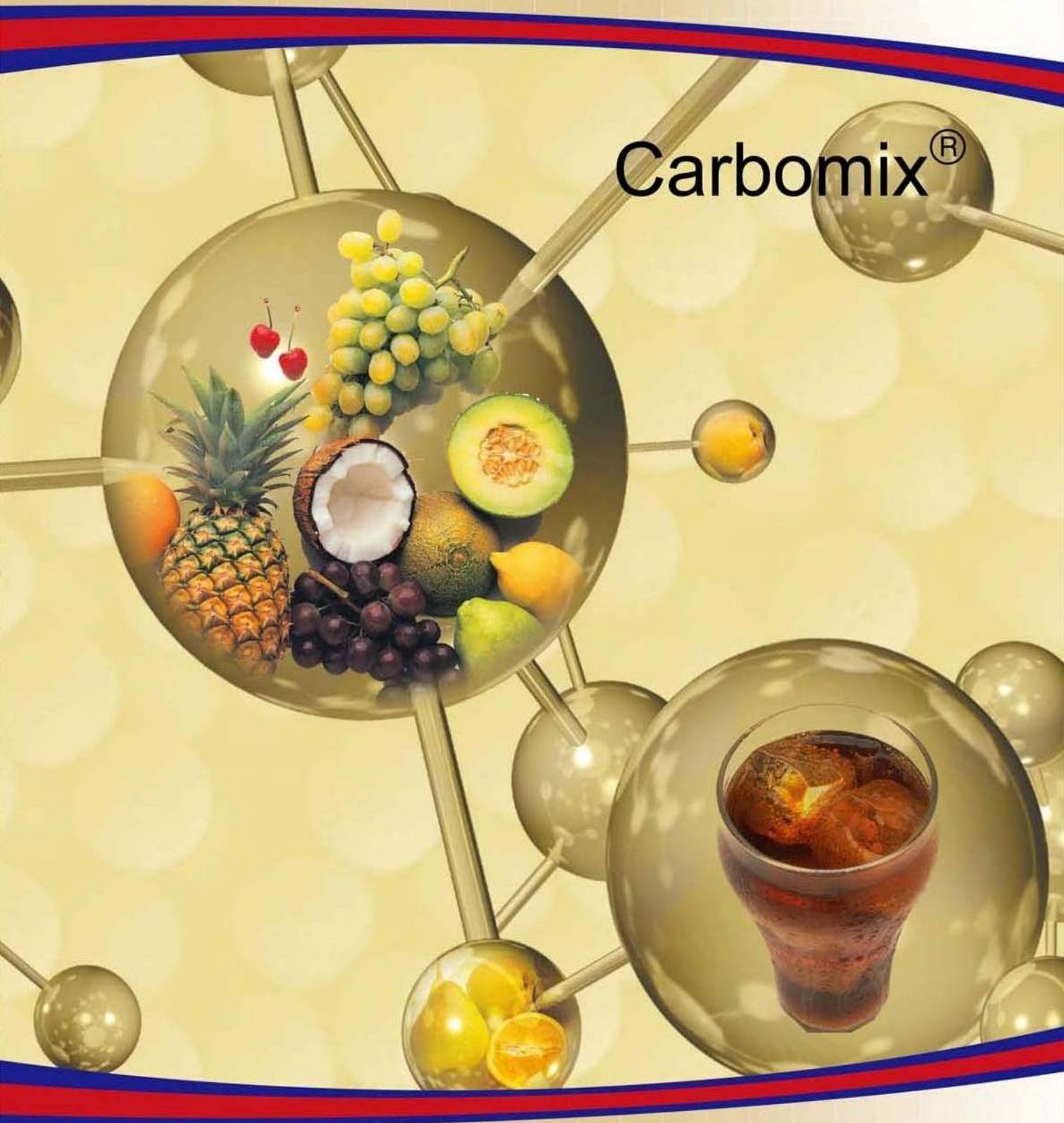


Carbohydrate and Organic Acid Separation



Sepax Technologies

Carbomix[®]



Better Surface Chemistry for Better Separation

Sepax Technologies, Inc.

Sepax Technologies, Inc. develops and manufactures products in the area of chemical and biological separations, biosurfaces and proteomics. Sepax product portfolio includes 1) liquid chromatography columns and media, 2) SPE and Flash chromatography columns and tubes, 3) bulk resin for preparative separation and process chromatography, and 4) natural product and Chinese traditional medicine separation and purification.



Leader in Biological Separations

Sepax develops and manufactures wide range of biological separation products using both silica and polymeric resins as the support. The selection of particle size is from 1 μm to 100 μm and pore size from non-porous to 2000 \AA . Unique and proprietary resin synthesis and surface technologies have been developed for solving separation challenges in biological area.



Bioseparation Products

Size Exclusion

SRT[®], SRT[®]-C

Nanofilm[®]

Zenix[™], Zenix[™]-C

Ion-exchange

Proteomix[®]

Generik[™] MC

Antibody Separation

Antibodix[™]

Carbohydrate Separation

Carbomix[®]

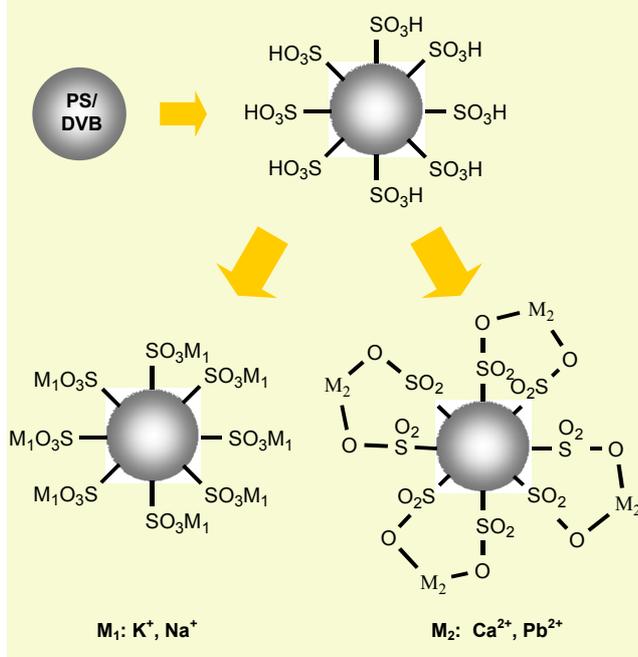
Analytical, Semi-prep and Preparative

Carbomix[®] Phases

General Description

Carbomix lines of columns have been specifically designed for high resolution separation of water soluble and partially water soluble organic compounds, including carbohydrates, organic acids, peptides, and small bio organic molecules involved in cell metabolism. These novel packing materials are based on low crosslinked (5%, 8% and 10%) polystyrene/divinylbenzene (PS/DVB) particles (5 and 10 μm) with surface modification of sulfonic acid ($-\text{SO}_3\text{H}$) for Carbomix H-NP resins, followed by chelating of various metal ions, calcium ions (Ca^{2+}) for Carbomix Ca-NP, lead ion (Pb^{2+}) for Carbomix Pb-NP, potassium ion (K^+) for Carbomix K-NP, and sodium ion (Na^+) for Carbomix Na-NP resins (Figure 1).

