Ultrasonic de-agglomeration of pigments nano-particles

Andrzej W Pacek
School of Chemical Engineering, University of Birmingham, Birmingham, UK;
a.w.pacek@bham.ac.uk

keywords: nano-particles, ultrasonification, de-agglomeration, energy density, rheology, morphology

Abstract

Dispersing pigments nano-particles in aqueous solutions is a critical step in manufacturing of paints and coatings. Morphology and rheology of suspension determine the quality of the paint and they depend on energy input, pH, type and concentration of surfactant. Ultrasonication is frequently used in de-agglomeration but literature information on this process is very limited. To fill this gap the effect of selected parameter on de-agglomeration of two nano-powders was investigated.

Kinetics of wet de-agglomeration of goethite and hematite nano-powders, as well as rheology and morphology of resulting suspensions, strongly depends on energy input, solid load and pH. Initially large aggregates are broken by fragmentation and as the process progresses nano-particles are gradually eroded from the surface of those large aggregates. The breakage of large aggregates can be described by size-energy model and the model describing the generation of primary particles was developed. The increase of solid load leads to an increase of the efficiency of both breakage of large aggregates and formation of fine particles. The pH and solid concentration have much stronger effect on rheology and morphology of goethite suspensions than on hematite suspension. Depending on pH morphology changes from a Newtonian suspension of primary nano-particles to a non-Newtonian, shear thinning suspension of large, porous flocks with the yield stress reaching maximum at an iso-electric point. The effect of pH on morphology and rheology is reversible. The rheological models based on DLVO theory do not allow the prediction of the effect of pH on viscosity and yield stress but the flow curves can be described by fractal model with adjustable parameters.

Contact Author's Information:

Name: Prof A.W.Pacek
Address: School of Chemical Engineering, University of Birmingham, B15 2TT Birmingham, UK
Phone number:++ 44 121 414 5308
e-mail address:A.W.Pacek@bham.ac.uk

Presenting Author's Information:

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