

IEC ION EXCHANGE CHROMATOGRAPHY

IEC PRODUCTS

➤ ANION EXCHANGE

- Toyopearl SuperQ-650
- Toyopearl QAE-550
- Toyopearl Q-600C AR
- Toyopearl DEAE-650
- Toyopearl GigaCap Q-650
- TSKgel SuperQ-5PW
- TSKgel DEAE-5PW

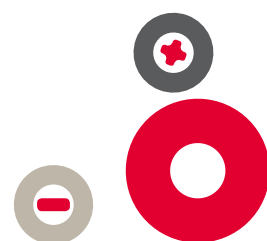
➤ CATION EXCHANGE

- Toyopearl MegaCap II SP-550EC
- Toyopearl SP-650
- Toyopearl SP-550
- Toyopearl CM-650
- Toyopearl GigaCap S-650
- Toyopearl GigaCap CM-650
- TSKgel SP-3PW
- TSKgel SP-5PW

≡ TOSOH FACT

The Tosoh logo symbolizes the corporate philosophy of Tosoh's vision of the ideal.

The curved lines represent the realization of happiness, reflecting Tosoh's management philosophy of putting people first. The square in the center expresses the advanced nature of Tosoh's technology and also represents the outstanding quality of Tosoh's products. The right-angle cut at the top portrays an image of contributing to society, Tosoh's stance towards the outside world. The red corporate color symbolizes the Tosoh spirit, which guides the ceaseless efforts to realize the ideal.





ION EXCHANGE CHROMATOGRAPHY

TOYOPEARL ION EXCHANGE CHROMATOGRAPHY RESINS

Ion Exchange Chromatography (IEC) is the most common liquid chromatographic method used in manufacturing therapeutic proteins. Due to the high dynamic binding capacities of ion exchange resins relative to those of the other chromatographic modes (Table I), it is the chromatographic technique selected by many developers for the capture or concentration step. Tosoh Bioscience offers a broad range of products for ion exchange applications.

HOW DOES IEC WORK?

IEC is based on the binding of proteins to positively or negatively charged groups which are immobilized on a stationary phase and which are in equilibrium with free counter ions in the mobile phase. In the process of adsorption, the mobile phase counter ions are exchanged by the protein solute. The binding of proteins to the ion exchange matrix predominantly occurs via charged amino acid residues located at the surface of the protein molecule.

The development of optimum chromatographic system conditions requires knowledge of both the protein's pI and the pKa of the ion exchange media. A binding buffer pH is selected between the pI of the target and the ion exchanger's pKa (Figure 1). This ensures that the protein is in the opposite charge state compared to the ion exchange media. When possible, the pH is also optimized to effect the highest solubility of the target protein. Higher protein solubilities make more efficient use of the overall ion exchange capacity of the resin. A salt is selected as the source of counter ions in the mobile phase and elution occurs as the salt strength is increased to a higher concentration than the target's binding salt conditions.

ION EXCHANGE GROUPS AVAILABLE

Toyopearl and TSKgel 5PW-type IEC resins are available with six different ion exchange groups as shown in Table II:

- 3 for anion exchange – Q, QAE, DEAE
- 3 for cation exchange – S, SP, CM

FEATURES

- porous, hydrophilic polymer based resin
- chemical stability
- column bed stability
- mechanical stability
- continuous selectivity

FIGURE 1

PK_a VALUES FOR ION EXCHANGE GROUPS

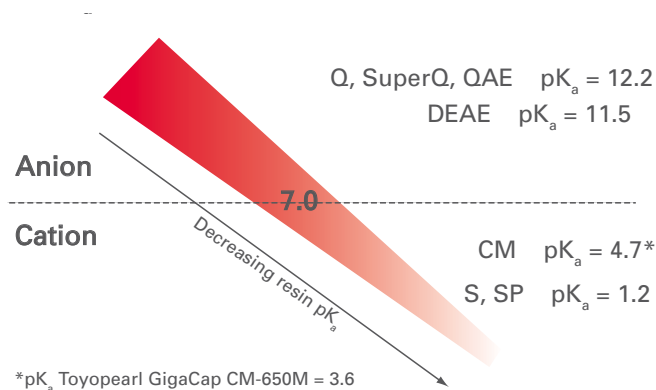


TABLE I

Separation Mode	Binding capacity for standard proteins (mg/mL)	Binding capacity in production processes (mg/mL)
Ion Exchange	100-200	50-100
Hydrophobic Interaction	40-60	10-30
Affinity (group specific ligands)	40-100	20-60
Reversed Phase (polymeric media)	60-100	30-50

PORE SIZES

Tosoh Bioscience offers a range of pore sizes for IEC resins originating from our size exclusion chromatography base resins. Four different mean pore diameters are used for the current ion exchange resins: 1000 Å, 750 Å, 500 Å, and 250 Å (Table III). Depending on the kind of ligand attachment, the effective pore size of the resulting IEC resin is smaller than the pore size of the base bead. When network ligand technology is applied the accessible pore size is varying with pH and salt concentration, therefore all pore sizes mentioned here are those of the respective Toyopearl HW or TSKgel base resin.

BENEFITS

- suitable for laboratory scale and process chromatography
- autoclavable at 121°C
- temperature range 4° - 60°C
- pH range 2-13, can be regenerated with acid or base
- compatible with organic solvents
- constant packing volume over a wide range of salt concentrations
- excellent flow characteristics in large industrial columns (up to 7 bar)
- easy scale-up from TSKgel IEC columns
- high yields of biologically active proteins

ION EXCHANGE CHROMATOGRAPHY


TABLE II

ANION EXCHANGE RESIN	Base bead	Pore size (Å)	Particle size (µm)	IEC (meq/mL)	DBC (BSA) (mg/mL-gel)	Recovery (%)
Toyopearl GigaCap Q-650M	HW-65	1,000	50-100	0.17	172	97
Toyopearl SuperQ-650M	HW-65	1,000	40-90	0.24	145	98
Toyopearl DEAE-650M	HW-65	1,000	40-90	0.11	25	97
Toyopearl Q-600C AR	HW-60	750	50-150	0.18	100	98
Toyopearl QAE-550C	HW-55	500	50-150	0.36	30	96
CATION EXCHANGE RESIN	Base bead	Pore size (Å)	Particle size (µm)	IEC (meq/mL)	DBC (hIgG) (mg/mL-gel)	Recovery (%)
Toyopearl GigaCap S-650M	HW-65	1,000	50-100	0.16	145	98
Toyopearl GigaCap CM-650M	HW-65	1,000	50-100	0.24	100	98
Toyopearl SP-650C	HW-65	1,000	50-150	0.12	12	98
Toyopearl CM-650C	HW-65	1,000	50-150	0.09	35 (lysozyme)	
Toyopearl SP-550C	HW-55	500	50-150	0.13	14	98

