Multi-Column Chromatography Process Modelling for Process Performance Prediction

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for Process Performance Prediction

Multi-column capture chromatography methods performed on the BioSMB platform have the potential to unlock increases in process performance. However, experimental methods to determine optimal process conditions are time and resource intensive. Modelling strategies can help to reduce time and resources necessary to optimize the process. In this study we evaluate three modelling approaches, and the most accurate of the three was chosen to explore how the number of columns and the column configuration strategy can impact productivity and binding capacity. Experimental methods to determine optimal process conditions are time and resource intensive. Modelling strategies can help to reduce time and resources necessary to optimize the process. In this study we evaluate three modeling approaches, and the most accurate of the three was chosen to explore how the number of columns and the column configuration strategy can impact productivity and binding capacity.

Introduction

Model Evaluation

Three different loading scenarios were examined:

- BioSMB Scenario 1 with 2 columns in the load zone
- BioSMB Scenario 2 with 3 columns in the load zone
- 2 column multi-phase variable flow load

The design space for each loading scenario is bound by low and high feed concentrations at 0.6 min. load residence time. For each point, three HETP experiments were conducted to confirm the maximum capacity usage of the column. Capture efficiencies of 99, 95, and 90% were targeted.

Three experimental points were compared to the computational and empirical models. Residual sum of squares analysis was conducted on 12 experimental points per model to determine goodness of fit.

Process Performance

For the BioSMB processes at each load residence time, varying load amounts were simulated in ChromWorks, and the amount that corresponded to 99% capture efficiency is reported as the operating binding capacity in figures 6 & 8.

The 2 column processes were simulated in ChromWorks to validate the absence of significant product loss. A duration of 1500 seconds, corresponding to 25 total column volumes at a 1 minute residence time, was allocated in each cycle for wash, elution, and regeneration steps. Residence times between 0.6 minutes and 3 minutes were simulated.

Conclusions

- An hybrid experimental and modelling approach for process prediction and optimization greatly reduces the amount of experimentation and time resources needed.
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- In addition to the productivity advantages, BioSMB processes have the ability to load at a continuous, uninterrupted flowrate.