COMPOSTING BASICS: DON'T OVERSIMPLIFY IT

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Overview of Composting Regulations

Mike Nork, NHDES

New Hampshire's Composting Regulations

NH Solid Waste Rules, Chapter Env-Sw 600

Contains requirements for solid waste composting facilities

Underwent significant updates in 2022

What do the rules regulate, exactly?

✓ Facilities that compost food waste, or other compostable "solid waste"

✗ Facilities that compost only leaf & yard waste (not considered "solid waste")

Permitting Options for a Composting Facility

Permit-Exempt

Site-of-Generation

schools

animal carcasses generated on farm

Small-Scale Community Composting

Community gardens, farms, etc.

Receive up to 5 cy per month

Permit-by-Notification (PbN)

Small Food Waste Composting Facility PbN

Available to public/private entities

Receive up to 10 tons of food waste per day

No application fee

No design review/approval by NHDES

Must adhere to operating boundaries specified in rule

Standard Permit (SP)

Processing/Treatment SP

Receive > 10 tons of food waste per day

Highly customizable

Application fee $ depends on facility processing capacity

Requires design review/approval by NHDES

Intended for large-scale or specialized facilities

Overview of Composting Regulations

Siting Requirements – Env-Sw 603

- Min. 250 ft from protected shorelands (public waterbodies)
- Min. 75 ft from all other surface waterbodies/wetlands
- Not within the protective radius of public water system well
- Min. 75 ft from private wells
- Working surface at least 2 feet above seasonal high water table
- Working surface at least 2 feet above bedrock or sand/gravel deposits (unless facility uses impermeable pad)
- Not within a flood plain

Overview of Composting Regulations

Operating Requirements – Env-Sw 605

- Limit odors
- Quickly incorporate or store incoming waste
- Maintain aerobic composting process
- Maintain compost process at 131F for specified period of time (different for windrows vs. in-vessel or aerated static pile)

Overview of Composting Regulations

Additional Operating Requirements – Env-Sw 607.02

(applicable to PbN composting facilities)

Authorized wastes can only include:

- Source-separated food waste
- yard waste
- animal manures
- compostable items (packaging, bags, serviceware)
- bulking/carbon amendments

"Initial" mix must have:

- Carbon-to-Nitrogen ratio at least 25:1
- Moisture content between 50-60%
- Bulk density less than 1,100 lbs

Overview of Composting Regulations

Quality/Maturity Requirements – Env-Sw 605.04 & 605.05

- Prior to distribution, finished compost must meet quality and maturity requirements
- Quality standards for
  - heavy metals
  - Bacteria
  - inert debris (manmade foreign objects like glass, plastic, metal, etc.)
- Maturity measures how "complete" the composting process is
- Testing for both quality/maturity to be conducted at least once annually.

Operator Training & Reporting Requirements

- Per state law, anyone who operates a permitted solid waste facility must be certified by NHDES (SWOT program)

- Exception – Env-Sw 607.02(a) allows alternative training for operators of a PbN composting facility. Examples:
  - Maine Compost School
  - USCC Compost Operations Training Course (COTC)
  - 131 School of Composting
  - SWANA Managing Composting Programs Training

- Annual Facility Report due annually (March 31) – Env-Sw 1105.07

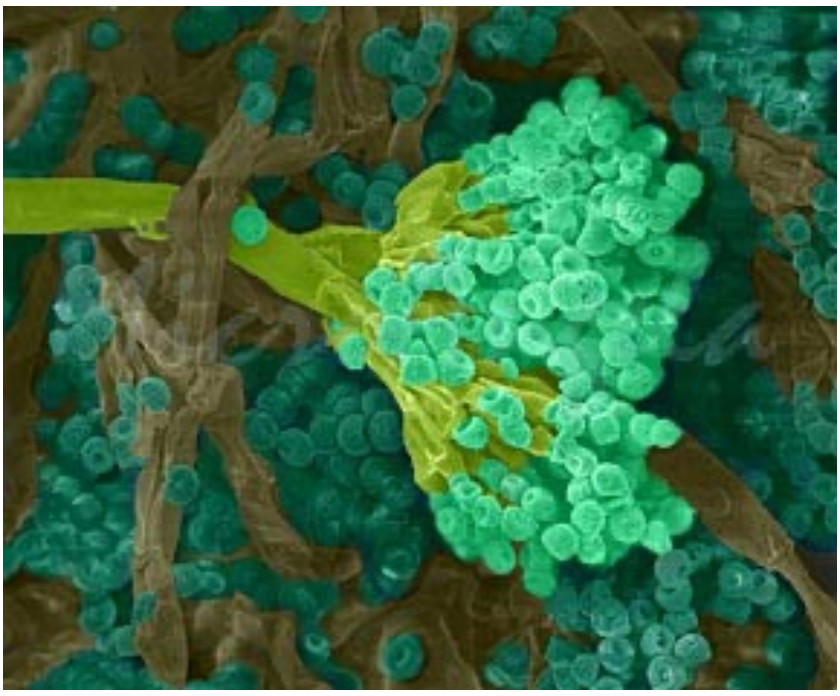
Part I
"The Biology of Composting"

