S Y N O P S I S

MATHEMATICAL MODELLING OF REDUCTION OF IRON ORE IN ROTARY KILN

Direct reduction is a process for reducing iron ore in the solid state. The product is in the form of sponge iron. This can be used directly as a raw material for steel making in an electric arc furnace. Alternately, partially reduced sponge iron can be used to enrich the burden of a blast furnace so as to lower coke rates and to increase productivity. Currently, there is a substantial increase in interest in the process of reduction of iron ore to sponge iron. It has been proven to be technologically feasible on a large scale and, more importantly, it has been shown to be economically competitive with pig iron production in blast furnace.

An alternate to blast furnace is especially important in view of the present scarcity of coking coal. In order to ensure efficient and economic production of iron in a blast furnace it is essential to use high grade coking coal, the reserve of which is increasingly becoming scarce. Modern blast furnace technology has reduced the coke burden of the furnace and, hence, the amount of high grade coal required. This has been accomplished by charging agglomerated and partly reduced ores and by injection of either natural gas, coal gas or fuel oil into the furnace. However, these innovations are not likely to reduce coke consumption very substantially. The other alternative technology of

Formed Coke also has so far failed to show adequate promise on substitute of blast furnace coke.

It is, therefore, necessary to seek an alternative process to extract iron from its ore.

In general, direct reduction utilizes either solid or gaseous fuels, depending on local conditions. Most solid-fuel processes (e.g., SL-RN, KRUPP-CODIR, ACCAR etc.) are carried out in rotary kilns. Some direct reduction processes using gaseous fuels employ shaft type reduction furnaces and reformed natural gas (e.g., MIDREX, HYL etc.). On the other hand, there are some processes based on the fluidized-bed technique (e.g., HIB, FIOR etc.), in which, during reduction, reformed natural gas are used to keep the particles of finely divided iron ore in suspension and to make them behave like fluid.

The global trend of direct reduction has been dominated by gas based processes which account for about 90% of total production of DRI. The development of coal based processes has been slower than gas based processes. This is mainly due to low productivity and operational constraints. However, as the reserves of natural gas/associated petroleum gas in India are limited and has to be largely committed to other priority sectors like fertilizer and power, it is important that a number of non-coking coal based smaller scale DR plants are installed in the country to meet partly the growth requirements of the steel industry with special emphasis on local needs.