

# 55 Manganese Ore

**M**anganese 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 ( $3Mn_2O_3 \cdot MnSiO_3$ , 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 and Jabua districts), Maharashtra (Bhandara and Nagpur districts), Gujarat (Panchmahal district) and Orissa (Sundergarh district) and with Kodurite Series (Archeans) of Orissa (Ganjam and Koraput districts) and Andhra Pradesh (Srikakulam and Visakhapatnam districts).

## RESOURCES

The total resources of manganese ore in the country as on 1.4.2005 are placed at 378.6 million tonnes as per UNFC system. Out of these, 138.2 million tonnes are categorised as reserves and the balance 240.4 million tonnes are in the remaining resources category. Gradewise, ferro-manganese grade accounts for only 7%, medium grade 8%, BF grade 34% and the remaining 51% are of mixed, low, others, unclassified, and not known grades including 0.5 million tonnes of battery/chemical grade.

Statewise, Orissa tops the total resources with 40% share followed by Karnataka 22%, Madhya Pradesh 16%, Maharashtra 8%, Goa 5% and Andhra Pradesh 4%. Rajasthan, Gujarat, Jharkhand and West Bengal together shared about 5% of the total resources (Table - 1).

## EXPLORATION & DEVELOPMENT

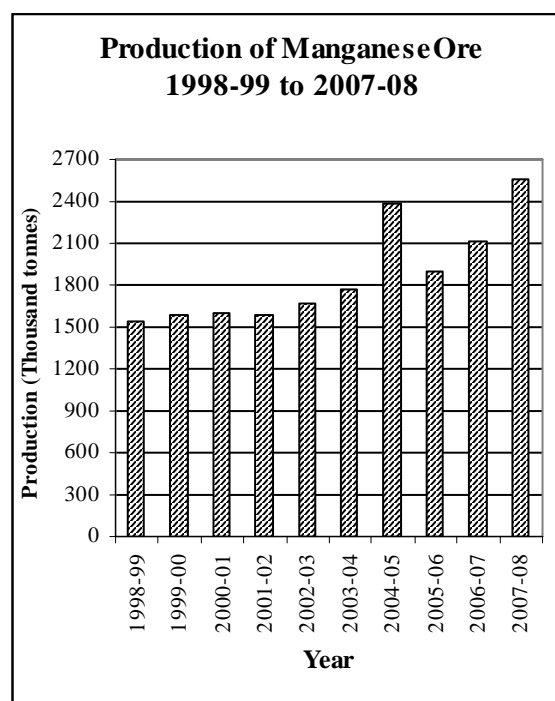
Details of exploration carried out for manganese ore by various agencies during 2006-07 and 2007-08 are given in Table - 2(A) and 2(B), respectively.

## PRODUCTION, STOCKS AND PRICES

The production of manganese ore at 2551 thousand tonnes during 2007-08 increased by 21% as compared to that in the previous year owing to sharp increase in demand.

There were 126 reporting mines during the year under review as against 114 in the previous year. In all 72 producers reported production of manganese ore in 2007-08. Five principal producers operating 25 mines contributed 78% of the production. About 71% of the total production was reported by 14 mines, each producing more than 50,000 tonnes per annum, while 13% was contributed by 10 mines being covered in the production range of 20,000 to 50,000 tonnes. The remaining 16% was covered by 97 mines in the production range upto 20,000 tonnes.

In 2007-08 twenty one public sector mines jointly accounted for 54 % of the total production. The contribution of captive mines was 12% of the total production.



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**Table - 1 : Reserves/Resources of Manganese Ore as on 1.4.2005  
(By Grades/States)**

(In '000 tonnes)

Grade/State	Reserves				Remaining resources						Total resources (A+B)		
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility STD221	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334		Total (B)	
		STD121	STD122										STD222
<b>All India : Total</b>	<b>76844</b>	<b>16683</b>	<b>44624</b>	<b>138151</b>	<b>7966</b>	<b>29541</b>	<b>11971</b>	<b>4175</b>	<b>24033</b>	<b>160183</b>	<b>2549</b>	<b>240418</b>	<b>378569</b>
<b>By Grades</b>													
Battery/chemical	1	-	54	55	-	4	26	-	-	444	-	474	529
Ferro-manganese	3071	262	4944	8277	161	869	1493	1746	3018	11054	1	18342	26619
Medium	5123	2043	4465	11631	145	955	841	551	1292	16204	-	19988	31619
BF	23256	10342	18189	51787	239	2013	3350	985	7631	64197	29	78444	130231
Mixed	84	-	53	137	-	48	-	-	-	8053	2061	10162	10299
Medium & BF mixed	10723	690	5873	17286	76	321	4153	149	1082	23586	265	29632	46918
Ferromanganese, medium & BF mixed	24310	36	4775	29121	6482	24741	1375	150	8337	4860	-	45945	75066
Ferromanganese & BF	4272	83	3126	7481	-	83	22	131	1236	7128	-	8600	16081
Low (-) 25% Mn	847	72	653	1572	7	-	52	319	531	2690	-	3599	5171
Others	602	654	994	2250	-	42	103	144	12	1409	131	1841	4091
Unclassified	4372	584	1340	6296	856	465	556	-	471	16229	62	18639	24935
Not known	183	1917	158	2258	-	-	-	-	423	4329	-	4752	7010
<b>By States</b>													
Andhra Pradesh	2457	188	1204	3849	-	-	42	322	3972	7398	-	11734	15583
Goa	28	444	2388	2860	-	706	1150	1019	423	12899	-	16197	19057
Gujarat	-	-	-	-	-	-	-	-	-	2954	-	2954	2954
Jharkhand	688	359	4002	5049	-	-	-	-	-	2429	-	2429	7478
Karnataka	6735	4426	8057	19218	384	1362	1835	1498	7329	51110	-	63518	82736
Madhya Pradesh	22796	36	4647	27479	6143	23587	2639	-	-	2309	265	34943	62422
Maharashtra	11544	64	5573	17181	341	300	2530	58	8120	1794	29	13172	30353
Orissa	31442	11166	18106	60714	1098	3586	3775	1278	4189	76069	2255	92250	152964
Rajasthan	1154	-	647	1801	-	-	-	-	-	3020	-	3020	4821
West bengal	-	-	-	-	-	-	-	-	-	200	-	200	200

Figures rounded off.

