COMPOSTING OF FATS, OIL, AND GREASE

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TOPICS TO BE COVERED

- Composting Basics
- Regulatory Requirements
- Knox County, TN Demonstration
COMPOST BASICS

Aerobic
Microbial
Process
COMPOST BASICS

Process Requirements:

• Oxygen
• Water
• Temperature
• Carbon
• Nitrogen
• Particle Size
COMPOST BASICS

Materials Composted:

- Biosolids
- Food Wastes
- Yard Wastes
- Manures
- Septage
COMPOST BASICS

Definitions:

- Co-composting
- Bulking Agent
- Amendment
- Materials Balance
COMPOST BASICS

Compost Systems:

• Windrow
COMPOSTING SYSTEMS

Windrow Basics:

• Aerate by Turning

• Specialized Turners or Front-end Loader
COMPOST BASICS

Compost Systems:

• Aerated Static Pile
COMPOST BASICS
COMPOST BASICS

Compost Systems:

• Static Pile

• In-vessel or Mechanical
REGULATORY REQUIREMENTS

Federal:

- "503" Regulations Cover Biosolids
  - Vector Attraction Reduction (VAR)
  - Pathogen Reduction
REGULATORY REQUIREMENTS

Pathogens:

- Static Pile Composting - 3 Days >55°C
- Windrow Composting - 15 Days >55°C with 5 Turnings
- All Products <1,000 MPN Fecal Coliform or <3 MPN Salmonella sp./4 grams Total Dry Solids
REGULATORY REQUIREMENTS

VAR Requirements:

• 14 Days Aerobic
• >40°C
• Average 45°C
REGULATORY REQUIREMENTS

Organic
Food
REGULATORY REQUIREMENTS

- Air Quality
- Odor
- Organics
KNOX COUNTY DEMONSTRATION

Participants:

- Knox County Solid Waste Board (KC)
- Knoxville Utility Board (KUB)
- First Utility District
KNOX COUNTY DEMONSTRATION

Materials:

- Lime-stabilized Biosolids
- Raw Sludge
- Ground Yard Waste
- Ground Pallet Wastes
- Grease Trap Wastes
KNOX COUNTY DEMONSTRATION
KNOX COUNTY DEMONSTRATION

Mix Characteristics:

• FOG Absorbed to Wood
• No Odor After Mixed
• 3 Days to 55°C
• 8 Days at 55°C
• Met VAR
• 57% Volatile Solids
KNOX COUNTY DEMONSTRATION

Mix Characteristics:

- 37% Solids
- pH = 8.7
- Bulk Density = 1,230 lbs/yd$^3$
- FOG = 7,570 lbs
- Green Wastes = 10,770 lbs
KNOX COUNTY DEMONSTRATION

Compost Characteristics:

- Fecal Coliform <1
- pH = 8.3
- 53% Volatile Solids
- Ammonia <56 mg/kg
- 40% Solids
- Cadmium = 0.2 mg/kg
- Chromium = 6.1 mg/kg
KNOX COUNTY DEMONSTRATION

Compost Characteristics:

- Copper = 12.5 mg/kg
- Nickel = 4.2 mg/kg
- Lead = 13.3 mg/kg
- Zinc = 113.2 mg/kg
- Selenium = BDL
- Mercury = 0.2 mg/kg
- Kjeldahl Nitrogen = 4,163 mg/l
KNOX COUNTY DEMONSTRATION

Observations:

• Co-composted Well
• No Trace After 7 Days
• No Odor
• Chips Could Hold More FOG
• No Mass Buildup
KNOX COUNTY
DEMONSTRATION

Economic Analysis:
Key Assumptions in Designing a
Liquid Grease Trap Waste Compost Site

<table>
<thead>
<tr>
<th>Item</th>
<th>Units</th>
<th>Recommended Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Storage</td>
<td>days</td>
<td>2</td>
</tr>
<tr>
<td>Daily Volume of Liquid</td>
<td>gallons</td>
<td>10,000</td>
</tr>
<tr>
<td>Method of Mixing</td>
<td>method</td>
<td>Mix Box</td>
</tr>
<tr>
<td>Method of Composting</td>
<td>method</td>
<td>Windrow</td>
</tr>
<tr>
<td>Days of Composting</td>
<td>days</td>
<td>14</td>
</tr>
<tr>
<td># of Cycles Bulking Agent Used</td>
<td>#</td>
<td>7</td>
</tr>
<tr>
<td>Solids Content of Liquid</td>
<td>%</td>
<td>3.5</td>
</tr>
<tr>
<td>Volatile Solids of Liquid</td>
<td>%</td>
<td>70</td>
</tr>
<tr>
<td>Bulking Agent Storage</td>
<td>days</td>
<td>14</td>
</tr>
<tr>
<td>Operational Days per Week</td>
<td>days/week</td>
<td>6</td>
</tr>
<tr>
<td>Hours of Operation/Day</td>
<td>hours/day</td>
<td>10</td>
</tr>
<tr>
<td>Odor Control</td>
<td>method</td>
<td>None</td>
</tr>
</tbody>
</table>
## Economic Analysis:
### Site Sizing Calculations

