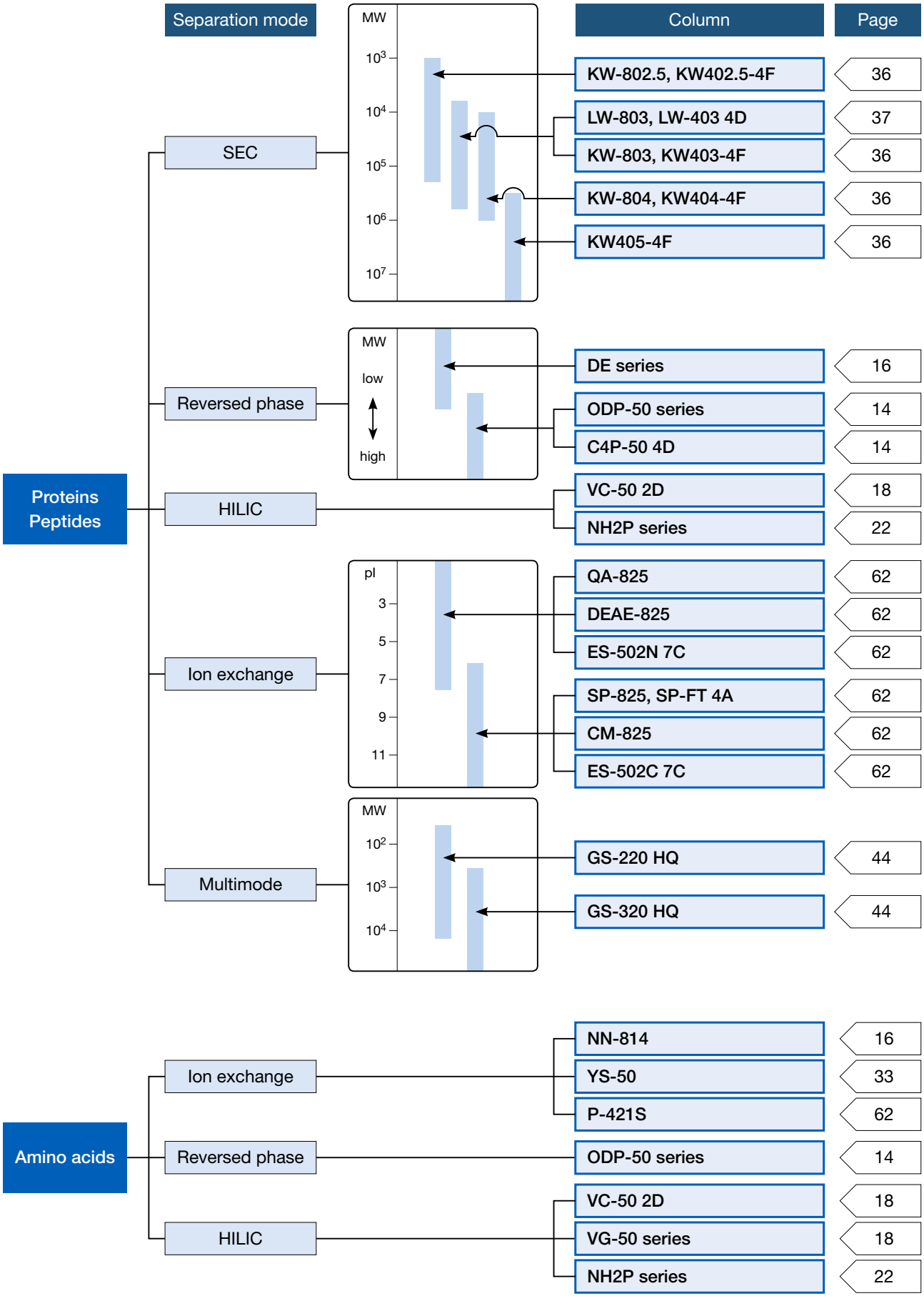
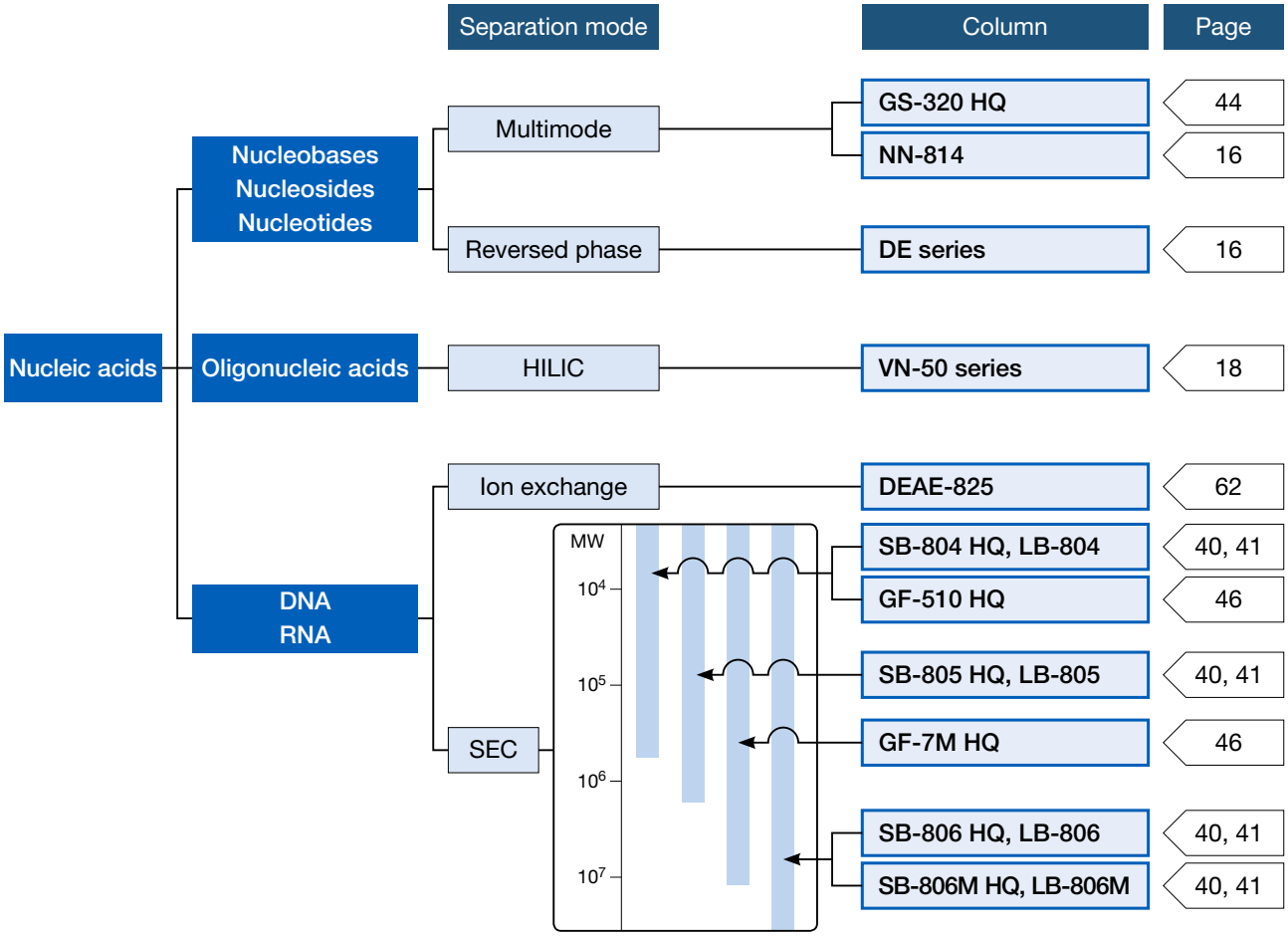
