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Environmental

Determination of perchlorate in drinking water using a compact RFIC ion chromatography system

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Introduction

Perchlorate contamination in drinking water can cause developmental issues in children and metabolic problems in adults by affecting hormone production and inhibiting thyroid function. United States Environmental Protection Agency (EPA) Method 314.0 uses high-performance anion exchange chromatography with suppressed conductivity detection to determine perchlorate in drinking water.[1] Thermo Scientific Application Update 148[2] and Application Note 73267[3] describe methods to determine perchlorate in drinking water according to EPA Method 314.0 and ISO 19340[4].

In this application proof note, the performance of a compact and easy-to-use Thermo Scientific™ Dionex™ Inuvion™ ion chromatography system equipped with a Thermo Scientific™ Dionex™ IonPac™ AS16-4µm (2 × 250 mm) anion-exchange column set, eluent generation, and a suppressor upgraded to current technology was shown to be ideal for determining perchlorate in drinking water.

Method

Reagents and standards

- Deionized (DI) water, Type I reagent grade, 18 MΩ·cm resistance or better
- Sodium perchlorate monohydrate, Aldrich (P/N 31,051-4)
- Sodium fluoride, Fisher Chemical (P/N S299)
- Sodium chloride, Sigma-Aldrich (P/N 9888-500G)
- Sodium bromide, Fisher Chemical (P/N S255)
- Sodium nitrate, Fisher Chemical (P/N S343)
- Sodium nitrite, Fisher Scientific (P/N S347)
- Sodium sulfate, EM (P/N SX0760-1)
- Sodium phosphate, dibasic, Aldrich (P/N 21,988-6)
- Sodium carbonate, Fisher Chemical (P/N S262-3)
- Sodium iodide, Sigma (P/N S-8379)
- 4-chlorobenzenesulfonic acid, TCI (P/N C0606)
- Sodium thiosulfate, J.T. Baker (P/N 1-3949)
- Sodium thiocyanate, Sigma (P/N S-7757)

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 AS16-4µm (2 × 250 mm), analytical separator, (P/N 302755) Dionex IonPac AG16-4µm (2 × 50 mm), guard column, (P/N 302756)
Eluent	65 mM KOH via RFIC eluent generation
Eluent source	Thermo Scientific™ Dionex™ EGC 500 KOH cartridge (P/N 075778), Thermo Scientific™ Dionex™ CR-ATC 600 continuously regenerated anion trap column (P/N 088662), Thermo Scientific™ Dionex™ RFIC™ eluent degasser module (P/N 106-60001)
Flow rate	0.38 mL/min
Column temp.	30 °C
Injection volume	250 µL
Detection	Suppressed conductivity, Thermo Scientific™ Dionex™ ADRS 600 (2 mm) suppressor (P/N 088667CMD or 088667), 62 mA , constant current, recycle mode
System backpressure	~3,800 psi (100 psi = 689.5 kPa)
Background conductance	<1.4 µS/cm
Noise	<1.1 nS/cm
Run time	12 min
Software	Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) software version 7.3.2

Results

Drinking water samples from different municipalities were analyzed for perchlorate. To quantify the samples, the response of perchlorate to concentration was determined using triplicate injections of 1, 2, 5, 10, 25, and 50 µg/L perchlorate. The response was shown to be linear without forcing through zero, with a coefficient of determination, $r^2 = 0.99965$.

Figure 1 shows a zoomed in view of the chromatograms of 25 µg/L perchlorate in DI water, in 200 mg/L each chloride, sulfate, and carbonate (MA 200), and 1,000 mg/L each chloride, sulfate and carbonate (MA 1,000).

