MAGNETOHYDRODYNAMICS (MHD) MIXED CONVECTION OF POWERLAW NANOFLUID IN A LID-DRIVEN CAVITY WITH TRIANGULAR SOLID IN THE PRESENCE OF HEAT GENERATION/ABSORPTION AND CHEMICAL REACTION

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Abstract

This paper investigates laminar mixed convection heat transfer in a lid-driven cavity containing a solid triangular block at its centre. Numerical simulations of steady, two-dimensional power-law nanofluid flow and heat transfer characteristics are performed using the finite element method via the automated solution platform Finite Element Numerical Computation Software (FEniCS). The study examined the effects of the powerlaw index ($0.6 \leq n \leq 1.4$), magnetic parameter ($0 \leq M \leq 4$),

heat generation/absorption (-1 ≤ Q ≤ 1) and chemical reaction (-1 ≤ κ ≤ 1) on heat transfer performance. Results indicated that the average Nusselt number increased by 41.28% as the power-law index increased, highlighting enhanced heat transfer due to intensified inertial effects and circulation zones near the lid. Conversely, the average Nusselt number decreased by 13.05%, 54.99%, and 2.25% with increasing magnetic effect, heat generation/absorption and chemical reaction, respectively. However, the Sherwood number increased significantly, showing respective rises of 32.63%, 20.87%, and 112.98% with increases in the power-law index, heat generation/absorption and chemical reaction. Among the dimensionless parameters, heat generation/absorption had the most pronounced impact on the Nusselt number, whereas chemical reaction exerted the greatest influence on the Sherwood number.

Author keywords

Buongiorno; cavity; Finite Element Numerical Computation Software (FEniCS); Magnetohydrodynamics (MHD); power-law nanofluid

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