POTW’s As An Emergency Option For Dairy Manure Disposal
— A POTW’s Perspective

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Lambeau Field Atrium

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City of Appleton Wastewater Treatment Plant
Overview of the Appleton Wastewater Treatment Plant (AWWTP)
POTW Considerations and Requirements
Dairy Operator Considerations
Waste Characteristics and Discharge Options
Process Control & Limitations
The AWWTP is advanced secondary wastewater treatment facility designed to treat 15.5 million gallons per day (MGD).
Population served = ~ 75,000.
Q–Q Significant Industrial Users (SIUs) = 5*
  • Flow = 10%, BOD = 30% , TSS = 5%–70%*
Receiving Station Waste Haulers = 10
Septage Waste Haulers = 1
Anually the AWWTP:

- Treats approximately 5 billion gallons of wastewater.
- Treats 20–25 million gallons of hauled waste.
  - 2010 – 18 million gallons leachate, 7.5 million gallons food process
- Treats approximately 250,000 gallons of septage.
- Processes and land applies approximately 20,000 wet tons of biosolids to agricultural fields.
POTW Considerations

- Available Treatment Capacity
- Toxic or inhibitory materials or substances
  - (salts/metals, antibiotics, disinfectants, fungicides)
- Treatment costs ($$$$
  - Waste strength (CBOD, TSS, TVSS, N, P)
  - Waste volumes (rates, HRT)
  - Waste temperature
  - Unwanted materials (sand, gravel, straw, wood, etc.)
- Odors
- Waste delivery
- Biogas yield
- Impact to biosolids production
- Impact to existing authorized users
AWWTP Requirements

- Representative waste characteristic data provided.
- Hauler/generator permitted through POTW.
- Haulers issued facility access cards.
- Certified scale weight needed for billing.
- Waste characteristics “reasonably” consistent.
- Volume of discharge estimated and anticipated discharge schedule made known.
- Communication maintained between generator, hauler, and POTW.
- Limitations or restrictions imposed???
Dairy Operator Considerations

- POTW discharge fees
  - (AWWTP $19.80 – $83.40 per th-gal)
- POTW hours of operation.
  - (AWWTP 6:00 am – 6:00 pm, M–F)
- Haul distance.
- Hauling/transportation fees.
- Tanker type (gravity, pump, pressure).
- Tanker condition (minimizes escape of odors and does not create a nuisance, free of sludge).
- Limitations or restrictions imposed by POTW???
- Farm fertilizer/nutrient balances.
Only two (2) options:
1. “High strength” directly to digestion.
2. “Low strength” to influent headworks.
### Waste Characteristics

<table>
<thead>
<tr>
<th>Description</th>
<th>CBOD (mg/L)</th>
<th>TSS (mg/L)</th>
<th>TVS (%)</th>
<th>N (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWWTP Influent</td>
<td>100–250</td>
<td>350–600</td>
<td>35</td>
<td>10–20</td>
</tr>
<tr>
<td>Industrial(^1)</td>
<td>300–2,500</td>
<td>10–1,000</td>
<td>--</td>
<td>30–100</td>
</tr>
<tr>
<td>Leachate(^2)</td>
<td>500–1,200</td>
<td>&lt;150</td>
<td>70</td>
<td>1,000–1,500</td>
</tr>
<tr>
<td>Food Process(^3)</td>
<td>1,300–215,000</td>
<td>250–75,000</td>
<td>40–99</td>
<td>100–3,300</td>
</tr>
<tr>
<td>Dairy Manure Liquid(^4)</td>
<td>16,176</td>
<td>15,000 TS</td>
<td>85</td>
<td>662</td>
</tr>
</tbody>
</table>

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1. Typical range of Appleton SIUs >25,000 gallons per day.
2. AWWTP receiving station leachate concentrations.
3. AWWTP receiving station food process waste concentrations.
AWWTP Receiving Station
AWWTP Receiving Station
AWWTP Digester Operation

- Raw Sludge (gal/day): Design Expected 192,000, 2010 100,000
- VS (lb/day): Design Expected 36,500, 2010 19,000
- TS (lb/day): Design Expected 60,800, 2010 42,000
- Gas (ft3/day): Design Expected 218,000, 2010 150,000
<table>
<thead>
<tr>
<th><strong>CONSTANTS</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Digester Capacity (Ea.)</td>
<td>2,200,000 Gallons</td>
</tr>
<tr>
<td>Digester Capacity (Cu Ft.)</td>
<td>297,000 Cu Ft</td>
</tr>
<tr>
<td>Biogas BTU Equivalent / cu ft Gas</td>
<td>500 BTU</td>
</tr>
<tr>
<td>Gas Production / lb TVS Destroyed</td>
<td>15 Cu Ft (12-20 cuft)</td>
</tr>
<tr>
<td>Avg Daily RS Flow (Gal)</td>
<td>20,000 Gallons</td>
</tr>
<tr>
<td>Avg LSG Output</td>
<td>150,000 Cu Ft / Day</td>
</tr>
<tr>
<td><strong>Est. per Substrate</strong></td>
<td></td>
</tr>
<tr>
<td>Digester Efficiency</td>
<td>80% (Typ. AWWTP AD 38%-45%, 45 day HRT)</td>
</tr>
<tr>
<td>BFP % Solids</td>
<td>40%</td>
</tr>
<tr>
<td><strong>LAB DATA</strong></td>
<td></td>
</tr>
<tr>
<td>Waste Temperature</td>
<td>50 degree F</td>
</tr>
<tr>
<td>Substrate TSS</td>
<td>15,000 mg/L</td>
</tr>
<tr>
<td>Substrate TVS</td>
<td>12,750 mg/L</td>
</tr>
<tr>
<td>% TVS</td>
<td>85%</td>
</tr>
<tr>
<td>CBOD</td>
<td>15,178 mg/L</td>
</tr>
</tbody>
</table>

