KAVIR Steel Cooperative

شرکت تعاونی فولاد کویر

Chemical Characteristics

Fe (metallic) = 83%avg.

Carbon = 0.15%to 0.25%(0.2%avg.)

Sulphur = 0.04%to 0.06%(0.055%avg.)

Phosphorus = 0.035%to 0.050%

Gangue = 5.0 %avg.

(Al2O3+SiO2+MgO+CaO)

What is DRI/Sponge Iron

Direct Reduced Iron (DRI), also known as Sponge Iron, offers an alternative steel production route to utilising Scrap in Electric Arc furnaces (EAF) or Induction Furnaces (IF). Two primary fuels used in DRI production, Natural gas and non coking coal. All DRI produced in Iran is through natural gas, which is understandable, Iran having one of the largest known resevoirs of Gas. A detailed that has lead to minimum investments and attraction towards the other fuel that can be very effectively utilised in DRI production, Coal. As a comparison, more than 78.6 %of the global DRI plants use (lower grade) natural gas, and about 21.2 %production of DRI is coal based.

Direct-reduced iron has about the same iron content as pig iron, typically 90–94%total iron (depending on the quality of the raw ore) so it is an excellent feedstock for the electric furnaces used by mini mills, allowing them to use lower grades of scrap for the rest of the charge or to produce higher grades of steel.

Some advantages of Coal Based DRI

Shortage of scrap coupled with steeply rising prices of both domestic and globally sourced scrap led to the substitution of scrap by sponge iron in the charge and this is possibly the single most important factor leading to the rapid growth of the sponge iron units.

Table 2 Comparison of coal based and Gas based DRI

Subject	Unit	Coal based	Gas based
Carbon content	%	0.2-0.25	1.2-2.5
Product size		varying	uniform
Material state		stable	Prone to re-oxidation
Bulk density	tons/Sqm	1.6-2.0	1.5-1.9
Non metalliks	%	0.3-0.5	Nil
Metallization	%	86-92	85-93

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Advantages of Coal Based Sponge Iron over Gas based Sponge Iron

Re-Oxidation - Gas based Sponge Iron is very highly susceptible to oxidation. And as it gets oxidised the metallization of the DRI decreases and the yield in Steel Melting also decreases. So there is a loss in yield if the DRI gets re-Oxidized which the gas based DRI is very prone to.

Risk of Fire Out while stored - As Gas based DRI is made by reducing gases, it has a porous, sponge like form. Consequently, it has a large surface area relative to its mass, which enhances its reactivity. If it becomes wet, it oxidizes and liberates hydrogen gas from the water. This particularly is true if the water contains dissolved salts such as sodium chloride (e.g. sea water). As part of the reaction, it heats up significantly, which further stimulates the oxidation of the still dry lumps or pellets, resulting in chain reaction that spreads rapidly throughout the DRI pile. When sufficient oxygen is available, temperature can reach as high as 1500 deg C. If stored in a closed environment, such as a ship's hold, the hydrogen liberated crates a potentially explosive mixture. Further, ventilation to remove the hydrogen would enhance the oxidation, and thus the overheating. Coal Based DRI does not have this problem

High FeO Content (Improves melting rate)– The oxygen in the DRI present in the form of FeO reacts vigorously with carbon in the molten bath, fostering improved heat transfer, slag-metal contact and homogeneity of the bath. This helps in saving electric energy.

Low Carbon Content - Carbon content is less in the coal based DRI as compared to Gas based DRI which is good for the melting rate. But there are some specific requirements for low carbon steel (0.10 – 0.15 %) especially for pipe making where the coal based DRI will be helpful to get low Carbon as against the Gas based DRI having high carbon.

Low Sulphur Content – Sulphur content is less in the coal based DRI as compared to Gas based DRI which is good for the Steel as high sulphur is not recommended for the good quality of steel. High Sulphur improves machinability but lowers transverse ductility and notched impact toughness and has effects on the longitudinal mechanical properties.

In India almost all the steel making companies are using more than 60 %Sponge in their Induction Furnace / Electric Arc Furnace. While some units have reported using nearly 100%sponge iron.
Also Induction Furnace units situated in locations where unit price of power is low, similar to the prevailing situation in Iran where electricity prices are low, can afford to use higher percentage of Sponge Iron.

At times higher percentage of Sponge Iron is reported to have been used out of compulsion due to non-availability of scrap.

Of late, main problems faced by steelmakers are short supply, fluctuating prices together with extremely heterogeneous nature and presence of tramp elements of steel scrap. Use of direct reduced iron (DRI) as a replacement to scrap, to some extent does help in overcoming this hurdle.

Attempts were made to study melting of DRI in a laboratory size induction furnace using molten steel bath as hot heel. The induction stirring accelerates the transfer of heat and promotes the melting of DRI. The effect of partial replacement of scrap by DRI on various melting parameters has been studied.

Also kinetic studies were made to evaluate net melting rate. It was revealed that since melting and refining are taking place simultaneously, the increasing proportion of DRI in the input charge increases net melting rate and metallic yield. It was concluded that higher proportion of DRI, as a replacement to scrap, contributes to improve mechanical properties with no segregation of carbon content and the decrease in sulphur and tramp elements in the product that improves steel quality.