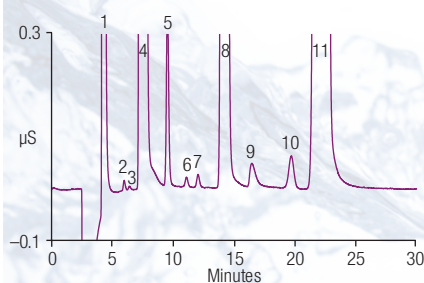


Thermo Scientific Dionex IonPac AS23 Anion-Exchange Column

The Thermo Scientific™ Dionex™ IonPac™ AS23 high-capacity, carbonate based anion-exchange column is designed for the analysis of oxyhalides and the common inorganic anions including fluoride, chlorite, bromate, chloride, nitrite, chlorate, bromide, nitrate, phosphate, and sulfate in drinking water, groundwater, wastewater, and other diverse sample matrices. The key application for the Dionex IonPac AS23 anion-exchange column is determination of trace bromate in drinking water matrices using an isocratic carbonate/bicarbonate eluent with suppressed conductivity detection. The Dionex IonPac AS23 column can be used in combination with the Thermo Scientific Dionex Eluent Generators and the Thermo Scientific Dionex Electrolytic pH Modifier (EPM), which automatically produce potassium carbonate/bicarbonate eluents from water.

Determination of Trace Concentrations of Bromate Using the Dionex IonPac AS23 Column with a Large-Loop Injection



Column: Dionex IonPac AG23/AS23 (4 × 250 mm)
 Eluent: 4.5 mM Sodium carbonate/
 0.8 mM Sodium bicarbonate
 Temperature: 30 °C
 Flow Rate: 1.0 mL/min
 Inj. Volume: 200 µL
 Detection: Suppressed conductivity, Thermo Scientific™ Dionex™ ASRS™ ULTRA II 4 mm Anion Self-Regenerating Suppressor, Thermo Scientific™ Dionex™ AutoSuppression™ device, external water mode

Peaks:	mg/L (ppm)
1. Fluoride	1.0
2. Chlorite	0.01
3. Bromate	0.005
4. Chloride	50
5. Nitrite	0.1
6. Chlorate	0.01
7. Bromide	0.01
8. Nitrate	10
9. Carbonate	50
10. Phosphate	0.1
11. Sulfate	50

Meets Regulatory Requirements

The Dionex IonPac AS23 column meets the performance requirements specified in U.S. EPA Methods 300.0 and 300.1 for the determination of oxyhalides produced as byproducts in disinfection of drinking water. The selectivity of the Dionex IonPac AS23 column ensures that bromate, a toxic byproduct in ozone disinfection, can be quantified at low µg/L concentrations using suppressed conductivity detection even in the presence of very high concentrations of

chloride, sulfate, and carbonate. The Dionex IonPac AS23 column allows the analysis of most drinking water, disinfected with ozone, without the use of sample pretreatment or pre-concentration. Solvent compatibility permits easy column cleanup after the analysis of samples with hydrophobic components. The Dionex IonPac AS23 column is available in 4 mm, 2 mm and 0.4 mm i.d. formats.



Superior Chromatographic Performance

- Recommended carbonate based anion-exchange column for trace bromate in drinking water matrices.
- Optimized isocratic carbonate/bicarbonate eluent for the separation of oxyhalides and inorganic anions in a variety of sample matrices.
- Carbonate peak well resolved from common inorganic anions and oxyhalides.
- Meets performance requirements specified in U.S. EPA Methods 300.0 and 300.1.
- Ideal alternative for Dionex IonPac AS9-HC column oxyhalide and inorganic anion applications.
- Simplified Reagent-Free™ Ion Chromatography (RFIC™) system operation provided by Dionex Eluent Generators and Dionex EPM, which require only a deionized water source to produce potassium carbonate/bicarbonate eluent.
- Simple, accurate eluent preparations with the Dionex IonPac AS23 Eluent Concentrate – just dilute in deionized water and start operation.
- Eluent suppression using the Thermo Scientific™ Dionex™ AERS™ 500 Anion Electrolytically Regenerated Suppressor or Thermo Scientific™ Dionex™ ACES™ 300 Anion Capillary Electrolytic Suppressor technology provides RFIC operation with low backgrounds and enhanced analyte sensitivity.
- High-capacity: 320 µeq/col. (4 × 250 mm column).
- Operate at ambient or elevated temperatures. Column selectivity is optimized for a 30 °C operating temperature to ensure reproducible retention times in all environmental conditions.
- Compatible with organic solvents to enhance analyte solubility, modify column selectivity, or for effective column cleanup.
- Available in standard bore, microbore and capillary formats supporting flow rates from 2.0 mL/min to 10 µL/min.

