Beneficiation of raw materials and utilisation of fines and slags

P. C. Laha* 

name of ferro alloy industry in India

Production of ferro-alloy on tonnage scale started in India with import and efficient alloys in small quantities. These supplies were in three stages. In the first stage, the production requirements for these alloys have increased appreciably. A large and for the establishment of integrated ferro-alloy units, aided by the monopoly of single element bearing countries, ensued in the early 1970s and the market conditions post-import liberalization in the country. 

The high proportion of these alloys in the country comprises mainly of ferro-alloys of different grades, ferro-manganese of high, medium and low carbon contents, high low carbon high silicon, silicon metal, low carbon ferro-manganese and silicon steel. These ferro-alloys are manufactured by the carbothermic process.

Some small quantities of ferro-cadmium, ferro-aluminate, and ferro-tantalum are being produced by the smelting processes. The high value ferro-alloys viz. vanadium ferro-alloy, ferro-carbon and ferro-aluminides, are mostly being produced by the smelting process. Many ferro-alloy units working in the country employing similar processes and also iron high grade low carbon steel. The products made by the ferro-alloy units include:

- P. C. Laha, Chairman-cum-Managing Director
- M. D. engineer, Managing Director
- C.E. Engineers Consultants (India) Ltd., Ranchi.

Raw materials are now the prime requirements of the consumers in the ferro-alloy sector and a constant doubleamount buying is required. 

Advantages of ferro-alloy industry in the country:

The high value ferro-alloys which have led to the steady growth of ferro-alloy industry in India is the capability of the large scale raw materials or scrap materials, away from the areas of high value ferro alloys which is the country. These areas are comparatively less. 

The raw materials/resources potential of the country can be used for the samereadily. However to utilise the same optimally, the ferro-alloy producers need to:

- make the most of the potential of their own raw materials in making ferro-alloys and employing latest modern furnaces at the time of the ferro-alloy units working in the country are over two decades old and need to be modernised to keep them running competitively with the newer plants. Under such modernisation programme, utilisation of lower grade run-of-mine raw materials is in an advantageous position.

- utilise the materials from the available lower grade raw materials. This may be achieved by beneficiating the technologies of manufacturing ferro-alloys and employing latest modern furnaces which is the case with the ferro-alloy units working in the country.

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In addition, fluxes in the form of lime employed for smelting of the basic raw-materials of ferro-alloys. This is also to reflect a general view to develop and adopt new production processes. By creating an appropriate environment for a detailed interaction amongst all concerned organisations for evolving the most suitable conclusions on the feasible measures to be adopted to overcome the same.

The problems of raw materials the changing requirements of ferro-alloys may pose some problem to the conventional ferro-alloy manufacturers but this offers scope in up-tacking the existing ferro-alloy production process for a better performance. The problems of raw materials and thereby achieve economics of scale.

Advantages of fines-agglomerates

The iron and steel industries in the country have always been largely dependent on the control of raw materials especially for the manufacture of high grade ferro-alloys and silicon metal. The fines also required for the manufacture of lower grade ferro-alloys and silicon metal. No flux is also required in the manufacture of higher grade silicon alloys and therefore, plays a key role. Although the quartzite available is of high purity, the size of quartzite particles is fine and hence the reducibility characteristics improve substantially.

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Beneficiation and utilization of manganese ores

Manganese ores are utilized in the manufacture of manganese steel, which is used in the production of machinery parts. Manganese steel is characterized by a high manganese content, typically between 12% and 18%, which imparts a certain level of toughness and wear resistance. The production process for manganese steel involves the smelting of manganese ore in a blast furnace, followed by refining in a basic oxygen furnace (BOF) to produce high-quality steel.

The use of higher-grade ores in the manufacture of manganese steel is crucial for achieving the desired mechanical properties. Lower grades of manganese ore may require additional processing steps, such as crushing, grinding, and magnetic separation, to meet the required specifications.

The extraction of manganese from ores involves several steps, including mining, crushing, grinding, beneficitation, and smelting. Beneficitation is the process of separating the desired minerals from the host rock, typically through gravity separation, magnetic separation, or flotation. The smelting process converts the powdered ore into a metallic form, which is then refined to produce high-purity manganese.

The utilization of manganese steel in various industries highlights the importance of efficient and effective manganese ore processing. The development of new technologies and methodologies to improve the extraction and utilization of manganese ore is an ongoing area of research, aiming to enhance the sustainability and efficiency of the manganese supply chain.
Utilisation of all fines generated during mining.

It is well known that the chromite mineral occurs very rarely in the country in the form of ore suitable for direct reduction. This is directly influenced by the prevailing weathering and leaching of lower grade chromite ores. The present chapter is therefore mainly concerned with the characterisation and exploitation of lower grade chromite resources.


tant used generally has melting temperature low enough for slagging of the hearth and as such use of any fluxing agent is not called for in the manufacture of chromite alloys. However, due to the small difference in the density of the slag and the metal produced higher amount of separation of slag from the metal is not required. The amount of slag produced is therefore generally less than 1%.

Due to the characteristics of the ore and the chosen product, demand for a small difference in the specific gravities of the slag and the metal produced higher amount of separation of slag from the metal is not required. The amount of slag produced is therefore generally small being less than 1%.

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With the advent of new metallurgical processes, it is necessary to optimise the metallurgical treatment of raw materials, especially in case of chromium ores. Beneficiation of these ores is aimed at increasing the chromium content of the concentrates and reducing the gangue content, thereby making them suitable for steelmaking processes. Beneficiation methods employed for chromium-bearing ores are influenced by the nature of the ore, its size distribution, and the desired end products. A variety of methods, including gravitational and non-gravitational techniques, have been employed for the beneficiati
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Ferro-Nickel

Conventionally, the primary nickel producers are Indonesia, Japan and various sulphide ore mines. However, the nickel production from these mines is not sufficient to meet the demand of the world market. The demand for nickel is increasing due to the increasing use of stainless steel in the construction industry. The production of nickel from oxide ores such as lateritic nickel ores has been gaining major attention by the nickel producers. This is because the nickel content in oxide ores is generally lower compared to the nickel content in sulphide ores. The nickel content in oxide ores is typically between 0.5% and 1.5%.

The above conditions, therefore, lead to a situation that the nickel ore reserves having nickel content of less than the average level of 1.1% and also not meeting other specifications will not find any use in the manufacture of ferro-nickel. It is noted that the overburden, which is being removed during the mining of the ore to the kiln — electric furnace (RK-EF) process, contains a small percentage of nickel (0.5 to 1.5%) but not cobalt. This overburden is a low-grade nickel ore which can serve as a feed in the manufacture of ferro-nickel. For example, if the overburden contains 1% nickel, it can be used as a charge material in the manufacture of ferro-nickel.

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