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**Table - 2(A) : Details of Exploration Activities for Manganese Ore, 2006-07**

Agency/ State/ District	Location/ Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
<b>GSI</b>							
<b>Orissa</b>							
Kendujhar (Bonai- Kendujhar belt)	Lasarda (Bolani block)	-	9	-	-	-	All boreholes intersected six manganese ore zones with thickness varying from 0.50 to 14 m and grade of 20 to 36.56% Mn. Estimated 2.47 million tonnes ore resources with an average grade of 24.61% Mn.
-do-	Lasarda and Pacheri blocks	-	-	-	-	-	A resource of 6.78 million tonnes was estimated in earlier field session and in 2006-07, 1.08 million tonnes with average grade of 26.15% Mn. was estimated. Thus total resources for these two blocks was estimated at 7.86 million tonnes with an average grade of 26.15% Mn.
-do-	Lasarda North Extension block	-	-	-	-	-	Estimated resources of 2.76 million tonnes of Mn ore with an average grade of 25.29% Mn.
-do-	Kendudihi Parulipada block	-	-	-	-	-	A resource of 0.70 million tonnes of manganese ore was estimated with an average grade of 22.27% Mn.
-do-	Pacheri South Block	-	-	-	-	-	Estimated resources of 0.19 million tonnes with an average grade of 25.51% Mn.
<b>MOIL</b>							
<b>Madhya Pradesh</b>							
Balaghat	Balaghat Mine Bharveli	-	-	3	1145.85	-	As on 1.4.2007, total reserves were estimated at 22.91 million tonnes.
<b>Maharashtra</b>							
Nagpur	Kandri Mine	-	-	6	1115.87	-	As on 1.4.2007, total reserves were estimated at 2.29 million tonnes
-do-	Beldongri Mine Teh. Parseoni	-	-	-	-	-	Exploratory drilling was in progress. Estimated total resources of about 6.05 thousand tonnes
Bhandara	Chikla Mine Extension	-	-	3	428.5	-	As on 1.4.2007, total ore reserves were estimated at 4.633 million tonnes

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**Table - 2(B) : Details of Exploration Activities for Manganese Ore, 2007-08**

Agency/ State/ District	Location/ Area/ Block	Mapping		Drilling		Sampling (No.)	Remarks Reserves/Resources estimated
		Scale	Area (sq km)	No. of boreholes	Meterage		
<b>GSI</b>							
<b>Orissa</b>							
Kendujhar	Bolani block (Bonai-Kendujhar belt)	-	-	-	-	-	In eight boreholes ore zone thickness varies from 0.20 m to 6.10 m. Total cumulative thickness of such ore zones was 39.30 m. Estimated about 0.65 million tonnes ore at 20% Mn cut-off.
-do-	Lasarda North Extension (Bolani) block	-	-	-	-	-	Based on exploration during FS 2006-07, at 20% cut off additional resources of 1.365 million tonnes of manganese ore were estimated with average grade of 26.42% Mn. Besides, 0.39 million tonnes of manganese ore resource was also estimated with marginal grade (15-20% Mn).
<b>DMG</b>							
<b>Karnataka</b>							
Gadag	Kelur village Mundargi Taluk	-	-	-	-	-	In Hirebetla range, about 25 thousand tonnes of low grade manganese ore resources have been estimated.
<b>OMC</b>							
<b>Orissa</b>							
	SGBK Lease/ Mines Siljora Guruda - Balda - Kalimati	1:500	12 (hect.)	58	2272.65	951	Estimated about 1.06 lakh tonnes reserves during the year. Total resources at the end of year was of the order of 34.59 lakh tonnes.
Kendujhar	Seremda Bhadrasahi Manganese Mine	1:500	15 (hect.)	37	1153	-	Estimated about 8.47 lakh tonnes resources.
<b>MOIL</b>							
<b>Maharashtra</b>							
Nagpur	Beldongri Mine Parseoni	-	-	-	-	-	As on 01.04.2008, total in situ reserves were estimated at 0.49 million tonnes
-do-	Kandri Mine Tah. Ramtek	-	-	2	529.85	-	As on 1.4.2007, total in situ reserves were estimated at 2.24 million tonnes.
-do-	Gumgaon Mine Saoner	-	-	4	1153.56	-	As on 1.4.2008, total in situ reserves were estimated at 5.18 million tonnes
Bhandara	(Chikla 'A' Section) Tah. Tumsar	-	-	3	659.60	-	As on 01.04.2008, estimated ore reserves at 4.14 million tonnes
-do-	Dongri Buzurg Mine	-	-	7	870.20	-	As on 1.9.2007, total in situ reserves were estimated at 8.322 million tonnes.
<b>Madhya Pradesh</b>							
Balaghat	Bharveli	-	-	2	1082.8	-	As on 01.04.2008, the total reserves were estimated at 22.01 million tonnes.
-do-	Tirodi Mine (North & South)	-	-	5	375.00	-	Estimated in situ reserves of about 1.72 million tonnes

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As regards gradewise composition of production in 2007-08, 54% of the total production was of low grade (below 35 % Mn) including 'others' category covering dust (fines:medium/high), 30% of medium grade (35-46%Mn) and 13% was of high grade (46% Mn and above) excluding dioxide. Production of manganese dioxide was 83,731 tonnes (3%) during the year as against 76,375 tonnes (4 %) in the previous year. The average metal content was 37.10 % Mn in 2007-08 as against 39.10 % Mn in the previous year.

Maharashtra was the leading producing State accounting for 33 % of the total production in 2007-08. Next in the order of production were

Orissa (26%), Madhya Pradesh (22%) , Karnataka (12%) and Andhra pradesh (6%). The remaining one percent of the total production was reported from the states of Jharkhand and Rajasthan (Tables- 3 to 7).

The mine-head stocks decreased to 361 thousand tonnes at the end of 2007 - 08 from 453 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 12,496 in 2007-08 as against 12,893 in the previous year. Domestic prices of manganese ore are furnished in Table -9.

**Table – 3 : Principal Producers of Manganese Ore 2007-08**

Name & address of Producer	Location of mine	
	State	District
Manganese Ore (India) Ltd. Katol Road, Nagpur -440 013 Maharashtra.	Madhya Pradesh	Balaghat
Tata Steel Ltd, 24, Homi Mody street Fort Mumbai-400 001.	Orissa	1. Keonjhar 2. Sundargarh
The Sandur Manganese & Iron Ores Ltd. Lakshmipur, Sandur Dist. Bellary Karnataka.	Karnataka	Bellary
Mangilal Rungta P .O. Chaibasa-833 201 Dist. West Singhbhum Jharkhand.	Orissa	Keonjhar
Orissa Mineral Development Co.Ltd P.O.Thakurani-via- Barbil-758 035, Dist. Keonjhar, (Orissa).	Orissa	Keonjhar

**Table – 4 : Principal Producers of Manganese Dioxide, 2007-08**

Name & address of Producer	Location of mine	
	State	District
Manganese Ore (India) Ltd. Katol Road Nagpur-440 013 Maharashtra.	Maharashtra	Bhandara
Tata Steel Ltd. 24, Homi Mody Street Fort Mumbai-400 001.	Madhya Pradesh	Balaghat
Orissa Manganese Mineral (P) Ltd. P. O. Koira-770 048 Dist. Sundargarh Orissa.	Orissa	Keonjhar
Mangilal Rungta P. O. Chaibasa-833 201 Dist. West Singhbhum Jharkhand.	Orissa	Sundergarh
Orissa Mineral Development Co Ltd. P.O. Thakurani-via- Barbil-758 035 Dist. Keonjhar (Orissa)	Orissa	Keonjhar
Aditya Minerals ( P) Ltd. 6-5-651 Hamidpura, Adilabad, Dist. Adilabad-504 001 Andhra Pradesh	Andhra Pradesh	Adilabad

