



Does It Have to **SMELL?**

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WHEN LIFE CEASES


- **Compounds normally used in maintaining life are no longer necessary and become “available” for use by other life forms.**
- **This availability is caused by many forces : thermal, ionic, chemical, biological, hydraulic, etc.**



WHAT IS BIO-CHEMICAL DECOMPOSITION?

**THE METHOD BY WHICH LIVING
CREATURES UTILIZE THE NUTRIENTS
AND MINERALS CONTAINED IN
PREVIOUSLY LIVING ORGANISMS.**

True Recycling!



Bio-Chemical Decomposition is the Pursuit of ENERGY and BUILDING BLOCKS for Cellular Growth and Reproduction.


Carbon is required for Energy (carbohydrates),

Nitrogen and other minerals are required for building new tissue.



In Nature, decomposition occurs randomly, based on

- **Energy Availability,**
- **Nutrient Availability,**
- **Water Availability,**
- **Temperature,**
- **External Disruptions**



When we attempt to control biochemical decomposition to create an end product, we use processes such as

- **Composting**
- **Anaerobic digestion**
- **Commercial Fermentation**

WHAT IS COMPOST?

It is Organic Material that


- has been digested (degraded) bio-chemically and chemically into a stable (non-reactive) state**
- is organized around a Carbon backbone to maintain structure**
- is high in humic acids, other stable organic compounds, and bio-mass.**

But

***Must the process of
composting be
odorous ?***

A vertical strip on the left side of the slide shows a thin, dark brown branch with several dried, brownish leaves. The leaves are elongated and have a slightly serrated edge. The background of the slide is a light beige, marbled paper texture.

***Does it have to
smell ?***



***Are the odors part
of the process?***

**or just symptoms of poor
feedstock mixes and
questionable operational
practices?**



What is an “Odor”?

A Volatile Compound that escapes or is intentionally released from the process prior to being digested (degraded).



Why didn't digestion occur?

Either,

- **There were insufficient and/or inappropriate microbial populations, or**
- **The populations were appropriate, but there was disruption and forced volatilization prior to digestion.**



Digestion is always a series (sequence) of reactions, each producing a product and bi-product.