<table>
<thead>
<tr>
<th>Activity</th>
<th>$\text{yd}^3$/Day</th>
<th># of Days</th>
<th>$\text{yd}^3$</th>
<th>Area Required ($\text{ft}^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Storage$^a$</td>
<td>50.0</td>
<td>2</td>
<td>100</td>
<td>314</td>
</tr>
<tr>
<td>Bulking Agent Storage$^b$</td>
<td>185.4</td>
<td>14</td>
<td>2,600</td>
<td>7,921</td>
</tr>
<tr>
<td>Mix Area$^c$</td>
<td></td>
<td></td>
<td></td>
<td>660</td>
</tr>
<tr>
<td>Compost Area$^d$</td>
<td>222.5</td>
<td>14</td>
<td>3,115</td>
<td>48,544</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>57,379</strong></td>
<td><strong>57,379</strong></td>
</tr>
</tbody>
</table>

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$^a$Assumes a 20-foot diameter silo.

$^b$Assumes a 12-foot pile height = 5,850 $\text{ft}^2$, or 77 x 77; therefore, accounting for slope need, 89 x 89 = 7,921.

$^c$Assumes a 20-foot x 30-foot area.

$^d$Assumes 14 piles areas: 12 active and 2 extra. Assumes a Scarab 16 = 2.29 $\text{yd}^3$/ft windrow capacity, 14 windrows, 100-foot windrows, 4.5 feet between windrows, 32-foot turn distance, and 16-foot-wide windrows.
## Economic Analysis:

### Capital Costs – Moving Equipment

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit Cost</th>
<th>Units</th>
<th>Quantity</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front-end Loaders</td>
<td>185,000.00</td>
<td>6 yd³</td>
<td>1</td>
<td>185,000</td>
</tr>
<tr>
<td>Mix Box</td>
<td>115,000.00</td>
<td>18 yd³</td>
<td>1</td>
<td>115,000</td>
</tr>
<tr>
<td>Scarab 16</td>
<td>227,000.00</td>
<td>ea</td>
<td>1</td>
<td>227,000</td>
</tr>
</tbody>
</table>

**Total Moving Equipment**

- **$527,000**

**Engineering (5%)**

- **$26,350**

**Total**

- **$553,350**

**Annual Amortization**

- **$95,537**

**Annual Amortized Cost**

- **$/gallon $0.0031**

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*a Assumes direct City purchase; no overhead and profit.

*b Amortized over seven years at five percent interest.

*c Based on 10,000 gallons/day x 6 days/week x 52 weeks/year = 3,120,000 gallons/year.
# Economic Analysis:

## O&M Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit Cost</th>
<th>Unit</th>
<th>Daily Quantity</th>
<th>Annual Quantity</th>
<th>Annual Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor</td>
<td>14.00</td>
<td>$/hour</td>
<td>12</td>
<td>31,201</td>
<td>436,814</td>
</tr>
<tr>
<td>Laboratory</td>
<td>3,000.00</td>
<td>$/year</td>
<td></td>
<td></td>
<td>3,000</td>
</tr>
<tr>
<td>Front-end Loader O&amp;M</td>
<td>29.59</td>
<td>$/hour</td>
<td>8</td>
<td>2,496</td>
<td>73,857</td>
</tr>
<tr>
<td>Scarab O&amp;M&lt;sup&gt;a&lt;/sup&gt;</td>
<td>59.82</td>
<td>$/hour</td>
<td>1</td>
<td>156</td>
<td>9,332</td>
</tr>
<tr>
<td>Batch Mixer O&amp;M</td>
<td>15.00</td>
<td>$/hour</td>
<td>4</td>
<td>1,248</td>
<td>18,720</td>
</tr>
<tr>
<td>Bulking Agent&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.20</td>
<td>yd&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
<td>6,886</td>
<td>42,693</td>
</tr>
<tr>
<td>Administrative O&amp;M Costs</td>
<td></td>
<td>lump</td>
<td></td>
<td></td>
<td>15,000</td>
</tr>
<tr>
<td>O&amp;M Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>599,416</td>
</tr>
<tr>
<td>O&amp;M Costs/gallon&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.192</td>
</tr>
</tbody>
</table>

<sup>a</sup>Assumes three turns per week.

<sup>b</sup>Assumes ground brush is obtained at average retail price for the Knoxville area.

<sup>c</sup>Assumes 10,000 gallons/day x 312 days.
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Conclusions:

• Can Compost
• Do Not Need to Dewater
• Can Co-compost
• Can Meet Regulations
• Can Be Cost Competitive