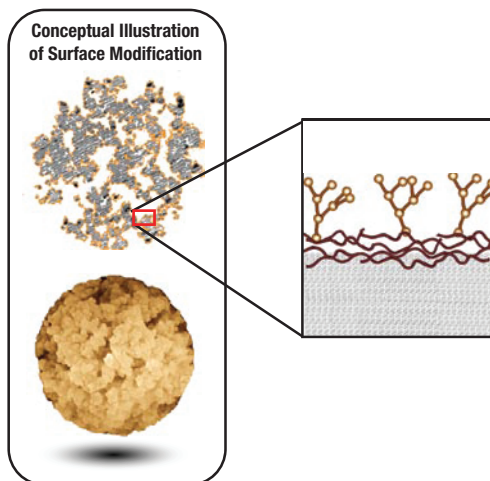


Figure 1. Structure of a Dionex IonPac AS23 packing particle.

High Efficiency Particle Structure

The Dionex IonPac AS23 column was developed using a unique polymer bonding technology. The stationary phase consists of a novel hyper-branched anion-exchange condensation polymer, electrostatically attached to the surface of a wide-pore polymeric substrate. The substrate is surface-sulfonated in exactly the same manner as is common in Thermo Scientific Dionex latex coated anion-exchange resin, alternating treatments of epoxy monomer and amines produce a coating which is grown directly off the substrate surface as illustrated in Figure 1. Resin capacity is controlled through the number of alternating coating cycles. The Dionex IonPac AS23 column uses a high-capacity resin (320 µeq/4 mm column) with optimized selectivity for the oxyhalides and common inorganic anions in diverse sample matrices.

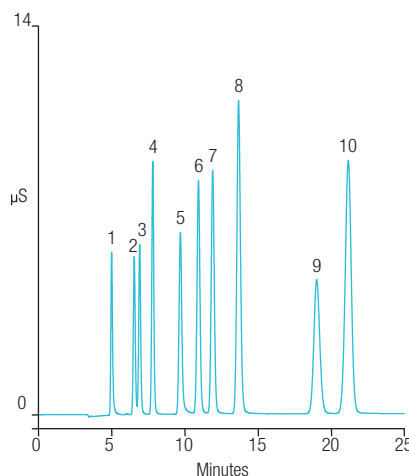


Figure 2. Determination of oxyhalides and inorganic anions using the Dionex IonPac AS23 Capillary column.

Economical Capillary Operation

The Dionex IonPac AS23 column is available in the 0.4 mm i.d. format for capillary operation to offer the advantage of reduced operating costs.

- Ideal for limited sample volumes due to higher mass sensitivity.
- One hundred fold reduction in eluent consumption and waste disposal.
- 4 mm applications can be directly transferred to the 0.4 mm format by reducing flow rate by one hundred fold.

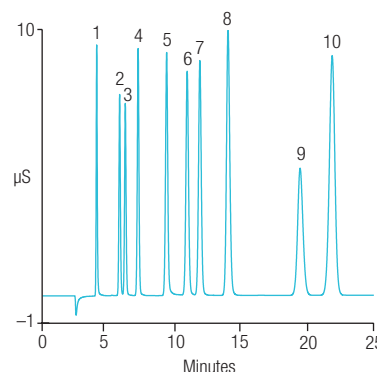
Figure 2 is an example of the separation of inorganic anions and oxyhalides using the Dionex IonPac AS23 Capillary column.

Determination of Oxyhalides and Inorganic Anions in Diverse Sample Matrices

The Dionex IonPac AS23 column is designed for the separation of oxyhalides and the common inorganic anions in a variety of sample matrices. These analytes can easily be separated in approximately 23 min using an isocratic carbonate/bicarbonate eluent coupled with suppressed conductivity detection as shown in Figure 3.

Column: Dionex IonPac AG23/AS23 (0.4 × 250 mm)
 Eluent: 4.5 mM Sodium carbonate/
 0.8 mM Sodium bicarbonate
 Temperature: 30 °C
 Flow Rate: 10 µL/min
 Inj. Volume: 0.4 µL
 Detection: Suppressed conductivity, Dionex ACES 300 Suppressor, recycle mode

Peaks:	mg/L (ppm)
1. Fluoride	1.9
2. Chlorite	6.3
3. Bromate	13.5
4. Chloride	3.8
5. Nitrite	9.4
6. Chlorate	15.6
7. Bromide	15.6
8. Nitrate	15.6
9. Phosphate	25
10. Sulfate	18.8



