

Composting Manure

September 2007

ENTSC

Manure Management Team

Net Meeting #1

Composting is the controlled aerobic biological conversion of manure and other agricultural wastes into a stable material.



Composting Rules

- ✦ C:N from 25:1 to 40:1
- ✦ Moisture ~ 40 to 65%
- ✦ Oxygen > 5 ppm
- ✦ Temperature 130-160 °F for
total of 5 days



Why do it?

- ◆ **Dry matter/volume reduction ~ 50%**
- ◆ **Cheaper transportation**
- ◆ **Land apply at farmer's convenience**
- ◆ **Reduced odor**
- ◆ **Reduces fly and disease problems**
- ◆ **Enables P removal from farm**
- ◆ **Can help manage storage capacity**

What's in the pile?

- ◆ **High-nitrogen material [“greens”]—**
 - ◆ **Manure— Dairy, beef, horse, poultry, swine**
 - ◆ **Hatchery waste— shells, washing, rejects**
 - ◆ **Food processing waste (vegetable or fruit)**
 - ◆ **Fish processing waste**

- **High carbon material [“browns”]---**
 - **Yard trimmings, leaves, woodchips**
 - **Sawdust, shavings, straw, old hay, seed cleaning waste**
 - **Shredded Paper and Un-waxed Cardboard**

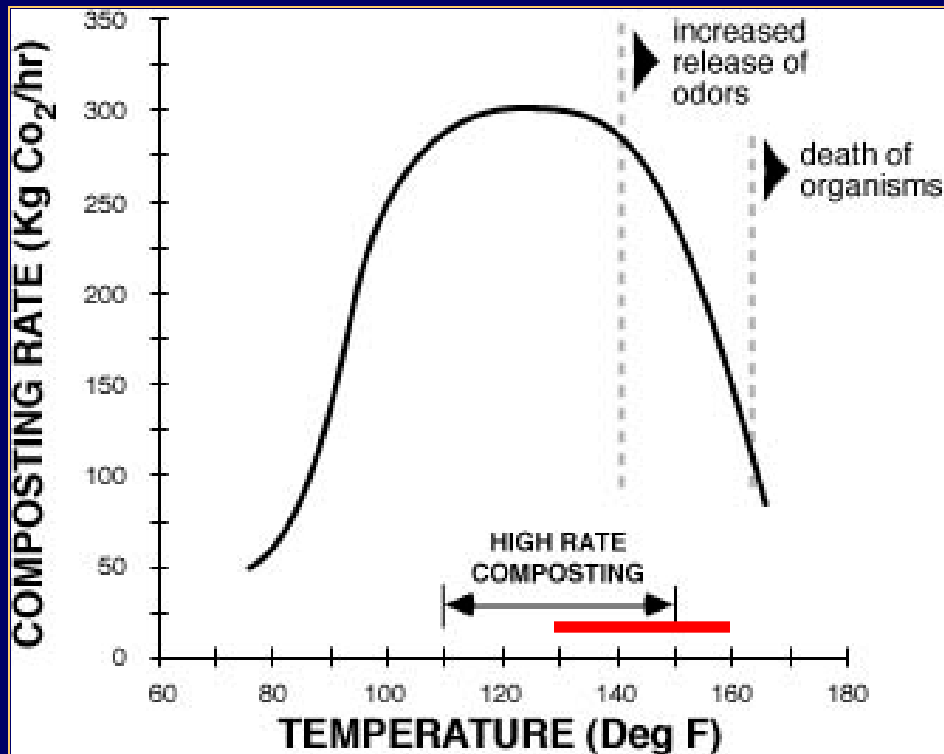
Controlled
aerobic
biological
decomposition



BIOLOGY

The process

Psychrophilic---Mesophilic---Thermophilic



Psychrophilic-mesophilic-- Microbes multiply exponentially; give off heat; pile warms up.

