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Effects of finite wall thickness and sinusoidal heating on convection in nanofluid–saturated local thermal non-equilibrium porous cavity

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Abstract

The effects of finite wall thickness and sinusoidal heating on convection in a nanofluid–saturated local thermal non-equilibrium (LTNE) porous cavity are studied numerically using the finite difference method. The finite thickness vertical wall of the cavity is maintained at a constant temperature and the right wall is heated sinusoidally. The horizontal insulated walls allow no heat transfer to the surrounding. The Darcy law is used along with the Boussinesq approximation for the flow. Water-based nanofluids with Cu nanoparticles are chosen for investigation. The results of this study are obtained for various parameters such as the Rayleigh number, periodicity parameter, nanoparticles volume fraction, thermal conductivity ratio, ratio of wall thickness to its height and the modified conductivity ratio. Explanation for the influence of the various above-mentioned parameters on the streamlines, isotherms, local Nusselt number and the weighted average heat transfer is provided with regards to the thermal conductivities of nanoparticles suspended in the pure fluid and the porous medium. It is shown that the overall heat transfer is significantly increased with the relative non-uniform heating. Further, the convection heat transfer is shown to be inhibited by the presence of the solid wall. The results have possible applications in the heat-storage fluid-saturated porous systems and the applications of the high power heat transfer.

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