Compost Biology, Terms & Uses

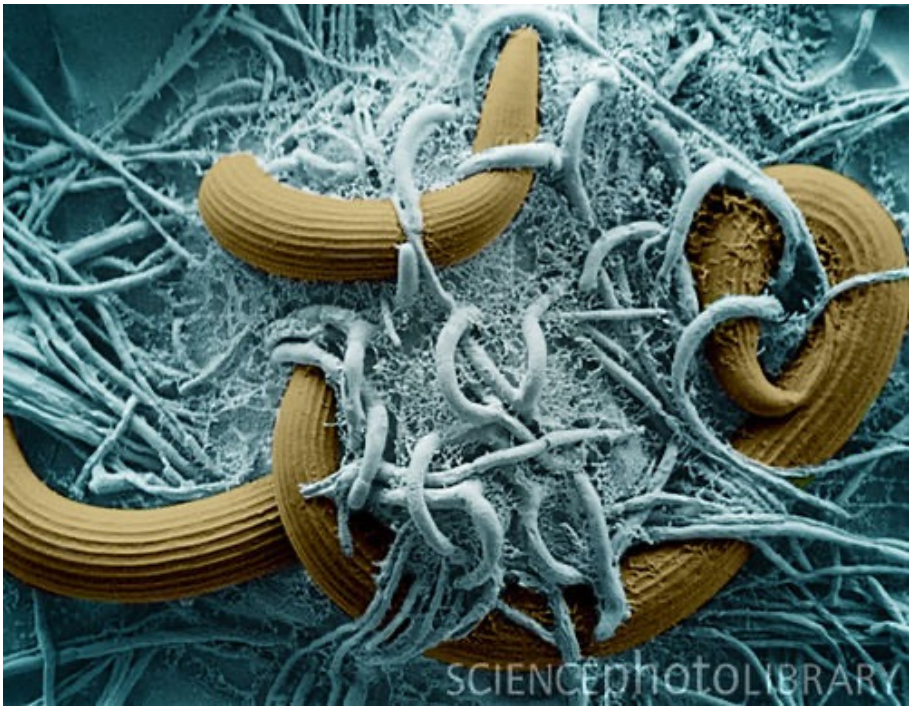
Good Morning!

