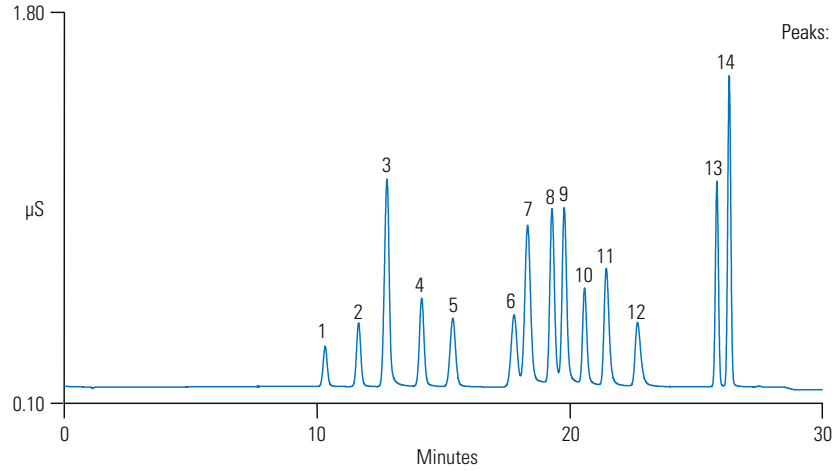
Product Specifications

Obtain excellent peak shapes for hydrophobic amines without the use of solvent using the Dionex IonPac CS17 Cation-Exchange Column.

Thermo Scientific Dionex IonPac CS17 Cation-Exchange Column

Separation of Alkylamines and the Group I and II Cations Using the Dionex IonPac CS17 Column



Peaks:		
1.	Lithium	0.03 mg/L (ppm)
2.	Sodium	0.10
3.	Ammonium	0.34
4.	Potassium	0.25
5.	Ethylamine	0.50
7.	*tert*-Butylamine	1.25
8.	*sec*-Butylamine	1.25
9.	*iso*-Butylamine	1.25
10.	n-Butylamine	3.75
11.	1,2-Dimethylpropylamine	1.00
12.	Di-n-propylamine	1.00
13.	Magnesium	0.14
14.	Calcium	0.34

The Dionex IonPac CS17 cation-exchange column is designed for the separation of hydrophobic and polyvalent amines-including biogenic amines, alkylamines and diamines-using simple aqueous eluents and elevated temperatures. This column offers improved peak shape for most Dionex IonPac CS14, CS15 amd CS16 amine applications without the use of solvent.

The Dionex IonPac CS17 column is a universal column for the separation of polyvalent and hydrophobic amines in complex sample matrices. Minimal baseline shifts and enhanced analyte sensitivity are obtained using the Thermo Scientific Dionex Cation Self-Regenerating Suppressor (CSRS 300) or Thermo Scientific Dionex Cation Capillary Electrolytic Suppressor (CCES 300). Operation is simplified with Reagent-Free IC provided by the Eluent Generator (EG), which requires only a deionized water source to produce methanesulfonic acid (MSA) eluent.

Sample matrices include environmental waters, power plant waters treated with ammonium, morpholine, or ethanolamine, chemical additives, chemical process solutions, scrubber solutions, plating baths and solvents. The Dionex IonPac CS17 is available in standard bore, microbore and capillary formats allowing flow rates from 1.6 mL/min to 10 µL/min. The capillary format offers increased mass sensitivity, reduced eluent consumption and the ability to operate on demand.

Highlights

- Separation of polyvalent and hydrophobic amines in complex sample matrices without the use of solvent
- Improved peak shapes over the Dionex IonPac CS17, CS15 and CS16 applications using simple aqueous gradients
- Available in standard bore, microbore and capillary formats

Unique Carboxylate Cation Exchanger

The Dionex IonPac CS17 column is a unique, hydrophilic, moderate capacity carboxylate-functionalized cation exchanger that provides excellent selectivity and peak shape for amines. Figure 1 shows the resin bead structure of the Dionex IonPac CS17. The resin bead consists of a highly cross-linked core. The substrate for this column is a macroporous resin bead (7 µm diameter) consisting of ethylvinylbenzene, crosslinked with 55% divinylbenzene.

