Systematic Process Design

In order to be able to systematically structure the process options, the method of cascaded option trees has been applied as shown in Figure 1. In these option trees all options are collected and the result of evaluation with respect to the relevant criteria is recorded with a color code indicated in Figure 1. This method can further be refined to account for e.g. process parameters, equipment type, and detailed equipment options. The first criterion considered was toxicity, where the phthalate as diluent has been discarded because of its hormone-like effects on humans.

An example for characterizing reactive extraction equilibrium is shown in Figure 2 obtained for the example extraction with D2EHPA (di-(2-ethylhexyl) phosphoric acid). Equilibration was realized with a mixing device, which allows slow over-head rotation of the sample flasks, which was performed for at least 30 min in a temperature-controlled water bath. Plotted is the degree of extraction, which is the fraction of the extracted component, here the diamine, which is transferred into the organic extractant phase at the indicated conditions. Two main parameters are apparently influencing the extraction equilibrium, namely the extractant concentration and pH. The pH is also relevant when considering in-situ extraction and the extraction concentration directly relates to the capacity of the organic phase.

In contrast to that, good coalescence behavior is achieved for low extractant concentrations. Because some microorganisms require continuous supply of oxygen, the extraction process has to be aerated in that case. This leads to the demand to realize a three-phase separation, which creates additional challenges. As an example case the production of diamine by fermentation has been chosen, because it is a component of potential industrial relevance as monomer for polyamide production. Such a high-added-value component has the chance to be economically competitive as bio-based product already today.

References