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NUMERICAL ANALYSIS OF STEEL SOLIDIFICATION AND PARTICLE ENTRAPMENT IN A CONTINUOUS BILLET CASTER

Suryanaman Chaube[*,§] and Varnita Bajpai[**]
[*]TCS Research, TCS Ltd., Pune, India
[**]Department of Metallurgical Engineering, Indian Institute of Technology (B.H.U), India
[§]Correspondence author. Email: suryanaman.chaube@tcs.com

ABSTRACT In this work, continuous casting process of a billet caster has been simulated using a simple, but comprehensive mathematical model. The solidification process is modelled through finite-difference calculations of heat conduction within the solidifying steel shell which give thermal gradients and columnar front velocity along the billet mid-plane. In order to account for bulk convection due to the submerged-entry nozzle, an effective thermal conductivity within the mush is defined under the solid-liquid coexisting zone theory. The model predicts solidified shell thickness, local solidification time, metallurgical length and two important microstructural parameters – primary and secondary dendritic arm spacings (PDAS and SDAS) – which are used to characterize inclusion redistribution during solidification. Inclusion-front interaction is modelled using a dynamic formulation that calculates the critical velocity for pushing or engulfment as a function of particle size and factors in the differences in thermal properties of particle and melt. Pushing of inclusions larger than the estimated PDAS and entrapment of inclusions smaller than SDAS is also considered.