A World Unknown

Fun guys…



… who mean business

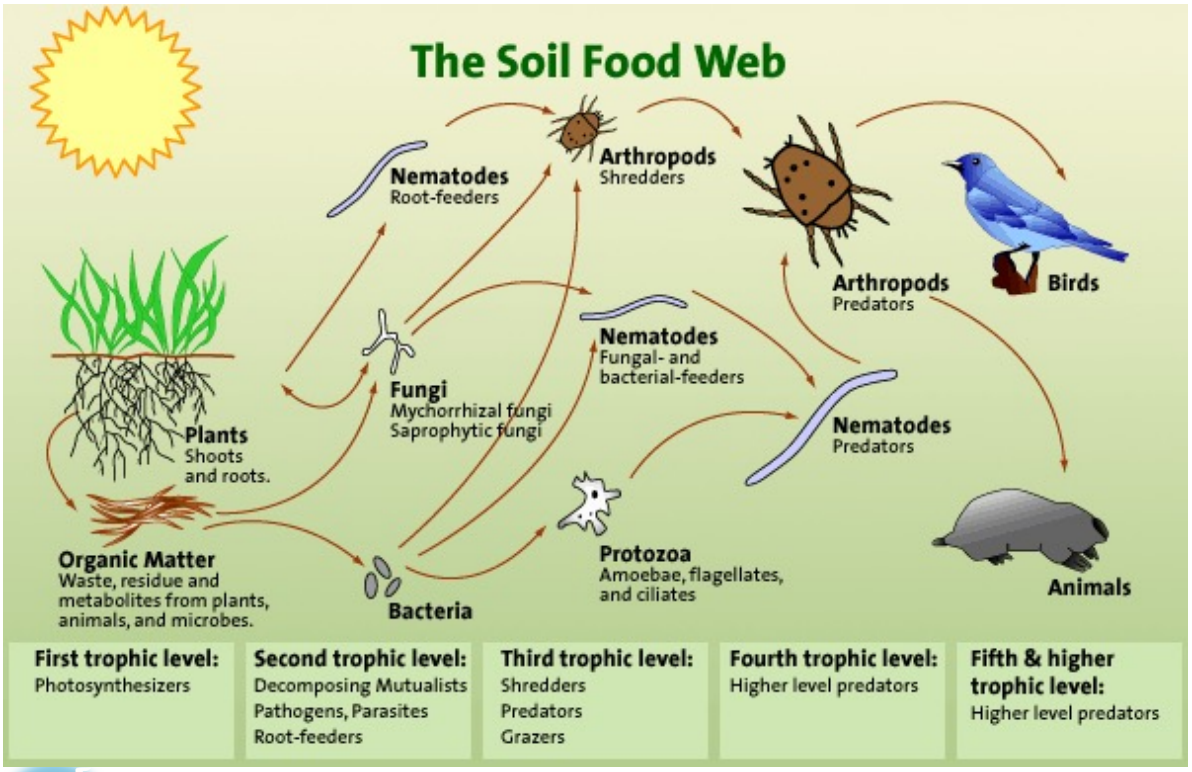


What is composting?

A managed, biological process involving natural decomposition of raw organic materials, transforming them into a nutrient-rich, stable soil amendment.

Why Compost?

- Natural process: microbes breakdown (decompose) organic matter naturally and build strong stable particles:
  - Decomposition
  - Immobilization
  - Mineralization
  - Humification
- Composting provides ideal conditions for them to thrive, accelerating the process!
- Waste diversion – claims unused resource
- Returns nutrients to ecosystem
- Strengthens soil foodweb
- Builds carbon in soil



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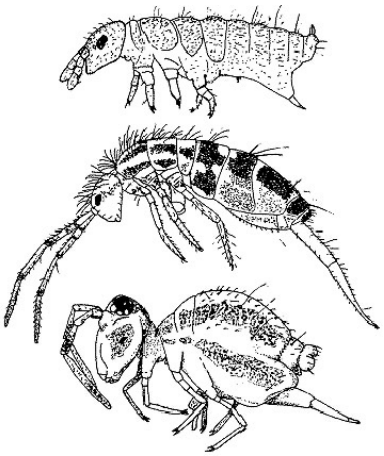
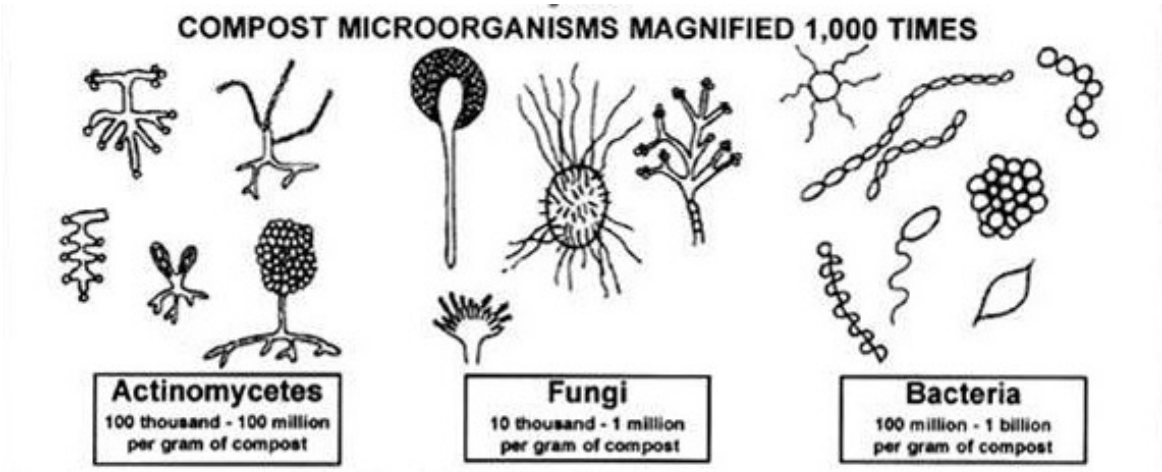
Macroscopic Organisms

- Mechanical breakdown of large particles
- Increase surface area for microbes
- Cycle nutrients
- Feed on bacteria and fungi



Microfauna

Do most of the "Heavy Lifting"



Reproduced with permission from On-Farm Composting Handbook, NRAES-54, published by NRAES, Cooperative Extension, 152 Riley-Robb Hall, Ithaca, New York 14853-5701. (607) 255-7654. Quantities of microorganisms from: Sterritt, Robert M. (1988). Microbiology for Environmental and Public Health Engineers, p. 200. E. & F. N. Spon Ltd., New York, NY 10001 USA.

