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EXPERIMENTAL AND NUMERICAL INVESTIGATION OF HEAT TRANSFER AUGMENTATION USING AL_2O_3-ETHYLENE GLYCOL NANOFLUIDS UNDER TURBULENT FLOWS IN A FLAT TUBE

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M. Kh. Abdolbaqi[a], Nor Azwadi Che Sidik[b*], Muhammad Noor Afiq Witri Muhammad Yazid[b], Rizalman Mamat[a], W. H. Azmi[a], Hind M. Kh.[c]

[a]Faculty of Mechanical Engineering, University Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
[b]Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia
[c]Department of Civil Engineering, University of Gaziantep, 27310 Gaziantep, Turkey

*Corresponding author
azwadi@mail.fkm.utm.my

Abstract

A study of computational fluid dynamics has been conducted to study the characteristics of the heat transfer and friction factor of Al_2O_3/Ethylene glycol-water nanofluid flowing inside flat tube. The three dimensional realizable k–ε turbulent model with an enhanced wall treatment was utilized. The evaluation of the overall performance of the tested tube was predicated on the thermo-hydrodynamic performance index. The obtained results showed that the difference in behaviour depending on the parameter that has been selected to compare the nanofluid with the base fluid. In addition, the friction factor and the heat transfer coefficient increases with an increase of the nanoparticles volume concentration at the same Reynolds number. The penalty of pressure drop is negligible with an increase of the volume concentration of nanoparticles. Conventional correlations that have been used in turbulent flow regime to predict average heat transfer and friction factor are Dittus-Boelter and Blasius correlations, for tubes are also valid for the tested nanofluids which consider that the nanofluids have a homogeneous fluid behaviour.

Keywords: Nanofluid, Heat transfer, flat tube, Ethylene glycol, ANSYS FLUENT

1.0 INTRODUCTION

The use of heat transfer enhancement techniques, can improve thermal performance of a tubes. The heat transfer techniques can be classified into three broad techniques: Passive techniques that do not need external power such as rough surfaces, swirl flow devices, treated surfaces, extended surfaces, displaced enhancement devices, surface tension device, coiled tube and additives such as nanoparticles. Active technique that need external power to enable the desired flow modification for increasing heat transfer such as electrostatic fields, mechanical aids, jet impingement, suction, injection, surface vibration, and fluid vibration: Compound technique is the mix of two or more of the techniques that mentioned above at one time. There are many applications of heat transfer augmentation by using nanofluids to get the cooling challenge necessary such as the photonics, transportation, electronics, and energy supply industries [1-6].A double tube coaxial heat exchanger heated by solar energy using Aluminium oxide nanofluid presented experimentally and numerically by [7]. Forced convection turbulent flow of nanofluid (Al_2O_3 / water) with variable wall temperature inside an annular tube has been experimentally investigated by [8]. The results shown