The Dionex IonPac CS17 resin bead is produced using a novel grafting technology. This new technology employs a grafted nonfunctional coating on the resin surface and pores with the cation-exchange polymer grafted onto this nonfunctional coating. This novel technology reduces hydrophobic interactions with the analytes and resin surface, resulting in excellent mass transfer characteristics which provides very high efficiency peaks.

The Power of Gradient Elution

Figure 2 illustrates improved resolution among adjacent peaks using gradient or step-change elution instead of isocratic elution. Gradient elution improves the resolution among the first five eluting peaks, the four monovalent cations, and dimethylamine. By using the EG, a Thermo Scientific Dionex Cation Trap Column (Dionex CTC) or Thermo Scientific Dionex Continuously Regenerated Cation Trap Column II (Dionex CR-CTC II) and the Dionex IonPac CS17 column, the baseline shift is minimal when stepping from a low to high eluent concentration, thus providing simplified peak integration and quantification of the analytes. Moderately hydrophobic amines, such as triethylamine, can be eluted efficiently without addition of organic solvent to the eluent.

Figure 1. Structure of a Dionex IonPac CS17 packing particle.

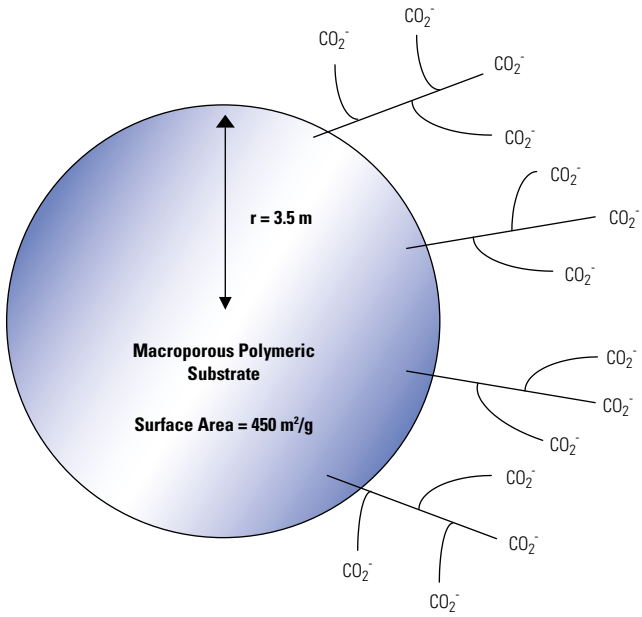


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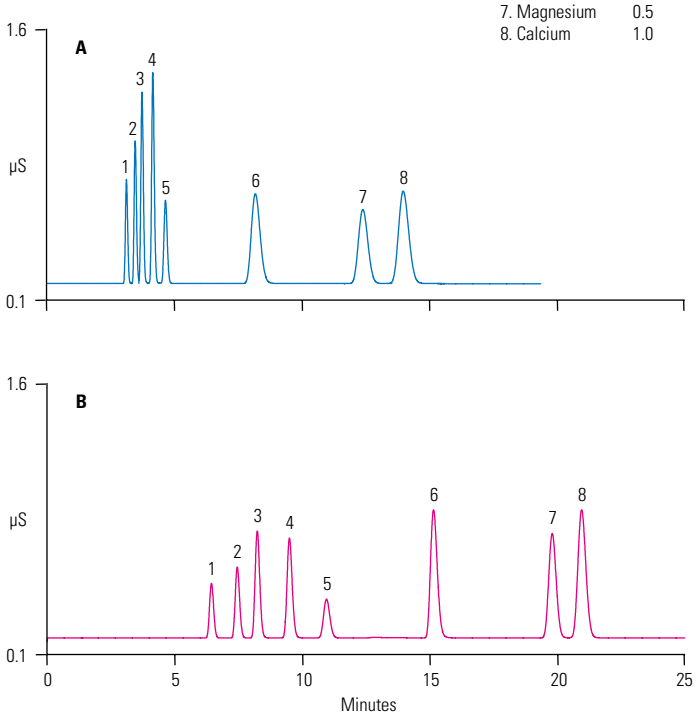
Figure 2. Separation of Group I and II cations and methylamines using a step-change elution and the Dionex IonPac CS17 column.

