



February 5, 2018 **BLOG**

Intensification of Process Development Using a Design Based Turnkey Solution: A Case from SMB Chromatography

Rapid technology development and an increasing number of technologies entering the market are setting the bar high for their successful application. This is no different for separation technologies. How does a design based turnkey solution help in the successful application of novel technologies? A case presented, based on SMB (simulated moving bed) technologies and intensification of SMB process development.

Background

SMB is an industrially proven technology, which can improve the efficiency of adsorption/ chromatography based processes by enabling continuous processing, better resin utilization, reduced buffer requirement, improved yield, purity and productivity with a compact footprint of equipment. However, these benefits do not proportionally indicate the extent to which SMB technologies are currently applied or even being investigated at a process development stage. Major factors leading to this situation include limited availability of:

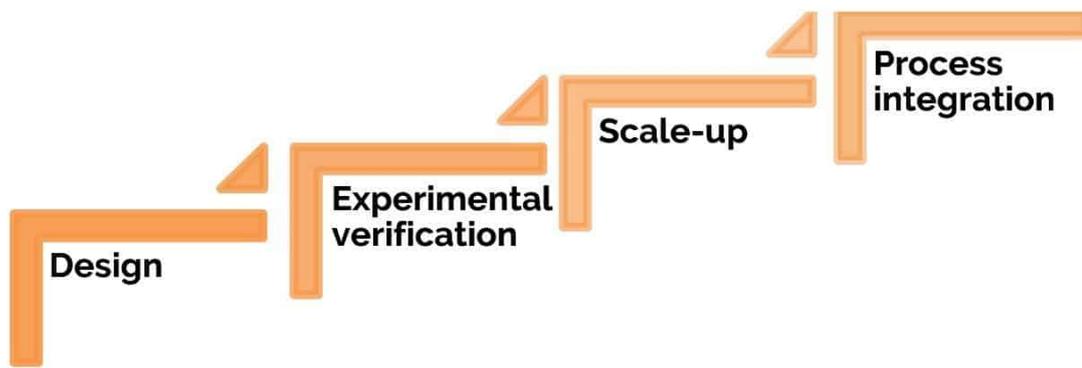
1. SMB specific design tools aiding SMB process development for a broad range of input streams
2. Flexible SMB lab equipment that can validate the design outcome
3. A system that can represent an appropriate scale-down model for an existing or to be developed industrial-scale operation
4. A system which is easy to set-up, CIP, maintain and modify in short time
5. Process control which is flexible to process integration and enhances operability

These limitations not only inhibit the successful application of SMBs but also reduce the efficiency during the process development stage.

