SkillPak™ Pre-Packed Columns

#CHROMATOGRAPHY EXPERTS

TOSOH BIOSCIENCE

NOMENCLATURE

What's in our names?

Tosoh Bioscience has the most comprehensive selection of process media resins, with a variety of pore and particle size combinations for several modes of chromatography. When it comes to naming our resins, we've got it down to a science (literally). Here's how you can identify the right resin for your purification process:

1. Resin Type

Tosoh Bioscience offers three base beads for our resin products: TOYOPEARL®, TSKgel®, and Ca++Pure-HA®. TOYOPEARL and TSKgel products are hydroxylated methacrylic polymer resins and are offered in many different pore sizes and particle diameters. The key differences between the two types are particle size availability, degree of crosslinking, dynamic binding capacity, and operating pressures. Since similarly functionalized TOYOPEARL and TSKgel resins have the same backbone polymer chemistry, the selectivity remains the same as you scale up or down.

5. Additional Abbreviations

Some of our products have additional features or need clarification about what type of product they are.

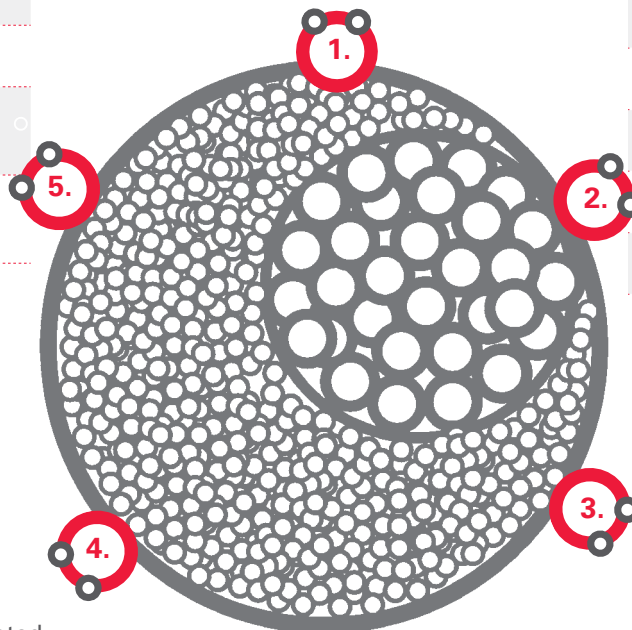| We use the following abbreviations to highlight these features:	
HC	High Capacity
MX	Mixed-Mode
AF	Affinity
Super	High Capacity Ion Exchanger
MegaCap	High Capacity Ion Exchanger for Capturing
GigaCap	Ultra High Capacity Ion Exchanger

2. Ligand

TOYOPEARL or TSKgel resins are available in the following modes of chromatography functionalized with these ligands:

TOYOPEARL ligands	
Mode	Ligand
HIC	Ether, PPG, Phenyl, Butyl, Hexyl
Anion Exchange	DEAE, QAE, Q, NH$_2$
Cation Exchange	CM, SP, Sulfate
Antibody Affinity	rProtein A, rProtein L
Affinity	Tresyl, Epoxy, Formyl, Amino, Chelate, Red, Heparin, Carboxy
Mixed-Mode	Tryptophan (Trp)

4. Particle Size

Particle size is typically denoted in the product name as letters or numbers denoting the grade.

Particle size of TOYOPEARL and TSKgel resins (µm)			
Grade	TOYOPEARL	TOYOPEARL GigaCap	TSKgel
EC	200		
C	100 (SEC resins are 75)		
M	65 (MX-Trp is 75)	75	
F	45		
S	35 (SEC resins are 30)	35	
(30)			30
(20)			20

3. Pore Size

TOYOPEARL or TSKgel resins are available in the following pore sizes:

TOYOPEARL and TSKgel resin number key		
TOYOPEARL 550 resins	HW-55 base resin	50 nm pore size
TOYOPEARL 600 resins	HW-60 base resin	75 nm pore size
TOYOPEARL 650 resins	HW-65 base resin	100 nm pore size
TOYOPEARL 750 resins	HW-75 base resin	> 100 nm pore size
TSKgel 3PW resin	PW-3000 base resin	25 nm pore size
TSKgel 5PW resin	PW-5000 base resin	100 nm pore size

Fast Method Development and Scale-up

SkillPak are chromatography columns pre-packed with TOYOPEARL, TSKgel, or Ca++Pure-HA process chromatography media. These columns have been designed to develop and scale-up purification processes for biomolecules, such as monoclonal antibodies, proteins and oligonucleotides.

SkillPak pre-packed columns are designed for your purification and separation tasks from platform design to pilot scale. These columns are ready to use upon receipt and show excellent physical strength and ideal flow characteristics for industrial downstream processing.

Tables 1 to 4 list the properties and operation specifications of the SkillPak 1, 5, 50, and 200 columns. These columns guarantee optimal performance and can be operated with commonly used low or medium pressure liquid chromatography systems. They are reproducibly packed and take into account the varying compressibility of each resin. This provides an accurate representation of conditions found in production scale columns.

