

55 Manganese Ore

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 ($\text{Mn}_2\text{O}_3 \cdot \text{H}_2\text{O}$, Mn 62.4%); and (iv) braunite ($3\text{Mn}_2\text{O}_3$, 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 (Archeans) of Madhya Pradesh (Balaghat, Chhindwara & Jhabua districts), Maharashtra (Bhandara & Nagpur districts), Gujarat (Panchmahal district), Odisha (Sundergarh district) and with Kodurite Series (Archeans) of Odisha (Ganjam & Koraput districts) and Andhra Pradesh (Srikakulam & Visakhapatnam districts).

RESOURCES

The total resources of manganese ore in the country as on 01.04.2010 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 only 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 about 3% of the total resources (Table - 1).

EXPLORATION & DEVELOPMENT

Details of exploration carried out for manganese ore by various agencies during 2009-10 is given in Table - 2.

PRODUCTION, STOCKS AND PRICES

The production of manganese ore at 2.44 million tonnes during 2009-10 decreased by 13%

as compared to that in the previous year owing to decrease in market demand.

There were 138 reporting mines during the year under review as against 149 in the previous year. Besides manganese ore production was reported by five and seven mines of iron ore in 2009-10 & 2008-09 respectively. In all 85 producers reported production of manganese ore in 2009-10. Five principal producers operating 27 mines contributed 73% of the production. About 66% of the total production was reported by 14 mines, each producing more than 50,000 tonnes per annum, while 20% was contributed by 17 mines (including 2 associate mines) each falling in the production range of 20,000 to 50,000 tonnes. The remaining 14% was reported by 109 manganese and 3 associate mines each producing up to 20,000 tonnes.

In 2009-10, twenty one public sector mines jointly accounted for 46 % of the total production. The contribution of captive mines was 11% of the total production.

As regards gradewise composition of production in 2009-10, 59% of the total production was of lower grade (below 35 % Mn), 26% of medium grade (35-46%Mn) and 13% was of high grade (46% Mn and above). Production of manganese dioxide was 62,903 tonnes (3%) during the year as against 86,491 tonnes (3 %) in the previous year.

The average metal content was 34.86 % Mn in 2009-10 as against 35 % Mn in the previous year.

Madhya Pradesh & Odisha being the leading producing states accounted for 25 % each of the total production in 2009-10. Next in the order of production were Maharashtra (24%) , Karnataka (13%) and Andhra Pradesh(10%). The remaining about 3% of the total production was reported from the states of Gujarat, Goa, Jharkhand and Rajasthan (Tables - 3 to 7).

The mine-head stocks decreased to 618 thousand tonnes at the end of 2009-10 from 827 thousand tonnes at the beginning of the year (Tables - 8(A) and 8(B)).

The average daily employment of labour in manganese ore mines was 13,080 tonnes in 2009-10 as against 13,796 tonnes in the previous year. Prices of manganese ore are furnished in the General Review on "Prices".

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

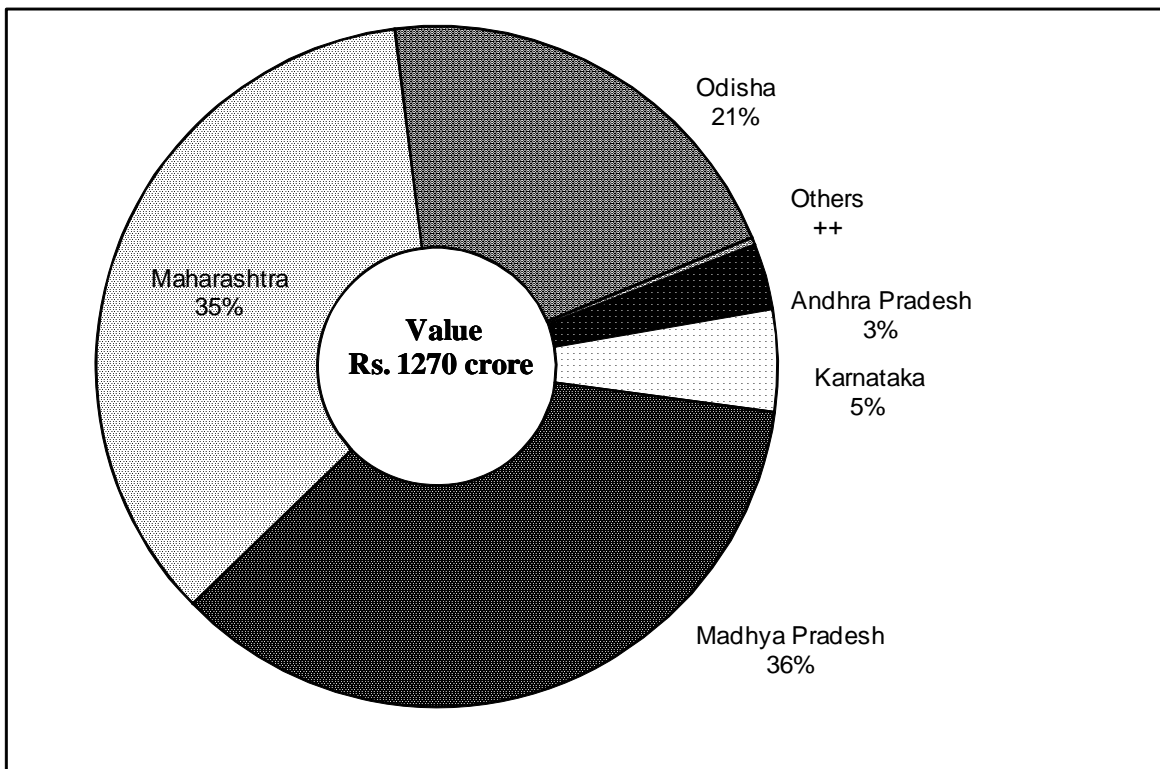
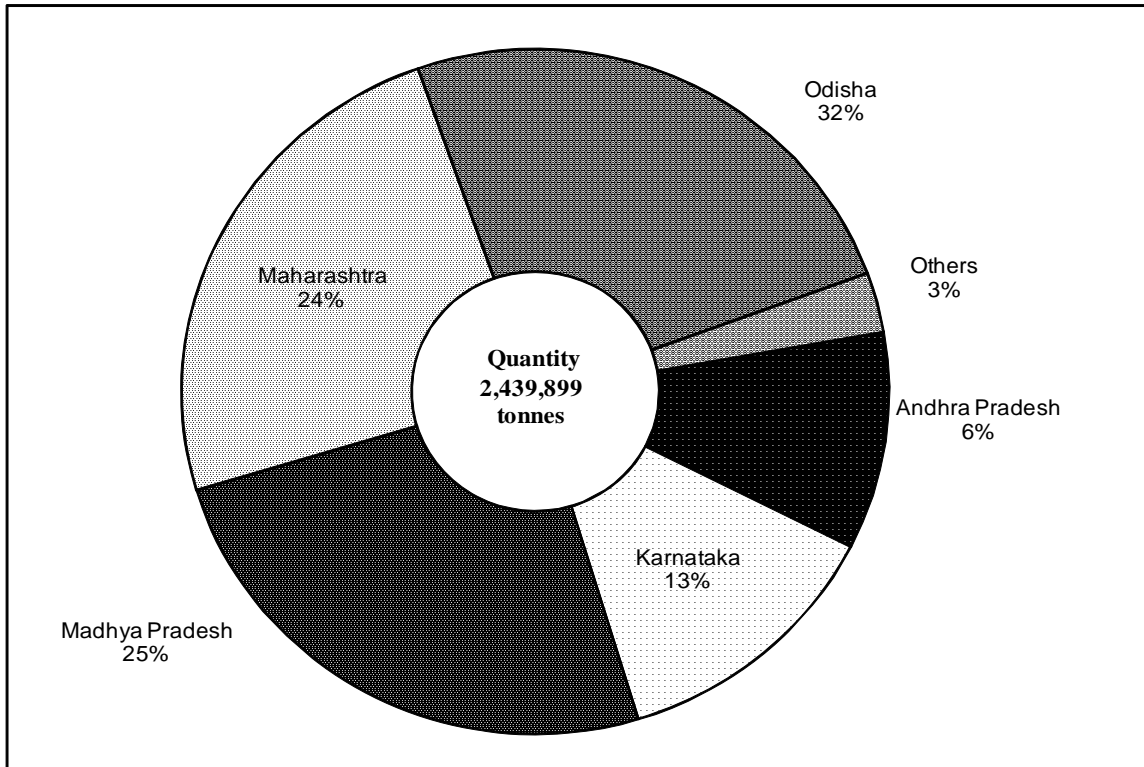
(In '000 tonnes)

