Trouble-Shooting Composting and Anaerobic Digestion Operations

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Nuisance Problems

• Nuisance problems are the #1 complaint about compost sites
• Engineering and technology to correct nuisance problems is often expensive and sometimes ineffectual
• These are "people problems"
• Prolonged nuisance conditions have led site shutdown
Understanding the “Trouble-Makers”

- **Nitrogen Compounds**
  - Ammonia—leachable form of N, usually in solution unless pH exceeds 8.5 or pile becomes too dry—leading to losses as ammonia gas

- **Organic acids**
  - Produced during periods of low pH and or anaerobic conditions
  - Long chained fatty acids that are persistent and very odorous
  - Fixed by turning pile, adding bulky materials, or through prolonged curing

- **Sulfur**
  - Usually a digester-specific problem
  - Too much leads to decreased efficiency and odorous releases
Foam...the Bane of “Digesters”

• Creeps into gas-line causing clog and “back-pressure”

• Usually caused by one of following:
  – Waste Activated Sludge
  – Excessive Filamentous Bacteria
  – Excessive Grease
  – Unstable Operating Conditions

• Solved by balancing conditions within digester
• Continued careful process monitoring
Compost Process Monitoring

- Operate piles in a manner that reflects consistent values:
  - C:N Ratio $25$ (20-30)
  - Moisture $55\%$ (40%-60%)
  - pH $7.0$ (5.5-8.5)
  - Oxygen content $\geq 5.0\%$
  - Bulk Density $< 1,000$ lbs./cubic yard
  - Homogeneous blend with adequate pore space
  - Active temperatures in excess of $131\,\text{F}$
General Observations—*Using Your Senses*

- **Sight:**
  - Look for colors, texture, steam, litter (non-compostables), and leachate

- **Smell:**
  - Smell for general odors (ammonia, VOAs, feedstock ingredients)

- **Touch:**
  - Check moisture with squeeze test, feel for pile density, and general warmth
Accessory Equipment

• Oxygen Probes
  – Reflect microbial activity, odor potential, and help decide when to turn

• Moisture Sampling—squeeze test/moisture probes
  – Help determine pile activity, tell you when to water, and odor potential

• Temperature
  – Microbial activity, when to turn, and possible spontaneous combustibility

• pH
  – Reflects compost process activity, can warn of anaerobic conditions or excessive alkalotic conditions (ammonia loss)
Common Composting Problems

• Pile fails to heat
• Uneven compost temperatures
• ODORS!!!
• Leachate
• Dust
• Vectors
• Fire???
• Failure to create a stable product
# Piles Fail to Heat

<table>
<thead>
<tr>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pile is too wet or too dry.</td>
<td>Adjust moisture to 40%-60%.</td>
</tr>
<tr>
<td>pH too low or too high.</td>
<td>Adjust pH to 5.5-8.5.</td>
</tr>
<tr>
<td>Mix is not uniform (homogeneous), leading to dead spots.</td>
<td>Breakdown and re-mix pile.</td>
</tr>
<tr>
<td>Particle size is too small or too big.</td>
<td>Add a bulking source to improve compaction, or grind particles to make a more compatible mix.</td>
</tr>
<tr>
<td>C:N too low or too high.</td>
<td>Adjust to 20:1 to 30:1.</td>
</tr>
<tr>
<td>Pile mass is too small.</td>
<td>Combine piles to increase mass.</td>
</tr>
</tbody>
</table>
“Uneven” Compost Temperatures

• Pile contains hot spots and dead spots
  – Mix is not uniform or particle sizes are mismatched
  – Bulk density needs to be between 800 and 1,000 lbs./cubic yard
    • Less than 800 and piles will lose moisture from wind action
    • Greater than 1,000 and material begins to compact—favoring anaerobic conditions
  – Remix piles in favor of balanced textures, C:N, moisture, pH and bulk density
Odors!!!
Odor Properties

• Character
• Concentration
• Intensity
• Hedonic tone 😊
Odor Releases

- **Ammonia**—natural part of compost process
  - However, losses can occur when:
    - pH > 8.5
    - pile too dry
    - C:N in recipe is too low, < 20:1

- **“Rotting” Smell**—strong pungent odors
  - Often caused by anaerobic conditions
    - pH < 5.5
    - pile is too wet
    - poor pile porosity (compaction of core)
Odor Influences

• Meteorology/topography
  - Atmospheric stability

• Prevailing winds

• Manmade structures
  - Powerlines
Odor Sampling

- Source emission sampling
- Dynamic dilution
  Olfactometry
    - Odor panel
- Scentometer
- Butanol scale
- Instrumental chemical analysis
- Gas chromatograph
Correcting for Odor Issues

- Identify odor and probable cause
- Fix parameter that is out of whack
- When in doubt, cover piles with 6 inch layer of finished compost to act as an odor scrubber

<table>
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<th>Cause</th>
<th>Cure</th>
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<tr>
<td>pH is too low or too high.</td>
<td>Adjust to 5.5-8.5 range.</td>
</tr>
<tr>
<td>Pile is too dry or too wet.</td>
<td>Adjust to 40%-60% range.</td>
</tr>
<tr>
<td>C:N ratio is too low.</td>
<td>Adjust to 20:1 to 30:1 range.</td>
</tr>
<tr>
<td>Pile is too dense, limiting O2.</td>
<td>Re-mix pile to enhance porosity and moisture balance. Add additional bulking agents as necessary.</td>
</tr>
</tbody>
</table>
Biofiltration

Figure 3.9 BIOFILTER - Used to clean contaminated air

Leachate
Leachate

• The liquid loss of nutrients from a compost pile.

