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Evaluation of Stability of Alumina Nanofluids and Its Impact on Viscosity and Density

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Extended Abstract

Nanofluids are defined as colloidal dispersions of nanoparticles (with size lower than 100 nm) into conventional heat transfer fluids [1]. Due to their improved thermophysical properties, they are proposed to enhance cooling and energy performance of thermal systems [1]. However, their practical application has been limited by the challenge of maintaining a long term good stability of nanofluids. Nanoparticles present a high tendency to agglomerate and sediment, that may cause settling down of particles and clogging of flow channels and lead to poorer thermal performance [2]. Therefore, improving nanofluids stability is essential to foment their industrial implementation and guarantee their efficiency as heat transfer fluids.

Many approaches have been proposed to increase nanofluids stability, such as the addition of surfactants, change the pH of the medium or increase sonication time [3]. Surfactants are composed by a hydrophobic tail accoupled with a hydrophilic polar head. When in solution, they have a tendency to stay on nanoparticle surfaces increasing their net charge, and consequently increasing the repulsive forces, which avoids the clusters formation [2,3]. The adjustment of the pH of solution directly influences the charge of nanoparticles surface and may lead to better dispersion and stabilization, while enlarging the sonication process enhances the break of the agglomerates of molecules. All these mentioned methods can impact the thermophysical properties of nanofluids [2,3].

In this work, stability of alumina (Al_2O_3) nanofluids prepared by the two-step method was evaluated through UV–vis absorbance technique and visual inspection along 7 days. Alumina nanoparticles were selected due to their wide utilization and considerably good relation between efficiency and price. The effect of surfactants SDBS and CTAB, pH changes (4.0 and 9.0) and ultrasonication time (30 and 60 min) were investigated and their impact on viscosity and density of nanofluids determined. Overall, the results showed that the addition of surfactants promoted the best dispersion of nanoparticles and produced the most stable nanofluids. Density was not affected by the method of nanofluids preparation or by time. Viscosity was higher (around 0.99 cP) for the nanofluid prepared with 30 min of ultrasonication and no pH adjust or surfactants addition. The other nanofluids presented approximately the same viscosity of about 0.95 cP. Viscosity reduced with time for the nanofluid with pH 4.0 and increased for the nanofluids containing surfactants. For the other nanofluids the effect of time on viscosity was considered negligible. In conclusion, the preparation method presented a significant impact on the dispersion of nanoparticles and highlighted the importance of investigate the most appropriate method of nanofluids stabilization for their optimum thermophysical properties.

References

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