Column:	Dionex IonPac CS17, 4 mm	Suppressor:	Dionex Cation Atlas™ Electrolytic Suppressor in AutoSuppression™ Recycle Mode, 24 mA
Eluent: A.	6 mM Methanesulfonic acid (MSA)		
Eluent B:	2 mM MSA isocratic to 11.0 min; step change to 7 mM MSA at 11.1 min; isocratic to 22 min; step change back to 2 mM MSA at 22.1 min	Peaks:	1. Lithium 0.1 mg/L (ppm) 2. Sodium 0.4 3. Ammonium 0.5 4. Potassium 1.0 5. Dimethylamine 1.0 6. Triethylamine 7.0 7. Magnesium 0.5 8. Calcium 1.0
	Equilibration time is 2 min		
Flow Rate:	1.0 mL/min		
Sample Volume:	25 µL		
Temperature:	30 °C		



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CS17 Capillary Format

The Dionex IonPac CS17 Capillary column (0.4 × 250 mm) is packed with the same material as the equivalent analytical scale version, thereby producing the same performance as a 4 mm column while requiring only 1/100th the eluent flow rate.

The capillary format offers the advantage of reduced eluent consumption which means reduced operating costs and the ability to operate "on demand". Figure 3 illustrates the separation of the common inorganic cations using the Dionex IonPac CS17 Capillary Column. Excellent retention time reproducibility can be achieved with the capillary format.

Determination of Biogenic Amines and Group I and II Cations

Biogenic amines—including putrescine, cadaverine, spermine, spermidine, and histamine—are indicators of food spoilage. As illustrated in Figure 4, the Dionex IonPac CS17 column can easily separate the biogenic amines and Group I and II cations using an aqueous eluent without added organic solvent. Good peak efficiencies and symmetries are shown when the column is operated with a simple acidic gradient at elevated temperature.

Biogenic amines can easily be determined in complex food matrices using the Dionex IonPac CS17 column with suppressed conductivity detection. Amperometric detection can also be used to detect these compounds. This detection mode provides improved specificity for oxidizable amines, including the biogenic amines. Inorganic cations present in the sample are not detected using this method, and high concentrations do not interfere with the quantification of the amines.

Figure 3. Separation of Common Cations, Ammonium and Amines Using the Dionex IonPac CS17 Capillary Column

Column:	Dionex IonPac CS17, 0.4 mm
Eluent:	6 mM MSA
Eluent Source:	Dionex EGC-MSA (Capillary)
Flow Rate:	0.010 mL/min
Inj. Volume:	400 nL
Temperature:	30 °C
Detection:	Suppressed conductivity, Dionex CCES 300, AutoSuppression, recycle mode

Peaks:		
	1. Lithium	0.05 mg/L
	2. Sodium	0.20
	3. Ammonium	0.25
	4. Potassium	0.50
	5. Dimethylamine	0.50
	6. Triethylamine	3.50
	7. Magnesium	0.25
	8. Calcium	0.50

