Utilizing Anaerobic Digester Capacity to Process Source Separated Organics: Two Case Studies

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Presentation overview

- Source Separated Organics Streams
- Nashua WWTF
- Ithaca Area WWTF
- Other Communities and Viability
Digester capacity

Hydraulic Retention Time (HRT)
- Time liquid is held in the digestion process
- Volume of liquids in reactor / quantity of biosolids removed daily

Volatile Solids (VS) Loading
- Amount of volatile solids in sludge entering digester / volume of digester
- TR16 maximum VS loading rate = 120 lbs VS per day / 1,000 ft³ digester volume
Potential waste streams

- Low strength waste
  - Cheese
  - Yogurt
  - Apple juice
  - Septage
- Mixed food waste
- High strength waste
  - Oils
  - Glycerin
  - Concentrated food products
Low strength single stream liquid food wastes

Characteristics
• Consistent chemical makeup of waste
• Typically good process control by food producers – minimizes potential for digester upset
• Limited packaging/inert materials

Processing
• Mechanical mixer for storage tanks
• Receiving facility
• Increased solids hauled off-site
Mixed food waste

Characteristics
• Highly variable stream
• High probability of packaging/inert materials

Processing
• Screen for packaging
• Macerate to consistent small particle size
• Slurry to 5 -7 % solids
• Increased solids hauled off-site
Brown & yellow grease

Yellow Grease:
- Used cooking oil
- Existing market for high strength wastes – hard to obtain
- Yellow grease – biodiesel

Brown Grease:
- Animal fat, grease
**Brown & yellow grease**

Characteristics:
- Excellent substrate for digesters
- Dramatically increase digester gas production
- High VS proportions and digests well

Processing (Brown Grease)
- Heated and mixed storage tank
- Odor issues
- Known to cause foaming in digesters – pilot typically required
- No measurable increase in amount of solids hauled off site
**Off-Spec** vegetable oils and glycerol

Characteristics
- 0.5 – 1% of total digester input – significantly increases digester gas production
- 1 – 2 % - begins to impede digester gas productions and upset digester biology

Processing
- Require mixed and heated storage tank
- Odors should not be concern
- No measurable increase in amount of solids hauled off site
**Required infrastructure**

**Liquid:**
- Low strength liquid waste
- Septage
- Grease
- Glycerol

**Solid:**
- Mixed Food Waste
Liquid unloading station

- Transfer pump and quick disconnect station
- Low odor potential
**Solids** unloading

- Typically delivered in roll-off containers or dump trucks
- Dump pit or Hopper
- Large screen
- Chopper/macerator
- Dilution system to add liquid and slurry to 5-7% solids
- Need odor control
Case Studies

- Nashua WWTF
- Ithaca Area WWTF
Nashua WWTP

- 16 MGD Secondary Treatment Facility
- 1.25 MG egg-shaped digester
- Minimum HRT = 15 days for Class B biosolids
- Facility currently has 3 tanks available to store substrates (~67,000 gallon capacity) – unheated
- Economic analysis of source separated organics
**Biogas production**

Measurement
- Unreliable in past
- Project to install new digester gas flow meters

2012 Estimate
- 335 kW

Uses:
- Digester gas-fired boiler
- Dual fuel boiler
- Engine generator
- Flare
HRT capacity

- Current HRT = 17.1 days
- Factor of Safety – 1 days storage
- Excess Capacity (~ 5%)

<table>
<thead>
<tr>
<th>2012 Influent Stream</th>
<th>Daily Quantity (gpd)</th>
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</thead>
<tbody>
<tr>
<td>Primary Sludge (PS)</td>
<td>56,500</td>
</tr>
<tr>
<td>Waste Activated Sludge (WAS)</td>
<td>16,800</td>
</tr>
<tr>
<td>Septage</td>
<td>Negligible</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>73,300</strong></td>
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</table>
Volatile solids capacity

- Traditional Circular Tanks with Vertical Walls = 50% reduction
- Egg Shaped Digester = 55 – 60%
- Excess Capacity = 2,000 lb/day VS
## Options

<table>
<thead>
<tr>
<th>Additional Substrate</th>
<th>gpd</th>
<th>Electrical Energy (kW)</th>
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</thead>
<tbody>
<tr>
<td>Low Strength</td>
<td>4,800</td>
<td>35 – 45</td>
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<tr>
<td>Septage (to head of plant)</td>
<td>12,000</td>
<td>15 – 25</td>
</tr>
<tr>
<td>Waste Grease or Vegetable Oil</td>
<td>4,800</td>
<td>80 – 110</td>
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<tr>
<td>Glycerol</td>
<td>400 - 800</td>
<td>135 - 145</td>
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</table>
**Liquid unloading station**