Column: Dionex IonPac AG23/AS23 (4 × 250 mm)
 Eluent: 4.5 mM Sodium carbonate/
 0.8 mM Sodium bicarbonate
 Temperature: 30 °C
 Flow Rate: 1.0 mL/min
 Inj. Volume: 25 µL
 Detection: Suppressed conductivity, Dionex ASRS ULTRA II 4 mm Suppressor, Dionex AutoSuppression device, recycle mode

Peaks:	mg/L (ppm)
1. Fluoride	3
2. Chlorite	10
3. Bromate	20
4. Chloride	6
5. Nitrite	10
6. Chlorate	25
7. Bromide	25
8. Nitrate	25
9. Phosphate	40
10. Sulfate	30

Figure 3. Determination of oxyhalides and inorganic anions using the Dionex IonPac AS23 column.

Figure 4 shows the separation of the oxyhalides and the common inorganic anions in a municipal drinking water sample. The high-capacity and selectivity allows for the separation of nitrate from carbonate even in the presence of high concentrations (over 300 mg/L) of carbonate. Figure 5 shows the separation of oxyhalides and common inorganic anions in a different municipal drinking water sample using the Dionex IonPac AS23 Capillary column. This sample was spiked with the surrogates malonate and succinate which are well resolved from the other anions.

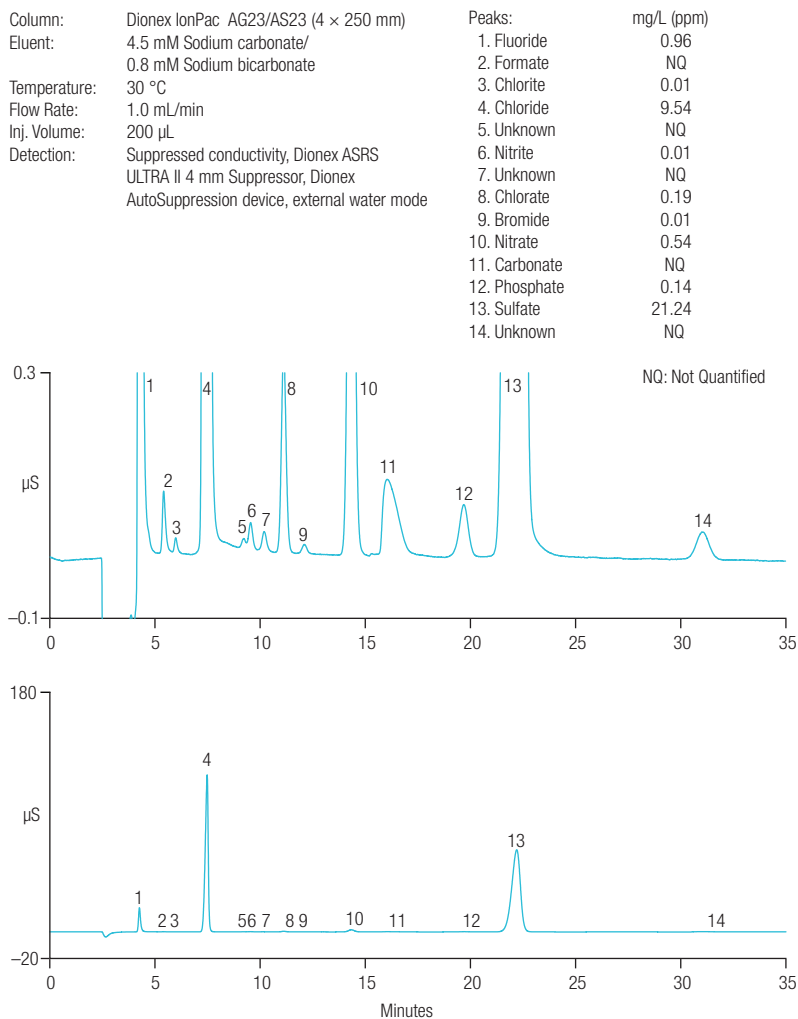


Figure 4. Determination of oxyhalides and inorganic anions in a municipal drinking water sample using the Dionex IonPac AS23 column.

