Indian Ferro Alloys Industry – An Overview

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Ferro Alloys are vital additives for steelmaking. These are special alloys of iron containing chemical elements like Magnesium, Chromium, Silicon, Molybdenum, Niobium, Titanium, Aluminium, Boron etc. About 80 percent of Ferro Alloy production is used in steelmaking in India.

Ferro Alloys are used in steelmaking which consists of less than one percent of the total raw materials required for steel production. Despite being a very low constituent, Ferro Alloys are vital inputs for steelmaking and are added not only for de-oxidation but also for corrosion resistance and to increase its hardenability, tensile strength at high temperatures. Ferro Alloys enhance wear and abrasion resistance and other properties like creep resistance etc. Depending on the process of steelmaking and the grade of steel to be produced, the requirement of Ferro Alloys varies widely. According to experts, Ferro Alloys account for 5 to 25 percent of the cost of steel production depending on the grade of steel to be produced.

Demand Drivers of Ferro Alloys

The major demand drivers of Ferro Alloys are :

- Crude Steel Production
- Alloy and special steel production
- Stainless steel production

Types of Ferro Alloys

There are two types of Ferro Alloys. These are :

- BULK Ferro Alloys
- NOBLE Ferro Alloys

BULK Ferro Alloys are H.C. Ferro Manganese, M.C. Ferro Manganese, L.C. Ferro Manganese, Silico Manganese, M.C. Silico Manganese, Ferro Silicon, HC Ferro Chrome / Charge Chrome, L.C. Ferro Chrome etc.

NOBLE FERRO ALLOYS are Ferro Molybdenum, Ferro Vanadium, Ferro Tungsten, Ferro Silico Magnesium, Ferro Aluminium, Ferro Silico Zirconium, Ferro Titanium, Ferro Boron, Ferro Nickel Magnesium etc.

Ferro Alloys as De-Oxidant for Steelmaking

Ferro Alloys are used for de-oxidation of the steel melt and also as an alloying element addition depending on the type of Ferro Alloy. It is the relative affinity of the alloying elements / de-oxidisers towards Oxygen at different temperatures that determines the method and the time of addition of Ferro Alloys for achieving the optimum result.

In general, the loss of Ferro Alloys is the highest when introduced in the furnace than when added to the jet of steel on the ladle on tapping. De-oxidants like Si-Mn, Fe-Mn, Fe-Si and aluminium are used singly or in combination depending on the grade of steel to be produced.

For achieving the lowest level of oxygen in the steelmelt, aluminium de-oxidation is preferred. Also, for the silicate inclusions in steel, Si-Mn and aluminium are used in combination as de-oxidants which results in effective de-oxidation.

Growth of Ferro Alloy Industry in India

In India, Ferro Alloy production in the organised sector started in the mid-sixties of the last century. Initially, Ferro Alloy units came-up in the states of Andhra Pradesh, Karnataka, Odisha and Maharashtra mainly due to the availability and proximity of raw material sources.

The second phase of the Ferro Alloy Industry in India occurred during the 1980 on product diversion, assimilation, and advanced technology as well as setting up of Export Oriented Units (EOUs) aimed at earning valuable foreign exchange.

The Indian Ferro Alloy industry was liberated in 1991-92. As a result, a number of small and medium scale units having a transformer rating between 2.5 MVA and 16.5 MVA emerged in the production of BULK Ferro Alloys in the States of Chhattisgarh, Madhya Pradesh, West Bengal, Pondicherry, Goa, Jharkhand and Meghalaya.

Major Producer of Ferro Alloys in India

The names, locations and product-mix of some of the major producers of Ferro Alloys having annual capacity of 25,000 tpy or more are shown in Table-1.

