

## Processes and Odor Control

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## Managing the Compost Process

Can make or break the operation

Good management

- ✓ Produces compost of desired quality with minimum odors and other environmental impacts
- ✓ Makes best use of materials, equipment, and labor available



## Managing the Compost Process

Poor management can lead to:

- ✓ Poor quality compost
- ✓ Odor problems and neighborhood complains
- ✓ Shutdown of operation



## Managing the Compost Process

Factors affecting the composting process

- Nutrients (C:N ratio)
- Moisture
- Temperature
- Oxygen availability (Aeration)
- Time – sufficient to reach desired decomposition level

## Temperature

The primary yardstick of the composting process

Heat generated by microorganisms as they decompose organic material increases the compost temperature



## Temperature

If pile gets too hot

- ✓ Can kill microbes
- ✓ Spontaneous combustion

Turning and/or watering can bring the temperature down



## Temperature

Abnormally low temperatures signal reduced aerobic activity

- ✓ Process lacking oxygen
- ✓ Low moisture content
- ✓ Freezing conditions

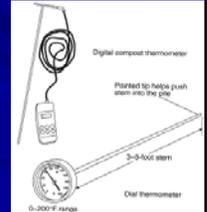
Remedy for low temperatures – turn or aerate the compost pile

## Temperature Monitoring

Instrument: Temperature sensor (Thermometer):

Recommended Thermometer

- ✓ Dial or digital with long enough stem to reach core of pile
- ✓ 0 to 200°F temperature range
- ✓ A pointed stem tip – penetrates compost pile better



## Temperature

Record compost pile temperatures daily

- ✓ By date – all pile records on one sheet
- ✓ By windrow/pile – records for each windrow on a separate sheet

Other observations to record (see attached forms)

- Date
- Time of day
- Pile identity
- Moisture rating
- Odor rating
- Location on the pile measured
- Name of person collecting information

## Moisture

- ✓ 40-60% moisture content is adequate for microbial decomposition
- ✓ Too dry – limits microbial activity
- ✓ Too wet – limits air/oxygen supply and activity of aerobic microorganism; may lead to odor

## Moisture Determination

- The Squeeze Method
  - ✓ A handful of material should feel damp not dripping wet
  - ✓ Material drips without being squeezed- **Too wet**
  - ✓ Material crumbles after squeezing- **Too dry**
- Moisture meters



## Moisture

Adding moisture – not always necessary

- ✓ During initial feedstock mixing – making recipe
- ✓ On piles – using side delivery tank trucks or wagons

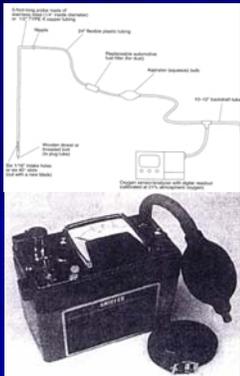
## Aeration

Microbes require oxygen for effective composting

- ✓ Use oxygen sensors to determine levels of oxygen in pile (5 to 16%)

Enhance pile aeration by

- ❖ Turning
- ❖ Forced aeration
- ❖ Using more coarse bulking materials in mix



## pH

- ✓ pH fluctuation may limit activity of certain microorganisms
- ✓ pH monitoring is especially important with RAW materials with high N contents due to loss of N through  $\text{NH}_3$  volatilization
- ✓ Alkaline pH – risk  $\text{NH}_3$  volatilization
- ✓ Acidic pH – risk release of sulfur smelling gases e.g. Hydrogen sulfide ( $\text{H}_2\text{S}$ )

## pH Measurement and Control

- ✓ Use pH meter on a composite sample steeped in distilled deionized water and thoroughly mixed into a paste
- ✓ Recommendation - Adjust pH during recipe formulation and blending stage

## Managing the Compost Process

### Odor and Odor Control

- Nuisance odors are common in facilities where proper management and control are not practiced
- Odors can be sufficiently disturbing to force the facility to shut down

