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Heat transfer improvement between a pair of heater and cooler inside an energy storage by using nano-encapsulated phase change material/water: A numerical modeling

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ABSTRACT

In the present study, the natural convection flow of water with Nano-encapsulated phase change material (NPCM) was simulated inside an insulated chamber, which a pair of pipes were considered as a heater and cooler sources with the boundary condition of uniform temperature. The NPCM's core was made of n-nonadecane with melting temperature of 30.44 °C. This core has ability to change the liquid-solid phase to transfer heat between the heater and the cooler sources. Current simulation was steady state and was solved by SIMPLE algorithm based on FVM to investigate the effects of Rayleigh number, volume fraction and location of phase change zone on the convective heat transfer coefficient. Observations showed that, phase change of NPCM occurs at low Rayleigh numbers but had no effect on the convective heat transfer coefficient, but it was directly related to the thermal conductivity of mixture. Moreover, adding volume fraction of NPCM 0.02 into water increased the convective heat transfer coefficient by 10.43%, 19.1% and 18.3% compared to pure water for Rayleigh numbers 10^2, 10^4, *and* 10^6, respectively.

1. Introduction

Phase change materials (PCMs) are a group of organic or inorganic materials that have the ability to change its phase. These materials have two major advantages including phase change at a constant temperature and receiving very high thermal energy [1], which are employed in many industrial processes such as cooling electronic components, controlling the temperature of batteries,

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