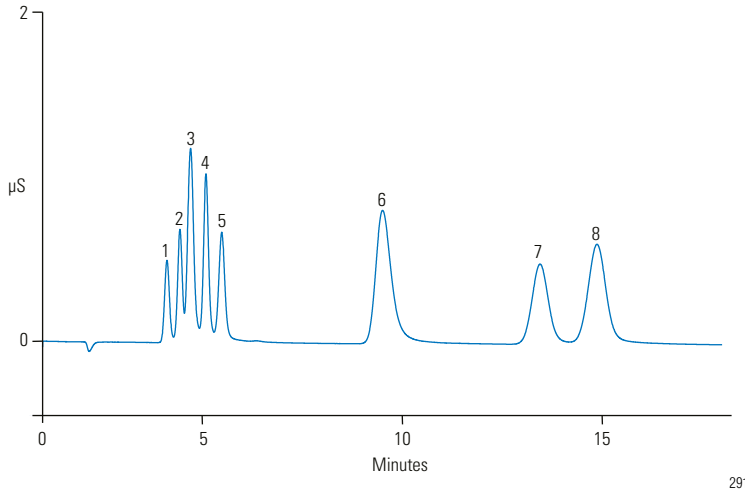

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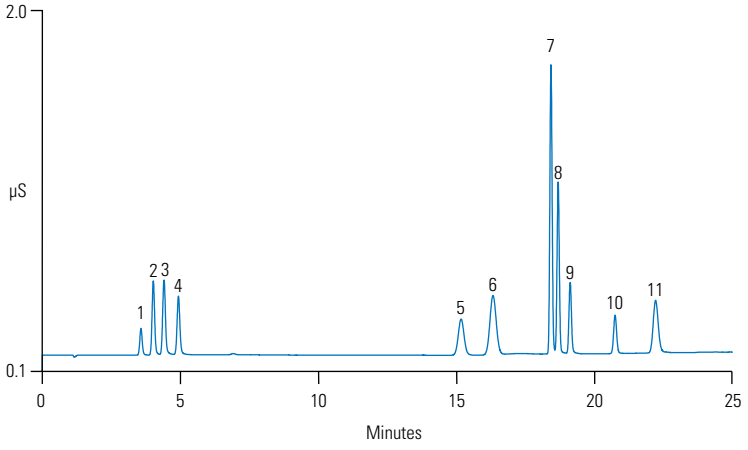
Figure 4. Determination of biogenic amines and the Group I and II cations using the Dionex IonPac CS17 column.

Column:	Dionex IonPac CG17, CS17, 2 mm
Eluent:	3 mM MSA isocratic to 3.5 min; 3 mM to 6 mM MSA gradient at 12 min; isocratic to 15 min; gradient to 40 mM MSA at 20 min, isocratic to 24 min; step change back to 3 mM MSA at 24.1 min Equilibration time is 2 min
Flow Rate:	0.40 mL/min
Sample Volume:	25 µL
Temperature:	40 °C
Suppressor:	Dionex CSRS ULTRA™2 mm Cation Self-Regenerating Suppressor™, AutoSuppression Recycle Mode, 100 mA

Peaks:			
	1. Lithium	10	µg/L (ppb)
	2. Sodium	40	
	3. Ammonium	50	
	4. Potassium	100	
	5. Magnesium	50	
	6. Calcium	100	
	7. Putrescine	1000	
	8. Cadaverine	600	
	9. Histamine	600	
	10. Spermidine	200	
	11. Spermine	400	



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Determination of Amine Additives in Power Plant and Boiler Waters

Ethanolamine is one of the most widely used corrosion prevention additives in power plant waters. Hydrazine, (H_2NNH_2) is a powerful reducing agent used in the power industry as an oxygen scavenger to reduce turbine corrosion present in µg/L (ppb) concentrations. The moderate capacity, hydrophilic Dionex IonPac CS17 column solves the difficult resolution problem of separating hydrazine from ammonium and ethanolamine.

Morpholine, 2-diethylaminoethanol, and cyclohexylamine are added to water as vapor-phase corrosion inhibitors in steam-generating plants and for other boiler applications. Concentrations of these amines must be monitored to maintain optimum levels. Using the Dionex IonPac CS17 column with suppressed conductivity, separation, detection, and quantitation of these amines are easily achieved using an MSA gradient at elevated temperature, as illustrated in Figure 5.

Determination of Alkanolamines in Power Plant Waters and Scrubber Solutions

Alkanolamines—including mono-, di-, and triethanolamine—are most commonly used individually or in any combination to optimize the efficiency of the scrubber treatment for a specific chemical process. In large plants, different alkanolamines may be used in adjacent units as tracers for leakage problems. The Dionex IonPac CS17 column resolves all combinations of these scrubber amines using a methanesulfonic acid gradient and elevated temperature (See Figure 6).

