Research Group for Process Metallurgy of Iron and Steelmaking, Indian Institute of Technology IIT Madras Chennai

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Scope of Research Work

- **Process modeling, control and optimization of iron and steelmaking.**
- **Computational thermodynamics and its application to high temperature metallurgical processes.**
- **Application of Artificial Intelligence (ANN, GA) to metallurgical processes.**
- **Heat and Mass Transfer.**
- **Extractive Metallurgy**
- **Computer Aided Process engineering (CAPE)**

What is Process Metallurgy

Metallurgical engineering is concerned with extracting metals from their ores, their development and production at large scale for application and use of metallic materials. Metallurgical engineering which is based on the principles of science and engineering, may further be divided into **process metallurgy** and **physical metallurgy. Process metallurgy** which is concerned with extracting metals from their ores to make refined alloys, and physical metallurgy, which involves the shaping, alloying, heat treatment, joining, corrosion protection and testing of metals.

Research Areas

- Thermodynamics and kinetics of pyrometallurgical processes
- New technologies for iron-making, steelmaking and ferroalloy-making
- Reduction, smelting and refining processes
- Gas-solid reactions at high temperatures
- Ferrous and non-ferrous Extraction Metallurgy
- New Direct Ironmaking technologies (COREX/MIDREX)
- New developments in blast furnace iron-making
- Basic Oxygen (BOF) and Electric arc furnace (EAF) steelmaking
- Kinetics of liquid/solid/gas reactions in metallurgical processes
- Mathematical modelling of metallurgical processes
- Refractory reactions in metals processing
- Transport phenomena in process metallurgy
- Fluid flow, heat and mass transfer in packed and fluidised beds
- Heat transfer based modeling of continuous casting process
- Optimization of steel plant supply chain by evolutionary technoques
- Data based modeling of iron and steelmaking process (ANN/MTS/PCA etc.)

JSW-IITM Center for Applied Research (JICAR)

JSW-IITM Center for Applied Research is an Industry-Academic collaboration initiative to conduct research and to provide innovative technologies in the area of Iron and Steel. It was established in January 2014.

The team of JSW-IITM Center for Applied Research (JICAR) is multi-disciplinary in nature consisting of members from Chemical as well as Metallurgy department from IIT Madras side and similar composition from JSW Steel Plant side.

JSW-IITM Center for Applied Research (JICAR)

The projects under this center are mainly applied in nature for direct industrial application. Following Projects are underway with JSW Steel Plant under this Center:

1. **Dry slag granulation process for energy recovery and clinker production (Also supported and funded by Ministry of Steel, under Govt. of India)**

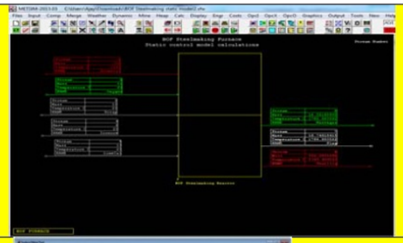
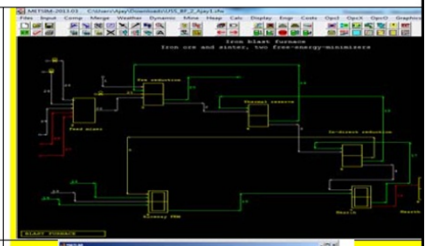
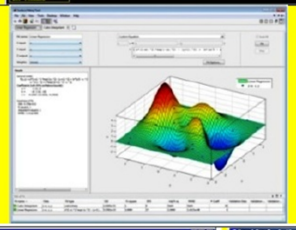
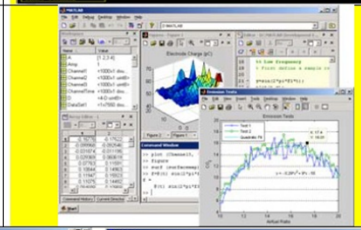
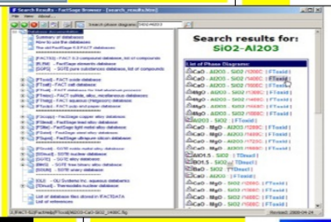
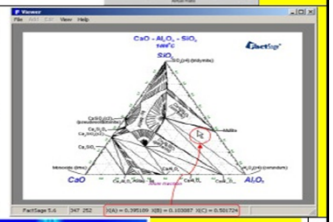
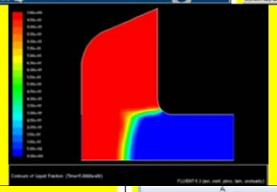
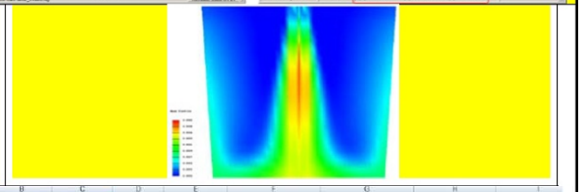
2. **Microwave assisted reduction roasting based beneficiation of lean quality iron ore and coal fines. (Supported by Ministry of Human Resources/JSW Steel, NMDC Ltd. project yet to start)**

