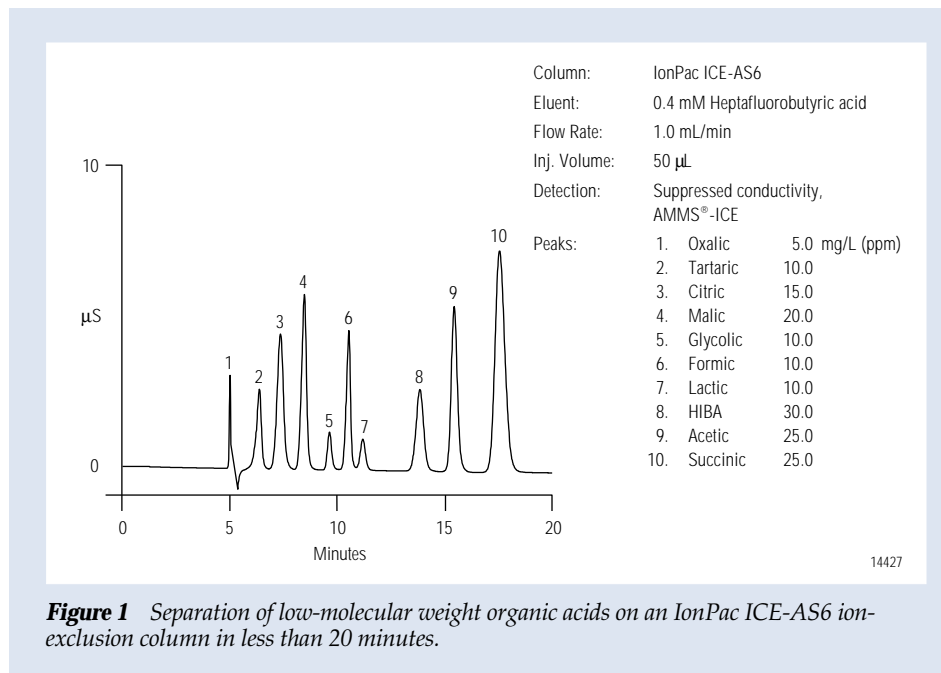


The IonPac ICE-AS6 ion-exclusion column provides fast analysis of aliphatic organic acids and alcohols in complex or high-ionic strength samples. A moderately hydrophobic resin functionalized with sulfonic acid and carboxylic acid groups improves selectivity. The column's unique polymeric structure helps control hydrophobic retention and provides easy column cleanup.



**Figure 1** Separation of low-molecular weight organic acids on an IonPac ICE-AS6 ion-exclusion column in less than 20 minutes.

The IonPac ICE-AS6 ion-exclusion column is designed for the determination of aliphatic organic acids and alcohols in complex or high-ionic strength samples, including food and beverage products, biological samples, fermentation processes, industrial process liquors, and waste waters. It provides improved peak efficiency and unique selectivity for applications typically performed using ICE-AS1 or ICE-AS5 columns.

The ICE-AS6 column is a moderately hydrophobic resin functionalized with sulfonic acid and carboxylic acid groups to improve selectivity. The unique polymeric structure of the ICE-AS6 allows HPLC solvents to control hydrophobic retention and provide effective column cleanup.

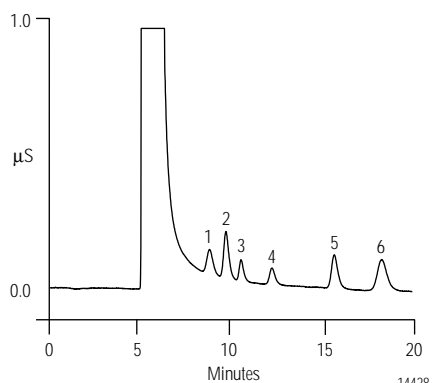
#### SUPERIOR CHROMATOGRAPHIC PERFORMANCE

- Weakly ionized acids are separated by  $pK_a$  differences.
- Unique selectivity using ion exclusion plus hydrogen bonding and hydrophobic adsorption.
- Strong acid anions such as chloride and sulfate elute in the void.
- Achieves difficult separations, including tartrate from citrate, glycolate from lactate and formate, lactate from malate, and formate from succinate.
- Uses a wide range of acid eluents and detection methods.
- Uses HPLC solvents to control hydrophobic retention of higher molecular weight acids or for effective column cleanup.