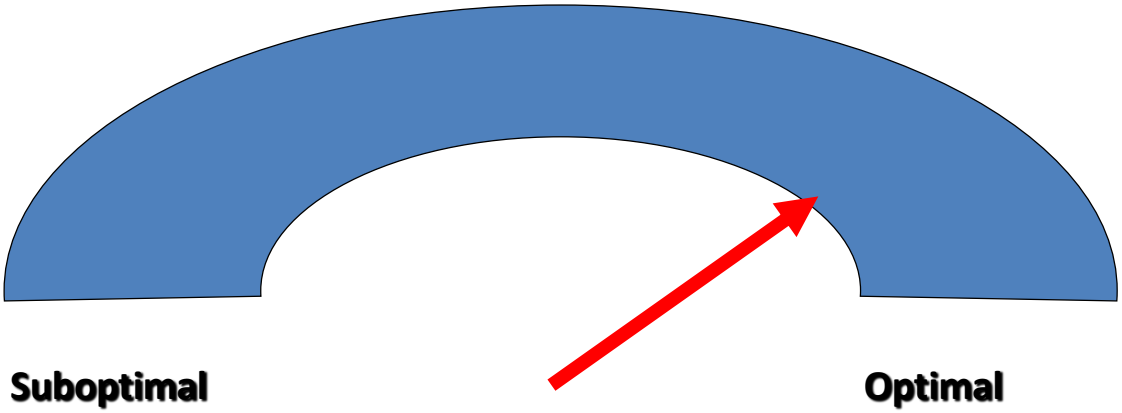
Factors Impacting Microbial Activity

- Oxygen content (Porosity)
- Temperature
- C:N ratio
- Moisture content
- pH
- Particle size

Oxygen Content

- Oxygen needed for efficiency
- 21% oxygen in air
- 5%-10% is optimal for compost process
  - <5% process slows remarkably
- As pile heats, more oxygen is being consumed by microbes

Anaerobic vs. Aerobic Composting



Suboptimal

Anaerobic :

- Low oxygen
- Inefficient
- High odors

Optimal

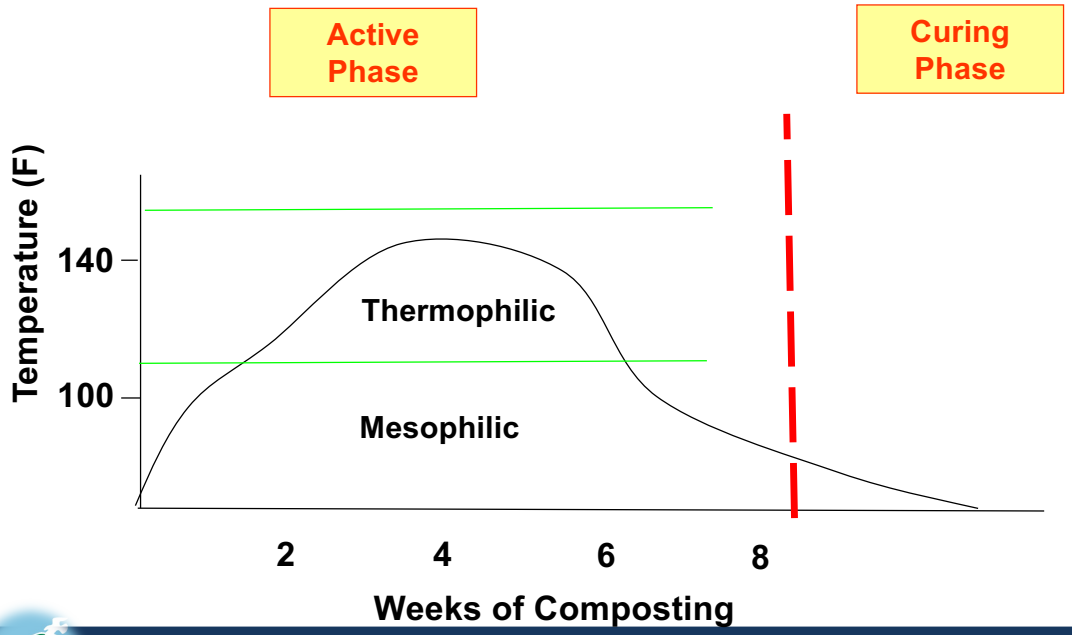
Aerobic :

- High oxygen
- Efficient
- Low odors

Microbial Classification (cont.)

- Temperature Range
  - Mesophiles (function at 50-110^{o} F)
    - Initiate compost process
    - Replaced by thermophiles as temperature increases
    - Re-colonize compost during curing
  - Thermophiles (110-160 ^{o} F)
    - Do most of “active composting”

Phases of *Aerobic* Composting



Aerobic composting & temp.

Active composting occurs in the temperature range of 50°F to 160°F

Compost pile heat is the direct result of microbial metabolism!

