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Dynamic viscosity prediction using artificial intelligence for an antifreeze containing MWCNT–alumina hybrid nanopowders

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Abstract

This paper investigates the impact of Solid Volume Fraction (SVF) and temperature on the dynamic viscosity of a hybrid antifreeze composed of MWCNTs and aluminum oxide in a mixture of water (80%) and ethylene-glycol (20%). An Artificial Neural Network (ANN) is used to predict the viscosity of the nanofluid, which was generated at different SVFs ranging from 0.25% to 1% and temperatures ranging from 25 °C to 50 °C. This study aims to establish a correlation between viscosity and input parameters in the antifreeze. Results demonstrate that Shear Rate (SR) and SVF have opposite effects on the viscosity of the nanofluid. Increasing SVF leads to a strong increase in viscosity deviation and higher mean values of viscosity while increasing SR results in a sharp decline in both the mean value and variation of the viscosity. The temperature has a smaller impact on viscosity variance than SR and SVF. The proposed ANN model with a two-layer network and 13 neurons having nonlinear activation functions in the hidden layer shows an accurate prediction of viscosity versus inputs. The proposed methodology offers an improvement of up to 10 times in predicting viscosity accuracy as compared to GMDH and decision tree techniques. The findings of this study can have important implications for the design of heat exchangers using nanofluids especially in portable devices.