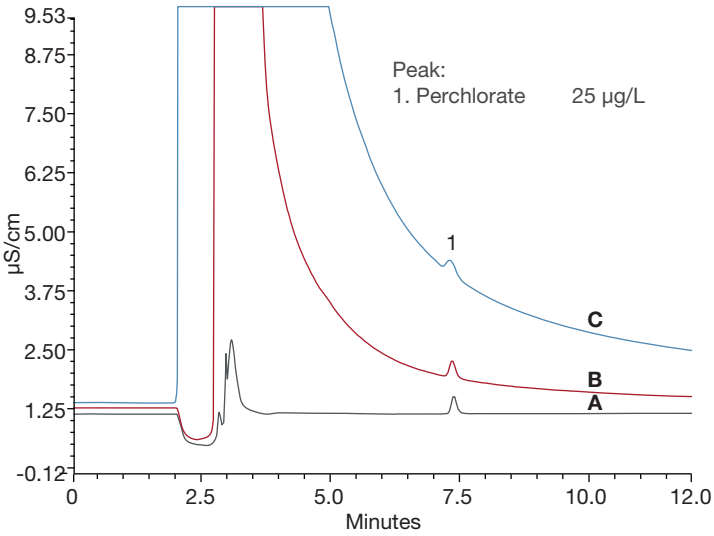

Figure 1. Determination of 25 µg/L perchlorate in (A) DI water, (B) MA 200, and (C) MA 1,000

Four drinking water samples were tested for perchlorate and the results are shown in Table 1. Perchlorate was not detected in two samples and less than 1 µg/L perchlorate was detected in the other two samples.

Table 1. Determination of perchlorate in four drinking water samples

	DW1	DW2	DW3	DW4
Perchlorate (µg/L)	0.94	n.a	0.83	n.a.

To evaluate method accuracy, 4 µg/L perchlorate was added to each drinking water sample and recovery was calculated (Figure 2). The range of recovery for perchlorate spiked in drinking water was 86–100%.

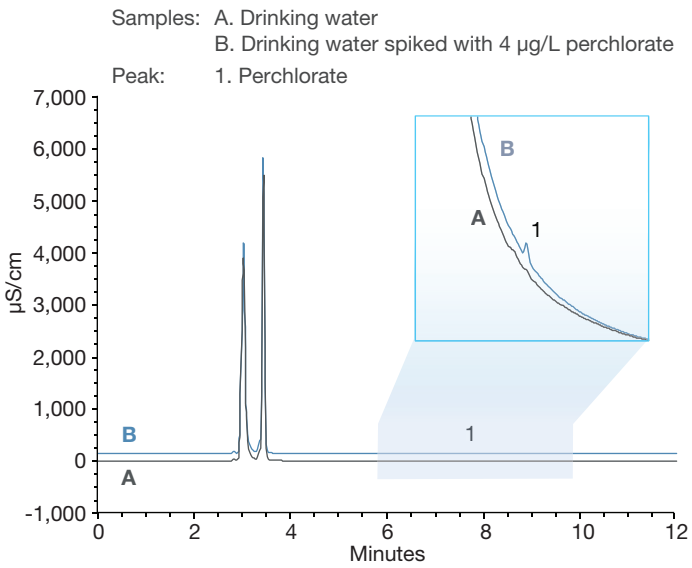

Figure 2. Determination of perchlorate in drinking water

Conclusions

The study successfully demonstrates the performance of the Thermo Scientific Dionex Inuvion system using a Dionex IonPac AS16-4µm column for determining perchlorate in drinking water as was previously shown in Thermo Scientific Application Note 73267.

References

1. U.S. EPA Method 314.0; U.S. Environmental Protection Agency; Cincinnati, OH, 1997.
2. Thermo Fisher Scientific Application Update 148: Determination of perchlorate in drinking water using a reagent-free ion chromatography system.
3. Thermo Fisher Scientific Application Note 73267: Determination of perchlorate in drinking water using ion chromatography.
4. International Organization for Standardization. (2017). Water quality - Determination of dissolved perchlorate - Method using ion chromatography (IC) (ISO Standard No. 19340:2017).

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