➤ Table 1. Specifications of SkillPak 1 columns

Column dimension	0.7 cm ID × 2.5 cm bed height
Volume	1 mL
Maximum flow rate	4 mL/min (600 cm/h)
Maximum operating pressure	0.3 MPa
Connections	Standard fittings (10-32 for 1/16 inch capillary)
Shipping buffer	20% ethanol for TOYOPEARL and TSKgel [with the exception of 0.5 mol/L sodium citrate with 20% ethanol for TSKgel SP-5PW (20) and SuperQ-5PW (20)], 20 mmol/L sodium phosphate with 20% ethanol for Ca++Pure-HA

➤ Table 2. Specifications of SkillPak 5 columns

Column dimension	0.8 cm ID × 10 cm bed height
Volume	5 mL
Standard flow rate	1.3 mL/min (150 cm/h)
Maximum flow rate	5 mL/min (600 cm/h) for TOYOPEARL M and C grade resins; 2.5 mL/min (300 cm/h) for TSKgel, Ca++Pure-HA and TOYOPEARL S- and F-grade resins, including TOYOPEARL AF-rProtein A HC-650F and TOYOPEARL AF-rProtein L-650F 1.6 mL/min (200 cm/h) for TOYOPEARL Phenyl-650S
Maximum operating pressure	0.3 MPa for TOYOPEARL resins, ≤ 0.4 MPa for TSKgel resins and Ca++Pure-HA
Connections	Standard fittings (10-32 for 1/16 inch capillary)
Shipping buffer	20% ethanol for TOYOPEARL and TSKgel, 20 mmol/L sodium phosphate with 20% ethanol for Ca++Pure-HA
Asymmetry factor (As) specifications	0.8-1.4 for TOYOPEARL and TSKgel, 0.8-2.6 for Ca++Pure-HA

➤ Table 3. Specifications of SkillPak 50 columns

Column dimension	2.5 cm ID × 10 cm bed height
Volume	approx. 50 mL (see labels and CoA)
Maximum recommended flow rate - in 2 mol/L NaCl for HIC media - in 1 mol/L NaCl for all other media	• ≤ 500 cm/h for most TOYOPEARL S, M, F, and C grade resins • ≤ 450 cm/h for TSKgel SP-5PW (20) • ≤ 400 cm/h for TOYOPEARL SuperQ-650S, NH2-750F, Sulfate-650F, and AF-rProtein A HC-650F • ≤ 300 cm/h for TSKgel SuperQ-5PW (20) and TOYOPEARL Phenyl-600 and HW-40F
Connections	1/4-28 Standard fittings with flat-bottom geometry for 1/8" OD or 1/16" OD capillary
Shipping buffer	20% ethanol for TOYOPEARL and TSKgel resins
Asymmetry factor (As)	0.8 - 1.4 for TOYOPEARL and TSKgel resins
Plate count	See resin-related specifications on the Certificate of Analysis

➤ Table 4. Specifications of SkillPak 200 columns

Column dimension	5.0 cm ID × 10 cm bed height
Volume	approx. 200 mL (see labels and CoA)
Maximum recommended flow rate - in 2 mol/L NaCl for HIC media - in 1 mol/L NaCl for all other media	• ≤ 300 cm/h for most TOYOPEARL S, M, F, and C grade resins and TOYOPEARL GigaCap Q-650M • ≤ 250 cm/h for TOYOPEARL SuperQ-650S, NH2-750F, GigaCap series, and Phenyl 600M, • ≤ 200 cm/h TSKgel SuperQ-5PW (20), TSKgel SP-5PW (20), and TOYOPEARL HW-40F
Connections	1/4-28 Standard fittings with flat-bottom geometry for 1/8" OD or 1/16" OD capillary
Shipping buffer	20% ethanol for TOYOPEARL and TSKgel resins
Asymmetry factor (As)	0.8 - 1.4 for TOYOPEARL and TSKgel resins
Plate count	See resin-related specifications on the Certificate of Analysis

Applications

The SkillPak 1 and SkillPak 5 (1 and 5 mL) columns are ideal to use for parameter and method optimization and for robustness testing for the development of a new or replacement purification process. The SkillPak 50 and SkillPak 200 (50 and 200 mL) columns are ideal for scaling-up the previously developed purification process in a controlled manner.

Method development for mAb purification: determine elution pH for a mAb using 1 mL and 5 mL SkillPak columns
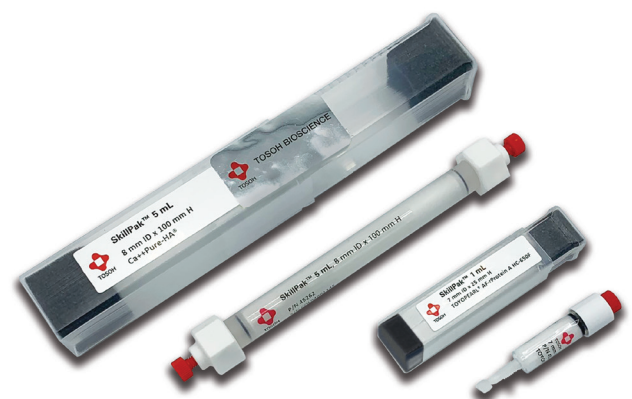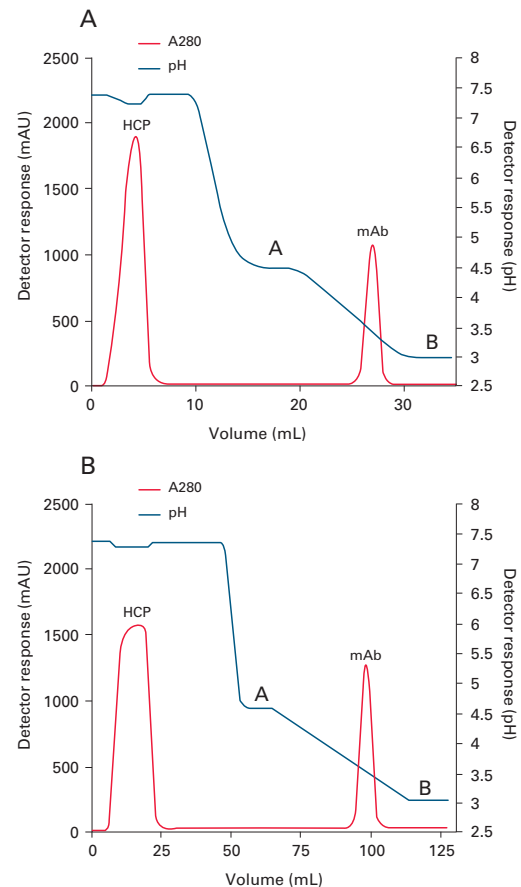
Finding the appropriate buffer and pH for mAb elution reduces the risk of increasing aggregation in the mAb sample. To identify optimized conditions for mAb binding and elution, a buffer-adjusted mAb containing Chinese Hamster Ovary (CHO) cell line supernatant was loaded onto a 5 mL SkillPak column pre-packed with TOYOPEARL AF-rProtein A HC-650F media.