3. **Static and Dynamic control of BOF Steelmaking process.**
4. **Development of dynamic control model for RH degassing process.**

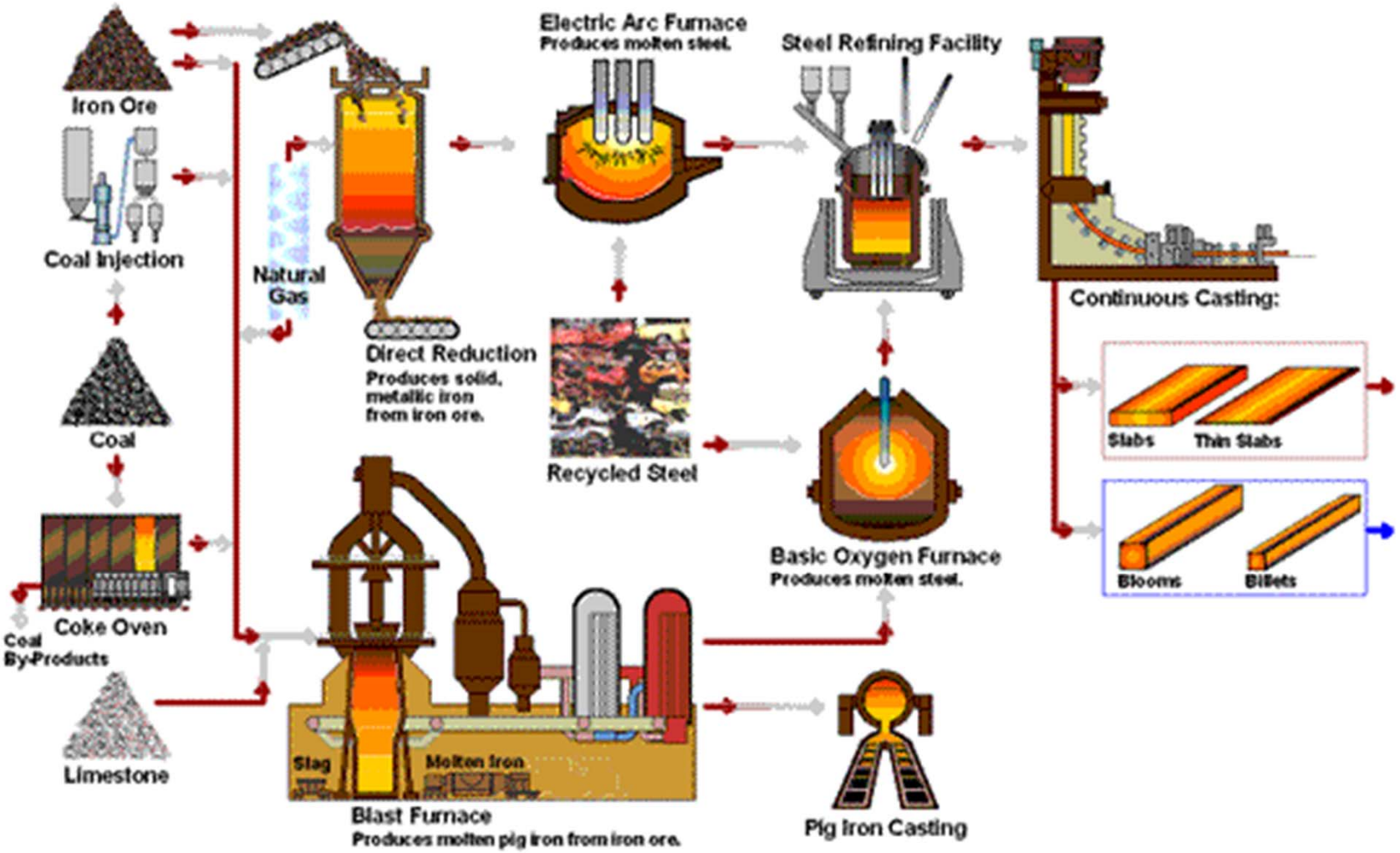
5. **Data based models (ANN-GA based) for steel plant process control.**

