

Fast Determination of Inorganic Anions Using the Thermo Scientific Dionex IonPac AS18-Fast and AS18-4 μ m Capillary Column

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Overview

Purpose

The work shown here demonstrates the Thermo Scientific Dionex IonPac™ AS18-4 μ m capillary column, which uses smaller-particle-size packing material, produces highly efficient peaks and increased resolution leading to fast sample throughput.

Methods

Inorganic anions and organic acids are determined using a Dionex ICS-5000 capillary Reagent-Free™ IC (RFIC™) system with hydroxide eluent with detection by suppressed conductivity.

Results

Fast IC analysis can be achieved using high flow rates with the Dionex IonPac AS18-4 μ m capillary column. Here, seven inorganic anions are separated within 3 minutes with baseline resolution at high flow rates. Acetate and formate can also be resolved from inorganic anions when a hydroxide gradient is used. Oxyhalides in municipal drinking water can be separated in less than 4 minutes using an isocratic eluent and increased flow rates.

Introduction

The Dionex IonPac AS18-Fast is a hydroxide-selective anion-exchange column designed for the determination of inorganic anions and low-molecular weight organic acids including fluoride, acetate, formate, chloride, nitrite, bromide, nitrate, sulfate, and phosphate.¹ This column is recommended for use in combination with an eluent generator, which automatically produces hydroxide eluents from water.

The capacity and selectivity of the Dionex IonPac AS18-Fast column provide the flexibility to modify the eluent conditions to optimize separations. This column is ideal for use with isocratic hydroxide eluents for fast separation of common inorganic anions in simple sample matrices. The high capacity of the Dionex IonPac AS18-Fast column also allows the use of hydroxide gradients.

The Dionex IonPac AS18-Fast column packing is a unique pellicular structure composed of a highly crosslinked core and MicroBead™ latex anion-exchange layer attached to the surface. The substrate is a 7.5 μ m diameter supermacroporous resin bead, consisting of ethylvinylbenzene crosslinked with 55% divinylbenzene. The anion-exchange layer is functionalized with strongly hydrophilic quaternary ammonium groups.

Advances in polymerization technology have enabled the formation of 4 μ m super-macroporous resin beads.² This substrate has been used in the new Dionex IonPac AS18-4 μ m capillary column (0.4 \times 150 mm), allowing faster, more efficient separations than the larger particle substrate.

The work shown here demonstrates that fast analysis and superior resolution are obtained with this new addition to the Dionex IonPac AS18 column line. Using an isocratic hydroxide eluent, the inorganic anions can be separated in a variety of sample matrices including drinking water, groundwater, and wastewater.

Methods

Sample Preparation

All samples were directly injected into the system without any pretreatment.

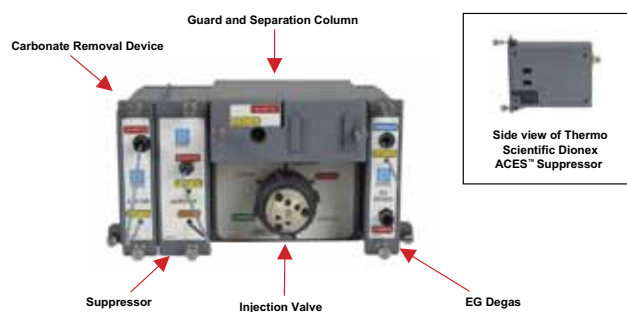
Ion Chromatography Equipment and Data Analysis

Thermo Scientific Dionex ICS-5000 Reagent-Free (RFIC) Capillary Ion Chromatography System consisting of:

- DP Dual Isocratic Capillary Pump
- DC Detector/Chromatography Module
 - IC Cube™ Capillary cartridge (Figure 1)
 - CD Capillary Conductivity Detector for anions and cations
- EG Eluent Generator Module
- AS-AP Autosampler with diverter valve
- Thermo Scientific Dionex Chromeleon™ Chromatography Data System software

The Dionex ICS-5000 IC Cube contains the consumables within cartridges that are easy to install, including: the EG Degas module, column tray, 4-port injection valve with 0.4 µL internal loop, suppressor module, and Carbonate Removal Device (CRD) module.

