

Investigations on the effects of small solid particles on the settling behaviour of dispersion systems

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Crude oil is in most cases produced along with water as dispersion. Gravity settlers are the most frequently used technology for the treatment of crude oil. Especially on Floating Production Storage and Offloading devices, where space is limited and separation units occupy a significant amount of this space, there is a strong need for separation equipment that is optimally designed.

Henschke [1] developed a model for the design of horizontal gravity settlers. The method is based on batch settling experiments to characterize the coalescence behaviour of a dispersion. The principle of the settling experiment is shown in figure 1.

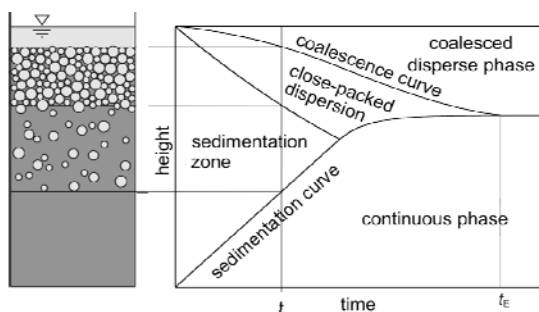


Fig. 1. Batch settling experiment (left-hand side) and respective settling curve (right-hand side).

Schlieper et al. [2] extended Henschke's method to account for the influence of internals. The batch settling experiments of Henschke were modified to be able to measure the influence of the internals on the separation behaviour of the system. The reduction of the settler length due to the internals can reliably predicted using Schlieper's method. Both methods have been tested with laboratory systems as well as with technical production systems and the predicted settler dimensions showed excellent agreement with experiments.

In technical separation processes a phenomenon occurs that is commonly known as crud. Crud in general is a stable dispersion layer that forms in most cases at the interface in a liquid-liquid separation process. Crud has in the past been attributed to the presence of small surface-active solid particles. Fletcher [3] found silica particles to be able to form stable dispersions in the solvent extraction of copper and zinc. Sullivan [4] reported, that the formation of crud in crude oil and water dispersions is enhanced by small inorganic particles. Although crud can be found in almost every extraction process, this

phenomenon cannot be accounted for in current design methods.

In order to support basic understanding on the formation of crud and to extend the methods of Schlieper and Henschke, the authors conducted experiments to evaluate the influence of solid particles on the settling behaviour of aqueous/organic systems. Toluene + water and methyl isobutyl ketone (MIBK) + water were used as model systems, for they are well characterised in regard to their settling behaviour. Small particles of hydrophilic silica (Aerosil 200, Evonik Degussa) were used as stabilizing particles. Figure 2 shows a REM image of a dispersion stabilized by the particles.

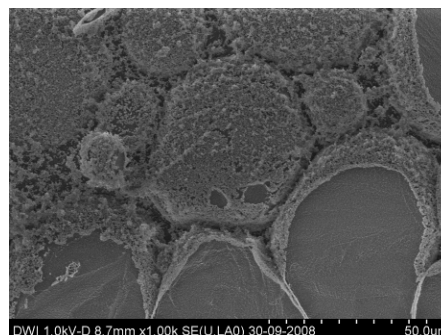


Fig. 2. REM image of a MIBK in water dispersion stabilized by silica particles adsorbed to the interface.

The influence of the amount of solid particles in the system was evaluated. In the model system MIBK + water + Aerosil 200 it was found that small amounts of particles stabilize emulsions. In Toluene + water + Aerosil 200, the amounts of solids required to stabilize emulsions is higher by a factor of at least 2. The strong influence of trace impurities in the systems can clearly be concluded from the experimental results. The addition of electrolytes in the system MIBK + water + Aerosil 200 resulted in a 6 times stronger crud formation. Experiments conducted with a technical system proved, that the influencing factors in the model system can be transferred to real production systems.

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