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What is a C:N Ratio? (Brown:Green Ratio)

- Supply of total carbon compared to total nitrogen in compost feedstock
- If C:N is too high the compost process will slow
- If C:N is too low, more likely to lose nitrogen as ammonia gas or in leachate
- Ideal initial C:N mixture range is 20 – 30:1

Carbon Feedstocks

- **Carbon: 30:1 or >**
  - **Leaves**
  - **Wood shavings**
  - **Cardboard: caution**
  - **Shredded Newspaper**
  - **Wood chips**
  - **Corn stalks**
  - **Straw**

Nitrogen Feedstocks

- **Nitrogen: 30:1 or <**
  - **Animal manures**
  - **Food waste**
  - **Lawn clippings: caution**
  - **Fish**
  - **Garden clippings: caution**

Compost Moisture

- Essential to the compost process.
- Provides space for microbes to live and thrive.
- Need an optimal level of 55% (range: 45-55%).
- Moisture too low – activity stalls.
- Moisture too high – pile performance suffers as free air spaces get clogged (loss of porosity).

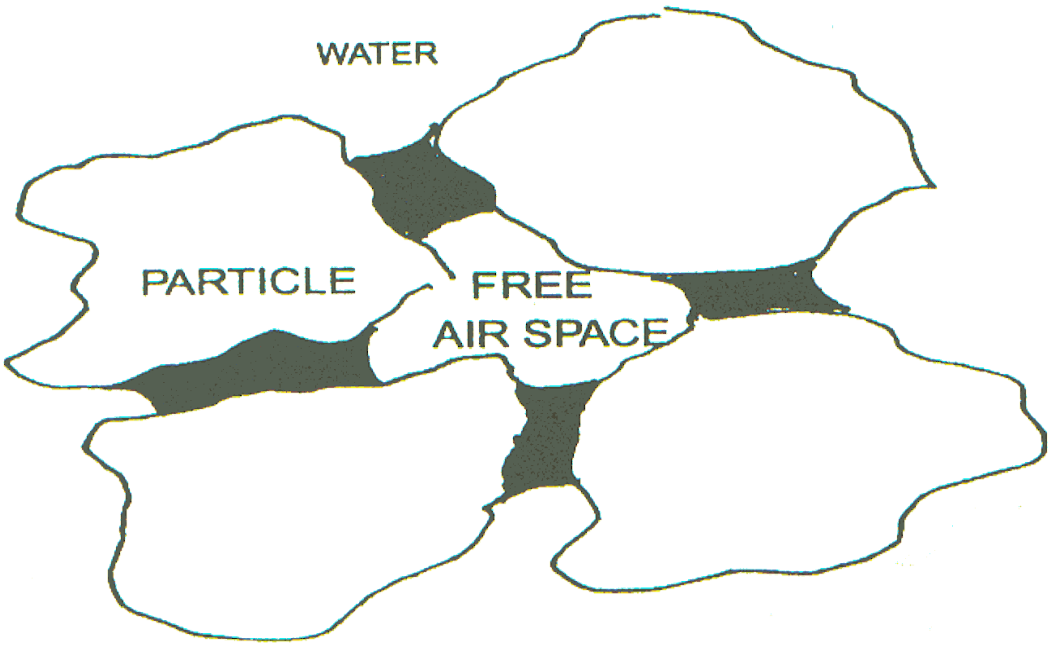
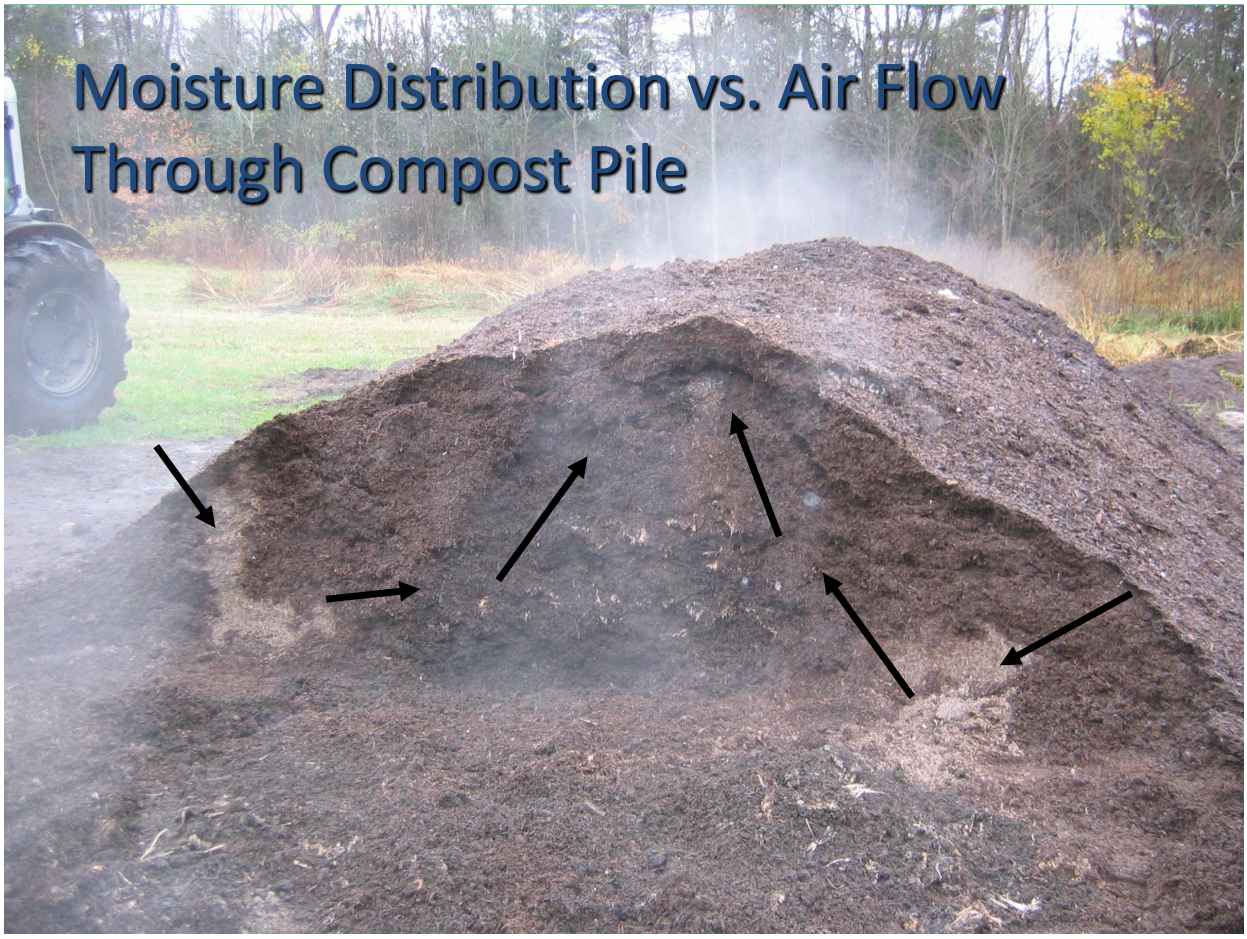


