Synthesis of Nanofluid for Heat Transfer Enhancement and Application in Annular Configuration Flow Passage

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Abstract

Since the invention of a heat exchanger, working fluids such as water, ethyl glycol, oil, and many others were used; however, they exhibit a relatively low thermal conductivity. Nanofluids were introduced in this research to overcome the problem. In the present work, heat transfer coefficient and hydrodynamic analysis of TiO_2 water-based nanofluid and distilled water flowing in an annular conduit under turbulent flow were investigated. The annular conduit with different shapes of the inner pipe (circular and square) under a constant heat flux with different concentrations of TiO_2 nanofluids were studied. The weight fractions of the nanoparticles were selected at 0.1%, 0.075%, and 0.05%. The simulations were conducted under a steady turbulent flow condition where the Reynolds number was varied from 2300 to 5000. Computational fluid dynamics (CFD) commercial package ANSYS FLUENT 18.2 software was used to obtain the heat transport in the annular geometry. The CFD analysis applied the finite volume method, a uniform surface heat flux boundary condition, and the SST-k-ω model for the solver. The simulation results showed that the Nusselt number enhances with an increment of a nano-particles fraction over the base fluid. The heat transfer rate is slightly higher when using a square inner pipe compared to a circular shape. The results concluded that by varying the inner shape of the annular conduit, the rate of heat transfer is enhanced.

Keywords**:** *Nanofluid, SST k-ω model, Heat transfer Coefficient, Inner pipe, Annular geometry*