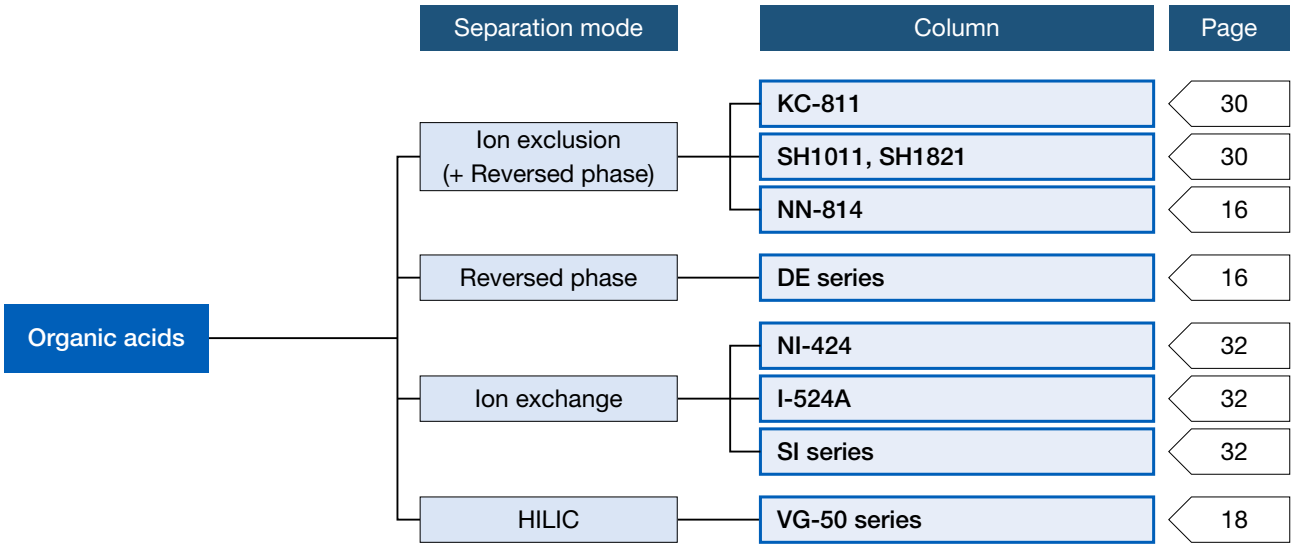
Column Selection (Proteins, Peptides, and Amino Acids)



