

Front Tracking Technique on a Fixed Grid in Modelling of Binary Mixture Solidification with Natural Convection

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A novel front tracking method is presented in calculations of binary mixture solidification driven by conduction and natural convection. The method, based on the local dendrite tip kinetics and tracking of mass-less marker particles within a control volume grid, enables the detection of the under-cooled liquid zone in front of the dendrite tips line. A classical single set of mass, momentum and energy conservation equations is used to get the velocity, pressure and temperature fields in solid, liquid and mushy zones, but the latent heat effect is considered by a careful definition of the source terms in the energy equation accounting for both: the advance of solidification front and subsequent thickening of the mushy zone within a control volume. The proposed model is verified and validated through detailed comparisons with both: the predictions of the enthalpy-porous medium model and the PIV experimental findings.

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