The Double-diffusive Natural Convective Study of an Inverted T-shaped Porous Enclosure under the Influence of an Immersed Circular Object: A Numerical Study

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ABSTRACT

This work is dedicated to investigating the impact of different positions of a circular body onthe double-diffusive convective flow of a hybrid nanofluid inside an inverted T-shaped porous enclosure. The numerical value of various thermophysical properties associated with the hybrid nanofluid (MWCNT+Fe_3O_4/water) is adapted from the published experimental research work at a fixed volume fraction of nanoparticle (ϕ=0.003). The mathematical model (Darcy-Brinkmann-Forchheimer) and the boundary conditions are formulated according to the practical applications of the current enclosure in the various scientific and industrial fields (e.g., solar power collector, heat exchanger, etc.). Moreover, the mathematical model is numerically simulated by the penalty finite element method atvarious values of flow parameters. The comprehensive numerical study has been analyzed based onthe results of fluid and heat transport characteristics through the streamlines, isotherms, and iso-con centration plots. In addition to it, the heat and mass transfer rates have been monitored through themean Nusselt and Sherwood number at varying values of flow parameters, such as Rayleigh numbers, Darcy numbers, porosity values, Lewis numbers, and buoyancy ratios. The results reveal that the pertinent flow parameters have strongly influenced the double-diffusive convective flow phenomena. Also, the higher Rayleigh numbers help in reinforcing the convective heat and mass transport processin the current enclosure.

Keywords: porous media, hybrid nanofluid, double-diffusion, finite element method.

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