Figure 5. Determination of power plant amine additives using the Dionex IonPac CS17 column.

Column:	Dionex IonPac CG17, CS17, 2 mm
Eluent:	0.5 mM to 0.7 mM MSA gradient at 25 min; step change to 4 mM MSA at 25.1 min; isocratic to 27 min; step change to 6.5 mM MSA at 27.1 min; isocratic to 37 min; step change back to 0.5 mM MSA at 37.1 min Equilibration time is 2 min
Flow Rate:	0.35 mL/min
Sample Volume:	25 µL
Temperature:	30 °C
Suppressor:	Dionex Cation Atlas Electrolytic Suppressor in AutoSuppression Recycle Mode, 8 mA

Peaks:		
1.	Lithium	25 µg/L (ppb)
2.	Sodium	100
3.	Ammonium	125
4.	Hydrazine	1000
5.	Ethanolamine	250
6.	Potassium	250
7.	2-(2-aminoethoxy) ethanol	1000
8.	5-amino-1-pentanol	500
9.	Morpholine	1000
10.	2-diethylamino ethanol	1000
11.	Cyclohexylamine	1000
12.	Magnesium	125
13.	Calcium	250

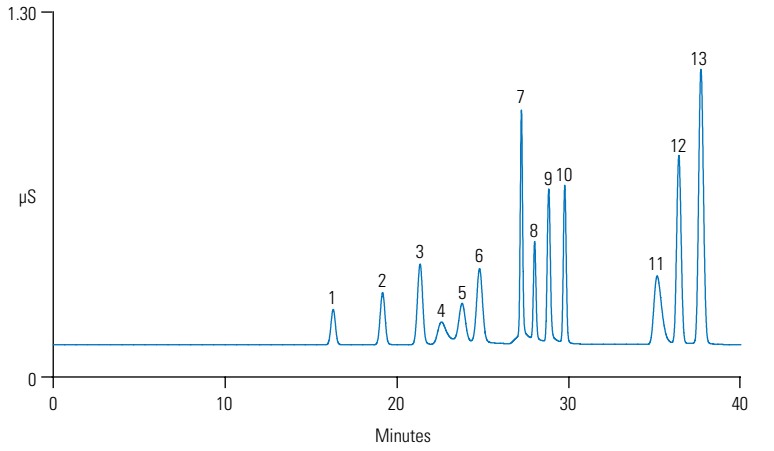

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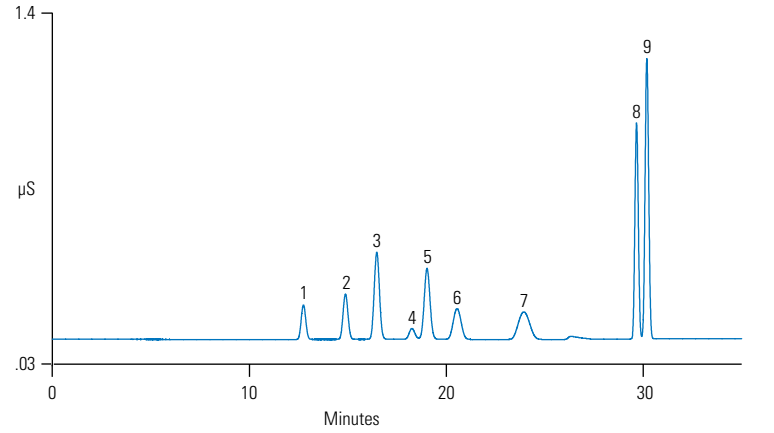
Figure 6. Determination of alkanolamines using the Dionex IonPac CS17 column.

