Pipe Corrosion in the Vicinity of a Major Soda Bottling Plant

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HRSD and one of its member jurisdictions are experiencing significant problems with line corrosion in an area down-line from a major soda bottling plant.
Line Corrosion

The corrosion was atypical

Photo by: Eric Jackson, HRSD
Purpose

➢ To determine cause of the underlying problems associated with the corrosion of sewer lines in the vicinity of a major soda bottling plant

➢ Work with bottling plant to implement pretreatment modifications/additions to prevent future corrosion
Study Area

- Southeast Virginia
- Study Area is mixed residential & commercial
  - Soda bottler discharges to city collection system
  - City pump station
  - City force main
  - HRSD Interceptor System
  - HRSD Treatment Plant
Sampling Activities

- **Continuous pH Monitoring**
  - MH ~1200 feet down-line of soda bottler
  - MH at influent to city pump station
    - ~3900 feet from bottler
  - Simultaneous at MH outside soda bottler and MH at influent to city pump station

- **Alkalinity grab samples**
  - Prompted by results from pH monitoring
    - MH outside soda bottler
    - MH ~1700 feet down-line of soda bottler
    - MH at influent to city pump station
    - HRSD Pump Station Wet Well (~5.75 miles from soda bottler)
    - HRSD Treatment Plant RWI (~8.5 miles from soda bottler)
pH Results
~1200 feet Down-line of Bottler

- Deployed from 6/10/07 through 6/18/07
- n=751
  - Average = 5.3 SU
  - Minimum pH = 4.0 SU (6/14/07 / 0100-0115)
  - Maximum pH = 10.2 SU (6/18/07 / 0345)
- 45% of the samples were less than 5.0 SU
- The bottler’s effluent pH was consistently above 5.4 SU
pH Results
Down-line of Soda Bottler

Date/Time
6/10/07 12:00
6/11/07 12:00
6/12/07 12:00
6/13/07 12:00
6/14/07 12:00
6/15/07 12:00
6/16/07 12:00
6/17/07 12:00
6/18/07 12:00

pH (S.U.)
3 4 5 6 7 8 9 10

Down-line
pH 5.0 Line
Bottler Eff.
pH Results
City Pump Station Influent

- ~3900 feet from the bottler
- Deployed from 6/19/07 through 6/25/07
- n=557

- Average = 4.9 SU
- Minimum = 4.2 SU (6/22/07 / 1115-1145)
- Maximum = 6.1 SU (6/25/07 / 0700)

- 70% of the samples were less than 5.0 SU
pH Results
City Pump Station Influent pH

Date/Time | pH (SU)
--- | ---
19/01/2007 00:00 | 7.0
19/01/2007 12:00 | 6.7
20/01/2007 00:00 | 6.0
20/01/2007 12:00 | 6.7
21/01/2007 00:00 | 6.7
21/01/2007 12:00 | 6.5
22/01/2007 00:00 | 6.5
22/01/2007 12:00 | 6.5
23/01/2007 00:00 | 6.5
23/01/2007 12:00 | 6.5
24/01/2007 00:00 | 6.5
24/01/2007 12:00 | 6.5
25/01/2007 00:00 | 6.5
25/01/2007 12:00 | 6.5
26/01/2007 00:00 | 6.5
26/01/2007 12:00 | 6.5

The pH results show a range of pH values from 6.0 to 7.0, with a trend indicating that the pH level remains relatively stable over the monitored period.
**pH Results**

**Simultaneous Comparison**

- Compared discharge from soda bottler to city PS influent from 6/26/07 through 7/13/07
- \( n = 1619 \)

<table>
<thead>
<tr>
<th></th>
<th>Bottler</th>
<th>City PS Inf.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average pH</td>
<td>6.3</td>
<td>5.1</td>
</tr>
<tr>
<td>Minimum pH</td>
<td>5.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Maximum pH</td>
<td>9.2</td>
<td>6.7</td>
</tr>
<tr>
<td>% of samples &lt; 5.0 SU</td>
<td>0%</td>
<td>38%</td>
</tr>
</tbody>
</table>
pH Results
Simultaneous Comparison

Date/Time

Soda Bottler
City PS Inf
pH 5.0
Alkalinity Results

- Decreased between bottler and ~1700 feet down-line
- Started to increase after commingling with other wastestreams

<table>
<thead>
<tr>
<th>Date</th>
<th>Bottler</th>
<th>1700 ft</th>
<th>City PS</th>
<th>HRSD PS</th>
<th>TP RWI</th>
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</thead>
<tbody>
<tr>
<td>6/25/07</td>
<td>121</td>
<td>107</td>
<td>91</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>7/9/07</td>
<td>38</td>
<td>39</td>
<td>81</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>8/29/07</td>
<td>50</td>
<td>18</td>
<td>48</td>
<td>144</td>
<td>220</td>
</tr>
<tr>
<td>9/12/07</td>
<td>70</td>
<td>33</td>
<td>55</td>
<td>182</td>
<td>200</td>
</tr>
</tbody>
</table>

All concentrations are in mg/L of CaCO₃
NS= No Sample taken
Conclusions

- Low pH and low alkalinity are the probable causes of the interior corrosion in the HRSD and city-owned force mains.
- “The lower the alkalinity, in milligrams per liter, the higher the pH value must be to prevent corrosive action.” (Hardenbergh 1960)
Conclusions

- The drop in pH and alkalinity can be attributed to:
  - Sugars from soda product (high BOD, citric acid) decompose producing organic acids. This in turn lowers the pH and could cause a further drop in alkalinity.

- Retention time in soda bottler’s equalization tank (5750 gallon tank, 10-20 minutes) is not sufficient to allow the solution to reach equilibrium following the addition of sodium hydroxide. The pH and alkalinity decrease as the solution approaches equilibrium further down the line.
Recommendations

- Study is on-going
  - Recently requested further information from the bottler

- Researching possible solutions
  - May include:
    - Increase pH permit limit
    - Increase alkalinity of wastestream prior to discharge
    - Increase retention time in equalization tank
    - Use existing processes (cleaning) to their advantage
Works Cited

Acknowledgements

- HRSD WQ-QST
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- Ed Hartman- HRSD P3 Division
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Questions?