- 4,800 gpd = 1 tanker truck per day
- Transfer pump and quick disconnect station
- Truck piped directly to storage tank – no odor control needed
- Storage tank vent piping to facilities existing odor control
- Unloading control panel – view tank levels
- **Construction costs = $150,000 to $200,000**
Solids unloading

- 2,000 lb VS = 3 to 4 tons of food scraps per day
- Typically delivered in roll-off containers or dump trucks (1 to 2 trucks/day)
- Dump pit or Hopper
- Large screen
- Chopper/macerator
- Dilution system to add liquid and slurry to 5-7% solids
- Need odor control
- Construction costs
  - $400,000 to $500,000 if in existing building
  - $1.0 to $1.5 mil incl. new building
## Substrate potential

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Annual Tipping Fees Possible</th>
<th>Electrical Generation Potential (kW)</th>
<th>Annual Value of Electrical Generation</th>
<th>Annual Sludge Disposal Costs</th>
<th>Annual Net Benefit</th>
<th>Construction Costs</th>
<th>Simple Payback (years)</th>
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</thead>
<tbody>
<tr>
<td>Yogurt waste</td>
<td>$87,600</td>
<td>41</td>
<td>$27,200</td>
<td>$35,900</td>
<td>$78,900</td>
<td>$175,000</td>
<td>2.2</td>
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<tr>
<td>Cheese waste</td>
<td>$87,600</td>
<td>41</td>
<td>$27,200</td>
<td>$35,900</td>
<td>$78,900</td>
<td>$175,000</td>
<td>2.2</td>
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<td>Food processing byproducts</td>
<td>$87,600</td>
<td>64</td>
<td>$42,400</td>
<td>$35,900</td>
<td>$94,100</td>
<td>$450,000</td>
<td>4.8</td>
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<td>Waste vegetable oil</td>
<td>$87,600</td>
<td>110</td>
<td>$72,600</td>
<td>$0</td>
<td>$160,200</td>
<td>$175,000</td>
<td>1.1</td>
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<td>Source-separated organics (curbside pickup)</td>
<td>$0</td>
<td>69</td>
<td>$45,400</td>
<td>$35,900</td>
<td>$9,500</td>
<td>$450,000</td>
<td>47</td>
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<td>Apple juice/vinegar waste</td>
<td>$87,600</td>
<td>14</td>
<td>$9,100</td>
<td>$35,900</td>
<td>$60,800</td>
<td>$175,000</td>
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<tr>
<td>Yellow grease</td>
<td>$0</td>
<td>110</td>
<td>$72,600</td>
<td>$0</td>
<td>$72,600</td>
<td>$175,000</td>
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<td>Brown grease</td>
<td>$0</td>
<td>80</td>
<td>$53,000</td>
<td>$0</td>
<td>$53,000</td>
<td>$175,000</td>
<td>3.3</td>
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<tr>
<td>Glycerol</td>
<td>$0</td>
<td>138</td>
<td>$90,800</td>
<td>$0</td>
<td>$90,800</td>
<td>$175,000</td>
<td>1.9</td>
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<tr>
<td>Septage</td>
<td>$346,000</td>
<td>21</td>
<td>$13,600</td>
<td>$35,900</td>
<td>$323,700</td>
<td>$1,750,000</td>
<td>5.4</td>
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</table>

**Notes:**
1. Tipping fees based on $0.05 per gallon, which is typical of the New England market.
2. Tipping fees based on 4,800 gpd for 365 days per year.
3. Septage tipping fee based on $79 per 1,000 gallons
4. Value of electricity estimated at $0.11 per kWh, 6000 hours per year
5. Annual net benefit = Tipping Fee + Value of Electricity – Sludge Disposal Cost

**Utilizing** Anaerobic Digester Capacity to Process Source Separated Organics
Ithaca, NY

- Population – 30,000
- Several area universities
- Liberal community
Ithaca Area Wastewater Treatment Facility (IAWWTF)

- 13.1 MGD facility
- Owned jointly by City of Ithaca, Town of Ithaca, Town of Dryden
- Primary and Secondary Anaerobic Digester
- Currently generates 25 – 30% of IAWWTF energy requirements
Ithaca community involvement

- Construction of new trucked waste receiving facility
- Constructed to accept food waste into anaerobic digester
- Facility coordinated delivery of food wastes from area universities and local grocery stores
**Other** Communities - Legislation

Toronto – Green Bin Program (2002)
- Mandatory for all City of Toronto residents receiving curbside collection.
- Sent to Dufferin Waste Management Facility

San Francisco Mandatory Recycling and Composting Ordinance (2009)

Massachusetts Commercial Organics Ban (2014)

Vermont Large Food Waste Generators (2014)
Factors to consider

- Existing infrastructure
- Excess capacity
- Siting potentially odorous process
- Tipping fee potential
Summary

• Several source separated waste streams economically viable to process at existing WWTP anaerobic digesters

• Mixed food waste streams require community involvement/legislation
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