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Multiphase CFD Investigation on Convective Heat Transfer Enhancement for Turbulent Flow of Water-Al_2O_3 Nanofluid

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Abstract

Because of extraordinary heat transfer capability, nanofluids have become a potential interest in engineering sectors. Despite being a multiphase fluid, nanofluids were treated as single phase fluids in many previous studies and comparison between single and two phase models was drawn. Examining nanofluids capability to augment heat transfer is one of the keys to utilize them properly in the field of thermofluids. However, the optimal multiphase model to simulate nanofluids heat

transfer enhancement is yet to be found out. In this study, the method of computational fluid dynamics has been used to simulate flow of water-Al2O3 nanofluid in a circular pipe in the purpose of identifying the best multiphase model to simulate heat transfer enhancement of nanofluids. Two multiphase models have been taken into account: Volume of Fluid and Mixture model. Three different volume fractions of nanoparticles in nanofluid have been tested for each of these models such as 1%,4% and 6% for highly turbulent flows where Reynolds number was ranged between 20000 to 80000. The standard k-ε turbulence model has been employed to model the flow of nanofluid with the mentioned multiphase models in the present study. The results have been carried out in forms of correlation between Re and Nu and have been compared with existing experimental results. The results showed that the heat transfer enhancement of nanofluid is mostly dominated by concentration of nanoparticles present in the fluid and suggested that Mixture model is suitable for predicting convective heat transfer enhancement of nanofluid for cases with high particle concentration though the necessity of further experimental study in some scopes has been detected.

Author keywords

Forced convection; Heat transfer ; Multiphase ; Nanofluid

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