Application proof note | 002341

Environmental

Determination of cations and ammonium in environmental waters using a compact RFIC ion chromatography system

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Keywords

Dionex Inuvion IC, Dionex IonPac CS16-4µm column, drinking water, wastewater

Introduction

The amount of alkali and alkaline earth cations and ammonium in drinking and environmental waters can vary significantly depending on the sample. A high-capacity cation exchange column installed on a reagent-free ion chromatography (RFIC™) system with suppressed conductivity detection provides the accuracy and sensitivity as well as a wide calibration range for determining these analytes.

In this application proof note, the performance of the easy-to-use, compact Thermo Scientific™ Dionex™ Inuvion™ ion chromatography system equipped with a Thermo Scientific™ Dionex™ IonPac™ CS16-4µm (4 × 250 mm) cation-exchange column was demonstrated and compared to previously published Thermo Scientific Application Update 204[1] to show the new instrument is suitable for this application.

Method

Reagents and standards

- Deionized (DI) water, Type I reagent grade, 18 MΩ·cm resistance or better
- Calcium chloride dihydrate, Fisher Chemical (P/N C79)
- Magnesium chloride hexahydrate, Sigma-Aldrich (P/N M9272)
- Potassium chloride, Fisher Chemical (P/N P330)
- Ammonium Standard, 1,000 µg/mL, Agilent Technologies (P/N ICC-101)
- Sodium chloride, Sigma-Aldrich (P/N S9888)
- Lithium chloride, Fisher Chemical (P/N L121)
- Thermo Scientific™ Dionex™ Combined Six Cation Standard-II (P/N 046070)

Instrument method parameters

Instrument	Dionex Inuvion IC system (P/N 22185-60108), including column heater, pump degas module, and eluent generation
Autosampler	Thermo Scientific™ Dionex™ AS-DV autosampler (P/N 068907) with 5 mL Thermo Scientific™ Dionex™ PolyVials™ and filter caps (P/N 038141)
Columns	Dionex IonPac CS16-4µm, Analytical, 4 × 250 mm (P/N 088584) Dionex IonPac CG16-4µm, Guard, 4 × 50 mm (P/N 088585)
Eluent	30 mM MSA
Eluent source	Thermo Scientific™ Dionex™ EGC 500 MSA cartridge (P/N 075779), Thermo Scientific™ Dionex™ CR-CTC 600 (P/N 088663), Thermo Scientific™ Dionex™ RFIC™ eluent degasser module
Flow rate	0.90 mL/min
Column temp.	40 °C
Injection volume	10 µL
Detection	Suppressed conductivity, Thermo Scientific™ Dionex™ CDRS 600 (4 mm) suppressor (P/N 088668CMD or 088668), 79 mA, recycle mode
System backpressure	~4,100 psi (100 psi = 689.5 kPa)
Background conductance	<0.5 µS/cm
Noise	~0.2 nS/cm
Run time	22 min
Software	Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) software version 7.3.2

Results and discussion

The analysis method in Application Update 204 was followed to demonstrate the performance of a Dionex Inuvion ion chromatography system.

Table 1 shows the calibration range and MDLs for each cation.

Table 1. Working range and MDLs for cations and ammonium

Cation	Range (mg/L)	Coefficient of determination (r^2)	MDL standard (µg/L)	Calculated MDL[a] (µg/L)
Li^+	0.03–80	1.0000	1	0.14
Na^+	0.1–1000	0.9999	4	0.59
NH_4^+ [b]	0.02–40	0.9965	5	1.76
K^+	0.03–80	0.9996	10	1.31
Mg^{2+}	0.03–80	0.9999	5	0.11
Ca^{2+}	0.03–80	0.9997	10	11.88

[a]MDL = (t) × (S), where t = Student's t value for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom (t = 3.14 for seven replicates of the MDL standard), and S = standard deviation of the replicate analysis.

[b]Quadratic fit

Two samples, drinking water and wastewater secondary effluent, were tested for cations and ammonium. The wastewater sample was filtered and injected without dilution (Figure 1).

Samples:	A. Drinking water	B. Wastewater secondary effluent
Peaks:		
1. Lithium	<0.03	<0.03 mg/L
2. Sodium	6.05	146
3. Ammonium	0.69	0.49
4. Potassium	0.38	16.1
5. Magnesium	0.77	36.7
6. Calcium	4.11	51.9

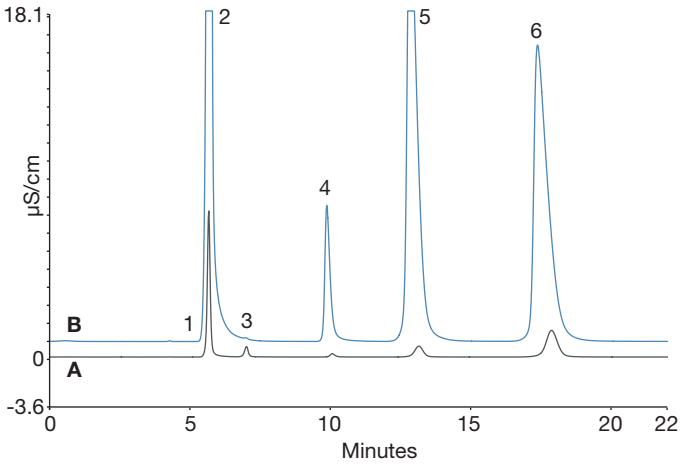

Figure 1. Determination of inorganic cations and ammonium in environmental waters

Conclusions

The study successfully demonstrates the performance of a Dionex Inuvion IC system using a Dionex IonPac CS16-4µm column for determining cations and ammonium in environmental waters.

Reference

1. Thermo Scientific Application Update 204: Analysis of Environmental Waters for Cations and Ammonium Using a Compact Ion Chromatography System. 2016 (accessed June 2023)

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AP002341-EN 0124S