

Ion Exchange Chromatography

Cation Exchange

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Ion Exchange Chromatography

Cation Exchange Chromatography

Cation exchange chromatography is practiced with either a strong or a weak cation exchange column, containing a sulfonium ion, or with a weak cation exchanger, having usually a carboxymethyl (CM) functional group. A counter ion, often Na⁺ maintains electroneutrality.

In ion exchange chromatography the pH of the mobile phase buffer must be between the pI or pKa of the charged molecule and the pKa of the charged groups on the solid support. For example, a molecule with a pI of 8.2 is run in a mobile phase buffer at pH 6.0 with the solid support pKa at 1.2 in cation exchange chromatography.

Specialty columns:

- Organic acids by ion-exclusion (OApak-A and SCX)
- Mono- and disaccharides (Sugar AXI and Sugar AXG).

Highlights

- Pore structure and bonding chemistry of TSKgel BioAssist S provides high capacity for medium to large molecular weight proteins.
- BioAssist columns are packed in 4.6mmID or 10mmID PEEK hardware. Other columns are available in glass and stainless steel for analytical, semi-preparative and preparative applications.
- Binding capacity for small to medium size proteins on TSKgel DEAE-3SW is approximately double that of the 5PW packings due to the smaller pore size and larger surface area.
- TSKgel sp-5PW column available in 2mmID format.
- Very efficient chromatography can be achieved with the TSK-GEL STAT columns due to the novel bonding chemistry and the absence of micro-pores.

Strong Cation Exchange	Weak Cation Exchange
Polymethacrylate: <ul style="list-style-type: none">• TSKgel BioAssist S• TSKgel SP-5PW• TSKgel SP-NPR Silica: TSKgel SP-2SW Polystyrene: TSKgel SCX Polymer: TSKgel SP-STAT	Polymethacrylate: <ul style="list-style-type: none">• TSKgel CM-5PW• TSKgel OApak-A Silica: <ul style="list-style-type: none">• TSKgel CM-2SW• TSKgel CM-3SW Polymer: TSKgel CM-STAT

Ion Exchange Chromatography

TSKgel BioAssist S

TSKgel BioAssist S columns are packed with porous hydrophilic polymer beads which are surface modified with a strong cation exchanger. The resin's large pores are very accessible even for high molecular weight proteins. This leads to higher chromatographic efficiency and binding capacity for purification.

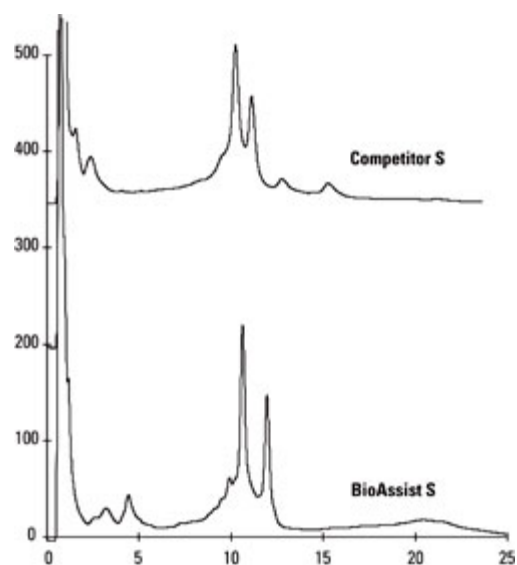
The application on this page shows the analysis of bromelain, a proteolytic enzyme that is used as a nutritional supplement. Bromelain is a basic glycoprotein with a MW of 33kDa and pI of 9.55.