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

Figures rounded off.

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Quantity and Value of Manganese Ore Production in Different States, 2009-10



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Table – 2 : Details of Exploration Activities for Manganese Ore, 2009-10

Agency/ State/ District	Location/ Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Geological Survey of India							
Maharashtra							
Nagpur	Parseoni extn. area	-	-	-	-	-	Prospecting (G-3) stage investigation has been carried out in collaboration with Maharashtra State, DGM. The area has been expose intricately folded and faulted sequence of manganese bearing Sausar metasediments associated with Tirodi gneiss of Archaean age. The overall trend of manganese ore bodies was found to be east-west. Pink and white marbles were the host rock for manganese mineralisation. Manganese ore occurs within the marbles as irregular bands and lenses varying in thickness from 0.5-1m. Two manganese ore bands were located in Salavi and Mohagaon blocks. Systematic pitting/trenching and bed rock sampling has been carried out in this block to assess the continuity of manganese ore horizons. The dominant manganese ore mineral are braunite with subordinate pisolomelane/Pyrolusite.
Odisha							
Keonjhar	Damurda South block, Bonai-Kendujhar belt	-	-	09	537.75m	-	Prospecting (G-3) stage investigation has been carried out. The area is covered by ferruginous as well as manganiferrous laterite along with massive and brecciated chert. A no. of abandoned quarries and pits are noticed in the area. The manganese mineralisation is mostly of pocket type and occurs as lensoidal bodies in the laterite profile. Mineralisation along joint and fracture planes were also recorded within brecciated chert. Manganese ore minerals are mostly pyrolusite and pisolomelane. Out of 9 boreholes, 7 boreholes have intersected manganese ore zones. A total cumulative thickness of 60.45 m of manganese ore zones have been intersected. The available chemical assay result indicate that manganese content (Mn) ranges from 9.09% to 45.24% iron (Fe) content varies from 11.35% - 40.15% and phosphorus (P) ranges from 0.04% - 0.70%. On the basis of available chemical analysis data 0.07 million tonnes manganese resources were estimated with an average grade of 30.44% Mn, 24-32% Fe and 0.25% P at 20% Mn cut off grade. Thus, a total of 14.84 million tonnes of manganese resources were estimated at 20% Mn cut off grade. (Contd.)

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Table - 2 (Contd.)

