XPURE
innovative continuous chromatography

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Simulated Moving Bed Reactors

Innovation through hybridization/integration of technologies is a well-known approach. This approach has been effectively applied to achieve specific process objectives in chemical, biochemical, food, and pharmaceutical industries. The approach can include either two separate units operating in tandem or as a single integrated unit. Membrane operations are usually found in tandem with other unit-operations for recycling cells during fermentation or buffers in case of downstream processing. In integrated operations, the overall efficiency is achieved by using two or more operating principles in parallel. Reactive distillation, pervaporation, fermentation with in-situ product removal through stripping etc. are some examples of integrated unit-operations. The current article briefly discusses one such integrated unit-operation called Simulated Moving Bed Reactors (SMBR).

SMB technology has proven to enhance the efficiency of chromatography/adsorption separation through continuous counter-current operation. This principle can have a similar impact on heterogeneous catalytic reactors with catalysts immobilized on support beads or adsorbent and packed as a fixed bed or fluidized bed. The countercurrent effect of SMB is known to enhance the performance of equilibrium driven reactions and mass transfer kinetics, whereas the continuous mode of operation helps in achieving improved productivity. Therefore, SMBR can find its application as a techno-economically viable process solution.

Fundamental phenomena during heterogeneous catalysis are mass transfer (MT), reaction, and inhibition kinetics. MT is more critical in the case of a catalyst on solid support and substrate dissolved in a liquid system. However, the difference in MT kinetics of a substrate and inhibitor can also be applied as a separation principle to maintain or improve catalytic efficiency. For example, consider a catalyst that exhibits product inhibition at a specific product concentration and it is identified that the substrate and product have different characteristic times at which they flow through the column. If the characteristic time difference in a batch reactor is not sufficient to minimize product inhibition, an SMBR can help in increasing the difference through the countercurrent effect. Thereby enhancing step efficiency and process economics.

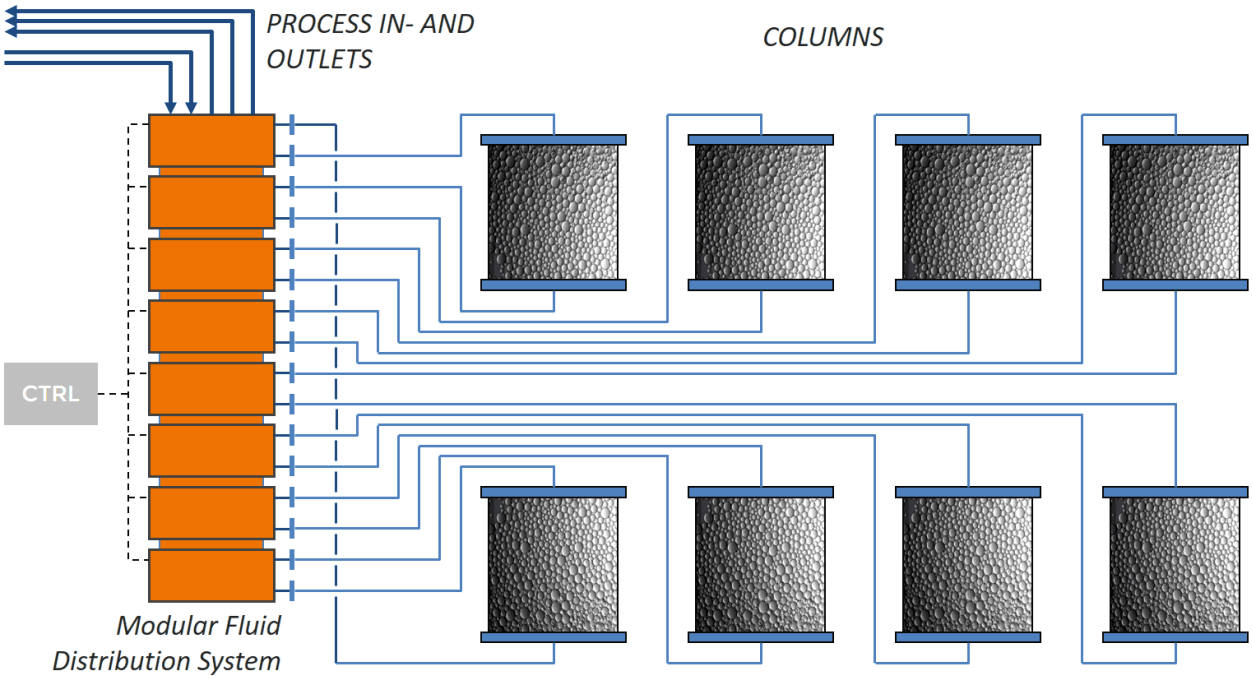

Figure 1. Schematic representation of modular fluid distribution system involving valves that enable SMB operation of catalysis columns/reactors