

Influence of Ions on the Coalescence Behavior

D. Leleu, A. Pfennig, Université de Liège, Lüttich, Belgium

Continuous settlers are used in many processes for separating liquid-liquid dispersions. In an efficient process, this downstream operation must be sufficiently well designed so that the dispersion is completely split into two separate phases. However, trace components such as salts strongly influence droplet coalescence. Their effect varies with the ion species and with their concentration making settling times quite unpredictable and, thus, making the design of technical equipment challenging. Usually, settling experiments are conducted in a so-called settling cell to quantify the effect of trace components [1]. Thus, the goal is to go further in the coalescence modelling by include the effect of ions on the separation process.

In more details, Kopriwa [2] showed that trace components, e.g. salts, have a strong influence on the coalescence time, because they influence the interaction between the interfaces. Pfennig and Schwerin [3] showed by testing different systems with an increased salt concentration that the salt effect on coalescence time can in principle be linked to the Derjaguin-Landau-Verwey-Overbeek (DLVO) theory [4-5]. The DLVO theory describes the force resulting from the repulsive electrostatic interaction and the attractive Van-der-Waals force acting between two approaching droplets. The DLVO force depends on the salt concentration and on the different ions present in the system [2]. The DLVO force typically shows a repulsive maximum for a given salt concentration. At this value, the repulsive force between two drops is large and, as a consequence, hinders the coalescence, as shown by Pfennig and Schwerin [3].

The DLVO force is related to the coalescence time in the presented study. This theoretical approach is introduced into the expression describing the coalescence time, leading to a Boltzmann-type term. The modeling approach is validated with experiments in a standardized settling cell for systems with varying salt composition.

References:

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