Column: IonPac ICE-AS6  
 Eluent: 1.0mM Heptafluorobutyric acid  
 Flow Rate: 1.0 mL/min  
 Detection: Suppressed conductivity  
 AMMS-ICE

Sample: 0.25% Sulfuric acid, 50  $\mu$ L

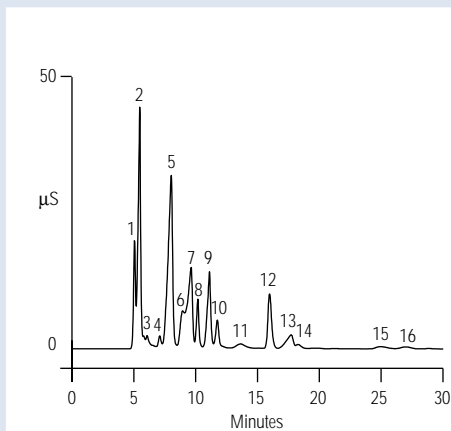
Peaks:  
 1. Citric  
 2. Malic  
 3. Glycolic  
 4. Lactic  
 5. Acetic  
 6. Succinic



**Figure 2** Ion exclusion allows the determination of organic acids in sulfuric acid and eliminates sulfate interference.

Column: IonPac ICE-AS6  
 Eluent: 0.4 mM Heptafluorobutyric acid  
 Flow Rate: 1.0 mL/min  
 Inj. Volume: 50  $\mu$ L  
 Detection: Suppressed conductivity  
 AMMS-ICE

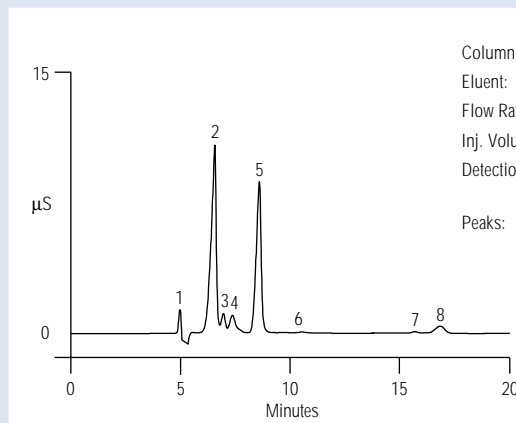
Peaks:  
 1. Inorganics  
 2. Inorganics  
 3. Maleic  
 4. Malonic  
 5. Citric  
 6. Malic  
 7. Quinic  
 8. Glycolic  
 9. Formic  
 10. Lactic  
 11. Unknown  
 12. Acetic  
 13. Unknown  
 14. Shikimic  
 15. Fumaric  
 16. Propionic



**Figure 3** Determination of organic acids in coffee.

Column: IonPac ICE-AS6  
 Eluent: 0.4 mM Heptafluorobutyric acid  
 Flow Rate: 1.0 mL/min  
 Inj. Volume: 50  $\mu$ L  
 Detection: Suppressed conductivity  
 AMMS-ICE

Peaks:  
 1. Inorganics  
 2. Tartaric  
 3. Galacturonic  
 4. Citric  
 5. Malic  
 6. Formic  
 7. Acetic  
 8. Unknown



**Figure 4** Determination of trace organic acids in grape juice using suppressed conductivity detection.

## UNIQUE SELECTIVITY

The retention mechanisms operating in the ICE-AS6 include:

- Ion exclusion
- Hydrogen bonding
- Hydrophobic interaction

The ICE-AS6 resin is derivatized with sulfonic acid and carboxylic acid functional groups. The ion-exclusion mechanism causes strong acid anions such as sulfate to be eluted in the column void volume, as illustrated in Figure 2. Due to the added hydrogen bonding and adsorption retention mechanisms, the ICE-AS6 has significantly higher retention for hydroxylated weak acids than is typically observed on ion-exclusion columns. Figure 1

illustrates the unique selectivity of the ICE-AS6 for aliphatic organic acids and hydroxy organic acids.

Use the ICE-AS6 for diverse sample matrices including:

- Brines
- Mineral acids
- Waste water
- Power plant water
- Foods and beverages
- Kraft liquors
- Soil extracts

## RESISTS FOULING

The polymer packing in the ICE-AS6 resists fouling and allows the analysis of a wide range of complex samples, as shown in Figure 3.

