Pelletization of Thermal Dried Sludge to Improve Usability and Marketability of Biofertilizer

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Meet the Team

Wes Yellin

Damon Forney

Sudhakar Viswanathan
Western Wake Regional Water Reclamation Facility
Wake County Water Reclamation

- 860 sq. miles (549,000 acres)
- Raleigh and 11 other cities
- County growing by ~86 people per day
- Raleigh and Cary were 9th & 10th fastest growing cities in the US in 2012
- Just over 1 million people in 2015
Western Wake Regional Water Reclamation Facility

❖ ~19 employees
❖ ~18 MGD liquid treatment
❖ Serves: Apex, Cary, Morrisville
Western Wake Regional Water Reclamation Facility

- Prior to drying at Western Wake
  - Lime stabilization
- High temp thermal drying at South Cary WRF
  - North Cary WRF
  - Apex WRF
Considered Technologies
Considered Technologies

- Considered various technologies during planning phase
  - *Keep Lime Stabilization (do nothing)*
  - *Digestion*
  - *Thermal Drying*
    - High, low or somewhere in between

- Drivers included
  - *Safety*
  - *End product quality*
  - *Cost*
Selection
Thermal Drying

- How do dryers differ?
  - Temperature
  - Feed system
  - Condensate system
  - Belt materials
  - Fans and blowers
Thermal Drying

Treatment Range

- **<180 F**
  - ★ Large Footprint
  - ★ Plastic Belts
  - ★ Requires more air
  - ★ Acid Corrosion Risk
  - ★ All Good ;)

- **180 to 350 F**
  - ★ Explosion Risk
  - ★ Dust Formation
  - ★ Operator Intense
  - ★ Corrosion Risk

- **> 350 to 1,800 F**
  - ★ Expensive
  - ★ Complex
  - ★ Operator Intense
  - ★ High Energy Usage

- **> 1,400 F**
Thermal Drying - Belt dryers

Feed System
- Hopper/sifter
- Single depositor
- Multiple depositors

Concerns:
- Single point of failure
- Dryer downtime

Photo Source: http://2gryphon.com/technology/modular-design-reduced-costs/
Thermal Drying - Belt dryers

- Dryer continues to operate uninterrupted with one dosing pump out of service
- Clogged depositors can be identified by looking into the dryer
- The clogged depositor can be isolated, removed, cleaned without interrupting the dryer
Condensate system
- Vertical Condensation
- Horizontal Condensation
- Condenser Coils

Photo Source: [http://2gryphon.com/technology/modular-design-reduced-costs/](http://2gryphon.com/technology/modular-design-reduced-costs/)
Thermal Drying - Belt dryers

Belt Material

- Plastic mesh
  - $150 \, C \, max \, temp$
    - Risk of melting/burning with temperature excursions
  - Low porosity
    - Fans
    - Clogging

- Stainless Steel
  - Long lasting
    - Can replace only section of belt
  - High porosity
  - Doors/access ports for service/viewing

Thermal Drying - Belt dryers

Fans and Blowers

- BioCon has 3 - 6 fans
  - *For circulating air within dryer*
  - *Located for easy maintenance*
- Other
  - *Forced air fans*
  - *Must overcome higher headloss through belt*
  - *Located on top of dryer*

Medium Temperature Belt Dryer

- Design minimizes noise, odor and dust production
  - Safe, simple and efficient
- Easy access for maintenance and sampling
  - Easy replacement and unclogging of nozzles
- Minimal operator intervention
- Remote monitoring capability
- Local support from Cary, NC

Dust and Energy
- Low Air Flow
- No agitation or back mixing

Safety

Odor Control
- Low Exhaust Air
- Negative Pressure

Medium Temperature Indirect Drying
### Economic Analysis

<table>
<thead>
<tr>
<th>Step</th>
<th>Lime Stabilization</th>
<th>Digestion</th>
<th>Thermal Drying</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Ton, Sludge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry Ton, Chem Sludge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VS, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VSR, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DS, End Product</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End Product, WT/yr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End Product, DT/yr</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disposal Cost/Revenue per Ton</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Cost/Revenue (WT/yr)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Cost/Revenue (DT/yr)</td>
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</tbody>
</table>

#### Key Metrics

<table>
<thead>
<tr>
<th></th>
<th>Lime Stabilization</th>
<th>Digestion</th>
<th>Thermal Drying</th>
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</thead>
<tbody>
<tr>
<td>VS, %</td>
<td>80%</td>
<td></td>
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</tr>
<tr>
<td>VSR, %</td>
<td>55%</td>
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<tr>
<td>DS, End Product</td>
<td>25%</td>
<td></td>
<td>90%</td>
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<tr>
<td>End Product, WT/yr</td>
<td>48,960</td>
<td>13,709</td>
<td>6,800</td>
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<tr>
<td>End Product, DT/yr</td>
<td>12,240</td>
<td>3,427</td>
<td>6,120</td>
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<tr>
<td>Disposal Cost/Revenue per Ton</td>
<td>($500,000)</td>
<td>($1,000,000)</td>
<td>($2,000,000)</td>
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<tr>
<td>Annual Cost/Revenue (WT/yr)</td>
<td>($1,958,400)</td>
<td>($548,352)</td>
<td>$68,000</td>
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<tr>
<td>Annual Cost/Revenue (DT/yr)</td>
<td>($489,600)</td>
<td>($137,088)</td>
<td>$61,200</td>
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</tbody>
</table>
Solution
BioCon® Medium Temperature Dryer
Air-to-Air Heater

- Plate and Frame Heat Exchanger
- Dryer air exits dryer cabinet and enters air heater via ductwork
- Dryer air exits air heater via ductwork returning to the dryer
- Flue gas exhausted to the stack
BioCon® Scope
Safety Equipment

Sprinkler system
- Installed inside dryer in case of a “thermal event”
- Activated by high temperature switches
- Sprinkler has separate valves for warm zone and end zone

Infrared level Switches
- Detect sludge back up in the system

Belt Speed Guards
- Detect solids are not moving adequately through the system

End Product
- N2 inerting
- Bag house for dust collection
BioCon® Design

- Design:
  - 3,800 lb/hr evaporative load per dryer (7,600 lb/hr total)
  - ~34,000 wet tons per year (15-18%DS)
  - Ability to incorporate imported sludge with native
  - Recirculation lines on wet cake silos
  - Dryer bypass

- Commissioning completed 2015

- Product sold and transported off-site by outside vendor for soil amendment
BioCon® Operation

Current Operation:
- Dewater native sludge
- Mix liquid sludge from Apex with native before dewatering
- One dryer operates 3-4 days per week
BioCon® Operation

- Daily sludge to dewatering
- Silo provides temporary wide spot between dewatering and drying

![Graph showing BioCon® Operation](image)
BioCon® Performance

- Roll Crusher
- Surge Bin
- Pellet Mill
- Cooler
- Hopper
- Crumbler
- Screen

Fines Recycle

ENHANCED END PRODUCT
Summary

- Ideal solution for achieving Class A without digestion
- Easily store dry product over winter months
- Growing bio-fertilizer market has potential for generating revenue

<table>
<thead>
<tr>
<th>Units</th>
<th>Before Drying</th>
<th>After Drying and Pelletizer</th>
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</thead>
<tbody>
<tr>
<td>Sludge Receiving</td>
<td>$/gallon</td>
<td>$0.03</td>
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<tr>
<td>Revenue from 3rd Party Sale</td>
<td>$/DT</td>
<td>-$40.00</td>
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<tr>
<td>Revenue from Private Sale</td>
<td>$/DT</td>
<td>N/A</td>
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</table>
Questions

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