



Environmental

Fast determination of anions in municipal drinking water using a compact ion chromatography system with a chemically regenerated suppressor

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Introduction

Ion chromatography (IC) is a well-accepted technique for monitoring inorganic anions in water, including surface, ground, drinking, and wastewaters. In the U.S., water quality is regulated through the Safe Drinking Water Act (SDWA) and the Clean Water Act (CWA) and enforced through the United States Environmental Protection Agency (U.S. EPA)¹. Ion chromatography methods have been approved by the U.S. EPA for compliance monitoring of inorganic anions in drinking water since the 1980s through U.S. EPA Method 300.0 that was updated in 1997 to U.S. EPA Method 300.1². Various IC methods for water analysis have been demonstrated in Thermo Scientific application notes using standard or microbore flow rate columns with both carbonate/bicarbonate and hydroxide eluents.³

This work demonstrates the determination of inorganic anions in drinking water by IC using a Thermo Scientific™ Dionex™ IonPac™ AS22-Fast-4 μ m column⁴ set on a Thermo Scientific™ Dionex™ Inuvion ion chromatography system with a peristaltic pump used for regenerant flow to a chemical suppressor. The Dionex Inuvion IC system is an integrated, single-channel compact IC system. Coupled to the Thermo Scientific™ Dionex™ AS-DV autosampler and using a chemically regenerated suppressor, it provides a fast and economical choice for routine water analysis.

Method

Reagent, sample, and standard

- Degassed deionized (DI) water, 18 M Ω -cm resistance or better.
- Drinking water
- Thermo Scientific™ Dionex™ Combined Seven Anion Standard II (P/N 057590)

System preparation and setup

Figure 1 shows the flow diagram of a Dionex Inuvion IC system using the peristaltic pump to deliver suppressor regenerant.

Instrument method parameters

Instrument	Dionex Inuvion system (P/N 22185-60108)
Autosampler	Thermo Scientific™ Dionex™ AS-DV autosampler (P/N 068907) with 5 mL Thermo Scientific™ Dionex™ PolyVials™ and filter caps (P/N 038141)
Columns	Thermo Scientific™ Dionex™ IonPac™ AS22-Fast-4 μ m and AG22-Fast-4 μ m, 4 mm i.d. column set (P/N 088487, 088486)
Eluent	4.5 mM Na ₂ CO ₃ / 1.4 mM NaHCO ₃ (Prepared from Thermo Scientific™ Dionex™ AS22 Eluent Concentrate, P/N 063965)
Eluent flow rate	2.0 mL/min
Inj. volume	10 μ L (full loop)
Column temp.	30 °C
Detection	Suppressed conductivity, Thermo Scientific™ Dionex™ ACRS 500 Anion Chemically Regenerated Suppressor, 4 mm (P/N 085090)
Regenerant	50 mM sulfuric acid (prepared from Thermo Scientific™ Dionex™ Anion Regenerant Concentrate (P/N 057555))
Regenerant flow rate	2.0 mL/min (delivered by the peristaltic pump in the Dionex Inuvion system)
Background conductance	~21 μ S/cm
System backpressure	~1,850 psi (100 psi = 0.6894 MPa)
Run time	5 min
Software	Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS) software version 7.3.2

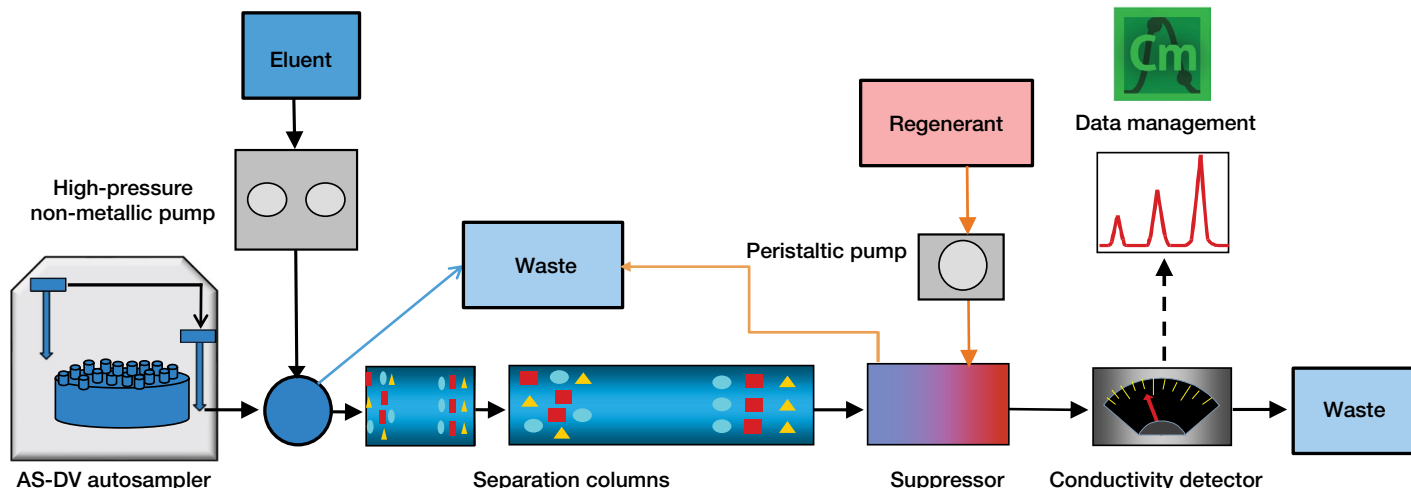


Figure 1. Illustration of the IC system flow diagram

Results

Figure 2 shows a separation of inorganic anions within 5 min using the Dionex IonPac AS22-Fast-4 μ m column. As this figure shows, seven inorganic anions are well resolved. The Dionex IonPac AS22-Fast-4 μ m column can be used for compliance monitoring of inorganic anions in water. This 5-min method allows additional samples to be run every hour compared to most IC methods used to determine anions in drinking water.

