

Parametric and Analysis Study of the Melting in Slabs Heated by a Laminar Heat Transfer Fluid in Downward and Upward Flows

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Abstract : The present work aims to investigate numerically the thermal and flow characteristics of a rectangular latent heat storage unit (LHSU) during the melting process of a phase change material (PCM). The LHSU consists of a number of vertical and identical plates of PCM separated by rectangular channels. The melting process is initiated when the LHSU is heated by a heat transfer fluid (HTF: water) flowing in channels in a downward or upward direction. The proposed study is motivated by the need to optimize the thermal performance of the LHSU by accelerating the charging process. A mathematical model is developed and a fixed-grid enthalpy formulation is adopted for modeling the melting process coupling with convection-conduction heat transfer. The finite volume method was used for discretization. The obtained numerical results are compared with experimental, analytical and numerical ones found in the literature and reasonable agreement is obtained. Thereafter, the numerical investigations were carried out to highlight the effects of the HTF flow direction and the aspect ratio of the PCM slabs on the heat transfer characteristics and thermal performance enhancement of the LHSU.

Keywords : PCM, TES, LHSU, melting

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