THE EFFECT OF INCLINATION ANGLE ON THE FREE CONVECTION IN POROUS ENCLOSURES WITH LOCAL THERMAL NON-EQUILIBRIUM MODEL

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ABSTRACT

In this study the phenomena of natural convection in an inclined square enclosure filled with a porous medium under local thermal non-equilibrium model are investigated numerically. Finite volume approach is used to solve steady-state equations of conservation of mass, momentum and energy on a collocated grid. The SIMPLEC algorithm is followed for handling the pressure-velocity coupling. It is assumed that the all walls are maintained at constant temperatures and the heat generation is occurred in solid phase. The fluid is assumed to be an incompressible, Newtonian, homogenous and Boussinesq approximation. The inclination angles of the enclosure is varying from 0º to 180º (ϕ), heat transfer coefficient from 1.0 to 10^3 (H), modified conductivity ratio from 10^{-3} to 10^3 (γ), Rayleigh number from 10^4 to 10^7 and Darcy Number is taken as 10^{-2}. The fluid flow is assumed to be two-dimensional, steady and in the laminar motion condition. The momentum equations include the Brinkman-Forchheimer extended to Darcy flow. Further, the fluid and solid phases are not in local thermal equilibrium. Isotherms for fluid and solid phases and streamlines have been obtained and scrutinized for different values of Ra,ϕ, H and γ. The effect of inclined angle on the natural convection heat transfer and fluid flow and also the effects of different parameters on the local thermal equilibrium condition have been studied. The results show that, with the increase of the fluid-to-solid heat exchange coefficient (H), two phases have been recovered where the fluid and solid temperatures fields are identical. In this case, the local thermal equilibrium assumption may be valid. The average Nusselt number of all walls is calculated with the change of inclination angle. It is clear that the average Nusselt number of each wall changes with inclination angle. It happens due to the fact that the location of the largest temperature gradient on the walls changes at the difference inclination angle. The Nusselt number of top wall decreases and also it increases on the bottom wall with enhancing in the inclination angle.