## INCREASED SENSITIVITY WITH SUPPRESSED CONDUCTIVITY DETECTION

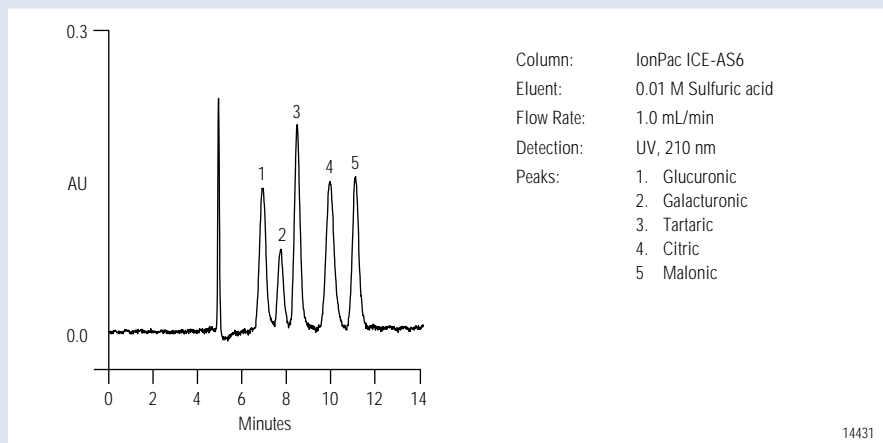
The ICE-AS6 is designed to be used with a wide range of detectors including conductivity, UV, refractive index, and amperometry. For sensitive detection of aliphatic organic acids and hydroxy organic acids, the ICE-AS6 is designed to be used with the AMMS-ICE, which is a low void volume, high-capacity eluent suppressor. The AMMS-ICE suppressor reduces the background conductivity of the eluent while increasing the conductivity of the analytes to provide a stable baseline and high signal-to-noise ratio (see Figures 1– 4).

## USE ICE-AS6 WITH A WIDE RANGE OF ACID ELUENTS AND DETECTORS

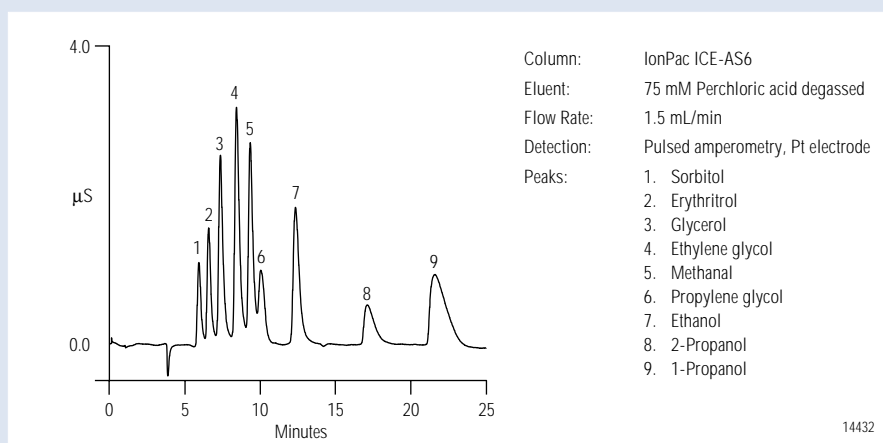
The ICE-AS6 can be used with any typical strong acid eluent. A high-acid eluent concentration is used to retain and separate organic acids with low  $pK_a$ s such as glucuronic, tartaric, citric, and malonic acids, as illustrated in Figure 5. These high eluent concentrations can be used with amperometric, UV, or refractive index detection. Figure 6 illustrates the selectivity achieved for aliphatic alcohols when chromatography with the ICE-AS6 is coupled with pulsed amperometric detection.

