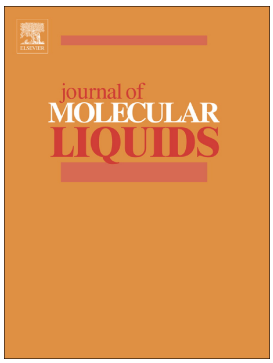

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Experimental investigation, model development of the Non-Newtonian behavior of CuO-MWCNT-10w40 nano-lubricant for lubrication purposes

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Abstract:

Nanofluid lubricants demonstrate superior thermal and mechanical characteristics compared with the traditional bare lubricating oils. Here we added cupper-oxide nano-particles and Multi-Wall Carbon Nano-tubes (CuO-MWCNT (9:1)) into a commericial lubricating oil (10w40) and achieved prominent rheological behaviors. The hybrid nano-particles and 10w40 were mixed with different volume fractions (0-10%). Viscosity of the issued nano-composite fluids was measured under different tempetures (5-55°C) and shear rates. It was inferred that CuO-MWCNT (9:1)-10w40 possesses non-Newtonian rheological characteristics, same as it's bare analogous. The experimental data were firstly approved by Ostwald de Waele model, and then used to develop a novel mathematical model, correlating the the volume fraction of the soild phase and the operating temperature to the viscosity of the composite nano-fluid. In order to further validation, an artificial neural network (ANN), based on multilayer perception (MLP) algorithm, was created and applied to support the rheological behavior of the prepared nano-fluids. The regression coefficient (R^2) and the mean squared error parameter (MSE) were respectively determined to be 0.9992 and 1.81E-4. It was concluded that the CuO-MWCNT (9:1)/ 10w40 nano-lubricant complies the essential requirements of a highly effective lubricant material, and suggested numerical model is a rieliable tool, to describe the rheological behaviors of the nanofluid lubricants, with various contents of nano-particles, in a wide range of operating temperatures.