Overcoming Challenges during Design, Construction, and Startup of a Cost Effective Nutrient Upgrade

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Agenda

- Purpose for Upgrade Project
- Process Selection
- Startup Challenges
- Project Outcome
Glen Rock WWTP – 2009, prior to Upgrade

- 0.6 MGD Annual Average Permitted Flow
- Designed for BOD, TSS, and Ammonia Removal
Key Issues for Upgrade

- Loadings & Performance
- Permit Compliance
  - Flexibility to meet stringent limits *(Bay TMDL – Summer 2010)*
  - *Annual Effluent Nutrient Mass Limits Equivalent to:*
    - 6.0 mg/L TN
    - 0.8 mg/L TP
- Plant operations impact
- *Project cost reductions?*
Existing Influent Flow

Glen Rock WWTP
Influent Flow Analysis (2009)

0.6 MGD Permitted Flow
Existing Influent BOD Load

Glen Rock WWTP
Influent BOD load (J2009)

BOD Influent Design Basis
= 1,207 lbs/day Average
= 241 mg/L
Existing Performance – Effluent NH3-N - 2009

NH3 Effluent Design Basis = < 0.5 mg/L
Existing Performance – Effluent NOx-N - 2009

Glen Rock WWTP
Effluent NOx-N Concentration (2009)

NOx Effluent Design Basis = < 4.0 mg/L
Existing Performance – Effluent TN - 2009

TN Effluent Design Basis = < 6.0 mg/L
Existing Performance – Effluent TP - 2009

TP Effluent Design Basis = < 0.8 mg/L
Glen Rock WWTP – Existing Conditions

- Excellent effluent quality
  - BOD, TSS, NH3
  - Not designed for denitrification

- Promising Ammonia Profiling results
  - Ammonia depleted half way through existing reactors

- Existing Bioreactor Tank Capacity Adequate for aBNR at current permitted design flow / load
  - Existing 24 hours Hydraulic Retention Time @ 0.6-MGD

- Projected growth not significant

- Existing Digester Capacity Adequate
  - Replacement not necessary
Initial Upgrade Proposal
Alternative Upgrade Plan – Cost Savings

Alternative Approach
Less Design
Less Construction (15-30%)
• Upgrade Bioreactors for Advanced BNR Plug Flow Process
• Right-Size Blowers
• Modernize and Automate Coagulant Feed Systems
Reconfigure Existing Bioreactors

- Remove surface aerators
  - Add Diffused Aeration
  - Add “Right Sized” Blowers

- Compartmentalize Plug Flow Reactors
  - Anaerobic
  - Pre-Anoxic
  - Oxic
  - Post-Anoxic
  - Re-aeration

- Swing Zones for Seasonal Flexibility

- Benefits
  - Re-Use Existing Tanks
  - More Efficient Mixing
  - Smaller HP Aeration

- Future Carbon Feed Option
### Plant Upgrade - Basis of Design

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Start-Up (1)</th>
<th>Average w/2 Basins</th>
<th>Cold Weather Max Month</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flow [MGD]</strong></td>
<td>0.29</td>
<td>0.59</td>
<td>0.74</td>
</tr>
<tr>
<td><strong>Food to Mass (F:M) Ratio</strong></td>
<td>0.07</td>
<td>0.07</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>BOD5 : TKN Ratio</strong></td>
<td>7.3</td>
<td>7.3</td>
<td>9.4</td>
</tr>
<tr>
<td><strong>Biological Sludge Yield [# TSS/# BOD]</strong></td>
<td>0.67</td>
<td>0.67</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>MLSS [mg/L]</strong></td>
<td>4,000</td>
<td>4,000</td>
<td>4,000</td>
</tr>
<tr>
<td><strong>Total SRT [days]</strong></td>
<td>22.3</td>
<td>22.3</td>
<td>11.5</td>
</tr>
<tr>
<td><strong>Oxic SRT [days]</strong></td>
<td>10.9</td>
<td>10.9</td>
<td>5.7</td>
</tr>
<tr>
<td><strong>Nitrate Internal Recycle [% inf flow]</strong></td>
<td>300%</td>
<td>300%</td>
<td>300%</td>
</tr>
<tr>
<td><strong>RAS [mg/L]</strong></td>
<td>8,000</td>
<td>8,000</td>
<td>8,000</td>
</tr>
<tr>
<td><strong>RAS [% of inf flow]</strong></td>
<td>60%</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Ferric Chloride Use [gpd]</strong></td>
<td>14</td>
<td>27</td>
<td></td>
</tr>
</tbody>
</table>

Assume 2% P in WAS
Assume 4% N in WAS
Bioreactor Upgrade – Process Flow
Swing Flexibility

Re-Aeration

Anoxic

Oxic

Anoxic

Anaerobic

Bioreactor Upgrade – Zone Configuration
GRSA – Aeration System Control Overview

SCADA

AEROBIC DIGESTERS

VFD Drive
Air Pressure Control

BIOLOGICAL REACTORS

2 DO Probes Each Basin

Control Valve

Air Flow Meters

Control Valve

Blower

Blower

Blower

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GRSA - Aeration System Monitoring and Control Features

