INDIAN FERRO ALLOY INDUSTRY - PRESENT STATUS AND FUTURE OUTLOOK

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ABSTRACT

Steel is the most versatile material, which has made the progress in every aspect on this earth possible. There are hundreds of varieties of steel because for each application it has to be made with specific properties to get the most optimum usage. Though the basic constituent of steel is iron, it is the proportion of other elements in it, which gives each type of steel certain specific properties. These elements are added in liquid iron in the form of Ferro alloys to get the desired composition and properties. Thus, Ferro alloys are important additives in the production of steel and Ferro Alloys industry is vitally linked for its growth and development to that of the Steel Industry.

There are two major groups of alloys.

1. Bulk alloys consisting of ferro alloys of Manganese, Chromium, Nickel and Silicon which are added in larger proportion to steels and are made by carbo thermal reduction in submerged arc electric furnaces(SAF). A schematic diagram of a submerged electric arc furnace is given in **Annexure 1.**
2. Noble ferro alloys which are used in much smaller proportion in special and alloy steels for addition of vanadium, molybdenum, Tungsten, Zirconium, Titanium, Boron, Tantalium, Magnesium Silicon and extra Low Carbon Ferro Chrome etc. These are generally made by alumino thermic or silico thermic reduction processes.

In this paper, an attempt is made to discuss on
(a) Industry's profile and expansion of the bulk Ferro Alloys industry in a phased manner.
(b) Current status of the industry with production level and extent of imports and exports of different Ferro Alloys,
(c) Availability of quality inputs
(d) Review of the technology adopted and
(e) Challenges and opportunities in the Ferro Alloy sector.

INDUSTRY'S PROFILE

Ferro alloys production in India is about six decades old. In India bulk ferro alloys production through electric submerged arc furnace route made a beginning in late 1950s. After the invention by Soderberg of self- baking type electrodes, during 1920s, this became the most preferred way for making bulk ferro alloys of Silicon, Manganese & Chromium in the world.

FIRST PHASE OF THE INDUSTRY IN INDIA

The initial/first phase of the industry is marked by the installation of small capacity furnaces mostly for the production of Manganese alloys with the starting up of the first furnace at VISL, Bhadravati, total of 18 furnaces were commissioned by the mid-sixties to cater to the domestic steel industry's requirement. The status of the Indian Ferro Alloy industry by mid-sixties is given in the table-1.

Table 1: Status of Ferro Alloy industry by the mid sixties

Sl. No.	Name of the Plant	Furnace No.	Capacity In MVA	Year of Start-up
1	Visveswaraya Iron & steel Co, Ltd (VISL)	1	1.5	1950
		2	1.5	1950
		3	9.0	1954
		4	12.0	1962
		5	12.0	1962
2	Dandeli Ferro Alloys Ltd	1	4.6	1956
3	Ferro Alloys Corporation Ltd(FACOR)	1	7.5	1957
		2	7.5	1958
		3	7.5	1960
4	Tata Iron & steel Co, Ltd (TISCO)	1	9.0	1958
		2	9.0	1958
5	Jeypur Sugar Co. Ltd (JEYSUCO)	1	3.6	1958
		2	7.5	1959
6	Universal Ferro Alloys Ltd(UFA)	1	9.0	1959
		2	9.0	1963
7	Khandelwal Ferro Alloys Co. Ltd.	1	9.0	1961
		2	9.0	1962
	TOTAL	**18**	**129.4**	

Second phase expansion

With the advent of production of stainless steel and alloy steels in India, of which Chromium is the most important ingredient, the chromium alloys production with totally indigenous raw materials, in view of restrictions on imports then, was innovated through research and developmental studies during sixties. Ferro Alloys Corporation Ltd., after successfully proving its production with Indian chrome ores, Giridhi low phos coke and non-coking coal in the 500 KVA pilot SAF at National Metallurgical Laboratory, Jamshedpur, started industrial scale production of chrome alloys in 1967.[1]&[4].

First, FACOR commissioned their 12 MVA, SAF for production of High carbon ferro chrome and Silico Chrome, then after installation of rotary kilns for pre-heating of ore fines and for calcination of lime-stone, they were fed to an 8 MVA tilting type open arc furnace for the production of Low carbon ferro chrome. started.

Thus the second phase of expansion of the industry took place between late sixties and late seventies, when 13 (thirteen) more moderately sized furnaces were added to undertake production of Silicon and Chromium alloys. The brief details of capacity additions are given in table-2.

Table 2: Capacity additions in late sixties & seventies

Sl. No.	Name of the Plant	Furnace No.	Capacity In MVA	Year of Start-up
1	Indian Metals and Ferro Alloys Ltd.(IMFA)	1 2	10.0 24.0	1967 1974
2	Ferro Alloys Corporation Ltd. (FACOR)	4 5	12.0 8.0	1968 1968
3	Sandur Manganese & Iron Ore Ltd,(SMIORE)	1 2	15.0 20.0	1968 1977
4	Ind. Development Corp.of Orissa Ltd.(IDCOL)	1 2	9.0 6.5	1969 1979
5	Dandeli Ferro Alloys Ltd	2 3	1.2 2.5	1969 1969
6	Maharashtra Electro Smelters Ltd.(MEL)	1 1	33.0 16.5	1977 1975
7	Nav Bharat Ferro Aloys Ltd. (NAVFAL)	2	16.5	1979
	Total	**13**	**174.2**	

Third phase of expansion:

The third phase of expansion in the country was prompted by product diversification, availability of advanced technology and encouragement from Government by way of incentives for setting up 100% export oriented plants, to earn valuable foreign exchange.