**DIGESTER CALCULATIONS**

<table>
<thead>
<tr>
<th>Production Values</th>
<th>Dose 1</th>
<th>Dose 2</th>
<th>Dose 3</th>
<th>General OM Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substrate Feed (Gallons / Day)</td>
<td>6,000</td>
<td>12,000</td>
<td>180,000</td>
<td>Avg = 20,000 gal/day</td>
</tr>
<tr>
<td>Substrate Feed (Pounds / Day)</td>
<td>50,040</td>
<td>100,080</td>
<td>1,501,200</td>
<td>Avg = 8,000 lbs/day</td>
</tr>
<tr>
<td>Avg Daily RS Discharge (Lbs)</td>
<td>165,800</td>
<td>166,800</td>
<td>186,800</td>
<td>Avg = 700 lbs/day</td>
</tr>
<tr>
<td>% Substrate in Avg Daily RS Flow</td>
<td>30.0%</td>
<td>60.0%</td>
<td>90.0%</td>
<td>Avg = 150,000 ft3/day</td>
</tr>
<tr>
<td>TS To Digestion (Lbs)</td>
<td>75.1</td>
<td>1,351</td>
<td>12,510</td>
<td>Avg = 150,000 ft3/day</td>
</tr>
<tr>
<td>TVS in Digestion (Lbs)</td>
<td>538</td>
<td>1,276</td>
<td>10,632</td>
<td>Avg = 150,000 ft3/day</td>
</tr>
<tr>
<td>%Substrate TS of Total Daily Avg Feed</td>
<td>1.8%</td>
<td>3.6%</td>
<td>28.8%</td>
<td>Avg = 150,000 ft3/day</td>
</tr>
<tr>
<td>%Substrate VS of Total Daily Avg Feed</td>
<td>1.3%</td>
<td>2.7%</td>
<td>25.6%</td>
<td>Avg = 150,000 ft3/day</td>
</tr>
<tr>
<td>VSS Destroyed (Lbs)</td>
<td>383</td>
<td>766</td>
<td>6,390</td>
<td>Avg = 150,000 ft3/day</td>
</tr>
<tr>
<td>Pounds VS / Day / Cu Ft (1-Digester)</td>
<td>0.000</td>
<td>0.001</td>
<td>0.005</td>
<td>Avg = 0.05-0.12</td>
</tr>
<tr>
<td>Total Gas Produced (Cu Ft)</td>
<td>5,742</td>
<td>11,484</td>
<td>95,702</td>
<td>Avg = 150,000 ft3/day</td>
</tr>
<tr>
<td>Total Gas Produced (m3 gas/kg VS)</td>
<td>0.561</td>
<td></td>
<td></td>
<td>Avg = 0.60</td>
</tr>
<tr>
<td>% of Avg. Daily AWWTP LSG Output</td>
<td>4%</td>
<td>8%</td>
<td>64%</td>
<td></td>
</tr>
<tr>
<td>Calculated BTU Output</td>
<td>3,445,254</td>
<td>6,890,508</td>
<td>57,420,900</td>
<td></td>
</tr>
<tr>
<td>BTU required heat waste to 95 F</td>
<td>2,502,000</td>
<td>5,004,000</td>
<td>41,700,000</td>
<td></td>
</tr>
<tr>
<td>BFP Solids Out (Wet Pounds)</td>
<td>1,139</td>
<td>1,839</td>
<td>15,325</td>
<td></td>
</tr>
<tr>
<td>BFP Solids Out (Wet Tons)</td>
<td>0.65</td>
<td>1.06</td>
<td>7.66</td>
<td></td>
</tr>
</tbody>
</table>
AWWTP Digester Operation

- Two (2) high rate, complete gas mix mesophilic (77°F – 113°F) anaerobic digesters with a capacity of 2.2 MG per digester.
- Temperature maintained at 95°F +/− 1°F for optimum bacterial stabilization.
- Volatile solids reduction ranges 40–50% (minimum required TVS = 38%).
- HRT typ. 45–days w/ two digesters operating (15 days required by WPDES).
- Desired pH range 6.8–7.2.
- Volatile acids 1,000 mg/L +/−
Anaerobic Digestion Waste Load Allocation

Scenario #1 (Gallons per Day)

- 45,000 Gallons
- 32,000 Gallons
- 20,000 Gallons

- 3 Loads

- 45 day HRT

- Receiving Station
- Waste Sludge
- Primary Sludge

4.4 Million Gallon Digester Capacity

Minimum Required HRT = 15 Days
Anaerobic Digestion Waste Load Allocation

Scenario #2 (Gallons per Day)

- 100,000 gallons
- 45,000 gallons
- 32,000 gallons

Legend:
- Receiving Station
- Waste Sludge
- Primary Sludge

- 4.4 Million Gallon Digester Capacity
- Minimum Required HRT = 15 Days
Anaerobic Digestion Waste Load Allocation

Scenario #3 (Gallons per Day)

- 16 Loads
- 12 day HRT
- 100,000
- 45,000
- 32,000

- Receiving Station
- Waste Sludge
- Primary Sludge

2.2 Million Gallon Digester Capacity
Minimum Required HRT = 15 Days
Are POTWs a possible emergency option for dairy manure? Yes, **but** will dependent on a number of site specific factors.

“Farm” around dairy manure to other POTWs?

Future opportunities?
QUESTIONS?