9810 Technology of Low Coal Rate and High Productivity of RHF Ironmaking

Benefits

- This technology will increase energy efficiency, reduce CO_2 emissions, and lower the capital investment and operating costs in Rotary Hearth Furnace iron ore reduction and waste oxide recycling processes.

Applications

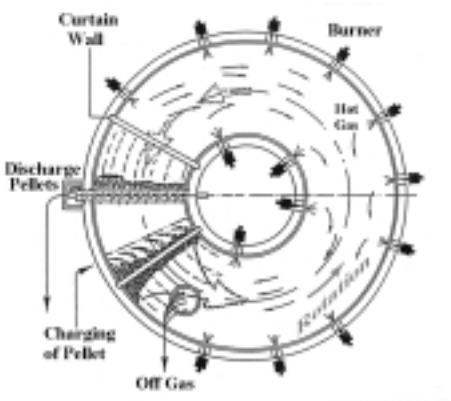
RHF iron ore reduction and waste oxide recycling processes.

Direct reduction processes using agglomerates composed iron ore or waste oxides and coal, coke, or other forms of carbon.

Productivity of rotary hearth furnace improved by increasing the reaction temperature and bed height

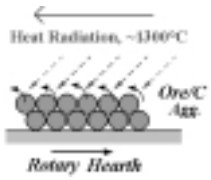
The reduction of iron ore/coal agglomerates in a Rotary Hearth Furnace (RHF) is a coke-free, environmentally friendly ironmaking process. However, the productivity and energy efficiency of the process is low due to shallow bed height, low reaction temperatures, and insufficient carbonaceous additives in the pellets.

The kinetics of reduction of iron oxide in iron ore/coal agglomerates is highly temperature-sensitive because it involves strongly endothermic reactions. On the other hand, a higher temperature promotes the re-oxidation of newly produced direct-reduced iron (DRI) by CO_2 and/or O_2. In current RHF practice the bed depth of agglomerates is shallow, only 2-3 pellets high, and the solid reductant is low in volatile matter. Therefore the flow of gases, that could protect the pellets from reoxidation is weak and unsteady. The practice of maintaining the CO/CO_2 ratio greater than 2 results in very poor fuel efficiency, while the low process temperature limits the productivity of the process



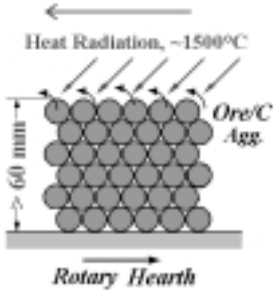
Rotary Hearth Furnace for Waste Oxide Recycling and Iron Ore Reduction

Hot Gas, $CO_2/(CO+CO_2) < 0.3$



Current Practice

Hot Gas, $CO_2/(CO+CO_2) = 1$



Goal of the Project

Project Description

Goals: The objective of this project is to increase the productivity of RHF, quality of DRI, and fuel efficiency by increasing the reaction temperature, the height of the bed of agglomerates, and the content of volatile matter in the carbonaceous reductant.

Progress and Milestones

- Construction and commissioning of a gas-fired furnace to heat specimens up to 7 kgs in mass and 120mm in height by radiation from the flame and furnace roof is complete.
- Completed experiments with 60-80mm high pellet beds and furnace temperatures of 1300 to 1500°C
- Experiments on pellet beds greater than 100 mm high are complete.
- Investigate the role of volatile matter in pellets and the effect of carbon reactivity in char and coke breeze in deeper beds. Perform comparative studies of ore/coal, ore/char, and ore/coke.
- Controlled experiments to establish the optimum conditions for RHF ironmaking to produce low CO_2 emission and high productivity are nearly complete.
- Perform controlled experiment s to establish the optimum conditions for recycling waste oxides in an RHF.
- Perform chemical analysis and metallographic examination of reduced specimens
- Mathematical analysis of experimental data and interpretation of results
- Present a workshop to transmit the results of this research to its sponsors.
- Issue the final report, first quarter, 2002.

Total Project Cost/Duration

$317,000/three years

Research Organization

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