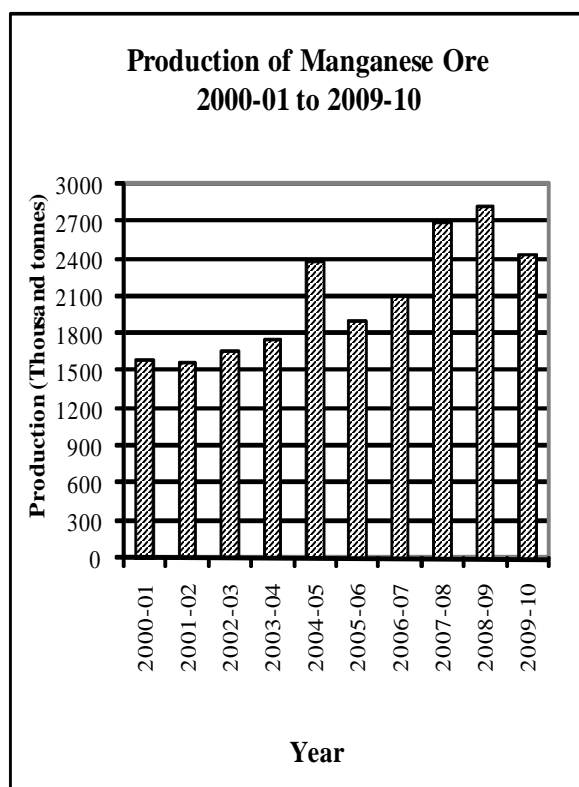
Agency/ State/ District	Location/ Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
Odisha							
Keonjhar	Balagorha- champausahi area	-	-	-	-	-	The area exposes ferruginous as well as manganiferous chert relicts within the manganiferous and ferruginous laterite. Manganese ore bodies are associated with chert bands. A number of abandoned manganese quarries with visible good grade of manganese have been recorded. Two manganese ore bodies have been delineated during detailed mapping. The manganese ore is hard and soft in nature and visual estimate of Mn is 30-35%. Manganese also occurs as fracture and cavity fillings within brecciated chert and within porous and cavernous laterite.
Directorate of Geology Odisha							
Sundergarh	Kusumdihi, N/VRangua Area	1:25,000	32	-	-	32	Three manganese ore occurrences at 1 km WSW of Rangua, West of Rangua and 1.62 km WSW of Rangua were reported.
Keonjhar	Baneikala, Kundurupani and Unchabali- Nayagarh	1:25,000	29.0	-	-	43	Five discontinuous lensoid manganese ore bodies were located in pink shale. The Unchabali Nayagarh block does not contain any manganese ore body. In Baneikala block dimension of lenses varies from 50 to 180 m in length and 2 to 10 m in width.
- do -	Brahmanijhari	1:2,000	0.3	-	-	72	A thin zone of manganese mineralisation (botryoidal forms psilomeal variety) was located within ferruginous shale and it is pockety and patchy in nature.
Directorate of Geology and Mining Maharashtra							
Nagpur	Parseoni Area	1:25,000	37	-	-	-	Manganese exposures were located near Savali and Mohgaon villages. Overall trend of manganese body was found to be East-West dipping 55° due south.
Directorate of Mines and Geology Rajasthan							
Banswara	N/V Karji,Jagta, Rawnt ka Padla & Lithan, Teh. Bagidora	1:50,000 1:10,000	155 10	-	-	17	-
	N/V Muska, Mahuri, Pandwal Chhota, Teh. Kushalgarh	1:50,000 1:10,000 1:2,000	150 10 1	-	-	15	Occurrence of manganese were seen in 200 m strike length with 30 m width.
MOIL Madhya Pradesh							
Balaghat	Tirodi mine Teh - Katangi	-	-	03	188	-	As on 01.04.2010, estimated 1.77 million tonnes of in situ reserves.
	Balaghat mine AT-Bharwelin	-	-	02	1108	-	-

(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		
Bhandara	Dongri Buzurg Mine Teh. Tumsar	-	-	03	660	-	As on 01.04.2010, estimated 11.13 million tonnes of in situ reserves.
	Chikla mine Post - Sitasongi Teh. Tumsar	-	-	02	415.1	-	Estimated 4.33 million tonnes of manganese ore reserves as on 1.04.2010.
Nagpur	Beldongri Mine Teh. Parseoni	-	-	-	-	-	As on 01.04.2009, estimated about 0.45 million tonnes of manganese ore.
	Gumgaon Mine Vill. Teghai Teh. Saoner	-	-	05	903	-	Estimated 5.44 million tonnes of manganese ore resources. as on 01.04.2009.
	Kandri mine/vill Teh. Ramtek Teh. Tumsar	-	-	-	550.50	-	Estimated 4.33 million tonnes of manganese ore reserves as on 01.04.2010.
	Mansar Mine Teh. Ramtek	-	-	02	600	-	Estimated about 3.72 million tonnes of manganese ore resources.



**Table - 3 : Principal Producers of
Manganese Ore, 2009-10**

Name & address of Producer	Location of mine	
	State	District
Manganese Ore (India) Ltd, MOIL Bhavan, 1A, Katol Road, Chhaoni, Nagpur - 440 013, Maharashtra.	Madhya Pradesh Maharashtra	Balaghat 1. Bhandara 2. Nagpur
Tata Steel Ltd, 24, Homi Mody Street, Fort, Mumbai - 400 001.	Odisha	1. Kendujhar 2. Sundergarh
The Orissa Manganese & Minerals (P) Ltd, At Post Koira via, Rourkela - 770 048, Dist. Sundergarh, Odisha.	Odisha	Sundergarh
The Sandur Manganese & Iron Ores Ltd, Lakshmipur, Sandur, Dist. Bellary, Karnataka.	Karnataka	Bellary
Mangilal Rungta, Rungt House, P.O. Chaibasa - 833 201, Dist. West Singhbhum, Jharkhand.	Odisha	Kendujhar

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Table – 4 : Principal Producers of Manganese Dioxide, 2009-10

Name & address of Producer	Location of mine	
	State	District
Manganese Ore (India) Ltd, MOIL Bhavan, 1A, Katol Road, Chhaoni, Nagpur – 440 013, Maharashtra.	Maharashtra	Bhandara
Tata Steel Ltd, 24, Homi Mody Street, Fort, Mumbai – 400 001.	Odisha	Kendujhar
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
Orissa Mineral Development Co Ltd. P.O. Thakurani – 758 035, Via Barbil, Dist. Kendujhar, Odisha.	Odisha	Kendujhar

**Table – 5 : Production of Manganese Ore, 2007-08 to 2009-10
(By States)**

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

State	2007-08		2008-09		2009-10(P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India	2696980	12060370	2789025	17737032	2439899	12695427
Andhra Pradesh	140963	170175	184552	307092	250416	395447
Goa	580	493	1170	2776	570	1143
Gujarat	–	–	–	–	54733	25370
Jharkhand	12048	10079	16044	14025	5558	5815
Karnataka	351889	432648	332686	638173	312649	618131
Madhya Pradesh	673999	4140929	726114	6234950	611128	4516107
Maharashtra	848267	5151240	680629	7364783	592417	4482685
Odisha	667780	2153715	839930	3163383	603985	2638064
Rajasthan	1454	1091	7900	11850	8443	12665

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Table – 6 (A) : Gradewise Production of Manganese Ore, 2008-09
(By Sectors/States/Districts)

