Rheological study of the aggregation state of alumina nanofluids.

J.L. Arjona-Escudero[1], I.M. Santos-Ráez[1], A.I. Gómez-Merino[2], F.J. Rubio-Hernández[2]

[1] *Dep. Ingeniería Mecánica Térmica y de Fluidos, Universidad de Málaga, Dr Ortiz Ramos s/n, Málaga (Spain).*
[2] *Dep. Física Aplicada II, Universidad de Málaga, Dr Ortiz Ramos s/n, Málaga (Spain).*
e-mail of the presenter: aimerino@uma.es.

The presence of alumina solid particles in aqueous phase induces a change in the viscosity of the suspension from Newtonian to non- Newtonian flow. Besides, the presence of solid particles is adequate for the use as a heat exchanger fluid. The effect of nanoparticle size on thermal properties of nanofluids is still today a question, which is far from being answered. In this respect, the results reported in the literature are contradictory [1], probably due to the formation of aggregates when particles are dispersed in the liquid phase. Regarding to the nanoparticle shape influence in thermal conductivity, cylinders and spheres have been considered as the more effective in heat transfer.

Spherical nanoparticles of alumina, which is one of the most investigated nanofluid, dispersed in water were used in this study. TEM images showed a mean average diameter of 50 nm. However, DLS measurements showed monodispersed particles of 260 nm. Very recently [2], the relationship between shear rheology and aggregation state of suspensions has been reviewed. Mechanical and physical properties of the resultant materials depend on shape, size and size distribution, which are considered determining parameters in the formation of particle aggregates. The steady shear flow (figure 1) has shown that these clusters, when they are at rest, are formed by highly branched aggregates that erode when shear rate increases, until a suspension of individual particles is achieved. These results are in good agreement with the intrinsic viscosity obtained by Money and Krieger-Dougherty models. In both cases, these values are far from the 2.5 corresponding to spherical particles. The temperature effects were also taken into account.

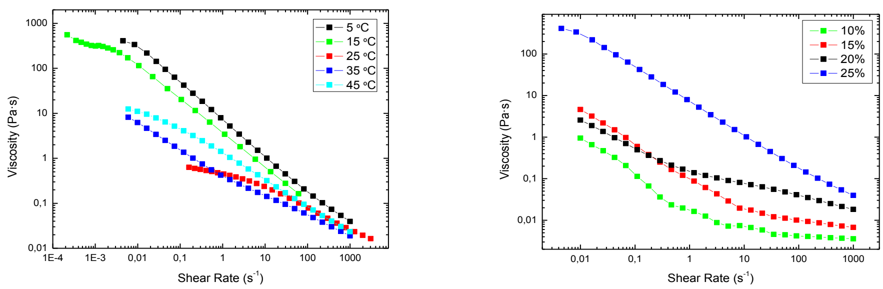

Figure 1. Viscosity curves of alumina, temperature and volume fraction effects.

Keywords: Intrinsic viscosity, Shear-thinning, Heat Transfer Nanofluids, Alumina.

References

[1] M. Lomascolo, G. Colangelo, M. Milanese, A. de Risi, A. Review of heat transfer in nanofluids: conductive, convective and radiative experimental results. Renewable and Sustainable Energy Reviews, **43**: 1182-1198 (2015).
[2] D.B. Genovese, Shear rheology of hard-sphere, dispersed, and aggregated suspensions, and filler–matrix composites, Adv. Colloid Interface Sci., **171**: 1–16 (2012).