*The Graphical Representations have been deleted*

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**Table - 5 : Production of Manganese Ore, 2005-06 to 2007-08  
(By States)**

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

State	2005-06		2006-07		2007-08(p)	
	Quantity	Value	Quantity	Value	Quantity	Value
<b>India</b>	<b>1906353</b>	<b>5070450</b>	<b>2115507</b>	<b>5573734</b>	<b>2550560</b>	<b>10983042</b>
Andhra Pradesh	84447	78361	64352	63593	141803	136309
Goa	5255	5306	3460	3562	-	-
Jharkhand	639	1875	523	1201	11654	7322
Karnataka	267107	271474	251995	336364	309716	388210
Madhya Pradesh	425136	1644258	474893	1759332	567915	3620454
Maharashtra	511960	1753209	633501	2010717	854120	5313228
Orissa	611809	1315967	686783	1398965	663898	1516428
Rajasthan	-	-	-	-	1454	1091

**Table - 6 (A) : Gradewise Production of Manganese Ore, 2006-07  
(By Sectors/States/Districts)**

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

State / District	No. of mines	Production By Grades : Mn Content						Total	
		MnO <sub>2</sub>	above 46%	35%-46%	25%-35%	below 25%	Others*	Quantity	Value
<b>India</b>	<b>114(5)</b>	<b>76375</b>	<b>361767</b>	<b>816220</b>	<b>786085</b>	<b>48004</b>	<b>27056</b>	<b>2115507</b>	<b>5573734</b>
Public sector	20	32466	284261	324792	391560	-	26396	1059475	3690937
Private sector	94 (5)	43909	77506	491428	394525	48004	660	1056032	1882797
<b>Andhra Pradesh</b>	<b>23</b>	-	-	<b>3650</b>	<b>58620</b>	<b>2082</b>	-	<b>64352</b>	<b>63593</b>
Adilabad	10	-	-	-	16802	2082	-	18884	28647
Vizianagaram	13	-	-	3650	41818	-	-	45468	34946
<b>Goa</b>	<b>3</b>	-	<b>310</b>	<b>160</b>	<b>2440</b>	<b>550</b>	-	<b>3460</b>	<b>3562</b>
South Goa	3	-	310	160	2440	550	-	3460	3562
<b>Jharkhand</b>	<b>2</b>	-	-	<b>118</b>	<b>405</b>	-	-	<b>523</b>	<b>1201</b>
Singbhum West	2	-	-	118	405	-	-	523	1201
<b>Karnataka</b>	<b>15</b>	-	-	<b>84045</b>	<b>165807</b>	<b>2143</b>	-	<b>251995</b>	<b>336364</b>
Bellary	9	-	-	77329	146932	-	-	224261	300737
Chitradurga	1	-	-	-	400	-	-	400	580
Davangere	2	-	-	-6664	9325	2143	-	18132	28463
Shimoga	1	-	-	52	140	-	-	192	84
Tumkur	2	-	-	-	9010	-	-	9010	6500
<b>Madhya Pradesh</b>	<b>20</b>	-	<b>199228</b>	<b>142672</b>	<b>96892</b>	<b>27887</b>	<b>8214</b>	<b>474893</b>	<b>1759332</b>
Balaghat	19	-	199228	136811	87079	9403	8214	440735	1721723
Chhindwara	1	-	-	5861	9813	18484	-	34158	37609
<b>Maharashtra</b>	<b>15</b>	<b>31034</b>	<b>90898</b>	<b>196078</b>	<b>281307</b>	<b>15342</b>	<b>18842</b>	<b>633501</b>	<b>2010717</b>
Bhandara	2	31034	56916	144070	205777	-	-	437797	1445212
Nagpur	13	-	33982	52008	75530	15342	18842	195704	565505
<b>Orissa</b>	<b>36(5)</b>	<b>45341</b>	<b>71331</b>	<b>389497</b>	<b>180614</b>	-	-	<b>686783</b>	<b>1398965</b>
Keonjhar	24(5)	45023	68815	247428	141936	-	-	503202	989084
Sundergarh	12	318	2516	142069	38678	-	-	183581	409881

\* Other grades include dust i.e. fines, medium & high grades  
Figures in parentheses indicate associated mines of iron ore.

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**Table - 6 (B) : Gradewise Production of Manganese Ore, 2007-08 (P)**  
(By Sectors/States/Districts)

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

State / District	No. of mines	Production By Grades : Mn Content						Total	
		MnO <sub>2</sub>	above 46%	35%-46%	25%-35%	below 25%	Others*	Quantity	Value
<b>India</b>	<b>126(6)</b>	<b>83731</b>	<b>325483</b>	<b>756888</b>	<b>1279528</b>	<b>102880</b>	<b>2050</b>	<b>2550560</b>	<b>10983042</b>
Public sector	21	37546	281814	336134	712800	7842	-	1376136	9109945
Private sector	105(6)	46185	43669	420754	566728	95038	2050	1174424	1873097
<b>Andhra Pradesh</b>	<b>28</b>	<b>137</b>	<b>-</b>	<b>2920</b>	<b>113198</b>	<b>25548</b>	<b>-</b>	<b>141803</b>	<b>136309</b>
Adilabad	10	137	-	-	14819	21748	-	36704	57210
Vizianagaram	18	-	-	2920	98379	3800	-	105099	79099
<b>Goa **/</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
South Goa *									
<b>Jharkhand/</b>	<b>3(1)</b>	<b>-</b>	<b>-</b>	<b>1469</b>	<b>10134</b>	<b>-</b>	<b>51</b>	<b>11654</b>	<b>7322</b>
Singbhum West									
<b>Karnataka</b>	<b>16</b>	<b>-</b>	<b>-</b>	<b>110619</b>	<b>183547</b>	<b>14050</b>	<b>1500</b>	<b>309716</b>	<b>388210</b>
Bellary	9	-	-	102819	136909	-	-	239728	295561
Chitradurga	2	-	-	-	260	-	-	260	140
Davangere	2	-	-	7800	30118	14050	1500	53468	79830
Shimoga	1	-	-	-	110	-	-	110	66
Tumkur	2	-	-	-	16150	-	-	16150	12613
<b>Madhya Pradesh</b>	<b>21</b>	<b>2242</b>	<b>196225</b>	<b>113850</b>	<b>213488</b>	<b>41611</b>	<b>499</b>	<b>567915</b>	<b>3620454</b>
Balaghat	20	2242	192741	101781	203382	13501	499	514146	3535399
Chhindwara	1	-	3484	12069	10106	28110	-	53769	85055
<b>Maharashtra</b>	<b>16</b>	<b>33901</b>	<b>94141</b>	<b>246912</b>	<b>470100</b>	<b>9066</b>	<b>-</b>	<b>854120</b>	<b>5313228</b>
Bhandara	2	33901	51589	181166	379842	-	-	646498	4006352
Nagpur	14	-	42552	65746	90258	9066	-	207622	1306876
<b>Orissa</b>	<b>40</b>	<b>47451</b>	<b>35117</b>	<b>281118</b>	<b>287607</b>	<b>12605</b>	<b>-</b>	<b>663898</b>	<b>1516428</b>
Keonjhar	22(5)	47028	32487	149148	214373	12310	-	455346	1097825
Sundergarh	18	423	2630	131970	73234	295	-	208552	418603
<b>Rajasthan/</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1454</b>	<b>-</b>	<b>-</b>	<b>1454</b>	<b>1091</b>
Banaswara									

Figures in parentheses indicate associated mines of iron ore.

