Salty Water Trend and Sources of Salt in the Delaware River

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Abstract

There were 13 recorded periods when sodium concentrations were above the 20 mg/l in drinking water recommended by US EPA and American Heart Association between 2009 and 2018 for the Delaware River at USGS Trenton gage station. If the current rising trend continues, the projection here is that by approximately year 2050 (or sooner), annual average sodium concentration in the Delaware River at Trenton station will reach this benchmark of 20 mg/l. Among the five sources of sodium chloride (winter deicing road salt, weathering of rocks, agricultural fertilizer, sewage treatment plants and precipitation) deicing road salt contributes to about 2/3 of the total salt loading and the continuing increase in the Delaware River. Annual retention of sodium from the deicing salt is about 30 to 40% (or more depending on the annual precipitation) in the Delaware River based on past studies.

1. Trend of salt level in Delaware River Watershed

1) Average annual sodium and chloride concentrations in the Delaware River at Trenton Na increased 4.5 times, chloride increased 7.6 times between 1940 and 2019

2) Amount of the deicing salt application in the Delaware River Watershed (DRW) 75% Centennial Lake Watershed

2. Salt sources of Delaware River watershed

1) Road salt —75% Centennial Lake Watershed

Water Data collected from 2/2/2018-4/25/2018. Increases of downstream salt is from Rider. Increase of upstream salt is mainly from highway I-95 runoff.

3) Weathering and others (water softeners, agricultural etc. —20-22%)

Normalized 10-year average annual concentrations and regression trends of major ions, in the Delaware River at Trenton, NJ station, Unit: mg/l

<table>
<thead>
<tr>
<th>Year</th>
<th>Na</th>
<th>Mg</th>
<th>Ca</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>1944</td>
<td>25.7</td>
<td>166.3</td>
<td>107.5</td>
<td>35.8</td>
</tr>
<tr>
<td>1961-1970</td>
<td>28.7</td>
<td>169.5</td>
<td>108.6</td>
<td>35.8</td>
</tr>
<tr>
<td>1971-2011</td>
<td>27.6</td>
<td>109.0</td>
<td>108.6</td>
<td>35.8</td>
</tr>
</tbody>
</table>

Regression for Ion Concentration between 1943-2012

<table>
<thead>
<tr>
<th>Ion</th>
<th>Coefficient</th>
<th>R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td>0.5</td>
<td>0.2</td>
</tr>
</tbody>
</table>

o Regression p-value < 0.05 or t-test value > 1.96 indicates a significant trend with 95% confidence.

4. Deicing Salt Chose: Sodium or Calcium Chloride?

Calcium Chloride (CaCl2): $20 to $25 per 50lbs

Sodium Chloride (also NaCl): $15 to $20 per 50lbs

Cost to $10 per 50lbs

Our vote goes to calcium chloride for now.

3) Weathering and others (water softeners, agricultural etc. —20-22%)

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Conclusions

By year 2050, average annual Na concentration in the Delaware River at Trenton will reach the 20 mg/l EPA and AHA recommended limit. By the end of the century, the average annual Na concentration will be 24.2 mg/l.

At the intake points of Philadelphia Water Department, it will reach this 20 mg/l benchmark sooner than at the Trenton gauging station.

Between now and 2050, there will be more periods in January and February in which sodium concentrations will be above 20 mg/l.