Column Selection (Nucleic Acids)

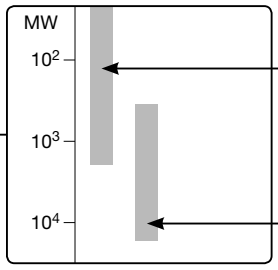


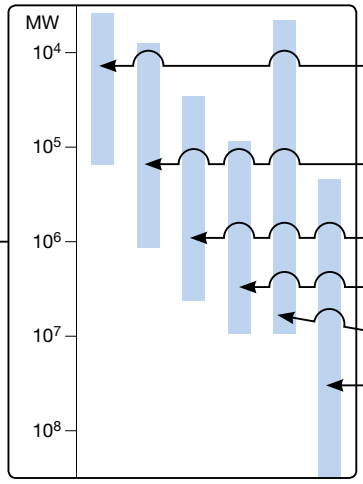
Column Selection (Organic Acids)



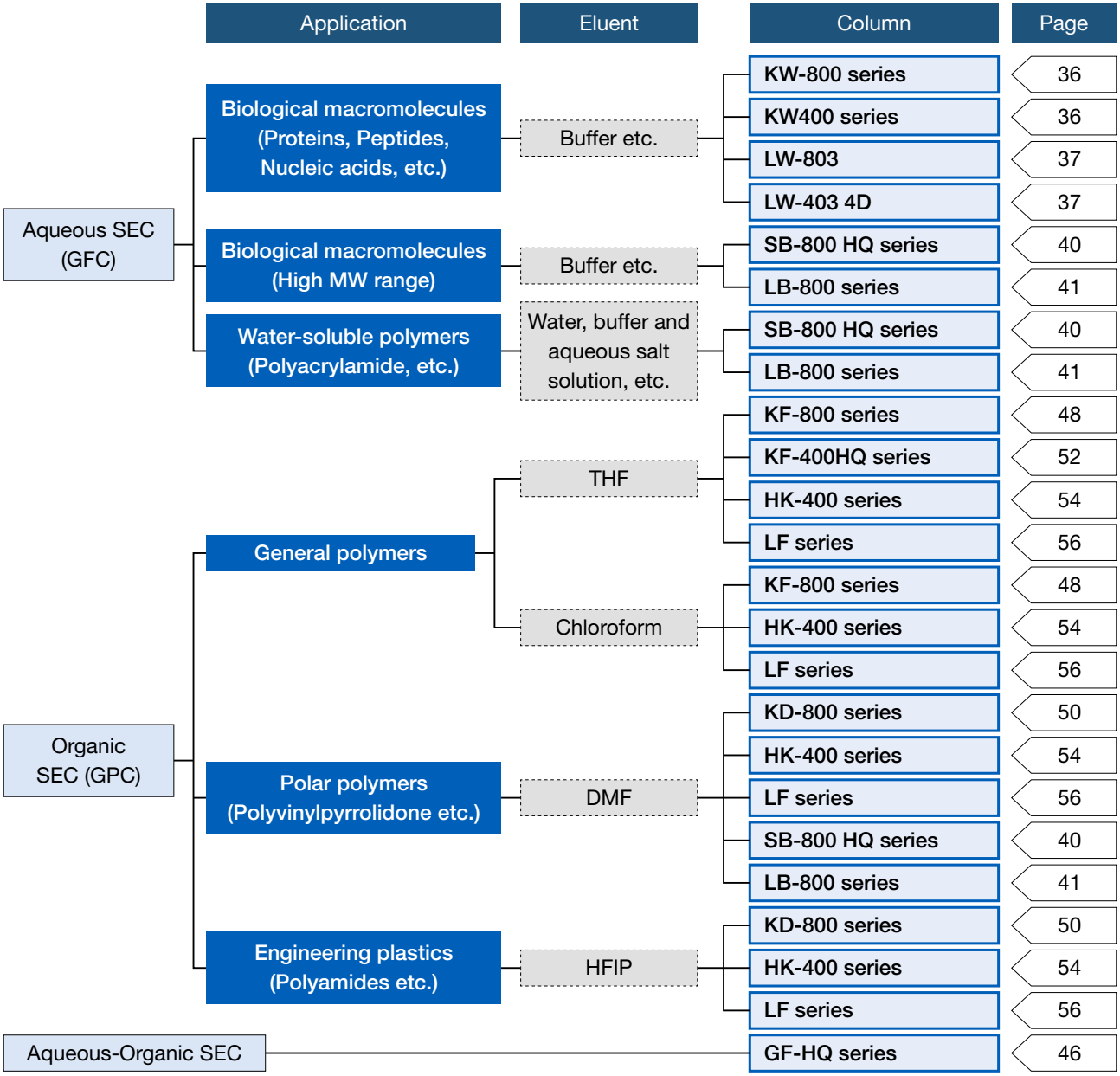
Column Selection (Saccharides)

	Separation mode	Column	Page
Mono-, di-saccharides, and sugar alcohols Saccharides and sugar alcohols	Ligand exchange + SEC	SP0810 (Pb^{2+})	26
		SC1011 (Ca^{2+})	26
		KS-801 (Na^{+})	26
	Ligand exchange + HILIC	SZ5532 (Zn^{2+})	26
		DC-613 (Na^{+})	26
	HILIC	VG-50 series	18
		NH2P series	22
Sugar alcohols	Ligand exchange + HILIC	SC1211 (Ca^{2+})	26
Oligosaccharides and sugar alcohols	Ligand exchange + SEC	KS-801 (Na^{+}) + KS-802 (Na^{+})	26
Amino sugars	HILIC	VG-50 series	18
		NH2P series	22
	Ion exchange	SC1011 (Ca^{2+})	26
Acidic sugars	Ion exclusion	SH1011 (H^{+})	30
		KC-811	30
	Ion exchange	VT-50 2D	18
		NH2P series	22
Saccharides and organic acids	Ion exclusion + SEC	SH1011 (H^{+}), SH1821 (H^{+})	30
Oligosaccharides	SEC	KS-801 (Na^{+})	26
		SB-802 HQ	40
		GS-220 HQ	44
		KS-802 (Na^{+})	26
		SB-802.5 HQ, LB-802.5	40, 41
		GS-320 HQ	44
	HILIC	VN-50 series	18
		NH2P series	22
Polysaccharides	SEC	KS-803 (Na^{+})	26
		SB-803 HQ, LB-803	40, 41
		KS-804 (Na^{+})	26
		SB-804 HQ, LB-804	40, 41
		SB-805 HQ, LB-805	40, 41
		SB-806 HQ, LB-806	40, 41
		SB-806M HQ, LB-806M	40, 41
		SB-807 HQ	40