TABLE III

Base bead	Toyopearl HW-65 TSKgel G5000PW	Toyopearl HW-60	Toyopearl HW-55	TSKgel G3000PW
Pore Diameter	1000 Å	750 Å	500 Å	250 Å
	Toyopearl GigaCap S-650 Toyopearl GigaCap CM-650 Toyopearl GigaCap Q-650 Toyopearl SuperQ-650 Toyopearl DEAE-650 Toyopearl SP-650 Toyopearl CM-650 TSKgel SP-5PW TSKgel SuperQ-5PW TSKgel DEAE-5PW	Toyopearl Q-600C AR	Toyopearl SP-550 Toyopearl MegaCap II SP-550 Toyopearl QAE-550	TSKgel SP3-PW

HIGHER ACCESSIBLE SURFACE AREA EQUALS MORE CAPACITY

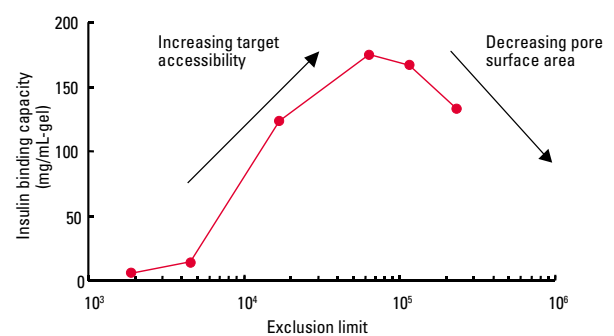
A bead with a small pore size has theoretically more surface area than the same size bead with a larger pore. Figure 2 shows insulin binding capacity on six different pore size beads. As the pore size increases to the point where the insulin has maximal access to the internal surface area the insulin capacity increases.

However, there is a point of diminishing return. Because the absolute surface area decreases as the pores become larger, the insulin capacity decreases accordingly. This effect is similarly demonstrated by the lysozyme static binding capacity range specifications of Toyopearl SP-550C and Toyopearl SP-650C which are 80-120 g/L and 35-55 g/L, respectively (data not shown).

For more information on pore size and particle size combinations not contained in our commercial products, please see the Custom Resin section of this catalog.

FIGURE 2

OPTIMIZATION OF INSULIN BINDING CAPACITY AS A FUNCTION OF PORE SIZE OF EXPERIMENTAL TSKgel SP-TYPE RESINS





ION EXCHANGE CHROMATOGRAPHY

MULTIPLE PARTICLE SIZES SIMPLIFY SCALING UP OR DOWN

Because Toyopearl HW-65 and TSKgel G5000PW products have similar backbone chemistry and selectivity, scaling up or scaling down for a selected ion exchange method is simple. Practically speaking, the chromatographic conditions that work for one particle size will work for all particle sizes with a given ligand functionality. The elution order of the feedstock components will remain the same with increasing resolution as the particle size gets smaller (Figure 3). Figure 4 lists the complete range of ion exchange products, particle sizes and suggests how they are typically placed into a manufacturing scheme. The availability of smaller bead sizes for greater resolution while maintaining the same selectivity is particularly useful in the areas of oligonucleotide and peptide purification.

RESIN PHYSICAL PROPERTY SELECTION

(for resins available in different pore sizes with the same ligand and ligand attachment chemistry)

For bind/elute chromatography:

- Select the smallest pore size resin appropriate for the size of the target molecule.
- Select a larger particle size for a capture step, a smaller one for intermediate or polishing steps

For flow through chromatography:

- If the target molecule's size is larger than most components of the feedstream, select a pore size which will tend to exclude it (known as kinetic exclusion, this technique can also be used under binding conditions as the excluded molecule only sees 1% of the resin surface area and the capacity/recovery loss is minimal)

For large molecule impurity clearance:

- Select a pore size which includes the target molecule, but excludes the impurity. (see the calibration curves of the Toyopearl base beads in the SEC section of the catalog as an aid).

OLIGONUCLEOTIDE PURIFICATIONS

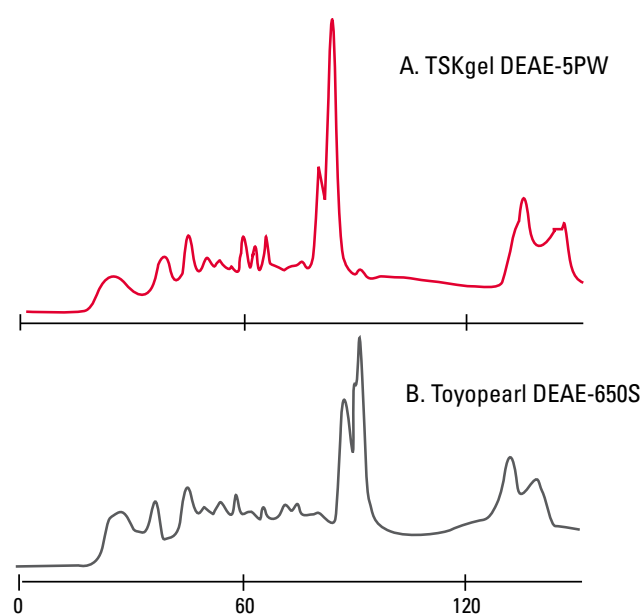
Table 4 shows the different particle sizes available with the anion exchange SuperQ functionality, which is typically used for oligonucleotide purifications. The relative binding capacities and predicted resolution of the five particle sizes are depicted by a series of "+" characters. The more "+" characters listed in the table the better one resin is relative to another for that parameter. If a process is developed using one of the five resins and more resolution is needed, select an appropriate smaller particle size product. Similarly if more capacity is needed, and resolution is not a critical issue, a

larger particle size resin can be selected. The larger particle Toyopearl resins are less crosslinked than the corresponding TSKgel 5PW type resin products and have more active sites for ligand attachment. Thus they have higher capacities than the TSKgel 5PW-type resins. In some cases, Toyopearl GigaCap Q-650M (also shown in Table IV) and its very high capacity can be used, although its selectivity is somewhat different than the other quaternary Q products.