6. **Development of Expert system for COREX Iron-making process**

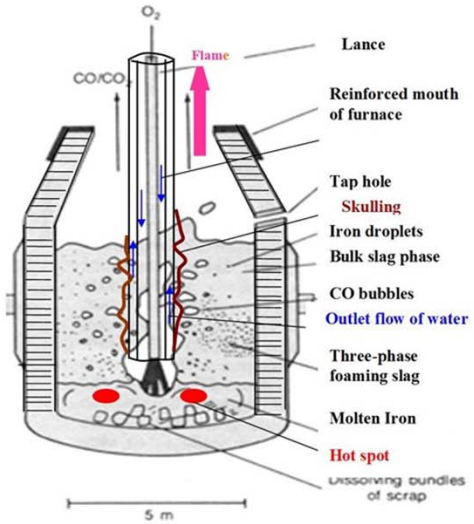
Modelling tools applied for simulation of iron and steelmaking processes

MetSim		
MATLAB		
FactSage	 	
Fluent		
Excel-VBA and Excel-Solver		

Process Layout Steel Plant (Courtesy : American Iron and Steel Institute)

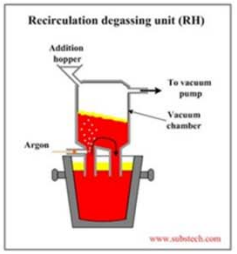


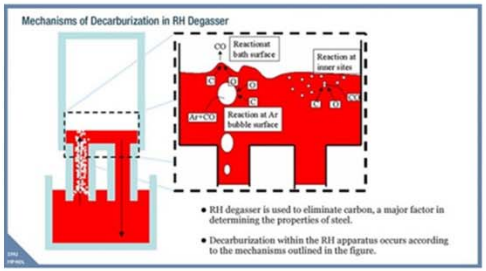
Basic Oxygen Steelmaking process

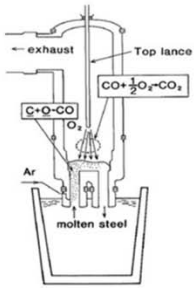


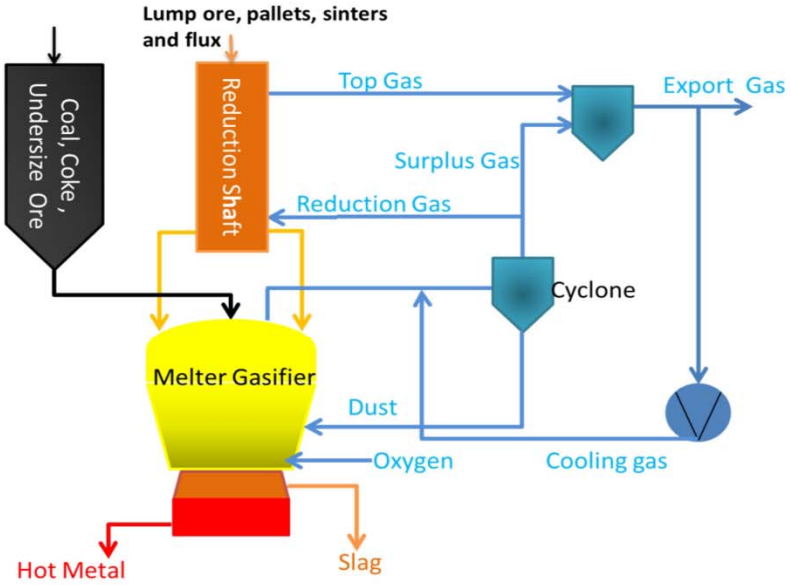
Physical state of the Basic Oxygen Steelmaking Process in the middle of the blow

