Opportunities and Challenges of Struvite Harvesting

Presented by Alan Grooms to the 20th Annual CSWEA Education Seminar – April 7th, 2015 – Madison, Wisconsin
Resource Recovery

* Water plus:
  * Biosolids
  * Energy
  * Materials
    * Recovery
    * Conversion
Why Phosphorus?

Graph taken from [http://phosphorusfutures.net/peak-phosphorus.html](http://phosphorusfutures.net/peak-phosphorus.html) on March 20, 2015.
Nutrient element

Critical to all known forms of life

Demand for food = demand for phosphorus

Irreplaceable and deposits non-renewable

Declining high quality deposits

Harder to get = increasing cost

Graph taken from [http://phosphorusfutures.net/peak-phosphorus.html](http://phosphorusfutures.net/peak-phosphorus.html) on March 20, 2015.
Struvite

* $(\text{NH}_4)\text{MgPO}_4 \cdot 6(\text{H}_2\text{O})$

* Considered a good fertilizer:
  * Magnesium a desirable mineral additive
  * 5-28-0 N-P-K ratio ... plus 10% Mg

* Wastewater good source
Why Struvite?

* We are already making it
  * Ingredients present
Why Struvite?

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- Nuisance
Why Struvite?

* We are already making it
  * Ingredients present
  * Nuisance

* Ready Partners

Struvite

* **Anaerobic digestion** results in ammonia and phosphate in abundance
* Magnesium typically comes from hard water, bio-P, chemical addition
* Raising pH triggers formation of precipitate
* Remove nuisance, send where needed
P-Recovery Around the World

Source: [https://batchgeo.com/map/68a91d8653dc0b4140b3530dca0b25424](https://batchgeo.com/map/68a91d8653dc0b4140b3530dca0b25424) Analysis of reference sites for Phosphorus Recovery as struvite.
Meet the Field

* Ostara “Pearl”       - 9+ operating sites
* Multiform Harvest   - 2+ operating sites
* Paques “Phosphaq”   - 3+ operating sites
* DHV Crystallactor   - 4+ operating sites
* NuReSys            - 7+ operating sites
* Airprex            - 3+ operating sites
* Others?
Nine Springs WWTF-Madison, WI
What can harvesting offer?

- Reduce biosolids phosphorus
- Reduce biosolids mass
- Reduce $O_2$ demand
- Nuisance struvite drop
- Revenue source
- “Non-tangibles”
### Biosolids Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before Harvesting</th>
<th>Ideal Harvesting*</th>
<th>Actual Harvesting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biosolids Total-P</td>
<td>2,114 ppd</td>
<td>1,150 ppd</td>
<td>1,161 ppd</td>
</tr>
<tr>
<td>Biosolids WEP</td>
<td>108 ppd</td>
<td></td>
<td>37 ppd</td>
</tr>
<tr>
<td>Biosolids Mass</td>
<td>43,700 ppd</td>
<td>39,050 ppd</td>
<td>39,960 ppd</td>
</tr>
<tr>
<td>Biosolids Thickness</td>
<td>5.69%</td>
<td></td>
<td>5.19%</td>
</tr>
<tr>
<td>Biosolids Polymer</td>
<td>30 lb. / ton DS</td>
<td></td>
<td>34 lb. / ton DS</td>
</tr>
<tr>
<td>NH4 O2 Demand**</td>
<td>42,880 ppd</td>
<td>40,851 ppd</td>
<td>41,933 ppd</td>
</tr>
<tr>
<td>Nuisance Struvite</td>
<td>Some</td>
<td>Little</td>
<td>Little</td>
</tr>
<tr>
<td>FeCl3 Addition</td>
<td>Moderate</td>
<td>None</td>
<td>Some</td>
</tr>
</tbody>
</table>

* Based on an assumed 2,000 ppd influent P (40 MGD at 6 mg/l) to the facility and 100 ppd effluent P (40 MGD at 0.3 mg/l).

** Calculated from recycle ammonia value and assuming demand of 4.6 lb. O2 per lb. ammonia.
Struvite harvesting challenges

* More complexity
  * Monitoring
  * Testing
  * Logistics
* Focus shift
  (production attitude)
Nine Springs with Class “A”
Operating challenges

- Feed ratios and values change with operations
- Thickening vs dewatering
- Mesophilic vs thermophilic
- Solids control
- Recipe control critical
Reducing recycled phosphorus

Recycle to Primary Clarifiers, ppd TP
Considerations

* Minimum size facility?
  * Concentrations + loads
  * Staffing

* Do I have the basic ingredients?

* Impacts on facility (+ and −)
  * Consider how nutrient return impacts plant
  * Interdependence of operations
    * P-release and impact on filtrates
    * RAS concentration
Current status at Nine Springs

* >500 tons Crystal Green® shipped
* Reduced P in anaerobic digesters
* Testing and evaluations ongoing
Thanks to collaborators at MMSD and Ostara Nutrient Recovery Technologies

Questions?

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