HEAT TRANSFER

ORIGINAL ARTICLE

Numerical analysis of Soret/Dufour MHD convection in a NEPCM-filled cavity with partial porous foam: Double pipe heat exchanger application

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Abstract

The current work extensively investigates double-diffusive of nano-encapsulated phase change material in a thermal storage system partially filled with porous foam. The generation of irreversibilities and the influence of Soret/Dufour and magnetohydrodynamic effects are also considered. The circular cold cavity contains a corrugated hot cylinder covered by an annular foam. The considered parameters are Rayleigh number (10^3–10^5), fusion temperature (0.1–0.9), Stefan number (0.1–0.9), volume concentration of nanoparticles (0–0.05), Darcy number (10^{-4}–10^{-1}). Hartmann number (0–80) and the undulations of the inner (3–9). The numerical analysis has exploited the finite element approximations. The results indicate that Rayleigh and Hartmann numbers greatly influence the fluid flow, isotherms, concentrations and the melting/solidification region. The fusion has also a great influence on the melting/solidification region while there is no evident influence on the flow, isotherms and the concentrations where both Nusselt and Sherwood numbers change with around 5% with the change of the fusion temperature and Stefan number. In contrast, both values are decreased by around 30% by decreasing the *Da* number from 0.1 to 10^{-4}. Furthermore, the change of the undulations number has very low influence on heat transfer, mass transfer and the melting/solidification region.