New Projects, Expansions and Upgradation

Some of the new projects, expansion and

TABLE : 1 – NAMES, LOCATIONS, PRODUCT-MIX WITH ANNUAL CAPACITIES OF 25,000 TONNES AND MORE SOME MAJOR PRODUCERS OF FERRO ALLOYS IN INDIA

COMPANY	LOCATION	PRODUCT-MIX	ANNUAL CAPACITY (TONS)
Ferro Alloy Corporation Ltd.	Vizianagram A.P. Bhadrak, Odisha	HC Fe Cr, HC Fe Mn Si-Mn, Fe Si, HC Fe Cr	72,500 65,000
Jindal Stainless Ferro Alloys Ltd.	Vizianagram, A.P.	HC Fe Cr	40,000
GMR Technologies & Industries Ltd.	Srikakulam A.P.	Fe Cr, Fe Mn, Si Mn, Fe Si (All High Carbon)	25,000
VBC Ferro Alloys Ltd.	Rudram, Medak, Telangana	Fe Si, Fe Cr, Si Mn, Fe Mn	68,500
Metkore & Industries Ltd.	Srikakulam, A.P.	Hc Fe Cr	25,000
Navbharat Ferro Alloys Ltd.	Kothagudem, Telangana and Odisha	Hc Fe Cr, Si Mn, FeSi	1,17,000
Hira Group of Industries	Raipur, Chhattisgarh	Hc Fe Mn, Si Mn	1,78,000
Sarada Energy & Minerals Ltd.	Raipur, Chhattisgarh	Fe Mn, Si Mn	66,000
Chhattisgarh Electric Co. Ltd.	Raipur, Chhattisgarh	Hc Fe Mn, Si Mn	36,000
Nav Chrome Ltd.	Raipur, Chhattisgarh	Hc Fe Cr, Hc Fe Mn, Si Mn	36,260
Indsil Energy & Electro Chemicals	Chhattisgarh	Si Mn, Fe Mn	46,500
Jindal Steel & Power Ltd.	Raigarh, Chattisgarh	HcFeCr, Si Mn	66,000
Bihar Foundry & Casting Ltd.	Jharkhand	Si Mn	39,500
Steel Authority of India Ltd.	Chandrapur, Maharashtra Bhadravati, Maharashtra	Si Mn, FeMn Si Mn, FeCr	2,80,000 36,000
Tata Steel Ltd.	Joda, Odisha Cuttack, Odisha Bamripal, Odisha	Hc Fe Mn, Si Mn Hc Fe Cr Charge Chrome	2,72,000
Indian Metals & Ferro Alloys Ltd.	Rayagara, Odisha	Charge Chrome, HcFeCr,FeSi	3,98,500
MM Minerals & Alloys Pvt. Ltd.	Mayurbhanj, Odisha	Hc Fe Cr	25,000
T. S. Alloys Ltd.	Cuttack, Odisha	Hc Fe Cr	59,400
Universal Ferro Alloys & Allied Chemicals	Odisha	Fe Cr	37,000
Visa Bao Steel Ltd.	Odisha	Fe Cr, Si Mn, Fe Mn	1,50,000
Indian Charge Chrome Ltd.	Odisha	Fe Cr	62,500
Cosmetic Ferro Tech Ltd.	Bankura, West Bengal	Hc Fe Mn, Si Mn	43,375
Hira Concast Ltd.	Burdwan, West Bengal	Si Mn, Fe Mn	26,800
Maithon Alloys	Burdwan, West Bengal	Fe Mn, Si Mn	52,600
Shyam Ferro Alloys Ltd.	Burdwan, West Bengal	Si Mn, Fe Mn, Fe Cr	1,00,000
Srinivasa Ferro Alloys Ltd.	Durgapur, West Bengal	Fe Mn, Si Mn	84,200
Sri Vasavi Industries Ltd.	Bankura, West Bengal	Fe Cr	45,000
Rohit Ferro Tech Ltd.	Bankura, West Bengal	Fe Cr	45,375
Sharp Ferro Alloys Ltd.	Durgapur, West Bengal	Si Mn	42,500
Nilkantha Ferro Ltd.	Bankura, West Bengal	Si Mn	80,160

upgradations in India's Ferro Alloy sector are mentioned below :