Conditions

Columns:	SkillPak 1 TOYOPEARL AF-rProtein A HC-650F (1 mL) and SkillPak 5 TOYOPEARL AF-rProtein A HC-650F (5 mL)
Equilibration buffer:	0.1 mol/L sodium phosphate, 0.15 mol/L NaCl, pH 7.3
Mobile phase A (gradient):	25 mmol/L citrate (NaOH), pH 4.5
Mobile phase B (gradient):	25 mmol/L citrate (NaOH), pH 3.0
Elution gradient:	Linear from gradient buffer A to 100% B over 10 CV
Flow (load):	0.25 mL/min (1 mL column); 1.5 mL/min (5 mL column)
Flow (wash, gradient):	1.0 mL/min (1 mL column); 2.0 mL/min (5 mL column) using AKTA™ avant 25
Samples:	2 mL of buffer-adjusted CHO cell culture supernatant containing 4 mg mAb (1 mL column); 14 mL of buffer-adjusted CHO cell culture supernatant containing 20 mg mAb (5 mL column)

Figure 1, Panels A & B, demonstrate that a sharp mAb peak with elution max at pH 3.5 was obtained using a linear pH gradient. To maximize recovery, pH 3.3-3.5 can be selected for step elution.

➤ Figure 1. Determination of elution pH for mAb using SkillPak 1 TOYOPEARL AF-rProtein A HC-650F column (Panel A); SkillPak 5 TOYOPEARL AF-rProtein A HC-650F column (Panel B)

Method development for Fab purification: capture of Fab antibodies using a 1 mL SkillPak column

Humanized IgG_1 was digested using a papain enzyme to obtain Fab. See procedure below. 100 µL of the papain-digested IgG_1 which contains Fab material was loaded onto a 1 mL SkillPak column pre-packed with TOYOPEARL AF-rProtein L-650F resin.

> 3.5 g/L human IgG_1
> 50 mmol/L sodium phosphate buffer, pH 7.0
> 150 mmol/L sodium chloride
> 10 mmol/L L-cystein
> 10 mmol/L EDTA
>
> ↓ 25 ˚C 5h incubation
> ← Add 1/10 volume of 0.3 mol/L N-Ethylmaleimide
> ↓
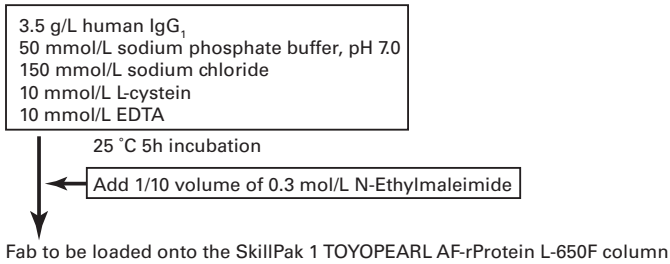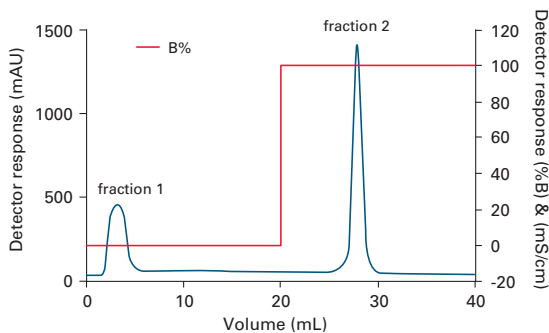> Fab to be loaded onto the SkillPak 1 TOYOPEARL AF-rProtein L-650F column

Figure 2 shows that Fab from the digested humanized IgG_1 was successfully captured by the SkillPak 1 TOYOPEARL AF-rProtein L-650F column. Fab was eluted at approximately 28 minutes.
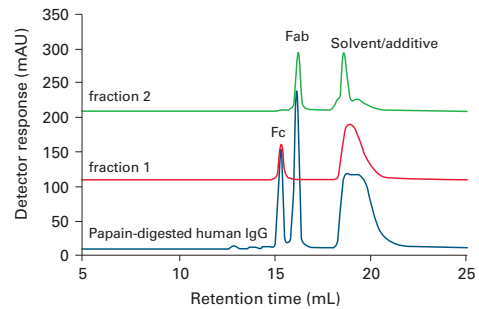
> Figure 2. Capture of Fab using the SkillPak 1 TOYOPEARL AF-rProtein L-650F column

Column:	SkillPak 1 TOYOPEARL AF-rProtein L-650F
Flow rate:	0.5 mL/min
Mobile phase:	A: 0.1 mol/L citrate buffer, pH 6.5
	B: 0.1 mol/L citrate buffer, pH 2.2
Detection:	UV @ 280 nm
Sample:	papain-digested human IgG_1

The unbound peak (fraction 1) and the Fab peak (fraction 2) were captured and then analyzed using a 2 µm size exclusion chromatography column, TSKgel UP-SW3000. Figure 3 shows that only fraction 2 contained Fab material, as compared to the papain-digested IgG (reference material).

