Sustainable Approaches to Water Treatment Residuals Management

Biosolids Workshop – December 6, 2018

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Paradigm Shift: Biosolids

Old Practices

New Practices

Ohio Mulch – Innovative Deep Row Hybrid Poplar (DRHP) Biomass Farming
Paradigm Shift: Water Treatment Residuals (WTRs)

Old Practices: Disposal Focused

New Practices: Market Focused

Start with the Solution in Mind
WTRs Current Approach
Residuals Characterization Critical to Evaluating Options
What are Water Treatment Plant Residuals?

- Coagulant solids (alum, ferric) – can include treatment additives like polymer, PAC.
- Lime softening solids – mostly CaCO$_3$, can be combined with coagulant in surface water plants.
- Spent filter backwash water – high flow, low solids. Similar for gravity filters, low pressure membranes.
- Regenerant brine from ion exchange – IX softening or nitrate removal. High TDS
- High pressure membrane filtration reject – softening membranes removing dissolved compounds. High TDS
Residuals Handling is Getting More Complicated
What Have Water Plants Done Historically?

Coagulant – generally not considered for beneficial use
- Discharged to sewer, dewatered/landfilled
- Costs are increasing, regulations more stringent, negative impacts to WWTPs

Lime – generally beneficial use is practiced
- Land applied – shrinking ag
- Recalcination – expensive, energy intensive
How Much Does a Typical Water Plant Produce?

- **Typical coagulation solids**
  - 400-800 lbs ds/mgd

- **Typical softening solids for surface water**
  - 1500-3000 lbs ds/mgd

- **Typical softening solids for groundwater**
  - 5000 lbs ds/mgd

  **Columbus - WTRs**
  ~228 tons ds/day (34 tons alum, 194 tons lime)

  **Columbus – Biosolids**
  ~60 tons ds/day

Affected by turbidity, hardness (lime), enhanced coagulation for additional TOC removal
What do other lime softening utilities do in Ohio?

<table>
<thead>
<tr>
<th>City</th>
<th>Plant</th>
<th>Capacity</th>
<th>Dewater</th>
<th>Quarry</th>
<th>Land App</th>
<th>Landfill</th>
<th>Recalcination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cincinnati, OH</td>
<td>Bolton - GW</td>
<td>40</td>
<td>lagoon</td>
<td></td>
<td></td>
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<tr>
<td>Columbus, OH</td>
<td>Hap Cremean - SW</td>
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<tr>
<td></td>
<td>Dublin Road - SW</td>
<td>80</td>
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<tr>
<td></td>
<td>Parsons Ave -GW</td>
<td>50</td>
<td>lagoon</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
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<tr>
<td>Dayton, OH</td>
<td>Ottawa -GW</td>
<td>96</td>
<td>Centrifuge</td>
<td></td>
<td>x</td>
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</tr>
<tr>
<td></td>
<td>Miami -GW</td>
<td>96</td>
<td>Centrifuge</td>
<td></td>
<td></td>
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<td>x</td>
</tr>
<tr>
<td>Del-Co Water</td>
<td>OLE - SW</td>
<td>19.2 (28.8)</td>
<td>lagoon</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
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<tr>
<td></td>
<td>TFM -SW</td>
<td>4</td>
<td>lagoon</td>
<td></td>
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<tr>
<td></td>
<td>RES - SW</td>
<td>6.6</td>
<td>lagoon</td>
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<td></td>
<td>x</td>
<td></td>
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<tr>
<td></td>
<td>TES - GW</td>
<td>6</td>
<td>lagoon</td>
<td></td>
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<tr>
<td>Massillon, OH</td>
<td>Aqua OH - GW</td>
<td>15</td>
<td>P&amp;F</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Toledo, OH</td>
<td>Collins Park -SW</td>
<td>120</td>
<td>P&amp;F</td>
<td></td>
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So Can We Reduce/Eliminate Lime Softening Residuals?

• Stop softening
  • Impacts to residential/industrial customers
  • Likely cause increase in home softeners – TDS discharge to sewers will increase

• Switch to caustic softening
  • Significant reduction in solids
  • Increased cost, increased sodium in finished water

• Ion exchange softening
  • Negative impacts to water quality, high TDS waste stream

• Membrane softening
  • Problematic disposal of high TDS waste stream

Lime Softening ✔
Considerations for Discharge to WRRFs

• Disposal to sanitary sewer / removal through primary clarifiers
  • Chemically enhanced primary treatment (P removal)
  • CEPT may result in diversion of carbon from BNR
  • Increased primary solids
  • Potential toxicity / inhibition to activated sludge biology
  • Inerts can consume secondary capacity if no PC

• Digestion considerations
  • Phosphorus speciation weighted toward precipitate solids
  • Reduction in VSS destruction because of inerts
  • Potential reduction in sulfide generation
Beneficial Use of WTRs
## WTRs Viewed as a Resource

<table>
<thead>
<tr>
<th>Alum/Ferric</th>
<th>Lime</th>
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<tbody>
<tr>
<td>Improves soil tilth</td>
<td>Provides liming value</td>
</tr>
<tr>
<td>Binds phosphorus</td>
<td>Binds heavy metals</td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Alum/Ferric: Improves soil tilth, Binds phosphorus, Binds heavy metals
- Lime: Provides liming value
Beneficial Use of Water Treatment Residuals

Water Treatment Plants

- Filter sediments from drinking water
- Generate 2 million tons WTRs DAILY (U.S.)

