Title: Numerical Simulation of Solidification and Free Floating Grains in DC Casting of Aluminum Alloys

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Abstract:
Numerical methods have become a powerful tool for modeling a wide variety of materials processing applications, including the solidification of metallic alloys. One of the processes at the forefront of modeling efforts in this area is direct chill (DC) casting of aluminum alloys, a semi-continuous process that produces billets for further downstream processing. Because grain refiner is often used in this process, one of the challenges for modeling is accounting for free floating solid particles that nucleate in the liquid metal. In particular, current methods for representing particle attachment to the rigid interface lack physical detail. Strategies for modeling solid motion will be reviewed, and the method implemented at the Purdue Center for Metal Casting Research will be discussed. Focus will be on the current state of modeling particle packing in large scale castings. Current models tend to assume that particle interactions reach a critical point at some volume fraction solid value at which the solid begins to act as a rigid structure. This approach has several disadvantages including neglecting the local fluid flow. A simple solid velocity-based model has been implemented at Purdue. These models will be compared, and avenues for future research will be identified.

Keywords: Solidification processing, finite volume, numerical methods