> Figure 3. Analysis of captured Fab from the digested IgG_1 using TSKgel UP-SW3000

Column:	TSKgel UP-SW3000, 2 µm, 4.6 mm ID x 30 cm
Flow rate:	0.5 mL/min
Mobile phase:	50 mmol/L phosphate buffer + 0.2 mol/NaCl, pH 6.8
Detection:	UV @ 280 nm
Samples:	fractions of protein L chromatography
	papain-digest of human IgG

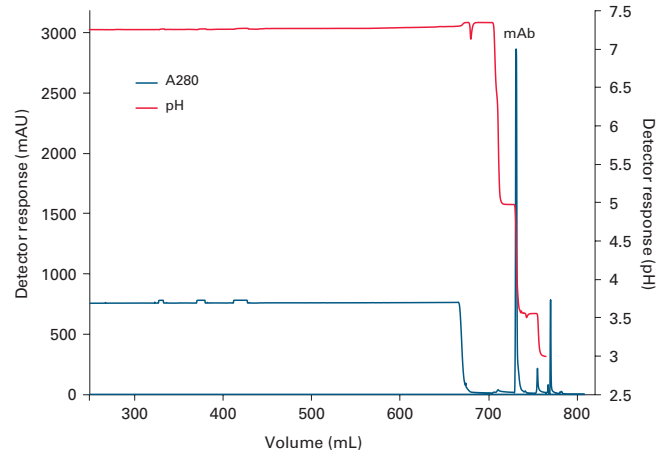## Method development for mAb purification: capture of intact antibodies using a 5 mL SkillPak column

340 mL of hybridoma cell line supernatant (titer ~0.03 g/L) was loaded on a 5 mL SkillPak column packed with TOYOPEARL AF-rProtein A HC 650F resin.

Conditions

Column:	SkillPak 5 TOYOPEARL AF-rProtein A HC-650F (5 mL)
Equilibration buffer:	0.1 mol/L Na_2HPO_4/NaH_2PO_4, 0.15 mol/L NaCl, pH 7.3
Post-loading 1st wash:	equilibration buffer (5 CV)
Post-loading 2nd wash:	0.1 mol/L acetate (NaOH), pH 5.0 (5 CV)
Elution:	0.1 mol/L acetate (NaOH), pH 3.5 (5 CV)
Column strip:	0.1 mol/L acetic acid, pH 2.9 (3 CV)
Column cleaning:	0.2 mol/L NaOH (3 CV), 15 min hold
Flow (load):	150 cm/h (1.25 mL/min), 4 min residence time
Flow (wash/elution):	240 cm/h (2.0 mL/min) (AKTA avant 25)
Temperature:	ambient (room temperature)
Sample:	340 mL hybridoma cell culture supernatant (buffer-adjusted)

After a short wash at pH 5.0, a sharp and efficient elution peak was obtained at the start of the pH 3.5 elution (Figure 4). Total mAb recovery was 9.8 mg in the elution peak (4.8 mL).

➤ **Figure 4.** Capture of intact mAb using SkillPak 5 TOYOPEARL AF-rProtein A HC-650F column

Column reproducibility: capture of intact mAb using a 5 mL SkillPak column

A 5 mL SkillPak column pre-packed with TOYOPEARL AF-rProtein A HC-650F resin was loaded with 23.5 mg of mAb feedstock. After 10 cycles the average recovery was 91% (average yield was 21.3 mg) as shown in the table below. Both pH max for elution and yield were highly consistent throughout the 10 cycles.

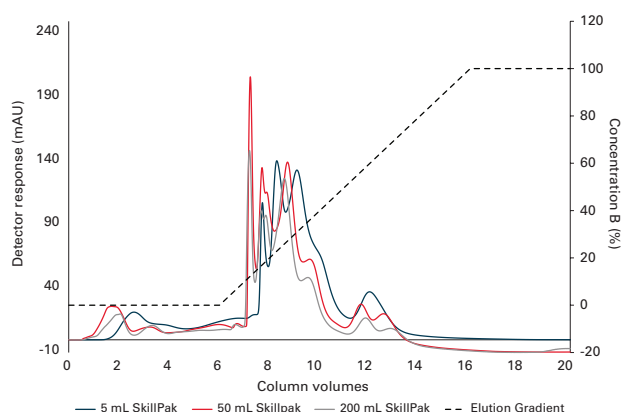| Reproducibility of a 5 mL SkillPak column for capture of intact mAb						
Run #	Retention @ peak max (mL)	Peak area (mL*mAU)	Peak height (mAU)	pH @ peak max	Eluate A280 (1:10 dil.)	Eluate (mL)	Yield (mg)
1	102.1	6327	1599	3.57	0.309	9.62	21.9
2	102.1	6335	1587	3.57	0.299	9.79	21.5
3	102.2	6351	1577	3.56	0.312	9.34	21.4
4	102.1	6358	1620	3.57	0.296	9.60	20.9
5	102.3	6308	1572	3.56	0.290	9.86	21.0
6	102.0	6310	1619	3.57	0.298	9.56	20.9
7	102.0	6300	1630	3.55	0.300	9.45	20.8
8	102.0	6294	1622	3.54	0.298	9.51	20.8
9	102.1	6309	1605	3.53	0.312	9.65	22.1
10	102.2	6291	1596	3.57	0.307	9.71	21.9
Ave.	102.1	6318	1603	3.56			21.3
St.Dev.	0.1	23	20	0.01			0.5

ext. coefficient=1.36

Seamless scale-up of downstream processes

To demonstrate the excellent scale-up capabilities of SkillPak pre-packed columns, we separated two different protein standards on different column dimensions packed with the anion exchange (AEX) resin TOYOPEARL NH$_2$-750F and cation exchange (CEX) resin TOYOPEARL Sulfate-650F.

