Numerical Predication of Solidification Phenomena of Phase Change Material in Concentric Annulus Pipe

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Abstract;

Two-dimensional numerical simulation is performed aiming to understand the role of buoyancy force convection during restricted solidification of phase change materials (PCMs) inside a shell and tube heat exchanger according to annulus cross section. Where the transient history of PCM solidification evolution was studied. The governing equations of mass, momentum and energy are solved to study the solidification behavior inside the annulus geometry. The fluid flow in the mushy zone was accounted for using the Darcy drag source term in momentum, and the liquid percentage in each cell was updated using the enthalpy-porosity method. Thermal conditions of the outer cylinder insulated (adiabatic) and the inner cylinder at constant temperature (isothermal). The results are presents as a temperature contour and liquid fraction distribution in the domain. The predicted result shows the capturing phenomenon: primary heat conduction in all regions, then heat convection and conduction become dominant in the top and bottom regions, respectively. The max. and min. temperature changes near the outer pipe surface during 16 hrs. are 56.25% and 42.5%, respectively.