FIGURE 2.10. The relationship of free air space to water and particles in a composting media.



Feedstock Texture, aka “Particle Size”

In Summary

- C:N Ratio: 20 to 30:1
- % Moisture: 50-65%
- Oxygen: 5-10%
- pH: 5.5-8.2 (acceptable)
- Particle size: 1/4 to 3 inches
- Thermophilic temp.: (110-160º F)

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Let's take a break!

Part II
“Compost Feedstocks”

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Compost Feedstocks

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Protecting Maine's Air, Land and Water

What is a Feedstock?

The raw materials used in the compost process to help develop the "Compost Recipe".

Common Feedstocks

- Carbon:
  - Shredded paper (?PFAS?)
  - Leaves
  - Newsprint (?PFAS?)
  - Old hay
  - Wood shavings
  - Horse bedding
  - Straw
  - Wood chips

- Nitrogen:
  - Food waste
    - PRE OR POST CONSUMER?
  - Grass clippings
  - Dairy and Hog Manure
  - Biosolids (PFAS)
  - Fish and Seafood
  - Coffee grounds
  - Mortalities

Feedstock Characteristics

- Carbon to Nitrogen Ratio
  - Balance needed to feed microbes.
  - If too low (<15:1) you will get ammonia loss
  - The better the balance to better the compost pile performance.

Carbon Feedstock Characteristics

- **High Carbon**
  - **Usually Drier and Bulkier.**
  - **Low odor/odor potential.**
  - **Often used for odor control.**
  - **Plant nutrients usually low.**
  - **Generally able to adsorb moisture.**
  - **C:N Ratio > 30:1 ratio.**
  - **Often referred to as "Bulking Agent".**

Sources of High Carbon Materials

- Local towns
  - leaves
- Lumber Mills
  - Wood shavings
- Farms
  - Horse-bedding
- Other
  - Pallet mills

Storage of Bulking Material

Nitrogen Feedstock Characteristics

- HIGH NITROGEN
  - GENERALLY WETTER
  - USUALLY HIGHER BULK DENSITY
  - OFTEN ODOROUS
  - HIGHER IN PLANT NUTRIENTS
- C:N Ratio <15:1

INTERMEDIATE FEEDSTOCKS

- **HAVE A MIX OF CHARACTERISTICS**
- **EXAMPLES:**
  - **ANIMAL BEDDING**

Feedstock Characteristics

- Volatile Solids:
  - The compostable portion of a feedstock.
  - Helps us determine “Heating Potential”
  - Need 40% dry wt. basis

Feedstock Characteristics

- Texture - Affects:
  - Mixing (large vs. small)
  - Handling
  - Aeration

    Coarser= more air.
  - Affects speed of breakdown.
- Preparation Needed
  - Grinding coarse materials.

