Process Control Observations

Stickney Water Reclamation Plant
October 26-31, 2013
October 25, 2013 (Permit NH$_3$ – 1.02 mg/L)

- Plant flow was 450 MGD, Batt. B was o/s from 9am to 3pm
- At ~10am NH$_3$ begins to rise in aeration tanks
- Battery B placed in service at 3pm
- At 3:53pm blower output increased due to rising plant NH$_3$ (Outfall @1.06 mg/L)
- Outfall ammonia continues to rise to 2.53 mg/L by 9pm
October 26, 2013 (Permit NH$_3$ – 9.44 mg/L)

- At 4:15am, SW pumps o/s and all flow sent to Batts A&B, believing that high NH$_3$ coming in through SW (outfall – 9.90 mg/L).
- Third blower i/s at 6:30am (outfall – 11.9 mg/L).
- IWD contacted to sample for toxic waste at 8:30am.
- At ~6pm M&R takes MLSS samples and determines that nitrifiers are compromised.
- At 11:20pm OEs test North Side Sludge line for reseeding, leak discovered.
Reseeding from the North Side Sludge Line
North Side Sludge Line Leak at Concentration
October 27, 2013 (Permit NH$_3$ – 18.10 mg/L)

- At 2:25am, “WAS only” solids leave North Side WRP plant- travel time is ~16 hours
- At 4am, outfall is 26.36 mg/L
- Trades mobilized to work on North Side sludge line overflow
- 5pm, reseeding starts at a rate of 1.4 MGD, 0.8 MGD to concentration
- 11pm, outfall NH$_3$ is 20 mg/L
October 28, 2013 (Permit NH₃ – 14.43 mg/L)

- Microbiology recommends minimal wasting to rid zooglea masses while reintroducing nitrifiers
- 11am, 50 lbs of powdered bacteria introduced into Battery A aeration tanks
- At 11:45am TARP pumpback begins and is directed to Batts C&D, WS flows isolated to Batts A&B
- Battery NH₃ effluents at noon A-10.32, B-10.93, C-19.42, D-19.18 mg/L
October 29, 2013 (Permit NH$_3$ – 9.24 mg/L)

- 12:55pm Battery A RAS sent to Battery D for reseeding
- 5:35pm reseeding of D ceased
- Draining of two Battery C aeration tanks for reseeding on Oct 30$^{th}$
- Battery NH$_3$ effluents at noon A-0.53, B-5.70, C-24.70, D-29.00 mg/L
October 30, 2013 (Permit NH$_3$ – 4.72 mg/L)

- Reseeding of Battery C starts at 7:50am
- By midnight the plant receives 0.47” of precipitation w/forecast of an EPE
- Battery effluents at noon A-0.25, B-4.16, C-19.54, D-13.71 mg/L
October 31, 2013 (Permit NH₃ – 1.78 mg/L)

- Plant receives an addition 3.09” of precipitation, TARP full
- Battery effluents at 7:45am A-2.42, B-1.72, C-4.10, D-3.10 mg/L
- Battery effluents at 1pm A-0.33, B-0.46, C-0.28, D-0.13 mg/L
Microscopic Observations

Stickney Water Reclamation Plant
October 26-November 1, 2013
Zoogleal Mass Index
Normal Healthy Floc

10/26 Stickney Battery C (40X magnification)
# Zoogleal Mass Index

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>10/26</th>
<th>Maximum prior to 10/26</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery A</td>
<td>136</td>
<td>575</td>
<td>195</td>
</tr>
<tr>
<td>Battery B</td>
<td>230</td>
<td>650</td>
<td>354</td>
</tr>
<tr>
<td>Battery C</td>
<td>102</td>
<td>892</td>
<td>134</td>
</tr>
<tr>
<td>Battery D</td>
<td>196</td>
<td>729</td>
<td>328</td>
</tr>
</tbody>
</table>
Protozoa and Metazoa
Shelled Protozoa & Metazoa
Additional Observations
Additional Observations
VIT Gene Probe Technique

Total Nitrifying Bacteria

- Battery A
- Battery B
- Battery C
- Battery D

Nitrifying Bacteria from Stickney WRP

AOB

NOB
Cadmium is the most highly toxic metal for the microbial communities present in the activated sludge process, followed by copper, and lastly zinc.

