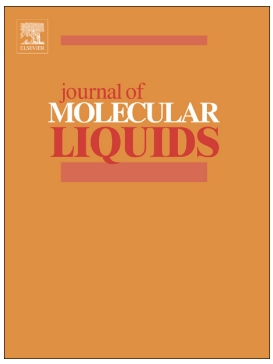

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Experimental Investigation on Thermal and Rheological Behaviour of PAG Lubricant Modified with SiO_2 Nanoparticles

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Abstract

Nanolubricant is prepared by dispersing SiO_2 nanoparticles into synthetic refrigerant compressor oil, polyalkylene glycol (PAG) using two-step method. Thermal conductivity and rheological properties of nanolubricant at various volume fractions (0.07 to 0.6vol %) in the temperature range 20^0C to 90^0C have been investigated. The results show that as the volume fraction increases thermal conductivity and viscosity increase. Conversely, the thermal conductivity and viscosity are found to be decreasing with increase in temperature. The highest thermal conductivity and viscosity of the nanolubricant(volume fraction 0.6%) are 1.31 and 10.34 times greater than that of pure lubricant. The measured thermal conductivity and viscosity are compared with that obtained from classical models and the classical models fail to predict these properties accurately. The non-newtonian shear thinning behaviour of SiO_2-PAG nanolubricant was confirmed by computing power law and consistency indices. At higher particle concentrations and lower temperatures, nanolubricant shows thixotropic behaviour.

Key words: Nanolubricant; thermal conductivity; rheology; shear thinning, thixotropy

Nomenclature:

English symbols	*Subscripts*
m mass of nanoparticles[g]	*bf* base fluid
k thermal conductivity[W/mK]	*eff* effective
T temperature [^{0}C]	*p* particle
Cp specific heat [kJ/kgK]	*Abbreviations*
Greek symbols	COP coefficient of performance
β ratio of nanolayer thickness to original radius	PAG polyalkylene glycol
φ volume fraction [%]	TEM transmission electron microscope
μ dynamic viscosity[cP]	SEM scanning electron microscope
ρ density[kg/m^3]	EER energy efficiency ratio
τ shear stress(dyne /cm)	
$\curlyvee$ shear rate(1/s)	

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