TSKgel SuperQ-5PW products typically have 2-4 times the binding capacity of other small particle anion exchange resins available on the market. This has significant bearing in the area of difficult to resolve "n-1" DNA and RNAi purifications as loading amounts are increased. Under higher loading conditions, the TSKgel SuperQ resins maintain their resolution much better than smaller particle, lower capacity resins. The smaller particle products may start out with a slight separation advantage under low oligonucleotide loading conditions, but this vanishes as the feedstock load is increased.

Figure 5 shows a comparison of one smaller particle size, competitive product, which starts out having better resolution than TSKgel SuperQ-5PW (20) resin at 1 mg oligonucleotide/mL of resin. At 20 mg oligonucleotide/mL of resin, however, the resolution of peaks on the competitive product deteriorates significantly. The TSKgel SuperQ-5PW (20) retains excellent resolution even at this higher oligonucleotide level.

FIGURE 3 COMPARISON OF TSKgel DEAE-5PW AND TOYOPEARL DEAE-650S



Column: 55 mm ID x 20 cm L; Sample: calf liver acetone powder, 94 mg in 4.7 mL in 0.02 mol/L Tris-HCl (pH 0 8.0)
 Mobile phase: 100 min linear gradient from 0 mol/L to 0.25 mol/L NaCl followed by a 20 min linear gradient from 0.25 mol/L to 0.5 mol/L NaCl in 0.02 mol/L Tris-HCl (pH = 8.0)
 Flow rate: 50 cm/h; Detection: UV @ 280 nm

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FIGURE 4

Process step	Bead size (µm)	Process media	
		ANION	CATION
Capture	200 µm		Toyopearl MegaCap II SP-550EC
	100 µm	Toyopearl SuperQ-650C Toyopearl DEAE-650C Toyopearl QAE-550C	Toyopearl SP-650C Toyopearl SP-550C Toyopearl CM-650C
	75 µm	Toyopearl GigaCap Q-650M	Toyopearl GigaCap S-650M
Intermediate Purification	65 µm	Toyopearl SuperQ-650M Toyopearl DEAE-650M	Toyopearl SP-650M Toyopearl CM-650M
	35 µm	Toyopearl SuperQ-650S Toyopearl DEAE-650S	Toyopearl SP-650S Toyopearl CM-650S
	30 µm	TSKgel SuperQ-5PW (30) TSKgel DEAE-5PW (30)	TSKgel SP-5PW (30) TSKgel SP-3PW (30)
Polishing	20 µm	TSKgel SuperQ-5PW (20) TSKgel DEAE-5PW (20)	TSKgel SP-5PW (20)
	10 µm	TSKgel SuperQ-5PW 7.5 mm ID x 7.5 cm L TSKgel DEAE-5PW 7.5 mm ID x 7.5 cm L	TSKgel SP-5PW 7.5 mm ID x 7.5 cm L TSKgel CM-5PW 7.5 mm ID x 7.5 cm L

Same selectivity HPLC columns are available for most process media

TABLE IV

Oligonucleotide Purification Products:

	Bead size (mean µm)	Binding capacity	Resolution	Bead type	Ligand attachment
TSKgel SuperQ-5PW (20)	20	++	+++++	methacrylic	Type A
TSKgel SuperQ-5PW (30)	30	++	++++	methacrylic	Type A
Toyopearl SuperQ-650S	35	++++	+++	methacrylic	Type A
Toyopearl SuperQ-650M	65	++++	++	methacrylic	Type A
Toyopearl SuperQ-650C	100	++++	+	methacrylic	Type A
Toyopearl GigaCap Q-650M	75	+++++	++	methacrylic	Type B

Peptide Purification Products:

	Bead size (mean µm)	Binding capacity	Resolution	Bead type	Ligand attachment
TSKgel SP-5PW (20)	20	++	+++++	methacrylic	Traditional
TSKgel SP-5PW (30)	30	++	++++	methacrylic	Traditional
TSKgel SP-3PW (30)	30	+++	++++	methacrylic	Traditional
Toyopearl SP-650S	35	++++	+++	methacrylic	Traditional
Toyopearl SP-650M	65	++++	++	methacrylic	Traditional
Toyopearl SP-650C	100	++++	+	methacrylic	Traditional
Toyopearl GigaCap S-650M	75	+++++	++	methacrylic	Type B



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PEPTIDE PURIFICATIONS

Cation exchange chromatography is commonly used for peptide purification. Table 4 shows the same particle size availability of Toyopearl and TSKgel PW strong cation exchange resins. Based on the needs for capacity and resolution, an appropriate S or SP resin is selected for a particular peptide application. The new TSKgel SP-3PW (30) is based on a 250 Å pore resin. It was developed to provide high binding capacities for peptides and small proteins. It also has a different selectivity than TSKgel SP-5PW (30).

LIGAND ATTACHMENT TECHNOLOGY

Tosoh Bioscience applies three different ligand attachment chemistries reflecting three generations of ligand attachment technology. The “traditional” method, or first generation of attaching the ion exchange ligand, is directly to the resin surface through a proprietary spacer arm. Toyopearl and TSKgel PW type ion exchange resins using this traditional bead functionalization method are:

