



An Analytical Study of the Production of Major Bulk Ferro Alloys with Special Reference to India.

KEYWORDS

Bulk Ferro alloys, Ferro manganese, silico manganese, Ferro chrome.

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ABSTRACT

Bulk Ferro alloys are the widely used Ferro alloys which are used in large quantity. The main purpose of this research paper is to understand pattern of production of major bulk Ferro alloys in India. The study has been carried out for the period 2001 to 2012. Various statistical tools, charts and graphs are used for the better understanding and interpretation of the data collected using secondary sources. Here, it has been concluded that the contribution of Bulk Ferro alloys to the total Ferro Alloy production in case of India is much higher as compared to total world and there is significant difference in the pattern of production of Bulk Ferro alloys in the India as well as in the world.

INTRODUCTION

Post LPG, India has emerged as one of the fastest growing economies. In fact, India grew at much faster rate as compare to most of the nations on the planet just below the China for more than a decade. Many industries have contributed to the growth of Indian economy, IT, Pharma, Automobile, are the important of them. The growth of any economy is indicated by the growth of the Steel sector as Steel is an important ingredient of Infrastructure and it also does play an important role in many economic activities. Indian Steel industry also has done remarkably well since independence but still there is a huge scope for the improvement as lot of development in infrastructure in India is yet to happen. The growth of Steel industry also impacted the growth of other allied sector. The industry which is closely associated with the steel industry is Ferro alloy industry. Thus it becomes imperative to study this industry. It is therefore necessary to understand what are Ferro alloys, its types etc.

Ferro alloys are the alloys of iron and one or more other elements. There are two major groups of alloys as stated below:

1. Bulk Ferro Alloys: -This is the group of Ferro alloy where Ferro alloys are made using the metals such as Manganese, Chromium, Silicon and Nickel to produce the Ferro alloys like Ferro manganese, Ferro chrome, Ferro silicon, silico manganese etc. This set of Ferro alloys are known as Bulk Ferro alloys as they are added in larger proportion to steels. Bulk ferroalloys are used in steel making and steel or iron foundries

2. Noble Ferro Alloys: - Noble Ferro alloys which are used in much smaller proportion in special and alloy steels for addition of vanadium, molybdenum, Tungsten, Zirconium, Titanium, Boron, Tantalum, Magnesium Silicon and extra Low Carbon Ferro Chrome etc. Noble ferroalloys are of high value and consumed in low proportions.

The main purpose of this research paper is to understand pattern of production of major bulk Ferro alloys in India as bulk ferro alloys constitute major portion of the total Ferro alloys. The first major bulk alloy under the study is 'Ferro-Manganese'. It is of great importance in the steel and stainless steel industry as it is used as deoxidation agent. The second major bulk alloy under the study is 'Silico-Man-

ganese' and it is gaining importance as the substitute to Low-carbon Ferro manganese. The third major bulk alloy is 'Ferro-Chrome' which is the major alloying element in the production of stainless steel. Out of these three Ferro alloys, Ferro manganese and silico manganese are manganese base Ferro alloys whereas Ferro Chrome is chromium base Ferro alloys. The productions of these Ferro-alloys are studied for the period 2001 to 2012. The production of Ferro Alloys under different category in India is tabulated below:

Table 1 :-

Category wise Production of Ferro-alloys during 2001-2012 in India(In MT)						
	2001	2002	2003	2004	2005	2006
A) Bulk Ferro-alloys						
HC Ferro-manganese	169269	201406	225137	232327	250873	256121
MC Ferro-manganese	324	2798	5339	9287	13345	11796
LC Ferro-manganese	751	2420	6200	6774	6016	5140
Silico-manganese	276008	235730	304212	380316	498047	564633
MC Silico-manganese						27739
LC Silico-manganese						4000
Ferro-silicon	67349	76209	81955	68844	99296	90652
HC Ferro-chrome	381879	301109	379328	525824	594494	662062
LC Ferro-chrome	460	1000	1200	0	500	235
TOTAL (A)	896040	820672	1003371	1223372	1462571	1622378
B) Noble Ferro-alloys	6570	7189	12763	15594	17422	23049
TOTAL (A) + (B)	902610	827861	1016134	1238966	1479993	1645427

Category wise Production of Ferro-alloys during 2001-2012 in India(In MT)						
	2007	2008	2009	2010	2011	2012
A) Bulk Ferro-alloys						
HC Ferro-manganese	281013	977958	370531	341883	388079	427415

MC Ferro-manganese	9190	7517	8291	8222	7625	12386
LC Ferro-manganese	6523	5735	5755	6018	6313	6932
Silico-manganese	738314	858601	845432	1066485	1193874	1418844
MC Silico-manganese	29581	35041	31521	24108	24068	33662
LC Silico-manganese	15067	17760	14505	25454	24197	25897
Ferro-silicon	92632	83716	99595	97682	115164	127092
HC Ferro-chrome	801138	948366	814868	890916	1001582	902840
LC Ferro-chrome	230	235	2371	2007	2016	3716
TOTAL (A)	1973688	2934929	2192869	2462775	2762918	2958784
B) Noble Ferro-alloys	27763	29685	27435	30858	33995	41613
TOTAL (A) +(B)	2001451	2964614	2220304	2493633	2796913	3000397

Source: - IBM year books; U.S. Geological Survey, minerals.usgs.gov

REVIEW OF LITERATURE

The authors Didaleusky, J.R., Jorgenson et.al. in their paper 'Changes in the North American ferroalloys industry structure and trends in the industry during the past 20 years' have analysed the changes in the North American (Canada, Mexico, and the United States) ferroalloys industry between 1987 and 2007 with respect to production, imports, exports, pricing, and the structure of ownership since 1987.