FIGURE 1. Dionex ICS-5000 IC Cube module.



Conditions

All experimental conditions are listed in Figures 2–6.

Results

Comparison of Inorganic Anions Separations Using the Dionex IonPac AS18-Fast 4µm and AS18-Fast Columns

The separation of common inorganic anions using columns packed with differently sized particles are compared in Figure 2. The Dionex IonPac AS18-Fast column is packed with 7.5 µm particles while the Dionex IonPac AS18-4µm capillary column uses 4 µm particles. The smaller-particle-size resin produces more efficient peaks, resulting in a faster analysis. The selectivity of these two columns is such that fluoride is separated well out of the void volume (system dip). Table 1 compares the peak height, efficiency, asymmetry and resolution of these two columns.

FIGURE 2. Comparison of the separation of inorganic anions using the Dionex IonPac AS18-Fast and AS18-4µm columns.

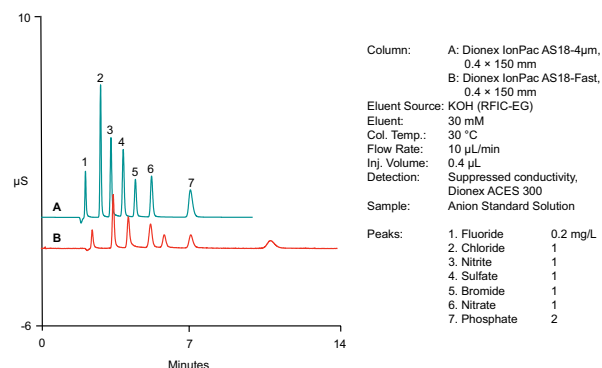


Table 1. Comparison of Dionex IonPac AS18-Fast Columns Packed with Two Different Sizes of Particles

Peak	Peak Height		Plate Count		Asymmetry		Resolution	
	4 μm	7.5 μm	4 μm	7.5 μm	4 μm	7.5 μm	4 μm	7.5 μm
Fluoride	2.2337	0.914	7081	4217	1.24	1.6	6.8	6.31
Chloride	6.3983	2.586	10403	6836	1.13	1.3	4.04	3.89
Nitrite	3.8074	1.467	9956	6625	1.26	1.45	4.03	4.48
Bromide	3.2138	1.115	9888	6010	1.07	1.06	3.63	2.42
Sulfate	1.7938	0.589	12340	7541	1.12	1.1	4.34	4.09
Nitrate	1.9585	0.622	11872	6759	1.15	1.32	7.07	7.65
Phosphate	1.2882	0.349	7406	4498	1.25	1.17	—	—

Fast IC Using the Dionex IonPac AS18-4 μm Columns

The Dionex IonPac AS18-4 μm column is ideal for Fast IC, with sufficient capacity to maintain resolution even in a short column format (150 mm). Figure 3 compares the separation of common inorganic anions using the Dionex IonPac AS18-4 μm capillary column at different flow rates. Figure 4 demonstrates the fast separation of common inorganic anions in municipal drinking water achieved using higher flow rates.

FIGURE 4. Fast determination of inorganic anions in municipal drinking water sample.

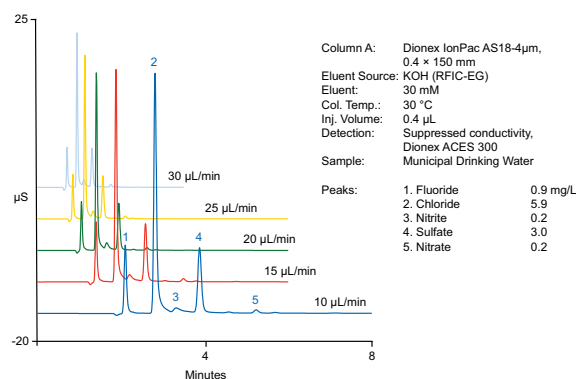
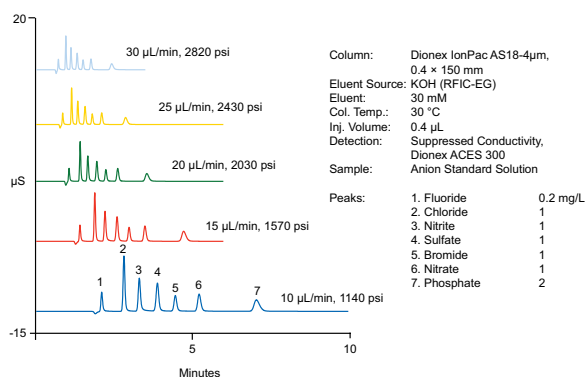