\* Other grades include dust i.e. fines, medium & high grades

\*\* There is only labour employment but no production of manganese ore in Goa.

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**Table – 7 : Production of Manganese Ore, 2006-07 and 2007-08(p)  
(By Frequency Groups)**

(Quantity in tonnes)

Production Group	No. of mines		Production for the group		Percentage in total production		Cumulative percentage	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
<b>Total</b>	<b>114(5)</b>	<b>126(6)</b>	<b>2115507</b>	<b>2550560</b>	<b>100.00</b>	<b>100.00</b>	-	-
Up to 1000	42(1)	41(2)	17287	13306	0.82	0.52	0.82	0.52
1001 - 5000	36(2)	34(1)	93248	78481	4.40	3.08	5.22	3.60
5001 - 10000	11(1)	15	90162	104944	4.26	4.11	9.48	7.71
10001 - 20000	7	14(1)	100784	212908	4.76	8.35	14.24	16.06
20001 - 30000	1(1)	6	42485	153842	2.01	6.03	16.25	22.09
30001 - 40000	2	(2)	70700	76440	3.34	3.00	19.59	25.09
40001 - 50000	3	2	133510	91225	6.31	3.58	25.90	28.67
50001 and above	12	14	1567331	1819414	74.10	71.33	100.00	100.00

*Note : Production range up to forty thousand tonnes includes associated production of manganese ore accrued from six iron ore mines in 2007-08 and five iron ore mines in 2006-07. Figures in parentheses indicate number of associated mines.*

**Table - 8 (A) : Mine-head Stocks of Manganese Ore at the Beginning of 2007-08  
(By States and Grades)**

(In tonnes)

State	B Grades : Mn content						Total
	MnO <sub>2</sub>	Above 46%	35%-46%	25%-35%	Below 25%	Others*	
<b>India</b>	<b>27326</b>	<b>49054</b>	<b>109716</b>	<b>255491</b>	<b>10966</b>	<b>363</b>	<b>452916</b>
Andhra Pradesh	-	-	664	18760	22	-	19446
Goa	-	158	50	2551	257	-	3016
Jharkhand	-	34	129	3931	112	-	4206
Karnataka	-	-	6277	29309	2758	-	38344
Madhya Pradesh	-	6960	19090	14360	2087	12	42509
Maharashtra	21891	28264	19162	22474	2950	-	94741
Orissa	5435	13638	64344	164106	2780	351	250654

\* Other grades include dust i.e. fines, medium and high grades.

**Table - 8 (B) : Mine-head Stocks of Manganese Ore at the End of 2007-08 (p)  
(By States and Grades)**

(In tonnes)

State	B Grades : Mn content						Total
	MnO <sub>2</sub>	Above 46%	35%-46%	25%-35%	Below 25%	Others*	
<b>India</b>	<b>12897</b>	<b>15302</b>	<b>100018</b>	<b>215941</b>	<b>17189</b>	-	<b>361347</b>
Andhra Pradesh	-	-	9	30295	3409	-	33713
Goa	-	289	64	2175	515	-	3043
Jharkhand	-	34	56	4196	112	-	4398
Karnataka	8631	-	9105	18010	-	-	35746
Madhya Pradesh	-	4330	6808	32591	3298	-	47027
Maharashtra	678	3636	12339	27022	3410	-	47085
Orissa	3588	7013	71637	101637	6445	-	190320
Rajasthan	-	-	-	15	-	-	15

\* Other grades include dust i.e. fines, medium & high grades.

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**Table - 9 : Prices of Manganese Ore, 2005-06 to 2007-08  
(Domestic Markets)**

(In Rs. per tonne)

Grade	Market	2005-06	2006-07	2007-08 (p)
MnO <sub>2</sub>	Ex-mine OMDC Ltd (Orissa )	7000-10000	8500-7000	16250-17250
+36 Mn	Ex-mine OMDC Ltd (Orissa )	2200	2230	4632-10210
30% Mn	Ex-mine OMDC Ltd (Orissa )	901-1225	1000	1992
MnO <sub>2</sub>	Ex-mine Siljora-Kalimati (Orissa )	9044.69	8838.33	15598.30
+46 % Mn	Ex-mine Siljora-Kalimati (Orissa )	6132.83	5615.04	13949.15
+35% Mn	Ex-mine Siljora-Kalimati (Orissa )	3590	2460.39	11231.36
+25% Mn	Ex-mine Siljora-Kalimati (Orissa )	1620.76	1655.71	5837.72
28-30% Mn	Ex-mine OMC Ltd (Orissa )	1070-515	615-515	10001-805
30-34% Mn	Ex-mine OMC Ltd (Orissa )	699-1598	699-1050	2514-8501
35-37% Mn	Ex-mine OMC Ltd (Orissa )	1129-3100	1129-2000	2200-13751
38-40% Mn	Ex-mine OMC Ltd (Orissa )	1694-4000	1694-2300	2900-16830
40-42% Mn	Ex-mine OMC Ltd (Orissa )	2540-4800	2540-3200	3600-19300
42-44% Mn	Ex-mine OMC Ltd (Orissa )	3303-5050	3303-3600	3900-20520
46-48% Mn	Ex-mine OMC Ltd (Orissa )	4200-6350	4200	4800-22410
74-76% MnO <sub>2</sub>	Ex-mine OMC Ltd (Orissa )	7215-10800	7215	5500-25200
78-80% MnO <sub>2</sub>	Ex-mine OMC Ltd (Orissa )	7845-11730	7845	9448-25200
82-84% MnO <sub>2</sub>	Ex-mine OMC Ltd (Orissa )	NA	10032	10273-25200

## MINING, PROCESSING, MARKETING & TRANSPORT

Manganese ore mining in the country is carried out by opencast as well as by underground methods. Of the 126 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 of stoping 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.

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 m<sup>3</sup> capacity of shovels and 20-25 tonnes dumpers are used for production. The workings vary from shallow depth in lateritoid-type deposits in Orissa, 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 Orissa, 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 had initiated the installation of an integrated 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 plant was commissioned in September, 2007 with imported technology including modern electronically controlled bottom air pulsated jigs. 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 upto 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 15.52 lakh saplings till 2007-08 including 52,500 saplings during 2007-08 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.