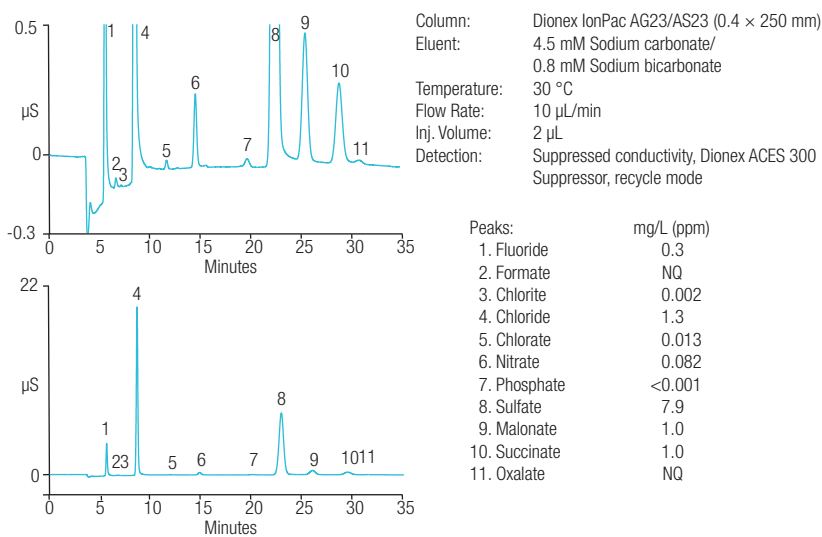


Figure 5. Separation of oxyhalides, common inorganic anions and surrogate anions in municipal drinking water using the Dionex IonPac AS23 Capillary column.

Figure 6 shows the separation of inorganic anions, oxyhalides, and organic acids in a chemical plant wastewater sample. Low levels of inorganic anions can easily be determined even in the presence of high levels of sulfate, chlorate, acetate, and formate. Figure 7 shows the analysis of a different wastewater sample using the Dionex IonPac AS23 Capillary column. Low levels of fluoride, bromate, chlorate and bromide are easily determined in the presence of relatively high levels of chloride, nitrate and sulfate.

Column:	Dionex IonPac AG23/AS23 (4 × 250 mm)	Peaks:	mg/L (ppm)
Eluent:	4.5 mM Sodium carbonate/ 0.8 mM Sodium bicarbonate	1. Acetate	877.8
Temperature:	30 °C	2. Formate	183.2
Flow Rate:	1.0 mL/min	3. Chloride	61.8
Inj. Volume:	2.5 µL	4. Nitrite	0.6
Detection:	Suppressed conductivity, Dionex ASRS ULTRA II 4 mm Suppressor, Dionex AutoSuppression device, external water mode	5. Chlorate	213.8
		6. Nitrate	1.5
		7. Phosphate	1.4
		8. Sulfate	1211.1
		9. Unknown	NQ

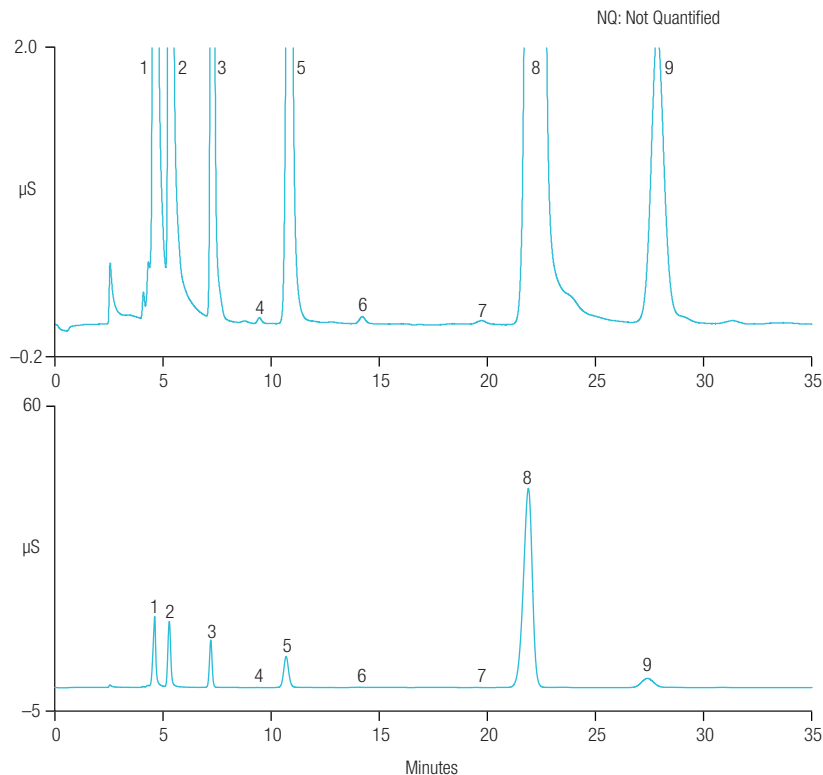


Figure 6. Separation of inorganic anions, oxyhalides, and organic acids in a chemical wastewater sample using the Dionex IonPac AS23 column.