Product Attributes:

Matrix:	polymethacrylate
Particle size (mean):	7 and 13 μm
Pore size (mean):	1,300Å
Functional group:	sulfopropyl
Counter ion:	Na ⁺
pH range:	2.0 -12.0
Capacity (gamma globulin)	70
Small ion capacity:	0.1 meq/mL
pKa:	2.4

Applications

Bromelain analysis on TSKgel BioAssist S and competitor S columns



Columns: TSKgel BioAssist S, 4.6mmID x 5cm, PEEK
Competitor S 5mmID x 5cm
Elution: 20 min (TSKgel) or 30 min (Competitor S)
linear gradient of NaCl from 0 to 0.5M in
20mM sodium phosphate buffer, pH 7.0
Flow Rate: 0.8mL/min for TSKgel;
1.0mL/min for Competitor S
Detection: UV @ 280nm
Temp.: 25°C
Sample: crude bromelain (C4882, Sigma), 1mg in 100L

Ordering information:

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P/N	Description	Particle size	Housing material	ID (mm)	Length (cm)	Price (\$)
19686	TSKgel BioAssist S	7 μm	PEEK	4.6	5	1,060
21411	TSKgel BioAssist S	13 μm	PEEK	10	10	4,055

Ion Exchange Chromatography

TSK-GEL CM-2SW

TSK-GEL CM-2SW columns are packed with 5 micron, high efficiency, spherical silica beads which are surface modified with a weak cation exchanger. They are used for the separation and analysis of small proteins, peptides, and other biologically active molecules.

They have a smaller pore size than the TSKgel CM-3SW columns.

Product Attributes:

Matrix:	spherical silica
Particle size (mean):	5µm
Pore size (mean):	125Å
Functional group:	-CH ₂ COO-
Counter ion:	Na+
pH range:	2.0 - 7.5
Capacity (mg Hb/mL):	110
Small ion capacity:	>0.3meq/mL
pKa:	4.2

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P/N	Description	Particle size	Housing material	ID (mm)	Length (cm)	Price (\$)
07167	TSKgel CM-2SW	5µm	Stainless Steel	4.6	25	1,060
07650	Guardgel Kit for P/N 07167					566

Ion Exchange Chromatography

TSKgel CM-3SW

TSKgel CM-3SW columns are packed with 5 micron, high efficiency, spherical silica beads which are surface modified with a weak cation exchanger. They are used for the separation and analysis of proteins, peptides, and other biologically active molecules.

They have a larger pore size than the TSKgel CM-2SW columns.

Product Attributes:

Matrix:	spherical silica
Particle size (mean):	10µm
Pore size (mean):	250Å
Functional group:	-CH ₂ COO-
Counter ion:	Na+
pH range:	2.0 - 7.5
Capacity (mg Hb/mL):	ND
Small ion capacity:	>0.3meq/mL
pKa:	4.2

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P/N	Description	Particle size	Housing material	ID (mm)	Length (cm)	Price (\$)
07162	TSKgel CM-3SW	10	Stainless Steel	7.5	7.5	1,060
07650	Guardgel Kit for P/N 07162					566

Ion Exchange Chromatography

TSKgel CM-5PW

TSKgel CM-5PW columns are packed with porous hydrophilic polymer beads which are surface modified with a weak cation exchanger. They are used for the separation and analysis of proteins, peptides, and other biologically active molecules.

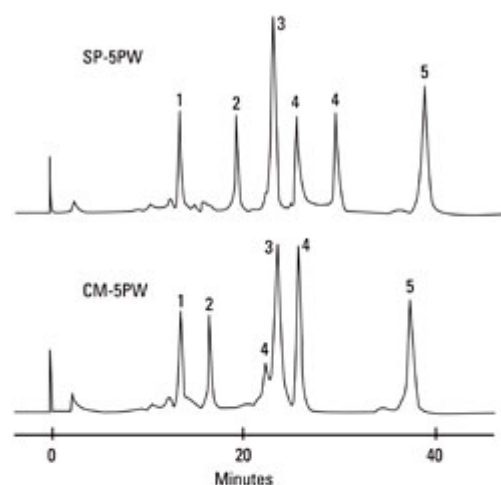
They have the same backbone chemistry and selectivity as the bulk process scale resin Toyopearl CM-650.