## SOLVENT-COMPATIBLE PACKING

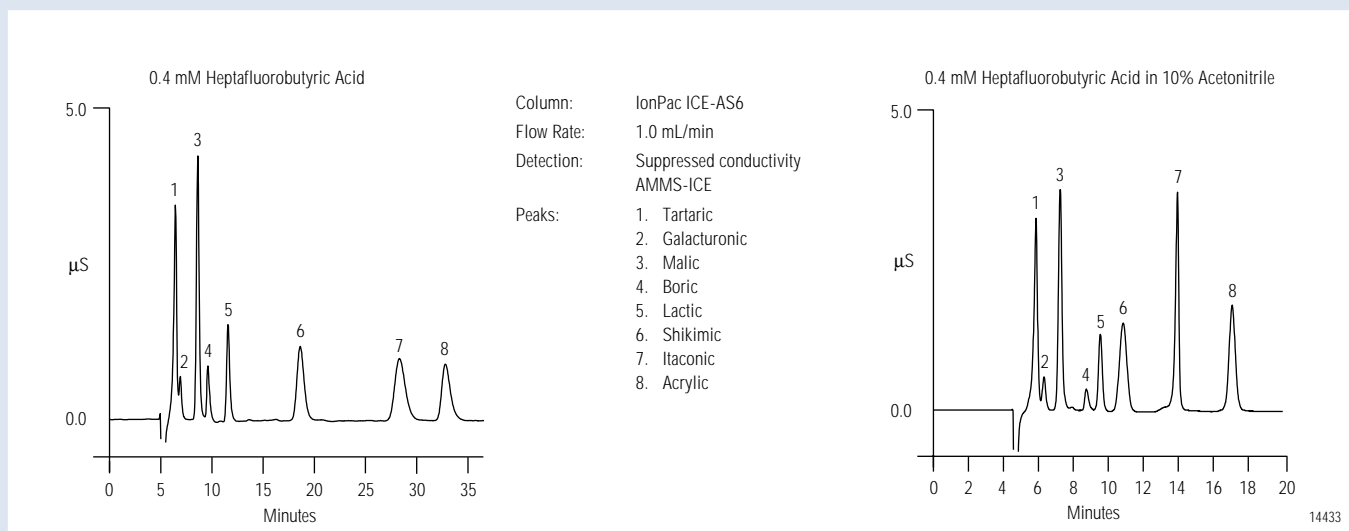
The IonPac ICE-AS6 column is compatible with HPLC solvents up to 20%, including methanol, isopropanol, and acetonitrile. Organic solvents can be used to decrease the hydrophobic retention of strongly retained organic acids, as illustrated in Figure 7. For columns fouled with hydrophobic matrix components, organic solvents can be used for effective column cleanup.



**Figure 5** Determination of weakly ionized organic acids using UV detection.



**Figure 6** Determination of aliphatic alcohols using pulsed amperometric detection.



**Figure 7** Organic solvent is used to elute highly retained hydrophobic organic acids.

## SPECIFICATIONS

### Column

*Analytical Column Dimensions:*

9 x 250 mm

*Maximum Operating Pressure:*

5.6 MPa (800 psi)

*Eluent Compatibility:*

pH 0–7, (Use eluents containing only hydronium ion as the cation. Avoid eluents containing sodium, potassium, etc.)

0–20% HPLC Solvents

*Column Construction:*

PEEK (Polyetheretherketone) with 10–32 threaded ferrule-style end fittings. All components are nonmetallic.

### Substrate

*Bead Diameter ( $\mu\text{m}$ ):*

8.0

*Bead Type:*

Microporous

*Crosslinking (%DVB):*

8%

### Functional Group

*Capacity ( $\mu\text{eq}/\text{column}$ ):*

27 meq (9 x 250 mm)

*Ion-Exchange Group:*

Sulfonic and carboxylic acid

*Surface Characteristics:*

Moderately hydrophobic

## ORDERING INFORMATION

In the U.S., call 1-800-346-6390, or contact the Dionex Regional Office nearest you. Outside the U.S., order the IonPac ICE-AS6 column through your local Dionex office or distributor. Refer to the part numbers below.

For suppressed conductivity detection, the IonPac ICE-AS6 column should be used with the AMMS-ICE MicroMembrane™ Suppressor.

*IonPac ICE-AS6 Analytical Column*

(9 x 250 mm) ..... P/N 46023

*AMMS-ICE MicroMembrane Suppressor*

(For use with ion exclusion columns.) ..... P/N 37107

*9-mm ICE-AS6 Hardware (0.62-in. O.D. Tube)*

*Bed support (frit and seal washer) ..... P/N 48238*

*Zitex® bed support (for ICE) ..... P/N 48297*

*End fitting ..... P/N 48298*

Zitex is a registered trademark of Norton Chempplast.

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