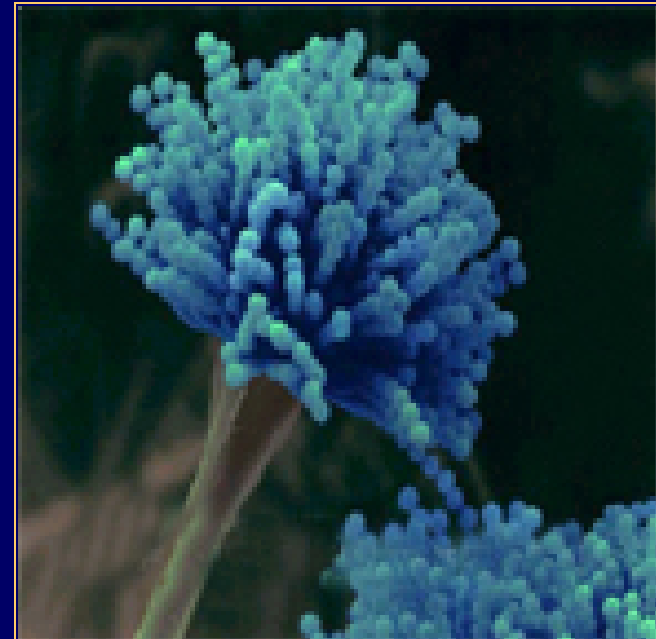
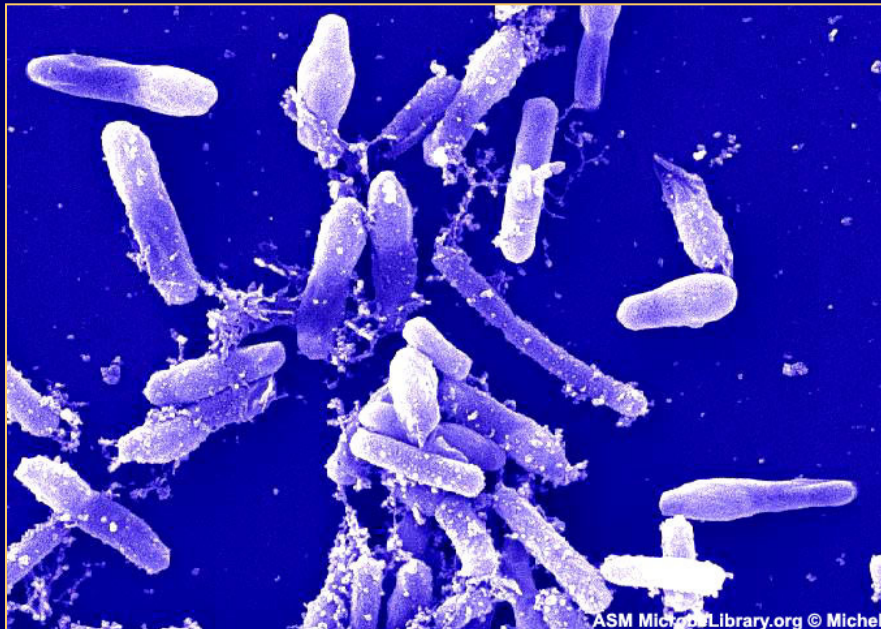
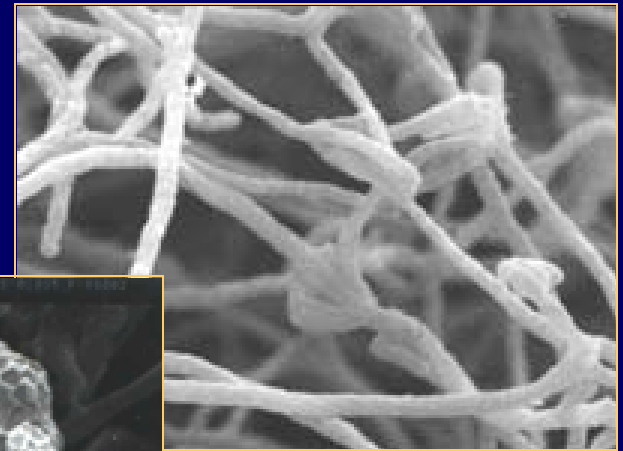
Thermophilic or “hot” phase -- Bacteria consume ‘easy’ food; pile heats rapidly; H₂O, heat, CO₂ given off in large amounts.

