Control of Odors from Composting

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15th International High Level Technical Meeting:
Industrial Composting of Waste
Campinas, Brazil
Odors at Composting Facilities

- #1 reason for problems at compost facilities
- We know a lot about odors
- An ounce of prevention IS worth a pound of cure
- Can be very site-specific
- Subjectivity provides significant challenge
Composting Odors

- A mix of several volatile compounds
- Inherent to decomposition of organic chemical bonds and part of the food chain for microbes
- Transient and changeable
- Subjectively offensive
- Manageable
Composting Odors

- A mix of several volatile compounds
- Inherent to decomposition of organic chemical bonds and part of the food chain for microbes
- Transient and changeable
- Subjectively offensive
- Manageable (Not Inevitable)
Oxygen and Aeration

- Lack of $O_2$ main reason for odors
  - Terpenes and Ammonia exceptions

- Odors form in anaerobic pockets or zones
  - Aeration and/or turning, releases odors trapped in pile
Where Do Odors Come From?

Odor Sources at One Windrow Facility

- Compost Tipping area
- Compost Chop pile
- Windrows
- Product Storage
- Stormwater ponds

(dt/min)
Where Do Odors Come From?

Odor Sources at a Different Windrow Facility

Source: Epstein and Wu, 2000
Where Do Odors Come From?

• Every site is different, but…
  – The largest *volume* of “odor molecules” are released from the windrows themselves
  – Not necessarily the largest *concentration*, but a constant low-level stream from every windrow, 24/7
  – In general, most odors released at the beginning of the process and trail off as the process proceeds…
  – However, other processing activities can be major sources by themselves.
Operator Challenges/Causes

- Desire to offer flexibility to generators
- Need to operate (almost) regardless of weather
- Seasonality of markets
- “New” feedstocks
- Competing odor sources
- Changing land use
- Compost industry still growing
Where Do Odors Come From?
Is Technology the Answer?
Composting Facilities by Type

- Yard trimmings: 70%
- On-site farm: 8%
- Mixed organics: 2%
- Food scraps: 7%
- Biosolids: 5%
- On-site institution: 7%
- Other: 1%

4,914 Sites Reported

Source: BioCycle Magazine, 2014
C-CORP

- Comprehensive Compost Odor Response Project
- Detailed study on Compost Odor (CalRecycle, March 2007)
- Great resource for any site
- Odor Mitigation Menu
- Available here: www.calrecycle.ca.gov/Publications
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Odor Mitigations

- Predominantly Management Practice based.
- Majority of facilities use windrow
- Other technologies allow alternative odor control
- Optimization of process conditions is the best odor control mechanism
Odor Mitigations

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- Majority of Facilities use windrow
- Other technologies allow alternative odor control
- Optimization of process conditions is the best odor control mechanism
Timing of Feedstock Delivery

Little Hannaford Farms receiving blood and fat from a chicken processor delivery had to be less than 2 hours from generation to reduce odors.

Information courtesy USCC, Photo Credit: Jeff Gage
Absorb Excess Moisture and Adjust Carbon to Nitrogen Ratio

• Blend wet materials with a drying agent to correct C:N ratio 25:1 - 40:1
  – Paper
  – Sawdust
  – Dried manure
  – Bark
  – Old compost

Photo Credit: Cary Oshins
Test Feedstocks - for C:N, Moisture, Degradability, Bulk Density, etc

Essa não foi uma boa idéia?
On-time Management

- Immediately blend mix or treat with aeration methods any incoming feedstocks
  - Set porosity (Bulk density) and moisture targets
  - Aerate, keep below 40° C, until pH raises above 5.8

Slide Courtesy US Composting Council
Create Porosity for Free Airflow

- Add sufficient bulking agent to meet the porosity needs of your compost system
  - Bulk density below 800 lbs/cu. yd.
  - Small and large particles as support matrix
  - Usually 30-50% of blend
Mixture Design

• **Targets**
  – C:N Ratio: 25:1 to 40:1
  – H₂O: 50-60%
  – pH: 5.8-7.5

• **Particle Size Distribution**
  – Don’t make concrete, test your mixture
  – Use sawdust to increase surface area for silt and clay size particles to decompose on, and dry it down
  – Use wood chips to provide Free Air Space (FAS)

Slide Courtesy US Composting Council
Mixture Procedures

- Always mix fresh ingredients with bulking agents within hours of delivery
- Use mixers for wet or sticky materials, adding in sawdust and chips first, then sludge on top
- Use loaders (5 turns) or windrow turners (2 turns) for mixing materials, or use specialized mixer
- Add water before or during mixing if required
Place Mixture at Right Height

