DESIGNING LAGOON-BASED WWTP FOR <1 MG/L AMMONIA (AND TN) IN <34°F WATER

Nick Janous
Regional Manager
Aerated Lagoon

Subdivide existing facultative pond into three cells using floating baffle curtains.
optAER fine-bubble aeration

- Excellent oxygen transfer rate at a wide range of airflows
- Specifically designed for cold climate lagoon applications
Getting lagoon-based WWTPs’ Ammonia down to <1 mg/L in <1°C water
What is a **SAGR**®?

Fully-aerated *coarse gravel* bed reactor

- Dense rock *not susceptible* to temperature shock
- Provides *surface area* attached-growth nitrifying biomass needs.
- Aeration throughout SAGR floor creates *aerobic* conditions.
Why does the SAGR work?

1. Fully aerated
2. Post-lagoon/sized for BOD polishing
3. Ample surface area in non-turbulent environment
4. Patented Step-Feed prebuilds/stores nitrifiers with built-in temperature buffering
Without Step-Feed: Winter
Step-Feed: Winter
SAGR® O&M

Operations & Maintenance similar to aerated lagoon

- No solids return to monitor/adjust
- Only moving parts are blowers
- Takes operators avg. 5 mins/day
Choose with confidence

• 70+ installations across North America
• 12,000+ data points
• 4 demonstration scale plants in Canada
• 19 year-old facilities
• Nexom contacts all SAGR installations at least once every year
## Third-Party Winter Operation Verification Data

<table>
<thead>
<tr>
<th>January 13 – April 21, 2010</th>
<th>Influent Avg (mg/L)</th>
<th>Effluent Avg (mg/L)</th>
<th>Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>cBOD</td>
<td>47</td>
<td>2.1</td>
<td>95.5%</td>
</tr>
<tr>
<td>TSS</td>
<td>30</td>
<td>1.3</td>
<td>95.7%</td>
</tr>
<tr>
<td><strong>TAN</strong></td>
<td><strong>24.9</strong></td>
<td><strong>0.12</strong></td>
<td><strong>99.5%</strong></td>
</tr>
<tr>
<td>TKN</td>
<td>32.5</td>
<td>1.8</td>
<td>94.5%</td>
</tr>
<tr>
<td><strong>FC (cfu/100mL)</strong></td>
<td><strong>253,000</strong></td>
<td><strong>13.5</strong></td>
<td><strong>99.99%</strong></td>
</tr>
<tr>
<td>Avg water temp (°C)</td>
<td>0.3</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>
Use caution before accepting pilot data at face value

- Can miss coldest winter
- Lagoon nitrification varies seasonally
- Variability of water flows and chemistry
- More media doesn’t mean more removal
Why a demonstration site in Steinbach MB?

<1°C water for 5 months

full scale with actual layout

full year 3 full years, actually

parallel trains: test & control
Long Plain First Nation

Operator continuity
Long Plain First Nation, MB

Non-compliant Sequencing Batch Reactor
Limited access to trained operators
Growing population
Long Plain First Nation, MB

2-Cell Aerated Lagoons

Alum Addition

Sand Filter

UV Disinfection

Effluent

Influent

Nexom™
Misipawistik Cree Nation

Remote & Extremely Cold, with pH Fluctuations
Misipawistik Cree Nation
Misipawistik Fecal Coliform (MPN/100mL)

- Influent
- Effluent
- Limit


Nexom
Newhall, IA
Denitrifying Nitrates/Total Nitrogen with Effluent Recycle
De-nitrification

Phosphorus limits algae in freshwater. **Nitrogen** is the limiting factor in marine waters.

- Often as nitrates.
Dead zones

2015 Gulf of Mexico dead zone: 6,747 square miles

• Second largest in the world
Newhall, Iowa

Project Type: Municipal Wastewater

Design Flow: 0.619 MGD

Effluent Objectives:
- August TAN: 1.4 mg/L
- February TAN: 8.1 mg/L
- BOD: <20 mg/L
- TSS: <20 mg/L
Newhall, Iowa

Settling Lagoon

Influent

Aerated Lagoon

Effluent Discharge

TN Recycle

Settling Lagoon

Aerated Lagoon

Influent

SAGR

Nexom™
Newhall, Iowa
TAN (mg/L)

Effluent
Limit


Effluent

Limit
Sundridge, Ontario

Project Type: Municipal Wastewater
Design Flow: 0.315 MGD
Sundridge, Ontario

Influent

Alum/Soda Ash Addition

Anoxic Lagoon

Recycle for partial TN removal & alkalinity recovery

Aerated Lagoon

Alum Addition

Effluent Discharge

Influent

Alum/Soda Ash Addition

Anoxic Lagoon

Aerated Lagoon

Alum Addition

Effluent Discharge

Sundridge, Ontario
## Sundridge Treatment

December 2015 – January 2017

<table>
<thead>
<tr>
<th>Parameters (mg/L)</th>
<th>Influent</th>
<th>Effluent</th>
<th>Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrates &amp; Nitrites</td>
<td>3.94</td>
<td></td>
<td></td>
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<tr>
<td>TKN</td>
<td>15.7</td>
<td>1.14</td>
<td>92.7%</td>
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<tr>
<td>TN</td>
<td></td>
<td>4.80</td>
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<tr>
<td>TAN</td>
<td>12.5</td>
<td>0.75</td>
<td>94.0%</td>
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<tr>
<td>cBOD\textsubscript{5}</td>
<td>80.4</td>
<td>3.44</td>
<td>95.7%</td>
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<tr>
<td>TSS</td>
<td>463</td>
<td>4.56</td>
<td>99.0%</td>
</tr>
<tr>
<td>E.Coli (CFU/100mL)</td>
<td>16.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water temp (°C)</td>
<td>1-24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Technology</td>
<td>Biomass Index</td>
<td></td>
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<tr>
<td>--------------</td>
<td>----------------------------------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>Sub-surface flow wetland (tertiary)</td>
<td>0.54 – 0.91</td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>Sub-surface flow wetland (secondary)</td>
<td>0.49 – 0.78</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>SAGR (tertiary)</td>
<td>0.43 – 0.46</td>
<td></td>
</tr>
</tbody>
</table>
System supports sufficient biomass to achieve treatment without compromising hydraulic performance.

How much available pore space is effectively filled with biological growth?

Steinbach SAGR Zone 1

0.46 - 0.53

System may lack the biomass or nutrients for optimal treatment.

System has excess biological growth, at risk of poor hydraulic function compromising hydraulic performance.
hydraulic conductivity testing
cBOD$_5$ Removal Area

Nitrification Area

During Installation