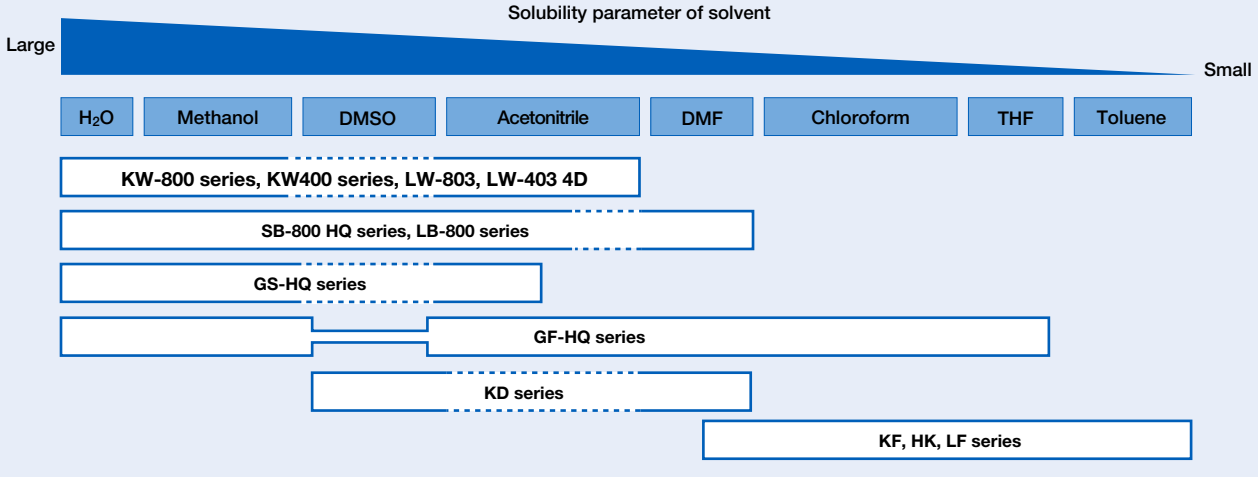




Column Selection (Polymers)



Guideline for SEC column selection by solvent usability



See page 60 for the solvent replaceability of organic solvent SEC (GPC) packed columns.

Precautions for Polar Polymer Analysis

Unexpected interactions in the column can affect the size exclusion chromatography analysis of polar polymers.
These interactions may change elution patterns and results in an invalid molecular weight calculation.
It is important to reduce these interfering interactions in order to obtain the accurate molecular weight distribution.

~ Interfering interactions likely to be observed ~

Interactions between the analyte and the packing materials

◆ Hydrophobic interaction
→ The analyte is adsorbed on the packing material.
This delays the analyte elution and results in under estimating the analyte's molecular weight. See (B) and (D).

◆ Ionic interaction
(1) Ion Exclusion
→ The analyte is repelled from the packing material.
This accelerates the analyte elution and results in over estimating the analyte's molecular weight. See (A) and (C).
(2) Ion Exchange
→ The analyte is adsorbed onto the packing material.
This delays the analyte elution and results in under estimating the analyte's molecular weight. See (B) and (D).