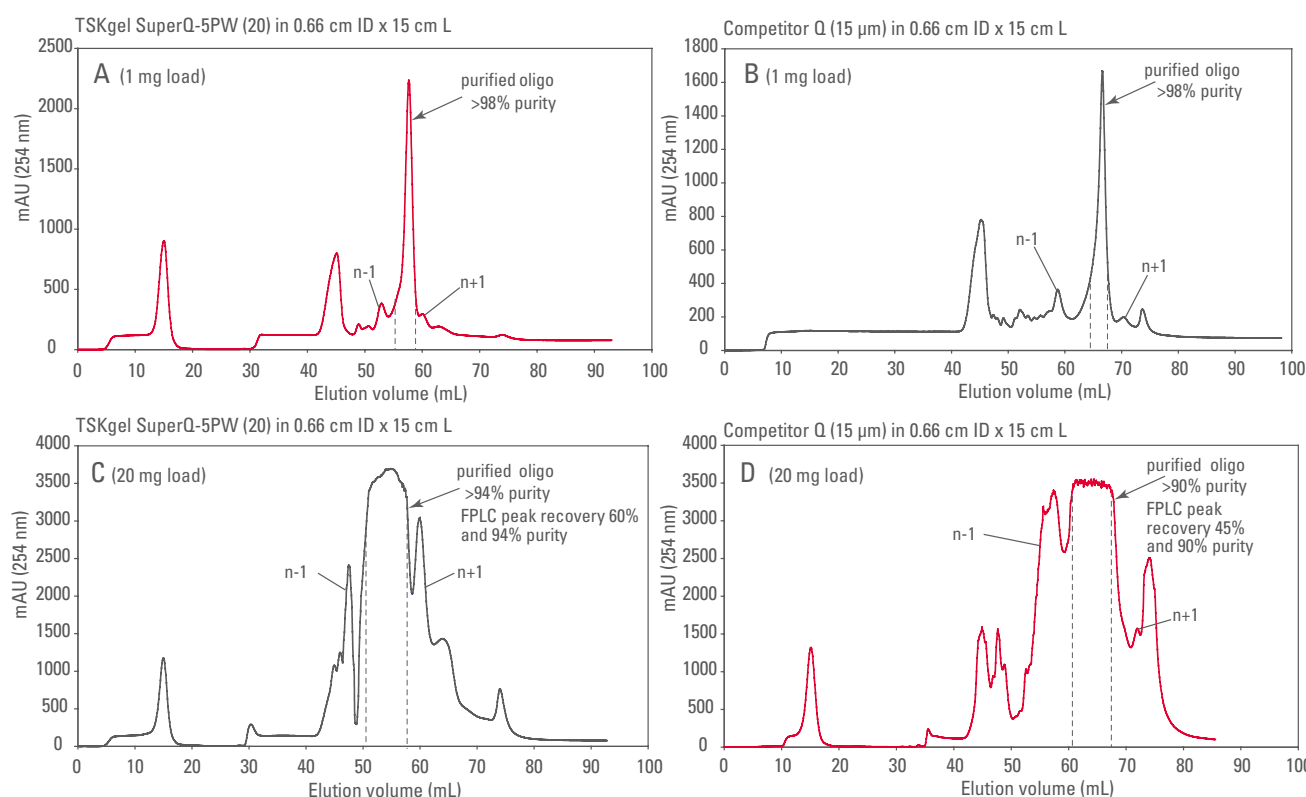
- Toyopearl SP-650 and SP-550
- TSKgel SP-3PW and SP-5PW
- Toyopearl CM-650
- Toyopearl Q-600C AR
- Toyopearl Q-550
- Toyopearl DEAE-650
- TSKgel DEAE-5PW
- Toyopearl MegaCap II SP-550EC

A second generation attachment chemistry (Type A noted in Table IV) for increasing protein binding within the accessible surface area, is to add a carbon spacer network between the bead surface and the ligand. It is also possible to attach ligand groups along the length of the spacer network thus improving capacity. There are two resins which incorporate this type A ligand attachment chemistry:

- Toyopearl SuperQ-650
- TSKgel SuperQ-5PW

➤ FIGURE 5

TSKgel SuperQ-5PW (20) MAINTAINS RESOLUTION AT HIGH OLIGONUCLEOTIDE LOAD



Column: 0.66 cm x 15 cm L (5.1 mL) (resin as noted in figure); Flow rate: 1.43 mL/min (250 cm/h)

Buffer A: 20 mmol/L Tris-HCl + 10 mmol/L EDTA (pH= 9.0); Buffer B: 20 mmol/L Tris-HCl + 10 mmol/L EDTA + 1.0 mol/L NaCl (pH= 9.0)

Sample loaded: DNA based oligonucleotides were loaded as followed: 1 mg/column panels A & B, 20 mg/column panels C & D

Separation conditions: Column was washed with 5 CV 100% buffer A followed by 11 mL injection. Column was then washed with 3 CV 100% buffer A followed by 6 CV of linear gradient 35-53 buffer B. Finally, column was washed with 5 CV 100% buffer B.

Detection: UV @ 254 nm; Fractions: 0.5 mL fractions were taken from peaks of interest and analyzed on a TSKgel DNA-NPR column

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A third generation ligand attachment chemistry (Type B noted in Table IV) improves the accessible location of the ligand groups. The result of this modification is significantly increased capacity and improved mass transfer. Improved mass transfer also reduces the target molecule elution volume. All Toyopearl GigaCap resins use this Type B ligand attachment chemistry:

- Toyopearl GigaCap S-650
- Toyopearl GigaCap CM-650
- Toyopearl GigaCap Q-650

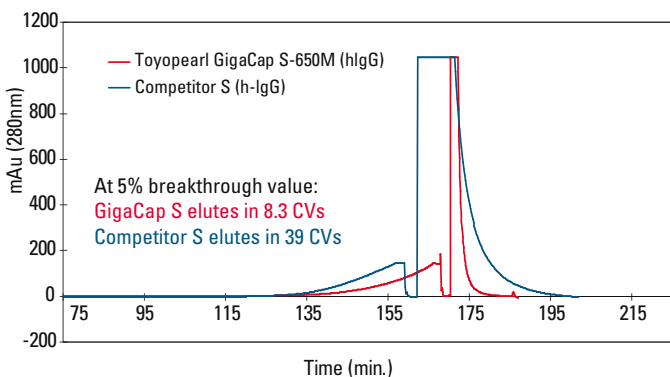
Figures 6, 7, and 8 show the breakthrough curves for the three Toyopearl GigaCap resins. They are compared where possible with the most current equivalent competitive resin. Each trace shows the dynamic binding capacity of the resin up to 10% breakthrough plus the elution profile for the target molecule. Please note the significant reduction in elution pool volumes of the Toyopearl GigaCap resins when compared to other products. The concentration of the eluted peak is proportionally increased as well. It is possible to achieve reductions in elution pool volumes of over 75%. This can reduce the cost of further downstream process steps.

