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- **Key words:** Numerical simulation, steelmaking, radiation heat transfer, free surface flow
- **Societal Challenge:** Climate action, environment, resource efficiency and raw materials
- **Economic Activities:** Materials
- **Brief description of the real benefits in terms of Societal Challenge / Economic**
- **Activities/Company:** The proposed methodology was useful to predict the details of the fluid flow of hot metal, slag and air over a Blast Furnace runner. Moreover, the temperature field inside the concrete refractories and the position of the critical isotherms were obtained, which are of importance in order to reduce its wear and thus, to help to increase resource efficiency

NUMERICAL SIMULATION OF FLUID FLOW AND HEAT TRANSFER AT A BLAST FURNACE RUNNER

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One of the major methods used by steelmaking industry is the basic oxygen steelmaking, which uses hot metal as feed material for steel production. It is obtained in the blast furnace (BF) altogether with slag, where both materials behave as fluids due to the high operation temperatures. Their removal takes place through a drilled opening in the side of the BF and the resulting jet of fluids falls over the blast furnace runner, a multi-layered concrete refractory structure designed to enable separation of both materials as they flow downstream.
In the framework of the Horizon 2020 societal challenge *Climate action, environment, resource efficiency and raw materials*, it is of interest to minimize the wear of the BF runner, which usually needs to have its first layer completely replaced after two months of usage. This wear is believed to be strongly related to the position of the critical isotherms and also to erosion due to both the impact of the jet of fluids and to their flow along the runner. The nature of the problem, with extreme heat posing a big challenge to experimentation, motivates the usage of numerical simulation in order to find these isotherms.
A problem-decoupling strategy was used to obtain the numerical solution of a three-dimensional thermo-hydrodynamic model based on a BF runner at the ArcelorMittal company in Veriña, Spain. The fluid phases –hot metal, slag and air– are assumed to be incompressible, with constant properties and the free surfaces separating them are found using the VOF method. The S2S model is used in order to account for thermal radiation. The proposed methodology has been shown to be useful in order to predict the position of the critical isotherms as well as to further understand how fluid flow and heat transfer take place at BF runner. The computed temperatures are validated using experimental measures supplied by ArcelorMittal.

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