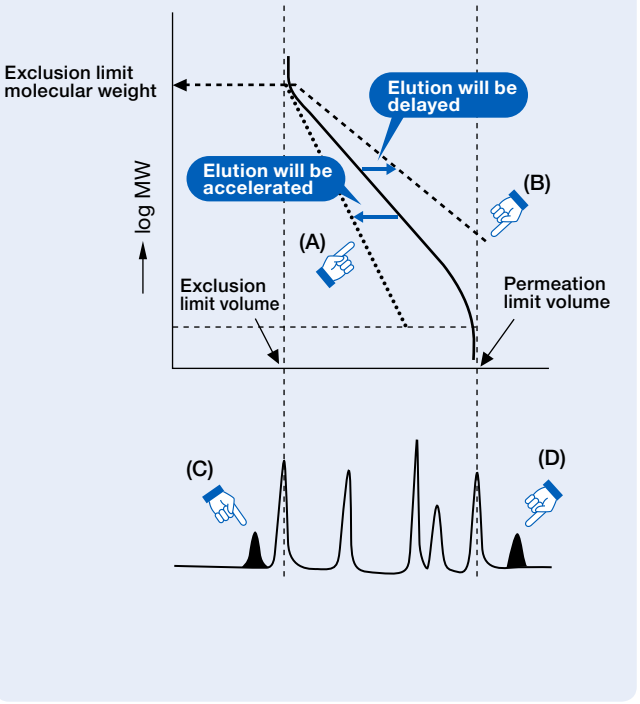
Interaction within and between the analyte

◆ Ionic repulsion effects observed within the multivalent macromolecules causes structure expansion
→ This accelerates the analyte elution and results in over estimating the analyte's molecular weight. See (A).

◆ Association between the molecules
→ This accelerates the analyte elution and results in over estimating the analyte's molecular weight. See (A).

Interactions between the analyte and the solvent

◆ The multivalent ion in the solvent works as a bridge to bind ionic molecules (analyte).



Methods to reduce interactions

Aqueous SEC (GFC)

Ionic interaction

◆ Add salt into the eluent

Hydrophobic interaction

◆ Increase the analyte dissociation
Cationic polymer → Lower the eluent pH
Anionic polymer → Higher the eluent pH

◆ Lower the eluent polarity
e.g. Add acetonitrile or methanol

Organic SEC (GPC)

Ionic interaction

◆ Add salt into the eluent
e.g. Add LiBr to DMF
Add CF_3COONa to HFIP

Hydrophobic interaction

◆ Lower the eluent polarity
e.g. Change the eluent from DMF to THF

Hydrophilic interaction

◆ Increase the eluent polarity
e.g. Change the eluent from THF to DMF

Aqueous-Organic SEC Columns

https://www.shodex.de/asahipak-gs-columns

Features

GF-HQ

- Polymer-based SEC columns with high solvent durability
- Works well with both aqueous and organic solvents

● Standard columns

Product Code	Product Name	Plate Number (TP/column)	Particle Size (µm)	Pore Size (Å)	Column Size (mm) I.D. x Length	Shipping Solvent
F7600000	**Asahipak GF-210 HQ**	≥ 19,000	5	180	**7.5 x 300**	H_2O
F7600001	**Asahipak GF-310 HQ**	≥ 19,000	5	400	**7.5 x 300**	H_2O/CH_3OH = 70/30
F7600002	**Asahipak GF-510 HQ**	≥ 19,000	5	2,000	**7.5 x 300**	H_2O/CH_3OH = 70/30
F7600004	**Asahipak GF-7M HQ**	≥ 13,000	9	10,000	**7.5 x 300**	H_2O/CH_3OH = 70/30
F6710018	**Asahipak GF-1G 7B**	(guard column)	9	—	**7.5 x 50**	H_2O/CH_3OH = 70/30
F7600110	**MSpak GF-310 4D**	≥ 10,000	5	400	**4.6 x 150**	H_2O

GF-7M HQ is a mixed-gel column capable of analyzing samples over a wide range of molecular weight.

Base Material: Polyvinyl alcohol
Usable pH range: pH 2 - 9

● Preparative columns [Preparative columns are made to order.]