- Tata Steel is setting up a Ferro Chrome plant at Gopalpur in Odisha. In the first phase a plant with a capacity of 55,000 tpy will be set up and in the second phase, another plant with a capacity of 2,40,000 tpy will be set up.
- Tata Steel has entered into a technology tie-up with Outotec Oyj for beneficiation of chromite tailings at Sukhinda in Odisha. The agreement is a part of Tata Steel efforts to bring about a 20 percent reduction in carbon foot print across its operations within the next ten years.
- Coastal Ferro Alloys has planned to set up a Ferro Manganese unit of 352,000 tpy capacity at Holdia in West Bengal. The unit will have 16 sub-merged arc furnaces of 13.5 MVA capacity each in two phases.
- Metsil Exports has planned to set up a ferro alloy unit of 36,000 tpy capacity at Gooty in the Anantapur district of Andhra Pradesh.
- Haritha Ferro Alloys is setting up a 62,380 tpy capacity Ferro Alloy plant at Hakimpet in the Medak district of Telangana.
- Sri Hari Ferro Alloys is setting up a 25,882 tpy capacity plant in Bhikanoor in the Nizamabad district of Telanagana in two phases. The first phase will include a Ferro Silicon Unit of 11,088 tpy capacity and a Ferro Manganese unit of 17,794 tpy capacity.
- Time Ferro Alloysis expanding the capacity of its Barjora facility in Bankura district of West Bengal from 11,000 to 34,000 tpy.
- Andhra Ferro Alloys is expanding the capacity of its plant at Srinivasnagar in the Vijianagram district in Andhra Pradesh from 20,000 tpy to 30,000 tpy.
- Utkal Manufacturing and Services, the logistic unit of IMFA Group, has planned to expand the capacity of its charge chrome furnace from 30 MVA to 60 MVA at its Chaudwar unit in the Jajpur district of Odisha.
- The Odisha Mining Corporation has planned to increase the capacity of its Sukurangi Chromite project from 1,50,000 tpy to 2,50,000 tpy in the Jajpur district of Odisha.
- Manganese Ore India Ltd. (MOIL) had planned to set up a plant in Chhattisgarh (1,06,000 tpy) in a joint venture with SAIL and another plant in Andhra Pradesh (57,000 tpy) in joint venture with RINL.

However, there have run into problem due to higher power tariff, particularly in Andhra Pradesh. It is now learnt that a three-way joint venture is being planned and a plant of 1,50,000 tpy of Fe Mn and Si Mn is proposed to be set up near Bhilai.

Performance of the Indian Ferro Alloys Industry

Capacity

Capacity of the Indian Ferro Alloy industry in 2011-12 was 4,124 MVA excepting Noble Ferro Alloys. In tonnage terms, it was 5.15 million tonnes including the estimated 0.5 Mt of Noble Ferro Alloys capacity.

The break-up is shown below :

With many new projects in the pipeline and due to the proposed expansions of the existing plant capacities, the capacity of the Indian Ferro Alloy industry will go up substantially in future years.

TYPE OF ALLOYS	NO. OF UNITS	CAPACITY (MVA)	CAPACITY (MT)
Manganese Alloys	140	2554	3.16
Chrome Alloys	38	1320	1.69
Silicon Alloys	19	250	0.25
Noble Ferro Alloys	==	==	0.05
TOTAL	==	==	5.15

Source : IFAPA

Production of Ferro Alloys in India 2008-09 – 2011-12

Production of Ferro Alloys in India between 2008-09 and 2011-12 is presented in Table-2.

