tonnes.*

Table – 15 : World Production of Manganese Ore (By Principal Countries)

(In '000 tonnes)

Country	2009	2010	2011
World : Total	34000	41900	47300
Australia	4444	6474	6961
Brazil	2300	2600	3100
China ^(e)	12000	13000	14000
Gabon	1992	3200	3562
Ghana	1013	1194	1828
India*	2492	2881	2387
Kazakhstan	2457	1094	2930
South Africa	4576	7156	8652
Ukraine [@]	932	1589	1590
Other countries	1794	2712	2290

Source: World Mineral Production, 2007-2011.

@ : Marketable

**India's production of manganese ore in 2009-10, 2010-11 and 2011-12 was 2,492 thousand tonnes, 3,056 thousand tonnes and 2,349 thousand tonnes, respectively.*

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**Table – 16 : Exports of Manganese Ore : Total
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	98979	803225	75183	442305
China	78130	419922	71054	370245
Bhutan	19165	365368	2968	44981
Nepal	-	-	982	22808
Italy	25	1231	50	2398
Japan	-	-	86	1132
Malaysia	-	-	21	476
Kenya	-	-	20	228
Chile	-	-	2	37
Other countries	1659	16704	-	-

**Table – 17 : Exports of Manganese Ore
(46% or more Mn)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	16222	289802	33051	129790
China	-	-	30500	82350
Nepal	-	-	982	22785
Bhutan	16147	286225	1517	22220
Italy	25	1231	50	2398
Chile	-	-	2	37
Other countries	50	2346	-	-

**Table – 18 : Exports of Manganese Ore
(35% or more but below 46% Mn)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2250	7552	-	-
China	2250	7552	-	-

**Table – 19 : Exports of Manganese Ore
(30% or more but below 35% Mn)
(By Countries)**

Country	2010- 11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	14858	116554	8099	49763
China	13780	106902	7000	31430
Bhutan	-	-	1099	18333
Other countries	1078	9652	-	-

**Table – 20 : Exports of Manganese Ore (Others)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	67899	396869	34013	262524
China	64350	313021	33554	256466
Bhutan	3018	79142	352	4427
Japan	-	-	86	1132
Malaysia	-	-	21	476
Nepal	-	-	++	23
Other countries	531	4706	-	-

**Table – 21 : Exports of Manganese Oxide : Total
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2885	95474	8972	348457
Spain	263	10474	1246	54453
Germany	-	-	1023	45251
Russia	220	9081	765	30431
Italy	378	13411	700	27511
Thailand	235	10462	546	25558
Indonesia	231	9630	464	19298
UK	50	2043	348	14430
Vietnam	58	2328	312	14246
Australia	25	1333	242	12381
Malaysia	258	7285	390	12112
Other countries	1167	29427	2936	92786

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**Table – 22 : Exports of Manganese Dioxide
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	766	15873	1757	45177
Bangladesh	147	2542	268	4475
USA	43	1463	95	4016
Poland	-	-	75	3834
Italy	-	-	75	3720
Thailand	-	-	51	3231
Spain	-	-	73	3142
Korea, Rep. of	200	2632	146	3075
Saudi Arabia	120	1895	235	2871
Kuwait	52	1265	117	2863
Kenya	48	549	152	2440
Other countries	156	5527	470	11510

**Table – 23 : Exports of Manganese Oxide
(Other than Manganese Dioxide)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	2119	79601	7215	303280
Spain	263	10474	1173	51311
Germany	-	-	1023	45103
Russia	220	9081	765	30431
Italy	378	13411	625	23791
Thailand	235	10462	495	22327
Indonesia	231	9630	433	18345
Vietnam	58	2328	272	12566
UK	50	2043	299	12386
Australia	25	1333	221	11416
Malaysia	255	6341	340	10982
Other countries	404	14498	1569	64622

**Table – 24 : Exports of Manganese & Alloys
(Incl. Waste & Scrap)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	143	118050	57	51592
Korea, Rep. of	++	619	14	19180
Italy	20	23853	5	7202
Brazil	2	2793	2	3139
Saudi Arabia	++	1	6	3043
Singapore	++	550	2	2849
China	-	-	1	2776
Czech Republic	2	2945	2	2158
Romania	++	513	1	2096
Poland	++	123	2	1798
Netherlands	-	-	1	1446
Other countries	119	86653	21	5905

**Table – 25 : Exports of Manganese & Alloys :
(Wrought/Unwrought)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	75	62960	29	42886
Korea, Rep. of	++	608	14	18693
Italy	20	23853	5	7202
Brazil	2	2793	2	3139
China	-	-	1	2776
Singapore	-	-	2	2353
Czech Republic	2	2797	2	2158
Romania	++	513	1	2096
Poland	++	123	1	1329
Germany	29	27504	1	1247
Slovakia	-	-	++	530
Other countries	22	4769	++	1363

**Table – 26 : Exports of Manganese &
Manganese Base Alloys :
(Waste/Scrap)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	-	-	8	467
Malaysia	-	-	8	467

