ENHANCEMENT OF CONVECTIVE HEAT TRANSFER WTIH NANOFLUIDS - SINGLE-PHASE AND TWO-PHASE ANALYSIS

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ABSTRACT

In this study, forced convection heat transfer characteristics of nanofluids are investigated by numerical analysis of laminar flow in a circular duct under constant wall temperature and wall heat flux boundary conditions. The thermal responses of the system are obtained by single-phase and two-phase approach for hydro-dynamically fully developed flow. In the single-phase numerical analysis, Al_2O_3/water nanofluid is assumed as a homogenous media and Koo-Kleinstreuer model which takes the effects of temperature and the particle diameter into account is used for the effective thermal conductivity of nanofluids. Variations of thermal conductivity in turn, heat transfer enhancement is obtained as a function of nanoparticle volume fractions, at a given nanoparticle diameter and Peclet number. In two-phase analysis, Computational Fluid Dynamics (CFD) simulations for initially hydro-dynamically fully developed laminar flow with nanofluids in a circular duct are performed with two-phase mixture model by using Fluent software. Thermal behaviors of the system are investigated for Al_2O_3/water nanofluid by using different thermal conductivity and viscosity models. The effects of thermal conductivity and viscosity models on the heat transfer enhancements are calculated for different nanoparticle volume fractions and diameters. The effect of the nanoparticle volume fraction and size are calculated for different mathematical approaches.

The single-phase and two-phase results are compared with a previous experimental study in the literature for the same geometry and boundary conditions. It is observed that the result are in good agreement with experimental findings.