Fig. 1. Chemical processing of Carbomix phases



Highlights of Carbomix Resins

- Uniform 5 and 10 μm particle choices for high resolution and efficiency separation
- 5%, 8% and 10% crosslinkage
- Compatibility with most aqueous mobile phases, including pure water as the eluent
- Wide selection on ionic forms: H^+ , Ca^{2+} , Pb^{2+} , K^+ , and Na^+
- Wide operating-temperature range (20 – 85 $^\circ\text{C}$)
- pH range (1-3) for Carbomix H-NP and (5-9) for the other types of Carbomix phase
- Analytical and preparative columns

Characters of Carbomix Resins

Uniform Particle size. The particle size distribution of Carbomix phases is very narrow, 5.0 ± 0.2 for 5 μm and 10.0 ± 0.2 for 10 μm respectively, as shown in Figure 2. This mono-dispersed particle size distribution guarantees high efficiency and high resolution separations. Figure 3 shows higher separation efficiencies of monosaccharides with Carbomix Ca-NP5 columns as a comparison to other brands.

Fig. 2. SEM images of 5 and 10 μm Carbomix resins ($\times 2000$).

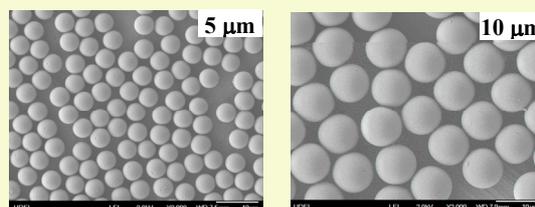
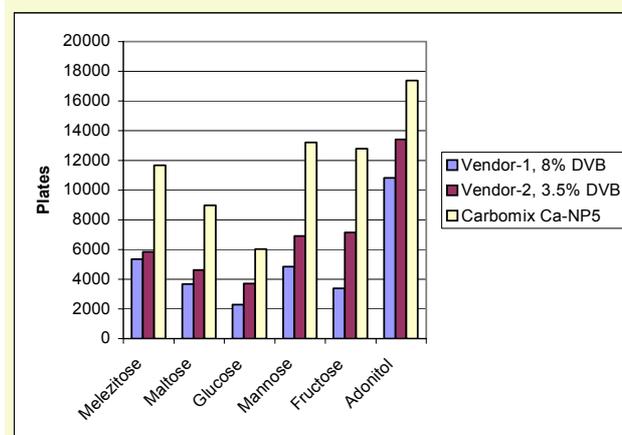


Fig. 3. Efficiency comparison of 6 monosaccharides on Carbomix Ca-NP5 (5 μm , 8% crosslinkage) and calcium columns (7.8 \times 300 mm) from other vendors. The separation conditions: mobile phase, H_2O ; flow rate, 0.60 mL/min; temperature, 85 $^\circ\text{C}$; injection volume, 20 μL ; detection, RI.



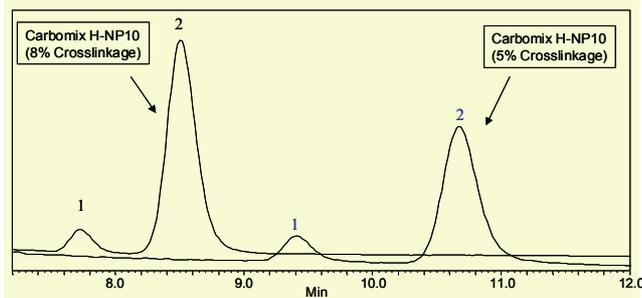
Variety of Ionic Forms. The available wide range ionic forms of Carbomix phases allow for most suitable column choices for achieving the best possible separation for different kinds of sugar molecules, sugar alcohols and other water soluble compounds from different sources (Table 1). For instance, arabinose, ribitol and arabitol are difficult to be separated on H-form phase but well resolved on Ca-form column; the peaks of xylose, galactose, and mannose on Ca-form column merge to one but elutes separately one after another on a Pb-form column.

Table 1. Selection of Ionic-form for Different Applications

Ionic form	Applications
H	Fermentation products, fruit juices containing organic acids, alcohols and carbohydrates
Ca	Carbohydrate in high fructose corn syrup; excellent for mono-, di-, tri- and tetrasaccharide and sugar alcohols
Pb	Pentoses and hexoses in wood products Dairy products containing sucrose, lactose, etc
K	Cane sugar, molasses, corn syrup, beet sugar and other plant products containing carbohydrates in the presence of betaine, and trimethylammonium zwitterionic compounds; Glyphosate
Na	Oligosaccharides, especially in the presence of high concentration of inorganic sodium, e.g. molasses

Low Crosslinkage. The low cross-linking property of Carbomix resins allows for proper swell in the mobile, especially at high temperature, a typical operation for fulfilling most separation tasks. Such swelling effect results in optimized surface area, permeability, capacity, selectivity, and response to changes in ionic strength for high resolution separation. The lower the crosslinkage of PS/DVB beads, the more open the phase structure and the permeability it is to samples like larger oligosaccharides. Fig. 4 shows that NGNA and NANA is separated with higher resolution on 5% crosslinkage Carbomix H-NP10 column than 8% crosslinkage column.

Fig. 4. Separation of NGNA and NANA on Carbomix H-NP10 columns with different crosslinkage.