**Table – 27 : Imports of Manganese Ore : Total
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1299643	17813482	1961396	20632696
South Africa	578953	6369494	935987	8535222
Australia	363984	5675871	568498	6446763
Gabon	156036	2702187	172879	2208206
Brazil	54656	929357	70404	806947
China	25905	350860	52253	636768
Ivory Coast	42077	614386	43306	588107
Zambia	10220	178208	22264	315612
Singapore	7403	192663	12308	225727
Burkina Faso	8041	106381	15011	178150
Turkey	13576	147134	16565	141132
Other countries	38792	546941	51921	550062

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**Table – 28 : Imports of Manganese Ore
(46% or more Mn)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	531465	8247614	860032	10178669
Australia	167106	2745065	344830	4116621
South Africa	185923	2371782	254734	2588620
Gabon	94524	1753526	124717	1648813
Brazil	5448	98067	47559	534663
Ivory Coast	15809	257916	25738	366120
China	21183	298209	17965	248479
Zambia	6830	125451	13284	197756
Singapore	7353	191484	6772	179413
Indonesia	7386	75630	4162	73811
Turkey	-	-	6304	59373
Other countries	19903	330484	13967	165000

**Table – 29 : Imports of Manganese Ore
(35% or more but below 46% Mn)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	752600	9386983	1070827	10213710
South Africa	384126	3908413	663593	5809124
Australia	196878	2930807	223668	2330142
Gabon	61512	948661	47212	547599
China	4722	52651	33095	377170
Brazil	48757	828189	22657	271390
Ivory Coast	26268	356470	17568	221987
Burkina Faso	5435	72433	13013	153278
Zambia	2675	40133	8980	117855
USA	-	-	5826	59817
Turkey	10512	113467	6474	53858
Other countries	11715	135759	28742	271490

**Table – 30 : Imports of Manganese Ore
(30% ore or more but below 35%)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	3097	30401	10253	78138
South Africa	2401	25646	4409	35990
Turkey	-	-	3787	27898
Oman	-	-	1971	13345
Philippines	-	-	86	905
Other countries	696	4755	-	-

**Table – 31 : Imports of Manganese Ore (Others)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	12481	148484	20284	162179
South Africa	6503	63653	13251	101488
Oman	-	-	3449	19395
Indonesia	2149	37362	1101	15507
Gabon	-	-	950	11794
China	-	-	1193	11118
Tanzania	-	-	100	1803
Brazil	-	-	188	893
Philippines	-	-	52	177
Turkey	3064	33667	++	3
Other countries	765	13802	++	1

**Table – 32 : Imports of Manganese Dioxide
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	7254	473538	6338	491500
China	7057	451483	5864	440141
South Africa	-	-	142	11367
USA	24	2861	74	9514
Belgium	28	5202	55	8087
Hong Kong	23	1704	50	4420
Germany	10	3380	10	4323
Kuwait	-	-	40	3657
Japan	49	3614	5	2529
France	-	-	24	1854
Myanmar	-	-	25	1834
Other countries	63	5294	49	3774

**Table – 33 : Imports of Manganese Oxide
(Other than Manganese Dioxide)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1709	150331	941	116357
Belgium	717	74767	375	51296
South Africa	338	34201	227	27424
USA	1	802	152	14982
Italy	-	-	40	5142
Germany	9	4280	21	4865
China	195	23105	21	4122
Israel	344	6365	57	3290
Russia	-	-	19	2387
Japan	6	2032	5	1510
Thailand	-	-	20	982
Other countries	99	4779	4	357

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**Table – 34: Imports of Manganese & Alloys
(Incl. Waste & Scrap)
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	13982	2028316	15890	2658100
China	11451	1656069	13898	2278904
UAE	495	59771	440	67880
Hong Kong	660	76766	456	60522
USA	116	60487	67	42997
France	25	18582	54	41091
Japan	24	3010	125	20550
Vietnam	451	61914	125	18953
Germany	6	6108	60	15428
Malaysia	25	3003	100	14668
Italy	-	-	102	14591
Other countries	729	82606	463	82516

**Table – 35 : Imports of Manganese & Alloys :
Unwrought
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	10967	1543355	11830	1937266
China	9662	1332433	10723	1690714
USA	85	51939	66	41679
France	25	18582	54	41091
Hong Kong	60	7409	148	24223
Japan	-	-	125	20550
Malaysia	25	3003	100	14668
Italy	-	-	102	14591
Netherlands	-	-	85	13177
Vietnam	431	59466	75	11138
South Africa	596	58613	35	11070
Other countries	83	11911	317	54365

**Table – 36 : Imports of Manganese
& Alloys, NES :
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	417	74661	265	38911
China	370	52489	252	28963
Germany	6	6108	11	8305
USA	11	6115	1	1318
UK	++	85	1	324
Other countries	30	9864	++	1

FUTURE OUTLOOK

Production of crude steel is the single most important factor in the demand for manganese ore. Steel industry accounts for approximately 90% world demand for manganese. Carbon steel is the principal market accounting for 65 to 70% manganese consumption.

As per the Report of the Working Group for 12th Plan Period (2012-17), Planning Commission of India estimated production of manganese ore would be about 4.56 million tonnes by 2011-12 and 6.70 million tonnes by 2016-17 at 8% growth rate. The apparent consumption is estimated at 7.31 million tonnes by 2016-17 at 8% growth rate.