

Fast and rugged method for low-cost determination of anions in water

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Introduction

Ion chromatography (IC) is a well-accepted technique for monitoring inorganic anions in water, including surface, ground, drinking, and waste waters. In the United States, 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 IC methods have been approved by the EPA for compliance monitoring of inorganic anions in drinking water and waste water since the 1980s through U.S. EPA Method 300.0 that was updated in 1997 to U.S. EPA Method 300.1.² Various IC methods for water analysis have been demonstrated in Thermo Scientific™ Dionex™ 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 the Thermo Scientific™ Dionex™ IonPac™ AS29-Fast-4 μ m column set on the Thermo Scientific™ Dionex™ Easion™ Ion Chromatography System in Displacement Chemical Regeneration (DCR)



mode. Figure 1 shows a diagram of the setup. The Dionex IonPac AS29-Fast-4 μ m column is specifically designed to handle high ionic strength samples and can tolerate samples with high or low pH without sample pretreatment. A thorough study using this column can be found in Thermo Scientific™ Application Note 73607.⁴ The Dionex Easion IC system is an integrated, single-channel low-cost system designed for isocratic applications with suppressed conductivity detection. Coupled to the Thermo Scientific™ Dionex™ AS-DV Autosampler, it provides a rugged and low-cost choice for fast routine water analysis.

Equipment and consumables

- Dionex Easion IC system
- Dionex AS-DV autosampler
- Thermo Scientific™ Dionex™ Chromeleon™ 7.2.10 MuA Chromatography Workstation

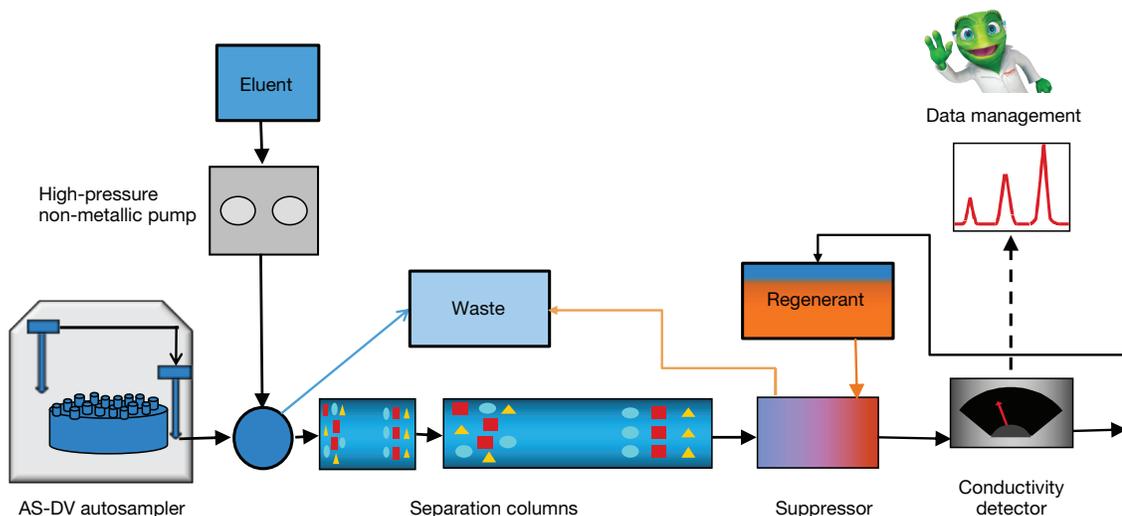


Figure 1. Illustration of an IC system in DCR mode.

Table 1. Consumables

Product name	Part no.
Thermo Scientific™ Dionex™ DCR Installation Kit for 4 mm column	056884
Thermo Scientific™ Dionex™ ACRS 500 Anion Chemically Regenerated Suppressor (4 mm)	085090
Thermo Scientific™ Dionex™ IonPac™ AS29-Fast-4µm Guard Column (4 x 30 mm)	302834
Thermo Scientific™ Dionex™ IonPac™ AS29-Fast-4µm Analytical Column (4 x 150 mm)	302833
Thermo Scientific™ Dionex™ Displacement Chemical Regeneration (DCR) Reagents	057559
Thermo Scientific™ Dionex™ AS29 Eluent Concentrate (100x)	302952
Thermo Scientific™ Dionex™ AS-DV Autosampler PolyVial (5 mL) with filter cap (20 µm), 250 pack	038141

Experimental

All reagents (eluent, regeneration solution, and standard) were prepared with degassed deionized (DI) water with 18 MΩ-cm resistance or better.

