Biosolids Technology Overview

Solids Thickening

Solids Dewatering
SOLIDS THICKENING
Increasing solids concentration reduces the required digestion volume

Assumes 10,000 lbs/day
Increasing solids concentration has an upper limit under conventional digestion.

<table>
<thead>
<tr>
<th>Percent Solids</th>
<th>Organic Loading @ 15 day HRT (lbs VSS/cfDay)</th>
<th>Limiting Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.03</td>
<td>Hydraulic</td>
</tr>
<tr>
<td>2</td>
<td>0.07</td>
<td>Hydraulic</td>
</tr>
<tr>
<td>3</td>
<td>0.10</td>
<td>Hydraulic</td>
</tr>
<tr>
<td>4</td>
<td>0.13</td>
<td>Hydraulic</td>
</tr>
<tr>
<td>5</td>
<td>0.17</td>
<td>Solids</td>
</tr>
<tr>
<td>6</td>
<td>0.20</td>
<td>Solids</td>
</tr>
<tr>
<td>7</td>
<td>0.23</td>
<td>Solids</td>
</tr>
</tbody>
</table>
Facilities with digesters can benefit significantly.
Gravity thickeners are often overloaded
An example from Longview, Texas

- Active Volume: 1.21 MG
- HRT: ~15.0 days
- Flow: 3%
HRT increases with thickened sludge

- HRT: 24.9 days
- Active Volume: 1.21 MG
Thickening should usually meet these goals:

- Maintenance friendly
- Operations friendly
- Capable of handling PS/WAS together
- Ability to integrate odor control
- Meet a 5% TS requirement
Thickening options:

- Gravity Belt
- Rotary Drum
- Disk
- Membrane
Gravity Belt Thickeners

**Advantages**
- Low energy requirement
- 90 – 98% capture rate
- Can be odor controlled
- Long term reliability
- Ease of operation

**Disadvantages**
- Larger footprint than other options
- Significant source of odor (if not enclosed)
  - Polymer dependent
  - High wash water usage
  - Spray
Rotary Drum Thickeners

**Advantages**
- Fully enclosed
- Odors are contained
- Smaller footprint
- Indoor/Outdoor use
- Low wash water usage

**Disadvantages**
- Higher capital costs
- Chance of shearing floc
- Polymer dependent
- Can’t see thickening process
Disk Thickeners

**Advantages**
- Fully enclosed
- Odor is contained
- Smallest footprint
- Indoor/outdoor use
  - Lower noise
- Low power consumption
  - Fully automated

**Disadvantages**
- Newer technology
- Polymer dependent, high usage
- Capacity of unit is relatively small
  - Proprietary no competition
Membrane Thickeners

**Advantages**
- Use of existing infrastructure
- Treats sidestream to high quality
  - No return of ammonia
  - No return of phosphorus
  - No separate building

**Disadvantages**
- High capital costs
- Maintenance
- Need for pumps
- Requires blowers
Comparing options...

<table>
<thead>
<tr>
<th></th>
<th>Gravity Belt</th>
<th>Rotary Drum</th>
<th>Disk</th>
<th>Membrane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic Capacity (GPD)</td>
<td>720,000</td>
<td>36,000-576,000</td>
<td>129,600-259,200</td>
<td>4-12 (g/d/ft^2)</td>
</tr>
<tr>
<td>Solids Capacity (lb/day)</td>
<td>54,741</td>
<td>2,400-48,000</td>
<td>10,560-21,120</td>
<td>varies</td>
</tr>
<tr>
<td>% Solids</td>
<td>4-8%</td>
<td>5-7%</td>
<td>4-8%</td>
<td>5%</td>
</tr>
<tr>
<td>Capture Rate</td>
<td>98%</td>
<td>93%</td>
<td>95%</td>
<td>99%</td>
</tr>
<tr>
<td>Footprint</td>
<td>Large</td>
<td>Medium</td>
<td>Small</td>
<td>Medium</td>
</tr>
<tr>
<td>Polymer need (lbs/dry ton)</td>
<td>3 to 10</td>
<td>5 to 10</td>
<td>7 to 12</td>
<td>0</td>
</tr>
<tr>
<td>Capital Cost</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>O&amp;M Cost</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
SOLIDS DEWATERING
What is mechanical dewatering?
Dewatering units come in several forms
Dewatering should usually meet these goals:

