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A Study of Laminar Natural Convection in Annular Spaces between Differentially Heated Horizontal Circular Cylinders Filled with Non-Newtonian Nano Fluids

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Abstract : Heat exchangers are one of the most widely used systems in factories, refineries etc. In this study, natural convection heat transfer using nano-fluids in between two cylinders is numerically investigated. The inner and outer cylinders are kept at constant temperatures. One of the most important assumptions in the project is that the working fluid is non-Newtonian. In recent years, the use of nano-fluids in industrial applications has increased profoundly. In this study, nano-Newtonian fluids containing metal particles with high heat transfer coefficients have been used. All fluid properties such as homogeneity has been calculated. In the present study, solutions have been obtained under unsteady conditions, base fluid was water, and effects of various parameters on heat transfer have been investigated. These parameters are Rayleigh number ($10^3 < Ra < 10^6$), power-law index ($0.6 < n < 1.4$), aspect ratio ($0 < AR < 0.8$), nano-particle composition, horizontal and vertical displacement of the inner cylinder, rotation of the inner cylinder, and volume fraction of nanoparticles. Results such as the internal cylinder average and local Nusselt number variations, contours of temperature, flow lines are presented. The results are also discussed in detail. From the validation study performed it was found that a very good agreement exists between the present results and those from the open literature. It was found out that the heat transfer is always affected by the investigated parameters. However, the degree to which the heat transfer is affected does change in a wide range.

Keywords : heat transfer, circular space, non-Newtonian, nano fluid, computational fluid dynamics.
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