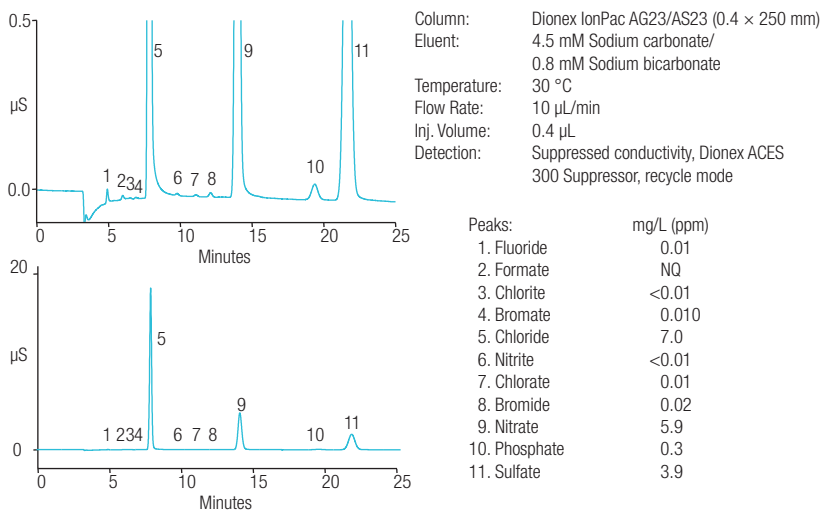


Figure 7. Separation of inorganic anions and oxyhalides in a wastewater sample using the Dionex IonPac AS23 Capillary column.

Determination of Trace Bromate in Drinking Water Matrices

The high-capacity Dionex IonPac AS23 column can easily determine bromate at low $\mu\text{g/L}$ concentrations in drinking water matrices. Bromate, a disinfection byproduct of the ozonation disinfection process for drinking water, has been cited by the U.S. EPA and the World Health Organization as a potential carcinogen, even at low $\mu\text{g/L}$ concentrations. Treatment plants that use ozone for disinfection are required to monitor bromate, with a MCL of $10 \mu\text{g/L}$, plus the common inorganic anions. The Dionex IonPac AS23 column allows the analysis of most drinking water, disinfected with ozone, without the use of sample pretreatment or preconcentration. This method uses a large-loop injection with an isocratic carbonate/bicarbonate eluent coupled with suppressed conductivity detection as shown in Figure 8. Figure 9 shows the analysis of trace level bromate in a simulated drinking water sample using the Dionex IonPac AS23 Capillary column. The injection volume was scaled down to $2 \mu\text{L}$ simulating the large-loop injection on the standard bore column.

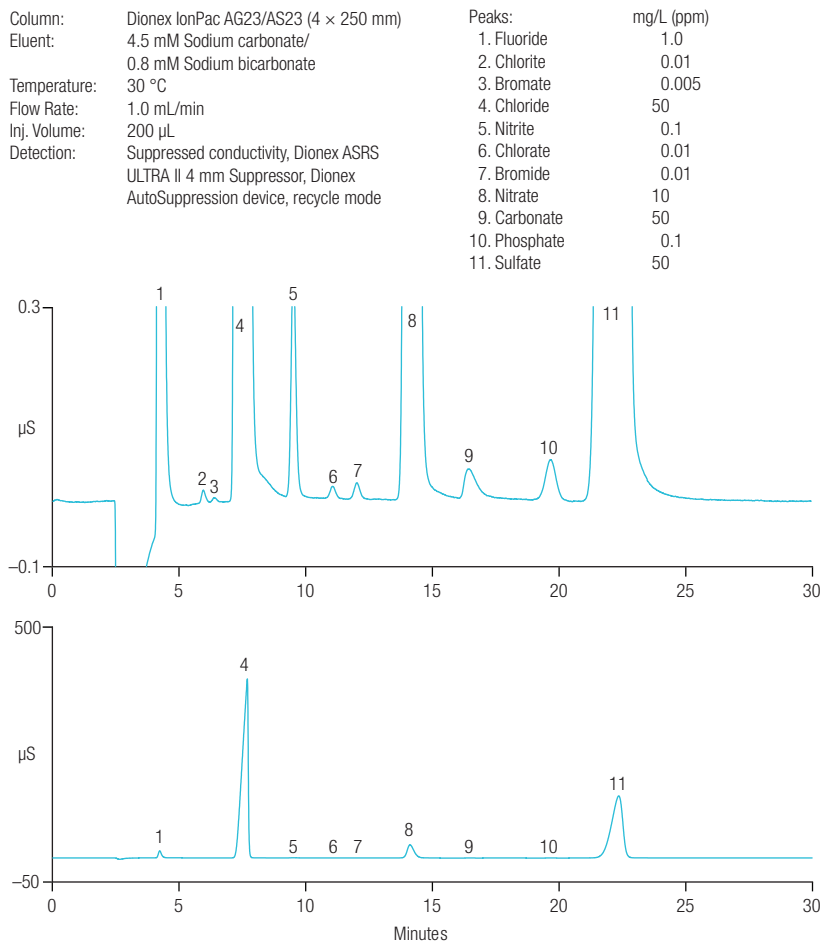


Figure 8. Determination of trace concentrations of bromate using the Dionex IonPac AS23 column with a large-loop injection.