Ferro Alloys Corporation Ltd., again for the first time in the country have pursued a strategy to utilize the disseminated ores, run of mine ore rejects and waste dumps containing on an average about 20% Cr_20_3 in their Boula Mining lease. They sponsored beneficiation studies on these in Regional Research Laboratory, Bhubaneswar, and with the process flow-sheet developed on these studies, they set up a pilot plant for chrome ore beneficiation at their plant in Andhra Pradesh and achieved excellent results by up-gradation of such ore rejects and fines to concentrates containing more than 40% Cr_20_3 with Cr/Fe ratio about 2 and SiO_2 4 - 6%. The development work was also carried out to mix these concentrates along with naturally occurring ore fines to form into briquettes which have the required crushing strength for being fed to the smelting furnaces.[2][4]. The feasibility for production of charge chrome (Cr 55-60%) using low grade lumpy chrome ores along with these briquettes was established and proved to an Expert Committee appointed by the Ministry of Steel in April 1979, in one of their sub-merged arc furnaces at Shreeramnagar. About 500 tonnes of charge chrome was produced and exported to consumers abroad. Their acceptance of this charge chrome as per international standard, enabled FACOR to obtain the industrial licence to set up the 45 MVA SAF to produce Charge Chrome and it was with their own technology. That the first "100% Export Oriented Unit" for production of 50,000TPA of 'charge chrome' in India.[3]. Thus, the era of charge chrome production began in 1983. Subsequently, two more export oriented units for ferro chrome/charge chrome with similar capacity were installed but with foreign technical collaboration. One with Outokumpo and other with Elkem A/s, during 1980s. 13 more furnaces were started with the already developed technology of briquetting to adopt to the prevailing raw material conditions. The details of capacity additions during eighties are given in table-3.

Table-3: Capacity additions during eighties

Sl. No.	Name of the Plant	Furnace No.	Capacity In MVA	Year of Start-up
1	Sandur Manganese & Iron Ore Ltd.(SMIORE)	3	20.0	1980
2	Maharastra Electro Smelters Ltd.(MEL)	2	33.0	1981
3	Ferro Alloys Corporation Ltd.(FACOR)Garividi	6	16.0	1981
4	Indian Metal & Ferro Alloys Ltd.(IMFA)	3	48.0	1983
5	Navbharat Ferro Alloys Ltd.(NABFAL)	3	16.5	1983
6	VBC Ferro Alloys Ltd	1	16.5	1984
7	Ferro Alloys Corporation Ltd. (CCP) (FACOR)	1	45.0	1984
8	OMC Alloys Ltd. (OMCAL)	1	30.0	1986
9	Ispat Alloys Ltd.(IAL)	1	10.5	1986
10	Indian Charge Chrome Ltd	1	48.0	1989
11	Universal Ferro Allied Chemicals Ltd.	3	4.0	1987
	(UNIFERRO)(LC FeMn)	4	16.5	1989
		5	16.5	1989
	Total	**13**	**320.5**	

Fourth phase of expansion

M/s. Electro kemish A/S of Norway who supplied most of the SAFs to India, on the basis of their pilot scale studies in a 2000 KVA furnace had expressed that there will be about 10% reduction in specific power while smelting in larger size furnaces compared to small size furnaces. But it is surprisingly not found to be correct in India! Smelting power and other usage norms reported by producers in small furnaces are found to be almost equal to those obtained in large furnaces! More over the smaller furnaces of capacity below 6.5MVA have been found to have better flexibility in change over from one ferro alloy to another and they can directly without agglomeration utilize ore fines without having any charge eruptions from the furnaces. Use of pin vibrators to avoid bridging of charge has been found to be a good way to maintain porosity and normal descent of charge to avoid eruptions. This gave the scope for establishing many small furnaces at comparatively low initial capital cost particularly after the announcement by the Govt. of India of a liberalized de-licensing and broad banding policy, in addition to incentives like concessions in power tariff and excise duty and other tax exemptions to small scale industries in selected industrially backward areas, in some states for promoting industrialization. This resulted in mush-room growth of small scale producers of ferro alloys during the fourth phase of expansion in India.[4]. About 69 plants with low furnace capacities ranging from 1 MVA to 7.5 MVA were established. List of such small scale ferro alloy units is given table-4.

Table- 4 : Small /Medium Scale Ferro Alloy Units

Sl.No	Particulars	Location	MVA Rating
1	Aloke Ferro Alloys	Raipur, M.P.	2 x 4 .5
2	Andhra Ferro Alloys	Kothavalasa,	1 x 3.6
3	Bansal Ferro Alloys	A.P.	1 x 3.5
4	Cronimet Alloys Limited	Bhalgaru,	1 x 16, 1 x 5.5
5	Jindal Stainless Limited	Haryana	1 x 16, 1 x 9
6	Andhra Ferro Alloys Ltd	Tekkali, AP	1 x 5.5, 2 x 9
7	Deccan Ferro Alloys	Kotthavalasa AP	2 x 16
8	RVR Smelters	Garbham AP	1 x 1
9	Shree Mahalaxmi Smelters	Pendurthi A.P.	1 x 6
10	Jayalakshmi Ferro Alloys	Bobbili AP	1 x 9
11	Berry Alloys Ltd	Garbham AP	2 x 9
12	Yona Smelters	Garbham AP	1 x 6
13	Abhijit Ferro tech	Bobbili AP	4 x 22
14	ASV Ferro Alloys	Bobbili AP	1 x 6
15	Anjaaney Ferro Alloys	Visakhapatnam	
16	GSN Ferro Alloys	AP	2 x 16
17	Team Ferro Alloys		1 x 9
18	RV Alloys Ltd		1 x 6
19	Raghavendra Ferro Alloys		
20	Rhodium Ferro Alloys		
21	Sai Durga Ferro Alloys		
22	Manishreni Ferro Alloys		
23	Snam Ferro Alloys		
24	Impex Ferro Alloys		3 x 16
25	Srihari Ferro Alloys		
26	Om Sai Ferro Alloys		
27	Deepak Ferro Alloys	Bobbili AP	1 x 4
28	Haryana Ferro Alloys		1 x 2.5
29	Hindustan Ferro Alloys		1 x 3.6
30	Mandsour Ferro Alloys	Raipur, M.P	2 x 4
31	Monnet Ferro Alloys	Haryana	1 x 7.5
32	Monnet Ferro Alloys	Hamirpur, U.P.	1 x 7.5
33	Pooja Ferro Alloys	Mandasour, M.P.	1 x 4.5
34	Srinivasa Ferro Alloys	Raipur, M.P.	2 x 5
35	Syam Sundar Ferro Alloys	Durgapur, W.B.	2 x 3.5
36	V.K. Ferro Alloys	Goa	1 x 1.25
37	Amit Ferro Alloys	Raipur, M.P.	1 x 3.6
38	Anjaney Ferro Alloys	Malanpur, M.P.	1 x 3.6
39	Balaji Electric Chemicals(P)	Vizag, A.P.	1 x 3.6
40	Ltd.	Raipur, M.P.	1 x 6
41	Bhaskar Ferro Alloys	Mihijam,Bihar.	1 x 1.8, 1 x 0.5
42	Bhubaneswar Ferro Alloys	Yeotmal,	1 x 2
43	Cochin Ferro Alloys	Durgapur, W.B	1 x 2.5
44	Cresent Alloys (P) Ltd	Pondichery	1 x 3
45	Gemeni Electro Chemicals (P)	Cochin	1 x 2
46	Ltd.	Seoni, M.P.	1 x 5
47	Golden Ferro Alloys	U.P.	1 x2.5
48	Goutam Ferro Alloys	Karaikal, T.N.	1 x 3
49	Grima Alloys Pvt. Ltd.	Ranchi, Bihar.	1 x 2.5
50	Hindusthan Ferro Alloys	Uroi, U.P.	1 x 7, 2 x 2.5, 1 x
51	Hindustan Melleables	Hamirpur, U.P.	5

