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Research papers

Controlling the freezing process of nano-enhanced phase change materials with internal fins in the latent thermal energy storage system

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Abstract

In this article, the freezing process of phase change material (PCM) in a latent energy thermal storage system with new internal fins was numerically discussed. Two PCMs: RT35 and RT50 are used. The finite volume method and the enthalpy-porosity model are employed. The effects of seven new internal fins, the addition of aluminum oxide nanoparticles in two volume fractions of 2.5% and 5%, and changes in the temperature boundary condition on the freezing process of the PCM are explored and the results were compared with the case without fins. The outcomes determine that with the addition of nanoparticles, the freezing time decreases for all states with fins compared to the state without fins, and the percentage of these changes is around 29–62%. Also, the outcomes show that the reduction in freezing time compared to the case without fins for case C3 is about 69.43% and 71.82% for RT35 and RT50, respectively, and this mode performed best among the considered cases. The spatial changes in the temperature of the active walls of the chamber along the y, and z-directions affect the freezing rate and increase the freezing rate compared to the constant temperature boundary condition.