Individual anion standard stock solutions (1000 mg/L) were prepared by dissolving sodium or potassium salts

(A.C.S. reagent grade or better) in DI water. Aliquots of these standard were combined and diluted with DI water to prepare mixed calibration standards (Table 2).

A drinking water sample was collected locally. No filtration was needed as filter caps were used on the Dionex AS-DV autosampler vials.

The chromatography conditions are listed in Figures 2 and 3.

Table 2. Calibration standards (mg/L)

Level	1	2	3	4	5	6	7
Fluoride	0.1	1	5	10	20	-	-
Chloride	0.2	2	10	20	40	50	100
Nitrite-N	0.1	1	5	10	20	-	-
Bromide	0.1	1	5	10	20	-	-
Nitrate-N	0.1	1	5	10	20	-	-
Phosphate-P	0.2	2	10	20	40	25	50
Sulfate	0.2	2	10	20	40	50	100

Results and discussion

Figure 2 shows a separation of inorganic anions within 10 min using the Dionex IonPac AS29-Fast-4 μ m column. As this figure shows seven inorganic anions are well resolved. Because the Dionex IonPac AS29-Fast-4 μ m column can handle high ionic strength samples and can tolerate samples with high or low pH4, and the filter cap in the Dionex AS-DV autosampler vial can automatically filter each sample, this method is simple and rugged and is an ideal choice used for quick and routine compliance monitoring of inorganic anions in various type of water samples.

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 (3.84 mg/L), sulfate (1.96 mg/L) with less than 1 mg/L of fluoride (0.54 mg/L), nitrite (0.01 mg/L), and nitrate (0.06 mg/L), which meet the safety criteria.

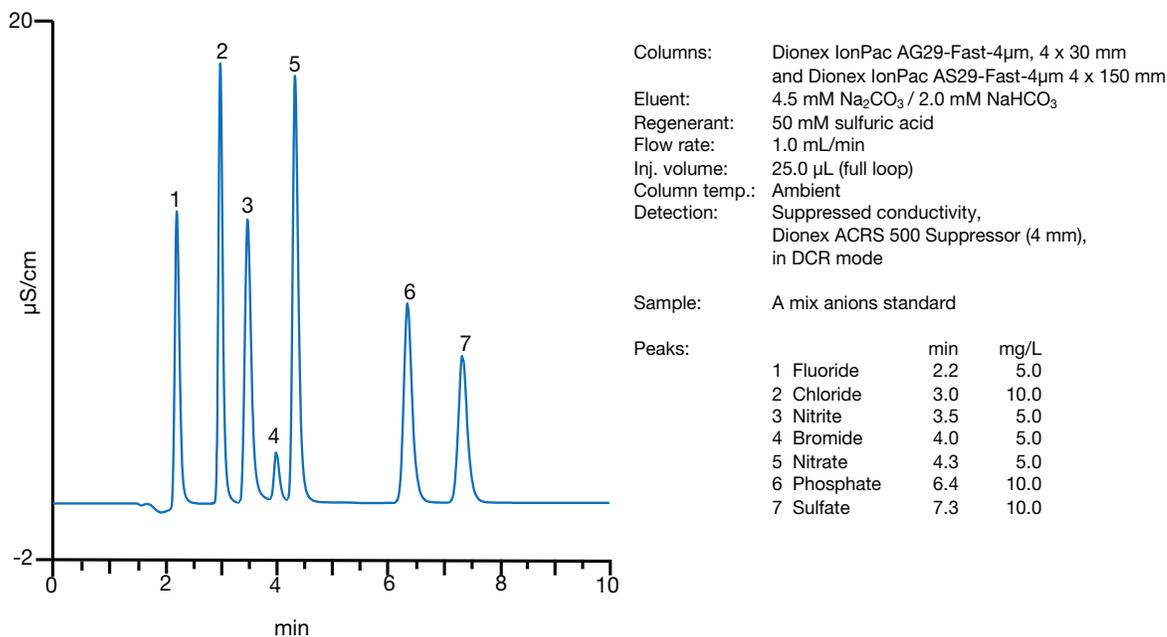


Figure 2. Separation of common anions using the Dionex IonPac AS29-Fast-4 μ m column.