TABLE – 2 : PRODUCTION OF FERRO ALLOYS IN INDIA : 2008-09 TO 2011-12 (TONNES)

PRODUCTS	2008-09	2009-10	2010-11	2011-12
BULK FERRO ALLOYS				
H.C. Ferro Manganese	372,286	341,883	390,000	427,415
M.C. Ferro Manganese	8,386	8,222	8,000	12,386
L.C. Ferro Manganese	5,775	6,018	6,000	6,932
H.C. Silico Managanese	889,434	1,066,485	1,250,000	1,418,844
M.C. Silico Managanese	24,087	24,108	24,000	33,662
L.C. Silico Managanese	22,368	25,454	25,000	25,897
Ferro Silicon	110,742	97,682	117,000	127,092
H.C. Ferro Chrome / Charge Chrome	790,072	890,916	1,030,000	902,840
L.C. Ferro Chrome	1,352	2,007	2,000	3,716
SUB-TOTAL (A)	**2,224,502**	**2,462,775**	**2,852,000**	**2,958,784**
NOBLE FERRO ALLOYS (B)				
Ferro Molybdenum	2,112	2,822	3,050	4,362
Ferro Vanadium	1,501	1,389	1,500	2,469
Ferro Tungsten	150	150	150	225
Ferro Silico Magnesium	13,400	17,132	18,500	24,452
Ferro Aluminium	8,170	7,017	7,600	7,393
Ferro Silico Zirconium	37	120	120	139
Ferro Titanium	1,561	1,929	2,100	2,217
Ferro Boron	83	90	90	103
Ferro Nickel Magnesium	221	209	250	272
SUB TOTAL (B)	**27,235**	**30,858**	**33,360**	**41,613**
GRAND TOTAL (A) + (B)	**2,251,737**	**2,493,633**	**2,885,360**	**3,000,397**

Source : Indian Ferro Alloys Producers' Association (IFAPA)

Between 2010-12 and 2011-12, total production of Ferro Alloys in India has gone up by 3.99 percent. In case of Bulk Ferro Alloys the growth was 3.74 percent while in case of Noble Ferro Alloys the same was a high of 24.74 percent.

Capacity Utilisation

Capacity utilisation of Indian Ferro Alloy industry is shown in Table – 3 in percentage terms.

TABLE – 3 : CAPACITY UTILISATION OF INDIAN FERRO ALLOY INDUSTRY (%)

TYPE OF ALLOY	2008-09	2009-10	2010-11	2011-12
Manganese Alloys	41.87	46.58	53.89	60.88
Chromium Alloy	46.80	52.84	61.06	53.67
Ferro Silicon	44.40	39.20	48.80	50.80
Noble Alloys	54.00	62.00	66.00	84.00
TOTAL	**43.73**	**48.43**	**56.02**	**58.25**

Exports of Ferro Alloys by India

Exports of Ferro Alloys by India between 2009-10 and 2012-13 are shown in Table-4.

TABLE – 4 : EXPORTS OF FERRO ALLOYS BY INDIA : 2009-10 TO 2012-13 ('000 TONNES)

ALLOY	2009-10	2010-11	2011-12	2012-13
Ferro Manganese	66.5	120.0	159.1	157.9
Ferro Silicon	20.1	50.0	46.4	18.8
Silico Manganese	298.3	699.6	732.4	970.1
Ferro Chrome	471.9	1305.9	567.7	517.7
Noble Ferro Alloy	5.9	14.4	27.3	18.7
TOTAL	**862.7**	**2189.9**	**1542.9**	**1683.2**

Source : IFAPA

In 2010-11 Indian Ferro Alloy industry earned foreign exchange equipment to about Rs. 133,915.10 million. Exports of Ferro Alloys in 2010-11 were about 77.64 percent of the country's total production.

Imports of Ferro Alloys by India

Imports of Ferro Alloys by India between 2009-10 and 2012-13 and are shown in Table-5.

TABLE – 4 : IMPORTS OF FERRO ALLOYS BY INDIA : 2009-10 TO 2012-13 ('000 TONNES)

ALLOY	2009-10	2010-11	2011-12	2012-13
Ferro Manganese	28.6	38.9	24.7	41.9
Ferro Silicon	1.4	135.1	148.8	134.8
Silico Manganese	125.1	1.6	13.2	2.6
Ferro Chrome	17.2	22.4	32.1	33.7
Noble Ferro Alloy	15.1	17.8	60.0	90.3
TOTAL	**187.4**	**215.8**	**278.8**	**303.3**

Source : IFAPA

Exports are mainly High Carbon Ferro Chrome, high Carbon Ferro Manganese and Ferro Silico Manganese. However, imports exceed exports in case of Ferro Silicon, low and medium Carbon Ferro Manganese and Noble Ferro Alloys.