Column:	Dionex IonPac CS17, 4 mm
Eluent:	0.5 mM to 0.8 mM MSA gradient at 25 min; step change to 9 mM MSA at 25.1 min; isocratic to 35 min; step change back to 0.5 mM MSA at 35.1 min Equilibration time is 2 min
Flow Rate:	1.4 mL/min
Sample Volume:	25 µL
Temperature:	30 °C
Suppressor:	Dionex Cation Atlas Electrolytic Suppressor in AutoSuppression Recycle Mode, 43 mA

Peaks:		
1.	Lithium	0.1 mg/L (ppm)
2.	Sodium	0.4
3.	Ammonium	0.5
4.	Ethanolamine	0.5
5.	Potassium	1.0
6.	Diethanolamine	1.0
7.	Triethanolamine	18.0
8.	Magnesium	0.5
9.	Calcium	1.0



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Determination of Alkylamines and the Group I and II Cations

Lithium, sodium, ammonium, potassium, magnesium and calcium and low-molecular-weight alkylamines can be easily separated using an organic solvent-free eluent. The alkylamines elute with good peak efficiencies and symmetries using a simple acidic gradient and elevated temperature, as illustrated in Figure 7.

Determination of Diamines in Complex Sample Matrices

The unique hydrophilic cation-exchange surface of the Dionex IonPac CS17 column allows the separation of lithium, sodium, ammonium, potassium, magnesium and calcium, and alkyl diamines with an organic solvent-free eluent. The diamines elute after the six common cations with good peak efficiencies and symmetries using a simple acidic gradient and elevated temperature. Figure 8 illustrates the excellent selectivity for the diamines. Despite the gradient change from 3 mM to 40 mM methanesulfonic acid, the baseline shift is undetected. Alkyl diamines larger than 1,10-decanediamine are not soluble in aqueous solutions, and therefore require the addition of organic solvent to the eluent when they are present in the sample.

Figure 7. Separation of alkylamines and the Group I and II cations using the Dionex IonPac CS17 column.

Column:	Dionex IonPac CG17, CS17, 2 mm
Eluent:	0.5 mM to 1.1 mM MSA gradient at 12 min; gradient to 1.3 mM MSA at 16 min; gradient to 10 mM MSA at 25 min; isocratic to 27 min; step change back to 0.5 mM MSA at 27.1 min Equilibration time is 2 min
Flow Rate:	0.40 mL/min
Sample Volume:	25 µL
Temperature:	40 °C
Suppressor:	Dionex Cation Atlas Electrolytic Suppressor in AutoSuppression Recycle Mode, 13 mA

Peaks:		
1.	Lithium	0.03 mg/L (ppm)
2.	Sodium	0.10
3.	Ammonium	0.34
4.	Potassium	0.25
5.	Ethylamine	0.50
7.	*tert*-Butylamine	1.25
8.	*sec*-Butylamine	1.25
9.	*iso*-Butylamine	1.25
10.	n-Butylamine	3.75
11.	1,2-Dimethylpropylamine	1.00
12.	Di-n-propylamine	1.00
13.	Magnesium	0.14
14.	Calcium	0.34