Product Code	Product Name	Plate Number (TP/column)	Particle Size (µm)	Column Size (mm) I.D. x Length	Shipping Solvent	Standard Column
F6810038	**Asahipak GS-310 20G**	≥ 14,000	13	**20.0 x 500**	H_2O/CH_3OH = 70/30	GF-310 HQ
F6710020	**Asahipak GS-10G 7B**	(guard column)	20	**7.5 x 50**	H_2O/CH_3OH = 70/30	(guard column)

Base Material: Polyvinyl alcohol

Usable solvents

Solvent	Product Name	
	GF-210 HQ	**GF-310 HQ GF-510 HQ GF-7M HQ**
Water (0 - 0.5 M salt concentration)	✓	✓
Methanol	✓	✓
Ethanol	✓	✓
Acetonitrile	✓	✓
Tetrahydrofuran (THF)	✓	✓

Solvent	Product Name	
	GF-210 HQ	**GF-310 HQ GF-510 HQ GF-7M HQ**
N,N-Dimethylformamide (DMF)	✓	✓
Acetone	✓	✓
Chloroform	✓	✓
Ethylacetate	✓	✓
Dimethyl sulfoxide (DMSO)	✓	△

✓: Solvent replacement possible △: Solvent replacement possible up to 50 %

Target molecular weight range and exclusion limit

● Measured with pullulan (eluent: ultrapure water)

Product Name	Target Molecular Weight Range	Exclusion Limit
GF-210 HQ	300 - 4,000	9,000
GF-310 HQ	300 - 30,000	40,000
GF-510 HQ	5,000 - 200,000	300,000
GF-7M HQ	300 - * (10,000,000)	* (10,000,000)

Please use the above table for reference purposes only when selecting columns.

* ( ) Estimated value

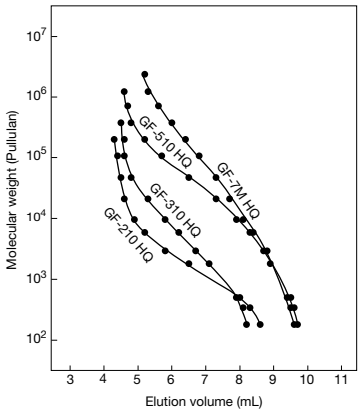
● Measured with *PEG/PEO (eluent: DMF)

Product Name	Target Molecular Weight Range
GF-210 HQ	100 - 2,000
GF-310 HQ	200 - 4,000
GF-510 HQ	2,000 - 200,000
GF-7M HQ	200 - ** (10,000,000)

Please use the above table for reference purposes only when selecting columns.

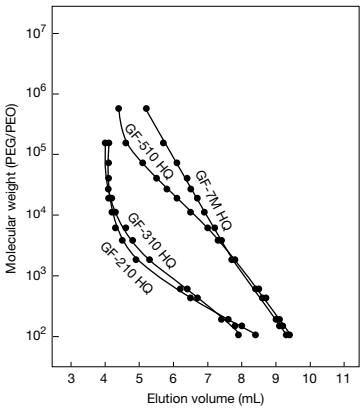
*PEG: polyethylene glycol
*PEO: polyethylene oxide
** ( ) Estimated value

Calibration curves for GF-HQ series using pullulan (eluent: H_2O)



Column : Shodex Asahipak GF-HQ series
Eluent : H_2O
Flow rate : 0.6 mL/min
Detector : RI
Column temp. : 30 ˚C

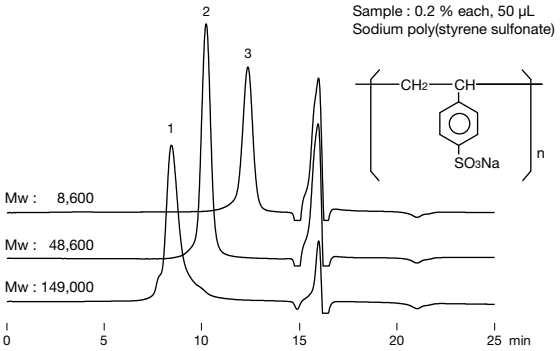
Calibration curves for GF-HQ series using PEG/PEO (eluent: DMF)