52	Hira Ferro Alloys	Dhanbad, Bihar.	1 x 1, 1 x 2.5, 2 x 7.5
53	Hitech Electro Thermics Ltd.	Raipur, M.P.	
54	Jain Carbide & Chemicals	Palakad	2 x 2.5, 1 x 3.5
55	K.R. Alloys (P) Ltd.	Raipur, M.P.	1 x 0.5, 1 x 1.5
56	Karthik Alloys	Palakad	1 x 5
57	Karthi Ferro Alloys	Goa	1 x 5, 1 x 3.6
58	Maithan Ferro Alloys	Durgapur, W.B.	2 x 5
59	Muscan Ferro Alloys	Asansol, W.B	1 x 5
60	Navchrome (Navbharat)	Pitampur, M.P.	1 x 3.6, 1 x 6.5
61	Sai Chemicals	Raipur	1 x 3.6
62	Shri Ganesh Ferro Alloys	Raipur, M.P.	1 x 7.5
63	Shyam Ferro Alloys	Raipur, M.P.	1 x 7.5
64	Silcal Electro Met. Ltd.	Burdwan, W.B.	1 x 2.5
65	SNAM Ferro Alloys	Avanash, T.N.	2 x 3.5
66	Srinivas Ferro Alloys	Pondichery	1 x 6.5, 2 x 7.5
67	Standard Ferro Alloys	Durgapur, W.B.	1 x 7.5
68	Standard Ispat Ltd.	Raipur, M.P.	1 x 3.5, 1 x 3.0
69	SUN metals & Alloys (P) Ltd.	Raipur, M.P.	2 x 1.5
70	Thesiblal Met. Ltd.	Palakad	1 x 4.5
	MB Smelters	Pondichery	1 x 2.25
	Swastik Ferro Alloys	Ananthapur Garividi	1 x 6

Then the down turn in ferro alloys demand started in 1990s and further decelerated in 1997-98 due to over all recession in steel industry. This caused a crash in price of ferro alloys. In addition to this because of increased demand for ores from China, there was sudden rise in price of ores. Also there was increase in power cost due to withdrawal of some of the earlier concessional tariffs given in some areas. This resulted in closure of many ferro alloys plants in the country. Only those who had captive mining leases and/or captive thermal power generation plants or were located in such backward areas where concessional power tariff was extended, survived.

Again in 2002, with the increase in demand of steel, the ferro alloys market started improving and some more plants like Jindal Stainless (2x60MVA),VISA Steel (2x16.5MVA), ROHIT Ferro Tech (3x16.5MVA), BALASORE Alloys etc. were added in the states of West Bengal, Orissa and Andhra Pradesh for the production of manganese and chrome alloys.

The present capacity as on date is estimated around 2300MW with transformer capacity around 2900MVA. By tonnage, the capacity has crossed 5.15 million tones in 2010-11. The breakup of different alloys is given here under:

Table- 5 :

	Capacity (mil.tons)	**Production during 2010-11 (in mil.tons)**	**Capacity Utilisation %**
Manganese Alloys	**3.16**	**1.7**	**54**
Chromium Alloys	**1.69**	**1.04**	**62**
Ferro Silicon	**0.25**	**0.12**	**48**
Noble Alloys	**0.05**	**0.03**	**60**
TOTAL/AVERAGE	**5.15**	**2.89**	**56**

Source: IFAPA

With the liberalization policy, the Industry is also given broad-banding facility and a producer of Ferro Alloys, can switch over their furnace for producing any Ferro Alloy, depending on the market conditions.

Table- 6 :

PRODUCTION OF FERRO ALLOYS DURING 2006-07 TO 2010-11

Quantity in Metric Tonnes

	2010-11 (P)	2009-10	2008-09	2007-08	2006-07
(A) BULK FERRO ALLOYS:					
HC Ferro Manganese	390,000	341,883	372,286	364,908	281,013
MC Ferro Manganese	8,000	8,222	8,386	7,704	9,190
LC Ferro Manganese	6,000	6,018	5,775	3,905	6,523
Silico Manganese	1,250,000	1,066,485	889,434	886,325	738,314
MC Silico Manganese	24,000	24,108	24,087	27,106	29,581
LC Silico Manganese	25,000	25,454	22,368	33,576	15,067
Ferro Silicon	117,000	97,682	110,742	96,972	92,632
HC Ferro Chrome/ Charge Chrome	1,030,000	890,916	790,072	964,806	801,138
LC Ferro Chrome	2,000	2,007	1,352	235	230
Sub. Total (A)	**2,852,000**	**2,462,775**	**2,224,502**	**2,385,537**	**1,973,688**
(B) NOBLE FERRO ALLOYS					
Ferro Molybdenum	3,050	2,822	2,112	2,899	3,120
Ferro Vanadium	1,500	1,389	1,501	1,585	1,139
Ferro Tungsten	150	150	150	51	54
Ferro Silicon Magnesium	18,500	17,132	13,400	13,525	11,387
Ferro Aluminium	7,600	7,017	8,170	8,877	9,947
Ferro Silico Zirconium	120	120	37	109	178
Ferro Titanium	2,100	1,929	1,561	1,937	1,761
Ferro Boron	90	90	83	80	80
Ferro Nickel Magnesium	250	209	221	122	97
Sub. Total (B)	**33,360**	**30,858**	**27,235**	**29,185**	**27,763**
GRAND TOTAL (A+B)	**2,885,360**	**2,493,633**	**2,251,737**	**2,414,722**	**2,001,451**
Growth Percentage	**15.70%**	**10.74%**	**(-) 6.75%**	**20.65%**	**21.64%**

Source: IFAPA

Capacity increase of the Ferro Alloy Industry in general followed the course to meet the planned target levels of the Steel Industry in the country, and to continue to remain potential exporters of Ferro Alloys in the international market for earning substantial foreign exchange for the country.

