MINIMIZATION OF BLAST FURNACE FUEL RATE BY OPTIMIZING BURDEN AND GAS DISTRIBUTIONS

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PROJECT OVERVIEW

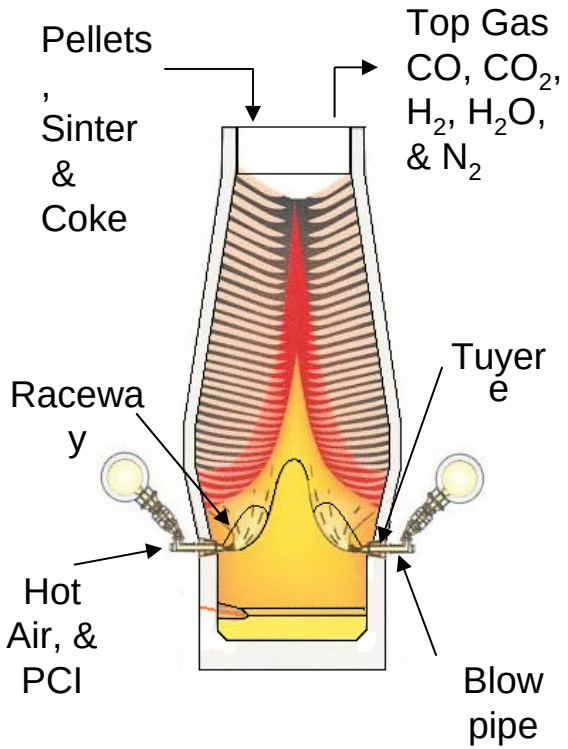
- Participants:
  - American Iron and Steel Institute
  - ArcelorMittal Steel
  - Dofasco
  - Severstal
  - Purdue University Calumet
  - Stelco Inc.
  - US Steel
  - Union Gas
- Duration: 3 Years
- Start Date: October 2007
- Funding Agent: DOE/AISI

PROJECT GOALS

- To help the steel industry in using advanced technology to
  - Increase pulverized coal injection rate and fuel efficiency
  - Reduce carbon emissions
  - Optimize BF efficiency
- To lay a solid foundation for developing a comprehensive model for the whole blast furnace to optimize the BF operation
- To enhance education program at PUC

BACKGROUND

- The fuel economy of the blast furnace process is directly coupled to the gas and burden distributions.
- The gas distribution, i.e., the effective contact between the gaseous reductant and the iron ores, strongly influences both the thermal and chemical phenomena in the lumpy zone of the furnace.
- The gas distribution also affects the pressure loss as well as productivity and smoothness of operation
- The gas distribution is controlled mainly by manipulating the distribution of the burden and tuyere operation.
- The proper gas and burden distributions are keys to realizing the high rate PCI and high fuel efficiency.

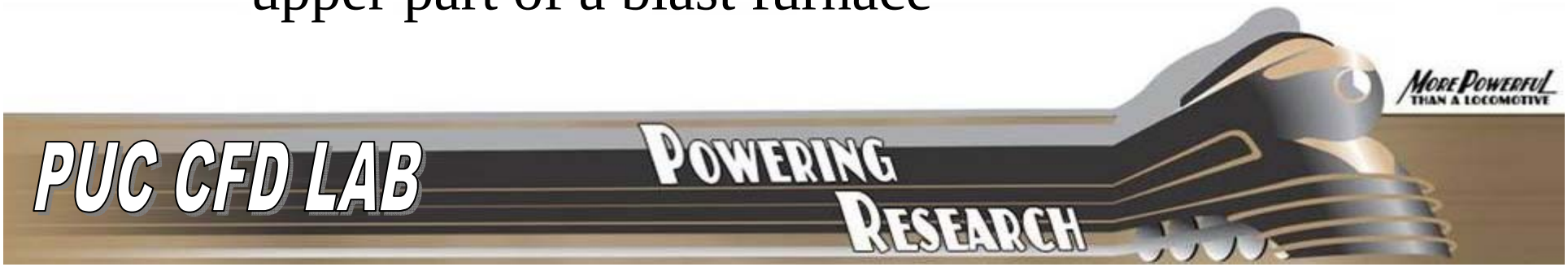


PROJECT OBJECTIVES

- To develop a state-of-the-art 3-D CFD model for simulating the gas distribution inside a blast furnace at given burden conditions, burden distributions and blast parameters
- To conduct measurements of top temperature and gas composition distributions as well as validations of the CFD model
- To optimize the burden and gas distribution for maximizing gas utilization with proper furnace permeability for given burden materials, productivities, and blast furnaces
- To optimize the burden and gas distributions for high fuel injection rate and low coke rate with the best fuel efficiency for given burden materials, productivities, and blast furnaces

PROJECT TASKS

- Task 1: Development of 3-D Computer Simulation
  - Subtask 1.1 Simulation of Gas Distributions
  - Subtask 1.2 Simulation of Melting and Gasification
    - Heat transfer sub-model
    - Cohesive zone sub-model
    - Sub-models for the chemical reactions
    - Coal and coke combustion
  - Subtask 1.3 Complete Simulation of PCI and upper part of a blast furnace



PROJECT TASKS

- Task 2: Measurements of Top Temperature and Gas Composition Distributions and Validations of CFD Model
  - Subtask 1.1 Validation of CFD sub models
  - Subtask 1.2 Validation of entire CFD model

PROJECT TASKS

- Task 3: Parametric Studies and Optimization
  - Subtask 3.1 Optimization of the burden and gas distribution to maximize gas utilization
  - Subtask 3.2 Optimization of the burden distribution and gas distribution for high fuel injection rate and low coke rate with the best fuel efficiency
- Task 4: Technology Transfer
- Task 5: Project Management and Reporting

PARAMETRIC STUDIES

- Burden material
- Charging pattern
- Layer structures
- Thickness ratio
- Productivity
- Furnace permeability,
- Furnace geometry

INDUSTRY INVOLVEMENT

- To provide technical know-how
- To make necessary measurements on blast furnaces and provide measured date for CFD simulations
- To provide geometrical and operating conditions for CFD simulations
- To participate in the commercialization of the CFD software
- To review the project progress quarterly and to evaluate technical contents every six month.
- One of the industrial collaborators, Dr. Frank Huang at ArcelorMittal Steel, will serve as the co-principal investigator to oversee the project

Year	I												II												III											
Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
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THANK YOU


PUC CFD LAB
POWERING
RESEARCH
MORE POWERFUL
THAN A LOCOMOTIVE