Experimental investigation of nanoparticle mixture ratios on TiO_2–SiO_2 nanofluids heat transfer performance under turbulent flow

K. Abdul Hamid [a], W.H. Azmi [a,b,*], M.F. Nabil [a], Rizalman Mamat [a,b,c]

[a] Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
[b] Automotive Engineering Centre, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
[c] Faculty of Bioengineering and Technology, Universiti Malaysia Kelantan, 17600 Jeli, Kelantan, Malaysia

ARTICLE INFO

Article history:
Received 19 August 2017
Received in revised form 8 November 2017
Accepted 8 November 2017
Available online 15 November 2017

Keywords:
Heat transfer
TiO_2-SiO_2nanofluids
Water-ethylene glycol mixture
Mixture ratio
Hybrid nanofluids

ABSTRACT

The new class of fluids namely nanofluids are highly desirable in the enhancement of thermal properties. Various studies were carried out based on their greater thermal performance. The nanofluids are also beneficial in improving the heat transfer performance of devices or systems that require cooling operations. However, the performance of nanofluids with dispersion of two or more different nanoparticles is limited in the literature. Hence, the present study was carried out to investigate the heat transfer performance of TiO_2–SiO_2 nanofluids for various nanoparticle mixture ratios dispersed in a water/ethylene glycol (W/EG) mixture. The convection heat transfer experiment is conducted under turbulent region with Reynolds number from 3000 to 24,000. Five composite mixtures in volume percent of TiO_2 and SiO_2 nanoparticles are prepared with mixture ratios (TiO_2:SiO_2) of 20:80, 40:60, 50:50, 60:40 and 80:20 for a constant volume concentration of 1.0%. The heat transfer performance and friction factor were evaluated for the bulk temperatures of 30, 50 and 70 °C. High performance was seen at a 40:60 mixture ratio with heat transfer enhancement of 35.32% at 70 °C temperature. The mixture ratio of 50:50 showed the least enhancement of 9.02% in heat transfer coefficient for a working temperature of 30 °C. Furthermore, the friction factor of the nanofluids is practically negligible due to the small increment. As a conclusion, the nanoparticle mixture ratios of TiO_2–SiO_2 nanofluids contributed to the overall performance of heat transfer. It was recommended to use 20:80 and 40:60 mixture ratios of TiO_2–SiO_2 nanofluids in heat transfer systems.