After initiation of the liberalization programme, there has been a spurt in the export of Bulk Ferro Alloys, like all other products. In 2010-11, exports of Ferro Alloys touched a high of 2,240,345 tones earning valuable foreign exchange equivalent of Rs.133,915 million. Exports of Ferro Alloys for last five years and the percentage of Exports in relation to production are given below :

Table- 7 :

EXPORT OF FERRO ALLOYS DURING 2006-07 TO 2010-11

Quantity in Metric Tonnes

Product	2010-11	2009-10	2008-09	2007-08	2006-07
BULK FERRO ALLOYS:					
Ferro Manganese: Carbon Containing >2% by weight	96,953	48,640	101,289	101,878	42,025
Other Ferro Manganese	23,098	17,883	20,244	12,580	12,200
Ferro Silicon containing >55% of Si	44,004	16,636	27,939	7,280	7,437
Other Ferro Silicon	6,007	3,471	9,228	2,094	506
Ferro Silico Manganese	699,581	298,299	300,421	262,592	152,050
Ferro Chromium: Carbon Containing >4% by weight	1,305,308	466,219	488,700	476,911	284,597
Other Ferro Chromium	547	5,734	2,974	6,042	3,163
Charge Chrome	6	-	1,001	-	-
TOTAL (A)	**2,175,504**	**856,882**	**951,796**	**869,377**	**501,978**
NOBLE FERRO ALLOYS					
Ferro Molybdenum	2,719	1,766	888	820	466
Ferro Tungsten	15	1	3	7	32
Ferro Titanium	45	5	2	146	132
Ferro Vanadium	169	30	387	787	1,971
Ferro Niobium	1,815	116	192	316	177
Ferro Phosphorus	233	11	169	1,135	807
Ferro Columbium	46	1	-	-	-
Ferro Silico Zirconium	26	1	24	30	31
Ferro Silico Magnesium	3,988	3,597	3,295	2.156	2,742
Ferro Boron	1	3	2	-	4
Ferro Silico Chromium	-	-	26	64	121
Ferro Silenium	-	-	-	2	-
Ferro Zircomium	-	-	-	-	6
Others	5,308	356	3,303	3,869	2,096
TOTAL (B)	**14,365**	**5,887**	**8,291**	**9,332**	**8,585**
GRAND TOTAL (A) + (B)	**2,189869**	**862,769**	**960,087**	**878,709**	**541,563**
Value (Approx.) (Rs in Million)	**133,915.10**	**41,394.46**	**68,777.66**	**48,849.50**	**6,426.72**
Percentage of exports in Relation to Production	**77.64%**	**34.60%**	**42.64%**	**36.39%**	**25.52%**

Source: DGCI&S

IMPORTS:

Initially the Industry was protected with high Import Customs Duty of 105%. After liberalization, the Import Duty was slashed to 85% in 1992-93 and thereafter, has been reducing every year and was Zero percent in the 2007-08. Owing to the recent domestic and global recession in 2008-09 and the international financial meltdown, the Customs Duty on Ferro Alloys has been restored to 5% from January 2009. As and when the Custom Duty has been reduced, the imports of Ferro alloys have increased. The import of Ferro Alloys except Ferro Nickel (which is not produced in India) during 2010-11 was 2,18,401 tonnes valued at

Rs.20,338 million. The outgo of foreign exchange has been Rs.69,495 million in last five years, which is unwarranted. This could have been avoided if duty was not made zero and it would have been possible to meet the total requirement from the domestic production, by utilizing the idle capacity.

Ferro Alloy imports are mainly from China, Russia, Norway, South Africa and erstwhile USSR countries like Kazakhstan and Ukraine.

India is out-beaten by the international prices of Ferro Alloys only because of the high Power tariff in India, which has been increasing every year by 15-20%.

The annual quantity and value of imports of Bulk and Noble Ferro Alloys during the last five years is given here below in Table-8.

Table- 8 :
IMPORTS OF FERRO ALLOYS DURING 2006-07 TO 2010-11

Quantity in Metric Tonnes

	2010-11	**2009-10**	**2008-09**	**2007-08**	**2006-07**
BULK FERRO ALLOYS:					
Ferro Manganese:					
Containing Carbon >2% by weight	17,482	9,292	6,012	1,988	1,074
Other Ferro Manganese	21,447	19,312	15,996	19,763	10,963
Ferro Silicon containing Si >55%	119,702	111,243	58,703	62,547	64,797
Other Ferro Silicon	15,394	13,895	24,048	33,763	22,038
Ferro Silico Manganese	1,642	1,377	239	513	207
Ferro Chromium:					
Containing Carbon >4% by weight	6,344	3,706	3,346	1,738	1,316
Other Ferro Chromium	16,068	13,518	9,028	17,564	17,737
Charge Chrome	2,503	500	-	869	10
TOTAL (A)	**200,582**	**172,843**	**117,372**	**138,745**	**118,142**
NOBLE FERRO ALLOYS					
Ferro Silico Chromium	16	6	-	59	114
Ferro Molybdenum	963	1,111	840	481	262
Ferro Tungsten	72	20	45	67	87
Ferro Titanium	1,658	1,843	558	570	441
Ferro Vanadium	891	881	242	195	523
Ferro Niobium	1,432	769	1,779	1,599	1,706
Ferro Phosphorus	1,748	1,138	1,336	1,264	1,098
Ferro Zircomium	-	4	10	-	5
Ferro Silico Zirconium	238	189	115	298	58
Ferro Silico Magnesium	1,597	1,523	3,833	4,062	1,758
Ferro Boron	429	263	198	197	175
Ferro Cobalt	-	-	-	-	-
Others	8,775	7,363	6,420	8,433	2,787
TOTAL (B)	**17,819**	**15,110**	**15,376**	**17,225**	**9,014**
GRAND TOTAL (A) + (B)	**218,401**	**180,590**	**132,748**	**155,970**	**127,156**
Total Value Rs in Million	**20,337.55**	**15,165.36**	**15,299.80**	**10,894.46**	**7,798.22**
Percentage of increase Over previous year in import Value	**34.10%**	**(-) 0.88%**	**40.44%**	**39.70%**	**31.87%**
Import Duty	**5%**	**5%**	**0%**	**5%**	**7.5%**