FIGURE 3. Fast determination of inorganic anions using the Dionex IonPac AS18-4 μm capillary column.



Hydroxide Gradient Separation of Organic Acids Using the Dionex IonPac AS18-4 μm Capillary Column

The Dionex IonPac AS18-4 μm capillary column can be operated with hydroxide gradients for separation of organic acids, as illustrated in Figure 5. Note the very efficient peaks and the excellent separation of fluoride, acetate and formate.

FIGURE 5. Separation of organic acids using a hydroxide gradient with the Dionex IonPac AS18-4µm capillary column.

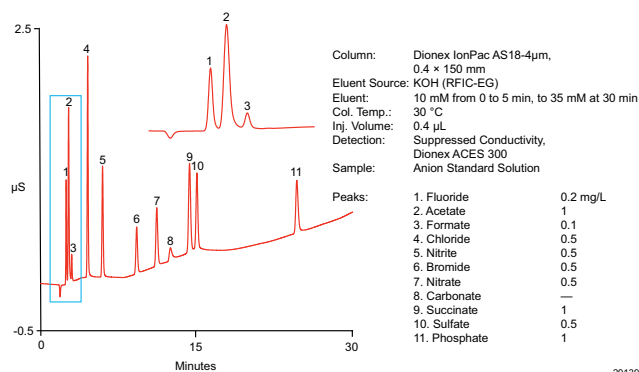
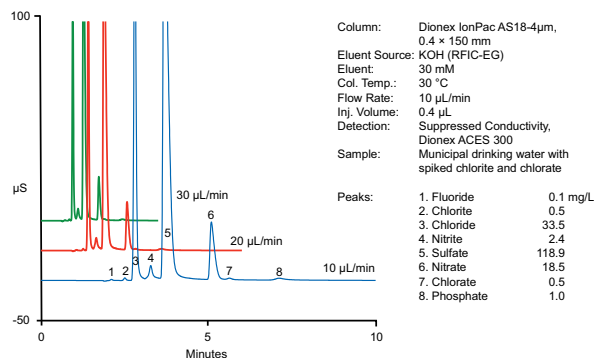


FIGURE 6. Determination of chlorite and chlorate in municipal drinking water.



Determination of Chlorite and Chlorate in Municipal Drinking Water

The Dionex IonPac AS18-4µm capillary column provides excellent separation of oxyhalides from common inorganic anions. Figure 6 shows the fast determination of chlorite and chlorate in a municipal drinking water sample. The analysis time can be decreased to less than 4 minutes by increasing the flow rate.

Conclusion

The Dionex IonPac AS18-4µm capillary column (0.4 × 150 mm) is the new addition to the Dionex IonPac AS18 column line, designed for inorganic anion separations in simple matrices. The Dionex IonPac AS18-4µm column provides excellent peak efficiencies and high resolution, resulting in increased sample throughput. This column can perform Fast IC analysis by using higher flow rates with a simple isocratic eluent. Low molecular weight organic acids can be separated from common inorganic anions using a hydroxide gradient.

References

1. Thermo Fisher Scientific. *Product Manual for the Dionex IonPac AG18, AS18, AG18-Fast, AS18-Fast, document No. 031878-07*, Sunnyvale, CA, 2011.
2. Thermo Fisher Scientific. Christopher Pohl, Paper, 830-2. *New Capillary Scale Chromatographic Materials for Use in Ion Chromatography*, Pittcon 2011, March 13-18, Atlanta, GA.

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