Major exports of Indian Ferro Alloys are made to China, Iran, UAE, Netherlands, Japan, Italy, South Korea etc. Major imports of Ferro Alloy are made from China, Russia, South Africa, Bhutan, Argentina, Japan, Brazil, U.K. etc.

Raw Materials For Ferro Alloys

(a) Manganese Ore

As per the Indian Bureau of Mines (IBM) Survey Report, the all-India reserves of Manganese Ore as on 01.04.2010 were as follows:

Proved Reserves	: 141.977 Mt
Remaining Resources	: 288.033 Mt.
Total Resource	: 429.980 Mt

About 95 percent of Manganese ore is used for the production of Ferro Alloys and in blast furnaces. Nearly 80 percent of Indian Manganese ore contains less than 35 percent Manganese and has a low Mn / Fe ratio. Ferro Alloy grade Manganese ore should have a minimum of 38 percent of Manganese and the ratio of Manganese to Fe should be 2.5:7. Therefore, India is importing large quantities of Manganese ore and blending if with low grade Indian ore. Manganese ore is available in the states of Karnataka, Madhya Pradesh, Maharashtra, Odisha, Andhra Pradesh, Goa and Jharkhand. MOIL is the biggest producer of Manganese ore in India with a production of about 1 Mtpy.

Manganese alloys had a share of over 64 percent in the total Ferro Alloys produced in India during 2011-12. Capacity utilisation of Manganese Ferro Alloys was 60.88 percent in 2011-12.

(b) Chrome Ore or Chromite

As per UNFC system, the total resources of chromite in India as on 01.04.2010 were as follows:

Reserves	000' Tonnes
Proved Reserves	53,970
Remaining Reserves	149,376
Total Reserves	203,346

During the period between 2009-10 to 2013-14, the production of chrome ore in India was in the range of 2.9 to 3.9 Mt. However, production came down sharply in 2014-15 due to delay in extension of mine lease validity and other statutory clearances.

Chromium alloys constituted a share of 30.21 percent of the total ferro alloys produced in India in 2011-12. Quality of the Indian

chrome ore is good and about 40 percent of the same is exported.

About 96 percent of chromium ore in India occurs in the Sukinda Valley of Odisha. Odisha Mining Corporation (OMC), the state-owned body controls about 80 percent of chromite deposits in Sukinda IFAPA observed that mines being a national property the Central Govt. should instruct OMC to supply chromium ore to all the manufacturers of Ferro chrome without any discrimination.

Useful of Chromium Ore

Chromium imports strength, hardness, toughness, Magnetism and offers resistance to abrasion, corrosion and also acts as a de-oxident.

Low chromium steel containing less than 5 percent chromium along with small quantities of nickel are used in the production of rails, automobiles, armour plates etc. Medium chromium steel containing up to 15 percent of chromium along with small quantities of tungsten, molybdenum or silicon are used in high speed valve engines and equipment that need resistance to abrasion, corrosion and de-oxidation. High chromium steels are stainless and super stainless steels that are used for making cutlery, cooking utensils, aircrafts, high speed trains etc.

Coke and Fluxes

Metallurgical coke is used as a reducing agent in the sub-merged electric arc furnaces. Merchant Coke ovens have come up in various parts of the country and the capacity available is about 10/11 Mt. Producers of ferro alloys use imported coking coal as domestic supply is almost non-available carbon content in HC Ferro Manganese varies between 6 to 8 percent while MC Ferro Manganese has usually a carbon content of 1 to 3 percent. Silico Manganese has a high carbon content of 20 percent. HC Fe Cr has 6-8 percent carbon and MC Fe Cr contains 3-4 percent carbon. Limestone and Dolomite are fluxing materials and are available in eastern and southern parts of the country. Dolomite is also imported from Bhutan.