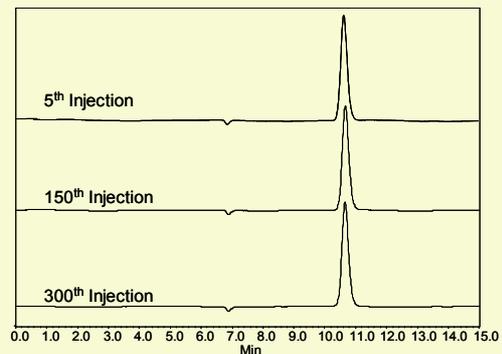


Columns: Carbomix H-NP10 (10 μ m, 7.8x300 mm)
 Mobile phase: Water
 Flow rate: 0.60 mL/min
 Temperature: 70 $^{\circ}$ C
 Injection volume: 20 μ L
 Detection: 206 nm
 Sample: 1) NGNA (0.01 mg/mL)
 2) NANA (0.1 mg/mL)

Stability. Carbomix columns are well manufactured with proprietary packing technique to guarantee high stability.

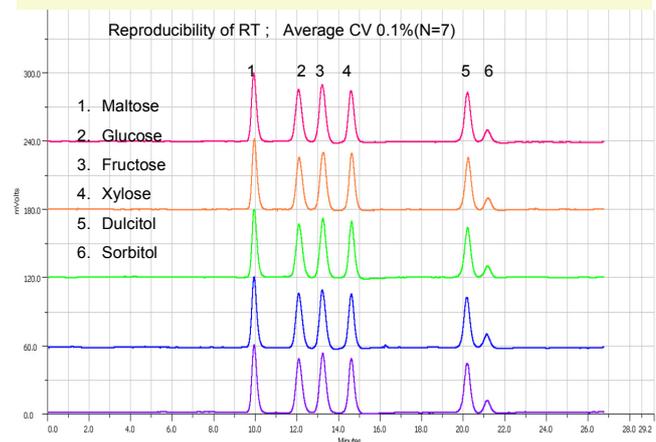
Carbomix resins are stable in pure water and other aqueous buffers at elevated temperature. As shown in Fig. 5, the variation of the retention time of galactitol is less than 0.3% within 300 injections at 80 $^{\circ}$ C. The robustness of Carbomix columns is further confirmed by its run-to-run reproducibility as Figure 6 shows consistent retention time with only 0.1% variation for Carbomix Ca-NP5 column.

Fig. 5. Robustness of Carbomix H-NP10 column (10 μ m, 8% crosslinkage) after 300 injections.



Column: Carbomix H-NP10 (10 μ m, 7.8x300 mm)
 Mobile phase: 5 mM H₂SO₄
 Flow rate: 0.60 mL/min
 Temperature: 80 $^{\circ}$ C
 Injection volume: 10 μ L
 Detection: RI
 Sample: Galactitol

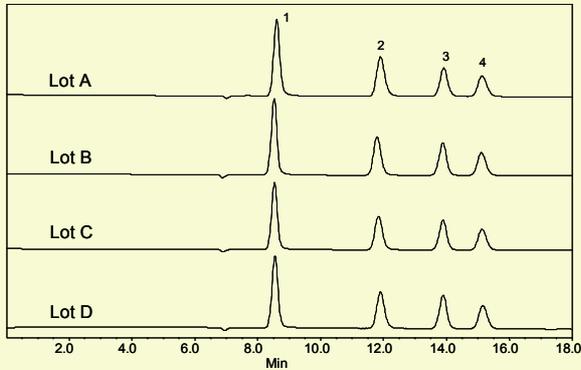
Fig. 6. Separation of carbohydrates by Carbomix Ca-NP5 column (5 μ m, 8% crosslinkage) (Courtesy of Miyako Kawakatsu, M&S Instruments, Inc.).



Column: 4.6 x 300 mm
 Mobile phase: Water
 Flow rate: 0.2 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 10 μ L
 Detector: ELSD
 Sample: Mixture of maltose, glucose, fructose, xylose, dulcitol and sorbitol (6 mg/mL of each in H₂O)

Lot-to-lot reproducibility. With well controlled polymer resin production, surface chemistry and column packing, the manufacturing of the Carbomix columns is highly reproducible. As shown in Figure 7, typical variation of retention time is less than 3% from batch to batch.

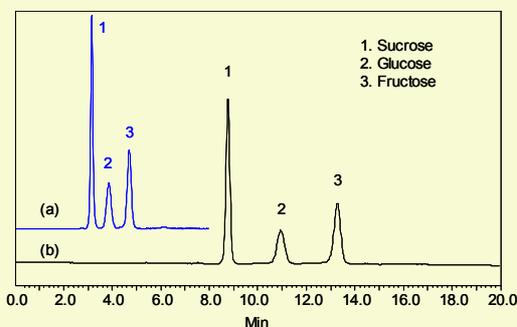
Fig. 7. QC of Carbomix H-NP10 columns from 4 different lots.



Column: Carbomix H-NP10 (10 μ m, 8% cross-linkage, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.6 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 10 μ L
 Detector: RI
 Sample: 1) Citric acid, 2) Succinic acid, 3) Formic acid, 4) Acetic acid.

Column Configuration. Carbomix resins can be packed into wide range of column dimensions with ID from 2.1mm to 50 mm and the length from 5 cm to 30 cm. Custom-made columns are also available upon request. Column length and diameter affect resolution and analysis time. The principle for choosing a suitable column is to use only as much resin as needed to achieve the desired separation. As shown in Figure 8, by using 7.8 \times 100 mm Carbomix Ca-NP5 column, the analysis time for orange juice sample is only 1/3 of that using 7.8 \times 300 mm.

Fig. 8. Separating profiles of orange juice by 7.8 \times 300 mm and 7.8 \times 100 mm Carbomix Ca-NP5 column (5 μ m, 8% crosslinkage).



Column: (a) 7.8 \times 100 mm; (b) 7.8 \times 300 mm
 Mobile phase: Water

Flow rate: 0.6 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 10 μ L
 Detector: RI
 Sample: Sucrose, glucose and fructose (15 mM/each)

Separation Mechanisms

The partition process on Carbomix phases is moderated by the counterion (H^+ , Ca^{2+} , Pb^{2+} , K^+ and Na^+) bounded to the surface. Usually, at least two or more mechanism, including size-exclusion, ion-exclusion, ion-exchange, ligand-exchange, reversed-phase and normal-phase, are involved. As shown in Fig. 4, size-exclusion mechanism is the primary one for separation of NGNA and NANA. However, ligand-exchange is the primary one for separating monosaccharides, e.g., separation of α - and β -anomers of glucose on Ca-form phase.