(Quantity in tonnes; value in Rs. '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(7)	86491	349258	763226	1323453	266597	2789025	17737032
Public sector	22	21963	288496	312774	524587	8400	1156220	129269633
Private sector	127(7)	64528	60762	450452	798866	258197	1632805	4810069
Andhra Pradesh	38	–	–	8200	153731	22621	184552	307092
Adilabad	11	–	–	–	–	20821	20821	52248
Vizianagaram	27	–	–	8200	153731	1800	163731	254844
Goa	2	–	–	250	920	–	1170	2776
South Goa	2	–	–	250	920	–	1170	2776
Gujarat	1	–	–	–	–	–	–	–
Panchmahal	1	–	–	–	–	–	–	–
Jharkhand	2(1)	–	–	5092	10952	–	16044	14025
Singbhum West	2(1)	–	–	5092	10952	–	16044	14025
Karnataka	17	–	–	99016	215172	18498	332686	638173
Bellary	9	–	–	99016	164581	–	263597	342098
Chitradurga	2	–	–	–	1301	–	1301	1842
Davangere	2	–	–	–	42818	18498	61316	264453
Shimoga	1	–	–	–	364	–	364	255
Tumkur	3	–	–	–	6108	–	6108	29525
Madhya Pradesh	28	–	225491	100955	267204	132464	726114	6234950
Balaghat	23	–	217823	87413	210780	21395	537411	5880849
Chhindwara	3	–	7668	13542	17596	9006	47812	127101
Jabalpur**	1	–	–	–	–	–	–	–
Jhabua	1	–	–	–	38828	102063	140891	227000
Maharashtra	17	20863	79875	248234	318365	13292	680629	7364783
Bhandara	2	20863	41333	186893	207793	–	456882	5146866
Nagpur	15	–	38542	61341	110572	13292	223747	2217917
Odisha	43(6)	65628	43892	301479	349209	79722	839930	3163383
Keonjhar	24(6)	64977	39774	169443	176981	17797	468972	2054528
Sundergarh	19	651	4118	132036	172228	61925	370958	1108855
Rajasthan	1	–	–	–	7900	–	7900	11850
Banswara	1	–	–	–	7900	–	7900	11850

\$ Figures in parentheses indicate associated mines of iron ore.

** Production not reported, only labour reported.

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Table – 6 (B) : Gradewise Production of Manganese Ore, 2009-10 (P)
(By Sectors/States/Districts)

(Quantity in tonnes; value in Rs. '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	138(5)	62903	312485	630188	1231683	202640	2439899	12695427
Public sector	21	13557	274569	311266	472626	54733	1126751	83248075
Private sector	117(5)	49346	37916	318922	759057	147907	1313148	4370620
Andhra Pradesh	32	-	-	10470	216222	23724	250416	395447
Adilabad	10	-	-	-	-	11874	11874	32538
Vizianagaram	22	-	-	10470	216222	11850	238542	362909
Goa	2	-	-	100	470	-	570	1143
South Goa	2	-	-	100	470	-	570	1143
Gujarat	1	-	-	-	54733	-	54733	25370
Panchmahal	1	-	-	-	54733	-	54733	25370
Jharkhand	3(1)	80	150	1280	1943	2105	5558	5815
Singbhum West	3(1)	80	150	1280	1943	2105	5558	5815
Karnataka	19	-	-	71385	224290	16974	312649	618131
Bellary	10	-	-	71385	178825	-	250210	515065
Chitradurga	4	-	-	-	2050	2139	4189	4203
Davangere	2	-	-	-	36179	14750	50929	74270
Shimoga	1	-	-	-	136	85	221	275
Tumkur	2	-	-	-	7100	-	7100	24318
Madhya Pradesh	25	-	216125	89156	259233	46614	611128	4516107
Balaghat	23	-	216125	89156	205840	19453	530574	4097206
Chhindwara	1	-	-	-	1558	-	1558	3115
Jhabua	1	-	-	-	51835	27161	78996	415786
Maharashtra	15	13557	65236	252311	257961	3352	592417	4482685
Bhandara	2	13557	42280	173723	183625	-	413185	3172380
Nagpur	13	-	22956	78588	74336	3352	179232	1310305
Odisha	40(4)	49266	30974	205486	263121	55138	603985	2638064
Keonjhar	21(3)	48698	30418	117337	122923	3966	323342	1485968
Sundergarh	19(1)	568	556	88149	140198	51172	280643	1152096
Rajasthan	1	-	-	-	8443	-	8443	12665
Banaswara	1	-	-	-	8443	-	8443	12665

Figures in parentheses indicates associated mines of iron ore.

Table – 7 : Production of Manganese Ore, 2008-09 and 2009-10(P)
(By Frequency Groups)

(Quantity in tonnes)

Production Group	No. of mines		Production		Percentage in total Production		Cumulative %	
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Total	149(7)	138(5)	2789025	2439899	100.00	100.00		
Up to 1000	48(1)	49(1)	16629	16192	0.60	0.66	0.60	0.66
1001 - 5000	41(2)	40(2)	108808	106314	3.90	4.36	4.50	5.02
5001 - 10000	16	9	113049	64905	4.05	2.66	8.55	7.68
10001 - 20,000	19(3)	11	268065	156992	9.61	6.43	18.16	14.11
20,001 - 30,000	4	7(1)	93240	162500	3.34	6.66	21.50	20.77
30,001 - 40,000	3(1)	5(1)	101134	180795	3.63	7.41	25.13	28.18
40,001 - 50,000	4	3	179283	136811	6.43	5.61	31.56	33.79
50,001 & above	14	14	1908817	1615390	68.44	66.21	100.00	100.00

Figures in parentheses indicate associated mines of iron ore.

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**Table – 8 (A) : Mine-head Stocks of Manganese Ore at the beginning of 2009-10
(By States and Grades)**

(In tonnes)

State	Grades : Mn content					Total Quantity
	MnO ₂	above 46%	35% - 46%q	25% - 35%	Below 25%	
India	18311	61362	171152	322248	253991	827064
Andhra Pradesh	–	–	7137	28984	2608	38729
Goa	–	128	250	1839	300	2517
Gujarat	–	–	–	–	87659	87659
Jharkhand	–	34	844	5216	112	6206
Karnataka	–	615	–	37889	44947	83451
Madhya Pradesh	–	24403	19943	31312	91466	167124
Maharashtra	10057	23029	41328	45877	11381	131672
Odisha	8254	13153	101650	168994	15518	307569
Rajasthan	–	–	–	2137	–	2137

**Table – 8 (B) : Mine-head Stocks of Manganese Ore at the end of 2009-10 (P)
(By States and Grades)**

(In tonnes)

State	Grades : Mn content					Total Quantity
	MnO ₂	above 46%	35% - 46%q	25% - 35%	Below 25%	
India	7592	24413	119947	243924	222610	618486
Andhra Pradesh	–	–	257	26950	9431	36638
Goa	–	–	200	1075	568	1843
Jharkhand	1	44	81	3918	461	4505
Karnataka	–	–	180	23836	79392	103408
Madhya Pradesh	–	9193	10461	24715	102270	146639
Maharashtra	4577	6739	16885	14805	9612	52618
Odisha	3014	8437	91883	145596	20876	269806
Rajasthan	–	–	–	3029	–	3029

MINING, PROCESSING, MARKETING & TRANSPORT

Manganese ore mining in the country is carried out by opencast as well as by underground methods. Of the 130 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 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.