• Often attributable to two factors:
  – Poor moisture management during recipe development
  – Moisture releases from piles exposed to precipitation events

• Simple fix is to optimize recipe moisture at 55%, and cover piles with compost fabrics whenever precipitation events are anticipated
2006 Poultry Study—Leachate Trial
Leachate Collection System
Precipitation Recorded During 2006 Poultry Compost Trials

Total Recorded Precipitation: 9.26 inches
"Cooling" effect of 2.7 inch rainfall
Leachate and Runoff Sources/Controls

- Run-on (Divert)
- Precipitation (Cover)
- Feedstock moisture (Good recipe)
- Groundwater discharge (Separation)
- To treat leachate
  - Level spreader
  - Pump and re-use
  - Pump and dispose
Dust

• Often results from low moisture or excessive pile drying
• Exacerbated by wind action
• Grinding and screening operations may also lead to dust emissions
• Solved by spraying piles with water or mixing in wetter ingredients
• Access roads may also need treatment
Vectors
Vectors

- Any organism capable of transmitting diseases to humans (i.e., birds, mammals, flies, etc.)
- Attracted by “rotting” odors or exposed feedstocks
- Eliminated by simple housekeeping procedures:
  - Balanced recipe
  - Cover piles with amendment (odor control)
  - Distractors may be used in extreme cases
    - Propane cannons, scarecrows, exploding ordinance
12-24 Day Fly Cycle
## Summary of Amendments Causing Odor and Vector Problems

*From 2004 MCT Large Animal Carcass Compost Study*

<table>
<thead>
<tr>
<th>Trial</th>
<th>Pile Composition</th>
<th>Odor #'s</th>
<th>Vector #'s</th>
<th>Vector Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4A</td>
<td>Wood Chips</td>
<td>14</td>
<td>4</td>
<td>Rodent</td>
</tr>
<tr>
<td>H3A</td>
<td>Shavings</td>
<td>6</td>
<td>4</td>
<td>Turkey Maggots</td>
</tr>
<tr>
<td>C4B</td>
<td>Wood Chips/Horse Bedding</td>
<td>4</td>
<td>5</td>
<td>Maggot</td>
</tr>
<tr>
<td>H1A</td>
<td>Horse Bedding</td>
<td>3</td>
<td>5</td>
<td>Rodent</td>
</tr>
</tbody>
</table>

- **High C:N:** 62-677 (high)
- **Bulk Density:** 250-450 lbs./yd³
- **Texture:** Coarse to Very Coarse
- **Porosity:** High optimal to Excessive
Vector Control Options

• Avoidance
  – Neat, clean, thorough mix
  – Compost away from areas of production/feedlots

• Cover piles
  – Extra amendment (2-3 feet thick)

• Block access to piles
  – Snow fencing or other barrier

• Re-form disturbed areas ASAP!

• Use of distracters
  – Scarecrows/predator “mimics”
  – Noise generators
  – “Flashy” devices
Fire!
Fire

• Serious problem in dry, arid parts of the country.
• Large compost piles rapidly exhaust moisture and become very dry—allowing fire conditions to develop.
• Treating Pile Fires:
  – If small, use extinguisher.
  – If large, break apart and spread out (drench material with water).
  – Smother with soil, wet compost or foam.
• Prevention involves building more, smaller piles with adequate space between them to allow for fire control equipment access.
• Work with local Fire Department.
Failure to Produce a Stabilized Product

• This is often a complaint among commercial composters trying to meet market deadlines.
  – Composting is a biological process and takes time!!!

• Two things may contribute:
  – Compost has not fully completed active compost phase.
  – Inadequate curing time.

• Compost piles should be cured for 3-6 months to ensure completeness of the compost process.
Simple Ways to Prevent Trouble

• Good site location and operations
• Strict process monitoring and control
• Adequate space for movement and storage of materials
• Efficient and common sense oriented process flow.
• Neat and clean operation
• Engineered storm water management
• Schedule delivery and handling of putrescible residuals
Why Chase Shadows?
Where To Find More Information

• On-Farm Composting Handbook
• Mark King-(207) 287-2430, (207) 592-0455 (Cell)
  – mark.a.king@maine.gov
• Compost School web page
  – www.composting.org
• Biocycle Magazine
• Other state agencies (USDA, NRCS, etc.)