Solution

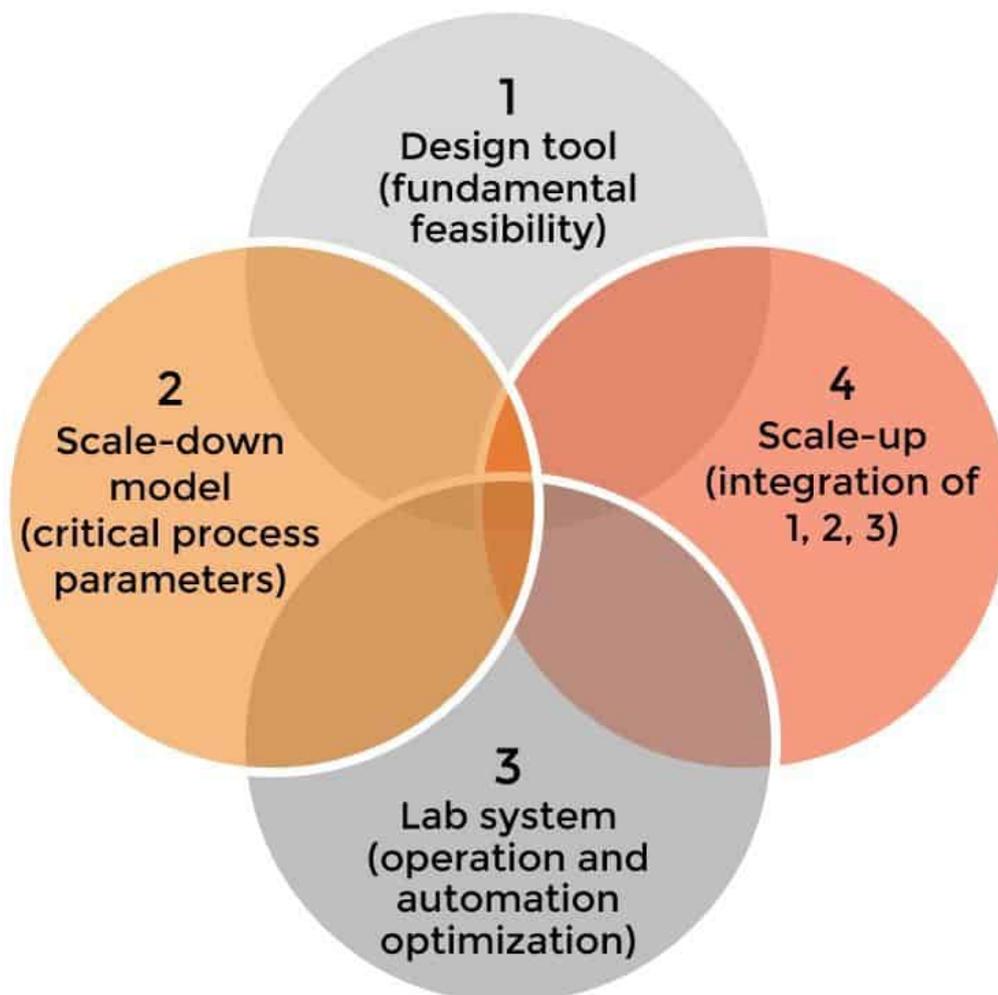
It is clear from the problem background that it is essential to provide a turnkey solution that enables investigation of SMB technology under diverse process development

scenarios overcoming the current limitations.



Stages of technology investigation and optimization during process development

Technology investigation and optimization as shown above consists of four major stages. Therefore, the proposed turnkey solution needs to be flexible to aid at any of these stages.



The solution contains 4 parts, which form a package that can aid in SMB technology testing and implementation during process development:

1. A design-based approach is proven to improve the efficiency of a development

process. A regular design tool for process technologies involves input from the user, iteration of design equations, and provides an output. Therefore, it is essential to define the appropriate input parameters and fundamentals that allows the tool to provide a representative output taking into account all the process performance attributes. To obtain such a design tool for SMB, we propose a parameter sensitivity based approach. In this approach, the design tool involves a sensitivity analysis prior to the design iteration, where you can identify the critical process parameters for the specific process scenario. Based on the outcome of sensitivity analysis, the design tool provides the flexibility to enable additional input parameters and iterations or eliminate redundant parameters and functions for a specific process scenario. This way, the tool can filter the SMB designs for a broad range of applications and at the same time guide design-based optimization. This can potentially enhance the freedom for process developers from different fields of application to investigate SMB as a potential alternative before deciding on further

2. The design outcome is used to build an appropriate scale-down model which not only takes into account all the critical process parameters but also provides an operating window for further investigation and optimization.
3. Stage 3 is highly critical in case of SMB, mainly because an SMB operating window can involve a range of column numbers and operating conditions to be experimentally investigated using a lab-scale system for determining the optimum. Therefore, it is important to design and build lab systems, which are flexible to mechanical modifications. The desired mechanical flexibility directly translates into the requirement for automation software that is highly flexible to implement additional changes and features based on process demand. Along with the process concerns, the practical concerns to set-up and maintain the system with minimal effort need to be addressed during system design stage. This can be done by dividing the system design and construction into several layers with corresponding options for customization at each layer and detailed outcomes related to both process and practical concerns. As a result, a system that can be readily deployed to determine the optimal operation and automation strategy can be
4. When all the above stages are integrated, a scale-up design can be obtained with relatively high accuracy as the above 3 stages give clear indication on critical aspects for large scale implementation

Conclusion

All the four stages discussed, when integrated, can provide a **turnkey DSP solution** for SMB process development as it will allow you to design, validate, and scale-up SMB systems for diverse process scenarios. Thereby enabling successful investigation and application of SMB technologies. This design-based approach, when implemented for other process technologies, can enhance the overall efficiency of process development in terms of time, process detailing, and performance, without requiring major additional investments.