COMPREHENSIVE MODEL FOR BLAST FURNACE WITH TWO WAY COUPLING OF RACEWAY MODEL USING OPENFOAM

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Abstract

Ironmaking Blast Furnace (BF) is about 30 m tall, complex, multi-phase and very high temperature metallurgical reactor involving multiple reactions and heat transfer among gas, solid and liquid phases along with phase change. Recently, Tata Steel has developed a 2-D BF process simulator named '***BlaSim***'. The model has been developed using OpenFOAM® platform due to its flexibility in incorporating additional physics over other commercial CFD solvers. The model has been validated using the plant data and found to be in good agreement with it. Further, the model is being implemented in the plant to be used by the process engineers. The model helps them in the diagnostics of the process of the passed day by giving important insights about the various in-furnace phenomena and then plan for the upcoming day's operation for optimal furnace performance.

In principle gas, solid and liquid are coupled with each other such that burning of solid coke particles inside the combustion region called as *Raceway's* decides the solid's descent rate and thereby controls the hot metal production rate and its quality. Considering the complexity and computation time requirements, raceway was kept outside the computation domain. This has limited the use of the model only to the past operation, wherein, some of the boundary conditions were obtained from known operational data e.g. the solids inlet velocity is calculated from known production rate, gas inlet flow rate, flame temperature and composition are obtained using the semi-empirical formulas or simple calculations.

While in case of scenario analyses, the model could not be used effectively due to lack of availability of data required to obtain inlet boundary condition for solid i.e. production rate. To solve this problem heat and mass balance of the raceway region has been coupled both ways with the existing blast furnace simulator such that the production rate evolve as a solution, instead of input to the model. With this coupling, it has become possible to perform various BF operation scenarios. Some case studies regarding the use of the model will be presented.