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

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general stipulations are Fe : 16 to 22%, SiO<sub>2</sub> : 2 to 8%, Al<sub>2</sub>O<sub>3</sub> : 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 -10. User's specifications of manganese ore for ferro manganese/silico manganese industries are furnished in Table-11.

**Table - 10 : 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 <sub>2</sub> (max.)	7.5%	9%	10%	11%	12%	13%
Al <sub>2</sub> O <sub>3</sub> (max.)	2%	3%	3.5%	4%	5%	6%
SiO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> (max.)	8%	10%	10%	12%	13%	15%
Mn:Fe ratio (min.)	7	6	4.5	3.5	3	2.5

**Table - 11 : User's Specifications of Manganese Ore in Different Ferro-Manganese/Silico-Manganese Units**

(In tonnes)

Name and location of plant	Specifications of ore consumed
<b>Andhra Pradesh</b>	
Ferro-Alloys Corp. Ltd, Shreeram Nagar, Dist. Vizianagram.	Mn : 70-75% C : 6-8%
Nav Bharat Ferro-Alloys Ltd, Paloncha, Khammam.	Mn : 30-50%
<b>Chhattisgarh</b>	
Chhattisgarh Electricity Co. Ltd, Siltara, Raipur	Mn : 28-30% (Low P) Mn:37-40%, 42-44%, 46% (High P)
<b>Hira Group of Industries, Raipur</b>	
i) Jain Carbides & Chemicals Ltd, Raipur (Unit-I)	Mn : 32-35%
ii) Jain Carbides & Chemicals Ltd, Raipur (Unit-II)	Mn : 32-35%
<b>Karnataka</b>	
S.R. Chemicals & Ferro Alloys, Belgaum.	Mn : 44 - 52%
Thermit Alloys Ltd, Shimoga.	Mn : 48-54%
<b>Kerala</b>	
INDSIL Electrosmelts Pallatheri, Palakkad.	Fe-Mn ratio 1:3 to 5% (50%) 1:5 to 8% (50%) P : 0.05% max Al <sub>2</sub> O <sub>3</sub> : 3 to 5% max

(Contd.)

Table - 11 (Concl'd.)

Name and location of plant	Specifications of ore consumed
<b>Madhya Pradesh</b>	
MOIL, Ferro-manganese Plant, Bharveli, Dist. Balaghat	Mn : 46-48%
<b>Maharashtra</b>	
Maharashtra Electro-Smelt Ltd, Chandrapur.	Mn : 38-46%, Fe : 6-17% SiO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> : 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 <sub>2</sub> : 3.6%, Al <sub>2</sub> O <sub>3</sub> : 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
<b>Orissa</b>	
Tata Steel Ltd., Joda, Dist. Keonjhar	Mn : 44-48%, Fe : 8-12% Size : +10-75 mm
<b>Tamil Nadu</b>	
Silcal Metallurgical Ltd, Ramanujanagar, Coimbatore.	Mn : 35-40% & above Size : 35 mm
<b>West Bengal</b>	
Cosmic Ferro Alloys Ltd, Bankura	75 mm
Sri Gayatri Minerals Pvt. Ltd, Bishnupura dist. Bankura.	

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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 MnO<sub>2</sub> 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 MnO<sub>2</sub> 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 MnO<sub>2</sub> 80% (min), SiO<sub>2</sub> 5% (max), Fe<sub>2</sub>O<sub>3</sub> 5% (max) and 200 to 250 mesh ore size is used. In glass industry, ore analysing MnO<sub>2</sub> 80% (preferably 86% min), Fe<sub>2</sub>O<sub>3</sub> 5% (preferably 0.75% max), SiO<sub>2</sub> 2.8% (max), Al<sub>2</sub>O<sub>3</sub> 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: MnO<sub>2</sub> 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 MnO<sub>2</sub> 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 2.50 million tonnes in 2007-08 as against 2.32 million tonnes in 2006-07. Silico-manganese (66%) and ferro-manganese (26%) industries together accounted for about 92% consumption followed by iron & steel (5%) and sponge iron (2%). The remaining (1%) was shared by battery, chemicals, zinc smelters, alloy steel, glass and ceramic industries (Table-12).

The reported consumption of ferro-manganese in 2007-08 increased to 121 thousand tonnes from 104 thousand tonnes in the previous year. Iron & steel industry was the bulk consumer of ferro-manganese accounting for about 91% consumption in 2007-08. The remaining 9% was consumed in alloy steel, foundry and electrode industries (Table-13(A)). Consumption of silico-manganese which was 166,700 tonnes in 2005-06 has been showing an increasing trend and reached to 189,500 tonnes in 2007-08 (Table-13 (B)).

**Table - 12 : Reported Consumption of Manganese Ore<sup>1/</sup>, 2005-06 to 2007-08 (By Industries)**

Industry	(In tonnes)		
	2005-06(R)	2006-07	2007-08(p)
<b>All Industries</b>	<b>1806000</b>	<b>2320600</b>	<b>2495900</b>
Alloy steel	100 (1)	100 (1)	100 (1)
Battery <sup>2/</sup>	31500 (7)	29700 (7)	29700 (7)
Chemical	2500 (4)	2500 (4)	2500 (4)
Ferro-manganese	573200 (19)	656600 (20)	662500 (19)
Silico-manganese <sup>(e)</sup>	1073500	1409300	1640500
Iron & steel	123400 (11)	139400 (11)	113200 (11)
Sponge iron	-	81200 (1)	45,600 (1)
Zinc smelters	1700 (3)	1700 (3)	1700 (3)
Others (Ceramic, glass, foundry, abrasive)	100 (6)	100 (6)	100 (6)

*Figures rounded off. Data collected on non-statutory basis.*

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

<sup>1/</sup> 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.

<sup>2/</sup> Excludes consumption of indigenous and imported electrolytic manganese dioxide (EMD) which was 5,644 tonnes, 5,520 tonnes and 5,520 tonnes during 2005-06, 2006-07 and 2007-08, respectively.

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**Table - 13 (A) : Reported Consumption of Ferro-manganese, 2005-06 to 2007-08 (By Industries)**

Industry	(In tonnes)		
	2005-06(R)	2006-07	2007-08(p)
<b>All Industries</b>	<b>91300</b>	<b>104100</b>	<b>121000</b>
Alloy steel	9600 (16)	9600 (16)	9600 (16)
Electrode	500 (14)	500 (14)	500 (14)
Foundry	1100 (27)	1200 (29)	1100 (29)
Iron & steel	80100 (12)	92800 (13)	109800 (13)
Sponge iron	-	++ (1)	++ (1)

Figures rounded off. Data collected on non-statutory basis. Figures in parentheses denote the number of units in organised sector reporting consumption.

**Table - 13 (B) : Reported Consumption of Silico-manganese, 2005-06 to 2007-08 (By Industries)**

Industry	(In tonnes)		
	2005-06(R)	2006-07	2007-08(p)
<b>All Industries</b>	<b>166700</b>	<b>178600</b>	<b>189500</b>
Alloy steel	3800 (8)	3800 (8)	3800 (8)
Foundry	100 (3)	100 (3)	100 (3)
Iron & steel	162800 (11)	172400 (12)	184100 (12)
Sponge Iron	- (1)	2300 (3)	1500 (3)

Figures rounded off. Data collected on non-statutory basis. Figures in parentheses denote the number of units in organised sector reporting consumption.