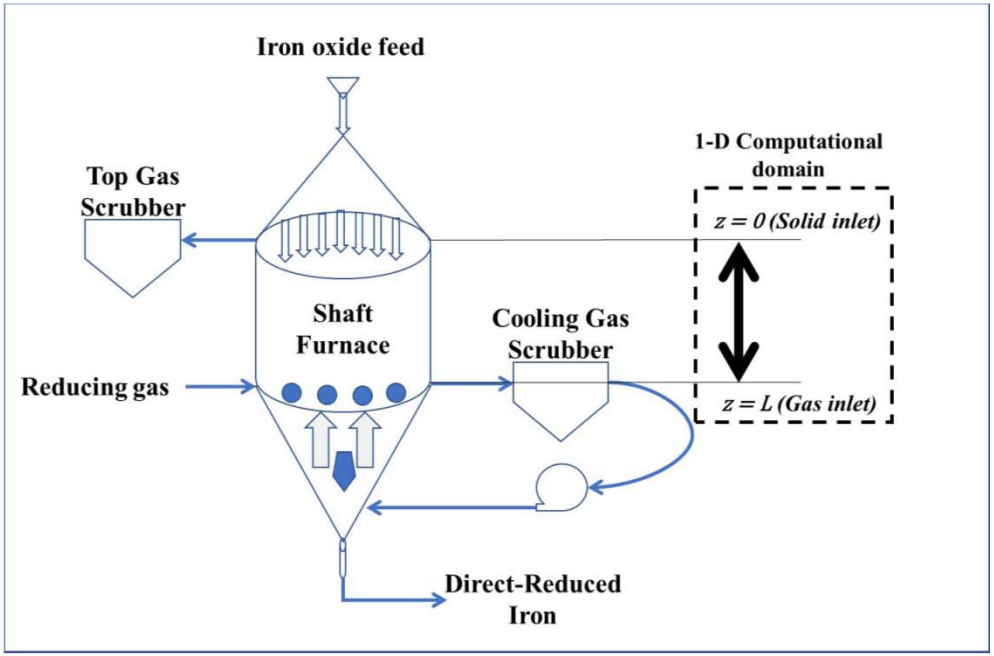
THE RH PROCESS



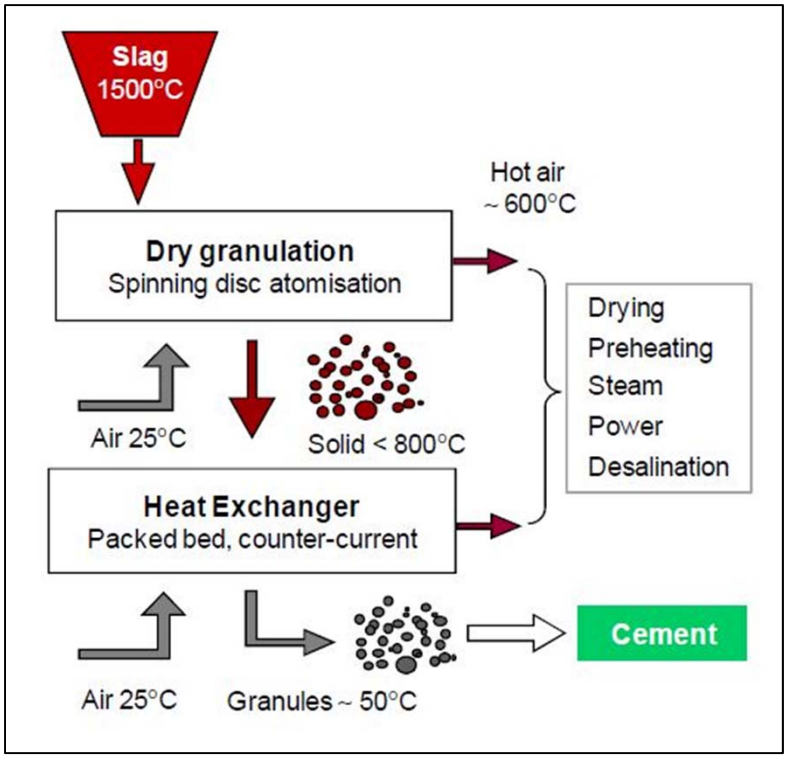




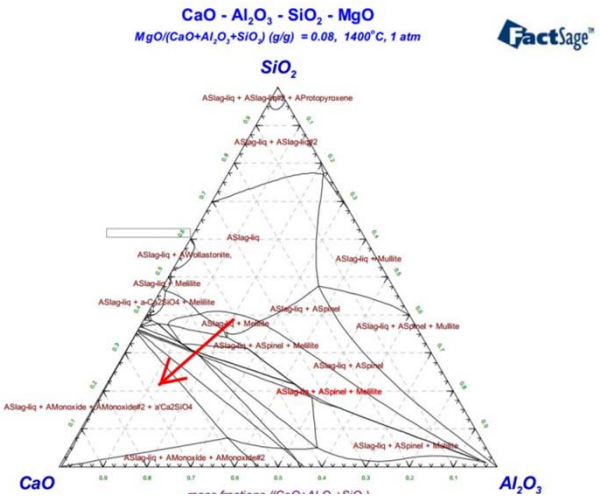




Dry Slag Granulation Process to recover energy from blast furnace slag