Source: DGCI&S

RAW MATERIALS FOR BULK FERRO ALLOYS:

The country has reasonable resources of Manganese Ore and Chrome Ore to meet the requirement of Bulk Ferro Alloys Industry, if the policy of conservation of minerals by using beneficiated low grade Ores is followed.

MANGANESE ORE: **Table- 9 :**

RESERVES: As per Indian Bureau of Mines Survey Report of 01.04.2010(Provisional) in '000 Tonnes)

Grade	Reserves	Remaining resources	Total Resources
All India (All Grade):Total	141,977	288,003	429,980
BF grade	49,894	95,961	145,855
Ferro Manganese grade	12,869	22,585	35,455
Ferro Manganese & BF	2,425	13,902	16,327
Ferro Manganese, Medium & BF Mixed	34,541	31,162	65,703
Low (-) 25% Mn	1,647	7,505	9,152
Medium	8,694	40,034	48,729
Medium & BF Mixed	12,263	32,024	44,287
Mixed	1,763	11,617	13,380
Not Known	2,731	6,702	9,433
Others	7,871	6,053	13,923
Unclassified	7,167	20,216	27,383

Source: Indian Bureau of Mines

Present Production is around 3.00 Million tones per annum.
Based on IBM's Report of 1-4-2010, the requirement of Manganese Ore for Ferro Alloy Industry, will be available domestically for 20 years (excluding the inferred reserves).

Table- 10 :

Production of Manganese Ore in India for last 5 years is given here below: (In million Tonnes)

Year	Production
2006-07	2.1
2007-08	2.7
2008-09	2.8
2009-10	2.44
2010-11(P)	2.86

(P) Provisional

Table- 11 :

Exports and Imports of Manganese Ore for last 5 years : (In Tonnes)

Year	Export	Import
2006-07	157312	284202
2007-08	208372	686053
2008-09	205424	852198
2009-10	289468	797933
2010-11(P)	117963	1299640

Source: Ministry of Mines / DGCI&S

CHROME ORE:

Reserves / Resources :
As per United Nations Framework Classification system (UNFC), total resources of Chromite in the country as on 1.4.2010 are estimated at 203 million tones, comprising 54 million tones Reserves (26%) and 149 million tones remaining resources (74%). Sukinda Valley in the State of Orissa, has 97% of Indian Chromite Ore deposits and it has one of the largest Chromite Ore deposits in the World. Minor deposits are scattered over Manipur, Nagaland, Karnataka, Jharkhand, Maharashtra, Tamil Nadu and Andhra Pradesh.

Grade wise, Charge-Chrome grade accounts for 35%of the Resources, followed by Ferro Chrome grade (19%), Beneficiated grade (17%) and Refractory grade (5%). Low, others, unclassified and not known grades together account for 24%. Grade wise Resources of chromite as on 1.4.2010 are given below.

Table- 12 :

Grade	Reserves	Remaining Resources	Total Resources
All India (All Grade): Total	**53,970**	**149,376**	**203,346**
Refractory	5,701	4,064	9,765
Beneficiable	13824	21154	34978
Charge - chrome	21418	50961	72379
Ferro - Chrome	9346	29061	38407
Low	52	3713	3765
Others	921	183	1104
Unclassified	2707	40062	42769
Not known		179	179

Source: Indian Bureau of Mines.
Based on the Survey report of Indian Bureau of Mines, the requirement of chrome ore will be available domestically for next 15 years (not including inferred) for Ferro Chrome Industry. The Industry has also started to use Chrome Concentrate (Beneficiated product from Low grade chrome ore). Since the year 2000, the domestic demand of Ferro Alloys is increasing.

Production :
The production of Chromite at 4.25 million tones during 2010-11, increased by 25% as compared to the previous year. Orissa continued to be the major producing state of Chromite, accounting for almost entire production during 2010-11. Karnataka reported nominal production.

Production of Chromite (BY States)
(2006-07 to 2010-11)
Table- 13 : in '000 Tonnes)

State	2006-07	2007-08	2008-09	2009-10(P)	2010-11(P)
ALL INDIA (Total)	**5296**	**4873**	**4073**	**3143**	**4262**
Karnataka	8	10	4	7	8
Orissa	5288	4863	4069	3406	4254
Mahaarashtra	-	-	-	++	-

Figures rounded off.
(P): Provisional
++- Negligible/less than one thousand tones
Sources: Indian Bureau of Mines

Chromite is used chiefly in Metallurgical Industry for manufacture of Ferro Alloys; e.g., Ferro chrome, charge chrome and Silico chrome which are used as additives in making Stainless Steel and Special Alloy Steel. Ferro Alloys are the essential ingredients for the production of high quality special Alloy Steel as well as Mild Steel. The demand for Ferro Alloys is associated with the production of Alloy Steel.

Table- 14 :

The Export and Import of Chromite during period 2006-07 to 2010-11 are furnished below: in '000 Tonnes)

Year	Export	Import*
2006-07	1203	5
2007-08	907	121
2008-09	1899	94
2009-10	689	96
2010-11	173	86

*mainly lumpy grades of Chrome Ore are imported
Figures rounded off

Source : DGCI & S

To support Ferro Chrome Industry, export of Chrome Ore/Concentrate has been reducing significantly over the years. In order to produce desired grade of Ferro Chrome and also to maintain the desired charge mix porosity, Industry imports lumpy Ore to blend with domestic low grade ore fines and Concentrates.
The Industry is using chrome ore fines and Concentrates to the extent of about 60% of the total ore requirement.