Feedstock Characteristics

- Moisture
  - Medium for bacteria.
  - Nutrient solution.
  - Limitations on aeration.

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Feedstock Characteristics

- Ammonia= NH_3
  - Readily available nitrogen source.
  - Raises pH.
  - Toxic to seedlings

Feedstock Characteristics

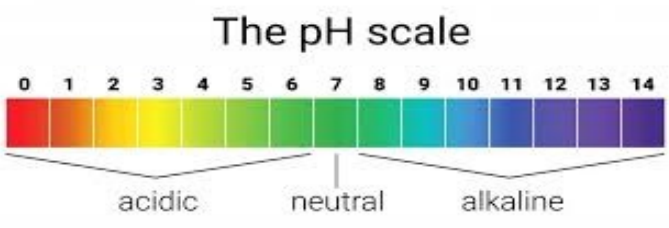
- **NUTRIENTS –**
  - **MAJOR NUTRIENTS:**
    - **NITROGEN, PHOSPHOROUS, POTASSIUM**
  - **MICRONUTRIENTS**
    - **ie: Ca, Fe, Mg, Mn, S, B, Zn, Cu, Cl,**
  - **FINAL PRODUCT QUALITY**
  - **MARKET VALUE**

Feedstock Characteristics

- Odor/Odor Potential
  - Presence of Ammonia (intense locally)
  - Presence of organic acids (repulsive odors)
  - Handling concerns.
  - Complementary ingredients necessary.
- Odor control potential (Horse-bedding, Peat, etc.).

Feedstock Characteristics

- pH
  - Low pH reduces activity.
  - High pH increases nitrogen (ammonia) loss.
  - High/low pH reduces microbial activity.



Feedstock Characteristics

- BULK DENSITY
  - Ease of operation.
  - Handling.
  - Ease of mixing.

Caution:

- There is variation within similar “named” feedstocks
  - Example:
    - WOOD CHIPS
    - LEAVES
      - Maple vs. Oak
    - FOOD WASTE

What about……?

- Wood Ash
  - Neither high nitrogen or high carbon.
  - High alkalinity (11-12 pH).
  - A little goes a long way.

What About…… ?

- Seaweed:
  - Pile structure
  - Good source of micro-nutrients
  - Salt is usually not a problem, especially if rinsed first.

Evaluation of Feedstocks Exercise

Let's Take a Break and then Head Outside!

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Part III
"Successful Siting"

8 Steps to Successful Siting

- 1. Identify Facility Need Clearly
  - Conduct a waste stream characterization study to determine waste quantities, composition and generators.
  - Perform an inventory of existing solid waste management programs.
  - Conduct "Cost/Benefit Analysis".
  - Determine Educational Benefits of Project.

8 Steps to Successful Siting

- 2. Determine Scope
  - How many sources?
  - How will material be moved to compost area?
  - How and where will compost ingredients be stored?
  - Who will do the transport? Composting?

8 Steps to Successful Siting

- 3. Involve The Public For Successful Siting
  - Early and continuous public involvement is necessary for a credible siting process.
  - A completely open process (two-way communication between all interested parties) maximizes public participation.
  - Public involvement serves two main purposes:
    - To determine the most suitable facility site
    - To ensure that the public completely understands the process, any possible problems and all potential solutions.

8 Steps to Successful Siting

- 4. Seek help from Knowledgeable parties

  Technical Advisors can:

  - Research environmental constraints
  - Conduct “Waste Audits”
  - Legal requirements
  - Costs (Financial Analysis)
  - Other relevant siting details.
  - Survey the Community

8 Steps to Successful Siting

- 5. Define Siting Criteria

  – Ideal Sites:
    - Easy to access.
    - Good drainage.
    - Secure.
    - Attractive (Design).
    - Nuisance Free (Odors/Vectors).
    - Good “Buffers” (Visual or Olfactory).
  – Avoid:
    - Wetlands.
    - Flood Plains.
    - “High” Traffic Areas.
    - Locations near where garbage is stored.

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Location….Location….Location….

- Avoid wet areas; the facility must be high & dry
- Divert clean water.
- Locate at least 3 ft. above high water table.
- Locate at least 300 ft. from streams, ponds, or lakes in the same drainage area.
- Provide for runoff collection & treatment or storage areas.
- Ensure all weather access.
- Locate safe distance from buried & overhead utilities
- Consider other farm traffic.
- Provide limited or appealing view to neighbors or passing motorists.
- Consider prevailing winds.
- Maintain biosecurity precautions.
- Consider aesthetics and landscaping.

