Lessons Learned from the First Year of Operation of an ANITA™ Mox System at Little Patuxent WRP

Tuesday August 18th, 2020
1:00pm – 2:00pm EST

Presenters
Larry Li
Chris Moline
Robert Hindt

How to Participate Today

- **Audio Modes**
  - Listen using Mic & Speakers
  - Or, select “Use Telephone” and dial the conference (please remember long distance phone charges apply).

- Submit your questions using the Questions pane.
- A recording will be available for replay shortly after this webinar.
ANITA™ Mox Process Overview
Alternate Nitrogen/Ammonia Strategies: Principle and Benefits

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ANITA™ Mox</th>
<th>Conv. NDN</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen Requirement (lb O₂ / lb N)</td>
<td>1.9</td>
<td>4.6</td>
<td>60%</td>
</tr>
<tr>
<td>External Carbon (lb / lb N)</td>
<td>0</td>
<td>3.0</td>
<td>100%</td>
</tr>
<tr>
<td>Sludge Production (lb VSS / lb N)</td>
<td>0.1</td>
<td>0.5 – 1.0</td>
<td>50 – 90%</td>
</tr>
</tbody>
</table>

MBBR for Simplicity; IFAS for THP or More Capacity
Maintenance-Free Components (Media, Air Grids, Sieves)

- **AnoxKaldnes™ K5 Media**
  - 800 m²/m³ SSA
  - Longevity
- **Media Retention Sieves**
  - 304L Stainless Steel
  - Cylindrical Perforated Plate
- **AnoxKaldnes™ Aeration Grid**
  - 304L Stainless Steel
  - Medium Bubble
- **I/C Instrument and Controls**
- **Mixers**
- **Blowers (if necessary)**

Mature for Sidestream, Ready for Mainstream
Dare to Compare

- Simplest, most stable and robust process in the Market
- Works well with existing tanks, any water depth (10-30ft) and geometry
- Compact design with minimal maintenance
- No anammox washout, Greater protection from shocks/toxicity
- Tolerate high range of TSS, polymer, DO, pH, NO2 residue etc. No need for media replacement
- Resilient, works with flexible dewatering schedules

Every Project Is a Success (30 + projects in 10 years)

U.S. Installations – Sidestream
- James River TP, VA (HRSD) (2014)
- South Durham WRF, NC (2015)
- Egan WRP, Chicago, IL (MWRDGC) (2016)
- Denver Metro, CO (2017)
- Howard County MD (2018)
- Tomahawk Creek, KS (2019)
- WSSC (2020)
- Central Valley (2021)

ROW Installations – Sidestream
- Malmo, Sweden (2010)
- Växjö, Sweden (2011)
- Holbaek, Denmark (2012)
- Grindsted, Denmark (2012)
- Industrial Client (F&B), Poland (2015)
- Locarno, Switzerland (2015)
- Arla Foods (Dairy), United Kingdom (2015)
- Väkimäki (near Helsinki), Finland (Large Scale Pilot) (2015)
- Borås, Sweden (2016)
- Stockholm Vatten-Bromma, Sweden (2016-17)
Plug & Play Package Plant for <10-15 mgd WWTPs & Pilot

1. Project Background
2. System Performance
3. Chemical Feed Requirements
4. Struvite Management
5. Temperature Management
6. Foam Management
Project Background

Little Patuxent WRP

- Average influent flow ~20 MGD
  - Influent screening + pumping + grit removal
  - Primary clarification
  - BNR activated sludge and clarification
  - Denitrification filters
  - UV disinfection
- Average solids production
  - 23 dry tons/day before anaerobic digestion
  - 12 dry tons/day after anaerobic digestion
Little Patuxent WRP – Liquid Treatment Process

- High influent BOD (industrial component)
- Effluent Limits: 4 mg/L TN, 0.3 mg/L TP, seasonal ammonia

LPWRP Biosolids Improvements

- Solids Handling
  - Gravity thickening for PS (upgraded)
  - Gravity belt thickeners for WAS (new)
  - Anaerobic digestion (new)
  - Centrifuge dewatering
  - Belt dryers (new)

- Nutrient Recycle Improvements
  - New, concentrated centrate (N & P)
  - Phosphorus precipitation (AirPrex)
  - Ammonia removal (ANITA Mox)
LPWRP Effluent Discharge Limits

- Permit compliance is the first consideration for managing nutrient recycles

<table>
<thead>
<tr>
<th></th>
<th>Annual Average Limit (mg/L)</th>
<th>Monthly Average Limit (mg/L)</th>
<th>Weekly Average Limit (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Nitrogen</td>
<td>4.0 (3.0 goal)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ammonia Nitrogen,</td>
<td>-</td>
<td>0.75</td>
<td>1.1</td>
</tr>
<tr>
<td>Apr 1 – Oct 31</td>
<td>0.75</td>
<td></td>
<td>1.1</td>
</tr>
<tr>
<td>Ammonia Nitrogen,</td>
<td>7.0</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Nov 1 – March 31</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>0.30</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>
ANITA Mox System Design