Reductants

The high ash and volatile matter contents in the reductants have marked adverse affect on the ferro alloys produced and furnace operation. The resistivity and reactivity of the reductants also has very significant effect on productivity of the furnaces. The high sulphur and phosphorous contents of the reductants adversely affect the quality of ferro alloys produced.

- Charcoal is considered as the most ideal reductant in the manufacture of silicon alloys.
- Metallurgical coke from steel plants and other coke making plants along with non-coking coal are used for the production of manganese alloys.
- Imported low ash & low phos. coke along with non-coking low phos. coals and Anthracite coal are used in the production of chrome alloys.

In India coal reserves are about 202 billion tonnes but only about 15% of this is coking coal.[5]. Most of the coals are very high in ash and not amenable to known methods of washing because the shale rock is finely distributed in coal. In the absence of low ash & low phos. coking coal/coke in the country, production of chrome alloys has to depend on imported coke. The Indian ferro alloy producers have substituted 50 to 70 percent of the requirement with low phos. non-coking coal though high in ash and imported low ash anthracite coal from Vietnam and recently from Russia and Ukraine. Typical analysis of reductants used in ferro alloy industry are given in table-6.

Table-15 : Typical Analysis of Reductants used in ferro alloy industry

No	Materials	Ash %	VM %	FC %	P %	S %	SiO2 %	FeO %	Al203 %	CaO %	MgO %
1	Steam	38.20	30.10	31.70	0.058	0.340	62.80	4.96	19.80	1.82	5.54
2	Coal	33.54	4.46	62.00	0.013	0.540	66.24	4.79	22.95	0.84	1.01
3	CIL Coke	12.90	4.80	82.30	0.020	0.560	56.92	6.68	22.30	1.82	6.65
	Low Ash		5.70	87.10	0.009	0.700	45.20	10.35	29.20	2.52	5.34
4	Met. Coke	7.20	1.90	66.10	0.079	0.980	31.20	9.23	22.82	2.66	8.87
	Anthracite		2.30	75.05	0.040	0.850	54.40	8.55	23.71	1.96	4.43
5	Coal	32.00									
6	Met. Coke	22.65	21.12	70.31	0.061	0.370	43.60	3.99	10.33	32.0	5.00
	Durgapur										
7	Pearl	8.57									
	Coke										
	Charcoal										

POWER:

Electrical energy is one of the major inputs in production of Ferro Alloys.

- Though the generation cost of power is not high in India, the Power Tariff borne by the Industry is high, because of cross-subsidization to Agricultural Sector, Low Plant Load Factor of old thermal plants and High T & D losses.
- Electricity Duty, which varies widely from State to State, creates additional burden for the Industry.
- Though power Reforms are on, the impact of this development on long-term prices, specifically power intensive consumers, such as Ferro Alloy producers, is difficult to assess, since the electricity market still seems to be in a state of flux.
- Captive Power generation may hold the key, though capitally intensive.

LOGISTICS :

- The Industry produces over 2.5 million tonnes of Ferro Alloys annually. To produce one tonne of Ferro Alloys it requires nearly 4 tonnes of Raw Material, viz., Ore, Quartzite, Coke, Charcoal, Limestone and Carbon Paste, etc. Nearly 1.4 tonnes of such raw materials are moved by Railway wagons for one tonne of Ferro Alloy Production. This means that the industry consumes over 3.5 million tonnes of raw materials, which are transported by rail every year.
- The Industry has been experiencing shortage of wagons for transporting raw materials so road transport becomes necessary.
- Freight element is very high, thus reducing competitiveness of the Industry.
- Poor infrastructure facilities at Port also lead to berthing delays for ships and take longer loading time.

CHALLENGES TO THE FERRO ALLOY INDUSTRY.

Ferro alloys industry in India has never been globally competitive, despite its rich ore deposits and low-cost manpower, essentially due to

a) Insufficient availability and high cost of electric power
b) Increasing ores and reductants cost
c) Non-availability of low ash, low phos. coking coal in the country for the production of desired coke with low ash, and low phos. contents, making import of such coke at a high cost imperative

d) High-cost and insufficient infrastructural facilities (both road and rail) for rapid transportation of ore from mines to plants
e) Stiff competition from producers and exporters of Ferro alloys in other countries like South Africa, Kazakhstan, China, Russia, Mexico, Australia etc. due to global trade agreements which has made drastic reduction in customs duty on imports necessary.
f) Wide fluctuations in the International price of Ferro alloys depending on demand versus supply.

To over come these challenges plus adhering to stringent pollution control norms innovations are inevitable in the process technology, and plant equipment size & design, along with frequent changes in product mix, to be more cost-effective

REVIEW OF TECHNOLOGY ADOPTED

Some of the recent plants have incorporated latest technologies to use both lumps as well as fines after necessary beneficiation and agglomeration. Also they have installed effective pollution control measures in the form of bag filters for gas cleaning after waste heat recovery.

Although the basic technique of ferro alloy production in submerged arc electric furnace has not undergone any major change, the design, the size, automation and control features of ferro alloy furnaces have undergone substantial changes in the recent past in order to meet the changing raw materials conditions and to achieve higher productivity, and better economy of operation and conservation of energy.