© Quartzite

Total estimated reserves of quartzite in India as on 01.04.2010 was 1175 Mt. Average annual production in India is about 0.5 Mt. Quartzite is available in the States of Andhra Pradesh, Jharkhand, Maharashtra, Chhattisgarh, Karnatakla, Odisha and Rajasthan.

(d) Power

Ferro Alloy is a power intensive industry. The ferro alloy units have to maintain a minimum demand of 85 percent of their power for their operation. Power accounts for 40 to 70 percent of the cost of production of Ferro Alloys depending on the alloy. Power tariff in India is very high and almost three to four times the cost of power in developed countries. Due to this, ferro alloy producers are setting up their own captive power plants and selling the excess power available which has helped them to reduce their losses. Supply of power at concessional rate is essential for the survival of Ferro Alloy Units.

Consumption of Power Ferro Manganese units is 2500-3000 Kwh per tonne, for Silico Manganese and Ferro Chrome units it is 4000-4500 Kwh per tonne and about 9000 Kwh per tonne for Ferro Silicon. For Noble Ferro Alloys the power consumption is still higher.

SWOT Analysis of The Indian Ferro Alloy Industry

As per IFAPA, the strengths, weaknesses, opportunities and threats in respect of Indian Ferro Alloy Industry are as follows:

(A) Strengths

- Mineral Reserves
- Growth Prospect of Indian Steel Industry
- Technical Manpower
- Proximity to Consumers
- Low Labour Cost
- Proximity to the Parts of Exports

(B) Opportunities

- Booming Capacity of Steel Markets
- Scope for Improving Infrastructure
- Industrial and Economic Reforms
- Captive Power Plants
- Increasing Export Markets

© Weaknesses

- High Cost of Capital
- High Cost of Power
- Dependency on Reductants
- Unavailability of High Grade Ores, Particularly Mn Ore.
- Less Importance to Research & Development
- Inadequate Infrastructure

(D) Threats

- Mushrooming Growth of Ferro Alloy Plants
- Increasing Imports of Ferro Alloys
- Export of Raw Materials
- Free Trade Agrrements

Contribution of Ferro Alloy Industry to Indian Economy

Major contributions of the Ferro Alloy industry to Indian economy are:

- The industry earns valuable foreign exchange for the country.
- Earnings of Ferro Alloy industry is plouged back to the Society as it reinvests its profits in setting up of captive power plants in acquiring coal and ore mines, building residential complexes, schools, colleges, hospitals which helps the economy of socially backward areas to grow, particularly in remote areas.
- The industry generates electricity through its captive power plants and supplies excess power to state grids thus increasing availability of power.
- By setting up Ferro Alloy units in the states like Odisha, West Bengal, Andhra Pradesh, Kerala etc., the industry has helped the economic development of these states.
- It has been estimated that a total of over 80,000 families are supported by the Indian Ferro Alloy industry which has provided jobs to the thousands of unemployed people, either directly or indirectly, in the plants and units which are located mainly in remote areas where there is no source of any other employment.

Conclusion

Despite the various constraints faced by it, the Indian Ferro Alloy industry has shown remarkable performance in recent years. The industry is providing vital inputs for the growth of Indian steel industry including the stainless steel industry. It is earning valuable foreign exchange for the country over the years. Major constraints faced by the highly power intensive industry is the high cost of power in India, steel increase in the costs of raw materials and other inputs, non-availability of high grade ore, high financial costs, ever increasing railway / rood freights, shortage of wagons, inadequate port facilities lack of government support for setting up of captive power plants. The Free Trade Agreements with many countries that have brought down Customs Duty and even exemption, have adversely affected the domestic industry.

The Indian Ferro Alloy industry is an unorganised entity. It essential to consolidate the achievements of the industry. Research and Development should be given top priority and the Government should render all positive help and guidance in this regard.

Finally, the recommendations made by IFAPA to the Government should be seriously taken up and the concerned ministry should implement them in a proactive manner.

Acknowledgements

1. IFAPA

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