DESIGN AND OPERATION OF SIMULATED MOVING BED PROCESSES FOR FINE CHEMICAL AND PHARMACEUTICAL SEPARATIONS

Stefanie Abel and Marco Mazzotti

Institute of Process Engineering, ETH Zurich, Sonneggstrasse 3, CH-8092 Zürich

The evolution of food, agrochemical, pharmaceutical and biotechnology industries is clearly moving towards purer products and cleaner processes, due to stricter regulations and growing environmental concerns. This trend calls for better technologies, particularly separation process technologies, which are better controlled once implemented. Preparative chromatography, particularly using SMBs, has been increasing its importance as a separation and purification process in the above mentioned industries, since it is flexible, energy efficient and achieves high purity performance. Nowadays, the SMB technology is adopted in these industries for difficult applications, such as the resolution of enantiomers, and it is considered attractive for complex separation tasks, such as bio-separations or separation of natural compounds involving a number of difficult-to-characterize compounds. Therefore, there are now a large number of potential small-scale applications of the SMB technology that call for a new SMB paradigm, which exploits the flexibility and versatility of the technology. Proper implementation of SMBs in production will require the application of robust control techniques. The issue of process control under uncertainties has to be addressed. SMBs are constituted of several chromatographic columns with inlets and outlets, whose position within the column carousel switches periodically. Therefore SMBs reach only a cyclic steady state, where compositions change periodically and exhibit nonlinear dynamics with dead-times and lengthy analytic techniques for product quality assessment. These features pose fundamental questions and challenges on both SMB technology and control theory.

The aim of this work is to broaden the range of SMB applications and include not only chiral separations but also multi-component multi-fraction separations, e.g. bio-separations. In this context two new SMB paradigms have been realized, i.e. the solvent gradient SMB (SG-SMB) [1,2] and the three fraction SMB (3F-SMB) [3,4]. Furthermore, the possibility of combining SMB and crystallization is considered [5] and in order to provide a tool to implement the SMB process properly in production, an optimizing control scheme for SMBs has been developed and tested [6,7,8].

References:

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