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CLOSE-CONTACT MELTING MODELING COMBINED WITH THE ENTHALPY METHOD

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ABSTRACT

Design of thermal energy storage systems based on solid-liquid phase-change materials (PCMs) can be complex, and involves a detailed analysis of different physical phenomena related to melting and solidification. All these phenomena usually cannot be described by analytical models, and require development of advanced and reliable numerical modeling techniques. One of the most common numerical methods, for a general solution of phase-change problems, is the enthalpy-porosity method. However, the available literature shows that this method is not completely suitable for cases in which the solid bulk moves, e.g. towards a heated surface. The latter phenomenon is called close-contact melting (CCM), because only a thin molten layer separates between the solid and the hot surface, as the melt is squeezed to the sides by the descending solid bulk. The present work demonstrates a numerical model that combines the enthalpy method with close-contact modeling. The model ability to solve CCM problems for an arbitrary solid shape is verified by comparison with a known solution from the literature. The model is then applied for a new problem, CCM of a horizontal cylinder on an isothermal plate.