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Integrated reaction-extraction process for the hydroformylation of long-chain alkenes with a homogeneous catalyst

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Abstract

A lingering issue with the hydroformylation of long-chain alkenes is the cost of catalyst leaching. One effective method to recover homogeneous catalysts is the use of thermomorphic solvent systems (TMS). However, catalyst leaching is still too high using the current solvents DMF and decane, limiting economic feasibility. This work presents extraction as a possible method for intensifying catalyst recovery when using a TMS for the hydroformylation of 1-dodecene. A thermodynamic model for determining the LLE of the solvent system and for catalyst leaching is developed for implementation within a process-wide optimization problem. Using this model, the optimal reactor design with an integrated downstream separation including the catalyst loss can be investigated in more detail. It is shown that in this process the reactor design strongly depends on catalyst recovery and that by using the proposed extraction cascade the process becomes economically viable and more robust in regards to reactor performance.

Keywords: Thermomorphic solvents, Homogeneous catalysis, Hydroformylation, Process optimization, Process intensification

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