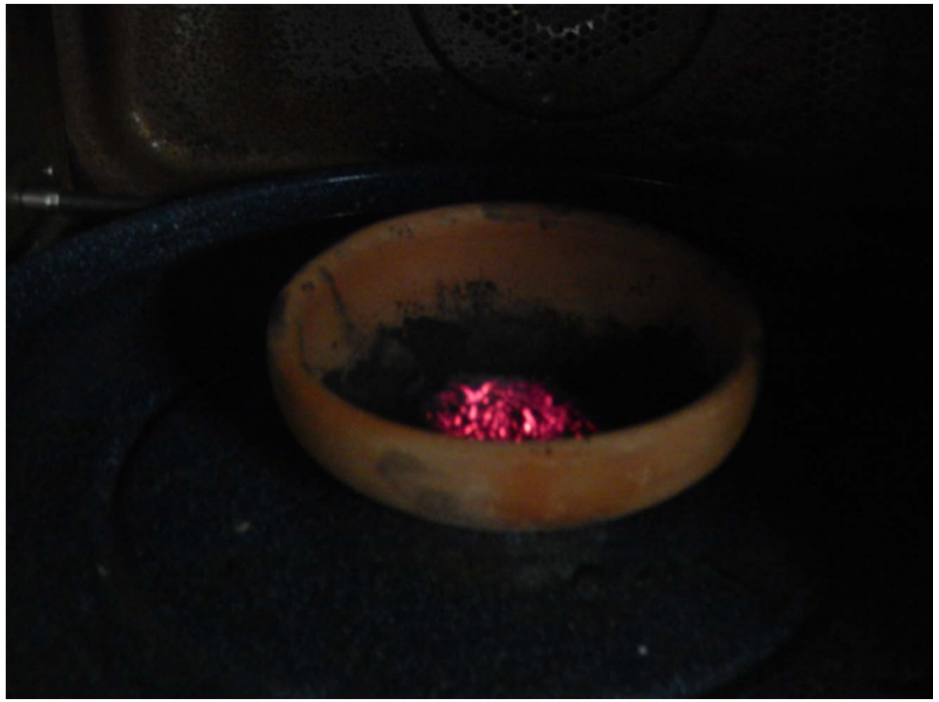


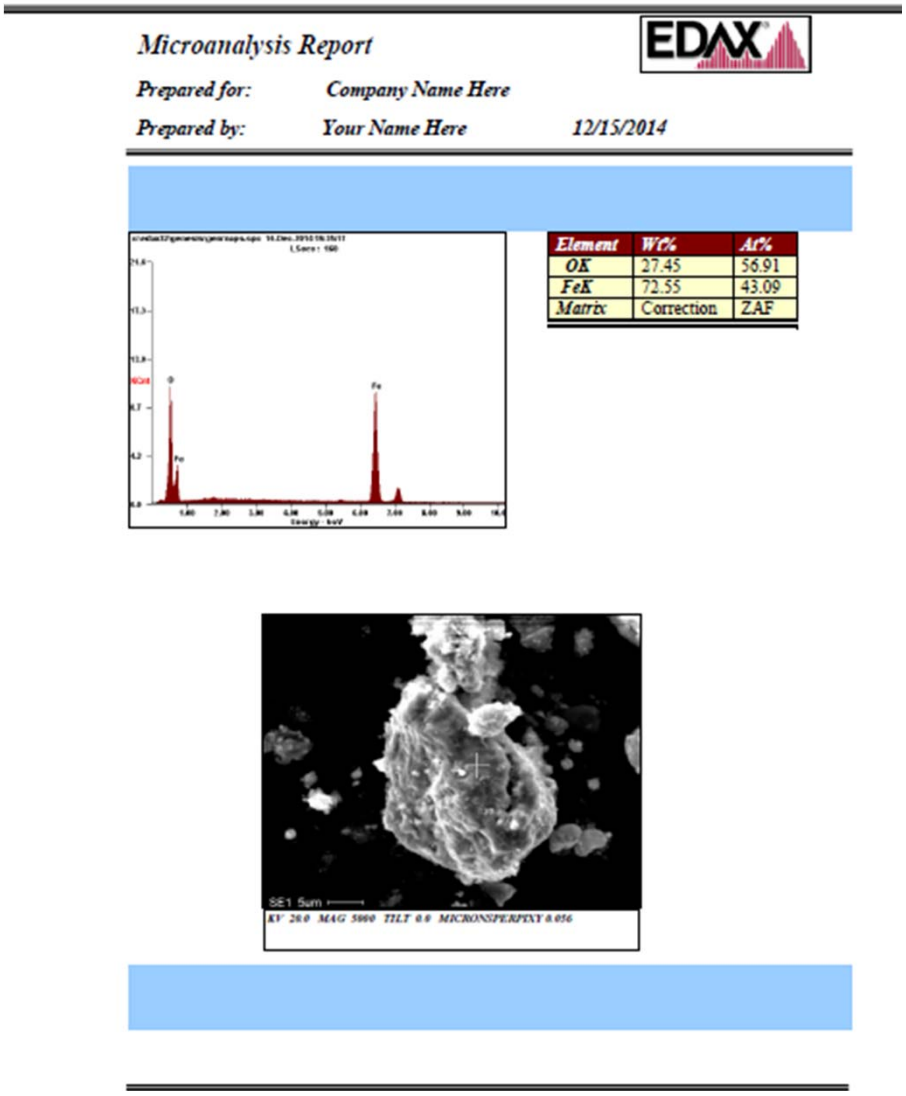
Sharif Jahanshahi et.al ICS 2012



The scope of work involves Physical Modeling, Mathematical Modeling to derive design parameters for pilot plant

