Improving Steel Production with a Virtual Blast Furnace

CPS Agreement Number:29332

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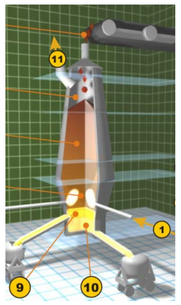
Phase I Complete, Phase II runs from June 2016 to July 2018

Project Objective

We plan to optimize blast furnace operation utilizing CFD models of these furnaces on high performance computers.



- ~1.5 billion tons/yr of Iron ore is processed in blast furnaces.
- Steel Production is the 4th largest energy consumer in the US.
- We plan to reduce coke consumption in a working furnace by 5%

Technical Innovation

- Current simulations are run at CIVS on desktop computers with multiple in house codes
- 3D simulations take upwards of 30 days to complete.
- We are integrating and transforming the CIVS codes to run on high performance compute clusters.
- We are targeting an improvement in simulation resolution/time of 1000x.
- Using this capability we plan to run parameter studies to understand the effects of furnace inputs on the coke consumption of a working furnace.

Approach

The furnace codes modeling the raceway and shaft of blast furnaces will be integrated parallelized utilizing MPI for cluster computing.

Parameter studies will simulate the conditions in a furnace while altering furnace inputs such as:

- Wind Rate
- O2 enrichment %
- Natural gas injection rate
- Hot blast temperature

Transition and Deployment

The new simulation code will be deployed on a cluster available to CIVS and the steel industry partners will work with CIVS and LLNL to model individual furnaces for process optimization.

Measure of Success

Success in this project can be measured by reduction in the coke consumed in a working blast furnace. A 5% reduction in coke rate industry wide would result in $80M/yr savings.

Project Management and Budget

The phase II project is 2 years long with the following top line budget:

Total Project Budget	
DOE Investment	995k
Cost Share	320k
Project Total	1495k

Milestones include:

- Integrated parallel raceway and shaft codes (18 mo)
  - Domain decomposition and MPI (6 mo)
  - Adapt to use with LLNL solvers (12 mo)
  - Improve raceway and integrate with shaft (18 mo)
- Completed parameter studies of working furnace (22 mo)
- Data shared with steel industry for experimental testing (23 mo)

Results and Accomplishments

Phase I project complete:

- Examined CIVS codes and made plans for integrating and parallelizing them.
- Demonstrated a 3x speed improvement utilizing multithreading.
- Demonstrated the ability to run parameter studies with hundreds of input combinations on LLNL clusters.

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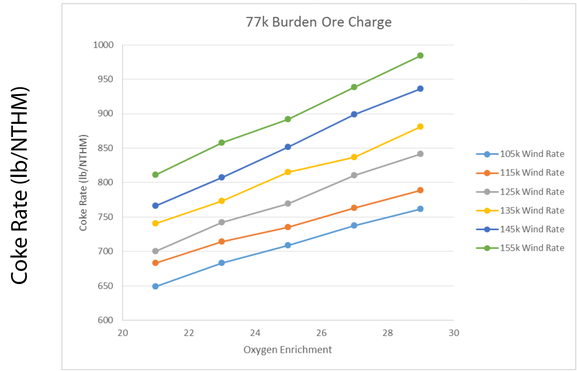
Demonstration parameter study



Oxygen enrichment %

Coke rate for a variety of operating conditions in our demonstration parameter study. 100s of 2D simulations were carried out allowing for a broad look on how parameters affect coke rate.