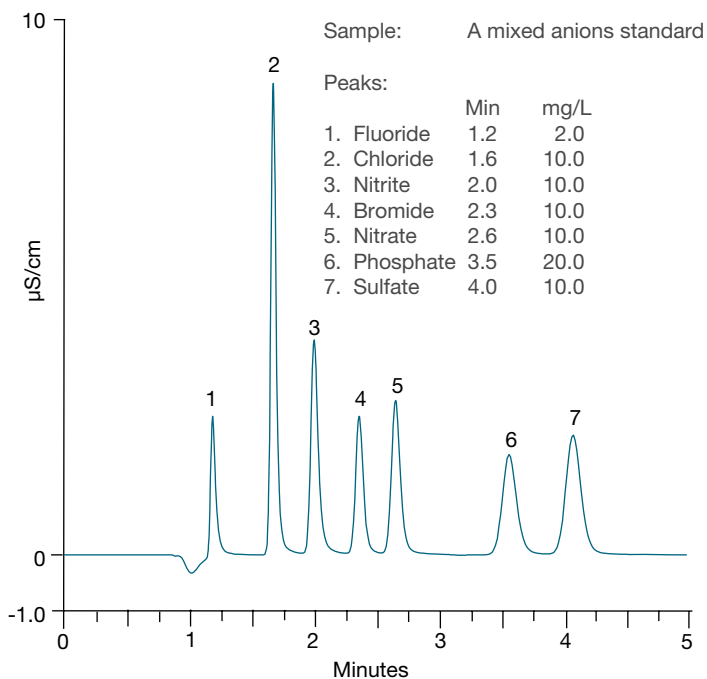


Figure 2. Separation of inorganic anions using the Dionex IonPac AS22-Fast-4 μ m column

Figure 3 shows the determination of inorganic anions in a drinking water sample. Among the common anions, fluoride, nitrate, and nitrite are regulated with the maximum contaminant level (MCL) for fluoride at 4 mg/L, nitrite at 1 mg/L, and nitrate at 10 mg/L. The results show that the drinking water sample contains chloride (9.5 mg/L), nitrate (1.2 mg/L), and sulfate (16.5 mg/L) with less than 1 mg/L of fluoride (0.6 mg/L), and nitrite (0.2 mg/L), which meet the regulatory criteria.

Sample: Municipal drinking water

Peaks:

	Min	mg/L
1. Fluoride	1.2	0.6
2. Chloride	1.6	9.5
3. Nitrite	2.0	0.2
4. Unknown	—	—
5. Nitrate	2.6	1.2
6. Phosphate	3.5	0.2
7. Sulfate	4.0	16.5

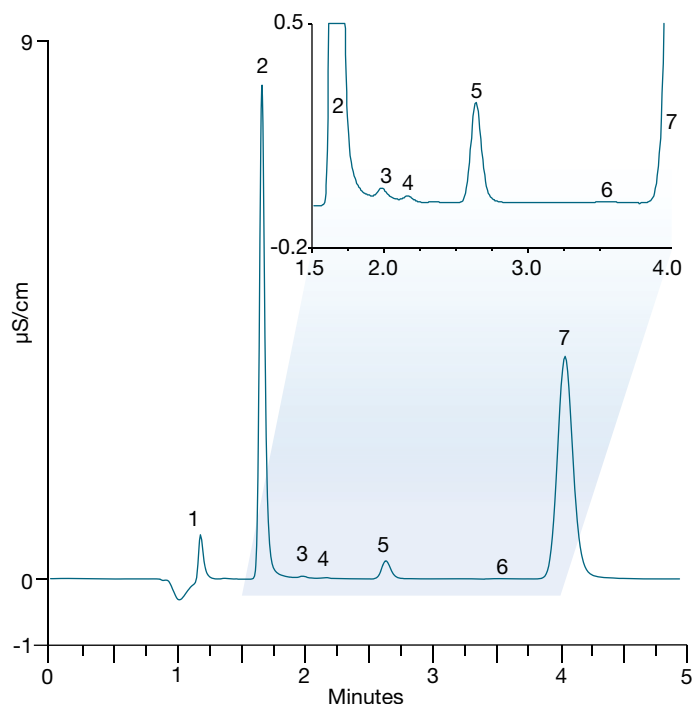


Figure 3. Determination of inorganic anions in a drinking water sample

Conclusion

This work shows the determination of inorganic anions in a drinking water sample using a Dionex Inuvion IC system with a peristaltic pump. The integrated Dionex Inuvion IC system coupled with the Dionex AS-DV autosampler, Dionex IonPac AS22-Fast-4µm columns, and chemically regenerated suppressor provides a fast, simple, and low-cost instrument setup for routine determination of inorganic anions in drinking water.

References

1. National Primary Drinking Water Regulations (Accessed May 31, 2023.)
2. U.S. EPA Method 300.1. The Determination of Inorganic Anions in Water by Ion Chromatography; rev 1.0; U.S. EPA, Office of Water: Cincinnati, OH, 1997. (Accessed May 31, 2023.)
3. Inorganic Anions Analysis by EPA 300.0 & 300.1. (Accessed May 31, 2023.)
4. The Dionex IonPac AS22-Fast-4µm IC columns. (Accessed May 31, 2023.)

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