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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. The workings vary from shallow depth in lateritoid-type deposits in Odisha, Karnataka, Goa and Bihar to deep operations in deposits of a more regular nature found in Madhya Pradesh, Maharashtra and Andhra Pradesh. Where the overburden is soft, bulldozers are used. 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 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 will upgrade the low/medium fines into high grade and the value addition in terms of value would be 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 commissioning of the beneficiation plant. The agglomerated 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.

MOIL has planted about 17.14 lakh saplings till 2010-11 including 53,000 saplings during 2010-11 at different mines. The major species planted are Shishum Cassia, Teak, Neem, Eucalyptus and Mangoes. A drive has been initiated for plantation of jatropa saplings in arid/dry and waste dumps, whose seeds will be utilised for production of bio-fuels on trial basis.

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Maharashtra Electros melt Ltd (MEL) 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

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: 11281-1985 (Reaffirmed 2003) specification is laid down for manganese ore. 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, according to the Bureau of Indian Standards (IS : 4763-1982) are given in Table -9. User's specifications of manganese ore for ferro manganese/ silico manganese industries are furnished in Table-10.

Table – 9 : Indian Standard Specifications of Manganese Ore for Ferro-manganese (IS: 4763-1982, First Revision, Reaffirmed 2003)

Constituent	Grade-I	Grade-II	Grade-III	Grade-IV	Grade-V	Grade-VI
Mn	48% & above	46-48%	44-46%	42-44%	40-42%	38-40%
Fe (max)	7%	8%	10%	11%	13%	15%
SiO ₂ (max)	7.5%	9%	10%	11%	12%	13%
Al ₂ O ₃ (max)	2%	3%	3.5%	4%	5%	6%
SiO ₂ +Al ₂ O ₃ (max)	8%	10%	10%	12%	13%	15%
Mn:Fe ratio (min)	7	6	4.5	3.5	3	2.5

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Table – 10 : 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. Nav Bharat Ferro-Alloys Ltd, Paloncha, Khammam.	Mn : 70-75% C : 6-8% Mn : 30-50%
Chhattisgarh Chhattisgarh Electricity Co. Ltd, Siltara, Raipur. Monnet Ispat & Energy Ltd, Raipur	Mn : 28-30% (Low P) Mn:37-40%, 42-44%, 46% (High P) Mn : 46 - 28% Fe : 16 - 05% SiO ₂ : 34 - 06% S & P : 28 - 01% Size : 0 - 100% (lumps & fines)
Hira Group of Industries, 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 : 44 - 52% 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 Maharashtra Electro-Smelt Ltd, Chandrapur. Nagpur Power & Industries Ltd, Nagpur.	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 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, Keonjhar.	Mn : 43%, min. (for FeMn) 36% min. (for SiMn), Size : 10-75 mm (for FeMn & SiMn)
Tamil Nadu Silcal Metallurgical Ltd, Ramanujanagar, Coimbatore.	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%
West Bengal Cosmic Ferro Alloys Ltd, Bankura.	MOIL, Manganese Below 35% (10-75) + 5% Imported Mn 46 to 49% (10-75) + 5% Mn : 35-40% & above Size : 35 mm Size : 75 mm

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Phosphorus in different grades shall be 0.08% for low grade, 0.08 to 0.15% for medium grade and more than 0.15% for high grade.

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 2003) for manganese dioxide and No. IS:15063-2001 for use in alkaline cells. 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 pyrotechnic industries as laid down in IS : 5713-1981 (First Revision, Reaffirmed 1999)

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 3.02 million tonnes in 2009-10 as against 2.7 million tonnes in 2008-09. Silico-manganese (62%) and ferro-alloys (31%) industries together accounted for about 93% consumption followed by iron & steel (3%) and sponge iron (2%). The remaining (2%) was shared by battery, chemical, zinc smelter, alloy steel, glass, ceramic and abrasive industries (Table-11).

The reported consumption of ferro-manganese in 2009-10 increased to 130 thousand tonnes from 122 thousand tonnes in the previous year. Iron & steel industry was the bulk consumer of ferro-manganese accounting for about 92% consumption in 2009-10. The remaining 8% was consumed in alloy steel, foundry and electrode industries. Consumption of silico-manganese which was 196,185 tonnes in 2008-09 has marginally increased to 201,639 tonnes in 2009-10 (Tables - 12 & 13).

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**Table – 11 : Reported Consumption of Manganese Ore^{1/}, 2007-08 to 2009-10
(By Industries)**

(In tonnes)			
Industry	2007-08	2008-09(R)	2009-10(P)
All Industries	2496200	2747100	3024700
Alloy steel	100(1)	100(1)	100(1)
Battery ^{2/}	29700(7)	29700(7)	29700(7)
Chemical	2500(4)	2500(4)	2500(4)
Ferro-alloys	763200(21)	1007800(26)	952000(26)
Silico-Manganese	1545500(e)	1521800(e)	1881400(e)
Sponge iron	45,600(1)	90600(3)	60300(3)
Iron & steel (incl pelletisation)	153400(11)	183200(15)	156900(15)
Zinc smelters	1700(3)	1700(3)	1700(3)
Others (Ceramic, glass, abrasive)	100(5)	300(6)	400(6)

Figures rounded off.

Data collected on non-statutory basis.

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 5,500 tonnes each during 2006-07, 2007-08 and 2008-09, respectively. Also excludes consumption of natural manganese dioxide in the manufacture of EMD.

**Table – 12 : Reported Consumption of
Ferro-manganese, 2007-08 to 2009-10
(By Industries)**

(In tonnes)			
Industry	2007-08 (R)	2008-09(R)	2009-10(P)
All Industries	119600	121800	130000
Alloy steel	8200(14)	8200(14)	8200(14)
Electrode	500(14)	500(14)	500(14)
Foundry	1100(29)	1100(30)	1100(30)
Iron & steel	109800(14)	112000(14)	120200(14)

Figures rounded off.

