Drop-Based Modeling of Batch Settlers: The Final Model

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In recent years a model has been derived that describes the drop interactions in solvent extraction. This model has been applied to simulate in detail the behavior of batch settlers, which can then be utilized e.g. to determine coalescence parameters from standardized settling experiments or to design large-scale batch settlers. In the simulations, drop-size distributions are accounted for. Thus, the separation efficiency of a settler for drops of different size can be determined, which also allows to calculate the remaining turbidity after phase separation as function of settling time.

The model has been validated based on lab-scale settling experiments using iso-optical systems, where a dye was added to one of the phases. This allows detailed evaluation of holdup as function of position and time. Also, the initial drop-size distribution has been determined with a SOPAT probe.

After preliminary results have been shown in previous years, now the final model has been derived and will be presented. The simulations together with the experimental results clearly indicate some effects that have previously not been considered in the literature:

- In settling, often a lag time is observed at the beginning of phase separation. It can be shown that such a lag time results from the initial small drops, which hardly sediment, coalescing until they reach a size where sedimentation becomes fast enough for visible phase separation.
- It also turns out that during the first few seconds of settling, effects with the character of Brownian motion dominate that foster coalescence especially for small drops. This effect is also responsible for the relatively sharp transition between sedimentation zone and remaining clarified continuous phase, which is often observed. This would not be observed without this additional effect.
- While it is common wisdom that a sedimentation and a close-packed zone exist during settling, a third zone is found in experiment and simulation, where the drops are sedimenting at high holdup but are not yet in contact. This densely-packed zone shows a holdup gradient until the holdup of close packing is reached.

The models allow to depict all of these effects in the settler simulations. The model will be presented and compared to experimental results.