Cool-down – Microbes run out of food and/or oxygen; pile cools; may be re-activated by turning, introducing air, and/or adding water.

Curing – At ambient temps; *actinomyces* and *fungi* multiply; slow breakdown of cellulose & lignins. Humic compounds form. Mineralization of N to NO₃.

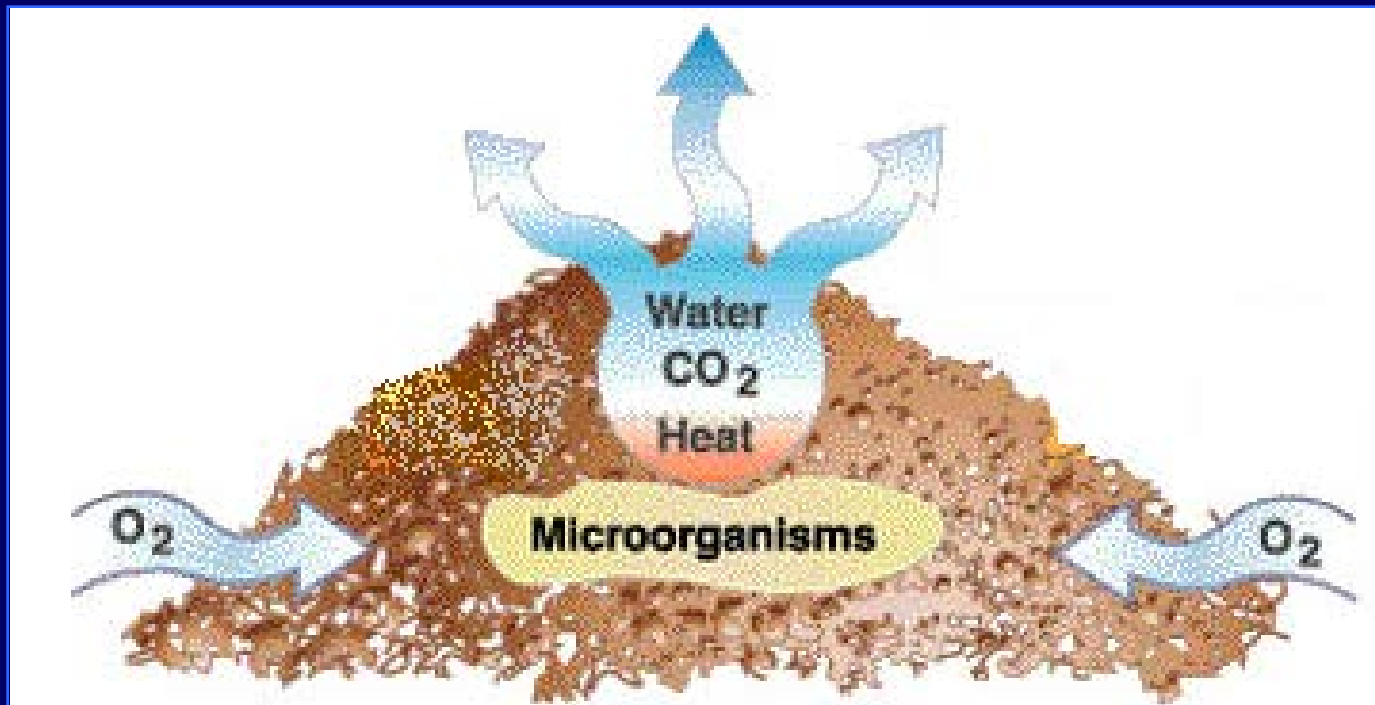
Bacteria, actinomycetes, fungi

How to eat
something bigger
than you are.....