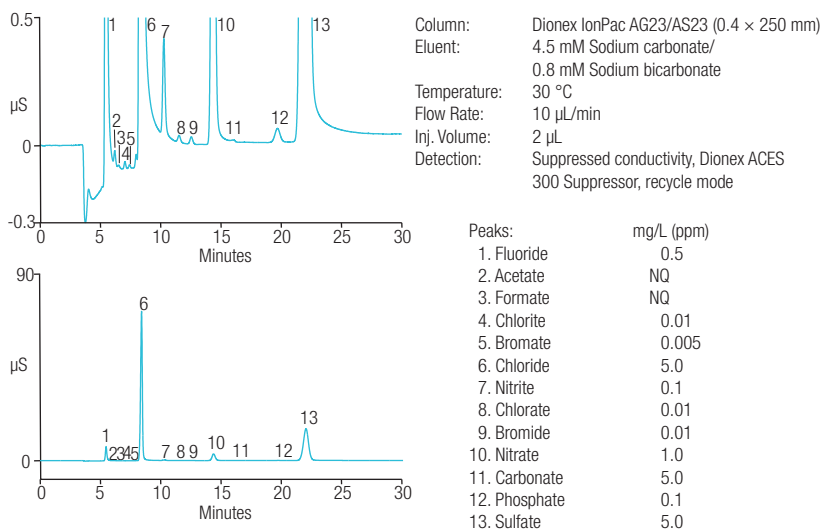


Figure 9. The analysis of trace bromate in a simulated drinking water sample using a large-loop injection on the Dionex IonPac AS23 Capillary column.

Extended Application Capabilities

The unique selectivity and high-capacity of the Dionex IonPac AS23 column make it an ideal column for method development of specialized anion applications. The Dionex IonPac AS23 column provides excellent separation of a variety of environmental anions including inorganic anions, oxyhalides, oxyanions, and organic acids using potassium hydroxide eluent. With a hydroxide gradient, these analytes are easily separated in less than 35 min as shown in Figure 10. Figure 11 shows the gradient separation of the same analytes using the Dionex IonPac AS23 Capillary column.

Column:	Dionex IonPac AG23/AS23 (4 × 250 mm)	Peaks:	mg/L (ppm)	Peaks:	mg/L (ppm)
Eluent:	Potassium hydroxide: 5 mM from 0 to 5 min, 5–30 mM from 5 to 15 min, 30–40 mM from 15 to 30 min	1. Fluoride	2	13. Sulfate	10
Eluent Source:	Thermo Scientific Dionex EGC II KOH Cartridge with Thermo Scientific Dionex CR-ATC Continuously Regenerated Anion Trap Column	2. Acetate	10	14. Selenate	10
Temperature:	30 °C	3. Butyrate	10	15. Oxalate	10
Flow Rate:	1.0 mL/min	4. Formate	10	16. Phthalate	20
Inj. Volume:	10 µL	5. Chlorite	10	17. Phosphate	20
Detection:	Suppressed conductivity, Dionex ASRS ULTRA II 4 mm Suppressor, Dionex AutoSuppression device, recycle mode	6. Bromate	10	18. Chromate	20
		7. Chloride	5	19. Iodide	20
		8. Nitrite	10	20. Arsenate	20
		9. Chlorate	10	21. Citrate	20
		10. Bromide	10	22. Thiocyanate	20
		11. Nitrate	10	23. Perchlorate	30
		12. Carbonate	20		

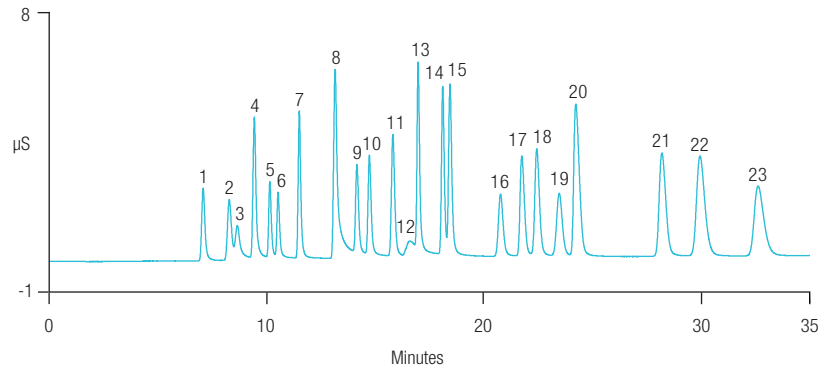


Figure 10. Anion separation including inorganic anions, organic acids, oxyanions, and oxyhalides using the Dionex IonPac AS23 column, using a potassium hydroxide eluent delivered by an eluent generator.