➤ Table 5. Composition of AEX protein standard

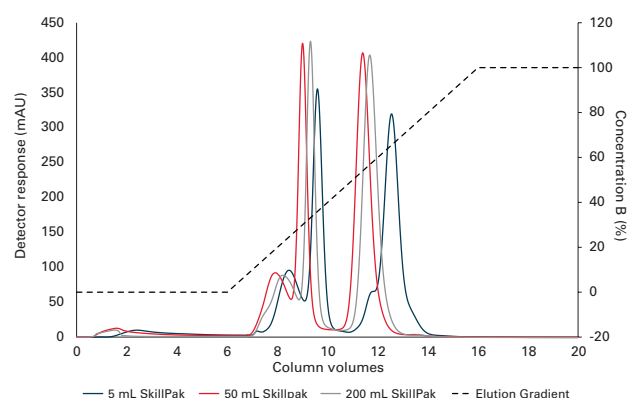| Protein	C (g/L)	pI
Papain	0.5	~8.8
Trypsin inhibitor (soy bean)	0.5	~4.1 - 4.5
BSA	1	~4.7
Pepsin	1	~ 2.7

➤ Figure 5. Separation of a protein standard on TOYOPEARL NH$_2$-750F in different scales

➤ Table 6. Composition of CEX protein standard

Protein	C (g/L)	pI
γ-Globulins (from human blood)	0.5	~ 7.2
Ribonuclease A	0.5	~ 8.5
α-Chymotrypsinogen	0.5	~ 9.6
Lysozyme	0.5	~ 11

➤ Figure 6. Separation of a protein standard on TOYOPEARL Sulfate-650F in different scales

The separation of the protein standards on AEX and CEX leads to similar elution profiles on the different column scales. The proteins eluted with increasing net surface charge during the linear salt gradient. In both cases, a shift to the right in retention volume can be observed with decreasing column volume. This can be attributed to the different influences of the system dead volume.

We also determined the dynamic binding capacity (DBC) of Bovine Serum Albumin (BSA) on the AEX resin on SkillPak 5, SkillPak 50, and SkillPak 200 columns to demonstrate scale equivalence. The values for Dynamic Binding Capacity (DBC) of BSA on the different scales of TOYOPEARL NH$_2$-750F are very close, with a maximum deviation of 4% (see Table 7). This shows the independence of binding capacity from column scale, which can be very important with regard to loading mass in scaled-up processes. With the given independence, binding capacity can be determined on a small scale to conserve both product and buffers. Later the determined capacity and thus maximum loading masses can be confidently assumed for larger-scale columns.

➤ Table 7. DBC of BSA on different scales of TOYOPEARL NH$_2$-750F

Column Volume	DBC 10%
5	67.10
50	64.89
200	64.58

(Full application note available)

Development and scale-up of an antibody platform

We developed and scaled up a 2-step platform to purify a specific mAB, Pertuzumab, using SkillPak pre-packed columns up to 200 mL. The 2-step platform consists of a Protein A capture and a single polishing step on a salt-tolerant anion exchange resin (AEX).

➤ Table 8. Summary of 2-step scale-up from 5 mL to 50 mL to 200 mL using TOYOPEARL AF-rProtein A HC-650F and TOYOPEARL NH$_2$-750F in SkillPak pre-packed columns

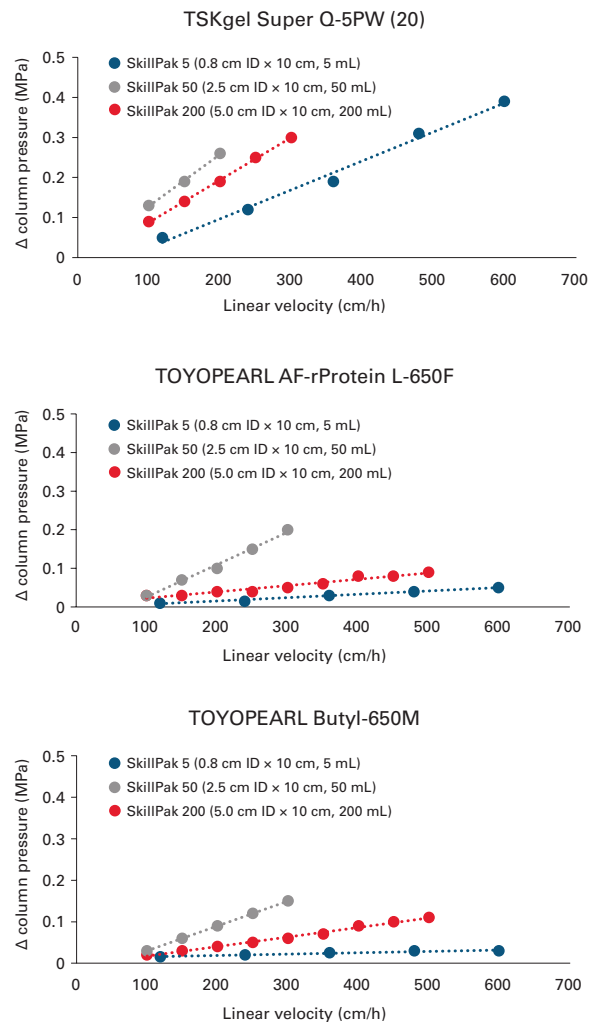| CV (mL)	Loaded mAb (mg)	Recovery Pro A (%)	Recovery NH$_2$ (FT) (%)	Overall recovery (%)	Monomer purity (%)
5	176	98.14	87.76	86.13	99.92
50	1932	98.58	94.97	93.62	99.69
200	7728	97.58	92.63	90.38	99.75

Overall recoveries of around 90 % and a high monomer purity of over 99.9 % were achieved. Using the SkillPak column platform, we could effortlessly develop and the scale-up the process without adjusting the process parameters between the different scales. This seamless scale-up using SkillPak pre-packed columns allows scientists to move from process development to pilot scale quickly, safely, and efficiently.

