Improved Determination of Trace Anions in High-Purity Waters by High-Volume Direct Injection with the EG40

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Ion chromatography eluent generation and anion-exchange columns with 5-μm particle size can be used to determine sub-μg/L anions in high purity water by large-loop injection.

This document describes the use of the EG40 potassium hydroxide (KOH) eluent generator with the IonPac® AS15-5μm (150 mm × 3 mm) column for trace anion analysis. The EG40 generates high-purity and carbonate-free hydroxide eluents on-line to improve the method performance for determination of target analytes at trace levels (1,2). The high-volume direct-injection technique is used to achieve sensitive detection at low to sub-μg/L. The AS15-5μm is used to separate common inorganic anions and low molecular weight organic acids in less than 20 min. The analytes are detected by suppressed conductivity with a 2-mm ASRS®-ULTRA operated in the gas-assisted recycle mode. This application update expands on work presented in Dionex Technical Note 48, “Determination of Trace Anions in High-Purity Water by High-Volume Direct Injection with the EG40” (2).

Equipment
Dionex DX-600 ion chromatography system consisting of a GP50 gradient pump, a CD25 conductivity detector, and a LC30 chromatography enclosure with typical anion-exchange columns, which results in lower detection limits. The use of a shorter column provides the advantage of a faster run time. The ASRS-ULTRA delivers low background and noise for sensitivity at trace levels.

Table I: Method detection limits* for anions by high-volume direct-injection ion chromatography with the EG40 and the IonPac AS15-5μm (150 mm × 3 mm)

<table>
<thead>
<tr>
<th>Anion</th>
<th>MDL (μg/L, ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoride</td>
<td>0.040</td>
</tr>
<tr>
<td>Glycolate</td>
<td>0.065</td>
</tr>
<tr>
<td>Acetate</td>
<td>0.49</td>
</tr>
<tr>
<td>Formate</td>
<td>0.42</td>
</tr>
<tr>
<td>Chloride</td>
<td>0.17</td>
</tr>
<tr>
<td>Nitrite</td>
<td>0.13</td>
</tr>
<tr>
<td>Sulfate</td>
<td>0.12</td>
</tr>
<tr>
<td>Oxalate</td>
<td>0.11</td>
</tr>
<tr>
<td>Bromide</td>
<td>0.27</td>
</tr>
<tr>
<td>Nitrate</td>
<td>0.25</td>
</tr>
<tr>
<td>Phosphate</td>
<td>0.18</td>
</tr>
</tbody>
</table>

*MDL = standard deviation × (t) 99%, where t is for a 99% single-sided Student’s t-test distribution for n = 7.

Table II: Calibration curve concentrations (μg/L) for anions by high-volume direct-injection ion chromatography with the EG40 and the IonPac AS15-5μm (150 mm × 3 mm)

<table>
<thead>
<tr>
<th>Anion</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoride</td>
<td>0.1</td>
<td>0.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Glycolate</td>
<td>0.3</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Acetate</td>
<td>0.3</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Formate</td>
<td>0.3</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Chloride</td>
<td>0.1</td>
<td>0.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Nitrite</td>
<td>0.1</td>
<td>0.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Sulfate</td>
<td>0.3</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Oxalate</td>
<td>0.3</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Bromide</td>
<td>1.0</td>
<td>3.0</td>
<td>10</td>
</tr>
<tr>
<td>Nitrate</td>
<td>0.3</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Phosphate</td>
<td>1.0</td>
<td>3.0</td>
<td>10</td>
</tr>
</tbody>
</table>

References
(2) “Determination of Trace Anions in High-Purity Water by High-Volume Direct Injection with the EG40,” Technical Note 48, Dionex Corporation (Sunnyvale, California, 1999).

Figure 1: Typical chromatogram for anions at trace levels.