Carnegie Mellon

Materials Science and Engineering Seminar Series

Materials Research at Carnegie Mellon

Sabuj Halder

Graduate Research Assistant
Department of Materials Science and Engineering
Carnegie Mellon University

"On a New Ironmaking Concept: Simulation of Reduction of Iron-Oxide-Carbon Composites in a Rotary Hearth Furnace"

Friday, April 6th, 2007
11:00 A.M. Seminar in Baker Hall 136A
Refreshments precede seminar at 10:30 A.M. in 2325 Wean Hall

The primary motivation of this work is to evaluate a new alternative ironmaking process. The driving force for the process is to produce iron by minimizing energy requirements, capital costs and environmental degradation. The new process route involves the combination of a Rotary Hearth Furnace (RHF) with a bath smelter. The RHF makes use of low grade iron ores, fines, mill scale and other iron containing sources which are not of much utility in an integrated steel mill. These are combined with a carbonaceous reductant like coal or wood-charcoal (biomass) and agglomerated into spherical composite pellets. The pellets are subsequently reduced to Direct Reduced Iron (DRI) in the RHF. The DRI is to be processed further in a bath smelter for complete reduction and removal of other impurities. This investigation is concerned with the RHF and the ways to optimize the operating parameters of the furnace which might influence its productivity. The strategy adopted in this study comprises of both experimental simulations and mathematical formulations to validate the experimental observations. The experiments involve laboratory scale simulations of the actual reduction conditions in the RHF and measurement of the reaction rates using a mass spectrometer. From previous works on this subject, it is known that the reduction kinetics in the RHF is controlled by several mechanisms like the chemical reaction kinetics of the carbon gasification and wustite reduction reactions as well as the heat transfer mechanisms to and within the pellets. Besides, the influence of pellet shrinkage on the reduction rates shall also be discussed. Forms of carbon like coal-char and wood-charcoal are being explored as feasible reductants. Wood-charcoal is a very promising carbonaceous reductant since it is a renewable resource unlike coal. The iron oxides under investigation include both synthetic reagent grade as well as commercial grade ores.

Sabuj received his Bachelor's degree in Materials and Metallurgical Engineering from Indian Institute of Technology, Kanpur (INDIA) in 2003 and his Master's degree in Materials Science and Engineering at Carnegie Mellon University in 2004. He is currently a PhD candidate in the Center for Iron and Steel Research under the guidance of Prof. R. J. Fruehan.