To fulfill the separation of molasses sample, the first primary mechanism involved is ion-exclusion, which allows inorganic sodium to be eluted near the void volume. And then size-exclusion and ligand-exchange take effect one after the other for oligosaccharides and monosaccharides. Ion-exclusion can still play a role for sugar alcohols and carboxylic acids in the matrix.

As to Carbomix-H-form phase for the separation of organic acids, both reversed-phase and ion-exclusion are the primary mechanisms. Hydrophobicity and pK_a together impact the retention time of a component in sample. It is due to this property, Carbomix-H phase is the ideal choice for monitoring changing components in the process of fermentation.

Applications

The Carbomix resins and columns offer many advantages for the analysis of carbohydrates, alcohols, and organic acids in food, beverage, biochemical, biomedical, and biotechnology applications.

Organic acid and alcohol analysis include carbohydrates with organic acids, alcohols, glycols, and fermentation products.

Carbohydrate analyses include samples of beet sugars, molasses, corn syrup, pentose sugars, cellulose hydrolysates, oligosaccharides, glucose, galactose, sucrose, and fructose.

Technical Specifications

Phase		Carbomix H-NP	Carbomix Ca-NP	Carbomix Pb-NP	Carbomix K-NP	Carbomix Na-NP
Support		Non-porous PS/DVB	Non-porous PS/DVB	Non-porous PS/DVB	Non-porous PS/DVB	Non-porous PS/DVB
Particle size (µm)		5, 10	5, 10	5, 10	5, 10	5, 10
Crosslinkage		5%, 8%, 10%	5%, 8%, 10%	5%, 8%, 10%	5%, 8%, 10%	5%, 8%, 10%
Stationary phase		-SO ₃ H	-(SO ₃) ₂ Ca	-(SO ₃) ₂ Pb	-SO ₃ K	-SO ₃ Na
pH stability		1 – 3	5 – 9	5 – 9	5 – 9	5 – 9
Maximum backpressure (psi)	10% 10 µm	1,200	1,200	1,200	1,200	1,200
	8% 10 µm	1,000	1,000	1,000	1,000	1,000
	5 µm	1,000	1,000	1,000	1,000	1,000
	5% 10 µm	1,000	1,000	1,000	1,000	1,000
Typical mobile phase		2.5 mM H ₂ SO ₄ or 0.1% H ₃ PO ₄	H ₂ O	H ₂ O	H ₂ O	H ₂ O
Typical flow rate (mL/min)	7.8x300mm	0.4-0.8	0.4-0.8	0.4-0.8	0.4-0.8	0.4-0.8
	4.6x300mm	0.1-0.3	0.1-0.3	0.1-0.3	0.1-0.3	0.1-0.3
Maximum temperature (°C)		85	85	85	85	85

Retention time Table for 43 Carbohydrates and Sugar Alcohols

Compound	Carbomix H-NP5	Carbomix H-NP10			Carbomix Ca-NP10	
	8%	5%	8%	10%	8%	10%
Acetic acid	16.07	17.52	14.64	13.39	/	/
Adonitol	12.15	13.59	11.10	10.26	14.73	13.67
Arabinitol	12.33	13.82	11.30	10.41	17.72	16.06
D-(-)-Arabinose	11.90	13.46	10.93	10.08	13.43	12.52
L-(+)-Arabinose	11.89	13.45	10.93	10.08	13.41	12.53
1,4-Butanediol	23.14	23.11	/	19.26	15.96	14.48
n-Butanol	/	35.93	/	32.66	/	/
sec-butyl alcohol	33.91	31.90	30.25	28.23	21.06	19.01
D-(+)-Cellobiose	9.41	9.79	8.18	8.17	8.81	8.96
Citric acid	9.63	10.26	8.69	8.35	/	/
Erythriol	13.16	14.70	11.94	11.00	15.98	14.47
Ethanol	25.07	23.13	21.82	20.72	16.38	15.89
Formic acid	14.97	16.11	13.51	12.48	/	/
D-Fructose	11.24	12.65	10.27	9.58	13.34	12.45
Fumaric acid	13.08	7.37	7.16	7.49	/	/
Galactitol	11.61	13.13	10.66	9.87	19.44	18.05
D-(+)-Galactose	11.16	12.54	10.15	9.48	11.77	11.20
Glycerol	14.89	16.07	13.61	12.46	16.20	15.12
D-Glucose	10.73	11.90	9.68	9.16	10.61	10.32
IPA	27.12	25.79	23.89	22.53	17.16	15.88
Lactic acid	13.66	15.41	12.70	11.55	/	/
B-Lactose	9.60	10.24	8.42	8.29	9.25	9.22
D-Lyxose	11.62	13.08	10.64	9.87	13.96	13.02
Maleic acid	10.01	9.50	8.53	8.56	/	/
Malic acid	8.66	12.03	9.80	9.24	/	/
Maltitol	9.72	10.51	8.41	8.29	11.92	11.24
D-(+)-Maltose	9.51	10.01	8.29	8.23	9.02	9.09
Maltotriose	9.08	8.94	7.70	7.90	8.33	8.57
D-Mannitol	11.56	12.99	10.53	9.79	17.34	15.60
D-(+)-Mannose	11.13	12.55	10.13	9.48	12.05	11.45
D-(+)-Melezitose	/	/	/	/	8.18	8.49
Methanol	22.17	20.60	19.21	18.28	16.08	15.64
Oxalic acid dihydrate	8.94	7.72	7.44	7.72	/	/
1-Propanol	30.00	27.83	26.56	25.16	20.44	18.95
Pyruvic acid	10.69	10.72	10.37	9.24	/	/
D-(-)-Ribose	12.09	13.73	11.16	10.25	20.70	19.23
D-Sorbitol	11.61	13.12	10.64	9.86	20.22	18.71
Succinic acid	12.26	14.45	11.54	10.47	/	/
D-(+)-Sucrose	/	/	/	/	8.93	9.03
Tartartic	10.00	10.74	8.94	8.64	/	/
Triethylene glycol	16.92	19.60	16.12	14.17	17.51	17.21
Xylitol	12.46	14.03	11.47	10.53	21.08	18.66
D-Xylose	11.32	12.61	10.24	9.60	11.63	11.19

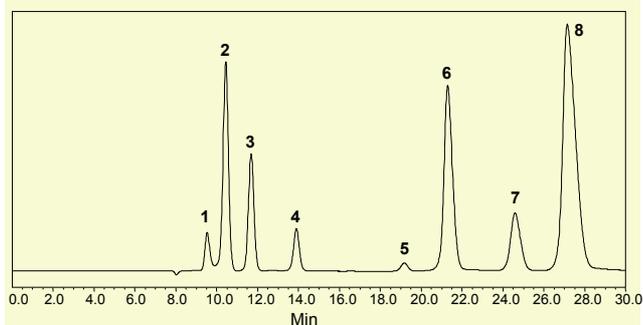
"/" means not suitable for analysis at the operation conditions or not available.