Data collected on non-statutory basis.

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

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

Table – 13 : Reported Consumption of Silico-manganese, 2007-08 to 2009-10 (By Industries)

(In tonnes)			
Industry	2007-08(R)	2008-09(R)	2009-10(P)
All Industries	189800	196200	201700
Alloy steel	3200(6)	3100(6)	3100(6)
Foundry	100(3)	200(4)	200(4)
Iron & steel	186500(16)	192900(19)	198400(20)

Figures rounded off.

Data collected on non-statutory basis.

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 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 2.1 million tonnes per annum.

MOIL had set up a High Intensity Magnetic Separation Plant and 1,300 tpy Electrolytic Manganese Dioxide (EMD) Plant at Dongri Buzurg mine. The plant is under expansion to 1,500 tpy capacity. In 2009-10 about 1,150 tonnes of EMD was produced as against 1,240 tonnes in 2008-09. Ferro-manganese plant of 10,000 tonnes per annum capacity has been set up at Bharveli, Balaghat. It produced 9,555 tonnes ferro-manganese in 2009-10 as against 10,120 tonnes in 2008-09. MOIL is also setting up a 100,000 tpy capacity ferro-manganese/silico-manganese plant at Bhilai in collaboration with SAIL.

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 2009-10, as per Indian Ferro Alloys Producers' Association was about 3.89 lakh tonnes as against 3.85 lakh tonnes in 2008-09.

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 11 lakh tonnes in 2009-10 from 8.91 lakh tonnes in 2008-09. MOIL is contemplating to set up two furnaces of 16.5 MVA capacity each, one for ferro-manganese and other for silico-manganese plant at Balaghat mine.

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 2008-09 and 2009-10 are given in Table-14.

Dry Battery

Consumption of manganese dioxide ore in this industry was reported by 7 units which together accounted for 29,700 tonnes in 2009-10, (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 are two plants producing EMD; one owned by MOIL in Bhandara district with 1,300 tpy capacity (under expansion to 1,500 tpy capacity) and the erstwhile Union Carbide Ltd at Thane, Maharashtra, with 2,500 tpy capacity.

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Table – 14 : Consumption, Specifications and Source of Supply of Manganese Ore in Different Iron and Steel Plants, 2008-09 and 2009-10

Plant	Production of pig iron/hot metal (tonnes)		Consumption of Mn-ore (tonnes)		Specifications of ore consumed	Source
	2008-09	2009-10	2008-09	2009-10		
Bhilai Steel Plant, Bhilai Nagar, Durg, Chhattisgarh	Hot metal 5387180	Hot metal 5370002	4066	7119	Size : 25 to 85 mm Mn : 30% min SiO ₂ : 30% max Al ₂ O ₃ : 5% max P : 0.3% max	MOIL/Ramtek Goberwahi, Gua Mines SAIL
Bokaro Steel Plant, Bokaro, Jharkhand.	Hot metal 4020992	Hot metal 4065568	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 2111127	Hot metal 2173953	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 2200928	Hot metal 2267765	2106	NA	–	–
Visvesvaraya Iron and Steel Ltd, Bhadravati, Shimoga Karnataka.	Hot metal 125343	Hot metal 125969	NA	NA	–	–
KIOCL Pellet Plant Mangalore, Dakshin Kannad, Karnataka	Hot metal 118000	Hot metal 62150	2421	2085	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.	3546000	3900000	20400	14700	Mn : 28%, (min) Fe : 16% SiO ₂ : 25% max Size : 10-60 mm(BF) (-) 10 mm (SP)	Garividi, Andhra Pradesh
IISCO Steel Plant Burnpur, Dist. Burdwan. West Bengal.	Hot metal 597729	Hot metal 502133	605	1363	Mn (dry) 30% (min.) -10 mm - 10.0% max +40 mm - 15% max	
IDCOL, Kalinga Iron Works Ltd, Barbil, Keonjhar, Odisha.	Hot metal NA	Hot metal NA	NA	NA	Size : 10-40 mm	From own/ local mines
Kirloskar Ferrous Industries Ltd, Berinahalli, Koppal, Karnataka.	Pig iron NA	Pig iron NA	NA	NA	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	Hot metal 148433	Hot metal 158503	2110	2208	NA	NA
Visa Steel Ltd., Kalinganagar Jajpur, Odisha	Hot metal 99909	Hot metal 170040	987	690	below 35% Mn	Siljoda Mines
Tata Steel Jamshedpur, Bihar	NA	Hot metal 7231424	NA	NA	NA	–

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, counter balancing 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:

Item description	Policy	Nature of restriction
1) 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
2) Lumpy/blended manganese ore with more than 46% Mn	Restricted	Export permitted under licence

Import Policy

The Foreign Trade Policy, and the import policy is as follows:

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 540 million tonnes of metal content which is unevenly distributed (Table-15). Reserves are located in Ukraine (26%), South Africa (24%), Australia (16%) and India and Gabon (10% each). 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 2009 was estimated to be around 33.4 million tonnes as compared to 38.2 million tonnes in 2008. China was the leading producer contributing about 36% followed by South Africa (14%), Australia (13%), India and Kazakhstan (7% each) (Table-16). 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 2009 China also was leading producer of EMD in the world.

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.

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

(In '000 tonnes of contained metal)

Country	Reserves
World : Total (rounded)	540000
Australia	87000
Brazil	29000
China	40000
Gabon	52000
India*	56000
Mexico	4000
South Africa	130000
Ukraine	140000
Other countries	Small

Source: Mineral Commodity Summaries, 2010.

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

**Table – 16 : World Production of
Manganese Ore
(By Principal Countries)**

(In '000 tonnes)

Country	2007	2008	2009
World : Total	35900	38200	33400
Australia	5289	4819	4444
Brazil	1866	2400	1700
China ^(e)	10000 ^(e)	11000 ^(e)	12000 ^(e)
Gabon	3334	3250	2000
Ghana	1173	1090	1045
India*	2697	2829	2396
Kazakhstan	2482	2485	2457
South Africa	5995	6808	4576
Ukraine [@]	1720	1447	1000 ^(e)
Other countries	1344	2072	1782

*Source: World Mineral Production, 2005-2009.**@ : Marketable*

*India's production of manganese ore in 2007-08, 2008-09 and 2009-10 was 2,697 thousand tonnes, 2,789 thousand tonnes and 2,440 thousand tonnes, respectively.

