An Experimental Determination of Thermal Conductivity and Viscosity of BioGlycol/water based TiO_2 Nanofluids

M.Kh. Abdolbaqi[a], Nor Azwadi Che Sidik[b,*], Amir Aziz[a], Rizalman Mamat[a,c], W.H. Azmi[a,c], Mohammad Noor Afiq Witri Muhammad Yazid[b], G. Najafi[d]

[a] Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
[b] Faculty of Mechanical Engineering, Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia
[c] Automotive Engineering Centre, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
[d] Tarbiat Modares University, Tehran, Iran

ABSTRACT

Nanofluid as a new brand of cooling fluid consisting of nanometer-sized particles dispersed in base fluid. In this study, nanofluids have been prepared by dispersing TiO_2nanoparticles in different base fluids such as 20:80% and 30:70% by volume of BioGlycol (BG)/water (W) mixtures. Thermal conductivity and viscosity experiments have been conducted in temperatures between 30 °C and 80 °C and in volume concentrations between 0.5% and 2.0%. Results show that thermal conductivity of nanofluids increases with increase of volume concentrations and temperatures. Similarly, viscosity of nanofluid increases with increase of volume concentrations but decreases with increase of temperatures. The maximum thermal conductivity enhancement among all the nanofluids was observed for 20:80% BG:W nanofluid about 12.6% in the volume concentration of 2.0% at a temperature of 80 °C. Correspondingly among all the nanofluids maximum viscosity enhancement was observed for 30:70% BG:W nanofluid about 1.53-times in the volume concentration of 2.0% at a temperature of 70 °C. The classical models and semi-empirical correlations failed to predict the thermal conductivity and viscosity of nanofluids with effect of volume concentration and temperatures. Therefore, a nonlinear correlation has been proposed with 5% maximum deviation for the estimation of thermal conductivity and viscosity of nanofluids.

KEYWORDS: Nanofluids; BioGlycol; Titanium oxide; Thermal conductivity; Viscosity

DOI: 10.1016/j.icheatmasstransfer.2016.07.007