

541a Hybrid Process Design-Analysis in Pharmaceutical and Biochemical Industry

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In pharmaceutical and biochemical industry complex reactions are progressing in organic solvents more than in an aqueous-organic solution. Usually desired products have to be separated from residual reactants and/or undesired products. More over, products are heat-sensitive which renders the conventional thermal separation processes infeasible. In order to increase the product yield, the reactor may be combined with a membrane separation unit or with better solvents. Such hybrid processes are usually operated in a batch-mode but an opportunity to integrate them into a continuous or fed-batch process also exists. Currently, these two processes are combined through an experimental-based trial and error approach into the hybrid processes. Although this experiment-based approach is acceptable in terms of reliability, it is considerably more expensive with respect to time and resources. Through model-based computer-aided techniques, it is possible to select better solvents and identify membrane-based nanofiltration operations that when combined with reactors, can reliably reproduce the experimental results. The experimental expenses can therefore be reduced through the use of model-based techniques to identify the operational window where the optimal design exists. The first stage of the work is to develop the needed models for solvent-based reactive systems and membrane separation systems (for instance nanofiltration and pervaporation). Reaction data (reaction kinetics) and membrane characteristic data (solvent fluxes, rejection of solutes) are the parameters that can be varied in the model depending on the application. At this step, a method for solvent selection has to be integrated. The second stage is to use the obtained models from the first stage to develop systematic methods for design/analysis of the two processing systems. In this work, results will be presented for two cases where it will be shown that the membrane separation unit combined with reactor can increase the product yield. The first case study is taken from the pharmaceutical industry and the second from biochemical manufacturing process. In both cases, numerical models use realistic values for parameters and shows that production of the desired product can be significantly increased by using separation process with membrane contactors and/or better solvents. The presentation of the case studies will also illustrate the main features of a general systematic methodology.