## 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 2.1 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. In 2007-08, about 1,122 tonnes of EMD was produced as against 1,312 tonnes in 2006-07. Ferro-manganese plant of 10,000 tonnes per annum capacity has been set up at Bharveli, Balaghat. It produced 11,130 tonnes ferro-manganese in 2007-08, as against 10,200 tonnes in

2006-07. MOIL is also setting up a 100,000 tpy capacity ferro-manganese/silico-manganese plant at Bhilai in collaboration with SAIL. The plant is likely to start latest by this year end or early next year.

### 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 2006-07, as per Indian Ferro Alloys Producers' Association, was about 2.97 lakh tonnes. There was a 31.6% increase in production of ferro-manganese to 3.91 lakh tonnes in 2007-08.

### 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 9.11 lakh tonnes in 2007-08 from 7.83 lakh tonnes in 2006-07. 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 2006-07 and 2007-08 are given in Table-14.

### Dry Battery

Consumption of manganese dioxide ore in this industry was reported by only 7 units which together accounted for 29,700 tonnes in 2007-08, (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 other of 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, 2006-07 and 2007-08**

Plant	Production of pig iron/hot metal (tonnes)		Consumption of Mn-ore (tonnes)		Specifications of ore consumed	Source
	2006-07	2007-08	2006-07	2007-08		
Bhilai Steel Plant, Bhilai Nagar, Durg, Chhattisgarh	Hot metal 4816773	Hot metal 5267670	38238	8440	Size : 25 to 85 mm Mn : 30% min SiO <sub>2</sub> : 30% max Al <sub>2</sub> O <sub>3</sub> : 5% max P : 0.3% min	MOIL/Ramtek Gobarwahi, Khapa, Tirodi in Nagpur area.
Bokaro Steel Plant, Bokaro, Jharkhand.	Hot metal 4588000	Hot metal NA	NA	NA	Mn : 30% max SiO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> : 20.5% max -10 mm -15% max +40 mm -10% max	Barbil, Barajamda & Banaspani
Durgapur Steel Plant, Durgapur, West Bengal.	Hot metal 2063801	Hot metal 2186507	172	0	BF Mn : 30.0% min Fe : 15-28% SiO <sub>2</sub> : 3.3% max Al <sub>2</sub> O <sub>3</sub> : 7.5% max	-
Rourkela Steel Plant, Rourkela, Orissa	Hot metal 2123936	Hot metal 2229410	19734	23129	-	-
Visvesvaraya Iron and Steel Ltd, Bhadravati, Karnataka.	237981	217892	NA	NA	-	-
Visakhapatnam Steel Plant, Visakhapatnam, A.P.	4046000	NA	NA	-	SP 0.10 mm Mn : 32.00%, Fe : 22.0% SiO <sub>2</sub> : 6.71%	
IISCO Steel Plant Burnpur, Dist. Burdwan. West Bengal..	Hot metal 775266	Hot metal 639800	61	235	Mn (dry) 30% (min.) -10 mm - 10.0% max +40 mm - 15% max	
IDCOL, Kalinga Iron Works Ltd, Barbil, Keonjhar, Orissa.	Hot metal 147456	Hot metal NA	4540	NA	BF : 10-40 mm	From own/ local mines
Kirloskar Ferrous Industries Ltd, Berinahalli, Dist : Koppal, Karnataka.	Pig iron	Pig iron	NA	NA	Size: 10 to 40 mm 90% min under & over size: 5% max each Mn : 28% min Fe : 20% min SiO <sub>2</sub> : 8% max Alkalies : 1% max	SMIORE, Adarsha Mining Co., Omkaramma
LANCO Industries Ltd, Chittoor, A.P.	Hot metal 141239	Hot metal 151832	2057	2340	NA	NA
Tata Steel Ltd, Jamshedpur, Jharkhand.	Hot metal 5552000	Hot metal	NA	NA	Size : 75+10 mm Mn : 31.25% Fe : 25.01% SiO <sub>2</sub> : 4.62% Al <sub>2</sub> O <sub>3</sub> : 6.62% P : 0.076%	Joda (Orissa)

## 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, 2004-09 (effective from 1st September 2004 and as amended with effect from 1st April 2008) 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

The export policy of manganese ore is made keeping in view the need for conserving high grade ores. Effort is also made to replace the exports of ores by value-added items.

### Import Policy

The amended Foreign Trade Policy, 2004-09 as effective from 1st April 2008 is as follows:

Imports of manganese ore and concentrates including ferruginous manganese ores and concentrates containing 10% or more manganese (calculated on dry weight basis), agglomerated manganese ore sinters, etc. are freely allowed.

## WORLD REVIEW

The total world reserve base is approximately 5,200 million tonnes which is large but unevenly distributed (Table-15). World's manganese ore reserves are estimated to contain 800 million tonnes metal. Unfortunately, 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. Manganese ore comes largely from China, Ukraine, Gabon, South Africa, Australia and Brazil and traded to Japan, France, Norway, South Korea, etc. Ferro-manganese and silico-manganese exports come from China, CIS countries (largely Russia) and Norway and traded to Japan and Germany.

By far, the largest manganese resources are in South Africa contributing about 77% to the world's identified resources and in a zone extending through Bulgaria, Ukraine and Georgia. The South African deposits, mostly in the Kalahari area, are thought to contain about 4 billion tonnes of manganese ore. Deposits in Varna, Nikopol and Tchiatura are estimated to contain about 500 million tonnes, much of which is either low grade or in the form of carbonate minerals. Other large manganese deposits in Australia, Gabon and Brazil have 44 to 50% manganese and are smaller in magnitude than the South African deposits. Only large deposits in North America, Molango in Mexico have low grades. Thus, only a small fraction of global manganese reserves are 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.

World production of manganese ore in 2007 was estimated to be around 33.8 million tonnes as compared to 33.2 million tonnes in 2006. China was the leading producer contributing about 24% followed by South Africa (18%), Australia (16%), Gabon (10%), Kazakhstan and India (7% each) and Brazil (6%) (Table-16). China remained the driving force behind world production of crude steel and demand for both manganese ore & alloys. 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 imports predominantly high grade manganese ore (with Mn content more than 44%) in order to blend with its low grade ore (with Mn content less than 30%). China was the world's largest consumer of manganese and producer of manganese alloys.

The Kalahar manganese field in northern Cape Province, South Africa is home for about 80% of the world's known high grade manganese reserve. Kumba Resource Ltd, South Africa's largest iron ore producer and the fourth largest iron ore producer in the world, was planning to study a project to build a ferro-manganese plant with an annual production capacity of 200,000 tonnes. The project would be based on innovative technology developed in-house by Kumba that would allow exploitation of low grade and fine manganese ore.

