

Liquid-liquid extraction design under uncertainty

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In the field of liquid-liquid extraction a variety of new processes like extraction from fermentation broths, aqueous two-phase systems or extraction with high viscous media is investigated in the recent years. Process engineers often do not have broad experience with these special applications of liquid-liquid extraction. Therefore it is necessary to find a metric to estimate the quality of a design solution and to compare different possible liquid-liquid extraction processes at an early stage of the design process. One possibility is to define an evaluation criterion like for example the overall process costs, which is determined for each option, and explicitly consider uncertainties in the design variables.

A framework for an easy comparison of different liquid-liquid extraction processes ranging from various solvents to diverse equipment during every stage of the process development is presented. Using uncertainty propagation the overall uncertainty of the chosen evaluation criterion is estimated. As each step of a design process is meant to reduce uncertainty about the final solution of the design challenge the following design steps are proposed in a way that the new information has the highest possible impact on deciding whether a process option is further investigated or not regarded in the next step. Within this framework it is possible to make sound decisions yet at an early stage of the process development and allocate resources for the process and equipment design in an efficient manner. To keep track on all investigated alternatives and decisions, results can be visualized and documented in option trees.

In this presentation an algorithm considering uncertainties in the design of liquid-liquid extraction is introduced and its general application on the design process is discussed.