(Full application note available)

Packing Performance

SkillPak columns exhibit excellent flow characteristics packed with specified process resins and are compatible with low to medium pressure chromatography systems. The figures below demonstrate the superior packing performance for SkillPak columns pre-packed with several TOYOPEARL and TSKgel resins. Representative results are shown here with different bead diameters (20 µm for TSKgel Super Q-5PW (20), 45 µm for TOYOPEARL AF-rProtein L-650F, and 65 µm for TOYOPEARL Butyl-650M). During development of the SkillPak columns, the pressure/flow characteristics have been evaluated for all resin grades to ensure the best performances during the use of the columns.

➤ Figure 7. Packing performance data for SkillPak columns

Ordering Information: SkillPak 1 columns

Part #	Description	Resin volume	Column dimensions
Affinity Chromatography			
0045200	SkillPak 1 TOYOPEARL AF-rProtein L-650F	1 mL	0.7 cm ID × 2.5 cm
0045221	SkillPak 1 TOYOPEARL AF-rProtein L-650F (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045201	SkillPak 1 TOYOPEARL AF-rProtein A HC-650F	1 mL	0.7 cm ID × 2.5 cm
0045222	SkillPak 1 TOYOPEARL AF-rProtein A HC-650F (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045202	SkillPak 1 TOYOPEARL AF-Chelate-650M	1 mL	0.7 cm ID × 2.5 cm
Ion Exchange Chromatography			
0045203	SkillPak 1 TOYOPEARL GigaCap Q-650M (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045204	SkillPak 1 TOYOPEARL GigaCap S-650S (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045205	SkillPak 1 TOYOPEARL Sulfate-650F (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045206	SkillPak 1 TOYOPEARL SuperQ-650S (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045207	SkillPak 1 TSKgel SP-5PW (20) (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045208	SkillPak 1 TSKgel SuperQ-5PW (20) (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045209	SkillPak 1 TOYOPEARL NH_2-750F (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045210	SkillPak 1 TOYOPEARL GigaCap DEAE-650M (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045211	SkillPak 1 TOYOPEARL GigaCap CM-650M (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045212	SkillPak 1 TOYOPEARL QAE-550C (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045213	SkillPak 1 TOYOPEARL SP-550C (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
Hydrophobic Interaction Chromatography			
0045214	SkillPak 1 TOYOPEARL Butyl-600M (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045215	SkillPak 1 TOYOPEARL Butyl-650M (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045216	SkillPak 1 TOYOPEARL Phenyl-600M (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045217	SkillPak 1 TOYOPEARL Phenyl-650M (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045218	SkillPak 1 TOYOPEARL PPG-600M (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045219	SkillPak 1 TOYOPEARL Hexyl-650C (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
0045220	SkillPak 1 TOYOPEARL Ether-650M (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
Mixed-Mode Chromatography			
0045224	SkillPak 1 TOYOPEARL MX-Trp-650M (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
Size Exclusion Chromatography			
0045223	SkillPak 1 TOYOPEARL HW-40F (qty. 5)	1 mL	0.7 cm ID × 2.5 cm
HA Chromatography			
0045225	SkillPak 1 Ca^{++}Pure-HA	1 mL	0.7 cm ID × 2.5 cm
Column Libraries			
0045226	SkillPak 1 Anion Exchange column library, (TOYOPEARL GigaCap Q-650M, GigaCap DEAE-650M, NH_2-750F)	1 mL × 2 ea	0.7 cm ID × 2.5 cm
0045227	SkillPak 1 Cation Exchange column library, (TOYOPEARL GigaCap S-650S, GigaCap CM-650M, Sulfate-650F)	1 mL × 2 ea	0.7 cm ID × 2.5 cm
0045228	SkillPak 1 Antibody column library, (TOYOPEARL AF-rProtein A HC-650F, AF-rProtein L-650F, NH_2-750F, Sulfate-650F, GigaCapQ-650M, GigaCapS-650S)	1 mL × 2 ea	0.7 cm ID × 2.5 cm
0045229	SkillPak 1 mAb Platform column library, (TOYOPEARL AF-rProtein A HC-650F, Sulfate-650F, NH_2-750F)	1 mL × 2 ea	0.7 cm ID × 2.5 cm

Ordering Information: SkillPak 1 columns, continued

Part #	Description	Resin volume	Column dimensions
Column Libraries			
0045230	SkillPak 1 Salt Tolerant column library, (TOYOPEARL Sulfate-650F, NH$_2$-750F)	1 mL × 2 ea	0.7 cm ID × 2.5 cm
0045231	SkillPak 1 Mixed Mode column library, (Ca^{++}Pure-HA, TOYOPEARL MX-Trp-650M)	1 mL × 2 ea	0.7 cm ID × 2.5 cm
0045232	SkillPak 1 Best-in-Class column library, (Ca^{++}Pure-HA, TOYOPEARL AF-rProtein A HC-650F, AF-rProtein L-650F, NH$_2$-750F, Sulfate-650F)	1 mL × 2 ea	0.7 cm ID × 2.5 cm
0045233	SkillPak 1 HIC column library, (TOYOPEARL Butyl-650M, Phenyl-650M, PPG-600M, Hexyl-650C, Ether-650M)	1 mL × 2 ea	0.7 cm ID × 2.5 cm
0045234	SkillPak 1 HIC column library, (TOYOPEARL Butyl-600M, Phenyl-600M, PPG-600M, Hexyl-650C, Ether-650M)	1 mL × 2 ea	0.7 cm ID × 2.5 cm
0045235	SkillPak 1 HIC column library, (TOYOPEARL Butyl-650M, Phenyl-650M, PPG-600M)	1 mL × 2 ea	0.7 cm ID × 2.5 cm
0045236	SkillPak 1 HIC column library, (TOYOPEARL Butyl-600M, Phenyl-600M, PPG-600M)	1 mL × 2 ea	0.7 cm ID × 2.5 cm
0045237	SkillPak 1 HIC column library, (TOYOPEARL Phenyl-650M, PPG-600M, Hexyl-650C)	1 mL × 2 ea	0.7 cm ID × 2.5 cm
0045238	SkillPak 1 HIC column library, (TOYOPEARL Phenyl-600M, PPG-600M, Hexyl-650C)	1 mL × 2 ea	0.7 cm ID × 2.5 cm