Column : Shodex Asahipak GF-HQ series
Eluent : DMF
Flow rate : 0.6 mL/min
Detector : RI
Column temp. : 40 ˚C

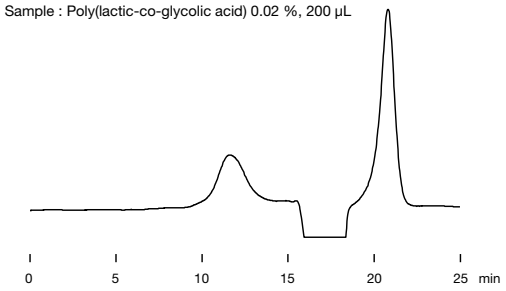
Sodium polystyrene sulfonates

Polymers having both hydrophobic and hydrophilic functional groups may exhibit hydrophobic interactions with packing materials.
When analyzing such polymers, addition of organic solvents to the eluent can suppress the hydrophobic interaction.



Column : Shodex Asahipak GF-510 HQ
Eluent : 50 mM LiCl aq./CH_3CN = 60/40
Flow rate : 0.6 mL/min
Detector : UV (254 nm)
Column temp. : 30 ˚C

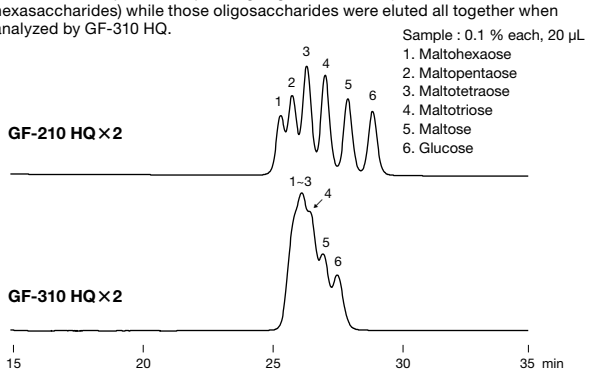
Biodegradable Polymer



Column : Shodex Asahipak GF-7M HQ
Eluent : CH_3CN
Flow rate : 0.6 mL/min
Detector : RI
Column temp. : 40 ˚C

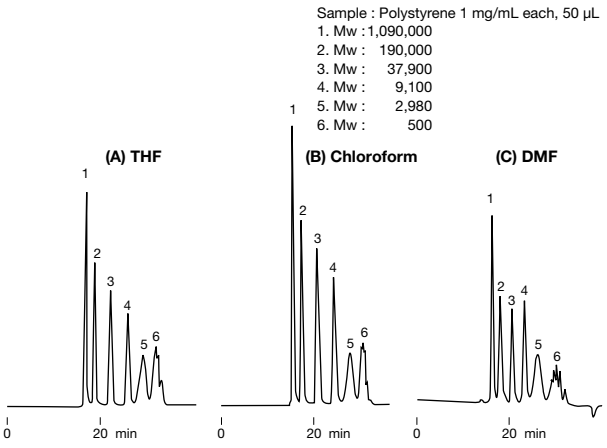
Comparison of two GF column performances for the separation of maltooligosaccharides

GF-210 HQ demonstrates an improved separation of low molecular substances. The chromatograms below show that the peaks obtained by GF-210 HQ are separated with deeper notches compared to peaks obtained by GF-310 HQ. GF-210 HQ is capable of separating oligosaccharides (trisaccharides to hexasaccharides) while those oligosaccharides were eluted all together when analyzed by GF-310 HQ.



Column : Shodex Asahipak GF-210 HQ x 2
Shodex Asahipak GF-310 HQ x 2
Eluent : H_2O
Flow rate : 0.6 mL/min
Detector : RI
Column temp. : 50 ˚C

Comparison of polystyrene separation under three different solvent conditions



Column : Shodex Asahipak GF-510 HQ + GF-310 HQ
Eluent : (A); THF, (B); Chloroform, (C); DMF
Flow rate : 0.5 mL/min
Detector : (A),(B) UV (254 nm), (C) UV (270 nm)
Column temp. : 30 ˚C