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# Energy Consumption and Conservation Measures in Ferro Chrome –A Step towards Green Manufacturing

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**ABSTRACT**

***Ferroalloys production is an energy-intensive industrial sector. In this paper, the current situation in ferroalloys processes is discussed from the standpoint of energy consumption and energy conservation issues, trends, and development. Progress and data of ferroalloys production are frequently compared with steel industry which is a closely related sector and the main user of ferroalloys. Operational factors of processes and electricity consumption are examined as well as possibilities and future scenarios to minimize energy consumption have been deliberated in this paper***.

## 1. INTRODUCTION

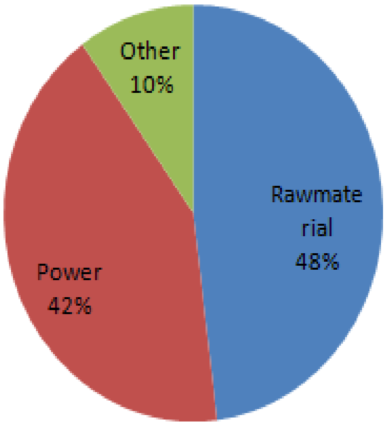
Though India is a significant player in world Ferro Chrome industry, it has never been globally competitive. The high cost of production of Ferro Chrome essentially attributed to:

a) High Power Cost
b) Increasing cost of Chrome ore and reductant
c) Non-availability of low ash, low phos. Coking coal in the country for the production of desired coke with low ash, and low prosperous contents making import of such coke.
d) High-cost and insufficient infrastructural facilities

## 2. ECONOMICS OF FERRO CHROME PRODUCTION

Major cost components of Ferro Chrome production can be segregated in to three parts, i.e., Raw material, Power cost, other costs. The contribution of each component to the total variable cost is as under. The raw material cost consist of Cost of coke, Flux, EC paste and Chrome ore where as the other variable costs include maintenance, stores consumables, packing, loading, labor charges, material handling etc. There are about 15 to 20 varieties of raw materials that are used for manufacturing Ferro alloys. The charge mix can be divided in to three broad categories as under.

Basic Ore – Chrome Ore. The ore may be in its natural form or in the form of Briquettes - About 12 varieties of materials in this category are used.




**Reductants –** Coke, about four verities of coke (Low Ash Metallurgical Coke) in this category are used.

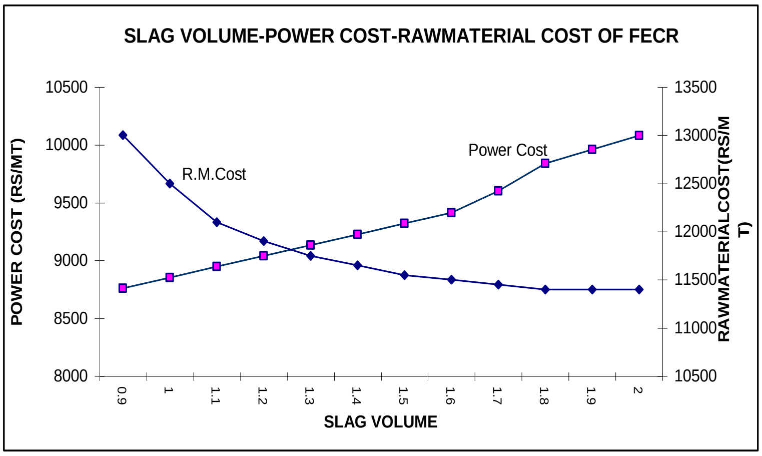
**Fluxes –** Quartz, Dolomite, Magnetite and dunite are used as flux and constitute as a major part of slag.

Raw material (Charge Mix) is fed to the Furnace. Electrode paste form soderberg electrode, which is submerged in the charge. Current is supplied through these electrodes and smelting of charge takes place. Reduced metal forms alloy, and impurities form a part of Slag. Ferro Alloys production is very much power intensive and power cost is about 40 to 45% of the product cost.

**Energy Consumption and Conservation measures**

Energy in terms of electricity and Carbon is the major input to Ferro Chrome manufacturing. The productivity of the industry solely depends upon the effective and efficient use of energy. Some activities for reducing energy consumption are discussed below. Though the list is not exhaustive but can significantly contribute towards energy conservation.