Respiration

- ✦ Oxygen in – bugs oxidize carbon sources
- ✦ Energy used to build cells
- ✦ CO₂ and heat out



Starters & Inoculants—do you really need them?

- ◆ Microbes & Enzymes
- ◆ Lime & fertilizer
- ◆ Foo-foo dust
- ◆ No need for steamed worms!





**Windrows-
turning**



METHODS



Continuous turning, Supersoils, NC



Passive aeration, Vermont



Composting under roof



Forced aeration, Idaho



Layering dead chicks in forced air bin



Tidy horse manure management



Caged layer droppings

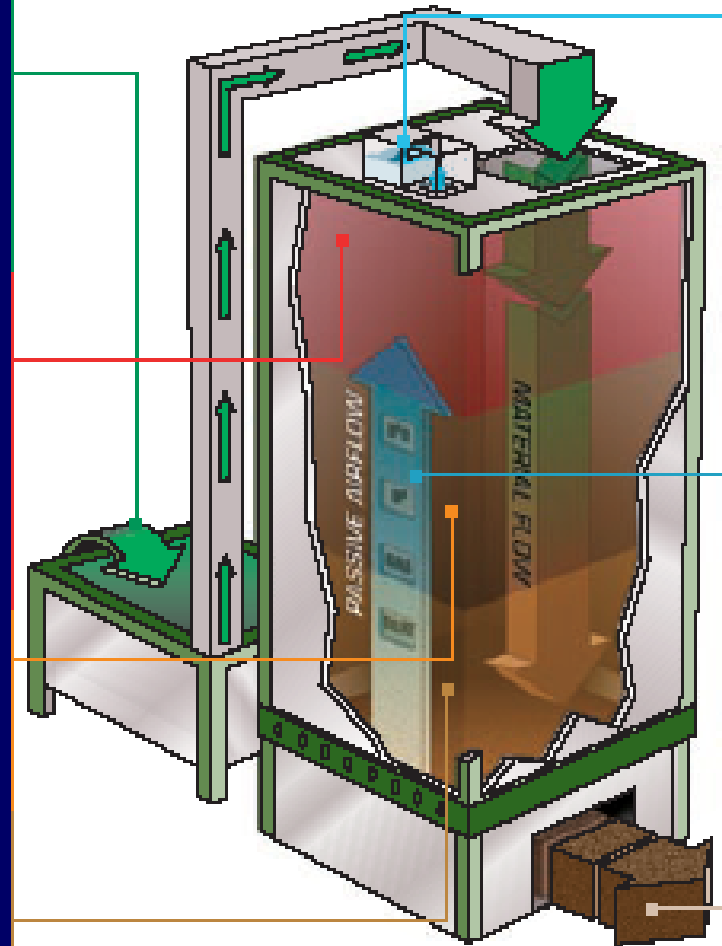


Compost sausage, Alberta CA



Tower system in the UK

Process Dynamics of the VCU



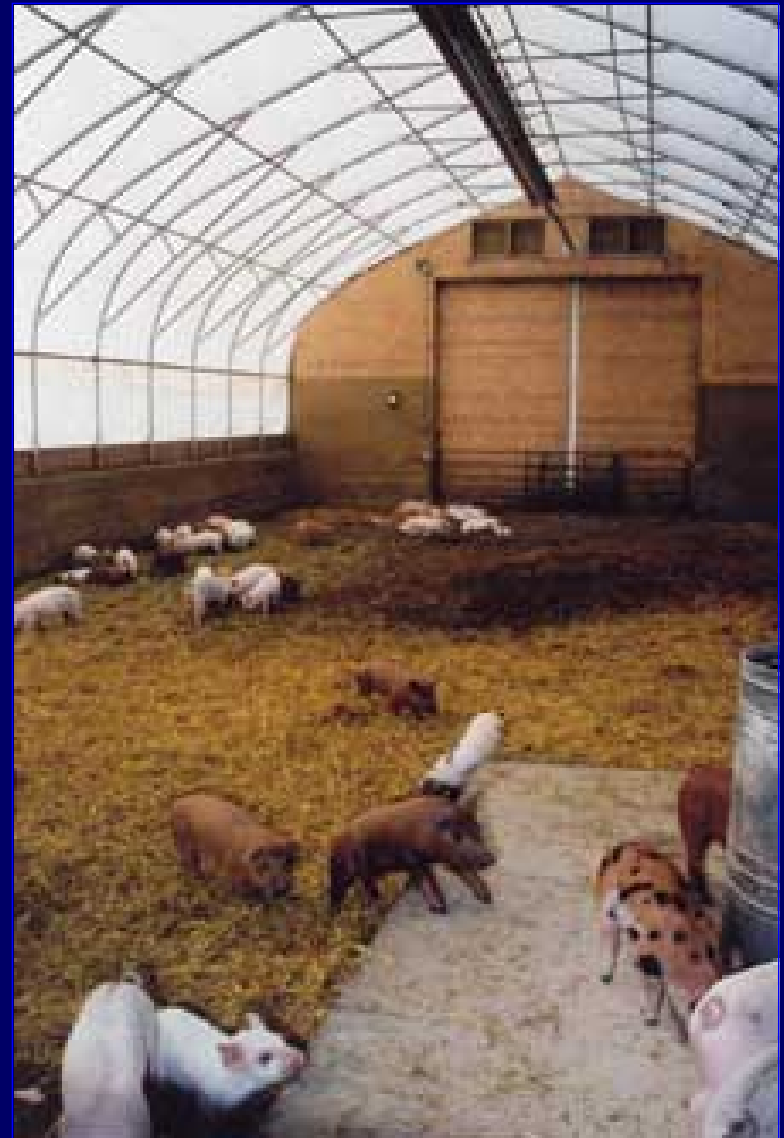


Is a few days enough?



Composting bedded pack dairy barn, MN, is tilled twice a day

Pigs in hoop structure





ENVIRONMENTAL ISSUES

Runoff & Leachate

- Phosphorus
- Nitrogen
- Pathogens

Air Emissions

- Odor
- Ammonia
- Methane, CO₂, N₂O
- Dust [particulates & pathogens]