Typical industrial applications:

- Food and Beverage
- Fruits and Vegetables
- Wine and Beer
- Clinical Applications
- Oligosaccharides Analysis
- Cellulose and Wood
- Plant Biochemistry
- Fermentation Monitoring
- Metabolite Analysis
- Bacteria and Yeast Analysis
- Glycoproteins and Glycoconjugates
- Nucleic Acids

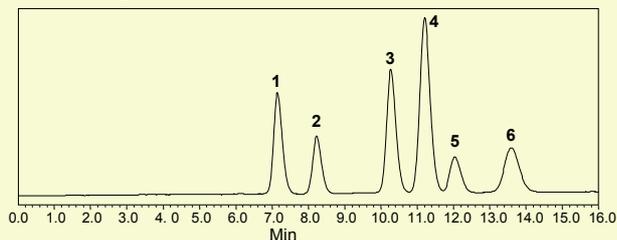
Analysis of Carbohydrates

Fig. 9. Analysis of main components of ethanol production broth on Carbomix H-NP10 column (5% crosslinkage).



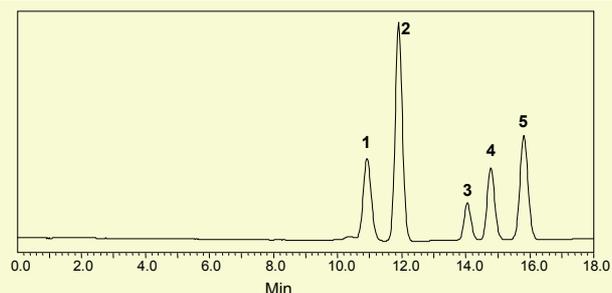
Column: Carbomix H-NP10 (10 μ m, 5%, 7.8 \times 300 mm)
 Mobile phase: 2.5 mM H₂SO₄ solution
 Flow rate: 0.6 mL/min
 Temperature: 55 $^{\circ}$ C
 Injection volume: 20 μ L
 Detector: RI
 Sample: 1) Stachyose, 2) Maltotriose, 3) Maltose, 4) Glucose, 5) Glycerol, 6) Acetic acid, 7) Methanol, 8) Ethanol

Fig. 10. Separation of carbohydrates on Carbomix Na-NP10 column (8% crosslinkage).



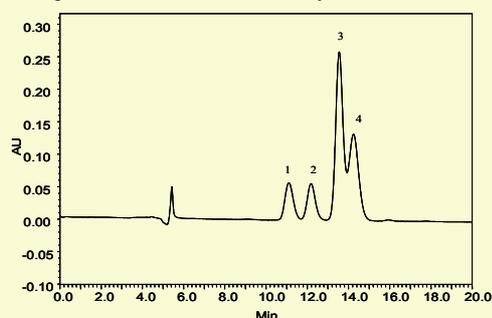
Column: Carbomix Na-NP10 (10 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.6 mL/min
 Temperature: 75 $^{\circ}$ C
 Injection volume: 10 μ L
 Detector: RI
 Sample: 1) Stachyose, 2) Cellobiose, 3) Glucose, 4) Fructose, 5) Arabinose, 6) Ribose

Fig. 11. Separation of carbohydrates on Carbomix K-NP5 column.



Column: Carbomix K-NP5 (5 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.4 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 5 μ L
 Detector: RI
 Sample: 1) Maltotriose, 2) Maltose, 3) Glucose, 4) Mannose, 5) Fructose

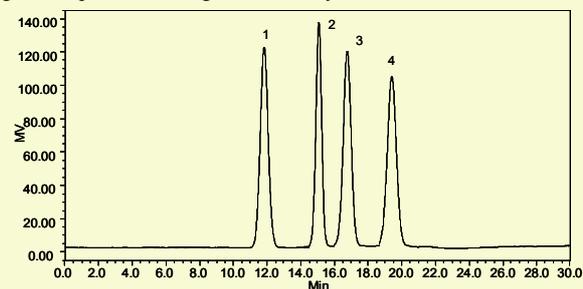
Fig. 12. Separation of monosaccharides by Carbomix Ca-NP5.



Column: Carbomix Ca-NP5 (5 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.6 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 2 μ L
 Detector: 192 nm
 Sample: 1) Glucose, 2) L-xyllose, 3) Fructose and 4) Lyxose (50 mM/each in water)

Analysis of Sugar Acohols

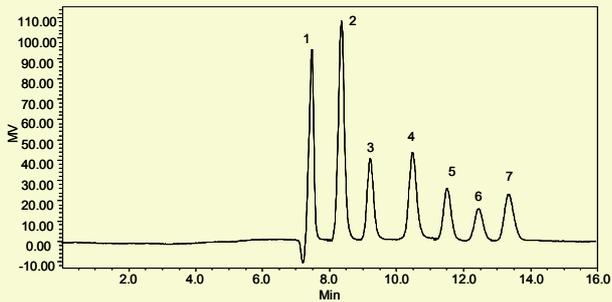
Fig. 13. Separation of sugar alcohols by Carbomix Ca-NP10.



Column: Carbomix Ca-NP10 (10 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.6 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 10 μ L
 Detector: RID
 Sample: 1) Maltitol, 2) Erythritol, 3) Mannitol and 4) Galactitol

Analysis of Organic Acids

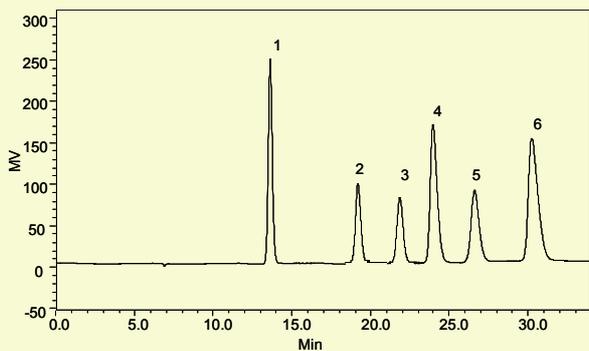
Fig. 14. Separation of organic acid mixture by Carbomix H-NP10.