Product Attributes:

Matrix:	hydroxylated methacrylic polymer
Particle size (mean):	10 and 13 μm
Pore size (mean):	1000Å
Functional group:	-CH ₂ COO-
Counter ion:	Na ⁺
pH range:	2.0 - 12.0
Capacity (mg Hb/mL):	45
Small ion capacity:	>0.1meq/mL
pKa:	4.2

Applications

Selectivity of TSK-GEL strong and weak cation exchangers



Columns: TSKgel SP-5PW and TSKgel CM-5PW, 7.5mm x 7.5cm

Sample: 1. trypsinogen, 2. ribonuclease A, 3. α -chymotrypsinogen, 4. cytochrome C, 5. lysozyme

Elution: 60min linear gradient from 0M to 0.5M NaCl in 0.02M phosphate, pH7

Flow Rate: 1.0mL/min

Detection: UV @ 280nm

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P/N	Description	Particle size	Housing material	ID (mm)	Length (cm)	Price (\$)
14012	TSKgel CM-5PW	13 μm	Glass	20	15	5,171
13068	TSKgel CM-5PW	10 μm	Stainless Steel	7.5	7.5	1,173
13069	Guardgel Kit for P/N 13068					543

Ion Exchange Chromatography

TSK-GEL CM-STAT

TSK-GEL CM-STAT columns are packed with 7 and 10 μ m hydrophilic non-porous resin particles of which the surface consists of an open access network of multi-layered weak cation exchange groups. The innovative bonding chemistry, combined with a relatively large particle size, results in a respectable loading capacity, low operating pressure and rapid analysis.

Applications for the TSK-GEL CM-STAT columns include the separation of proteins, protein aggregates, charge isomers of monoclonal antibodies, PEGylated proteins, and peptide digests.

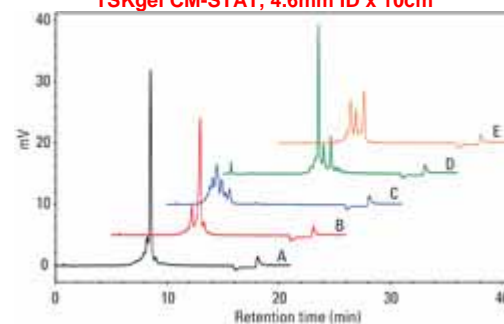
Product Attributes:

Matrix:	hydrophilic polymer
Particle size (mean):	7 and 10 μ m
Pore size (mean):	non-porous
Functional group:	carboxymethyl
Counter ion:	Na
pH range:	3.0 - 10.0
Static binding capacity (mg Lysozyme/mg dry gel):	ca. 20 (7 μ m) ca. 15 (10 μ m)
Small ion capacity:	100 μ eq/g dry gel
pKa:	4.9

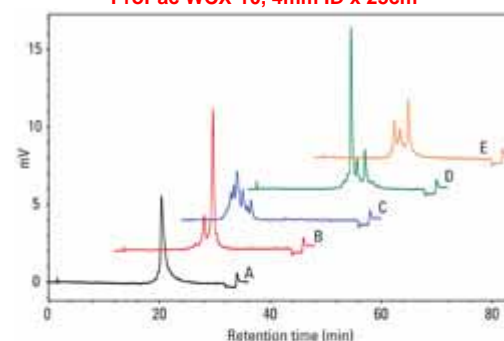
Applications

The analysis profiles for five antibodies on a TSKgel CM-STAT column were compared with the profiles obtained on a competitive non-porous cation exchange column. Similar or higher resolution profiles were obtained on the TSKgel CM-STAT column in approximately half the time.

TSKgel CM-STAT, 4.6mm ID x 10cm



ProPac WCX-10, 4mm ID x 25cm



Columns: A: TSKgel CM-STAT, 7 μ m, 4.6mm ID x 10cm
B: ProPac WCX-10, 10 μ m, 4mm ID x 25cm
Eluent: A: 20mmol/L MES (pH6.0)
B: 20mmol/L MES + 0.5mol/L NaCl (pH6.0)
Gradient: A: 10% B (0min), 30% B (15min), 100% B (15min),
100% B (17min), 10% B (17min), 10% B (21min)
B: 10% B (0min), 30% B (30min), 100% B (30min),
100% B (32min), 10% B (32min), 10% B (36min)
Flowrate: A: 1.0mL/min
B: 2.0mL/min
Temp.: Ambient
Detection: UV@280nm
Inj. Vol.: 20 μ L