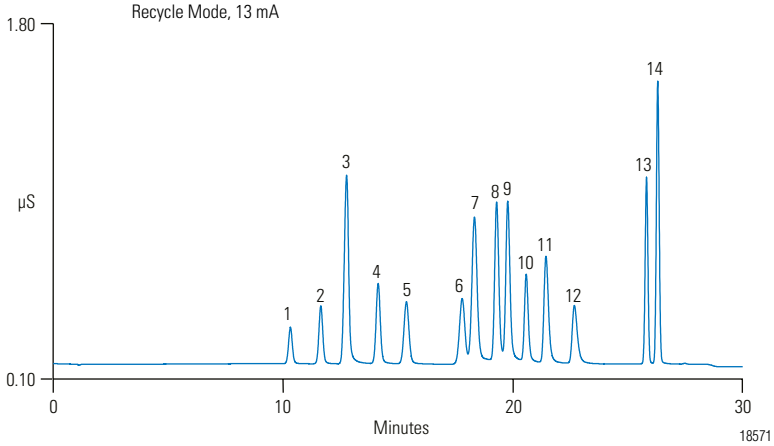
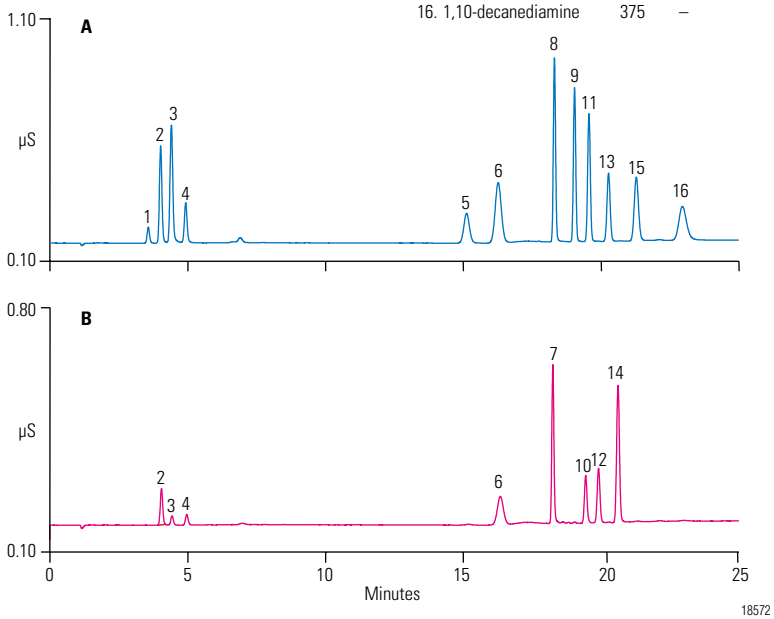


Figure 8. Determination of diamines and the Group I and II cations using the Dionex IonPac CS17 column.

Column:	Dionex IonPac CG17, CS17, 2 mm
Eluent:	3 mM MSA isocratic to 3.5 min; 3 mM to 6 mM MSA gradient at 12 min; isocratic to 15 min; gradient to 40 mM MSA at 20 min, isocratic to 24 min; step change back to 3 mM MSA at 24.1 min Equilibration time is 2 min
Flow Rate:	0.40 mL/min
Sample Volume:	25 µL
Temperature:	40 °C
Suppressor:	Dionex CSRS ULTRA 2 mm Cation Self-Regenerating Suppressor, AutoSuppression Recycle Mode, 100 mA

Peaks:		A	B
			– µg/L (ppb)
1.	Lithium	5	
2.	Sodium	65	16
3.	Ammonium	89	4
4.	Potassium	47	8
5.	Magnesium	24	–
6.	Calcium	56	18
7.	Ethylenediamine	–	200
8.	1,2-propanediamine	500	–
9.	1,6-hexanediamine	250	–
10.	N,N-diethylenediamine	–	200
11.	1,7-heptanediamine	125	–
12.	N,N,N,N-tetramethyl-ethylenediamine	–	200
13	1,8-octanediamine	250	–
14.	3,3-diaminopropylamine	–	200
15.	1,9-nonanediamine	375	–
16.	1,10-decanediamine	375	–



Solvent-Compatible Packing

The Dionex IonPac CS17 column is 100% solvent-compatible, including alcohols. Adding solvent to the eluent modifies column selectivity and facilitates the elution of nonpolar analytes or contaminants from the column. Solvent can be used to enhance sample solubility, reduce retention times, and improve peak shapes of hydrophobic amines. Time and expense can be saved by eliminating time-consuming sample preparation steps. This feature allows analysis of complex sample matrices with minimal preparation.

System Recommendations

The Dionex IonPac CS17 column in suppressed conductivity mode is recommended for use with the Thermo Scientific Dionex ICS-2100 or Thermo Scientific Dionex ICS-5000 equipped with an EG, or with older Dionex IC systems equipped with an EG or a Dionex RFC-30 Reagent-Free Controller. The eluent generator is used to automatically produce methanesulfonic acid gradients from deionized water. The Dionex CS17 capillary column requires the use of the Dionex ICS-5000 capillary system.

Suppressors

For optimum ease of use and performance, the Dionex IonPac CS17 analytical column can be used with the Dionex CSRS 300 and the Dionex IonPac CS17 capillary column can be used with the CCES™ 300.

