Interpretation and applicability of parallel superposition rheology techniques on liquid like flocculated hard sphere dispersions.

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Abstract

The use of superposition rheology for the study of microstructure behaviour on flowing dispersions was proposed several decades ago and early analysed by H.C. Booji [1]. Of the two main configurations (parallel and orthogonal superposition) orthogonal superposition is far more used because of its little interference with the flowing structure and, in consequence, its analytical simplicity. However, the parallel geometry rotatory rheometer is widely used in rheometric and colloidal laboratories. This work is an attempt of providing an analysis of the technique and a simple model for applying it and be able to interpret its results.

This work make use of the current knowledge of clusters and some previous work on this topic like good predictions of Dhont [2] emerged from his mathematical analysis. We attempt a prediction of the qualitative behavior of floc based micro-structure and its stability under a superposed oscillatory shear. An evaluation of the conditions of applicability is performed by relying on the interferences mathematically described on [3].

We focus on flocculated colloidal dispersions of hard spheres ligated mainly by double layer electronic repulsion and Van der Waals attraction. A liquid like phase is required for our model. Only structures ligated by the secondary minimum equilibrium point of the interaction potential are analyzed.

Given a stress model, simulations are performed showing parallelisms with external results of nonlinear shear tests like LAOS [4].

References

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[4] K. Hyuna, M. Wilhelmb, C.O. Kleinb, K. S. Choc, J. G. Namd, K. H. Ahnd, S. J. Leed, R. H. Ewoldte, G. H. McKinleyf, Progress in Polymer Science, (2011), pp1697-1753 .

Figures

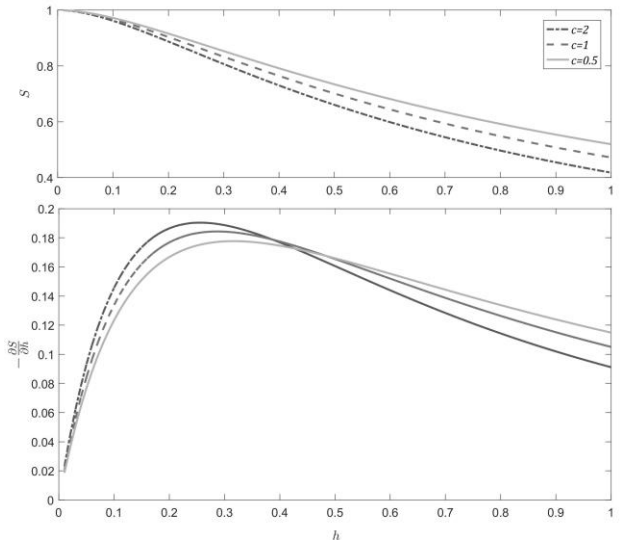

Figure 1: Adimensional structure potential (*S*) versus adimensional dispersion parameter (*h*).