Column: Carbomix H-NP10 (10 μ m, 10%, 7.8 \times 300 mm)
 Mobile phase: 2.5 mM H₂SO₄ solution
 Flow rate: 0.6 mL/min
 Temperature: 80 $^{\circ}$ C
 Injection volume: 10 μ L
 Detector: RI
 Sample: 1) Fumaric acid, 2) Citric acid, 3) Malic acid, 4) Succinic acid, 5) Lactic acid, 6) Formic acid, 7) Acetic acid

Analysis of Alcohols

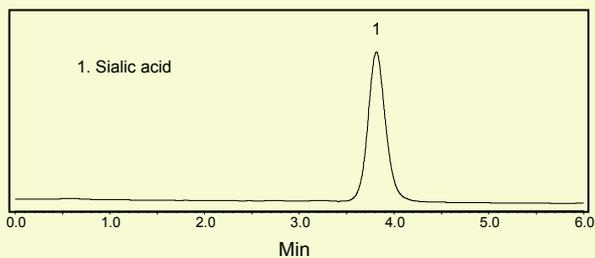
Fig. 15. Separation of alcohol mixture by Carbomix H-NP10.



Column: Carbomix H-NP10 (10 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: 2.5 mM H₂SO₄ solution
 Flow rate: 0.6 mL/min
 Temperature: 80 $^{\circ}$ C
 Injection volume: 10 μ L
 Detector: RI
 Sample: 1) Glycerol, 2) Methanol, 3) Ethanol, 4) Iso-propanol, 5) 1-Propanol, 6) sec-Butyl alcohol

QC of Pharmaceuticals

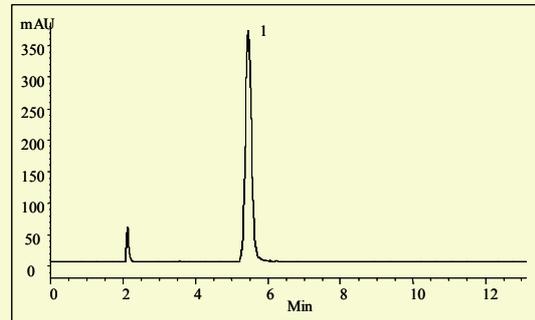
Fig. 16. Analysis of Sialic acid by Carbomix H-NP5



Column: 7.8 \times 100 mm
 Mobile phase: 2.5 mM H₂SO₄ solution
 Flow rate: 0.6 mL/min
 Temperature: 55 $^{\circ}$ C

Injection volume: 10 μ L
 Detector: 192 nm
 Sample: Sialic acid (1mg/mL)

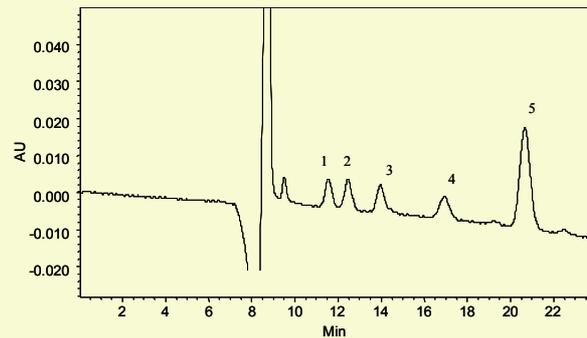
Fig. 17. Analysis of Ribavirin by Carbomix H-NP5 column.



Column: Carbomix H-NP5 (5 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: 2.5 mM H₂SO₄ solution
 Flow rate: 0.6 mL/min
 Temperature: 55 $^{\circ}$ C
 Injection volume: 10 μ L
 Detector: 207 nm
 Sample: Ribavirin (50 μ g/mL)

Separation of Carbohydrates in Beer

Fig. 18. Separation of carbohydrates in beer by a Carbomix Ca-NP5 column (5 μ m, 8% crosslinkage).

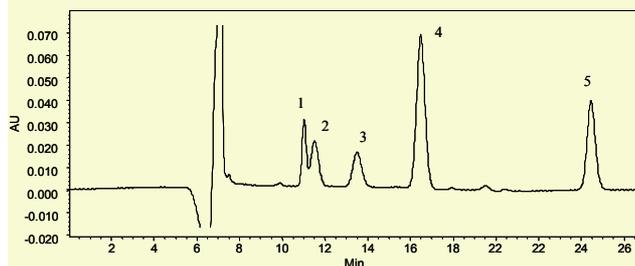


Column: Carbomix H-NP5 (5 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.4 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 2 μ L
 Detector: 192 nm
 Sample: 1) Maltotetraose, 2) Maltotriose, 3) Maltose, 4) Glucose, 5) Fructose (6 mg/mL of each)



Separation of Carbohydrates in Food

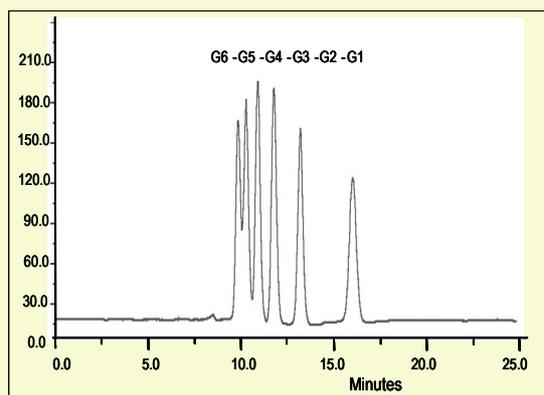
Fig. 19. Separation of carbohydrates in food by a Carbmix Ca-NP5 column (5 μ m, 8% Crosslinkage).



