TOSOH

Technical Note

Packing Guidelines for TOYOPEARL® Super A Resin

TOYOPEARL Super A resin is designed for high dynamic binding capacity, excellent alkaline stability, and robust mechanical properties. These features make it suitable for both process development and commercial manufacturing of monoclonal antibodies.

Optimal column packing is critical for resin performance. A well-packed column ensures uniform flow distribution, minimizes channeling, and supports consistent separation efficiency. Poor packing can lead to peak distortion, reduced capacity, and elevated pressure. This document provides practical guidance for packing TOYOPEARL Super A resin, supported by performance data.

Packing Recommendations

Packing Buffer

The optimal packing buffer depends on the application. Generally, the highest ionic strength mobile phase used in the separation, including cleaning and sanitization steps, is suitable.

For TOYOPEARL Super A resin, 0.5 mol/L NaCl has been shown to provide consistent and reproducible packing across various column formats. High ionic strength buffers minimize electrostatic interactions, supporting stable and homogeneous bed formation.

Note: Optimal packing conditions may vary with column hardware, scale, and system configuration. Minor adjustments to buffer composition or ionic strength may be required.

Calculating Resin Volume for Column Packing

Resin volume for column packing is determined from the desired bed volume or column dimensions, considering the compression factor:

$$V\ (mL) = \frac{\pi}{4} * Column\ ID\ (cm)^2 * Bed\ height\ (cm) * Compression\ Factor$$

For TOYOPEARL Super A resin, a compression factor of 1.2–1.3 is recommended, depending on column hardware and intended flow rate.

Buffer Change & Defining – Optional

Before slurry preparation, the storage solution must be exchanged into the intended packing buffer. The removal of fines prevents screen/frit obstruction and reduces pressure drop.

1. Transfer the resin to a container at least 4× the resin volume.
2. Allow the resin to settle and carefully decant the supernatant.
3. Add 3× the resin volume of packing buffer and re-suspend gently (avoid magnetic stir bars).
4. Repeat steps 2–3 at least two more times.

Slurry Preparation

After defining and buffer exchange of the resin, the slurry concentration can be adjusted for packing the column. The slurry concentration is calculated as the volume of settled resin divided by the total volume of the slurry. The slurry concentration is adjusted as follows:

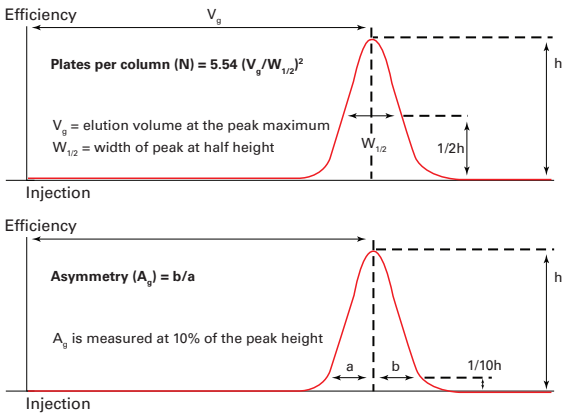
1. Re-suspend the slurry in the defining vessel and transfer the homogeneous slurry to a graduated cylinder
2. Allow the resin to settle.
3. Determine the settled resin volume and adjust the slurry concentration to 25 – 75 % by adding or removing packing buffer. For TOYOPEARL Super A resin, a maximum slurry of 60 % is recommended.

Packing Performance Evaluation

After packing, equilibrate the column with 5–10 column volumes of low ionic strength buffer. Evaluate packing by injecting a low molecular weight, unretained tracer (e.g., acetone or NaCl, 0.25–1 % of column volume) and determine:

- Column plate count (HETP)
- Peak asymmetry (AS)

Figure 1. How to calculate Asymmetry and HETP using a tracer injection.



Packing Study of TOYOPEARL Super A resin

Column Hardware:

20 cm ID BPG200 (Cytiva), 10 µm mesh size, max. 0.6 MPa

Column Performance Test

Packing performance was evaluated by injecting 1 mol/L NaCl solution - 31 mL for a 10 cm bed height and 62 mL for a 20 cm bed height - using a conductivity detector at a flow rate of 35 cm/h.

Bed stability was assessed in 0.5 mol/L NaCl by measuring the pressure-flow relationship: up to 1000 cm/h for a 10 cm bed and 600 cm/h for a 20 cm bed, simulating conditions typical for monoclonal antibody feedstock applications.

Packing Procedure & Results

10 cm Bed Height

The column was packed following the TOYOPEARL Instruction Manual using a slurry with a concentration of 40 – 50 %. The packing buffer was 0.5 mol/L NaCl.

