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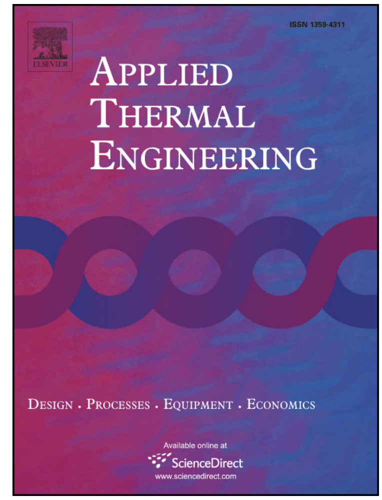

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Solid-liquid phase change investigation through a double pipe heat exchanger dealing with time-dependent boundary conditions

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Abstract

The use of phase change materials has been seriously recommended due to their high capacity of energy saving and delivering arising from phase change process. In addition, a constant temperature of melting or freezing provides a desirable condition to transfer a large amount of heat in a low-temperature fluctuation. This work attempts to present a numerical study to simulate the solid-liquid phase change considering a double pipe heat exchanger dealing with time-dependent boundary conditions. For this reason, a time dependent boundary condition of the third kind is applied. In a condition which the amplitude and periodicity of both bulk temperature and heat transfer coefficient (HTC) are varying in the sinusoidal form. The PCM container involves two separate sections to insert two different PCMs of RT28HC and RT35. In addition, in order to make up for the low thermal conductivity of PCMs, a porous medium with high thermal conductivity is located in PCM containers. Numerical model benefits the enthalpy-porosity approach based on the finite volume method, which models the phase change in the fixed grid domain. Moreover, in order to accurate simulation, fluid flow arising from Boussinesq approximation in the liquid phase is also considered using PISO algorithm. According to the results, the arrangement of RT35 in section A and RT28HC in section B accelerates the system response to the boundary oscillation. In addition, increasing the periodicity of the bulk temperature variation increases the amount of phase changing process in both sections while varying the same parameter of HTC does not influence the liquid fraction of PCMs considerably.

Keywords: Solid-liquid phase change**,** Time dependent boundary condition, Double pipe heat exchanger, Numerical study, Thermal conductivity enhancement.

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