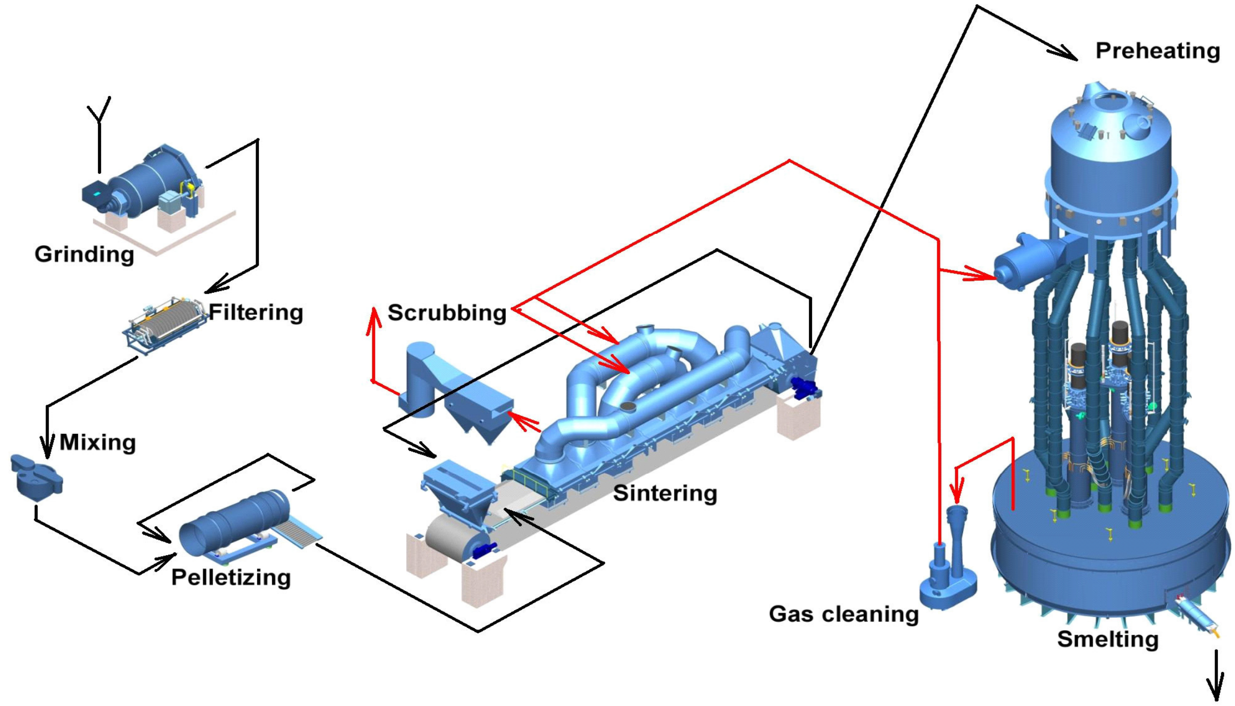
There are some well-known processes, which have been developed and adopted on large scale elsewhere in the world. For instance

SRC process (Showa Denko, Japan)[6][7]

In this process pellets made from chrome ore fines are pre-reduced in solid state and are fed to submerged arc furnaces in hot condition. Depending on the extent of pre-reduction of the chromium oxide in pellets obtained in the rotary kilns which utilizes the heat of the furnace exhaust gases, the specific power consumption can be reduced to 50% of the normal.

Outo Kumpu Process from Finland [6][7]

In this process pellets are made from chrome ore fines/concentrates and are preheated and fed to the furnace in cold or hot condition along with other charge materials. In this process the power consumption for smelting is brought down by about 25%. A flow sheet of this process is given here below.



Source: Infacon XI

This process has been adopted by Tisco at their Bamnipal plant in India. Because of several problems in filtration after wet grinding and in the pellet sintering shaft furnaces supplied to them earlier instead of sinter belt being provided now, the plant could not be operated with full capacity. Now they are using pellets along with briquettes after installing a briquetting plant to achieve full production capacity. However, several plants in South Africa have successfully adopted Outokumpu process feeding cold pellets since larger quantities of chrome ore fines from platinum producers have become available to Ferro Chrome producers.

FACOR, at its Shreeramnagar plant carried out R&D work on pelletisation of high-grade chrome ore fines. About 1500 tonnes of sintered pellets of chrome ore fines were produced and fed to furnace using 80% of the ore requirement in the form of these pellets.[7]. The results are encouraging. Very stable and smooth furnace operation was achieved with very good flame distribution over the whole surface area of the charge in furnace. The height of the flames was found to be very small, say few inches compared to few feet otherwise, particularly in the center of the furnace. It was further observed that fumes had extremely low content of flue dust. The specific power for smelting was lower by about 12% and the fixed carbon requirement was also lower by about 10%. Further studies are being made in this regard to use sintered pellets on regular basis. Considering the technological developments all Fe Cr furnaces should use baked pellets made from concentrates. Also they should be covered furnaces of minimum 30 MVA and cogeneration of power using furnace gas must be done to make the process more economical and conserve the energy. Chrome ores are mostly friable in nature and necessitate some form of agglomeration before being charged into the furnace along with other raw materials. Most of the chrome alloy producers in India have adopted the briquetting process towards agglomeration of fines.

- There has been developed the D.C arc furnace process [8][9] where fines are charged through a pre-baked carbon hollow electrode but problems have been found with furnace cover parts and other equipments due to very high heat radiation from the open bath. Recently some improvements have been reported by better cooling of parts by introducing water cooled copper panels etc. But the specific energy consumption is still higher than conventional process. So unless sensible heat and latent heat in the exhaust gases is fully recovered by generating power, the process may not be economically attractive.

- FACOR had done R&D work on solid state reduction of chrome ore fines in a fluidized bed reactor using mixture of natural gas, nitrogen and hydrogen. Bench scale trials were very encouraging. They hoped to get positive results in a pilot plant but non-availability of natural gas in our country has not made it possible to put up the proposed one ton per hour plant which was planned earlier.

Regarding Mn ore fines, they are being directly used along with lumps in small furnaces without affecting the specific power required for smelting. However, Research and Development work were carried out on the sintering of Mn ore fines by Paramount Sinters Limited for Maharastra Electrosmelt and by Regional Research Laboratory, Bhubaneswar for FACOR.

FACOR had set up a 15000 tonnes per year capacity Manganese ore pan type sinter plant at their Shreeramnagar works with the collaboration of Regional Research Laboratory, Bhubaneswar in 1985. The sinters produced were used at the rate of about 15% of the ore charge for production of ferro manganese. All minus 6 mm fines in the received ores were utilized. MEL are also sintering Mn ore fines and using all the minus 6mm fines in a pressurized pan sintering plant where apart from suction below, pressure is applied by use of compressed air over the top of the sinter pan, thereby increasing the production rate of sinter.

