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Fast Determination of Inorganic Anions in Municipal Drinking Water Using Capillary Ion Chromatography

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Key Words

- Capillary IC
- HPIC
- Dionex ICS-5000
- U.S. EPA Method 300.0
- Dionex IonSwift MAX-100

Introduction

The determination of common inorganic anions in drinking water is one of the most important applications of ion chromatography (IC) worldwide. IC has been approved for compliance monitoring of common inorganic anions in U.S. drinking water since the mid-1980s, as described in U.S. EPA Method 300.0.[1] A considerable number of regulatory IC methods have been published in many other industrialized countries (e.g., in Germany, France, Italy, and Japan). In addition, many standard organizations (including ISO, ASTM, and AWWA) have validated IC methods for the determination of inorganic anions in drinking water.[2,3] The concentrations of some anions in drinking water are regulated due to their toxic effects. For example, high levels of fluoride cause skeletal and dental fluorosis, and nitrite and nitrate can cause methemoglobulinemia, which can be fatal to infants. Other common anions, such as chloride and sulfate, are considered secondary contaminants and can affect odor, color, and certain aesthetic characteristics.

This application brief describes the fast determination of inorganic anions in drinking water samples with the Thermo Scientific Dionex ICS-5000 capillary system tolerating 5000 psi backpressure. This capability facilitates higher sample throughput by simply increasing the flow rate of analysis. Figure 1 shows the analysis of inorganic anions using a Thermo Scientific Dionex IonSwift MAX-100 capillary column and suppressed conductivity detection. The Dionex IonSwift™ MAX-100 column uses monolith technology and is designed for the separation of small molecules including organic acids and inorganic anions using a hydroxide gradient delivered by an eluent generator. All analytes of interests are baseline resolved and elute within 8 min at 24 µL/min flow rate. At this flow rate, about 4500 psi backpressure is generated.

Scaling down from standard bore to capillary scale brings many benefits to IC users. One of the most important values is that the system can be always on and ready for analysis because of its low consumption of eluent (15 mL of source water a day at 10 µL/min flow rate). The system remains stable when operated continuously, greatly reducing time spent equilibrating and calibrating. The amount of waste generated is significantly decreased and the Thermo Scientific Dionex EGC Eluent Generation Cartridge producing the eluent typically lasts 18 months under continuous operation, which translates into reduced overall cost of ownership.

Column:	Dionex IonSwift MAX-100G/ MAX-100, 0.25 mm
Eluent:	Dionex EGC-KOH (Capillary)
Gradient:	0.1 mM KOH (0.1 min), 0.2–2 mM (0.1 to 1 min), 2–15 mM (1 to 4 min), 15–35 mM (4 to 6 min), 35 mM (6 to 10 min)
Flow Rate:	24 µL/min
Inj. Volume:	0.4 µL
Temperature:	35 °C
Detection:	Suppressed Conductivity, Thermo Scientific Dionex ACES 300 Anion Capillary Electrolytic Suppressor

Samples: A: Bottled water
B: UK Municipal Drinking Water
C: Standard

Peaks:	A	B	C
1. Fluoride	0.06	0.06	2 mg/L
2. Chloride	30.9	8.6	10
3. Nitrite	—	—	10
4. Bromide	—	—	10
5. Nitrate	12	3.5	10
6. Carbonate	—	—	10
7. Sulfate	104	13.5	10
8. Phosphate	3.1	—	20

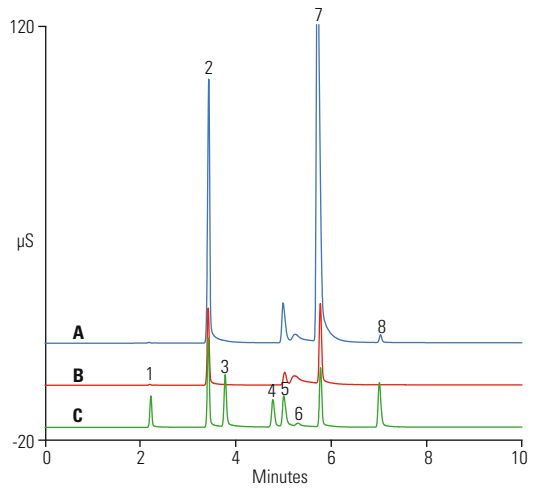

Figure 1. Fast determination of anions in two drinking water samples using high-pressure capillary IC.

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Conditions

Dionex ICS-5000 capillary system, Thermo Scientific Dionex AS-AP Autosampler, and Thermo Scientific Dionex Chromeleon Chromatography Data System software are used in this experiment. All experimental parameters are listed in Figure 1.

Sample Information and Preparation

Municipal drinking water was analyzed by capillary IC without sample pretreatment.

References

1. The Determination of Inorganic Anions in Water by Ion Chromatography; Method 300.0, Revision 2.1; U.S. Environmental Protection Agency; Cincinnati, Ohio, 1993.
2. Greenberg, A. E.; Clesceri, L. S.; Eaton, A. D., Eds.; Standard Methods for the Examination of Water and Wastewater, 18th ed.; Am. Public Health Assoc.; Washington, DC, 1992.
3. Standard Test Methods for Anions in Water by Chemically Suppressed Ion Chromatography; D4327-97, Vol. 11.01; American Society for Testing and Materials; West Conshohocken, Pennsylvania, 1999; p. 420-427.

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