Ordering Information: SkillPak 5 columns

Part #	Description	Resin volume	Column dimensions
Affinity Chromatography			
0045257	SkillPak 5 TOYOPEARL AF-rProtein L-650F	5 mL	0.8 cm ID × 10 cm
0045258	SkillPak 5 TOYOPEARL AF-rProtein A HC-650F	5 mL	0.8 cm ID × 10 cm
0045259	SkillPak 5 TOYOPEARL AF-Chelate-650M	5 mL	0.8 cm ID × 10 cm
Ion Exchange Chromatography			
0045239	SkillPak 5 TOYOPEARL GigaCap Q-650M	5 mL	0.8 cm ID × 10 cm
0045240	SkillPak 5 TOYOPEARL GigaCap S-650S	5 mL	0.8 cm ID × 10 cm
0045241	SkillPak 5 TOYOPEARL Sulfate-650F	5 mL	0.8 cm ID × 10 cm
0045242	SkillPak 5 TOYOPEARL SuperQ-650S	5 mL	0.8 cm ID × 10 cm
0045243	SkillPak 5 TSKgel SP-5PW (20)	5 mL	0.8 cm ID × 10 cm
0045244	SkillPak 5 TSKgel SuperQ-5PW (20)	5 mL	0.8 cm ID × 10 cm
0045245	SkillPak 5 TOYOPEARL NH$_2$-750F	5 mL	0.8 cm ID × 10 cm
0045246	SkillPak 5 TOYOPEARL GigaCap DEAE-650M	5 mL	0.8 cm ID × 10 cm
0045247	SkillPak 5 TOYOPEARL GigaCap CM-650M	5 mL	0.8 cm ID × 10 cm
0045248	SkillPak 5 TOYOPEARL QAE-550C	5 mL	0.8 cm ID × 10 cm
0045249	SkillPak 5 TOYOPEARL SP-550C	5 mL	0.8 cm ID × 10 cm
Hydrophobic Interaction Chromatography			
0045250	SkillPak 5 TOYOPEARL Butyl-600M	5 mL	0.8 cm ID × 10 cm
0045251	SkillPak 5 TOYOPEARL Butyl-650M	5 mL	0.8 cm ID × 10 cm
0045252	SkillPak 5 TOYOPEARL Phenyl-600M	5 mL	0.8 cm ID × 10 cm
0045253	SkillPak 5 TOYOPEARL Phenyl-650M	5 mL	0.8 cm ID × 10 cm
0045254	SkillPak 5 TOYOPEARL PPG-600M	5 mL	0.8 cm ID × 10 cm
0045255	SkillPak 5 TOYOPEARL Hexyl-650C	5 mL	0.8 cm ID × 10 cm
0045256	SkillPak 5 TOYOPEARL Ether-650M	5 mL	0.8 cm ID × 10 cm
Mixed-Mode Chromatography			
0045261	SkillPak 5 TOYOPEARL MX-Trp-650M	5 mL	0.8 cm ID × 10 cm
Size Exclusion Chromatography			
0045260	SkillPak 5 TOYOPEARL HW-40F	5 mL	0.8 cm ID × 10 cm
HA Chromatography			
0045262	SkillPak 5 Ca^{++}Pure-HA	5 mL	0.8 cm ID × 10 cm
Column Libraries			
0045263	SkillPak 5 mAb Platform column library, (TOYOPEARL AF-rProtein A HC-650F, Sulfate-650F, NH$_2$-750F)	5 mL × 1 ea	0.8 cm ID × 10 cm
0045264	SkillPak 5 Salt Tolerant column library, (TOYOPEARL Sulfate-650F, NH$_2$-750F)	5 mL × 1 ea	0.8 cm ID × 10 cm
0045265	SkillPak 5 Mixed Mode column library, (Ca^{++}Pure-HA, TOYOPEARL MX-Trp-650M)	5 mL × 1 ea	0.8 cm ID × 10 cm
0045266	SkillPak 5 Best-in-Class column library, (Ca^{++}Pure-HA, TOYOPEARL AF-rProtein A HC-650F, AF-rProtein L-650F, NH$_2$-750F, Sulfate-650F)	5 mL × 1 ea	0.8 cm ID × 10 cm

