Role of Fructose in Rheology of Nanometric Powder Suspensions: Magic or Science?

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Technological implication of reduction in viscosity of nanometric ceramic suspensions with environmentally benign and inexpensive additives is not trivial. This presentation will discuss the flow characteristics of dense nanometric alumina powder suspensions. For a given solids content, as the particle size decreases so does the interparticle distance leading to overlapping interparticle forces. Concomitant with the particle size reduction, increase in surface area of the solids requires higher surfactant concentrations for effective steric stabilization. The rheology of nanometric alumina suspensions and its variation with solids content and with fructose concentration were explored by rheometry. The mechanism of dramatic viscosity reduction by mono saccharides (primarily fructose) is studied by TGA, DSC, and NMR. The interparticle forces between the nanometric alumina particles in water and in fructose solutions were investigated by AFM.

Viscosity of alumina nanometric alumina suspensions decrease dramatically by the addition of mono saccharides, such as fructose. TGA and DSC data indicate that the fraction of free water increases with the addition of fructose. This unusual effect is believed to be due to reduction in the interparticle forces.

The interactions between the nanometric alumina particles in water can be explained by the DLVO theory. However, DLVO theory can not adequately describe the interactions between particles for suspensions containing fructose. The interaction forces (amplitude and range) between nanometric alumina particles decrease with increasing fructose concentration.