Authors Par Jonsson, Thobias Sjoqvist, and Oystein Grong in their article on 'Future Demands on Ferroalloys from the Customers in the Steel Industry', discussed the possible reasons for increasing trend in improving the knowledge of how size, distribution and composition of inclusions change during steel making in the recent years.

In the paper 'Indian Ferro Alloy Industry- Present Status and Future Outlook' the authors C.N. Harman and N.S.S.RamaRao, discussed in detail about the evolution of the Indian Ferro alloy industry in a phased manner.

OBJECTIVES

Thus the objectives of the study are as under:-

- 1) To study the contribution of Ferro-manganese, Silico-managenes and Ferro- chrome to the total Ferro alloys production in India.
- 2) To compare the production of these major Ferro alloys on year on year basis.
- 3) To observe the trend in the production of major Ferro alloys.
- 4) To find out the variation in the production.

RESEARCH METHODOLOGY

Sample size and period : - The data for a period of twelve years i.e. from 2001 to 2012 is taken for this study.

Nature and source of the data : - The major source of data is the year books of Indian Bureau of Mines (IBM). Further the data is collected using the websites of Indian Ferro Alloy Producers' Association; US government Geological department.

Tools and Techniques:- The percentage method to analyse the trend and pattern of production of the Ferro alloys in India is used . The one way ANOVA test is carried out for the purpose of Hypothesis testing.

Formulation of Hypothesis :-The hypothesis are formulated taking into account the objective of the study. The hypotheses for this study are as follows:-

- (1) **H0**:- There is no significant difference in the pattern of production of Bulk Ferro alloys in the world.
- (2) **H0**:- There is no significant difference in the pattern of production of Bulk Ferro alloys in the India.

Data Analysis Hypothesis Testing:-

The data for the world's total Bulk Ferro alloys production is tabulated in the table 2. The data is taken from 2001 to 2012.

Table:-2

World Bulk Ferro Alloys Production				Total world Ferro alloy
	ferro Man-ganese	Silico-Manganese	Ferro Chrome	
2001	4,001,000	3,780,000	4,680,000	19200000
2002	3,604,000	4,360,000	5,050,000	20300000
2003	4,029,000	4,620,000	6,070,000	22800000
2004	4,706,000	6,030,000	6,590,000	26300000
2005	4,527,000	6,500,000	6,960,000	28000000
2006	5,194,000	7,470,000	7,330,000	32800000
2007	5,899,000	8,510,000	8,410,000	37900000
2008	5,849,000	8,660,000	8,060,000	37600000
2009	4,450,000	8,590,000	7,020,000	38300000
2010	5,692,000	10,100,000	9,300,000	45800000
2011	6,247,000	11,400,000	9,320,000	48300000
2,012	6,376,000	11,400,000	8,980,000	47900000

Source:- U.S. Geological Survey

From the data tabulated above, it is evident that there is an increasing trend in the production of the Bulk Ferro alloys during the period 2001-12 but there is wide variation in the pattern of their production. In percentage terms the contribution of Ferro Manganese and Ferro Chrome to the total Ferro alloy production has decline from 21% to 13% and from 24% to 19% respectively whereas contribution of silico manganese has increased from 20% to 24%. These three Bulk Ferro Alloys put together has contributed in the range 55% to 65% in all years except 2009 when they contributed 52%.

The application of one way ANOVA gives us following statistical information.

ANOVA	SS	df	MS	F	F crit
Source of Variation	446318230668047.00	3	148772743556016.00	58.16722605	2.816466
Between Groups	112537612000143.00	44	2557673000003.25		
Within Groups					

The F calculated is 58.16 and F critical is 2.81 hence we may reject the Null hypothesis and accept the alternate hypothesis.

The production of Bulk Ferro alloys during the period 2001-2012 in India has been tabulated in the table-3 below.

Table:-3

	Ferro Man- ganese	Silico- Manga- nese	Ferro Chrome	India total Ferro alloy Production
2001	170344	276008	382,339	902,610
2002	206624	235730	302,109	827,861
2003	236676	304212	380,528	1,016,134
2004	248388	380316	525,824	1,238,966
2005	270234	498047	594,994	1,479,993
2006	273057	596372	662,297	1,645,427
2007	296726	782962	801,368	2,001,451
2008	391210	911402	948,601	2,964,614
2009	384577	891458	817,239	2,220,304
2010	356123	1116047	892,923	2,493,633
2011	402017	1242139	1,003,598	2,796,913
2,012	446733	1478403	906,556	3,000,397

Source:- IBM yearbooks and U.S. Geological Survey

Similar to the table 2 from the table 3 also indicate the variations in the production of the Ferro alloys in India as well. The contribution of Bulk Ferro alloys to the total Ferro alloy contribution has been more than 90% throughout the period except in 2008 when it had contributed 76%. The contribution of Ferro manganese has decreased from 19% to 15% and Ferro chrome from 42% to 30% from 2001 to 2012 however Ferro Chrome's contribution has increased from 31% to 49% for the same period.

To test the hypothesis, one way ANOVA test has been used. The calculation on applying ANOVA is as under:

Source of Variation	SS	df	MS	F	F crit
Between Groups	4211519806132.23	3	1403839935377.41	23.74188429	2.816466
Within Groups	2601687229749.25	44	59129255221.57		

Here F calculated is 23.74 which is higher than the F critical 2.81 so we may reject the null hypothesis that there is no significant difference in the pattern of production of Bulk Ferro alloys in the world.

CONCLUSIONS

- (1) The contribution of Bulk Ferro alloys to the total Ferro Alloy production in case of India is much higher as compared to total world.
- (2) There is significant difference in the pattern of production of Bulk Ferro alloys in the India.
- (3) There is significant difference in the pattern of production of Bulk Ferro alloys in the world.

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