Ordering Information: SkillPak 50 columns

Part #	Description	Resin volume	Column dimensions
Size Exclusion Chromatography			
0045300	SkillPak 50 TOYOPEARL HW-40F	50 mL	2.5 cm ID × 10 cm
Ion Exchange Chromatography			
0045302	SkillPak 50 TSKgel SuperQ-5PW (20)	50 mL	2.5 cm ID × 10 cm
0045304	SkillPak 50 TOYOPEARL SuperQ-650S	50 mL	2.5 cm ID × 10 cm
0045306	SkillPak 50 TOYOPEARL GigaCap Q-650M	50 mL	2.5 cm ID × 10 cm
0045308	SkillPak 50 TOYOPEARL GigaCap DEAE-650M	50 mL	2.5 cm ID × 10 cm
0045310	SkillPak 50 TOYOPEARL NH$_2$-750F	50 mL	2.5 cm ID × 10 cm
0045312	SkillPak 50 TOYOPEARL QAE-550C	50 mL	2.5 cm ID × 10 cm
0045314	SkillPak 50 TOYOPEARL GigaCap S-650S	50 mL	2.5 cm ID × 10 cm
0045316	SkillPak 50 TSKgel SP-5PW (20)	50 mL	2.5 cm ID × 10 cm
0045318	SkillPak 50 TOYOPEARL Sulfate-650F	50 mL	2.5 cm ID × 10 cm
0045320	SkillPak 50 TOYOPEARL GigaCap CM-650M	50 mL	2.5 cm ID × 10 cm
0045322	SkillPak 50 TOYOPEARL SP-550C	50 mL	2.5 cm ID × 10 cm
Hydrophobic Interaction Chromatography			
0045324	SkillPak 50 TOYOPEARL PPG-600M	50 mL	2.5 cm ID × 10 cm
0045326	SkillPak 50 TOYOPEARL Butyl-600M	50 mL	2.5 cm ID × 10 cm
0045328	SkillPak 50 TOYOPEARL Butyl-650M	50 mL	2.5 cm ID × 10 cm
0045330	SkillPak 50 TOYOPEARL Hexyl-650C	50 mL	2.5 cm ID × 10 cm
0045332	SkillPak 50 TOYOPEARL Phenyl-600M	50 mL	2.5 cm ID × 10 cm
0045334	SkillPak 50 TOYOPEARL Phenyl-650M	50 mL	2.5 cm ID × 10 cm
0045336	SkillPak 50 TOYOPEARL Ether-650M	50 mL	2.5 cm ID × 10 cm
Affinity Chromatography			
0045338	SkillPak 50 TOYOPEARL AF-rProtein A HC-650F	50 mL	2.5 cm ID × 10 cm
0045340	SkillPak 50 TOYOPEARL AF-rProtein L-650F	50 mL	2.5 cm ID × 10 cm
0045342	SkillPak 50 TOYOPEARL AF-Chelate-650M	50 mL	2.5 cm ID × 10 cm
Mixed-Mode Chromatography			
0045344	SkillPak 50 TOYOPEARL MX-Trp-650M	50 mL	2.5 cm ID × 10 cm

Ordering Information: SkillPak 200 columns

Part #	Description	Resin volume	Column dimensions
Size Exclusion Chromatography			
0045301	SkillPak 200 TOYOPEARL HW-40F	200 mL	5.0 cm ID × 10 cm
Ion Exchange Chromatography			
0045303	SkillPak 200 TSKgel SuperQ-5PW (20)	200 mL	5.0 cm ID × 10 cm
0045305	SkillPak 200 TOYOPEARL SuperQ-650S	200 mL	5.0 cm ID × 10 cm
0045307	SkillPak 200 TOYOPEARL GigaCap Q-650M	200 mL	5.0 cm ID × 10 cm
0045309	SkillPak 200 TOYOPEARL GigaCap DEAE-650M	200 mL	5.0 cm ID × 10 cm
0045311	SkillPak 200 TOYOPEARL NH_2-750F	200 mL	5.0 cm ID × 10 cm
0045313	SkillPak 200 TOYOPEARL QAE-550C	200 mL	5.0 cm ID × 10 cm
0045315	SkillPak 200 TOYOPEARL GigaCap S-650S	200 mL	5.0 cm ID × 10 cm
0045317	SkillPak 200 TSKgel SP-5PW (20)	200 mL	5.0 cm ID × 10 cm
0045319	SkillPak 200 TOYOPEARL Sulfate-650F	200 mL	5.0 cm ID × 10 cm
0045321	SkillPak 200 TOYOPEARL GigaCap CM-650M	200 mL	5.0 cm ID × 10 cm
0045323	SkillPak 200 TOYOPEARL SP-550C	200 mL	5.0 cm ID × 10 cm
Hydrophobic Interaction Chromatography			
0045325	SkillPak 200 TOYOPEARL PPG-600M	200 mL	5.0 cm ID × 10 cm
0045327	SkillPak 200 TOYOPEARL Butyl-600M	200 mL	5.0 cm ID × 10 cm
0045329	SkillPak 200 TOYOPEARL Butyl-650M	200 mL	5.0 cm ID × 10 cm
0045331	SkillPak 200 TOYOPEARL Hexyl-650C	200 mL	5.0 cm ID × 10 cm
0045333	SkillPak 200 TOYOPEARL Phenyl-600M	200 mL	5.0 cm ID × 10 cm
0045335	SkillPak 200 TOYOPEARL Phenyl-650M	200 mL	5.0 cm ID × 10 cm
0045337	SkillPak 200 TOYOPEARL Ether-650M	200 mL	5.0 cm ID × 10 cm
Affinity Chromatography			
0045339	SkillPak 200 TOYOPEARL AF-rProtein A HC-650F	200 mL	5.0 cm ID × 10 cm
0045341	SkillPak 200 TOYOPEARL AF-rProtein L-650F	200 mL	5.0 cm ID × 10 cm
0045343	SkillPak 200 TOYOPEARL AF-Chelate-650M	200 mL	5.0 cm ID × 10 cm
Mixed-Mode Chromatography			
0045345	SkillPak 200 TOYOPEARL MX-Trp-650M	200 mL	5.0 cm ID × 10 cm

TOSOH HISTORY

1935	Founding of Toyo Soda Manufacturing Co., Ltd.
1936	Operation of Nanyo Manufacturing Complex begins
1979	Tosoh develops TOYOPEARL media
1983	First TOYOPEARL hydrophobic interaction (HIC) resin
1995	Tosoh Nanyo gel factory receives ISO9001
2007	TOYOPEARL GigaCap high capacity ion exchange series starts
2012	A second TOYOPEARL production site doubles manufacturing capacity
2012	First TOYOPEARL multimodal resin
2013	High capacity TOYOPEARL Protein A resin for antibody purification introduced
2014	TOSOH Bioscience GmbH celebrates its 25th anniversary
2016	First salt-tolerant TOYOPEARL ion exchanger
2016	TOYOPEARL® Sulfate-650F receives the TMM Innovation Award 2016
2017	High capacity TOYOPEARL Protein L resin for antibody purification introduced
2019	Completion of the third TOYOPEARL factory
2020	SkillPack pre-packed columns launched globally

TOSOH

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