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INERTIAL EFFECTS ON THE HYDROMAGNETIC NATURAL CONVECTION OF SWCNT-WATER NANOFLUID-SATURATED INCLINED RECTANGULAR POROUS MEDIUM

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The problem of magnetohydrodynamic (MHD) natural convection of a single-wall carbon nanotube (SWCNT)-water nanofluid in a tilted square cavity filled with a saturated porous medium and subjected to an inclined magnetic field is numerically studied. The Dupuit–Darcy model is adopted to describe the flow inside the porous medium for analyzing the departure from the linear Darcy situation. The enclosure is bounded by differentially heated vertical walls, and the horizontal ones are kept adiabatic. The dependency of the fluid flow and the heat transfer rate on the Rayleigh number (R_T), nanotubes volume fraction (ϕ), Hartmann number (Ha), inertial effect parameter (G), inclination angle of the cavity (γ), and the inclination angle of the magnetic field (ξ) is analyzed. The obtained partial differential equations (PDEs) governing the problem have been solved by the finite difference method along with their corresponding boundary conditions. It is found that increasing the SWCNT concentration significantly enhances the convection intensity until a threshold value of the Rayleigh number due to the increase of dynamic viscosity is reached. The increase of the inertial effect parameter or the Hartmann number reduces the fluid flow and the convection strength, and the conduction mode is dominated for high values of both parameters. Furthermore, the heating of the cavity through the left vertical walls produces a better fluid flow and convection strength for a Hartmann number greater than 2. The inclination angle $\xi = 45°$ of the magnetic field represents the best for the fluid flow strength and the heat transfer rate, regardless of the Hartmann and Rayleigh numbers.

KEY WORDS: *free convection, SWCNT-water nanofluid, porous media, magnetic field, inertial effect parameter, Dupuit–Darcy model*

1. INTRODUCTION

In recent years, the study of heat transfer in porous media has been an ongoing research field. This interest is due to the frequent use of research in many engineering and environmental applications like heat exchangers, ground water and oil flow, cooling electronic devices, nuclear reactor systems, and thermal insulation. In the process of designing a fusion reactor, the natural convection heat transfer, electrically conducting fluids, and liquid metals are essential problems because of the strong magnetic field and high temperature difference. Magnetic fields are used for the technologies of drying and lubrication, food cleaning, float glass, hydrodynamic behavior control during the processes of float glass production, solidification, and crystal growth. Moreover, magnetic field applications of nanofluid flows are gaining interest due to their large use in many technological applications such as nuclear reactor