

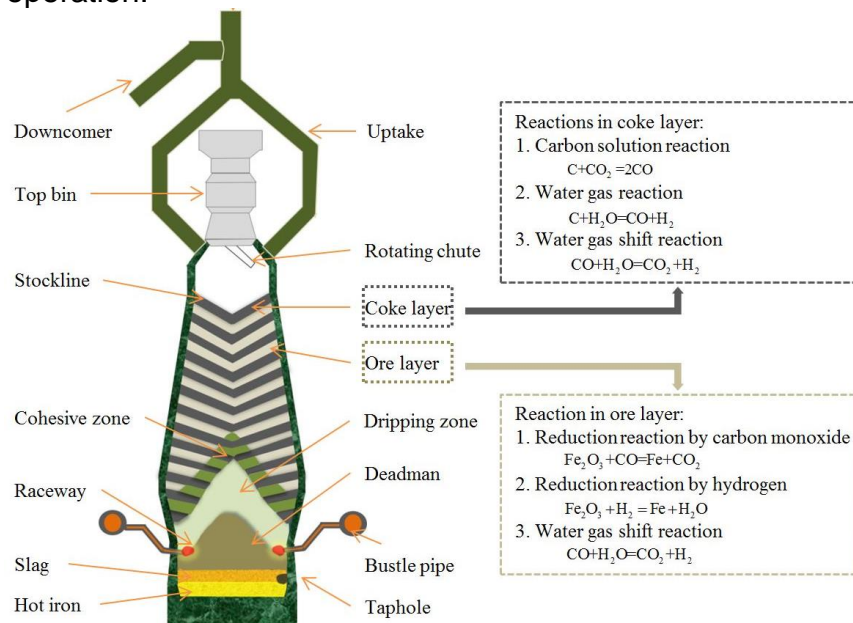
# Computational Fluid Dynamics Study of Thermochemical Behavior in a Blast Furnace with Respective Chemical Reactions in Coke and Ore Burden Layers

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Ironmaking blast furnace (BF) is an efficient chemical reactor to produce liquid iron from solid iron ore, where the solids of coke and iron ore are charged in alternative layers and then respective chemical reactions will occur in the two types of burden layers as they descend. The in-furnace phenomena are thus very complex including multiphase flows coupled with heat and mass transfers related to various respective chemical reactions in respective porous layers. Such respective reacting burden layers have not been considered explicitly in the previous BF models. In this study, a mathematical model based on multi-fluid theory is developed for describing the multiphase reacting flows considering respective reacting burden layers. Then this model is applied to a BF covering from burden surface at the furnace top to liquid surface above the hearth and describe the inner states of a BF in terms of multiphase flows, temperature distribution and reduction process. The results show that some key important features in layered burden with respective chemical reactions are captured; including fluctuating iso-lines in terms of gas flow and thermochemical behaviour, particularly the latter cannot be well captured in the previous BF models. Three chemical reserve zones of hematite, magnetite and wustite can also be observed near the stockline, in the shaft near wall and near center, respectively. Inside each reserve zone, the corresponding ferrous oxides stay constantly high in alternative layers; the overall performance indicators including gas utilization efficiency and reduction degree also stay stable in an alternative-layered structure. This model provides a cost-effective tool to investigate BF in-furnace process and optimize BF operation.



*Schematic of an ironmaking BF with key chemical reactions in alternative coke and ore burden layers*