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Natural convection enhancement in an eccentric horizontal cylindrical annulus using hybrid nanofluids

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Abstract

The problem of natural convection in an eccentric annulus between two horizontal cylinders filled with Cu–Al₂O₃/water hybrid nanofluids is investigated numerically in this paper. The inner cylinder wall is heated at a uniform temperature whereas the outer wall is kept isothermally cooled. The basic equations that govern the problem are formulated in the bipolar coordinates and written in terms of the vorticity-stream function equations using the dimensionless form for the bidimensional, laminar, and incompressible flow under steady-state conditions. The dimensionless equations are discretized using the finite-volume method and solved by a FORTRAN program. A numerical parametric study is performed for an annulus filled with regular water, Al₂O₃/water nanofluid, and Cu–Al₂O₃/water hybrid nanofluid for various volume fractions of nanoparticles and hybrid nanoparticles ($0 \leq \phi \leq 0.12$) and Rayleigh numbers ($103 \leq Ra \leq 106$). It is found that employing a Cu–Al₂O₃/water hybrid nanofluid provides a better thermal and dynamic performance compared with the similar Al₂O₃/water nanofluid. © 2017 Taylor & Francis.

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