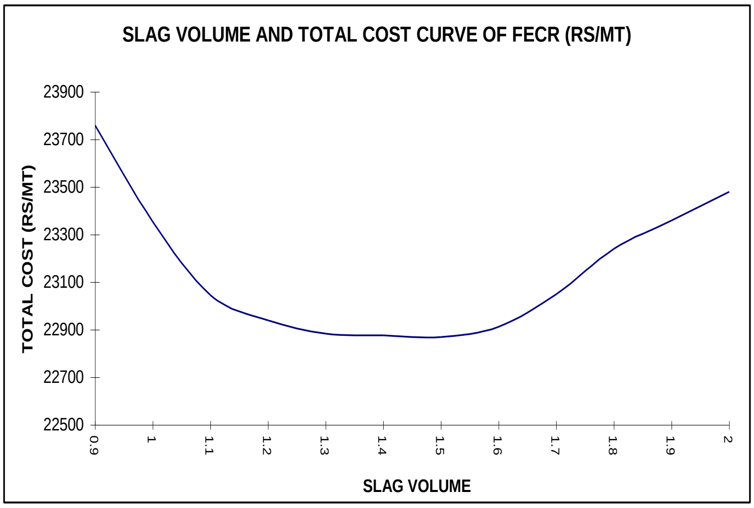
### a. Maintaining Slag Volume at an Optimum Level.




Ferro Chrome production being a slag process, about 1 to 1.2 MT slag is generated along with one MT of metal. The power consumption is influenced by the raw material mix in the sense that higher the volume of slag higher is the power consumption. The skill of the metallurgist to maintain a lower slag volume results in lower cost of production.

**Fig. 1 Relationship between Power, Raw Material and Slag Volume**

The study shows a direct relationship between slag volume, raw material, and consumption of power. Fig.1 and Fig 2 shows the relationship between the slag volume, raw material, and consumption of power and between the slag volume and total cost. Higher gang material in the ore leads to increases in slag volume. The higher volume of low grade ore with high alumina content along with flux may increase the slag volume.




Since the cost and royalty of low-grade ore is less, compared to that of high-grade ore, the raw material cost may decrease but slag volume will increase due to use of low grade ore. As the total charge volume increases it requires more power for smelting and results in increasing in cost of power. The charge balance should be selected in such a manner so as to maintain an optimum slag volume at a level where the total cost will be minimum.

**Fig. 2 Relationship between the Slag Volume and Total Cost**

**b. Installation of Auto Furnace Control System with Auto On-Load Tap Changers and Ht Capacitor Banks to Obtain Effective Power Utilization**

Installation of auto furnace control equipment coupled with auto load tap changers and H.T Capacitor banks are today's common feature of modern furnaces which contribute towards enhancing productivity by minimizing consumption of unproductive power.

**C. Minimizing Heat Losses in Furnace**

Today there are several open furnaces operating in the country today. Closed furnaces should be envisaged during modernization/expansion or new projects for manufacturing of Chromium alloys. This will not only reduce the heat losses from the furnace but also enable recovery of sensible and latent heat in exhaust gases. This will bring down the volume of gases and will impact in reducing the size of gas cleaning units.

**d. Control of Moisture in Raw Materials**

Often moisture content in chrome ore, coke, and other raw materials goes beyond acceptable limits particularly during rainy season and impacts in increasing specific power and reductant requirement. Drying operation is imperative for lowering down the moisture level in input materials since it will help not only to bring down the specific power consumption but also reduce the specific consumption of reductants, besides maintaining a steady slag volume and metal composition.

**e. Use of Agglomerated feed to the Furnace**

Agglomerates, being consistent in size and uniform in chemical composition, are better than natural lumps in their reducibility and therefore use of agglomerates lowers the specific power consumption, as well as helps to attain smooth furnace operation. Sinters can be used in the production of chrome alloys in order to bring down the specific power consumption.

**F) Other Energy Conservation Measures**

In addition to the above practices, there are many other energy conservation measures which can be implemented in order to minimize energy consumption. Some of these are listed below:

- Use of exhaust gases from the chimney to produce electricity. Further, the exhaust gases can be utilized for heating the raw materials before feeding to the furnaces which will enhance chromium recovery and reduction in power consumption.
- Use of the excess heat to melt secondary materials without the use of additional fuel
- Heat recovery by using hot gases from melting stages to preheat the furnace charge. The recovered heat is approximately 4 – 6 % of the furnace fuel consumption
- collecting monoxide from closed Furnaces and burning as a fuel for several different processes or to produce steam or other energy

## 3. CONCLUSION

India has rich mineral resources as it stands 2nd to South Africa in chrome ores production. In spite of having natural resources, the Indian ferroalloys industry is facing many challenges for its survival. The Indian Ferro Alloy Industry has a lot of potentials to be energy efficient. With the implementation of energy conservation measures, the position of the industry can be strengthened in the global market.

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