Column:	Dionex IonPac AG23/AS23 (0.4 × 250 mm)	Peaks:	mg/L (ppm)	Peaks:	mg/L (ppm)
Eluent:	Potassium hydroxide: 5 mM KOH from 0 to 4 min, 5–30 mM KOH from 4 to 9 min, 30–40 mM KOH from 9 to 24 min	1. Fluoride	0.5	13. Sulfate	2.5
Eluent Source:	Dionex EGC 500 KOH cartridge	2. Acetate	2.5	14. Selenate	2.5
Temperature:	30 °C	3. Butyrate	2.5	15. Oxalate	2.5
Flow Rate:	10 µL /min	4. Formate	2.5	16. Phthalate	5.0
Inj. Volume:	0.4 µL	5. Chlorite	2.5	17. Phosphate	5.0
Detection:	Suppressed conductivity, Dionex ACES 300 Suppressor, recycle mode	6. Bromate	2.5	18. Chromate	5.0
		7. Chloride	1.0	19. Iodide	5.0
		8. Nitrite	2.5	20. Arsenate	5.0
		9. Chlorate	2.5	21. Citrate	5.0
		10. Bromide	2.5	22. Thiocyanate	5.0
		11. Nitrate	2.5	23. Perchlorate	6.0
		12. Carbonate	5.0		

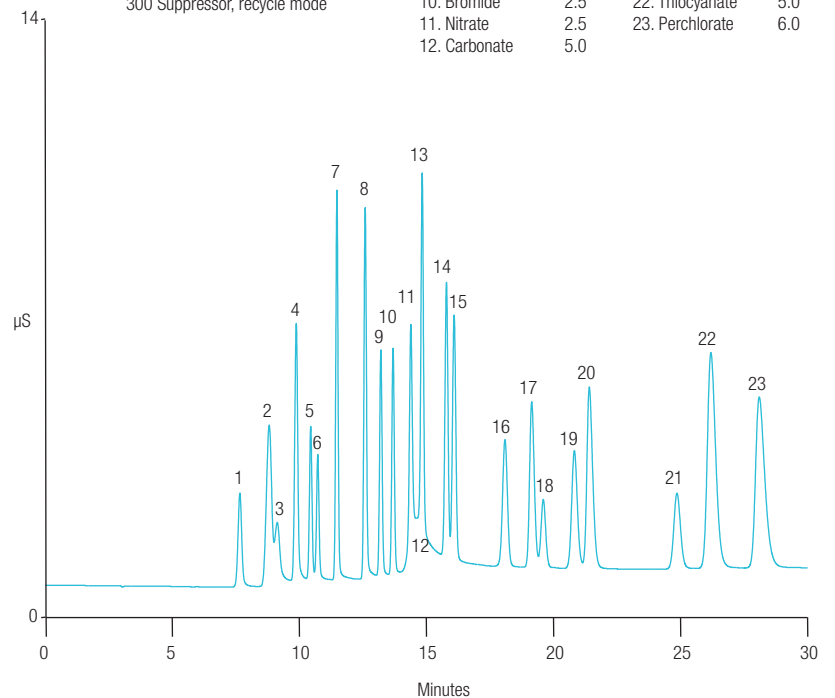


Figure 11. Separation of a wide variety of environmental anions using the Dionex IonPac AS23 Capillary column.

System Requirements

The Dionex IonPac AS23 Capillary column is recommended for use with the Thermo Scientific Dionex ICS-5000+ or Thermo Scientific Dionex ICS-4000 Capillary HPIC system. The Dionex IonPac AS23 Analytical column is recommended for use with the Dionex ICS-2100 or Dionex ICS-5000+ RFIC system equipped with an eluent generator and EPM. The Dionex IonPac AS23 Analytical column can also be used with older Dionex IC systems equipped with an eluent generator and EPM or a Thermo Scientific Dionex RFC-30 Reagent-Free Controller. The eluent generator is used to automatically produce carbonate and bicarbonate eluents from deionized water.