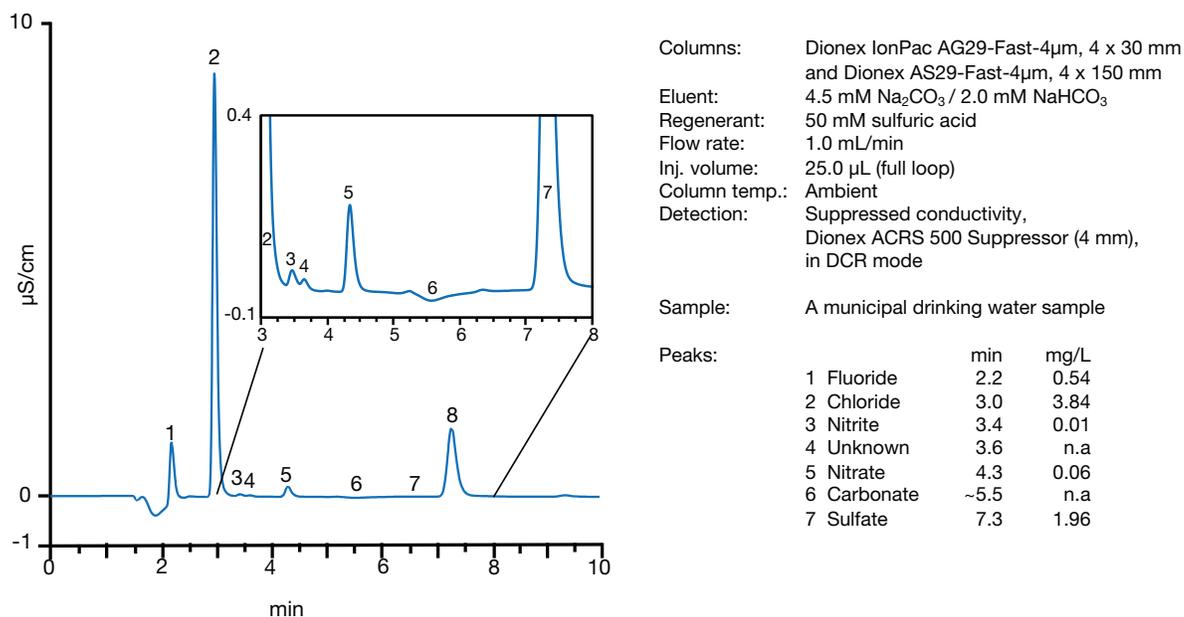


Figure 3. Analysis of municipal drinking water using the Dionex IonPac AS29-Fast-4 μ m columns.

Linearity

Table 3. Linearity obtained using the Dionex IonPac AS29-Fast-4µm column with a 25.0 µL injection

Analyte	Range (mg/L)	Coefficient of determination [*] (r ²)
Fluoride	0.1-20	1
Chloride	0.2-100	0.999
Nitrite-N	0.1-20	1
Bromide	0.1-20	0.999
Nitrate-N	0.1-20	0.995
Phosphate-P	0.2-50	0.996
Sulfate	0.2-100	0.998

* Calibration type is linear and forced through the origin.

Table 3 shows the calibrations are linear for the inorganic anions with r² from 0.995 to 1.

Conclusion

This work shows the determination of inorganic anions in a drinking water sample using the Dionex Easion IC system in DCR mode. With use of the Dionex IonPac AS29-Fast-4µm column which can handle high ionic strength samples and can tolerate samples with high or low pH⁴, and with use of the filter cap that provides auto-filtration, the integrated Dionex Easion IC system coupled with the Dionex AS-DV autosampler provides a simple, rugged and low-cost instrument setup for routine determination of inorganic anions in various water samples.

References

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