**Table - 15 : World Resources of Manganese Ore (By Principal Countries)**

(In '000 tonnes)

Country	Reserve base
<b>World : Total (rounded)</b>	<b>520000</b>
Australia	160000
Brazil	57000
China	100000
Gabon	160000
India	150000**
Mexico	9000
South Africa	400000*
Ukraine	520000
Other countries	Small

*Source: Mineral Commodity Summaries, 2008.*

\* Includes inferred resources.

\*\* As per UNFC System, total resources of manganese ore as on 1.4.2005 are estimated at 378.6 million tonnes.

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

(In '000 tonnes)

Country	2005	2006	2007
<b>World : Total</b>	<b>30900</b>	<b>33200</b>	<b>33800</b>
Australia	3829	4567	5289
Brazil	3200	3128	1866
China <sup>(e)</sup>	7500	8000	8000
Gabon	2753	2979	3300
Ghana	1720	1578	1173
India	1906	2143	2473
Kazakhstan	2208	2531	2482
South Africa	4612	5213	5995
Ukraine <sup>(e)</sup>	2000	2000	2000
Other countries	1172	1061	1222

@ : Marketable

*Source: World Mineral Production, 2003-2007.*

## FOREIGN TRADE

### Exports

Exports of manganese ore increased to 2,08,372 tonnes in 2007-08 from 1,57,312 tonnes in 2006-07. Out of the total exports in 2007-08, exports of manganese ore having +46% Mn were 20,538 tonnes, ore having 35 to 46% Mn were 67,950 tonnes, ore having 30 to 35% Mn were 66,778 tonnes and manganese ore (others) were 53,106 tonnes. Exports were mainly to China (76%), Bhutan (12%) and Japan (11%). Exports of manganese dioxide and other oxides, increased to 1,403 tonnes in 2007-08, as against 1,141 tonnes in the previous year. Out of total manganese oxide exported in 2007-08, exports of manganese dioxide were 434 tonnes and other oxides were 969 tonnes. Exports were mainly to Malaysia (18%), Italy (16%), Republic of Korea and Sri Lanka (10% each). In 2007-08, exports of manganese and alloys (including waste & scrap) increased to 378 tonnes from 9 tonnes in the previous year. Out of total exports in 2007-08 un-wrought manganese alloys were 344 tonnes and remaining 34 tonnes were manganese alloys, NES. Exports were mainly to Netherlands, Germany and Saudi Arabia (Tables - 17 to 27).

### Imports

Imports of manganese ore increased substantially to 6,86,053 tonnes in 2007-08 from 2,84,202 tonnes in 2006-07. Australia (45%), Gabon (27%) and South Africa (10%) were the main suppliers of manganese ore in 2007-08. Out of the total imports in 2007-08, manganese ore imports having +46% Mn comprised 4,97,385 tonnes, manganese ore having 35 to 46% Mn were 1,81,184 tonnes, manganese ore having 30 to 35% Mn were 1,002 tonnes, ferruginous manganese ore having 10% or more Mn were 704 tonnes and manganese ore (others) 5,778 tonnes. In 2007-08, imports of manganese oxides were 7,039 tonnes out of which manganese dioxide was 5,809 tonnes and other manganese oxides were 1,230 tonnes. Imports were mainly from China and Belgium. During 2007-08, imports of manganese & alloys (including waste and scrap), were 10,635 tonnes, out of which manganese alloys (wrought and unwrought) comprised 9,125 tonnes, manganese waste and scrap 11 tonnes and manganese alloys, NES 1,499 tonnes. Imports of manganese & alloys were mainly from China and Hong Kong (Tables - 28 to 41).

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>157312</b>	<b>451953</b>	<b>208372</b>	<b>833870</b>
China	35221	114545	158267	701383
Bhutan	2562	18184	25986	64387
Japan	85420	233834	22500	54490
Bangladesh	-	-	1552	12101
Nepal	-	-	1	730
Kenya	-	-	28	518
Ireland	-	-	20	139
Baharain	-	-	18	++
Pakistan	34000	84854	-	-
UAE	108	517	-	-
Other countries	1	19	-	-

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>984</b>	<b>5933</b>	<b>20538</b>	<b>69352</b>
Bangladesh	-	-	1552	12101
Bhutan	984	5933	18986	57251

**Table -19 : Exports of Manganese Ore  
(35% or More but Below 46% Mn)  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>1579</b>	<b>12270</b>	<b>67950</b>	<b>452810</b>
China	-	-	60950	445674
Bhutan	1578	12251	7000	7136
Saudi Arabia	1	19	-	-

**Table - 20 : Exports of Manganese Ore  
(30% or More but Below 35% Mn)  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>120641</b>	<b>348379</b>	<b>66778</b>	<b>167342</b>
China	35221	114545	44260	112730
Japan	85420	233834	22500	54490
Bahrain	-	-	18	122

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>34108</b>	<b>85371</b>	<b>53106</b>	<b>144366</b>
China	-	-	53057	142979
Nepal	-	-	1	730
Kenya	-	-	28	518
Ireland	-	-	20	139
Pakistan	34000	84854	-	-
UAE	108	517	-	-

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>1141</b>	<b>19006</b>	<b>1403</b>	<b>22716</b>
Malaysia	133	2007	249	4314
Italy	73	1013	224	3226
Sri Lanka	28	440	135	3012
Korea, Rep. of	43	582	143	1682
Poland	97	1443	50	1416
Sweden	96	1774	48	922
Indonesia	48	1682	38	516
Kenya	132	2448	41	470
Tanzania	166	1860	13	364
Saudi Arabia	150	2806	5	117
Other countries	175	2951	457	6677

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>620</b>	<b>10591</b>	<b>434</b>	<b>6070</b>
Sri Lanka	2	38	84	1281
Korea,Rep. of	43	582	103	1156
Iran	-	-	60	1147
Thailand	-	-	59	592
Indonesia	10	208	38	516
Kenya	132	2448	39	444
Bangladesh	15	430	18	134
Saudi Arabia	150	2806	5	117
Malaysia	34	545	-	-
Tanzania	127	1378	-	-
Other countries	107	2156	28	683

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**Table - 24 : Exports of Manganese Oxides  
(Other than Manganese Dioxide)  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>521</b>	<b>8415</b>	<b>969</b>	<b>16646</b>
Malaysia	99	1462	249	4314
Italy	49	729	224	3226
Sri Lanka	26	402	51	1731
Poland	97	1443	50	1416
Yemen Republic	-	-	81	1356
Sudan	-	-	125	1321
Sweden	96	1774	48	922
Korea, Rep. of	-	-	40	526
Tanzania	39	482	13	364
Indonesia	38	1474	-	-
Other countries	77	649	88	1470

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>9</b>	<b>7846</b>	<b>378</b>	<b>57427</b>
Netherlands	++	55	193	24991
Germany	1	641	120	17354
Italy	5	5309	19	10142
Saudi Arabia	1	288	33	3021
UAE	-	-	6	711
Israel	-	-	2	345
UK	-	-	4	280
Nepal	++	2	1	278
Thailand	1	362	++	35
Iran	++	530	-	-
Other countries	1	659	++	270