IMPACT OF PORE SIZE AND LIGAND ATTACHMENT ON DBC

Table 5 contains DBC data for five of our Toyopearl resins using three different sized proteins. There are three different pore sizes and three different ligand attachment methods represented. Toyopearl GigaCap Q-650M has the highest capacity for all combinations of pore size and attachment chemistries. Please note the decrease in capacity for the larger proteins on the Toyopearl SuperQ-650M resin indicating that the accessible pore volume has diminished by the ligand attachment chemistry used.

➤ **FIGURE 6**

TOYOPEARL GIGACAP S-650M VS. COMPETITOR S ELUTION POOL VOLUME COMPARISON



Column size: 6 mm ID x 40 mm bed; Sample: polyclonal human IgG (1 mg/mL); Loading Buffer: 0.1 mol/L acetate buffer (pH= 4.7) Elution Buffer: 0.1 mol/L acetate buffer (pH= 4.7) + 1.0 mol/L NaCl Linear velocity: 212 cm/h; Detection: UV @ 280 nm

PEGylated PROTEINS

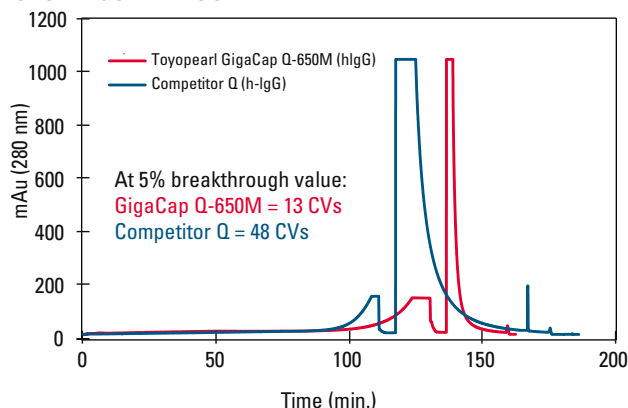
Ion exchange resins are frequently used for the purification of pegylated proteins. Figure 9 shows the breakthrough curves of five Toyopearl cation exchange resins for mono-pegylated lysozyme.

RESIN PRESSURE FLOW PROPERTIES

All Toyopearl resins are designed to withstand pressures up to 3 bar. The newer Toyopearl GigaCap resins have a particle size of 50-100 microns which is slightly larger than our normal M-grade 40-90 micron beads. This particle size difference generates a lower back pressure (Figure 10) than our more traditional M-grade ion exchange products. The TSKgel 5PW type resins can be operated at pressures up to 20 bar.

➤ **FIGURE 7**

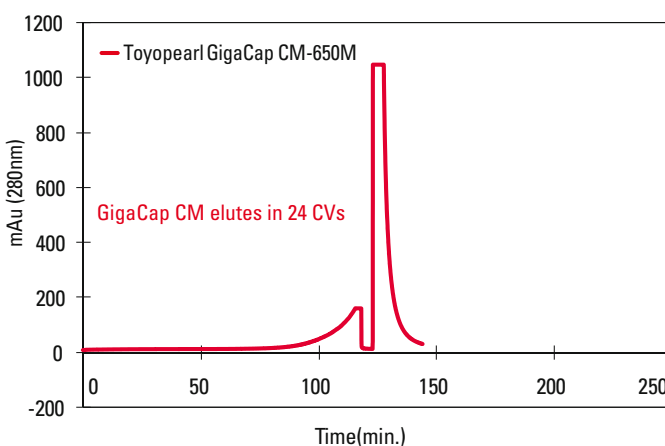
TOYOPEARL GIGACAP Q-650M VS. COMPETITOR Q ELUTION POOL VOLUME COMPARISON



Column size: 6 mm ID x 40 mm L; Sample: polyclonal human IgG (1 mg/mL); Loading buffer: 15 mmol/L Tris-HCl (pH= 8.7); Elution buffer: 15 mmol/L Tris-HCl (pH= 8.7) + 1.0 mol/L NaCl; Linear velocity: 212 cm/h; Detection: UV @ 280 nm

➤ **FIGURE 8**

TOYOPEARL GIGACAP CM-650M ELUTION POOL VOLUME



Column size: 6 mm ID x 40 mm L; Sample: polyclonal human IgG (1 mg/mL); Loading buffer: 50 mmol/L sodium acetate buffer (pH= 4.7); Elution buffer: 15 mmol/L Tris-HCl (pH= 8.7) + 1.0 mol/L NaCl Linear velocity: 212 cm/h; Detection: UV @ 280 nm



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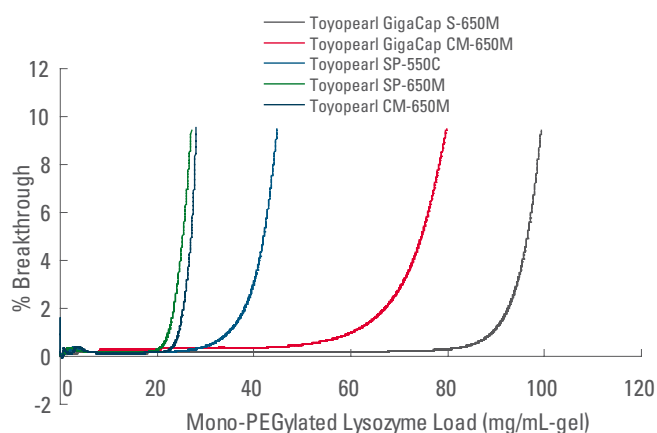
If recommended packing procedures are followed, Toyopearl and TSKgel IEC resins maintain stable bed volumes during the pH and ionic strength changes that occur during normal ion exchange chromatography (Consult our Toyopearl Instruction Manual for the recommended packing conditions). Multi-cycle gradient operation and re-equilibration are accomplished without volume changes in the Toyopearl column bed. The mechanical stability of Toyopearl resins allows the use of longer column beds with more efficiency or higher operational flow rates.