1. ***Initial Packing:***

   The column flow was set to 50 cm/h and then increased stepwise every 10–20 seconds, starting from 100 cm/h up to 800 cm/h, prior to lowering the piston to the top of the bed.

2. ***Final Bed Compression:***

   To achieve uniform bed compression, the flow was again increased stepwise from 100 cm/h to 800 cm/h (or until reaching a maximum pressure of 0.26 MPa). Subsequently, the piston was lowered 5–7 mm into the final bed to complete the packing process.

The column performance test yielded a peak asymmetry (AS) of 1.14 and a height equivalent to a theoretical plate (HETP) of 10,500 plates per meter.

20 cm Bed Height

The column was packed following the TOYOPEARL Instruction Manual using a slurry with a concentration of 50–60% . The packing buffer was 0.5 mol/L NaCl.

1. ***Initial Packing:***

   The column flow was set to 50 cm/h and then increased stepwise every 10–20 seconds, starting from 100 cm/h up to 600 cm/h, prior to lowering the piston to the top of the bed.

2. ***Final Bed Compression:***

   To achieve uniform bed compression, the flow was again increased stepwise from 100 cm/h to 600 cm/h (or until reaching a maximum pressure of 0.26 MPa). Subsequently, the piston was lowered 3–6 mm into the final bed to complete the packing process.

The column performance test yielded a peak asymmetry (AS) of 0.96 and a height equivalent to a theoretical plate (HETP) of 5,900 plates per meter.

Results

Table 1 summarizes the optimal flow rates and residence times for various bed heights in a 20 cm ID column.

Table 1. Flow recommendations for various bed heights

Bed Height (cm)	Optimal Flow (cm/h)	Residence time
9,5	< 800 (0.5 mol/L NaCl)	> 0.75 min
19,8	< 400 (0.5 mol/L NaCl)	> 3.0 min

Across six packing experiments at various bed heights, the column performance test consistently achieved:

- Packing quality: 5,900 – 10,500 theoretical plates per meter for the unretained peak
- Peak symmetry: 0.9 – 1.3

These results demonstrate reproducible, high-quality packing suitable for robust chromatographic performance.

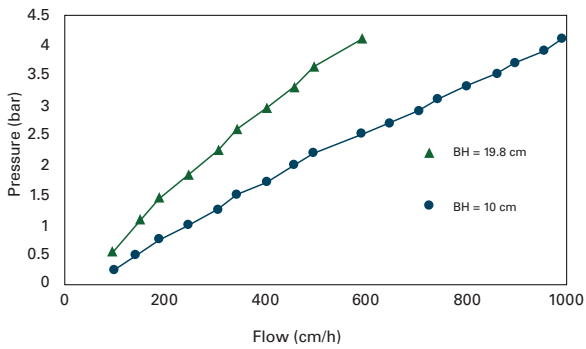
Pressure-Flow Characteristics

Understanding the pressure-flow behavior of chromatography resins is essential for designing robust purification processes. The pressure-flow curve defines the maximum practical operating velocity at a given bed height and ensures that the resin can be run under process conditions without exceeding system pressure limits. TOYOPEARL Super A resin was evaluated to determine its mechanical stability and suitability for scale-up across a range of bed heights.

Pressure-flow curves were determined at 10 cm and 20 cm bed heights.

- ***10 cm bed height:*** Linear pressure-flow behavior up to ***1000 cm/h***.
- ***20 cm bed height:*** Linear pressure-flow behavior up to ***600 cm/h***.

Figure 2. Pressure-flow curves of TOYOPEARL Super A resin at 10 cm and 20 cm bed heights.



Summary

TOYOPEARL Super A is a high-performance Protein A chromatography resin designed for monoclonal antibody purification, offering high binding capacity, alkaline stability, and mechanical robustness. Optimal performance requires careful column packing using a medium ionic strength buffer (0.5 mol/L NaCl), a slurry concentration of 40 – 60 %, and a compression factor of 1.2 – 1.3. Bed performance should be evaluated with a low molecular weight, unretained tracer to determine plate count (HETP) and peak asymmetry (AS). Testing across 10 – 20 cm bed heights shows 5,900 – 10,500 plates/m and AS of 0.9 – 1.3, with linear pressure-flow behavior up to 1000 cm/h (10 cm) and 600 cm/h (20 cm). These guidelines ensure reproducible, high-quality packing for development and commercial purification.

Ordering Information

Part #	Product name	Resin vol.	Pore size	Particle size
0023580	TOYOPEARL Super A	10 mL	100 nm	45 µm
0023581	TOYOPEARL Super A	25 mL	100 nm	45 µm
0023582	TOYOPEARL Super A	100 mL	100 nm	45 µm
0023583	TOYOPEARL Super A	1 L	100 nm	45 µm
0023584	TOYOPEARL Super A	5 L	100 nm	45 µm