- Air monitoring
  - Flow, Pressure, DO

- Air Control
  - Set flow rate to digesters
  - Pick blower pressure setpoint
    - Blower Speed Adjusts
  - Pick DO probe / setpoint
    - Control Valve Adjusts
## Startup Challenges – Aeration Control

<table>
<thead>
<tr>
<th>Issues</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Control Valve Failure</td>
<td>Valve Vendor Calibration of Valve</td>
</tr>
<tr>
<td></td>
<td>Contractor Wiring Fix</td>
</tr>
<tr>
<td></td>
<td>CSI Calibration with SCADA</td>
</tr>
<tr>
<td>Wide Swings in Air Valve % Open</td>
<td>CSI Programming Modifications</td>
</tr>
<tr>
<td></td>
<td>- trial and error under real-time conditions</td>
</tr>
<tr>
<td></td>
<td>- added minimum valve %open setpoint</td>
</tr>
<tr>
<td></td>
<td>- added lag between valve adjustments</td>
</tr>
<tr>
<td>High DO</td>
<td>Under-Loaded Reactors</td>
</tr>
<tr>
<td>Solids Falling Out of Suspension</td>
<td>- Mixing Limited Diffused Aeration</td>
</tr>
<tr>
<td></td>
<td>- Limit # of reactors online to what is necessary for treatment</td>
</tr>
<tr>
<td></td>
<td>- Develop SOP for Wet Weather Flows</td>
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In-situ Instrumentation

- **DO Probes** –
  - Monitor Oxic DO Profile

- **TSS Probes**
  - Monitor MLSS

- **Ammonium Probe** –
  - Monitor Influent Load

- **Nitrate Probe** – End of Oxic
  - Monitor Ammonia conversion
Instrumentation Challenges

- Faulty Readings
  - O&M Frequency
  - Costly Consumables

- Probe Placement (TSS, DO)

- Calibration
  - Portable Probes
    - DO
  - Grab Sampling Program
    - NH3, NOx, TSS

Ammonium Analyzer (Hach)  DO Probes (Endress+Hauser)
Startup Challenges - Influent Loading Variability - BOD

BOD Influent Design Basis = 241 mg/L
During Startup = 150 mg/L +/-
Startup Challenges - Influent Loading Variability – BOD:TKN

Glen Rock WWTP
Influent BOD:TKN ratio (Jan - Nov 2012)

Design BOD:TKN > 7.4
During Startup = 5.0 +/-
Effluent TN Performance - Post Construction – 2013

TN Effluent Goal = 6.0 mg/L
2013 Average = 6.43 mg/L without carbon feed
NPDES Permit Compliance – TN Pre and Post Construction

GRSA Effluent TN Trends

- **During Construction**
- **After Upgrade**
- **TN Target**

The graph shows the trends for GRSA effluent TN from October to September, with data for 2012-2013 in blue, 2011-2012 in green, and the TN Target in red. The graph highlights the periods before and after construction and upgrade, showing a reduction in TN discharge.
Effluent TP Performance - Post Construction – 2013

Glen Rock WWTP
Effluent TP Concentration (2013)

TP Effluent Goal = 0.8 mg/L
2013 Average = 0.79 mg/L
with Ferric Chloride Feed

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NPDES Permit Compliance – TP Pre and Post Construction

GRSA Effluent TP Trends

During Construction

TP Target

After Upgrade
Conclusions

- Re-Configuration of existing tankage
  - Possible to optimize to meet lower nutrient limits
  - Can equate to substantial cost savings
- Initial calibration and O&M of in-situ instrumentation is critical to automated process control
- Startup of Aeration Control is an iterative process
- Match load to Process Tankage for best results
  - Energy and Chemical Cost Savings
  - Stable process

<table>
<thead>
<tr>
<th>2012-2013 Permit Cycle</th>
<th>TN</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Permit Limits</td>
<td>10,959 lbs</td>
<td>1,461 lbs</td>
</tr>
<tr>
<td>Pounds Left Over</td>
<td>2,145 lbs</td>
<td>552 lbs</td>
</tr>
<tr>
<td>% Pounds Remaining</td>
<td>20%</td>
<td>38%</td>
</tr>
</tbody>
</table>
QUESTIONS?
THANK YOU
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On October 30, 2013, O'Brien & Gere representatives joined Rhode Island Resource Recovery Corporation (RIRRC), Rhode Island Governor Lincoln D. Chafee, Johnston Mayor Joseph M. ...

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energy master planning at the university at albany

events

» RE3 CONFERENCE
   01/27/14 - 01/29/14

» 17th Annual AWWA/NYWEA Joint Seminar
   02/12/14

» 18th Annual CNY AWWA Technical Conference
   03/29/14

in the news

» Council votes plans to overhaul wastewater treatment plant, Olean, NY

» Nearly $1M flows for NY dams

» Improving Production Safety with Integrated Heat Treat and Quenching Cells

» Innovative Partnership with USACE Charleston District

» Recognized among nation's top 200 environmental firms

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