



May 12, 2020 **BLOG**

Streamlined Design of Successful SMB Processes with the XPure Design Tool

Introduction

Purification techniques, such as chromatography, have been around since the beginning of the 20th century, and are an essential step in downstream operations of industrial processes. Classic chromatography using a single column can be a lengthy and expensive process, due to an inability to perform purification continuously. Simulated Moving Bed (SMB) technology overcomes the intermittent nature of classical chromatography by introducing more columns, thus allowing for simultaneous separation to occur.

There are two aspects of SMB design: the hardware and the process itself. Think of it as a classical music piece. You need the hardware, which is the orchestra. Selecting the musical instruments, how many of each are needed within the orchestra, depends upon the desired symphony – this is the SMB process. Once all the musical instruments are assembled, a musical notation sheet is composed to instruct how and when each instrument is played. The more complex the symphony, the more complex the assembly and the performance.

XPure Systems provides solutions for efficient and customizable construction of a chromatographic symphony. This blog will focus on the assembly of the orchestra via the XPure Design Tool.



Photo Credit: Courtesy of Wikimedia Commons.

Basics of SMB Design

As stated earlier, the more complex the process, the more complex the design of said process. Chromatography consists of multiple steps, such as adsorption and elution, also known as zones. Each zone can have multiple positions, which is the place a column may occupy. To advance to the next position or zone, columns must switch. The switch time can be either synchronous, as in the case of carousel SMB, as evidenced by our [XPure-C System](#). In this setup, all positions are occupied by columns, which experience a continuous flow. At the end of the switch time, all columns are rotated, switching synchronously.

Asynchronous switching allows further optimization of SMB processes. Switch times are defined per position, and, based on the time it takes to cycle through all positions, less columns than the number of positions may be necessary. Complex valve-switching, as present in our [XPure-S System](#), is needed to realize asynchronous operation.

For further details, check out our previous [blog](#) about process control for SMB systems. Once all zones are defined in the proper sequence; the process is complete.

Using the symphony analogy, the chromatography zones are, in a sense, the instruments. How many of these instruments are needed? In which order should they be played? And once they are all put together, how long will the symphony last? Will it be as melodious/efficient as desired? The XPure Design Tool enables the user to rapidly design the SMB process by answering all these questions.

Features of XPure Design Tool

At the core of the XPure Design Tool is accessibility and flexibility. The tool can be used to rapidly design SMB processes. The fundamental framework, comprised of linear

isotherms and analogies with counter-current heat exchangers, allows easy access design in which a minimum amount of process parameters are needed.

Optimization is based on representative design parameters, and outputs include everything necessary to compare designs and support decision-making. With export of design outputs to the XPure Recipe Manager, design can be transformed rapidly into functional processes with our hardware solutions.

Other features include:

- **Excel-based accessibility:** No special software is needed. The XPure Design Tool is based on Microsoft Excel, allowing maximum accessibility.
- **Rapid design:** The whole design process can be completed in less than half an hour. Every design begins with input of either experimental or literature data, after which a process is constructed. Optimization of the process is based on design parameters, such as number of transfer units, capacity ratio, and adsorption efficiency.
- **Flexibility:** Compatible with various modes of chromatography, such as asynchronous or asynchronous, bind-elute or fractionation, and packed bed or expanded bed.
- **User interface:** Users are guided step-by-step through the design process via an easy-to-use interface (figure 1). Warnings are given if parameters are out of proper design range.
- **Unit conversion:** Conversion of units is integrated into the design tool and allows changing units on the fly.
- **Process reports:** At the end of the design process, a report of the process will be generated, including the most important parameters and a process flow diagram (see figure 2).
- **Export recipe parameters:** After completion of the design process, relevant parameters can be exported for input into the XPure Recipe Manager.
- **User manual:** The XPure Design Tool provides a detailed user manager, explaining every parameter and guiding users step-by-step through the design process. It also allows users without specific knowledge regarding SMB to design SMB processes.

Conclusion

SMB processes are like complex musical symphonies – both require a unique assembly of elements in order to come to fruition. The XPure SMB Design Tool allows for the rapid and accessible construction of the orchestra, thereby streamlining the design process. With XPure Systems solutions, the symphony you have envisioned is just a few steps away. What will you design first, maestro?

[Contact Us](#) for more information.



Step	Zone	Inflow new	Inflow con.	Inflow tot.	Velocity	Bed height	NC series	NC parallel	Switch time	NTU	Capacity ratio	Efficiency	Pressure drop
[-]	[-]	[BV]	[BV]	[BV]	[m/h]	[m]	[-]	[-]	[hh:mm:ss]	[-]	[-]	[-]	[mbar]
1	Adsorption wash	1.50		1.5	5.00	0.90	1	1	00:16:12				31.25
2	Adsorption	6.60		6.6	2.50	0.90	1	3	00:47:31	25.10	1.08	98.64%	17.19
3	Regeneration wash	1.50		1.5	5.00	0.90	1	1	00:16:12				31.25
4	Regeneration	1.00		1	2.50	0.90	2	1	00:21:36				30.50
5	Elution wash	1.50		1.5	5.00	0.90	1	1	00:16:12				31.25
6	Elution	2.00		2	2.50	0.90	3	1	00:43:12	22.32	1.14	99.19%	45.44

Previous Finish

- 1. Project info
- 2. Equipment
- 3. Streams (1/3)
- 4. Streams (2/3)
- 5. Streams (3/3)
- 6. Mass transfer
- 7. Process (1/2)
- 8. Process (2/2)

Figure 1. A screenshot of the XPure Design Tool showcasing the user interface at the last step of the SMB design process.

