Struvite Recovery Lessons Learned

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David Wrightsman, P.E., CEM

Chris Martin, Frederick Winchester Service Authority
Aidan Murphy, ESG
Navit Johal, Ostara
Frederick Winchester Service Authority
Plant Overview

- 2010 - $50M upgrade to ENR to meet Chesapeake Bay requirements
- 12.6 MGD design, 8.0 MGD average, 16.0 MGD peak
- Permitted for monthly averages of 7.1 mg/l BOD; 10 mg/l TSS, 3.0 mg/l Ammonia, 0.197 mg/l total phosphorus annual average

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Influent (mg/l / lbs/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSS</td>
<td>158 / 16,603</td>
</tr>
<tr>
<td>CBOD</td>
<td>169 / 17,759</td>
</tr>
<tr>
<td>TKN</td>
<td>25.7 / 2,704</td>
</tr>
<tr>
<td>Ammonia</td>
<td>14 / 1,473</td>
</tr>
<tr>
<td>Total P</td>
<td>4.6 / 484</td>
</tr>
</tbody>
</table>
Frederick-Winchester Service Authority
Needs

- Lime stabilized sludge
- Frame Press dewatering
- Centrifugal blowers, oversized
- No DO control on aeration
- HVAC issues in main building
- Escalating costs for chemicals & electricity
2017

New AD Facility

Struvite Recovery Process
Why was struvite recovery process added to this project?

1. Struvite formation may occur with a biological phosphorus removal is combined with anaerobic digestion
2. As this project included an extensive hauled waste program, they wanted to have wide range of feedstocks to select in order to maximize new revenue
3. Phosphorus recycle loads from dewatering increase ferric oxide consumption to meet effluent limits

Envirotec Magazine
## Basis of Design

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Flow</td>
<td>718</td>
<td>gpm</td>
</tr>
<tr>
<td>Ortho-phosphorus</td>
<td>390</td>
<td>Pounds per day</td>
</tr>
<tr>
<td>Ammonia</td>
<td>495</td>
<td>Pounds per day</td>
</tr>
<tr>
<td>Phosphorus removal efficiency</td>
<td>90</td>
<td>%</td>
</tr>
<tr>
<td>Nitrogen Removal</td>
<td>38</td>
<td>%</td>
</tr>
</tbody>
</table>
Mg²⁺ + NH₄⁺ PO₄⁻³ + 6H₂O → NH₄MgPO₄•6H₂O
Feb 10, 2017 – Substantial Completion
Bagging and pellet storage
Annual Cost Optimization

Ran scenarios for different loading rates to optimize chemical feed design

- Assuming different Phosphorus loads from startup to 20 year design life
- 0 to 100% centrate capture on Belt filter press
- 0 to 100% centrate capture on Gravity belt thickener
- Use magnesium chloride versus magnesium hydroxide
- With or without cost of power (due to CHP)

<table>
<thead>
<tr>
<th>Results</th>
<th>Average Conditions</th>
<th>Worst Conditions - minimum struvite</th>
<th>Best Conditions – max struvite + zero cost of power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case</td>
<td>($57,142)</td>
<td>($84,517)</td>
<td>$17,710</td>
</tr>
<tr>
<td>Base Case + No MgOH</td>
<td>($93,496)</td>
<td>($120,871)</td>
<td>($18,643)</td>
</tr>
</tbody>
</table>
Pellet Production

<table>
<thead>
<tr>
<th>Year</th>
<th>Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>6</td>
</tr>
<tr>
<td>2018</td>
<td>18</td>
</tr>
<tr>
<td>2019</td>
<td>22</td>
</tr>
</tbody>
</table>
Chemicals

Chemical Consumption

- mag Chloride
- Mag Hydroxide
- Causitc soda
Changes

- MgCl2 pump was inconsistent due to bad check valve
- Pellet production is better for smaller size
- Ensuring accurate lab data on the feed characteristics (PO4-P and Mg in the BFP filtrate and GBT filtrate).
Lessons Learned

- More technology options available today
- Require active management
- Weekly calls
- Operator buy-in
- Keep current data in control system for optimum chemical dose
- Still below design loads

Also see: “Operating Experience with Ostara Struvite Harvesting Process”, Authors: Steve Reusser, Alan Grooms, Aaron Dose, Ahren Britton, Ram Prasad