Ion Exchange Chromatography

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P/N	Description	Particle size	Housing material	ID (mm)	Length (cm)	Price (\$)
21965	TSKgel CM-STAT	10 μ m	Stainless Steel	3	3.5	850
21966	TSKgel CM-STAT	7 μ m	Stainless Steel	4.6	10	900

Ion Exchange Chromatography

TSKgel OApak-A

TSKgel OApak-A columns are packed with porous hydrophilic polymer beads which have been chemically modified with a weak cation exchanger. They are optimized for the separation and analysis of organic acids by an ion-exclusion mechanism.

This column is to be used in conjunction with the TSKgel OApak-P guard column which has a strong cation exchanger for the removal of dissociated strong acids under the isocratic eluent conditions of 0.75mM H₂SO₄.

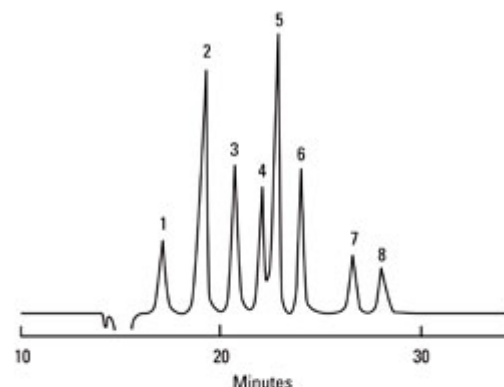
Applications include: organic acids in fruit juices, wine, beer, coffee, and salt solutions. Consult the HPLC Application Database for more information.

Product Attributes:

Matrix:	hydrophilic polymer
Particle size (mean):	5µm
Pore size (mean):	ND
Functional group:	proprietary
Counter ion:	H+
pH range:	2.0 - 12.0
Small ion capacity:	>1.5meq/mL

Applications

Separation of organic acids commonly found in wine and beer on TSKgel OApak-P and OApak-A



Column: TSKgel OApak-P, 6mm x 4cm,
TSKgel OApak-A, 7.8mm x 30cm
Mobile phase: 0.75mM Sulfuric acid
Flow Rate: 0.8mL/min
Temperature: 60°C
Detection: Conductivity
Injection: 20µL
Sample: 1. pyruvic acid (50ppm)
2. tartaric acid (500ppm)
3. citric acid (500ppm)
4. malic acid (500ppm)
5. pyroglutamic acid (500ppm)
6. lactic acid (1000ppm)
7. acetic acid (2000ppm)
8. succinic acid (1000ppm)

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P/N	Description	Particle size	Housing material	ID (mm)	Length (cm)	Price (\$)
16653	TSKgel OApak-A	5µm	Stainless Steel	7.8	30	1,376
16654	TSKgel OApak-P Guard column	10µm	Stainless Steel	6	4	448

Ion Exchange Chromatography

TSKgel SCX

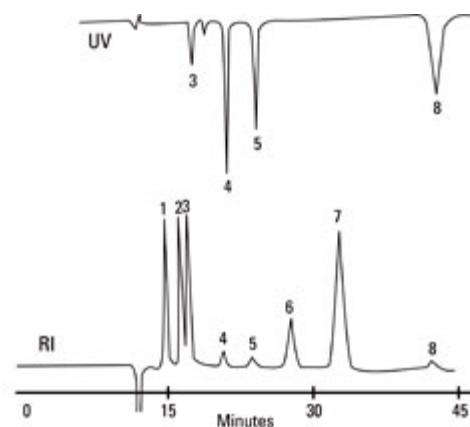
TSKgel SCX columns are packed with porous hydrophilic polymer beads which are surface modified with a strong cation exchanger. They are optimized for the separation and analysis of organic acids, saccharides and alcohols.

