Background, Exergetic Evaluation

The increased demand for sustainable processes will lead to a shift from fossil to bio-based feedstock for production of chemicals and materials. Thus research is focused on separation steps suitable for corresponding processes. Also overall bio-based process-routes are evaluated based on exergy, i.e. accounting for the value of energy. This leads to foresee that the oxygen-content of intermediates and products will increase leading e.g. to higher viscosity of process streams.

The advantage of drop-based modelling is the ability to extrapolate beyond the region of data acquisition, e.g. for all types of column internals without any additional experiments. Our ReDrop program (representative drops) depicts extraction-column performance including reactions in either phase as well as reactive extraction, where the reaction occurs at the interface, with better than 10% accuracy.

From Drops to Processes

Examples are selective extraction of pharmaceuticals or monomers from a fermentation broth, in-situ in the optimal case.

For the equipment design individual-drop behavior is studied, which allows the drop-based modelling and detailed simulation of equipment performance. This is realized in standardized drop equipment e.g. for mass transfer and sedimentation to evaluate the behavior of real systems including all impurities present in technical systems.

Extraction-Column Simulation and Optimization

In an extraction column with rotating internals the drops inside the stacked compartments are investigated with a camera allowing full 3D tracking. The results allow e.g. optimization of equipment-size without loss in performance.

This approach is the basis also for tackling increasingly complex real-world technical challenges like crud formation, almost regularly observed in technical extraction processes.

Phase Separation, Settler Design

Also for liquid-liquid phase separation drop-based process modeling can be achieved with similar accuracy, resolving details accessible in experiment only with significant effort.

The drop-based approach has been and is continually developed in close cooperation with industrial partners.

Dissertation Perspectives

Dissertation projects include a wide variety of facets in extraction, phase separation, as well as fundamentals like mass transfer, fluid dynamics and interfacial behavior. Scales of interest range from molecular level, e.g. for molecular simulation of interfaces, via lab-scale measuring cells to characterize drop behavior to pilot-plant scale for validation of the simulation tools. Depending on the individual project the individual preferences for experimental or theoretical work can be taken into account. Almost all projects include interaction with the partners local or international companies.