## Sources of Odor

- ✓ Odorous raw materials – wet, high N containing feedstock e.g.
  - ❖ Fish processing residuals
  - ❖ Food residues
  - ❖ Manure
  - ❖ Biosolids
  - ❖ Grass clippings
- ✓ Ammonia released from the compost pile
- ✓ Anaerobic conditions in the compost pile

## Odor Control

Proper process management will assist in controlling odor problems

- ✓ Start material composting as soon as possible
- ✓ **Correct recipe mix**
- ✓ Consider a holistic approach which examines the entire system from feedstock preparation to utilization

## Odor Control

Schedule activities which tend to release odors such as windrow turning and mixing and moving odorous raw materials to minimize odors - e.g.

- ❖ Avoid turning windrows on hot still days, holidays, or weekends when neighbors are more likely to be affected
- ❖ Monitor wind direction; postpone activities that release odors when wind is blowing towards the most sensitive neighbors

## Odor Control

Operators must be ready to

- React quickly when complaints are raised
- Work proactively to develop good neighbor relations at all times

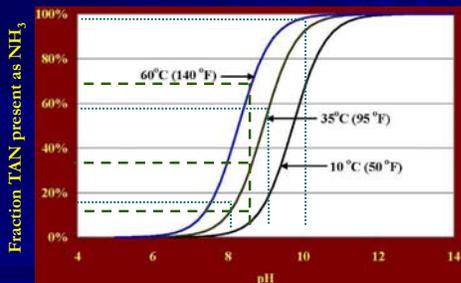
## Nitrogen (N) Conservation

- Conserve N to reduce  $\text{NH}_3$  odor
- Most N loss through  $\text{NH}_3$  volatilization
- Additional N loss may occur through denitrification

## Nitrogen Conservation

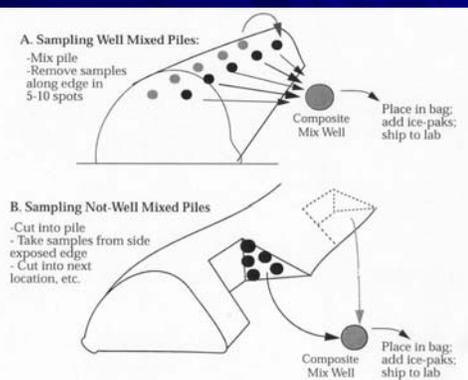
- Conserve N by matching available N to requirements of microorganisms i.e. correct C:N ratio
- Higher  $\text{NH}_3$  volatilization risk at high pH values
- Higher  $\text{NH}_3$  volatilization risk at high temperatures

## Temperature and pH Effects on $\text{NH}_3$ Volatilization



Ammonia Volatilization increases with pH and Temperature

## Compost Sampling



## Monitoring Frequency

| Parameter   | Frequency       |
|-------------|-----------------|
| Temperature | Daily           |
| Oxygen      | Daily to Weekly |
| Moisture    | Weekly          |
| pH          | Weekly          |

## Trouble Shooting - Examples

1. The composting of a pile has been going on well for over two months and then suddenly, the temperature of the pile started to fall gradually. The pile does not reheat even after turning and the oxygen level is at 9%. What is happening to the pile

## Trouble Shooting - Examples

2. You cannot squeeze water from the composting pile and the interior of the smells charred. The temperature of the pile is above optimal. What is happening to the pile and how can you remedy the situation

## Trouble Shooting - Examples

3. You have prepared a recipe with the following characteristics
  - ✓ C:N ratio 28:1
  - ✓ Moisture Content – 55%
  - ✓ Bulk density – 2,000 lbs per cubic yard
  - ✓ pH – 8On starting the composting process, you notice that the pile cannot heat. What corrective measures should you take to get the composting started

## Trouble Shooting - Examples

*For more details on Processes and Odor control refer to Chapter 6 of NRAES-54: On-Farm Composting handbook*