Product Attributes:

Matrix:	PS-DVB
Particle size (mean):	5µm
Pore size (mean):	60Å
Functional group:	sulfonic acid
Counter ion:	H ⁺ , and Na ⁺
pH range:	2-12
Capacity	ND
Small ion capacity:	>1.5 meq/mL
pKa:	

Applications

Separation of saccharide, organic acid and alcohol mixture



Column: TSKgel SCX(H⁺), two 7.8mm x 30cm (in series)
 Sample: 1. maltose, 2. glucose, 3. fructose,
 4. lactic acid, 5. acetic acid, 6. methanol,
 7. ethanol, 8. butyric acid
 Elution: 0.05M HCl O₄
 Flow Rate: 0.8mL/min
 Detection: UV @ 210nm, Refractive Index

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P/N	Description	Particle size	Housing material	ID (mm)	Length (cm)	Price (\$)
07156	TSKgel SCX (Na ⁺)	5µm	Stainless Steel	6	15	947
07158	TSKgel SCX (H ⁺)	5µm	Stainless Steel	7.8	30	1,179

Ion Exchange Chromatography

TSKgel SP-2SW

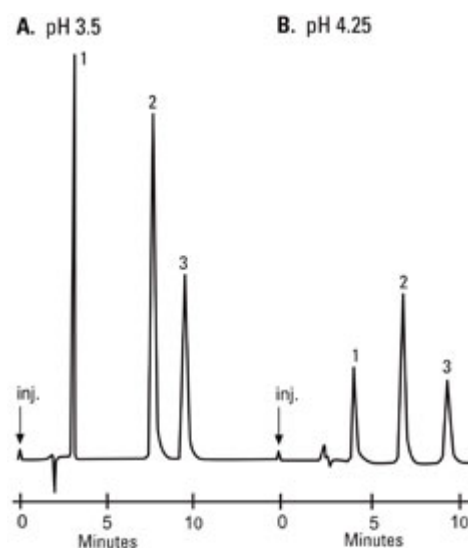
TSKgel SP-2SW columns are packed with 5 micron, high efficiency, spherical silica beads which are surface modified with a strong cation exchanger. They are used for the separation and analysis of small proteins, peptides, nucleosides, and other biologically active molecules.

Product Attributes:

Matrix:	spherical silica
Particle size (mean):	5 μm
Pore size (mean):	125 \AA
Functional group:	sulfopropyl
Counter ion:	Na ⁺
pH range:	2.0 - 7.5
Capacity (mg Hb/mL):	ND
Small ion capacity:	0.3 meq/mL
pKa:	2.2

Applications

Separation of nucleosides by ion-exchange chromatography on TSKgel SP-2SW



Column: TSKgel SP-2SW 4.6mm x 25cm
 Sample: Nucleoside Standards
 1) Guanosine, 2) Cytidine, 3) Adenosine
 Mobile Phase: A) 0.1 mol/L sodium citrate - phosphoric acid buffer, pH 3.5
 B) 0.1 mol/L sodium citrate - acetic acid buffer, pH 4.25
 Flow Rate: 0.75 mL/min
 Temperature: 23°C
 Detection: UV detection @ 260nm

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P/N	Description	Particle size	Housing material	ID (mm)	Length (cm)	Price (\$)
07165	TSKgel SP-2SW	5 μm	Stainless Steel	4.6	25	1,237
07644	Guardgel Kit for P/N 07165		Stainless Steel			496

Ion Exchange Chromatography

TSKgel SP-5PW

TSKgel SP-5PW columns are packed with porous hydrophilic polymer beads which are surface modified with a strong cation exchanger. They are used for the separation and analysis of proteins, peptides, and other biologically active molecules.

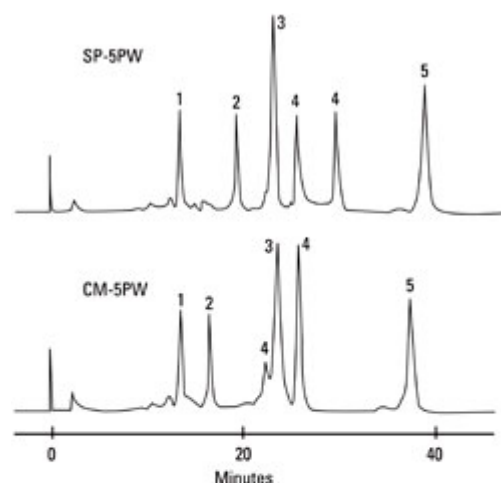
TSK-GEL SP-5PW columns have the same backbone chemistry and selectivity as the bulk process scale resins Toyopearl SP-650 and TSK-GEL SP-5PW.