Cation Trap Columns

When using the Eluent Generator, a Dionex CR-CTC II Continuously Regenerated Cation Trap Column for concentration should be installed between the Eluent Generator cartridge and the Eluent Generator Degas Module. Alternately, a Dionex CTC Cation Trap column can be installed between the gradient pump and the injection valve to remove cationic contaminants from the eluent.

Concentrator Columns

For trace analysis, use the Dionex IonPac CG17 Guard Column when a single-piston pump such as the Thermo Scientific Dionex AXP is used for sample delivery. Use one of the Thermo Scientific Dionex Trace Cation Concentrator columns (Dionex TCC-LP-1, TCC-ULP1, or TCC-XLP1) when using a syringe or autosampler. For concentrator work with a 0.4 mm capillary column, use the Dionex IonPac CG17 Capillary Guard Column or the Thermo Scientific Dionex MCC-100 Concentrator Column.

Product Specifications

SPECIFICATIONS

Dimensions	Dionex IonPac CS17 Capillary Column: 0.4 x 250 mm Dionex IonPac CG17 Capillary Guard Column: 0.4 x 50 mm Dionex CS17 Analytical Columns: 2 × 250 mm and 4 × 250 mm Dionex CG17 Guard Columns: 2 × 50 mm and 4 × 50 mm
Maximum Operating Pressure	4000 psi
Mobile Phase Compatibility	Acidic eluents, 100% HPLC solvents, including alcohols
Substrate Characteristics	Bead Diameter: 7 µm Crosslinking (%DVB): 55%
Ion-Exchange Group	Grafted carboxylic acid
Functional Group Characteristics	Very low hydrophobic
Capacity	14.5 µeq/column (0.4 × 250 mm) 2.9 µeq/column (0.4 × 50 mm) 1450 µeq/column (4 × 250 mm) 290 µeq/column (4 × 50 mm) 363 µeq/column (2 × 250 mm) 73 µeq/column (2 × 50 mm)
Column Construction	PEEK with 10-32 threaded ferrule-style end fittings. All components are nonmetallic.

ORDERING INFORMATION

To order in the U.S., call 1-800-346-6390, or contact the Thermo Fisher Scientific office nearest you. Outside the U.S., order through your local Thermo Fisher Scientific office or distributor. Refer to the following part numbers.

Dionex IonPac CS17 Columns	**Part Number**
Dionex IonPac CS17 Analytical Column (4 × 250 mm)	060557
Dionex IonPac CG17 Guard Column (4 × 250 mm)	060560
Dionex IonPac CS17 Analytical Column (2 × 250 mm)	060561
Dionex IonPac CG17 Guard Column (2 × 50 mm)	060563
Dionex IonPac CS17 Capillary Column (0.4 × 250 mm)	075774
Dionex IonPac CG17 Capillary Guard Column (0.4 × 50 mm)	075775

Trap Columns	**Part Number**
Dionex CR-CTC II Continuously Regenerated Cation Trap Column	066262
Dionex CR-CTC Continuously Regenerated Cation Trap Column (Capillary) (For use with Capillary Cation Columns)	072079
Dionex CTC-1 Cation Trap Column (9 × 24 mm) for use with the 4 mm columns	040192
Dionex CTC Cation Trap Column (4 × 35 mm) for use with the 2 mm columns	043132

Cation Concentrator Columns	**Part Number**
Dionex TCC-LP1 Low Pressure Trace Cation Concentrator (4 × 35 mm) for use with the 2 mm and 4 mm columns	046027
Dionex TCC-ULP1 Ultra Trace Cation Concentrator-Ultra Low Pressure (5 × 23 mm)	063783
Dionex TCC-XLP1 Ultra Trace Cation Concentrator-Extremely Low Pressure (6 × 16 mm)	063889
Dionex MCC-100 Monolith Cation Concentrator Column (0.5 × 80 mm)	075462

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ISO 9001 REGISTERED

Thermo Scientific Dionex products are designed, developed, and manufactured under an ISO 9001 Quality System.

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