ICCES, 2023, vol.27, no.2
DOI: 10.32604/icces.2023.09609

PROCEEDINGS

Simulation of Reheating Furnace for Steel Billets by a Meshless Method

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ABSTRACT

A simulation of reheating furnace in a steel production line where the steel billets are heated from room temperature up to 1200 ˚C, is carried out using a novel meshless solution procedure. The reheating of the steel billets before the continuous hot-rolling process should be employed to dissolve alloying elements as much as possible and redistribute the carbon. In this work, governing equations are solved by the local radial basis function collocation method (LRBFCM) in a strong form with explicit time-stepping. The solution of the diffusion equations for the temperature and carbon concentration fields is formulated on a two-dimensional slice. The concentration equation is strongly coupled with the temperature equation through the temperature-dependent diffusion coefficient. The simulation includes the solution of these two coupled equations. The temperature field is solved by considering the position in the furnace and the radiative and convective heat fluxes on the boundaries. Ray tracing procedure is employed to determine the radiative heat flux. The diffusion of carbon is calculated without decarbonisation at the boundaries. The initial carbon macrosegregation is provided from the continuous casting model. A comprehensive sensitivity study on the influence of the distance between the billets and the total time of the billet in the reheating furnace is performed. A relation to the energy consumption and the product quality is provided from these simulations. This allows for automatic optimisation of the furnace's productivity by coupling the described model with artificial intelligence. For the first time, LRBFCM is successfully demonstrated for solving such a complex industrial problem.

KEYWORDS

Reheating furnace; steel; thermal solution; strong form meshless method; radial basis functions; carbon concentration

Funding Statement: This research was funded by the Slovenian Grant Agency by grant numbers P2-0162 and L2-2609 and Štore-Steel Company (www.store-steel.si).

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.