Microwave assisted reduction of iron ore/slimes: An innovative and cost effective approach for dry beneficiation for maximization of iron recovery from low grade ores





Microanalysis Report

EDAX

Prepared for: *Company Name Here*

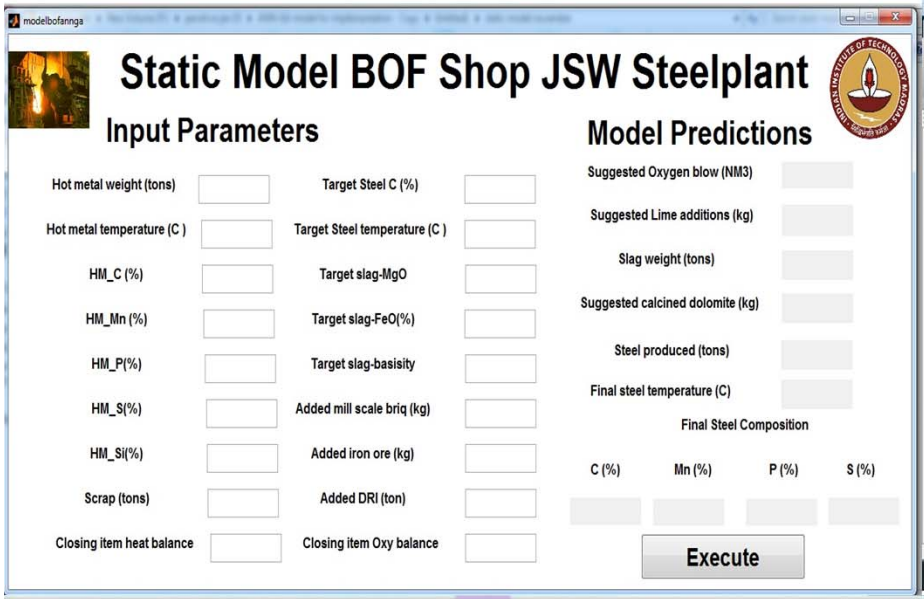
Prepared by: *Your Name Here* *12/15/2014*

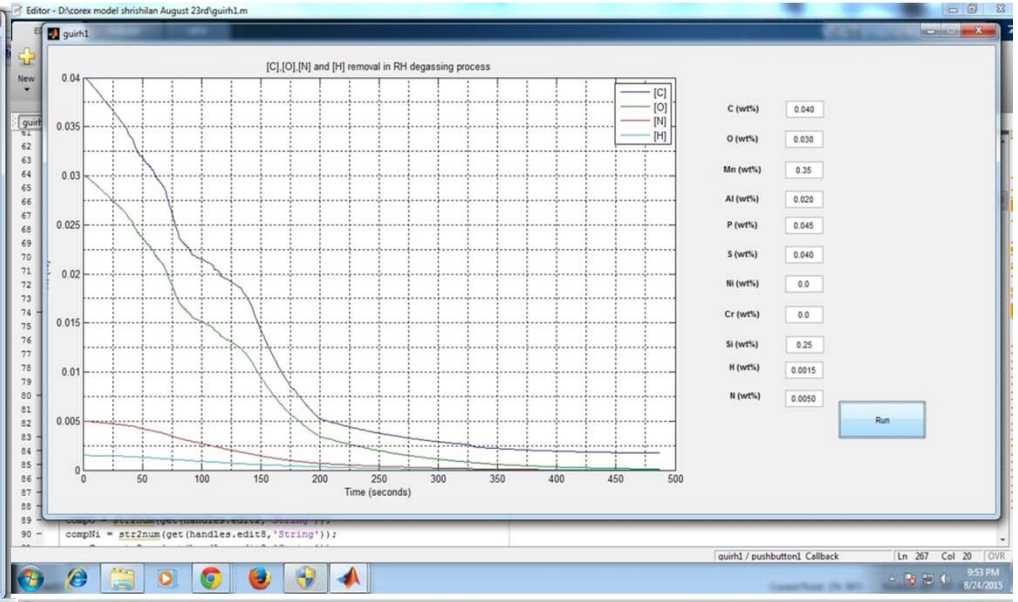
Element	Wt%	At%
OK	27.45	56.91
FeK	72.55	43.09
Matrix	Correction	ZAF