Suppressor Recommendations

For optimum ease-of-use and performance, the Dionex IonPac AS23 column should be used with the Dionex AERS 500 Suppressor or the Dionex ACES 300 Suppressor.

Concentrator Columns

For concentrator work with a 2 mm or 4 mm Dionex IonPac AS23 column, use the: Dionex IonPac AG23 guard column; Ultratrace Anion Concentrator Columns (Dionex IonPac UTAC-ULP1, UTAC-XLP1, UTAC-ULP2, or UTAC-XLP2) or Trace Anion Concentrator Column (Dionex IonPac TAC-ULP1) when a single piston pump such as the Thermo Scientific Dionex AXP Auxiliary Pump (pulse damper required) is used for sample delivery. In addition to the concentrator columns listed above, use the Dionex IonPac UTAC-LP1, UTAC-LP2 or TAC-LP1 when the sample is delivered using a syringe or a low-pressure autosampler, such as the Thermo Scientific Dionex AS-DV Autosampler. For concentrator work with a 0.4 mm capillary column, use the Dionex IonPac AG23 Capillary Guard Column or the Thermo Scientific™ Dionex™ IonSwift™ MAC-100 Concentrator Column.

SPECIFICATIONS

Dimensions:	Dionex IonPac AS23 Analytical Column:	2 × 250 mm and 4 × 250 mm
	Dionex IonPac AS23 Capillary Column:	0.4 × 250 mm
	Dionex IonPac AG23 Guard Column:	2 × 50 mm and 4 × 50 mm
	Dionex IonPac AS23 Capillary Guard Column:	0.4 × 50 mm
Maximum Operating Pressure:	3000 psi	
Mobile Phase Compatibility:	pH 0–14; 0–100% HPLC solvents	
Substrate Characteristics:	Analytical Column:	Supermacroporous resin Bead diameter (µm): 6 Pore Size: 2000 Å Cross-linking (%DVB): 55%
	Guard Column:	Microporous resin Bead Diameter (µm): 11 Pore Size: <1 Å Cross-linking (%DVB): 55%
Ion-Exchange Group:	Functional Group:	Alkanol quaternary ammonium ion
Functional Group Characteristics:	Hydrophobicity:	Ultralow
Capacity:	80 µeq (2 × 250 mm column)	
	1.5 µeq (2 × 50 mm column)	
	320 µeq (4 × 250 mm column)	
	6.0 µeq (4 × 50 mm column)	
	3.2 µeq (0.4 × 250 mm column)	
	0.06 µeq (0.4 × 50 mm column)	
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.

Description	Part Number
Dionex IonPac AS23 Columns	
Dionex IonPac AS23 Analytical Column (4 × 250 mm)	064149
Dionex IonPac AG23 Guard Column (4 × 50 mm)	064147
Dionex IonPac AS23 Analytical Column (2 × 250 mm)	064145
Dionex IonPac AG23 Guard Column (2 × 50 mm)	064143
Dionex IonPac AS23 Capillary Column (0.4 × 250 mm)	079782
Dionex IonPac AG23 Capillary Guard Column (0.4 × 50 mm)	083160
Trace Anion Concentrator Columns	
Dionex IonPac TAC-2 Trace Anion Concentrator (3 × 35 mm)	043101
Dionex IonPac TAC-LP1 Trace Anion Concentrator (4 × 35 mm)	046026
Dionex IonSwift MAC-100 Monolith Anion Concentrator (0.5 × 80 mm) (for use with Capillary IC)	074702
Dionex IonPac TAC-LP1 Trace Anion Concentrator (4 × 35 mm)	046026
Dionex IonPac TAC-ULP1 Trace Anion Concentrator (5 × 23 mm)	061400
Dionex IonPac UTAC-LP1 Ultra Trace Anion Concentrator Low-Pressure (4 × 35 mm)	063079
Dionex IonPac UTAC-ULP1 Ultra Trace Anion Concentrator Ultra Low-Pressure (5 × 23 mm)	063475
Dionex IonPac UTAC-XLP1 Ultra Trace Anion Concentrator Extremely Low-Pressure (6 × 16 mm)	063459
Dionex IonPac UTAC-LP2 Ultra Trace Anion Concentrator Low-Pressure (4 × 35 mm)	079917
Dionex IonPac UTAC-ULP2 Ultra Trace Anion Concentrator Ultra Low-Pressure (5 × 23 mm)	079918
Dionex IonPac UTAC-XLP2 Ultra Trace Anion Concentrator Extremely Low-Pressure (6 × 16 mm)	072781
Anion Eluent Concentrates	
Dionex IonPac AS23 Eluent Concentrate (100×), 250 mL	064161

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