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CFD Studies on Forced Convection Nanofluid Flow Inside a Circular Conduit

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Abstract : This work provides an overview on the experimental and numerical simulations of various nanofluids and their flow and heat transfer behavior. It was further extended to study the effect of nanoparticle concentration, fluid flow rates and thermo-physical properties on the heat transfer enhancement of Al2O3/water nanofluid in a turbulent flow circular conduit using ANSYS FLUENT™ 14.0. Single-phase approximation (homogeneous model) and two-phase (mixture and Eulerian) models were used to simulate the nanofluid flow behavior in the 3-D horizontal pipe. The numerical results were further validated with experimental correlations reported in the literature. It was found that heat transfer of nanofluids increases with increasing particle volume concentration and Reynolds number, respectively. Results showed good agreement (~9% deviation) with the experimental correlations, especially for a single-phase model with constant properties. Among two-phase models, mixture model (~14% deviation) showed better prediction compared to Eulerian-dispersed model (~18% deviation) when temperature independent properties were used. Non-drag forces were also employed in the Eulerian two-phase model. However, the two-phase mixture model with temperature dependent nanofluid properties gave slightly closer agreement (~12% deviation).

Keywords : nanofluid, CFD, heat transfer, forced convection, circular conduit
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