Beneficial Use of a RESOURCE or Disposal of a WASTE?

What is WTR? Silica-based, alum, ferric, lime, organic matter...soil substitute and P-binder

### Beneficial Use Markets for WTR

<table>
<thead>
<tr>
<th>Manufacturing Markets</th>
<th>Landscaping/Restoration</th>
<th>Other Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick manufacturing</td>
<td>Stormwater BMPs</td>
<td>Agricultural land application</td>
</tr>
<tr>
<td>Cement manufacturing</td>
<td>Wetland/Stream/Floodplain</td>
<td>Phosphorus (P) removal structures (e.g. Phrog)</td>
</tr>
<tr>
<td>Topsoil blending</td>
<td>Dirt &amp; Gravel Road (fill)</td>
<td>Blending with biosolids to reduce P availability</td>
</tr>
<tr>
<td>Composting</td>
<td>Landfill alternative daily cover</td>
<td>Recalcination, Flue gas de-S</td>
</tr>
</tbody>
</table>
Beneficial Use Challenges

- Markets not as fully developed compared to biosolids.
- Phosphorus control – genuine opportunity, but still emerging.
- Dewatering technologies for coagulant difficult to achieve high solids concentrations. Trucking costs for hauling dewatered residuals drive costs.
- Polymer use for dewatering can be problematic for beneficial end users.
- Some markets have uncertain futures – flue gas desulfurization.
- Algal toxin impacts to land application.
Characteristics of WTRs will Determine Markets

- Characterize your residuals prior to developing beneficial use options
- Collect data on residuals for permitting and end user information
  - Calcium (CaO, CaCO3, Calcium Carbonate Equivalence) – liming value
  - Solids, sieve analysis
  - Effective Neutralizing Power (ENP)
  - Metals (permit requirements)
  - Possibly microcystin (if in source water) – method still uncertain
  - Nutrient analysis
Beneficial Use (Coagulant) Opportunities in Ohio

- Cleveland – currently discharge to NEORSD at three of their plants. Considering dewatering, beneficial use at all four plants.
- Akron – soil blending.
- Columbus – considering beneficial use alternatives for all three plants (alum and lime).
- Avon Lake – dewater combined biosolids/alum residuals. Currently landfill, considering beneficial use.
## Beneficial Use Options To Consider

<table>
<thead>
<tr>
<th>Market</th>
<th>Lime-Only WTR</th>
<th>Alum-Only WTR</th>
<th>Alum/Lime Blend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture (Phosphorus-binding / Integration into biosolids)</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Agriculture (Liming Value)</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Cement Manufacturing</td>
<td>X</td>
<td></td>
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<tr>
<td>Disturbed Land Reclamation</td>
<td>X</td>
<td></td>
<td>X</td>
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<tr>
<td>Flue Gas Desulfurization</td>
<td>X</td>
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<tr>
<td>Industrial Waste Scrubbing</td>
<td>X</td>
<td></td>
<td>X</td>
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<tr>
<td>Landfill Daily Cover</td>
<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td>Soil Blending</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Considerations for Dewatering/Thickening

- Beneficial use options will likely require dewatering/thickening
- Dewatering significantly impacts trucking costs
- Understand how product will be applied (if land app).
- Mechanical vs nonmechanical
- Dewatering WTRs with biosolids
  - Need to understand performance when comingled prior to dewatering
  - Charge differences and polymer selection
  - Bench-scale testing and manufacturer input
Non-Mechanical Dewatering Processes

Freeze-Thaw Beds or Drying Beds

Lagoons
Mechanical Dewatering Processes

Centrifuge
Plate and Frame Press
Belt Filter Press
Screw Press
Volute Press
Lessons Learned
Beneficial Use Lessons Learned

- Diversify the beneficial use portfolio – similar to biosolids market
- Separate lime and coagulant for more beneficial use options
- Discuss coordination opportunities between biosolids and WTR beneficial use markets
- Understand all of the potential waste streams from water plants and impacts on WWTP ops.
- Compare costs, including environmental impact, using life cycle assessment. Understand the true costs of the residuals management options before making a decision.
- Fully evaluate liquid and solids processing impacts (some good / some bad) at WRRF
Questions?

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