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>++</b>	<b>88</b>	<b>344</b>	<b>44474</b>
Netherlands	-	-	193	24991
Germany	-	-	120	17354
Saudi Arabia	++	88	27	1812
UK	-	-	4	280
Nigeria	-	-	++	37

**Table - 27 : Exports of Manganese & Alloys, NES  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>9</b>	<b>7758</b>	<b>34</b>	<b>12953</b>
Italy	5	5309	19	10142
Saudi Arabia	1	200	6	1209
UAE	-	-	6	711
Israel	-	-	2	345
Nepal	++	2	1	278
Thailand	1	362	++	35
China	++	185	++	32
Germany	1	641	-	-
Iran	-	530	-	-
Romania	++	219	-	-
Other countries	1	310	++	201

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>284202</b>	<b>1685063</b>	<b>686053</b>	<b>6311862</b>
Gabon	76891	494194	185619	2211310
Australia	194767	1063394	309570	2184645
South Africa	800	12407	67408	853778
Ivory Coast	-	-	30723	249282
Saudi Arabia	-	-	21800	243169
Indonesia	4135	21942	20582	162192
Singapore	3438	58821	10644	161320
China	-	-	10500	63185
Egypt	-	-	13600	60036
Pakistan	2711	13130	4224	25065
Other countries	1460	21175	11383	97880

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>280023</b>	<b>1652688</b>	<b>497385</b>	<b>4315760</b>
Australia	194767	1063394	262758	1905973
Gabon	76591	489446	138833	1282450
South Africa	800	12407	43236	566537
Saudi Arabia	-	-	21800	243169
Singapore	2798	47319	10584	160240
China	-	-	10500	63185
Indonesia	2429	13179	6407	54093
Colombia	843	12600	1365	18948
Nigeria	-	-	640	7948
Pakistan	1199	5878	580	2637
Other countries	596	8465	682	10580

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**Table - 30 : Imports of Manganese Ore  
(35% or More but Below 46% Mn)  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>2431</b>	<b>11731</b>	<b>181184</b>	<b>1947428</b>
Gabon	-	-	46786	928860
South Africa	-	-	22000	281293
Australia	-	-	46812	278672
Ivory Coast	-	-	30300	244513
Indonesia	1331	6556	10701	82528
Egypt	-	-	13600	60036
Thailand	-	-	3691	23203
Turkey	21	110	3109	21640
Pakistan	1079	5065	3044	19913
Malaysia	-	-	1001	5833
Other countries	++	++	140	937

**Table - 31 : Imports of Manganese Ore  
(30% ore More but Below 35%)  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>-</b>	<b>-</b>	<b>1002</b>	<b>9609</b>
Indonesia	-	-	1002	9609

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>-</b>	<b>-</b>	<b>704</b>	<b>2686</b>
Indonesia	-	-	604	2237
Pakistan	-	-	100	449

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>1748</b>	<b>20644</b>	<b>5778</b>	<b>36387</b>
Indonesia	375	2207	1868	13733
Turkey	-	-	680	8393
South Africa	-	-	2172	5948
Ivory Coast	-	-	423	4769
Pakistan	433	2187	500	2066
Singapore	640	11502	60	1080
Thailand	-	-	50	208
Philippines	-	-	25	190
Gabon	300	4748	-	-

**Table - 34 : Imports of Manganese Oxides : Total  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>8978</b>	<b>437168</b>	<b>7039</b>	<b>339579</b>
China	6567	277012	5630	230605
Belgium	1175	85193	1110	85274
Australia	589	27956	127	5617
Germany	8	3242	12	5128
UK	18	2121	23	4411
Japan	12	2471	13	2010
South Africa	49	2941	++	2
Greece	70	3752	-	-
Norway	160	20984	-	-
Unspecified	120	4880	20	1544
Other countries	210	6616	104	4988

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>7408</b>	<b>314081</b>	<b>5809</b>	<b>240286</b>
China	6483	270785	5590	225222
Australia	589	27956	127	5617
UK	7	1238	17	3470
Belgium	15	3053	10	2443
Korea, Rep. of	-	-	60	1561
Germany	1	217	3	1207
USA	1	803	1	715
Singapore	85	1776	-	-
South Africa	29	1310	-	-
Unspecified	120	4880	-	-
Other countries	78	2063	1	51

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**Table - 36 : Imports of Manganese Oxides  
(Other than Manganese Dioxide)  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
<b>All Countries</b>	<b>1570</b>	<b>123087</b>	<b>1230</b>	<b>99293</b>
Belgium	1160	82140	1100	82831
China	84	6227	40	5383
Germany	7	3025	9	3921
Japan	12	2471	12	1959
UK	11	883	6	941
France	1	819	1	624
South Africa	20	1631	++	2
Greece	69	3719	-	-
Norway	160	20984	-	-
Unspecified	-	-	20	1544
Other countries	46	1188	42	2088

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
<b>All Countries</b>	<b>14931</b>	<b>1033403</b>	<b>10635</b>	<b>1358990</b>
China	14043	930911	9658	1200327
Hong Kong	-	-	660	87184
Germany	525	51457	126	18030
USA	36	20114	36	17200
France	-	-	27	14858
Mexico	162	17443	57	11249
UK	24	3828	29	2636
Belgium	-	-	2	1835
Korea, Rep. of	80	4579	-	-
Unspecified	59	3748	40	5401
Other countries	2	1323	++	270

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>20</b>	<b>1585</b>	<b>1783</b>	<b>235292</b>
China	20	1585	1103	146588
Hong Kong	-	-	660	87184
Germany	-	-	20	1520

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
<b>All Countries</b>	<b>7269</b>	<b>484242</b>	<b>7342</b>	<b>966220</b>
China	6875	445503	7125	924014
USA	6	3020	24	15505
Mexico	-	-	54	8995
Germany	318	30710	59	7881
UK	9	730	29	2634
France	-	-	11	1790
St. Helena	2	531	-	-
Unspecified	59	3748	40	5401

**Table - 40 : Imports of Manganese & Alloys : (Waste & Scrap)  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
<b>All Countries</b>	<b>179</b>	<b>11531</b>	<b>11</b>	<b>254</b>
China	179	11531	-	-
USA	-	-	11	254

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**Table - 41 : Imports of Manganese & Alloys, NES  
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
<b>All Countries</b>	<b>7463</b>	<b>536045</b>	<b>1499</b>	<b>157224</b>
China	6969	472292	1430	129725
France	-	-	16	13068
Germany	207	20747	47	8629
Mexico	162	17443	3	2254
Belgium	-	-	2	1835
USA	30	17094	1	1441
Sweden	-	-	++	206
UK	15	3098	++	2
Japan	++	756	-	-
Korea, Rep. of	80	4579	-	-
Other countries	++	36	++	64

**FUTURE OUTLOOK**

Production of crude steel is the single most important factor in the demand for manganese. 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.