TOSOH

Performance Data

Flow Stability of Pre-packed Chromatography Columns Designed for High Flow Rate and MCC Applications

The adoption of continuous chromatography represents a paradigm shift in biopharmaceutical production. This approach offers advantages over standard batch chromatography such as enhanced productivity, reduced operational costs, and improved resource utilization. Notably, a substantial portion of productivity gains stems from the ability to operate at higher flow rates in the continuous chromatography approach. SkillPak™ BIO pre-packed chromatography columns, tailor-made for continuous chromatography applications, integrate seamlessly with Octave™ MCC Systems. They are designed to withstand high flow rates while maintaining high performance and reproducibility.

The goal of this study is to prove flow stability at linear flow rates up to 1200 cm/h.

Experimental Conditions

To assess the impact of elevated flow rates on column performance, SkillPak BIO columns were installed on an FPLC instrument. Initially, a flow rate of 100 cm/h was applied for one minute using a mobile phase comprising 1 mol/L NaCl in water. Performance evaluation ensued by injecting a tracer molecule (3 mol/L NaCl) at 150 cm/h, at a volume of 1% of the respective column volume. Asymmetry and theoretical plate count were calculated based on the resulting tracer peak.

Subsequently, the flow rate was elevated to 200 cm/h for one minute, followed by another performance assessment at 150 cm/h. This sequence continued incrementally, with flow rates reaching up to 1200 cm/h, each followed by a performance test at 150 cm/h.

The delta column pressure at the various flow rates was recorded and graphically plotted against linear flow velocity. Due to flow rate limitations of the FPLC system, the SkillPak BIO 100 could only be tested up to 900 cm/h. The investigation involved various models of SkillPak BIO columns, all packed with TOYOPEARL® AF-rProtein A HC-650F *(see Figure 1)*. Detailed column dimensions are provided in *Table 1*.

Figure 1. SkillPak BIO columns

Table 1. SkillPak BIO pre-packed column dimensions

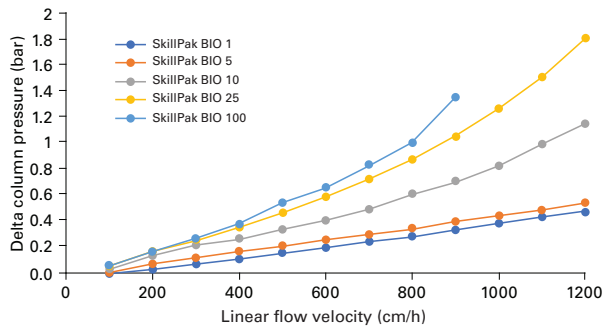
Column name	Column dimensions
SkillPak BIO 1	0.8 cm ID × 2 cm L
SkillPak BIO 5	1.6 cm ID × 2.5 cm L
SkillPak BIO 10	1.6 cm ID × 5.1 cm L
SkillPak BIO 25	2.5 cm ID × 5.1 cm L
SkillPak BIO 100	5.0 cm ID × 5.1 cm L

Results and Discussion

Pressure flow behavior

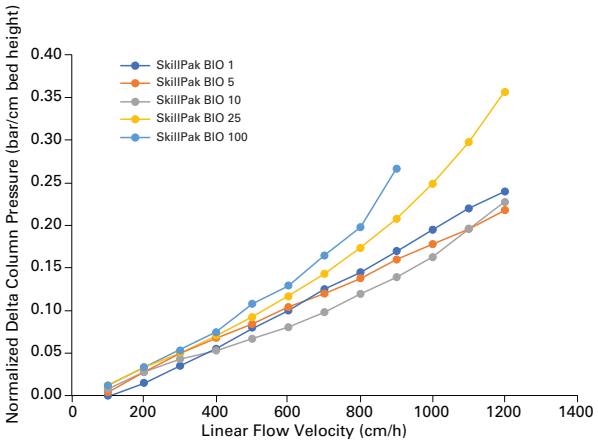
Figure 2 shows the recorded pressure flow curves corresponding to the different sizes of SkillPak BIO columns:

Figure 2. Pressure flow curve of TOYOPEARL AF-rProtein A HC-650F in the different SkillPak BIO formats



Upon first glance, a linear pressure increase with increasing flow velocity becomes apparent. The absolute values differ for the different column types, which can be explained with the heterogeneous bed heights of the columns used. To facilitate a more meaningful comparison, the recorded delta column pressure was normalized by the respective bed height. The resulting normalized pressure-flow curves are depicted in *Figure 3*.

Figure 3. Normalized pressure flow curve of TOYOPEARL AF-rProtein A HC-650F in the different SkillPak BIO formats

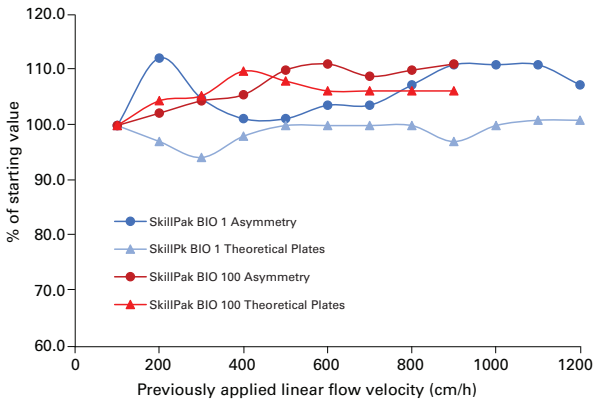


Upon normalizing pressure against the column bed height, it is evident that the values are nearly identical for the 1, 5, and 10 mL columns. In contrast, the larger columns exhibit higher values, a phenomenon which can be attributed to the increased volumetric flow, leading to elevated pressure drops in the connection points between the column and the FPLC system. Unlike the columns, these connection points do not experience an increase in internal diameter, resulting in larger pressure drops when subjected to higher volumetric flow rates.

Column performance

Being the extreme points in the column array, the performance assessments of the 1 and 100 mL columns were selected to represent the overall performance of all SkillPak BIO columns. *Figure 4* illustrates the percentage change from the initial values observed in these representative tests.

Figure 4. Percentage change in Asymmetry and Theoretical plate count after applying flow stress to SkillPak BIO 1 and SkillPak BIO 100 columns



The study showed that the columns consistently maintained their performance even when subjected to elevated flow rates. The data indicates a resilient performance profile for the columns, showcasing minimal deviations in crucial performance parameters throughout the spectrum of applied stress-inducing flow rates.

Conclusion

Neither of the tested columns showed a stark increase in back pressure at the tested flow rates. Also, no visible bed compression occurred. This can be viewed as a strong indication of high bed stability over a broad flow rate range. The findings underscore the stability and resilience of the columns under the experimental conditions, indicating their suitability for sustained operation across a spectrum of flow rate challenges.

Featured Products

Part #	Description
0045346	SkillPak 1 BIO Protein A HC-650F, 6 × 1 mL col.
0045348	SkillPak 5 BIO Protein A HC-650F, 6 × 5 mL col.
0045350	SkillPak 10 BIO Protein A HC-650F, 6 × 10 mL col.
0045352	SkillPak 25 BIO Protein A HC-650F, 1 × 25 mL col.
0045355	SkillPak 100 BIO Protein A HC-650F, 1 × 100 mL col.