Aerated Static Pile Composting

Hands-on Workshop
December 10 – 11, 2014
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Converting Raw Feedstocks
Into High Quality Soil Amendments
The “Grouper’s” Definition of Composting

Transformation of raw organic materials into biologically-stable, humus-rich substances suitable for growing plants.
There are Many Layers to the Discussion of Composting

1. The Micro-Biology of Composting
2. Preparing a Suitable Mix
3. Methods to Optimize the Biology
4. A Manufacturing Process
5. Siting and Designing a Facility
6. Permitting a Facility
7. Full-Scale Operations
8. Marketing and Selling Compost
Turned Windrow Composting

- **Windrows**: Elongated Piles, typically ranging between 8- and 20-feet in width, 4- to 8-feet in height and hundreds of feet long.

- **Turned**: Remixed the compost pile using a front-end loader or a specialized “Windrow Turner” to remix materials and reintroduce oxygen into the pile.
Small Turned Windrow Composting
Large Turned Windrow Composting
Aerated Static Pile Composting

1. **Aerated:** We Induce Airflow into the Compost Pile to Maintain Aerobic Conditions Throughout the Active Phase of Composting (~30-days).

2. **Static:** We Do Not Turn the Compost Pile During The Active Phase of Composting.
Aerated Static Pile Composting

Sonoma Valley Stables in Petaluma, CA
The Anatomy of an Aerated Static Pile
Aerated Static Pile Composting

ASP Hands-on Workshop
Aerated Static Pile

Rule of Thumb
Max Pile Length 75 – 80-feet
Plan View Dimensions
Length 75 – 80 Feet

Height 6 – 12 Feet
Section View ASP

Mix

H'

Rule of Thumb
Max Pile Length 75 – 80-feet
Section View ASP

- Uniform Air Distribution
- Absorbs Excess Moisture
- Provides Drainage

Rule of Thumb
Max Pile Length 75 – 80-feet
Section View ASP

Unscreened Compost Cover (1-foot)

- Insulating Layer (PFRP)
- Biofiltration Layer
- Nutrient Retention
- Vector Barrier
- Moisture Retention
- Improve Aesthetics

Rule of Thumb
Max Pile Length 75 – 80-feet
Section View Extended ASP

Unscreened Compost Cover

Cell 1
Cell 2
Cell 3
Cell 4

Screen Overs Plenum

Mix
Extended ASP Composting

Two Particular Acres, Royersford, PA
Beltsville, Maryland

- USDA Research Project – Starting in 1974
- Small group of scientists & engineers (Dr. Elliot Epstein)
- Develop a better means of managing biosolids
- Used biologic principles borrowed from WWTP
Beltsville, Maryland

- Trial & Error Process, evaluating failures – (many)
- Negative aeration w/ compost cover
- Developed criteria for pathogen reduction >> PFRP
- Resulted in current methods and standards
The ASP Process with a 3-Bin System
3-Bin Top Down Compost System
Completed Aeration System
Cross Section of an Aerated Bay
Filling the Bin

- **Raw Mix**
- ~ 30-days to fill
- **Moisture** ~ 60 – 65%
Placing the Compost Cover

- Thermal Blanket
- Odor Control (VOC & Ammonia)
- Retains Nutrients
- Fly Control (Vectors)
- Retains Moisture
- Improves Aesthetics
Turning On the Airflow

Typical Aeration Cycle: 2-min ON & 30-min OFF

No Turning!
Monitoring Pile Temperatures

Highest Heat

131°F

Steam
Active Composting to Curing

Volume Loss 25% – 40% in 4 weeks
Stall Management
Removing Solid Manure
Moisture Conditioning the Mix
Dumping Cart into Compost System
Adding Final Cover Layer
Adding the Final Touch
Monitoring Compost Temperatures
Cross Section of a 3-Bay System