- One that meets the
  - Porosity
  - Turning regime
  - Amount of aeration your system provides

- Assure at least 5% oxygen is maintained
  - Interstitial air testing
  - Goal of 10% to 15%
  - Until next handling

Slide Courtesy US Composting Council
Compost Cap

- *Envisioned* for odor control
- *Studied* for emissions control
- Initial studies sought to quantify emissions; create emission factors
  - “Modesto Study” (CalRecycle 2007) quantified the effect of the Cap – in the field = 75% VOC reductions
  - SJVAPCD Study (2013); positive forced air + Compost Cap = 98% VOC reduction
Emissions w/ and w/o Cap

Source: Appendix I to study results report (SJVAPSA Draft 2011)
How it Works

- Warm air rises through pile bringing odors and emissions
- Finer, mature cap provides a filter of fine particles.
Why Does it Work?

• Creates a “filter” that odor molecules (and VOCs) must pass before exiting the pile.

• Finished, screened compost works best because it has more surface area.

• Finished compost, once “turned in” also “power boosts?” (inoculates?) the fresh pile with active microorganisms.
Compost Cap in Practice

- Cover windrows with:
  2 - 4 inches screened finished compost, or
  6 - 8 inches unscreened compost, or
  12 inches woody overs

- More surface area = more areas for odor/VOC molecules to pass through/adhere to.

- Cooler temps outside of cap condenses moisture w/some volatiles
The Challenge:

- How to apply the “Cap” efficiently?
- Loaders work, but require lots of space
- Articulated loaders work
- Excavators work (slowly)
- Blower trucks? (Probably not)
- Create a custom solution?
- (Two major air districts in CA now require the “cap”)

Two major air districts in CA now require the “cap”
Disadvantages

• Difficult to apply
• Some double-handling
• Loss of site capacity
• Increase in bulk density/loss of porosity
• Impact on quality?
## Results

Table ES-1: Project Results

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<td>% reduction from Baseline</td>
<td>-98.8%</td>
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98% VOC Reduction!

Perimeter Misting System

Photo Courtesy NCM Odor Control
Containerized Biofilter

Photo Courtesy of Likusta
Uncontained Biofilter

Exhaust Piping

Biofilter bed

Distribution Piping

Distribution blowers

Photo Courtesy McGill Composting
Odor Monitoring

• Meteorology
  – Typical
  – Current on site

• Receptors
  – Distance
  – Sensitivity
Correlate Odors and Events

- Odor Complaint
- Screening
- Turning

Graph showing dates and times with notation for events and odor complaints.
Odor Control & Management

A good isolated site (nothing better)
Good housekeeping
Prompt handling of feedstocks
Sensible process management
Cover open piles with compost!
Contain or enclose the odor source
Capture and treat foul air (biofilters)
Be a good neighbor … generally
Odor Control & Management

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Pile Odor Emissions Are Controlled By:

• Limiting pile odor generation by correct porosity, moisture, C:N, homogeneity, and oxygen levels
• Limiting handling during poor meteorological conditions
• Limiting exposed surfaces
• Treating the air in biocovers, biofilters, or chemical scrubbers
• Entrainment of odor molecules in water films on media or air

Slide Courtesy US Composting Council
Be a Good Neighbor and Citizen
Changing Land Use
Before...
California Bio-Mass Inc.

Photo Credit: Paul Rosenfeld
Issues/Solutions

• Evaluated each incoming feedstock
  – Eliminated grease trap waste

• Reviewed Compost BMPs
  – Adjusted porosity and moisture targets

• Documented competing odor sources
  – Used Nasal Ranger to “Score”

• Confirmed that facility was indeed an odor source
  – Got owner buy-in
Issues/Solutions Cont.

• Hired lawyer, consultants, sought state assistance  
  – Showed commitment to action
• Investigated odor neutralizers  
  – Installed small downstream system
• Held neighborhood meetings  
  – Asked for time and patience
• Reviewed and revised OIMP  
  – Documented BMPs
Result:

• Facility survived
• Facility is still operating and has expanded food scraps acceptance
• Hard to say which of the strategies employed you could skip – kitchen sink approach worked
It is rarely one thing that closes a site

• Offsite odor impacts are a symptom
• Uncontrolled stormwater runoff
• Accepting more material than designed for
• Changing land use