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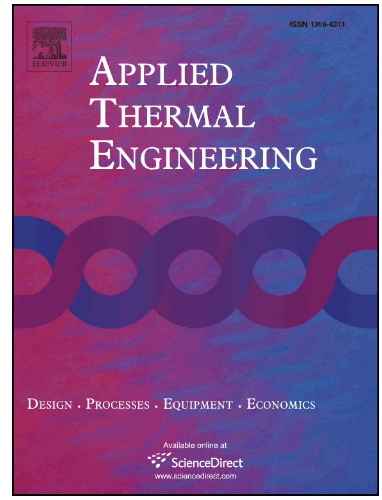

Nanostructures assisted melting of phase change materials in various cavities

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Nanostructures assisted melting of phase change materials in various cavities

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Abstract

The inherent low thermal conductivity of phase change materials (PCM) forms a big challenge of employing these materials in latent heat thermal energy storage systems. Dispersing nanostructures solid materials of high conductivity in PCM represents a one method to enhance heat transfer rate of phase change processes (melting and solidification). In this paper, a review of analytical, numerical and experimental investigations of melting of Nano-enhanced phase change materials (NePCM) inside different shape containers is introduced. The common shapes of the containers used for thermal energy storage being rectangular containers, spherical vessels, cylindrical enclosures of two orientations (horizontal and vertical) and annular cavities are covered. The effect of geometrical parameters and operation conditions on the heat transfer modes (conduction and/or convection) and resulted melting characteristics are reported. Increasing the amount of supplied heat (augment the Rayleigh and Stefan numbers) results in fast evolution of natural convection dominated melting which expediting the melting process. Numerical studies indicated that the increasing the amount of nanoparticles dispersion in PCM leads to enhancing the thermal conductivity, increasing the heat transfer rate and shortening the melting time. On the other hand, experimental works proved that there are some restrictions on the amount of nanostructures suspended in PCM such as agglomeration, precipitation and dramatic increase in viscosity. Majority of experimental findings referred to small positive influence was observed due to adding low concentration of nanostructures on the thermal performance of melting of NePCM. It is recommended to use the measured thermophysical properties of NePCM in numerical investigations instead of depending on simple mixture models or correlations to reduce the relative big discrepancy between experimental results and predicted ones.