- Maintenance friendly
- Operations friendly
- Minimize O&M costs
Hauling liquid sludge is not cheap
A significant drop was immediately noticed
The primary technology includes

- Belt Filter Press
- Centrifuge
- Screw Presses
Other dewatering options exist

- Plate and Frame Press
- Drying Beds
- Dewatering Boxes/Bags
Belt Filter Press

**Advantages**
- Low energy requirement
- 90 – 98% capture rate
- Long term reliability
- Ease of operation
- Medium polymer usage

**Disadvantages**
- Larger footprint than other options
- Polymer dependent
- High wash water usage
  - Spray
- Regular O&M required
BFP Options: How many belts do I want?
The improved operation...

- Clarifier
- Aerobic Digester
- Pump
- Polymer
- Belt Filter Press
- Belt Conveyor
- Dry Haul
Dewatering Screw Press

**Advantages**
- Fully enclosed
- Odors are contained
- Smaller footprint
- Indoor/Outdoor use
- Low wash water usage
- Better cake percentage

**Disadvantages**
- Polymer dependent
- Can’t see process
- More expensive
Dewatering Screw Press
Dewatering Screw Press
General Process Flow

- Digester 1
- Digester 2
- Day Tank
- Polymer Skid
- Polymer Tank
- Pumps
- Screw Press
- Stabilization
Advantages

• “Cleaner” dewatering process
• Advanced technology
• 20-26% dryness
• 98% Solids Capture
• Controls based operation
• Compact footprint

Disadvantages

• Highest power consumption
• 20-25 lbs/tn polymer usage
• Closed operation
• Aggressive (shear) dewatering process

Centrifuge
Inside the centrifuge
Drying Bed

**Advantages**
- Simple dewatering process
- Advancing technology
- Can achieve 85% dryness
- Excellent water recovery
- Very low polymer usage
- Minimal labor during dewatering

**Disadvantages**
- Very large footprint
- Labor intensive during cleaning
- Extended time for drying
Drying Bed

Fill Line

3 Months Loading

2" to 20" Cake Depth

14 Day Drying
Comparing options...

<table>
<thead>
<tr>
<th></th>
<th>Belt Filter Press</th>
<th>Screw Press</th>
<th>Centrifuge</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Solids</td>
<td>15-20%</td>
<td>17-25%</td>
<td>20-25%</td>
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<td>10 to 20</td>
<td>15 to 30</td>
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Sludge dewaterability comparison (BFP Example)

<table>
<thead>
<tr>
<th>Sludge Type</th>
<th>Expected Cake Percentage</th>
</tr>
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<tbody>
<tr>
<td>Primary Sludge</td>
<td>25%</td>
</tr>
<tr>
<td>Biological Sludge</td>
<td>20%</td>
</tr>
<tr>
<td>Lime Sludge</td>
<td>15%</td>
</tr>
<tr>
<td>Alum Sludge</td>
<td>10%</td>
</tr>
<tr>
<td>Ferric Sludge</td>
<td>5%</td>
</tr>
<tr>
<td>Carbon Sludge</td>
<td>0%</td>
</tr>
</tbody>
</table>

Polymer Usage (lbs/ton):
- Primary Sludge: 15 lbs/ton
- Biological Sludge: 10 lbs/ton
- Lime Sludge: 5 lbs/ton
- Alum Sludge: 2 lbs/ton
- Ferric Sludge: 1 led/ton
- Carbon Sludge: 0 lbs/ton
We need to condition the sludge with polymers for improved dewatering.
Polymer is plant and technology specific

- Testing is required to determine appropriate polymer
  - Cationic (+)
  - Anionic (-)

Recommended Manufacturers

Wallace & Tiernan® ChemFeed

VELODYNE VELOCITY DYNAMICS, INC.
Questions?

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