Product Attributes:

Matrix:	hydroxylated methacrylic polymer
Particle size (mean):	10, 13, 20 μ m
Pore size (mean):	1000Å
Functional group:	$-(CH_2)_3SO_3^-$
Counter ion:	Na^+
pH range:	2.0 -12
Capacity (mg Hb/mL):	40
Small ion capacity:	>0.1 meq/mL
pKa:	2.3

Applications

Selectivity of TSK-GEL strong and weak cation exchangers



Columns: TSKgel SP-5PW and TSKgel CM-5PW, 7.5mm x 7.5cm

Sample: 1. trypsinogen, 2. ribonuclease A, 3. α -chymotrypsinogen, 4. cytochrome C, 5. lysozyme

Elution: 60min linear gradient from 0M to 0.5M NaCl in 0.02M phosphate, pH7

Flow Rate: 1.0mL/min

Detection: UV @ 280nm

Ion Exchange Chromatography

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P/N	Description	Particle size	Housing material	ID (mm)	Length (cm)	Price (\$)
18758	TSKgel SP-5PW	10µm	Stainless Steel	2	7.5	881
42153	Guard Cartridge 3pk for P/N 18758		Stainless Steel	2	1	319
19308	Guard Cartridge Holder for P/N 42153		Stainless Steel	2	1	292
07161	TSKgel SP-5PW	10µm	Stainless Steel	7.5	7.5	1,173
07211	Guardgel Kit for P/N 07161		Stainless Steel			543
07575	TSKgel SP-5PW	13µm	Stainless Steel	21.5	15	4,088
16093	Guardgel Kit for P/N 07575		Stainless Steel			838
07934	TSKgel SP-5PW	20µm	Stainless Steel	55	20	13,406
07932	Guard Column for for P/N 07934		Stainless Steel	45	5	3,825
13062	TSKgel SP-5PW	10µm	Glass	5	5	920
08803	TSKgel SP-5PW	10µm	Glass	8	7.5	1,200
08807	Guardgel Kit for for P/N 08803		Glass			580
14017	TSKgel SP-5PW	13µm	Glass	20	15	5,171

Ion Exchange Chromatography

TSKgel SP-NPR

TSKgel SP-NPR columns are packed with non-porous hydrophilic polymer beads which are surface modified with a strong cation exchanger. They are used for the separation and analysis of proteins and peptides.

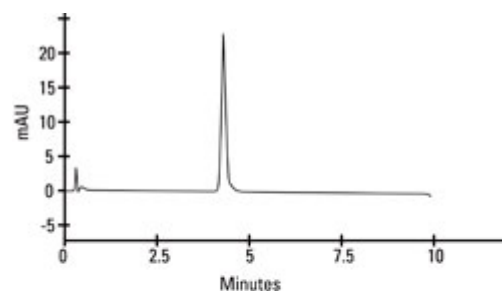
They are particularly useful for adeno-associated viruses and other large macromolecules.

Product Attributes:

Matrix:	hydroxylated methacrylic polymer
Particle size (mean):	2.5 μm
Pore size (mean):	non-porous
Functional group:	$-(\text{CH}_2)_3\text{SO}_3^-$
Counter ion:	Na^+
pH range:	2.0 - 12.0
Capacity (mg Hb/mL):	5
Small ion capacity:	>0.1 meq/mL
pKa:	2.3