8 Steps to Successful Siting

- 6. Pick Multiple Sites and “Rank” them
  - Choose the Site and Compost System that “Best” fits your needs.
    - Use criteria in Step 5.
  - Sites can be modified to fit and area:
    - Impervious surfaces
    - Buildings
    - Fences

Which System?.....

Static

Dynamic

8 Steps to Successful Siting

- 7. Secure Funding and Build Facility
  - Notice of Intent to Construct/Operate to NHDES.
  - Make sure that you have all of your funding allocated before you begin construction phase.
  - Use as much local help as you can to reduce costs and enhance community involvement.

8 Steps to Successful Siting

- 8. Provide Regular Updates:
  - Keeps Community Members Involved.
  - Student Reports to Enhance Education.
  - Newsletters.
  - Open Houses.

Putting It All Together…

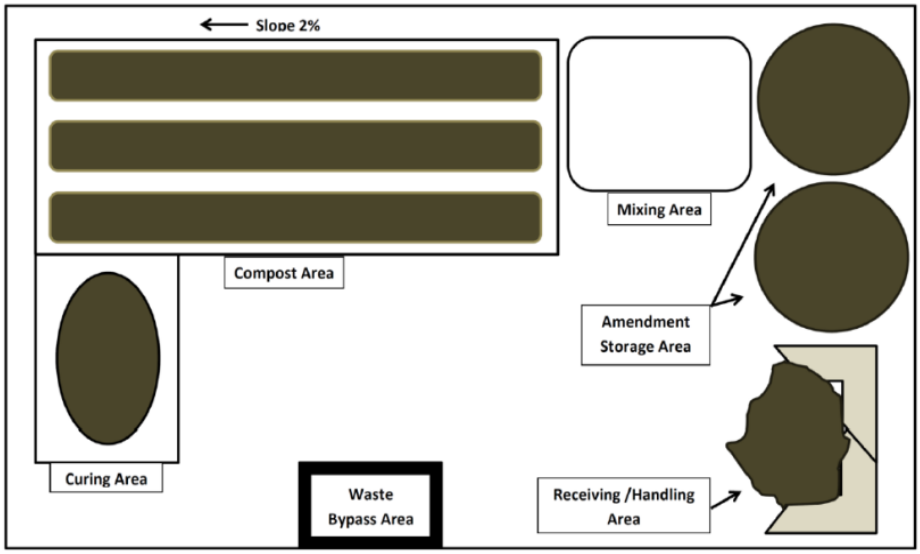
1. Optimal Site

Deep, well-drained soils

Durable Work-Surface

Excellent Stormwater Control

2. Excellent Site Management



3. And Finally…Process only what you can manage!!

Occasionally, "Things Go Wrong".....

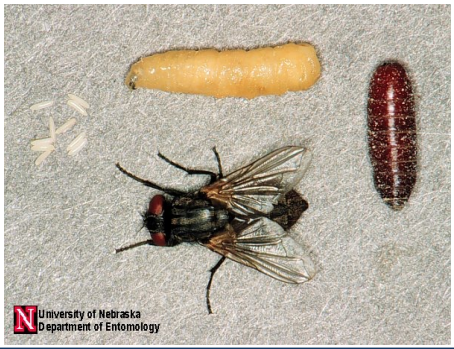
Nuisance Problems

- Nuisance problems are the No. 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 to site shutdown.

ODORS!!!

- Pile C4A--Holstein in Wood Chips

VECTORS



Site Drainage Requirements

- Good site drainage is a MUST!
- Pad Choice
- Site should have slight slope to aid drainage (~2 to 4%)
  - less slope will result in ponding
  - more slope will cause erosion

Engineered Site Improvements to Protect Ground and Surface Water

•Installation of Gravel Pad to create “Separation Distance”.

•Impervious Surface (Concrete, Asphalt, Geo-membrane).

• Enclose entire operation in free-standing building (UNE).

• Use of a well-drained base (i.e., crushed stone).

Protecting Water Quality

- Locate site away from drainage ditches, streams and surface water bodies.
- Collect/store or treat all runoff and leachate.
- Avoid flood-plains.
- Site only on well-drained soils with at least 24 inches to Seasonal High Water Table and Bedrock

Final Thoughts

- All composting should be done in a nuisance-free and environmentally sound manner.
  - Minimize odors (stay away from garbage storage areas).
  - Minimize Attraction of Vectors (i.e., rodents and other pests).
  - Avoid siting compost piles in wetlands or other sensitive areas.
  - Pick well-drained, low pedestrian-traffic area.
- Be sure to follow recommendations on what types of food scraps can be composted and what your permit allows.
- Repair Vector damage to prevent odor releases and further Vector attraction

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