















Research papers

Numerical analysis of MHD free convection in curvilinear porous enclosure with two active cylinders filled with NE-phase change material

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Abstract

In nuclear power industry, the energy conservation of heat exchangers is a crucial demand. The current study addresses the influence of nano-encapsulated phase change material (NEPCM) on free convection under magnetic force in a porous enclosure involving two active cylinders. The curvilinear geometry of the enclosure is set with undulated top wall. The top, horizontal and the inclined walls are set cold while the two cylinders presented the hot surface. All other walls are assumed to be adiabatically isolated. The considered parameters are Rayleigh number, Ra (10^3 – 10^5), Hartmann number, Ha (0–64), fusion temperature, θ_f (0.1–0.9), Stefan number, Ste (0.1–0.9), volume concentration, ϕ (0–0.05), Darcy number, Da (10^{-5} – 10^{-2}). Finite element method has been used in the numerical analysis. Some of the most important results stated that fusion temperature has a significant influence on heat transfer only with high Ra number and low Ste number. Furthermore, the melting solidification region notably changed with the change of Da and θ_f with less influence under the magnetic force. Also, the heat transfer is enhanced with the increase of Ra , Da and ϕ while it diminished with the increase of Stephan number and MHD. It found that a promotion in the percentage of Nu_{avg} when the volume concentration is raised from 0 to 0.05 is about 65%, while the Nu_{avg} dwindles by 14% when Hartman number is raised from 0 to 64. It can be concluded that using NEPCMs is crucial for enhancing heat transfer and hence the improving the related engineering applications.