ALKALINE STABILITY

Tosoh has focused on improving the alkaline stability of its newer ion exchange resins. Higher capacity resins can bind not only more of the target molecule, but the impurities and isoforms as well. In some cases more rigorous cleaning agents like 0.5 mol/L NaOH and even 1.0 mol/L NaOH are needed to insure proper resin regeneration. Naturally, the resins need to tolerate these more stringent conditions. As seen in Table VI all three of the new Toyopearl GigaCap series ion exchange resins have excellent alkaline stability.

FIGURE 9

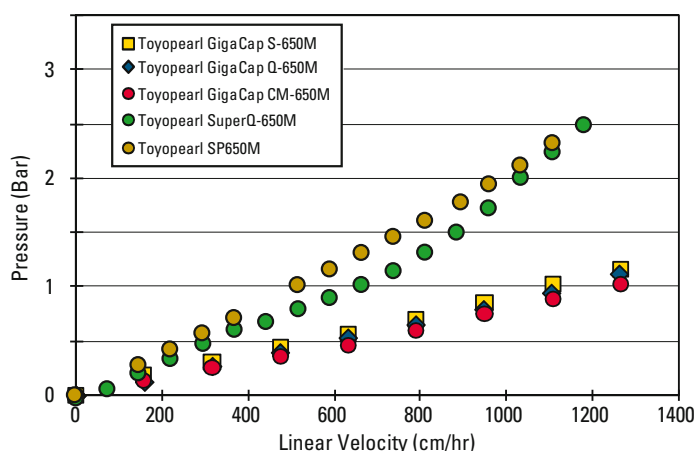
BREAKTHROUGH CURVES OF MONO-PEGYLATED LYSOZYME USING TOYOPEARL CATION EXCHANGE RESINS



Dynamic binding capacities were determined at 10% breakthrough. Column size: 6 mm ID x 40 mm L; Sample: mono-PEGylated lysozyme; Loading buffer: 20 mmol/L phosphate buffer (pH= 7.0) Elution buffer: 20 mmol/L phosphate buffer (pH= 7.0) + 0.5mol/L NaCl. Linear velocity: 212 cm/h; Detection: UV @ 280 nm PEG MW= 5kDa

FIGURE 10

PRESSURE-FLOW CURVE COMPARISON



Column size: 22 mm ID x 20 cm L; Mobile phase: distilled water. Temperature: 25 °C

TABLE V

DYNAMIC BINDING CAPACITY VARIES WITH PROTEIN SIZE

Resin	Pore size (Å)	BSA 66 kDa	Binding capacity (mg/mL gel)	
			Human IgG 160 kDa	Thyroglobulin 660 kDa
Toyopearl GigaCap Q-650M	1.000	173	108	71
Toyopearl SuperQ-650M	1.000	145	13	3
Toyopearl Q-600C AR	750	108	90	26
Toyopearl QAE-550C	500	29	32	6
Toyopearl DEAE-650M	1.000	25	31	3

Column size: 6 mm ID x 4 cm L; Sample concentration: 1 mg/mL; Loading buffers: BSA 0.05 mol/L Tris-HCl (pH = 8.5); Human IgG 0.05 mol/L Tris-HCl (pH = 8.7); Thyroglobulin 0.05 mol/L Tris-HCl (pH = 8.7) + 0.15 mol/L NaCl. Elution buffers: loading buffer + 1.0 mol/L NaCl; Flow rate: 212 cm/h; Detection: UV @ 280 nm

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TABLE VI

TOYOPEARL GIGACAP RESIN BASE STABILITY

Resin solution	Storage Molecule	Test	Capacity	Starting capacity	Week 1	Week 2	Week 3
Toyopearl GigaCap S-650M	1.0 mol/L NaOH	h-IgG	Dynamic	143 (mg/mL)	144	140	135
Toyopearl GigaCap CM-650M	0.5 mol/L NaOH	h-IgG	Dynamic	99 (mg/mL)	88	90	91
Toyopearl GigaCap Q-650M	0.5 mol/L NaOH	BSA	Static	166 (mg/mL)	NA	153*	136

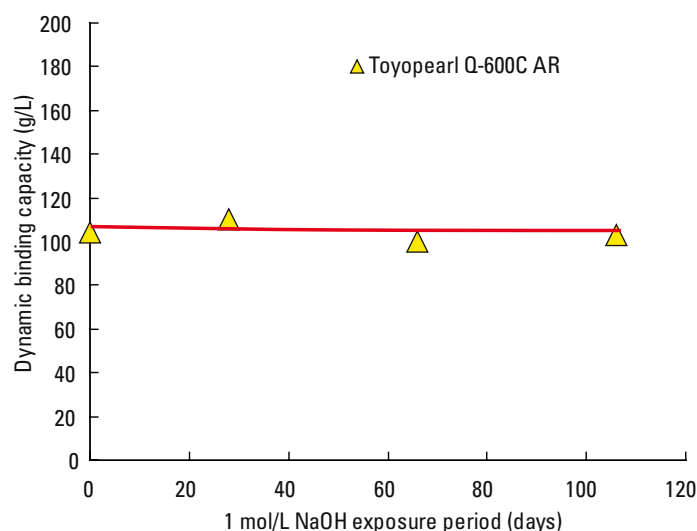
* 12 days

FIGURE 11

TOYOPEARL Q-600C AR

TOYOPEARL Q-600C AR RESIN DBC AS A FUNCTION OF SODIUM HYDROXIDE EXPOSURE

For this catalog we are announcing a new, high capacity anion exchange resin, Toyopearl Q-600C AR (using first generation ligand attachment chemistry). This new resin has a slightly smaller pore size than Toyopearl GigaCap Q-650M and has a typical BSA binding capacity of 100 mg/mL. As shown in Figure 11, after 100 days of exposure to 1 mol/L NaOH, its DBC remains unchanged. Figure 12 shows the preservation of selectivity after extensive exposure to caustic.



