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Modelling of ingot size effects on macrosegregation in steel castings

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Abstract

A mixed columnar dendritic-equiaxed three-phase solidification model that considers the secondary dendrite arm spacing (SDAS), nucleation and growth of equiaxed crystals, sedimentation of equiaxed crystals, growth of columnar dendritic trunks, and columnar-to-equiaxed transition (CET) was employed to study the formation of macrosegregation in steel ingots of different sizes. A reported experimental case (55000 kg ingot) was used to verify the rationality of the current three-phase model. The predicted segregation patterns were in good agreement with the experimental results. The formation of macrosegregation in a series of steel ingots with different sizes (50 kg, 400 kg, 3300 kg, 6000 kg, 25000 kg, 55000 kg, and 97000 kg) was studied using this solidification model. The results showed that the severity of macrosegregation increased with the increasing ingot weight. The thermal-solutal buoyancy and sedimentation of the dendritic equiaxed grains played dominated roles in