Column: Carbmix Ca-NP5 (5 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.5 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 2 μ L
 Detector: 192 nm
 Sample: 1) Sucrose, 2) Lactose, 3) Glucose, 4) Fructose, 5) Sorbitol (6 mg/mL in H₂O for each)

Separation of Glucose and its Oligomers

Fig. 20. Separation of glucose and its oligomers by a Carbmix Ca-NP5 column (5 μ m, 8% crosslinkage). (Courtesy of Miyako Kawakatsu, M&S Instruments, Inc)

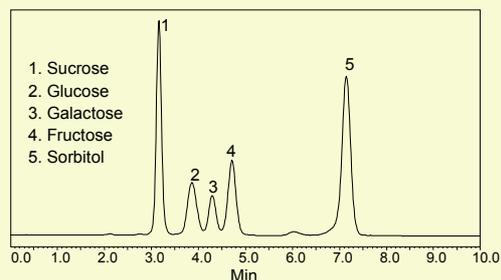


Column: 4.6 \times 300 mm
 Mobile phase: Water
 Flow rate: 0.15 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 10 μ L
 Detector: 192 nm
 Sample: Glucose (G1) and its oligomers (G2 to G6)



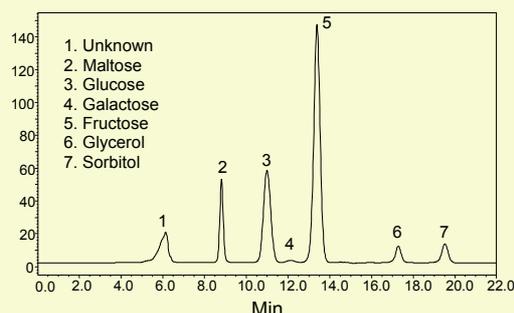
Separation of Carbohydrates and Sugar Alcohols in Beverage

Fig. 21. Separation of carbohydrate and sugar alcohol in apple juice on a Carbmix Ca-NP5 column (5 μ m, 8% Crosslinkage).



Column: 7.8 \times 100 mm
 Mobile phase: Water
 Flow rate: 0.6 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 2 μ L
 Detector: RI
 Sample: Mixture of sucrose, glucose, galactose, fructose and sorbitol (50 mM/each in water)

Fig. 22. Profile of carbohydrates and alcohols in a Martinelli's Sparkling Apple-Cranberry juice on a Carbmix Ca-NP5 column (5 μ m, 8% Crosslinkage).

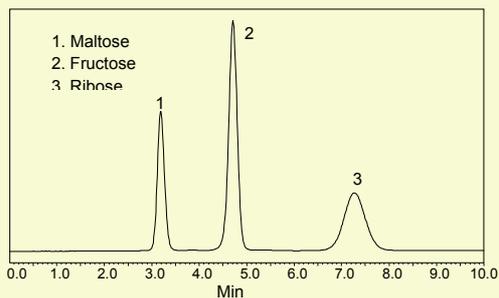


Column: Carbmix Ca-NP5 (5 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.6 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 5 μ L
 Detector: RI
 Sample: Martinelli's Sparkling Apple-Cranberry juice



Separation of Carbohydrate in Corn Syrup

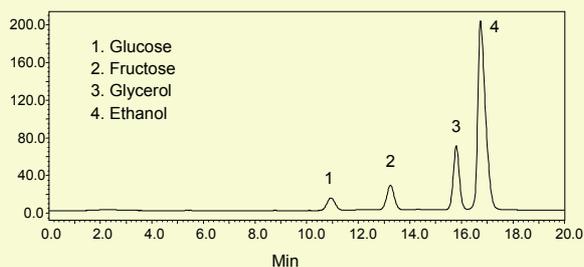
Fig. 23. Separation of carbohydrates on a Carbomix Ca-NP5 column (5 μ m, 8% crosslinkage).



Column: Carbomix Ca-NP5 (5 μ m, 8%, 7.8 \times 100 mm)
 Mobile phase: Water
 Flow rate: 0.5 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 2 μ L
 Detector: RI
 Sample: Mixture of maltose, fructose and ribose (50 mM/each in water)

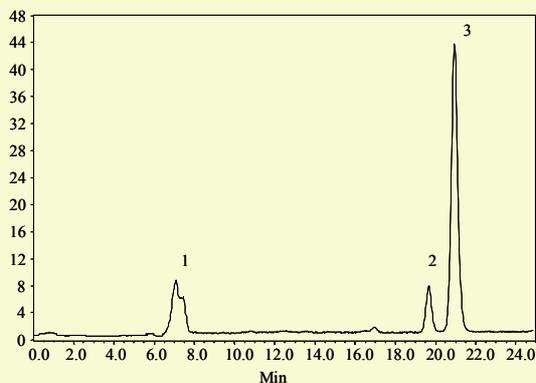
Analysis of Carbohydrate and Alcohol in Wine

Fig. 24. Profile of carbohydrate and alcohols in a Cabernet Sauvignon wine on a Carbomix Ca-NP5 column (5 μ m, 8% crosslinkage).



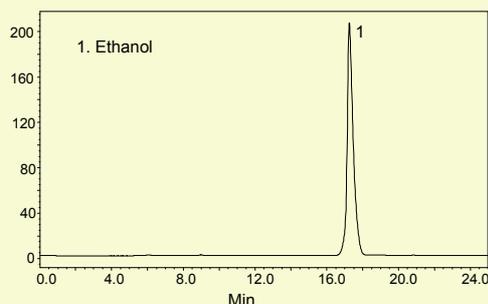
Column: Carbomix Ca-NP5 (5 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.6 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 10 μ L
 Detector: RI
 Sample: Cabernet Sauvignon

Fig. 25. Profile of main components in a Beaujolais-Villages wine on a Carbomix Ca-NP5 column (5 μ m, 8% crosslinkage).



Column: Carbomix Ca-NP5 (5 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.6 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 2.5 μ L
 Detector: RI
 Sample: Beaujolais-Villages (Louis Jadot 2007)

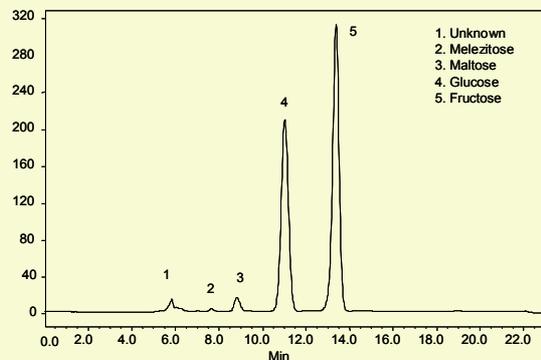
Fig. 26. Profile of a Chinese white wine on a Carbomix Ca-NP5 column (5 μ m, 8% crosslinkage).



Column: Carbomix Ca-NP5 (5 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.6 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 2.5 μ L
 Detector: RI
 Sample: Fen-Jiu (Apricot Blossom Village)

Separation of Carbohydrate in Beverage

Fig. 27. Profile of carbohydrates in Sprite on a Carbomix Ca-NP5 column (5 μ m, 8% crosslinkage).



