Heat Transfer and Inverse Problems; Blast Furnace Optimization

P. Dziembaj, R. Filipek

World raw steel production annually exceeds 1 000 000 mln tons. But blast furnace (BF) technology is one of the oldest and least known in heavy industry. One of the reasons is an extremely aggressive environment occurring inside the furnace hearth. It is very profitable to extend BF lifetime and maximize its production. Mathematical modeling is a powerful tool capable creating new more efficient BFs but also a diagnostic tool for already working ones. Heat transport phenomena in the framework of continuum media mechanics is presented. Equations for conservation laws and finite volume numerical method based on these equations are discussed. FLUENT computational fluid dynamics (CFD) package was used for calculations of the temperature distribution in Blast furnace heart. Calculations in 3D geometry were compared with measured temperatures (readings of thermocouples placed in BF refractory walls). Solving the inverse problem a shape of refractory linings in BF after 5 years of operation was calculated. A skull layer thickness in BF was also found. The results obtained indicate that the inverse problem methodology is a very promising tool in BF optimization (e.g., materials to be used and its thickness).