Conclusions

• Microscopic evidence of acute stress to the microorganisms.
• Impact large enough to affect all major microbiological populations.
Wastewater Treatment & Process Research Observations

Stickney Water Reclamation Plant
October 26-31, 2013
M&R WTPR section Actions

- Biological health in the aeration tank
  - Eight (8) field OUR tests of aeration tank ML
- Nitrification activity
  - Sixty six (66) lab OUR tests of aeration tank ML and thickened WAS from Calumet and Egan WRP w/ and w/o NH₄ spike
- Heterotrophic activity
  - Ten (10) lab OUR tests of aeration tank ML w/ and w/o sugar spike to check if heterotrophs were affected
- Nitrification rates
  - Twenty four (24) respirometer nitrification tests of ML and WAS samples
- Toxicity of upset sludge
  - Eight (8) lab OUR tests of seeded WAS and Battery A ML mixed with slow responding aeration tank ML w/ and w/o NH₄ spike
  - Monitored on line ammonia probe in Battery D
  - Used operational change information from control room to guide lab tests
- Provided action suggestions to M&O based on lab test results
M&R Suggestions

- North Side WAS: positive nitrifier activity therefore suggested to seed Battery A
- Calumet thickened WAS: no nitrifier activity therefore not suggested to use as seed sludge
- Egan thickened WAS: positive nitrifier activity therefore suggested to seed Battery D
- Cross seed slow responding batteries (C&D) with recovered battery sludge (A&B)
- Don’t feed a few digesters w/ the affected sludge
Field OUR tests (mg O$_2$/L-hr) - 10/26/13

<table>
<thead>
<tr>
<th></th>
<th>Battery A</th>
<th>Battery B</th>
<th>Battery C</th>
<th>Battery D</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 (middle of pass 1)</td>
<td>23.3</td>
<td>28.1</td>
<td>20.3</td>
<td>34.2</td>
</tr>
<tr>
<td>P4E (end of pass 4)</td>
<td>11.2</td>
<td>14.5</td>
<td>8.7</td>
<td>11.1</td>
</tr>
</tbody>
</table>

- Normal field OUR in the middle of Pass 1 (P1): ~ 50 mg O$_2$/L-h; by the end of pass 4 (P4E): ~10 mg O$_2$/L-h.
- OUR at P1 much lower than normal values.
- The difference between P1 and P4E indicates some biological activity remained with elevated ammonia episode.
## Lab OUR tests (mg O₂/L-hr)

<table>
<thead>
<tr>
<th>Date</th>
<th>Battery A</th>
<th>Battery B</th>
<th>Battery C</th>
<th>Battery D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>control</td>
<td>NH4 Spike</td>
<td>Control</td>
<td>NH4 Spike</td>
</tr>
<tr>
<td></td>
<td>Carbon</td>
<td>Spike</td>
<td>Carbon</td>
<td>Spike</td>
</tr>
<tr>
<td></td>
<td>nd</td>
<td>nd</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>10/26</td>
<td>11</td>
<td>11.2</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td></td>
<td>12.7</td>
<td>13.5</td>
<td>11.5</td>
<td>12.9</td>
</tr>
<tr>
<td>10/27</td>
<td>15.3</td>
<td>15.6</td>
<td>13.6</td>
<td>13.4</td>
</tr>
<tr>
<td>10/28 AM</td>
<td>15.4</td>
<td>17.9</td>
<td>14.2</td>
<td>18.6</td>
</tr>
<tr>
<td>10/28 PM</td>
<td>17.4</td>
<td>19</td>
<td>12.7</td>
<td>17.8</td>
</tr>
<tr>
<td>10/29</td>
<td>14</td>
<td>23.7</td>
<td>18.5</td>
<td>22.2</td>
</tr>
<tr>
<td>10/30</td>
<td>11.7</td>
<td>27.6</td>
<td>25</td>
<td>29.5</td>
</tr>
<tr>
<td>10/31</td>
<td>13.7</td>
<td>28.8</td>
<td>11.5</td>
<td>19.2</td>
</tr>
<tr>
<td>11/1</td>
<td>14.6</td>
<td>26.7</td>
<td>17.8</td>
<td>25.7</td>
</tr>
</tbody>
</table>

**Highlighted area indicates recovery of nitrifier activity in the aeration tank.**

*Recovered w/ higher nitrification rate (>1 mg NH4-N/L-h)*
Lab OUR tests (mg O$_2$/L-hr) continued

<table>
<thead>
<tr>
<th></th>
<th>10/29/2013</th>
<th>10/30/2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>control</td>
<td>BatC ML+OB WAS</td>
<td>BatD ML+OB WAS</td>
</tr>
<tr>
<td>NH4 Spike</td>
<td>40.1</td>
<td>42.4</td>
</tr>
<tr>
<td>Control</td>
<td>43.6</td>
<td>46.0</td>
</tr>
</tbody>
</table>

Batteries C&D activated sludge didn’t show toxicity with reseed sludge because of increased OUR response.
Seeding with other plant’s WAS or thickened WAS is an efficient way to recover knocked out nitrifiers.
Lessons Learned

- Plant Specific Emergency Reseeding
- Real Time Monitoring of NH$_3$
- Interceptor Discrete Sampling
- Change Early Warning Probe to End of 1$^{st}$ Pass
Sewer was blocked by large Pooh

Last updated 17 Feb 2014 00:03 GMT
Battery A, B, & C (end of pass 2) and Plant Outfall NH₃
Battery A End of Pass 2 DO probes