Column: Carbomix Ca-NP5 (5 μ m, 8%, 7.8 \times 300 mm)
 Mobile phase: Water
 Flow rate: 0.6 mL/min
 Temperature: 85 $^{\circ}$ C
 Injection volume: 10 μ L
 Detector: RI
 Sample: Sprite

Ordering Information

Carbomix resin	5 µm, 8% Crosslinkage				
Column	P/N				
ID x Length (mm)	Carbomix H-NP5	Carbomix Ca-NP5	Carbomix Pb-NP5	Carbomix Na-NP5	Carbomix K-NP5
4.6x300	SEP260508-4630	SEP250508-4630	SEP240508-4630	SEP230508-4630	SEP220508-4630
4.6x250	SEP260508-4625	SEP250508-4625	SEP240508-4625	SEP230508-4625	SEP220508-4625
4.6x50 (Guard)	SEP260508-4605	SEP250508-4605	SEP240508-4605	SEP230508-4605	SEP220508-4605
7.8x300	SEP260508-7830	SEP250508-7830	SEP240508-7830	SEP230508-7830	SEP220508-7830
7.8x250	SEP260508-7825	SEP250508-7825	SEP240508-7825	SEP230508-7825	SEP220508-7825
7.8x100	SEP260508-7810	SEP250508-7810	SEP240508-7810	SEP230508-7810	SEP220508-7810
7.8x50 (Guard)	SEP260508-7805	SEP250508-7805	SEP240508-7805	SEP230508-7805	SEP220508-7805
10x300	SEP260508-10030	SEP250508-10030	SEP240508-10030	SEP230508-10030	SEP220508-10030
21.2x300	SEP260508-21230	SEP250508-21230	SEP240508-21230	SEP230508-21230	SEP220508-21230
30x300	SEP260508-30030	SEP250508-30030	SEP240508-30030	SEP230508-30030	SEP220508-30030

Carbomix resin	10 µm, 5% Crosslinkage				
Column	P/N				
ID x Length (mm)	Carbomix H-NP5	Carbomix Ca-NP5	Carbomix Pb-NP5	Carbomix Na-NP5	Carbomix K-NP5
4.6x300	SEP261005-4630	SEP251005-4630	SEP241005-4630	SEP231005-4630	SEP221005-4630
4.6x250	SEP261005-4625	SEP251005-4625	SEP241005-4625	SEP231005-4625	SEP221005-4625
4.6x50 (Guard)	SEP261005-4605	SEP251005-4605	SEP241005-4605	SEP231005-4605	SEP221005-4605
7.8x300	SEP261005-7830	SEP251005-7830	SEP241005-7830	SEP231005-7830	SEP221005-7830
7.8x250	SEP261005-7825	SEP251005-7825	SEP241005-7825	SEP231005-7825	SEP221005-7825
7.8x100	SEP261005-7810	SEP251005-7810	SEP241005-7810	SEP231005-7810	SEP221005-7810
7.8x50 (Guard)	SEP261005-7805	SEP251005-7805	SEP241005-7805	SEP231005-7805	SEP221005-7805
10x300	SEP261005-10030	SEP251005-10030	SEP241005-10030	SEP231005-10030	SEP221005-10030
21.2x300	SEP261005-21230	SEP251005-21230	SEP241005-21230	SEP231005-21230	SEP221005-21230
30x300	SEP261005-30030	SEP251005-30030	SEP241005-30030	SEP231005-30030	SEP221005-30030

Carbomix resin	10 µm, 8% Crosslinkage				
Column	P/N				
ID x Length (mm)	Carbomix H-NP5	Carbomix Ca-NP5	Carbomix Pb-NP5	Carbomix Na-NP5	Carbomix K-NP5
4.6x300	SEP261008-4630	SEP251008-4630	SEP241008-4630	SEP231008-4630	SEP221008-4630
4.6x250	SEP261008-4625	SEP251008-4625	SEP241008-4625	SEP231008-4625	SEP221008-4625
4.6x50 (Guard)	SEP261008-4605	SEP251008-4605	SEP241008-4605	SEP231008-4605	SEP221008-4605
7.8x300	SEP261008-7830	SEP251008-7830	SEP241008-7830	SEP231008-7830	SEP221008-7830
7.8x250	SEP261008-7825	SEP251008-7825	SEP241008-7825	SEP231008-7825	SEP221008-7825
7.8x100	SEP261008-7810	SEP251008-7810	SEP241008-7810	SEP231008-7810	SEP221008-7810
7.8x50 (Guard)	SEP261008-7805	SEP251008-7805	SEP241008-7805	SEP231008-7805	SEP221008-7805
10x300	SEP261008-10030	SEP251008-10030	SEP241008-10030	SEP231008-10030	SEP221008-10030
21.2x300	SEP261008-21230	SEP251008-21230	SEP241008-21230	SEP231008-21230	SEP221008-21230
30x300	SEP261008-30030	SEP251008-30030	SEP241008-30030	SEP231008-30030	SEP221008-30030

Carbomix resin	10 µm, 10% Crosslinkage				
Column	P/N				
ID x Length (mm)	Carbomix H-NP5	Carbomix Ca-NP5	Carbomix Pb-NP5	Carbomix Na-NP5	Carbomix K-NP5
4.6x300	SEP261010-4630	SEP251010-4630	SEP241010-4630	SEP231010-4630	SEP221010-4630
4.6x250	SEP261010-4625	SEP251010-4625	SEP241010-4625	SEP231010-4625	SEP221010-4625
4.6x50 (Guard)	SEP261010-4605	SEP251010-4605	SEP241010-4605	SEP231010-4605	SEP221010-4605
7.8x300	SEP261010-7830	SEP251010-7830	SEP241010-7830	SEP231010-7830	SEP221010-7830
7.8x250	SEP261010-7825	SEP251010-7825	SEP241010-7825	SEP231010-7825	SEP221010-7825
7.8x100	SEP261010-7810	SEP251010-7810	SEP241010-7810	SEP231010-7810	SEP221010-7810
7.8x50 (Guard)	SEP261010-7805	SEP251010-7805	SEP241010-7805	SEP231010-7805	SEP221010-7805
10x300	SEP261010-10030	SEP251010-10030	SEP241010-10030	SEP231010-10030	SEP221010-10030
21.2x300	SEP261010-21230	SEP251010-21230	SEP241010-21230	SEP231010-21230	SEP221010-21230
30x300	SEP261010-30030	SEP251010-30030	SEP241010-30030	SEP231010-30030	SEP221010-30030