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Natural convective nanofluid flow in an annular space between confocal elliptic cylinders

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Abstract

The natural convection fluid flow and heat transfer in an annulus of two differentially heated confocal elliptic cylinders filled with the Cu-water nanofluid are investigated numerically. The outer cylinder is maintained at a constant temperature T_c while the inner cylinder is kept at a differentially higher constant temperature T_h . Equations of continuity, momentum, and energy are formulated using the dimensionless form in elliptic coordinates for two-dimensional steady, laminar, and incompressible flow, which is expressed in terms of stream function, vorticity, and temperature. The basic equations are discretized using the finite-volume method. Using a developed code, calculations were performed for Rayleigh number ($103 \leq Ra \leq 3 \times 10^5$), volume fraction of nanoparticles ($0 \leq \phi \leq 0.12$), and eccentricity of the inner ellipse, $\epsilon_1 = 0.7, 0.8, \text{ and } 0.9$. The eccentricity of outer ellipse and the angle of orientation are fixed at 0.6 deg and 0 deg, respectively. Results are presented in the form of stream lines, isotherm plots, and local and average Nusselt numbers. The results discussed in this present work show the existence of a very good agreement between the present results and those from the previous researches. © 2017 by ASME.

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