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The Effect of Liquid Metal Cooling on Thermal Gradients in Directional Solidification of Superalloys: Thermal Analysis

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Abstract

Numerical methods were used to examine the influence of casting and baffle geometry, mold thickness as well as withdrawal speed on solidification conditions and resulting microstructure. Achievable thermal gradients, stability limits and primary dendrite arm spacings for Liquid Metal Cooling (LMC) and High Rate Solidification (HRS) process are reported. Calculations were compared with experimental results from the literature and good agreement was found. A thermal gradient almost 1.8 times higher was observed for the use of LMC in the case of simple cylindrical castings. In contrast, a thermal gradient up to three times higher was calculated with LMC compared to HRS for large section size castings. The numerical investigations indicate that the nature of the baffle has a stronger effect than the different mechanism of heat dissipation when HRS and LMC are compared.

Keywords

Liquid Metal Cooling, Thermal Gradients, Numerical Simulation, Superalloys