Rheological behaviour and thermal conductivity of polyvinyl ether lubricant modified with SiO_2- TiO_2 nanoparticles for refrigeration system

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ABSTRACT

Before any nanolubricant is being applied in a refrigeration system, its thermo-physical properties shall be investigated. In this paper, hybrid nanolubricant is prepared by dispersing SiO2-TiO2 nanoparticles at 50:50 composition ratio into the polyvinyl ether (PVE) compressor lubricant using a two-step method. The investigation was done for volume concentrations from 0.01 to 0.10% under temperature range of 303 to 353 K. The Newtonian behaviour of the nanolubricant was obtained, and relative thermo-physical enhancement was determined by comparing its performance to the pure lubricant. It was observed that the maximum increment viscosity does not exceed 3% from the base fluid, while thermal conductivity for 0.1% concentration increases up to 1.6%. Overall observation also reveals that both rheological and thermal properties increase by increasing concentrations, but the same properties decrease with temperature. An interesting finding is the nanolubricant had viscosity decrement than the pure lubricant specifically at 303 K. New regression models were suggested for thermo-physical properties with high accuracy R-squared values of 0.9989 and 0.9920 for viscosity and thermal conductivity, respectively. As a conclusion, SiO2-TiO2/PVE nanolubricant is recommended in refrigeration systems with a volume concentration of less than 0.10%.

KEYWORDS

Hybrid nanolubricant; Newtonian; Polyvinyl ether lubricant; Regression model; Thermal conductivity; Viscosity

ACKNOWLEDGMENTS

The authors are grateful to the Universiti Malaysia Pahang (www.ump.edu.my) for laboratory facilities and financial supports given under RDU213302 and additional financial support under Postgraduate Research grant PGRS2003202. The authors would like to also thank the research teams from Centre for Research in Advanced Fluid and Processes and Advanced Automotive Liquids Laboratory (AALL) who have provided professional insights and expertise that greatly assisted the present research work.