FOREIGN TRADE

Exports

Exports of manganese ore increased to about 289 thousand tonnes in 2009-10 from 205 thousand tonnes in 2008-09. Out of the total exports in 2009-10, exports of manganese ore having +46% Mn were 3,371 tonnes, ore having 30 to 35% Mn were 104,737 tonnes and manganese ore (others) were 161,660 tonnes. Exports were mainly to China (87%) Japan (11%) and Bhutan (2%). Exports of manganese oxide (total) marginally increased to 1,313 tonnes in 2009-10, as against 1,191 tonnes in the previous year. Manganese oxide exports in 2009-10 comprised manganese dioxide 458 tonnes and other oxides 855 tonnes. Exports were mainly to Italy (19%) and Malaysia (17%). In 2009-10, exports of manganese and alloys (including waste & scrap) decreased to 68 tonnes compared to 267 tonnes in the previous year. Exports of un-wrought manganese alloys in 2009-10 were at 23 tonnes (Tables - 17 to 27).

Imports

Imports of manganese ore decreased to about 798 thousand tonnes in 2009-10 from 852 thousand tonnes in 2008-09. South Africa (45%), Australia (28%), Gabon (11%) and Brazil (9%) were the main suppliers of manganese ore in 2009-10. Imports in 2009-10 comprised manganese ore having +46% Mn were 283,146 tonnes, manganese ore having 35 to 46% Mn were 512,498 tonnes, manganese ore having 30 to 35% Mn were 299 tonnes and manganese ore (others) were 1,990 tonnes. In 2009-10, imports of manganese oxides were 7,154 tonnes. Imports of manganese oxides comprised manganese dioxide 5,941 tonnes and other oxides 1,213 tonnes. Imports were mainly from China (82%) and Belgium (8%). During 2009-10, imports of manganese & alloys (including waste and scrap) were 11,214 tonnes, out of which manganese alloys (wrought and unwrought) comprised 11,149 tonnes and NES 65 tonnes. Imports of manganese & alloys were mainly from China (Tables - 28 to 40).

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**Table – 17 : Exports of Manganese Ore : Total
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	205424	1206074	289468	1167004
China	156995	802302	251065	898910
Japan	22500	224665	31500	145637
Bhutan	22800	148334	6903	118273
Nepal	27	9496	++	4100
USA	2	23	++	47
Chinese Taipei/ Taiwan	-	-	++	37
Korea, Rep. of	2094	10021	-	-
Nigeria	1000	11139	-	-
Pakistan	6	94	-	-

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

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	4212	104668	3371	59208
Bhutan	4185	104652	3371	59208
Nepal	27	16	-	-

**Table –19 : Exports of Manganese Ore
(35% or more but below 46% Mn)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	1344	7631	-	-
Korea, Rep. of	1344	7631	-	-

**Table – 20 : Exports of Manganese Ore
(30% or more but below 35% Mn)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	68122	506401	104737	402400
China	45616	281642	97997	375049
Japan	22500	224665	6300	20246
Bhutan	-	-	440	7105
Pakistan	6	94	-	-

**Table – 21 : Exports of Manganese Ore (Others)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	131746	587374	161660	650669
China	111379	520660	133368	469134
Japan	-	-	25200	125391
Bhutan	18615	43682	3092	51960
Nepal	++	9480	++	4100
U S A	2	23	++	47
Chinese Taipei/ Taiwan	-	-	++	37
Korea, Rep. of	750	2390	-	-
Nigeria	1000	11139	-	-

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

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	1191	48209	1313	31394
Italy	155	6884	250	6502
Malaysia	151	5021	226	5597
Saudi Arabia	140	10050	100	4611
Nepal	22	796	74	2243
Korea, Rep. of	289	8615	96	1441
Kenya	101	3121	90	1407
UAE	59	2236	54	1310
Indonesia	62	3819	24	853
Tanzania	47	1513	32	391
Korea, Dem. People's Rep. of	20	2206	-	-
Other countries	145	3948	367	7039

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

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	202	6841	458	10213
Nepal	20	760	70	2124
Kenya	74	794	88	1331
UAE	28	1680	54	1298
Korea, Rep. of	46	1022	90	1177
Sri Lanka	1	8	45	997
Indonesia	25	2187	24	853
Russia	-	-	24	736
Thailand	-	-	26	707
USA	7	173	1	434
Bangladesh	-	-	21	251
Other countries	1	217	15	305

**Table – 24 : Exports of Manganese Oxide
(Other than Manganese Dioxide)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	989	41368	855	21181
Italy	155	6884	250	6502
Malaysia	151	5021	226	5597
Saudi Arabia	140	10050	100	4607
Tanzania	47	1513	22	318
Korea, Rep. of	243	7593	6	264
Kenya	27	2327	2	76
Yemen Republic	35	953	2	65
Chinese Taipei/ Taiwan	25	1003	-	-
Indonesia	37	1632	-	-
Korea, Dem. People's Rep. of	20	2206	-	-
Other countries	109	2186	247	3752

**Table – 25 : Exports of Manganese & Alloys
(Incl. Waste & Scrap)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	267	72865	68	64327
Ghana	-	-	18	33884
Italy	16	21128	10	11388
Sweden	-	-	8	7378
Germany	24	24195	5	3390
Belgium	-	-	4	2088
Brazil	4	4466	1	1607
Saudi Arabia	-	-	13	1233
Sri Lanka	87	8351	2	193
Bangladesh	100	9164	-	-
China	2	2302	-	-
Other countries	34	3259	7	3166

**Table – 26 : Exports of Manganese & Alloys :
(Unwrought)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	27	21039	23	19109
Italy	8	10288	10	11388
Germany	5	5008	5	3390
Brazil	2	2821	1	1607
Indonesia	-	-	6	1082
Romania	-	-	++	733
Korea, Rep. of	1	112	++	350
Latvia	-	-	1	151
Singapore	++	258	++	132
Chinese Taipei/ Taiwan	1	1276	-	-
Pakistan	10	1098	-	-
Other countries	++	178	++	276

**Table – 27 : Exports of Manganese &
Manganese Base Alloys :
(Waste/Scrap)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	20	693	1	188
Saudi Arabia	c	-	1	188
UAE	20	693	-	-