- Design Load
  - 1,600 lb/d Ammonia, 1,100 mg/L typical

- Treatment Specifications
  - ≥80% Ammonia Removal
  - ≥70% TN Removal

- Reactors and Equalization
  - Existing aerobic treatment basins
  - (2) EQ tanks @ 200,000 gal/each
  - (2) reactors @ 141,000 gal/each

- Major Equipment
  - Existing solids gallery
  - (3) Centrate feed pumps
  - (3) 50 hp blowers, 850 SCFM each
  - Reactor mixers, air lift pumps
  - Sodium Hydroxide and Micronutrient Feed Systems

ANITA Mox System Process Flow
System Performance

Typical Performance

- Centrate Feed
  - 140,000 gal/d total
  - 1,080 mg/L NH₃-N (1,260 lb/d)
  - 1,100 mg/L TSS

- Effluent
  - 230 mg/L NH₃-N (79% removal)
  - 55 mg/L NO₃-N
  - 10 mg/L NO₂-N
  - 750 mg/L TSS
  - pH 6.6

- Chemical Feed
  - 150 gal/day 25% NaOH
ANITA Mox System Startup

- 5% seed media added 1/15/2019

Ammonia Removal & Influent TSS

- System has been resilient to influent solids spikes
Example Operation over 24 Hours

- pH oscillating
- D.O. zero to <1 mg/L
- Feed flow constant

- Adjust feed rate slowly (max 5% per day)
- Nitrogen species monitored daily, and 2x/day if there's a process concern
  - NH₃-N: Target between 150 and 250 mg/L. Increase D.O. if higher.
  - NO₂-N: Target <15 mg/L. Reduce D.O. if higher.
  - NO₃-N: Target between 10-15% of NH₃-N removed

- pH, Alkalinity, and Sodium Hydroxide Feed
  - Air shuts off at pH 6.3-6.5 (adjustable) to allow pH to increase before aerating again
  - Sodium hydroxide feed set to provide sufficient alkalinity for ammonia removal

- Temperature
  - Add dilution water to centrate drain if reactor >95°F
  - Can also heat if temperature is low

System Monitoring and Control

<table>
<thead>
<tr>
<th>Tag</th>
<th>Historical Model</th>
<th>Unit</th>
<th>Value</th>
<th>Format</th>
<th>Value</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

air flow rate on / off based on pH
Chemical Feed Requirements

Supplemental Alkalinity

- Alkalinity consumed by AirPrex process upstream, due to struvite formation
- Calculate alkalinity dose based on either
  - Phosphorus removed at AirPrex
  - Target alkalinity-to-ammonia ratio in centrate
- 25% sodium hydroxide added directly to reactors
Micronutrients

- System includes micronutrients feed pumps and tote
- Micronutrient has not been needed during operation at LPWRP

Struvite Management
**Struvite Management**

- LPWRP has enhanced biological phosphorus removal process → struvite potential in centrate
- Upstream AirPrex process removes >85% of phosphorus but some struvite can still form in centrate
- Struvite forms when pH rises due to turbulence or exposure to air

**Pumping Considerations**

- Struvite formed on centrifugal impeller and downstream
- Hair/ragging and foam also an issue
- Rotary lobe pump provides more consistent performance
Piping Considerations

- Struvite buildup has occurred in centrate feed lines
- Has been removed with jetting or citric acid recirculation
- Provide flushing connections for citric acid circulation and access for pipe jetting

Temperature Management
**Reactor Temperature**
- Optimal temperature 77 – 95°F (25 – 35°C)

**High reactor temperature can cause inhibition**
- While low temperatures reduce reaction rate, temperatures >98°F can also be problematic
- Reactor temperature > feed temperature
  - Exothermic reactions
  - ~8°F temperature rise calculated from biological activity
- Dilution is simplest method to address elevated temperature
  - Reduces feed temperature
  - Reduces energy content of feed
Foam Management

- Reactors each include two airlift pumps each for foam control
- Portion of reactor surface separated by existing walkway beam, leading to foam build-up
  - Temporary spray nozzles
  - Additional airlift pump to be added
Foam Photos

Centrate Equalization Tank

Reactor surface without airlift pump

Airlift Pump Installation
Questions?
Chris Moline, HDR Christopher.Moline@hdrinc.com
Larry Li, Veolia Water Technologies USMunicipal@veolia.com

www.veoliawatertech.com