Experimental investigation on stability and thermo-physical properties of Al_2O_3–SiO_2/PAG nanolubricants with different nanoparticle ratios

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ABSTRACT

The thermo-physical properties enhancement of nanolubricants can improve the heat transfer performance in refrigeration system. In this study, thermo-physical properties of Al2O3–SiO2/PAG nanolubricants were investigated at 30–80 °C temperatures for different nanoparticle ratios. Al2O3 and SiO2 nanoparticles were dispersed in the polyalkylene glycol (PAG 46) lubricant using the two-step method of preparation. Thermal conductivity and dynamic viscosity of the nanolubricants were measured by using KD2 Pro thermal properties analyser and LVDV-III Rheometer, respectively. All the hybrid nanolubricants are witnessed to behave as Newtonian fluids. A maximum thermal conductivity enhancement of 2.41% occurred at the temperature of 80 °C. Meanwhile for dynamic viscosity, the highest percentage increment was found up to 9.34% at 70 °C temperature. Increments in both properties were recorded for 50:50 nanoparticle ratio. The property enhancement ratio (PER) evaluation was suggested 60:40 as the optimum nanoparticle ratio with the lowest PER in comparison with other nanoparticle ratios at all temperatures by considering of both properties. Finally, new correlations have been proposed based on the experimental data to predict the thermo-physical properties of Al2O3–SiO2/PAG nanolubricants. As a conclusion, Al2O3–SiO2/PAG nanolubricants with nanoparticle ratio of 60:40 and volume concentrations of less than 0.1% are highly recommended for application in refrigeration system.

Keywords: Hybrid nanolubricants; Thermal conductivity; Dynamic viscosity; Newtonian

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