TOYOSCREEN PREPACKED COLUMNS FOR PROCESS DEVELOPMENT

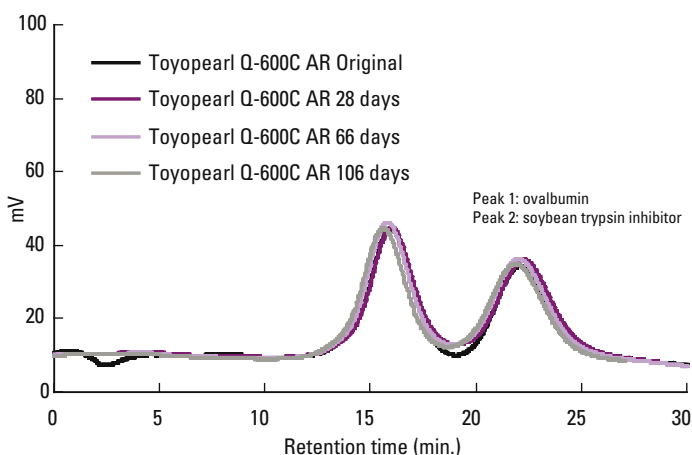
ToyoScreen columns packed with the full range of our Toyopearl IEC products are available in 1 mL and 5 mL resin volumes. The ToyoScreen columns provide a convenient way to perform early resin screening for both target retention and recovery. Multiple columns can be connected in series for additional capacity or resolution. Please see the ordering information at the end of this section or contact us for more information on these products.

FIGURE 12

LABPAK

STABILITY OF TOYOPEARL Q-600C AR RESIN AFTER EXPOSURE TO 1 MOL/L NaOH

For scientists wishing to develop a better physical understanding of the packing properties of Toyopearl and TSKgel ion exchange resins, we offer Toyopearl LabPaks containing small volumes of the bulk resins. Please see the ordering information at the end of this section or contact us for more information on these products.



SUMMARY

Since 2007, major additions have been made to the Toyopearl ion exchange resins offered by Tosoh Bioscience. The Toyopearl GigaGap family of resins and the new Toyopearl Q-600C AR media represent significant improvements in terms of dynamic binding capacity, elution kinetics, and alkaline stability. When these products are used, process developers have more options available to design and optimize their process to improve productivity and lower operating costs.

Column: 6.0 mm ID x 4 cm L; Flow rate: 1.0 mL/min;
 Elution: Buffer A: 0.05 mol/L Tris-HCl buffer (pH= 8.5); Buffer B: 0.05 mol/L Tris-HCl buffer + 1.0 mol/L NaCl (pH= 8.5);
 Gradient: 60-min linear gradient from buffer A to buffer B;
 Detection: UV @ 280 nm



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ORDERING INFORMATION

TOYOSCREEN PROCESS DEVELOPMENT COLUMNS FOR IEC:

PART #	PRODUCT DESCRIPTION	PACKAGE
21360	ToyoScreen DEAE-650M	1 mL x 6 each
21361	ToyoScreen DEAE-650M	5 mL x 6 each
21859	ToyoScreen GigaCap Q-650M	1 mL x 6 each
21860	ToyoScreen GigaCap Q-650M	5 mL x 6 each
21362	ToyoScreen SuperQ-650M	1 mL x 6 each
21363	ToyoScreen SuperQ-650M	5 mL x 6 each
21364	ToyoScreen QAE-550C	1 mL x 6 each
21365	ToyoScreen QAE-550C	5 mL x 6 each
21992	ToyoScreen Q-600C AR	1 mL x 6 each
21993	ToyoScreen Q-600C AR	5 mL x 6 each
21951	ToyoScreen GigaCap CM-650M	1 mL x 6 each
21952	ToyoScreen GigaCap CM-650M	5 mL x 6 each
21366	ToyoScreen CM-650M	1 mL x 6 each
21367	ToyoScreen CM-650M	5 mL x 6 each
21868	ToyoScreen GigaCap S-650M	1 mL x 6 each
21869	ToyoScreen GigaCap S-650M	5 mL x 6 each
21870	ToyoScreen MegaCap II SP-550EC	1 mL x 6 each
21871	ToyoScreen MegaCap II SP-550EC	5 mL x 6 each
21368	ToyoScreen SP-650M	1 mL x 6 each
21369	ToyoScreen SP-650M	5 mL x 6 each
21370	ToyoScreen SP-550C	1 mL x 6 each
21371	ToyoScreen SP-550C	5 mL x 6 each
21392	ToyoScreen IEC Anion Mix Pack, NEW (DEAE-650M, SuperQ-650M, QAE-550C, GigaCap Q-650M, Q-600C)	1 mL x 5 Grades x 1 each
21393	ToyoScreen IEC Anion Mix Pack (DEAE-650M, SuperQ-650M, QAE-550C, GigaCap Q-650M, Q-600C)	5 mL x 5 Grades x 1 each
21394	ToyoScreen IEC Cation Mix Pack NEW (CM-650M, SP-650M, SP-550C, GigaCap CM-650M, GigaCap S-650M)	1 mL x 5 Grades x 1 each
21395	ToyoScreen IEC Cation Mix Pack (CM-650M, SP-650M, SP-550C, GigaCap CM-650M, GigaCap S-650M)	5 mL x 5 Grades x 1 each
21396	ToyoScreen IEC Mix Pack, NEW (GigaCap Q-650M, GigaCap S-650M, GigaCap CM-650M, Q-600C, SuperQ-650M, SP-550C)	1 mL x 6 Grades x 1 each
21397	ToyoScreen IEC Mix Pack, NEW (GigaCap Q-650M, GigaCap S-650M, GigaCap CM-650M, Q-600C, SuperQ-650M, SP-550C)	5 mL x 6 Grades x 1 each

TOYOSCREEN COLUMN ACCESSORIES

PART #	PRODUCT DESCRIPTION
21400	ToyoScreen Column Holder



ION EXCHANGE CHROMATOGRAPHY



ORDERING INFORMATION

TSKgel LABPAK

PART #	PRODUCT DESCRIPTION	CONTAINER SIZE (mL)	PARTICLE SIZE (µm)
43380	IEXPAK PW (20) (SP-5PW, DEAE-5PW, SuperQ-5PW)	3 x 25 mL	15-25
43280	IEXPAK PW (30) (SP-5PW, DEAE-5PW, SuperQ-5PW)	3 x 25 mL	20-40

TOYOPEARL LABPAK

PART #	PRODUCT DESCRIPTION	CONTAINER SIZE (mL)	PARTICLE SIZE (µm)
19817	IEXPAK HP (CM-650S, SP-650S, DEAE-650S, SuperQ-650S)	4 x 25 mL	20-50
43210	AIEXPAK (GigaCap Q-650M, SuperQ-650M, Q-600C) NEW	3 x 100 mL	40-90 and 50-150
43220	CIEXPAK (GigaCap CM-650M GigaCap S-650M, SP-650M, SP-550C) NEW	3 x 100 mL	40-90 and 50-150