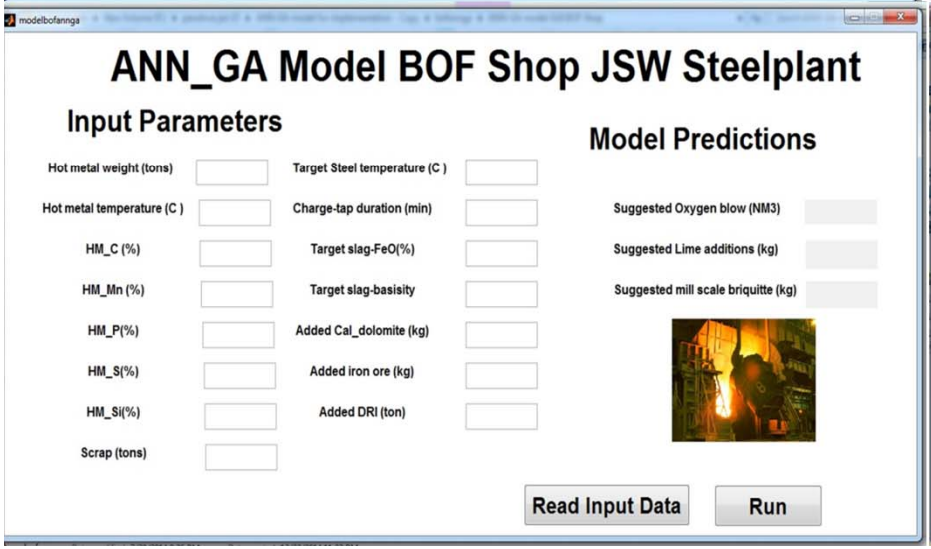
SE1 5um

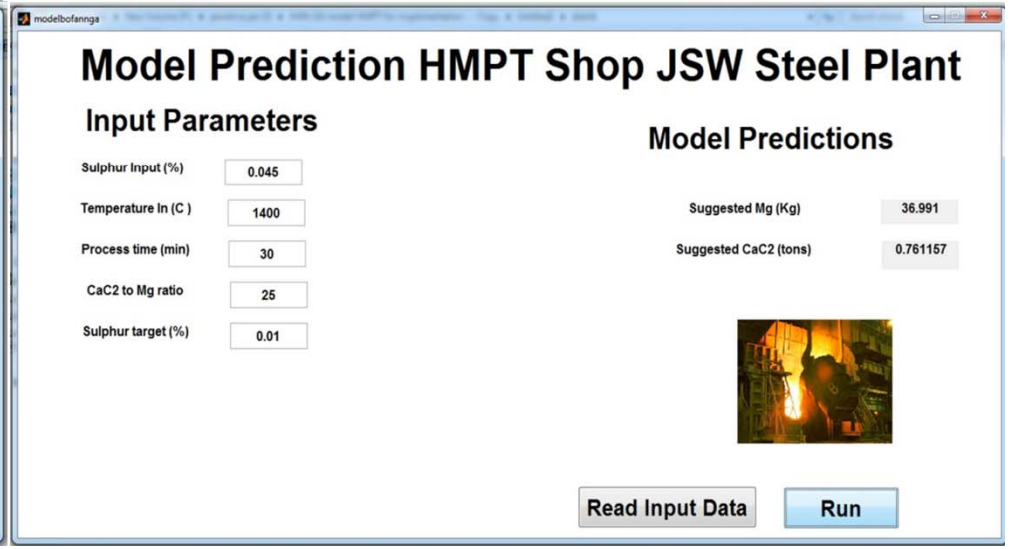
KV 20.0 MAG 5000 TILT 0.0 MICRONSPERPIXY 0.056