Applications

Analysis of purified AAV with TSKgel SP-NPR



Column: TSKgel SP-NPR, 4.6mm x 3.5cm
 Sample: purified adeno-associated virus
 Elution: A. 50mM HEPES, 1mM EDTA, 5mM MgCl, pH 7.5;
 B. 50mM HEPES, 1mM EDTA, 5mM MgCl, pH 7.5 with 0.5M NaCl; linear gradient from 20% to 100% B in 10 column volumes
 Flow Rate: 1mL/min
 Detection: UV @ 280nm

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P/N	Description	Particle size	Housing material	ID (mm)	Length (cm)	Price (\$)
13076	TSKgel SP-NPR	2.5	Stainless Steel	4.6	3.5	908

Ion Exchange Chromatography

TSK-GEL SP-STAT

TSK-GEL SP-STAT columns are packed with 7 and 10 μ m hydrophilic non-porous resin particles of which the surface consists of an open access network of multi-layered cation exchange groups. The innovative bonding chemistry, combined with a relatively large particle size, results in a respectable loading capacity and a low operating pressure.

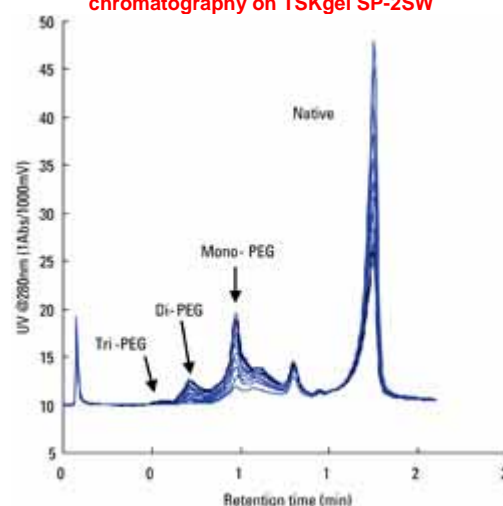
Applications for the TSK-GEL SP-STAT columns include the separation of proteins, protein aggregates, charge isomers of monoclonal antibodies, PEGylated proteins, and peptide digests.

Product Attributes:

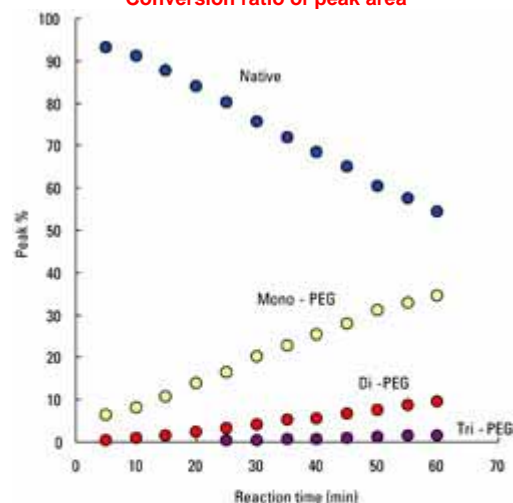
Matrix:	hydrophilic polymer
Particle size (mean):	7 and 10 μ m
Pore size (mean):	non-porous
Functional group:	sulfopropyl
Counter ion:	Na
pH range:	3.0 - 10.0
Static binding capacity (mg Lysozyme/mg dry gel):	ca. 15 (7 μ m) ca. 10 (10 μ m)
Small ion capacity:	23 μ eq/g dry gel
pKa:	4.0

Applications

Separation of nucleosides by ion-exchange chromatography on TSKgel SP-2SW



Conversion ratio of peak area



Column: A: TSKgel SP-STAT, 10 μ m, 3mm ID x 3.5cm
 Eluent: A: 20mmol/L Sodium Acetate buffer (pH5.0)
 B: 1.0mol/L NaCl in buffer A (pH5.0)
 Gradient: 0% B (0min), 100% B (2min)
 Flowrate: 2.0mL/min
 Detection: UV@280nm
 Sample: Pegylated β -lactoglobulin

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P/N	Description	Particle size	Housing material	ID (mm)	Length (cm)	Price (\$)
21963	TSKgel SP-STAT	10 μ m	Stainless Steel	3	3.5	850
21964	TSKgel SP-STAT	7 μ m	Stainless Steel	4.6	10	900