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Nanofluids and Hybrid Nanofluids: Comparative Study of Mixed Convection in a Round Bottom Flask

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Abstract : This research project focuses on the numerical investigation of the mixed convection of Hybrid nanofluids in a round bottom flask commonly used in organic chemistry synthesis. The aim of this study is to improve the thermal properties of the reaction medium and enhance the rate of chemical reactions by using hybrid nanofluids. The flat bottom wall of the flask is maintained at a constant high temperature, while the top, left, and right walls are kept at a low temperature. The nanofluids used in this study contain suspended Cu and Al2O3 nanoparticles in pure water. The governing equations are solved numerically using the finite-volume approach and the Boussinesq approximation. The effects of the volume fraction of nanoparticles (φ) ranging from 0% to 5%, the Rayleigh number from 103 to 106, and the type of nanofluid (Cu and Al2O3) on the flow streamlines, isotherm distribution, and Nusselt number are examined in the simulation. The results indicate that the addition of Cu and Al2O3 nanoparticles increases the mean Nusselt number, which improves heat transfer and significantly alters the flow pattern. Moreover, the mean Nusselt number increases with increasing Rayleigh number and volume fraction, with Cu- Al2O3 hybrid nanofluid producing the best results. This research project focuses on the numerical investigation of the mixed convection of Hybrid nanofluids in a round bottom flask commonly used in organic chemistry synthesis. The aim of this study is to improve the thermal properties of the reaction medium and enhance the rate of chemical reactions by using hybrid nanofluids. The flat bottom wall of the flask is maintained at a constant high temperature, while the top, left, and right walls are kept at a low temperature. The nanofluids used in this study contain suspended Cu and Al2O3 nanoparticles in pure water. The governing equations are solved numerically using the finite-volume approach and the Boussinesq approximation. The effects of the volume fraction of nanoparticles (φ) ranging from 0% to 5%, the Rayleigh number from 103 to 106, and the type of nanofluid (Cu and Al2O3) on the flow streamlines, isotherm distribution, and Nusselt number are examined in the simulation. The results indicate that the addition of Cu and Al2O3 nanoparticles increases the mean Nusselt number, which improves heat transfer and significantly alters the flow pattern. Moreover, the mean Nusselt number increases with increasing Rayleigh number and volume fraction, with Cu- Al2O3 hybrid nanofluid producing the best results.

Keywords : bottom flask, mixed convection, hybrid nanofluids, numerical simulation
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