GUI Snapshots…

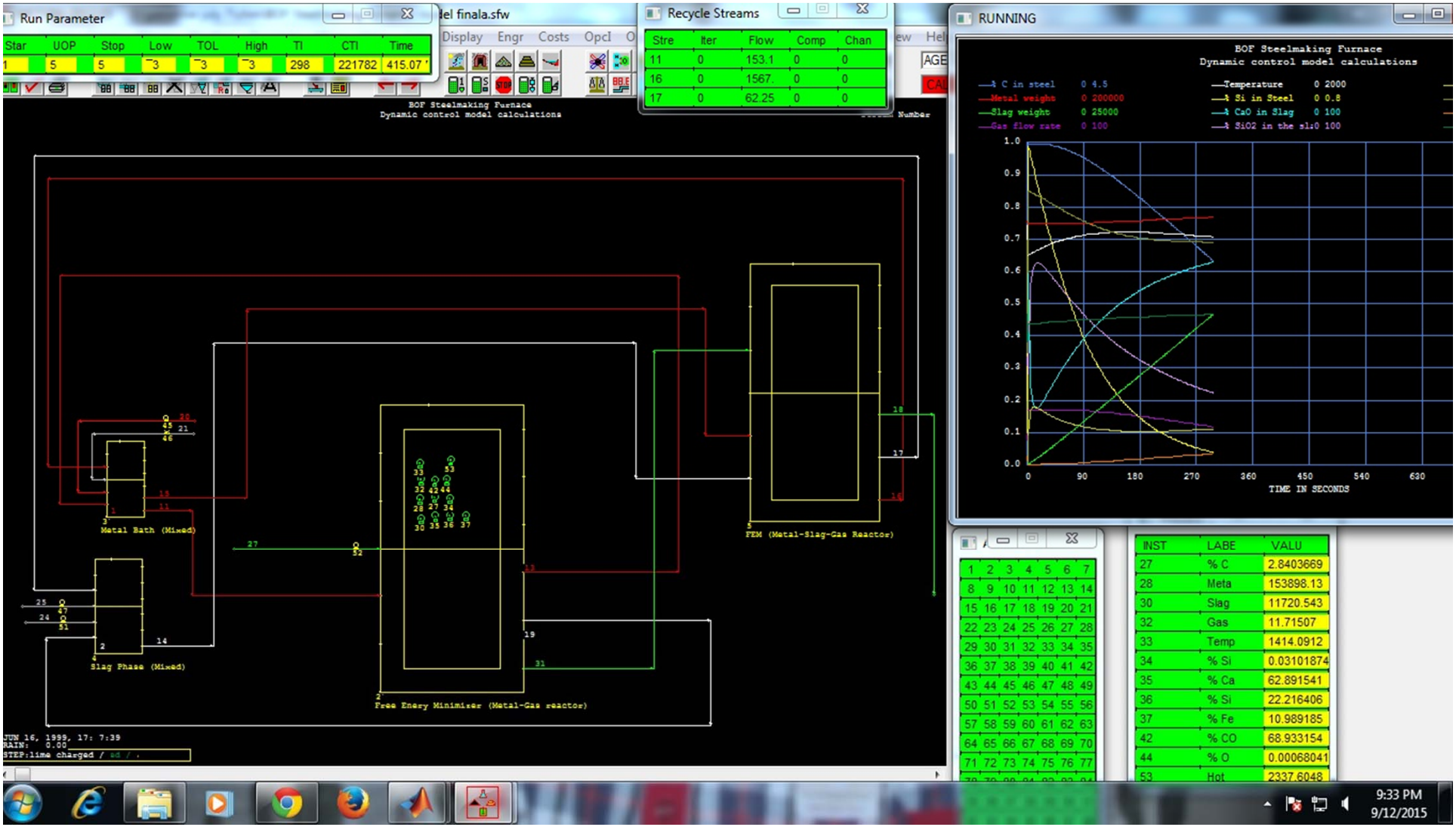








Virtual Simulation Laboratory



Research Group:

Current Students:

Ph.D.

1. Mr. C. Srishilan (since 2013)
Project title: Optimization and control of Corex Ironmaking process employing suitable expert systems.

M.Tech

1. Priyesh Jain (since 2017)
Project title: Heat Transfer based Modeling of dry slag granulation process and its integration with earlier developed models predicting particle size.

2. Arvind M (since 2017)
Project title: Microwave assisted reduction of iron-ore and coal composites

Research Group:

Past students:

MS:

1. Mr. Yuvaraj Patil (2017)
Project title: Heat transfer, fluid flow and solidification modeling of Twin Roll Casting Process.
2. Mr. Kali Prasad (2017)
Project title: Physical and mathematical modeling of dry slag granulation process for energy recovery and cement clinker production.

M.Tech:

1. Mr. Tanay Pandey (under sandwich DAAD programme with RWTH Aachen, Germany) (2014)
Project title: Mathematical modeling of RH degassing process for clean steel production.

2. Mr. Shwetank Pandey (under sandwich DAAD with RWTH Aachen, Germany) (2014)
Project title: Expert model of Basic Oxygen Steelmaking process.

3. Mr. Sachin Santosh (Dual degree scholar) (2014)
Project title: Role of Artificial Intelligence and Data Based Modelling approaches for control of various iron and steelmaking processes.

4. Mr. Deepjyoti Mukherjee (DAAD with RWTH Aachen, Germany) (2016)
Project title: Physical an Mathematical modeling of RH degassing process.

5. Mr. Abhishek Sharma (2016)
Project title: Optimization of steel plant supply chain with minimum cost and energy consumption by application of Genetic Algorithm.
6. Mr.S. Sivakumar (2017)
Project title: Mathematical modeling and industrial validation of MIDREX Ironmaking process.

7. Mr.S. Hariharan (2017)
Project title: CFD modeling of dry slag granulation process.

8. Ms. J. Vaishnavi (2017)
Project title: Optimization of steel plant supply chain with minimum cost and energy consumption by application of Genetic Algorithm.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