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Rheological behaviour and the hysteresis phenomenon of Al₂O₃ nanofluids

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Abstract

The effects of temperature and low-volume concentration on the dynamic viscosity of the Al₂O₃/water and Al₂O₃/ethylene glycol/water nanofluids are investigated. Nanofluids were prepared and characterised. Data were collected for temperatures ranging from 25 to 80°C. The presence of aggregated Al₂O₃ nanoparticles in the fluid, with average diameter of 109 nm which is ~8 times the primary diameter (13 nm) of Al₂O₃ nanoparticles was witnessed. Furthermore, only at temperature below 40°C water-based alumina nanofluid at 0.05% v/v showed Newtonian behaviour. On the other hand, Al₂O₃/ethylene glycol/water mixture exhibited Newtonian behaviour. Results clearly showed the presence of a critical temperature, beyond which the particle suspension properties were noticed to be radically changed, which results in activating the hysteresis phenomenon. The hysteresis phenomenon on viscosity measurement, which is believed to be the first observed for ethylene glycol/water-based nanofluids, has raised serious concerns regarding the use of nanofluids for heat transfer enhancement.

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