**Table – 28 : Imports of Manganese Ore : Total
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	852198	19818562	797933	7470849
South Africa	359794	9320356	359959	2891368
Australia	348003	8092201	220175	2050748
Gabon	45547	1065729	91735	958622
Brazil	-	-	69647	772974
Ivory Coast	28705	328129	36757	454486
Singapore	8745	216853	7805	190242
Zambia	6161	156052	1557	25695
Indonesia	18692	196438	1933	18569
Turkey	11951	171389	-	-
Unspecified	-	-	6508	85714
Other countries	24600	271415	1857	22431

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

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	398033	11041290	283146	32227278
South Africa	151016	4362469	146589	1495317
Australia	197853	5654314	85281	992032
Gabon	16958	388028	33415	411558
Singapore	8605	214372	7805	190242
Ivory Coast	3587	64398	6847	91576
Zambia	4756	129075	1557	25695
Indonesia	5384	59744	652	7465
Colombia	917	23976	126	4794
Tanzania	1988	41779	121	1773
Turkey	3494	62567	–	–
Other countries	3475	40568	753	6926

**Table – 30 : Imports of Manganese Ore
(35% or more but below 46% Mn)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	431162	8557785	512498	4212534
South Africa	202030	4912891	213370	1396051
Australia	150150	2437887	134894	1058716
Brazil	–	–	69647	772974
Gabon	28589	677701	58320	547064
Ivory Coast	22658	230461	28549	340275
Indonesia	10924	112294	736	7075
Nigeria	1072	18533	26	249
Thailand	5389	38344	–	–
Turkey	5085	73409	–	–
Unspecified	–	–	6508	85714
Other countries	5265	56265	448	4416

**Table – 31 : Imports of Manganese Ore
(30% ore more but below 35%)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	11062	115633	299	3126
Kenya	–	–	299	3126
Indonesia	598	7227	–	–
Ivory Coast	1853	29282	–	–
Malaysia	3709	32182	–	–
Pakistan	150	814	–	–
Philippines	637	5165	–	–
South Africa	27	285	–	–
Thailand	675	4412	–	–
Turkey	3372	35413	–	–
Zambia	41	852	–	–
Other countries	++	1	–	–

**Table – 32 : Imports of Manganese Ore
(Ferruginous, 10% or more)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	–	–	19700	54727
China	–	–	19700	54727

**Table – 33 : Imports of Manganese Ore (Others)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	11941	103854	1990	27811
Ivory Coast	607	3988	1361	22635
Indonesia	1786	17173	545	4029
Philippines	291	3450	74	583
USA	–	–	10	564
Nigeria	247	7129	–	–
Pakistan	1265	8988	–	–
Poland	10	1419	–	–
Singapore	140	2481	–	–
South Africa	6721	44711	–	–
Zambia	874	14515	–	–
Other countries	–	–	–	–

**Table – 34 : Imports of Manganese Oxide : Total
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	6449	499483	7154	637750
China	4869	353434	5892	481956
Belgium	879	109232	594	82490
Germany	12	3908	31	21940
South Africa	71	4105	160	14815
Japan	2	669	23	9577
Norway	–	–	100	7314
USA	53	5225	62	6111
Israel	31	2436	31	2525
Tanzania	273	3734	165	1976
Australia	195	10489	–	–
Other countries	44	38338	96	9046

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**Table – 35 : Imports of Manganese Dioxide
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	5380	375482	5941	489003
China	4726	340069	5661	464246
Japan	2	653	16	6283
Germany	9	2606	12	4902
Belgium	15	4955	14	4789
USA	31	3905	23	2925
South Africa	71	4105	20	2080
Tanzania	273	3734	165	1976
Singapore	25	907	26	958
Australia	195	10489	-	-
Unspecified	20	2064	-	-
Other countries	13	1995	4	841

**Table – 36 : Imports of Manganese Oxide
(Other than Manganese Dioxide)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	1069	124001	1213	148747
Belgium	864	104277	580	77701
China	143	13365	231	77710
Germany	3	1302	19	17038
South Africa	-	-	140	12735
Norway	-	-	100	7314
Mozambique	-	-	40	3500
Japan	++	16	7	3291
USA	22	1320	39	3186
Vietnam	-	-	20	2550
Israel	20	1484	31	2525
Other countries	17	2237	6	1195

**Table – 39 : Imports of Manganese & Alloys : Unwrought
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	6399	1049059	7884	968421
China	6242	994555	6877	838178
South Africa	20	2743	669	72480
Vietnam	-	-	204	24153
France	43	18156	18	13179
USA	25	20256	4	5501
Hong Kong	20	2195	45	5194
Germany	++	1	21	2721
Korea, Rep. of	20	3876	++	16
Mexico	25	3836	-	-
Unspecified	4	3434	20	2291
Other countries	++	7	26	4708

**Table – 37 : Imports of Manganese & Alloys
(Incl. Waste & Scrap)
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	7176	1191814	11214	1351356
China	6971	1112042	10114	1202834
South Africa	20	2810	749	80910
Vietnam	-	-	204	24153
France	59	29750	20	14952
Germany	11	9241	26	6432
USA	25	21151	5	6265
Hong Kong	20	2195	45	5194
Korea, Rep. of	20	3876	++	16
Mexico	26	3938	-	-
Unspecified	4	3434	20	2291
Other countries	20	3377	31	8309

**Table – 38 : Imports of Manganese : Wrought
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	252	37472	3265	365660
China	252	37343	3185	356717
South Africa	-	-	80	8430
UK	-	-	++	513
USA	++	129	-	-

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**Table – 40 : Imports of Manganese
& Alloys, NES :
(By Countries)**

Country	2008-09		2009-10	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	525	105283	65	17275
China	477	80144	52	7939
Germany	11	8240	5	3711
Sweden	1	86	5	3050
France	16	11594	2	1773
USA	++	766	1	764
UK	19	3283	++	30
Italy	-	-	++	8
Mexico	1	102	-	-
South Africa	++	67	-	-
Other countries	++	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.

The norm of consumption of manganese ore for steel making which was around 46 kg per tonne of steel is expected to be low at around 30 kg per tonne due to technological upgradation; thus, lowering the consumption of manganese ore per tonne of steel. There is a need for the development of techno-commercially viable value-added intermediates like beneficiated manganese ore, agglomerates like sinters and pellets for export.