9945 CFD Modeling for High Rate Pulverized Coal Injection (PCI) to Blast Furnaces

Benefits

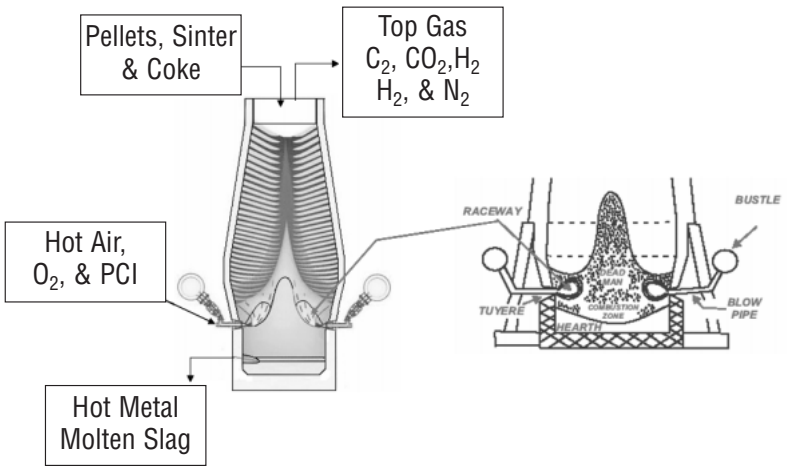
- Increase productivity by reducing the reliance on coke in ironmaking.
- Maximize fuel efficiency.
- Increased utilization of coal and reduction of coke in blast furnace operations.
- Cost savings by substituting less expensive coal for coke.
- Reduced pollution through the minimization of coke.
- Annually U.S. steel industry ships approximately 105 million tons of products. Roughly 53 million tons of these shipments are produced by blast furnaces. With the proposed increases of PCI rate, and replacement ratio, a total energy of 15.4 MMBtu can be saved every year in the U.S.

Applications

- Integrated steel production.
- Improved understanding of coal injection and combustion process.
- Advancing the state-of-the-art in CFD modeling techniques.

The U.S. steel industry produces over 100 million tons of steel annually. All steel originates from iron ore, which is reduced in the blast furnace. The major fuel for this process is coke derived from coal. The modern trend in blast furnace operations is to inject coal directly into the furnace. However, increased use of coal is associated with lower flame temperature, burden permeability, and chemical reactivity.

The objective of this project is to help increase the level of coal injected from 300 to 500 pounds per ton of hot metal. To accomplish this it is necessary to increase our understanding of the complex physical and chemical interaction of coal in the blast furnace.



BLAST FURNACE

Project Goal: To develop a state-of-the-art CFD model to better understand the high rate PCI process. The CFD model will include major features of the PCI process in real BF operation conditions.

The Eulerian approach will be used to treat multi-phase (gas-coal-coke) flows. Both coal and coke combustion will be modeled. The CFD model will provide detailed information of velocity, temperature and species distributions, coke particle and unburned char distributions, raceway formation, as well as combustion efficiency. The CFD model will be validated with experimental data. It will then be used for parametric and optimization studies to investigate impacts of key factors such as coal type, coal injection rate, coal-to-coke replacement ratio, injection system, and hot oxygen injection.

Progress and Milestones

- ❖ Project start date: May 2005
- ❖ Simulation of gas-solid flow in raceway: July 2005
- ❖ Simulation of coal and coke combustion: October 2005
- ❖ Complete simulation of PCI in the BF: April 2006
- ❖ Parametric studies and optimization: February 2007
- ❖ Technology transfer: April 2007
- ❖ Project completion date: May 2007

Total Project Cost $440,872

Duration 2 years

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