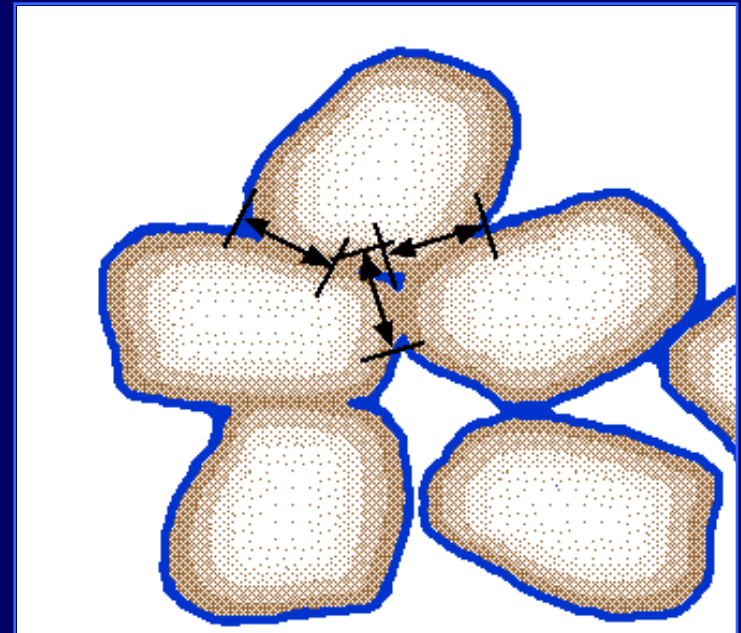
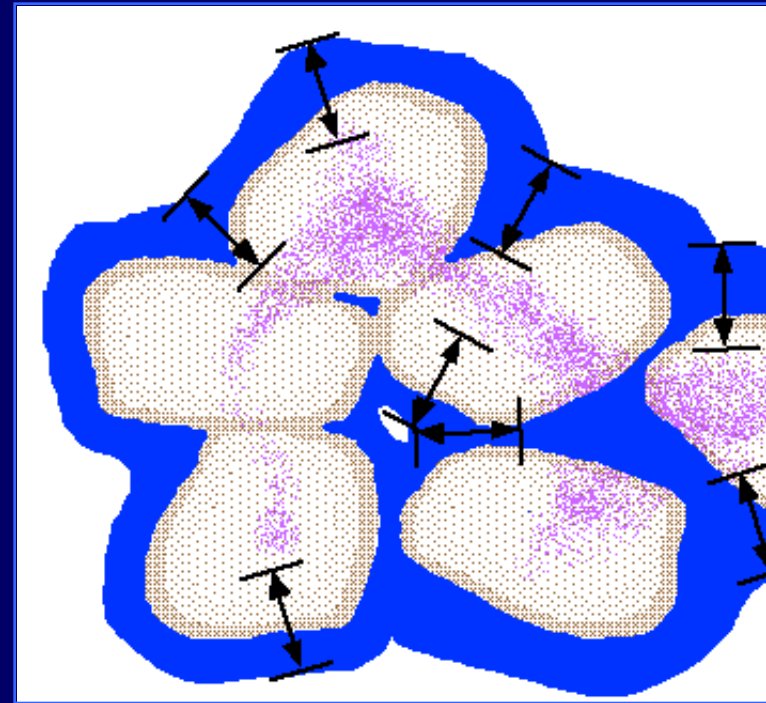


Phosphorus

- ◆ It's still theeeere.....
- ◆ Concentration increases because volume decreases
- ◆ P taken into bug bodies, inorganic converted to organic

Nitrogen Loss

- ◆ Some ammonia will be produced
- ◆ Volatilization rate depends on pH, temperature, rate of air exchange
- ◆ Why we care:
 - Particulates
 - Health issues
 - Atmospheric deposition in surface water systems





Carbon Loss

- ◆ CO₂ major product of bio activity
- ◆ Loss of carbon cause of volume and mass loss in pile
- ◆ Rate of C conversion depends on C:N balance, oxygen, bio activity



Pathogens

- ✦ Attenuation during composting
- ✦ Never say never.... There is always some risk
- ✦ Minimizing risk: **get it all hot, get it hot long enough, let it age**

Why does it smell?

Odor reduction



Odor





While these are greenhouse gases, they could occur when raw manure is land applied-- just a slower delivery.

Planning Considerations

- ◆ **Solids separation / drying / mixing**
- ◆ **Material transport**
- ◆ **Machinery movement**
- ◆ **Space**
- ◆ **Labor**
- ◆ **Drainage**
- ◆ **Fire prevention**
- ◆ **Maintenance**





I've got compost--- now what?

- ◆ **Using compost on-farm**
 - **Bedding**
 - **Soil amendment/fertilizer**
- ◆ **Marketing**
 - **Local, casual markets**
 - **Competing with the big boys**
 - **Screening, packaging, etc.**
 - **Making other products**

Where to go for more info...

<http://www.info.usda.gov/CED/ftp/CED/neh637-ch02.pdf>
[Chapter 2, National Engineering Handbook]

<http://www.ams.usda.gov/NOP/indexIE.htm> [USDA
National Organic Program]

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Manure Management Information Sheets:
#1- Composting Manure-What Goes on in the Dark
#2 – Managing for Better Compost
#3 – Composting Bedded Pack Barns