World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:9, No:01, 2015

Turbulent Forced Convection of Cu-Water Nanofluid: CFD Models Comparison

Authors : I. Behroyan, P. Ganesan, S. He, S. Sivasankaran

Abstract : This study compares the predictions of five types of Computational Fluid Dynamics (CFD) models, including two single-phase models (i.e. Newtonian and non-Newtonian) and three two-phase models (Eulerian-Eulerian, mixture and Eulerian-Lagrangian), to investigate turbulent forced convection of Cu-water nanofluid in a tube with a constant heat flux on the tube wall. The Reynolds (Re) number of the flow is between 10,000 and 25,000, while the volume fraction of Cu particles used is in the range of 0 to 2%. The commercial CFD package of ANSYS-Fluent is used. The results from the CFD models are compared with results from experimental investigations from literature. According to the results of this study, non-Newtonian single-phase model, in general, does not show a good agreement with Xuan and Li correlation in prediction of Nu number. Eulerian-Eulerian model gives inaccurate results expect for φ=0.5%. Mixture model gives a maximum error of 15%. Newtonian single-phase model and Eulerian-Lagrangian model, in overall, are the recommended models. This work can be used as a reference for selecting an appreciate model for future investigation. The study also gives a proper insight about the important factors such as Brownian motion, fluid behavior parameters and effective nanoparticle conductivity which should be considered or changed by the each model.

Keywords : heat transfer, nanofluid, single-phase models, two-phase models
Conference Title : ICFDT 2015 : International Conference on Fluid Dynamics and Thermodynamics
Conference Location : London, United Kingdom
Conference Dates : January 19-20, 2015