Numerical Analysis of Phase Change Material with Variable Heat Load using OpenFOAM

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Abstract

This study aims to conduct numerical investigation of the melting of gallium and ice in a 2D channel using OpenFOAM v1906's `buoyantPimpleFoam` solver with the `solidificationMeltingSource` term. Two mesh sizes of 1800 cells, 7200 cells and 28800 cells are employed to examine mesh sensitivity. The temperature profiles and liquid-phase velocity fields are analysed to characterize the phase change dynamics. The simulation captures melting front progression, convective heat transfer effects, and recirculation patterns in the molten phase, with validation supported by established gallium phase-change studies using enthalpy-porosity method demonstrating the influence of mesh resolution on predicting interface motion and thermal transport during melting.

Keywords: *Phase Change Material, ice, gallium, OpenFOAM*