FUTURE OUTLOOK :

At present, the Ferro Alloy Industry is facing problems due to high input prices of Manganese and Chrome Ores, Coal, Coke and a high energy tariff. On the other hand it is not getting required prices from the Steel Producers. This has slowed down the production of Ferro Alloys in 2011-12.

Ferro Alloys being intermediate products, their fortunes are linked to the state of well being of the Steel Industry. In the first half of 2011, the Steel Industry witnessed sustained momentum in recovery of Steel demand globally carrying over from 2010. This despite a series of anticipated and un-anticipated negative developments like the ongoing Euro area sovereign debt crisis, the earthquakes in Japan, the political and social unrest in some countries of Middle East Region, leading to the surge in Oil prices, increase in Coal and Coke prices and the tightening of Government monetary measures in many emerging economies.
World Steel Association had forecast that apparent steel use will increase by 6.5% to 1308 million tones in 2011. In 2012 it forecasts that world steel demand will grow further by 5.4%.

Global stainless Crude steel production increased in the first half of 2011 by 3.8% compared to the same period of 2010. Total production for first 6 months of 2011 was 16.4 million tones, a new all time high. However, increase in production was restricted to China and Eastern Europe Region, compensating for losses in other major areas.

India is expected to show strong growth in Steel use in the coming years due to its strong economy, massive infrastructure needs and expansion of industrial production in 2011-12. India is expected to be one of the highest in growth of Steel consuming nations in the next decade.

With this Steel scenario globally and domestically, the Ferro Alloy Industry estimates that the consumption of Ferro Alloys will increase domestically and internationally in the coming years. Some of the Ferro Alloy Producers have already gone in for expansion and some new units are coming up in West Bengal and Andhra Pradesh. Though some of the units are having captive Power Plants, the main concern would be the availability of Coal, Coke and high grade Manganese Ore and Chrome Ore. The Industry has to depend for high grade

Manganese Ores on imports. Further new ferro alloys plants are coming up and details are given in the table no.16.

TABLE NO.16

Ferro alloy Plants planned to be Commissioned :

Sl.No	Particulars	Location	MVA Rating
1	Sai Laxmi Tulasi Ferro Alloys	Andhra Pradesh	1 x 6
2	Mor Alloys	Garividi	1 x 3.0
3	Sharada Alloys.	Kothavalasa	2 x 33

As explained above, in the last 6 months of this fiscal year, the market has come down, due to various reasons given by World Steel Association, and the prices have not yet stabilized. With the current high cost of Coal, Coke, Manganese Ore from MOIL and Chrome Ore from OMC, it is difficult for the Ferro Alloy Producers to produce and sell at the current prices. This has slowed down the production of Alloys during this year. However, it is expected that the Industry will improve in the next fiscal year 2012-13, with increased domestic demand.

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Annexure 1

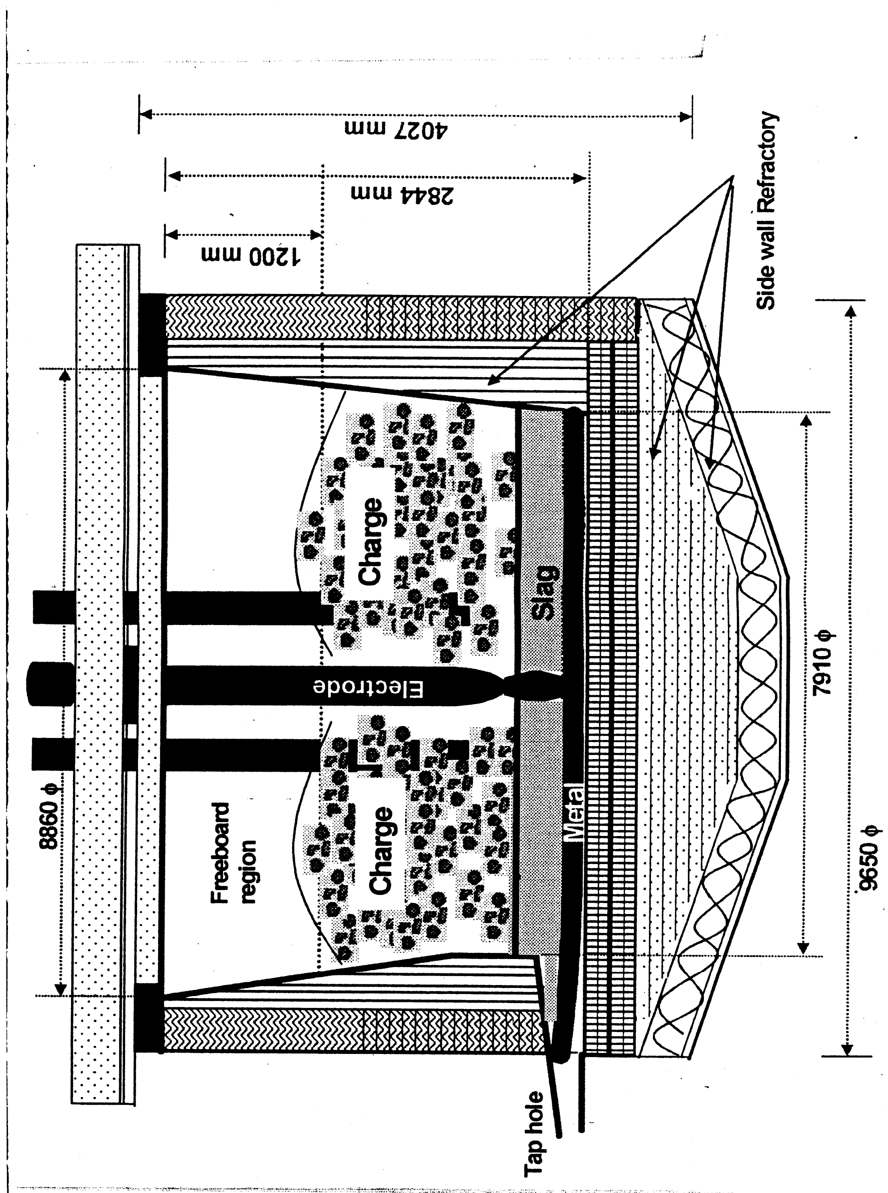

Figure 1: Schematic diagram of closed submerged arc furnace