Multi-Column Chromatography: Applications and Opportunities

Jungmin Oh
School of Chemical and Biomolecular Engineering, Georgia Institute of Technology, Atlanta, GA, 30332

Chromatographic reactors have raised considerable interest in the chemical engineering research and industry, mainly for equilibrium-limited reactions. This is because a continuous removal of products from the reaction mixture shifts the equilibrium and increases the final conversion. Conventional batch chromatographic reactors are widely used due to its simplicity. However, this is not the most efficient mode of operation, due to the well-known drawbacks associated with batch processes such as low yields and high product dilution. Therefore, over the last 40 years, research has focused on the development of continuous chromatographic reactors in order to enhance productivity and reduce solvent consumption [1].

One of the most interesting continuous chromatographic reactors is the Simulated Moving Bed Reactor (SMBR). It is a process that utilizes the advantage of chromatographic reactors in a train of multiple columns connected in a cyclic way. It has been commercialized for a number of large-scale separations in the petrochemical industries (Parex, Molex, Olex) and sugar production (Sarex) [1]. This work focuses on an illustration of SMBR with variety of applications and detailed example of propylene glycol methyl ether acetate (DOWANOL™ PMA) production [2,3]. DOWANOL™ PMA is one of the most commonly used esters with a high industrial demand. Commonly, it is used in household products such as cleaners, paints, lacquers, varnishes, and pesticides. Thus, the potential application of DOWANOL™ PMA synthesis have substantial economic benefit for the industrial demand, which motivates us to develop a simulated moving bed reactor (SMBR) system for large-scale production as shown in Figure 1.

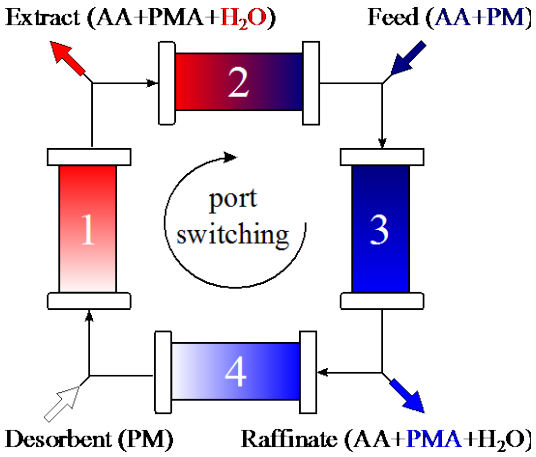

Figure 1. Schematic of SMBR for the synthesis of DOWANOL™ PMA through esterification [2]

[1] Alirio E. Rodrigues , et al. *Chromatographic Reactors* **Chemical Engineering &Technology** 2012 (1171-1183)

[2] J. Oh, G. Agrawal, B. Sreedhar, M.E. Donaldson, A.K. Schultz, T.C. Frank, A.S. Bommarius, Y. Kawajiri, *Conversion Improvement for Catalytic Synthesis of Propylene Glycol Methyl Ether Acetate by Reactive Chromatography: Experiments and Parameter Estimation*, **Chemical Engineering Journal** 2015 (397-409)

[3] J. Oh, G. Agrawal, B. Sreedhar, M.E. Donaldson, A.K. Schultz, T.C. Frank, A.S. Bommarius, Y. Kawajiri, *Evaluation of Esterification and Transesterification Reactions for Propylene Glycol Methyl Ether Acetate in Reactive Chromatography Systems*. Paper presented at Annual AIChE Meeting, Nov. 16-21, 2014, Atlanta, GA.