Stage 1

- Bin #1: Active Phase
- Bin #2: Filling
- Bin #3: Empty

Start Airflow

No Airflow
Cross Section of a 3-Bay System

Stage 2

- Bin #1: Curing Phase
  - 10% Airflow
  - ~ 100 - 110°F

- Bin #2: Active Phase
  - 90% Airflow
  - ~ 140 - 165°F

- Bin #3: Filling
  - No Airflow

- 25 – 40% Volume Loss

- ~ 100 - 110°F

- ~ 140 - 165°F

- ~ 100 - 110°F

- ~ 140 - 165°F

- ~ 100 - 110°F

- ~ 140 - 165°F

- ~ 100 - 110°F

- ~ 140 - 165°F
Cross Section of a 3-Bay System

Stage 3

Bin #1
Ready for Batch #4

Bin #2
Curing Phase

Bin #3
Active Phase
What Can Be Composted?

Organic Wastes
or
Natural Resources?
Agricultural

- Livestock Manure
- Zoo Manure
- Crop Residuals
- Waste Feed
- Paunch Waste
- Mortalities
Municipal / Institutional

- Green Waste
- Food Waste
- Biosolids
- Septage
- “Night Soil”
- Garbage
- Road Kill
Industrial

- Fruit Pomace
- Vegetable Culls
- Fish Waste
- Nursery Waste
What is Food Waste?
What is Food Waste?
What is Food Waste?

“Vegetable Soup”
The Composting Process

1) Mix
- Raw Organic Materials
- Minerals
- Water
- Microorganisms

2) Oxygen

3) Time
- Heat
- CO₂

Raw Materials

Stable Organic Matter
- Minerals
- Water
- Microbes

Finished Compost
Compost Mix

3 Critical Parameters

1. Carbon to Nitrogen Ratio (C:N ~ 30:1)

2. Porosity: Volume of Void Space
   1. Bulk Density: 550 – 950 pounds per cubic yard
   2. Free Airspace: 35 to 60%

3. Moisture Content (60 – 65%)
The Secret to Composting is... 

Oxygen!

Will this be on the test? Absolutely!
Oxygen Depletion in Compost Pile

The graph illustrates the oxygen level (%) over time in a compost pile, categorized into aerobic and anaerobic conditions. Two weeks are compared: Week 1 and Week 2. The graph shows a peak aerobic level followed by a drop into anaerobic conditions by Week 2.
Aeration

Allows the Operator to:

• Maintain Aerobic Conditions
• Mitigate Impacts from Objectionable Odors
• Manage Pile Temperatures
• Reduce the Loss of Nutrients
• Expedite the Rate of Composting & Curing
• Produce Superior Compost Products
Rate of Aeration

Maintaining Desired $O_2$ Levels in the Compost Pile:

1. Frequency
   - On / Off Cycles / Continuous Flow

2. Duration
   - Blower Output (Size & VFD)

3. Volume
   - Size of Manifold & Lateral Pipes
   - Number of Lateral Pipes
   - Valves & Dampers
Temperature Change in a Typical Compost Pile

A = Mesophilic
B = Thermophilic
C = Curing

Active Composting Phase
Curing Phase

Time

Temperature °F

70°C (158°F)
55°C (131°F)
40°C (104°F)
PFRP
Actual Temperature Data Curve

2002-2003
28Nov 6Dec 14Dec 24Dec 1Jan 9Jan 19Jan 29Jan 8Feb
Temperature, F
100
105
110
115
120
125
130
135
140

Active Composting
Curing
Simple Field Tests for Evaluating the Initial Compost Mix

- Bulk Density – Bucket Test
- Free Air Space
- Moisture Content
- pH
Checking Initial Mix Parameters
Pop Quiz

• The secret to composting is __________.

• After turning, Oxygen is depleted in a turned windrow in roughly _______ to _______ minutes.

• The desired Oxygen content in a pile is _________ % or greater.

• The three critical parameters in a compost mix include: _______________; _______________; and _______________.

• PFRP means: A Process to ________________________________.

• With ASP Composting, PFRP requires that the entire pile reach temperatures of _____ °F or greater for a minimum of _____ days.