ANION EXCHANGE RESINS:

TOYOPEARL BULK MEDIA

PART #	PRODUCT DESCRIPTION	CONTAINER SIZE (mL)	PARTICLE SIZE (µm)	ION EXCHANGE CAPACITY (meq/mL RESIN)	TYPICAL CAPACITY (mg BSA/mL RESIN)
43271	Toyopearl QAE-550C	100	50-150	0.28-0.38	60-80
14026		250			
14704		1,000			
14027		5,000			
18365		50,000			
21985	Toyopearl Q-600C AR	100	50-150	0.15-0.20	>120
21986		250			
21987		1,000			
21988		5,000			
21989		50,000			
21854	Toyopearl GigaCap Q-650M	100	50-100	0.10-0.20	>170
21855		250			
21856		1,000			
21857		5,000			
21858		50,000			
19823	Toyopearl SuperQ-650S	25	20-50	0.20-0.30	105-155
17223		250			
17224		1,000			
17225		5,000			
19679		50,000			
43205	Toyopearl SuperQ-650M	100	40-90	0.20-0.30	105-155
17227		250			
17228		1,000			
17229		5,000			
21311		50,000			
43275	Toyopearl SuperQ-650C	100	50-150	0.20-0.30	105-155
17231		250			
17232		1,000			
17233		5,000			
19804	Toyopearl DEAE-650S	25	20-50	0.08-0.12	25-35
07472		250			
14692		1,000			
07973		5,000			
21483		50,000			



ION EXCHANGE CHROMATOGRAPHY

► ORDERING INFORMATION

ANION EXCHANGE RESINS:

TOYOPEARL BULK MEDIA

PART #	PRODUCT DESCRIPTION	CONTAINER SIZE (mL)	PARTICLE SIZE (µm)	ION EXCHANGE CAPACITY (meq/mL RESIN)	TYPICAL CAPACITY (mg BSA/mL RESIN)
43201	Toyopearl DEAE-650M	100	40-90	0.08-0.12	25-35
07473		250			
14693		1,000			
07974		5,000			
18367		50,000			
07988	Toyopearl DEAE-650C	250	50-150	0.05-0.11	25-35
14694		1,000			
07989		5,000			

TSKgel BULK RESIN

43383	TSKgel SuperQ-5PW (20)	25	15-25	0.12-0.18	52-88
18535		250			
18546		1,000			
18547		5,000			
43283	TSKgel SuperQ-5PW (30)	25	20-40	0.12-0.18	52-88
18536		250			
18548		1,000			
18549		5,000			
43381	TSKgel DEAE-5PW (20)	25	15-25	0.05-0.11	25-45
14710		250			
14711		1,000			
18436		5,000			
43281	TSKgel DEAE-5PW (30)	25	20-40	0.05-0.11	20-40
14712		250			
14713		1,000			
18370		5,000			

CATION EXCHANGE RESINS:

TOYOPEARL BULK MEDIA

PART #	PRODUCT DESCRIPTION	CONTAINER SIZE (mL)	PARTICLE SIZE (µm)	ION EXCHANGE CAPACITY (meq/mL RESIN)	TYPICAL CAPACITY (mg LYSOZYME/mL RESIN)
21833	Toyopearl GigaCap S-650M	100	50-100	0.14-0.18	80-120
21834		250			
21835		1,000			
21836		5,000			
21837		50,000			
21946	Toyopearl GigaCap CM-650M	100	50-100	0.17-0.28	>110 (γ-globulin)
21947		250			
21948		1,000			
21949		5,000			
21950		50,000			
43272	Toyopearl SP-550C	100	50-150	0.14-0.18	80-120
14028		250			
14705		1,000			
14029		5,000			
18366		50,000			

ION EXCHANGE CHROMATOGRAPHY



ORDERING INFORMATION

CATION EXCHANGE RESINS:
TOYOPEARL BULK MEDIA

PART #	PRODUCT DESCRIPTION	CONTAINER SIZE (mL)	PARTICLE SIZE (µm)	ION EXCHANGE CAPACITY (meq/mL RESIN)	TYPICAL CAPACITY (mg LYSOZYME/mL RESIN)
19822	Toyopearl SP-650S	25	20-50	0.13-0.17	40-60
08437		250			
14698		1,000			
08438		5,000			
21477		50,000			
43202	Toyopearl SP-650M	100	40-90	0.13-0.17	40-60
07997		250			
14699		1,000			
07998		5,000			
18369		50,000			
07994	Toyopearl SP-650C	250	50-150	0.12-0.18	35-55
14700		1,000			
07995		5,000			
19803	Toyopearl CM-650S	25	20-50	0.08-0.12	30-50
07474		250			
14695		1,000			
07971		5,000			
43203	Toyopearl CM-650M	100	40-90	0.08-0.12	30-50
07475		250			
14696		1,000			
07972		5,000			
19839		50,000			
07991	Toyopearl CM-650C	250	50-150	0.05-0.11	25-45
14697		1,000			
07992		5,000			
19329		50,000			
21804	Toyopearl MegaCap II SP-550EC	100	100-300	0.14-0.18	60-90*
21805		250			
21806		1,000			
21807		5,000			
21808		50,000			

TSKgel BULK MEDIA

PART #	PRODUCT DESCRIPTION	CONTAINER SIZE (mL)	PARTICLE SIZE (µm)	ION EXCHANGE CAPACITY (meq/mL RESIN)	TYPICAL CAPACITY (mg INSULIN/mL RESIN)
21976	TSKgel SP-3PW (30) NEW	25	20-40	0.07- 0.22	≥ 65
21977		250			
21978		1,000			
21979		5,000			
43382	TSKgel SP-5PW (20)	25	15-25	0.06-0.12	20-40
14714		250			
14715		1,000			
18435		5,000			
43282	TSKgel SP-5PW (30)	25	20-40	0.06-0.12	20-40
14716		250			
14717		1,000			
18384		5,000			

* Adsorption capacity for insulin: 90-120 mg/mL resin