Most odors in composting operations are caused by

**INCOMPLETE OXIDATION SEQUENCES,
INCOMPLETE REDUCTION SEQUENCES,
INCOMPLETE FERMENTATION
SEQUENCES.**

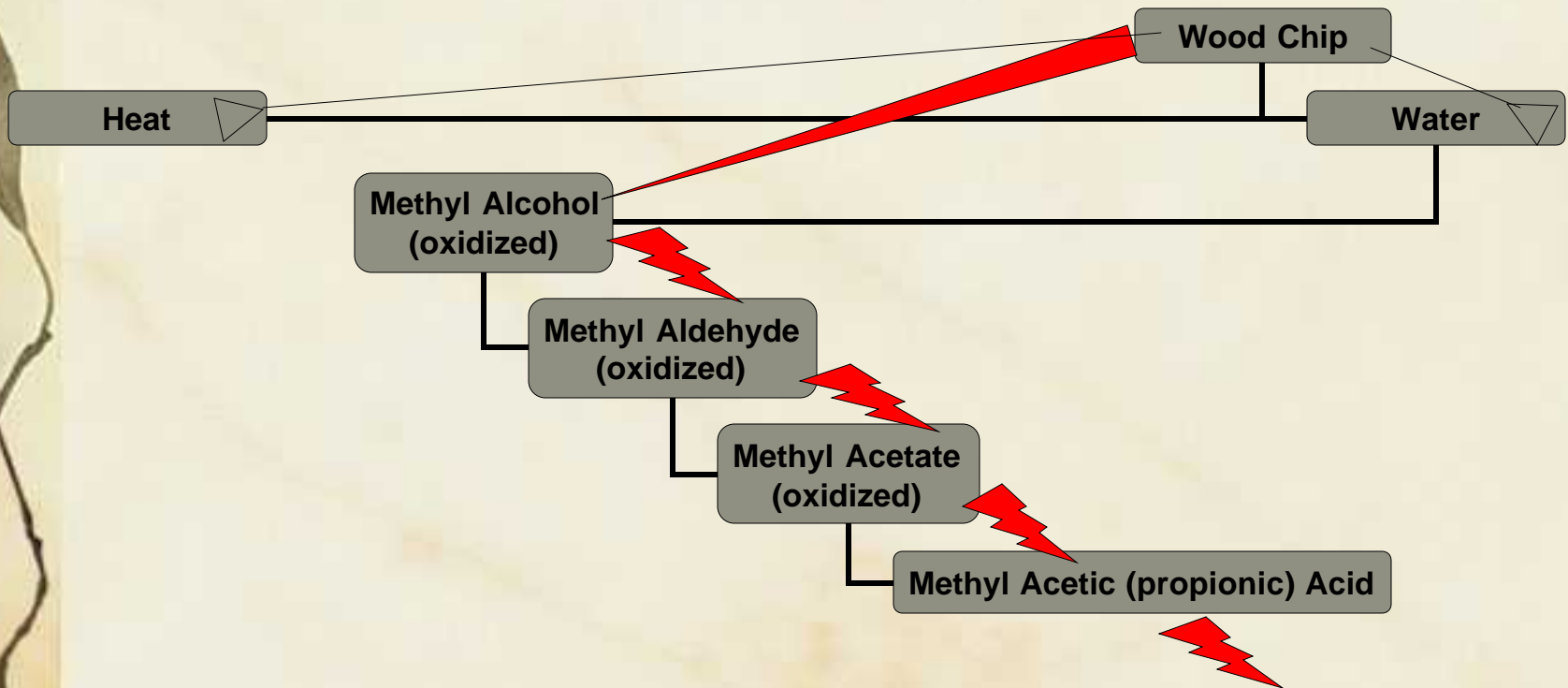
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That is to say,

A series of reactions in a chain are interrupted prior to completion of the series, leaving compounds available that are only partially digested and which may be odorous.

Example of Simple Chain

When the wood chip is exposed to heat and water, it begins to release wood alcohol, and a chain of reactions begins.





Even After this Point in the Chain,

- **Many more reactions are required to achieve a compound that can easily be converted to energy!**
- **If the chain is interrupted, the alcohol, the aldehyde, the acetate, and the acid are all volatile and all**

odorous !!



Odor Can Be the Result of

- Incomplete Bio-chemical Degradation**
- Incomplete Chemical Degradation**
- And is Usually Caused by Disruptions to the Above Processes.**

Typical Manifestations of Odor at Compost Sites

- Incoming Loads *****
- Grinding ***
- Turning*****
- Screening **
- Loading End Product *

Number of *'s = likelihood of odor occurrence.




Notice that
every

**instance on the previous list
involves moving or disrupting
the compost !**



***When Odor is Coming from
Undisturbed Piles or Rows,***

**This is an indication that there
is little to no microbial activity
or diversity in the top
sections of the pile or row.**



Example of Thermo-Chemical Odor Problem

- **Already hot wood in pile or row gets exposed to excess oxygen. Combustion occurs on the wood surface.**
- **This Results In Wood dehydrating to release alcohols.**
 - **Primary alcohols are oxidized to aldehydes.**
 - **Secondary alcohols are oxidized to ketones.**
 - **Wood surface becomes too hot to sustain bio-activity, limiting population and diversity.**



Examples of Bio-Chemical Odor Problems

- **Excess moisture provides population advantage to motile strains, limiting diversity.**
- **Relative lack of diversity leaves many substrates unavailable to existing strains, causing incomplete decomposition .**
- **Cold ambient temperatures inhibit surface fungal and bacterial activity, allowing incompletely digested compounds to escape, even when pile is undisturbed.**



Examples of Mechanical Disruption Odor Problems

- **Odors during or after unnecessary** turning.**
- **Odors from premature screening when materials are not finished.**
- **Odors from mixing materials that have already begun to putrefy.**
- **Odors from the off-loading of incoming materials that already smell.**

**** Turning when the row gives no indication of any problem or need.**

Solutions

The operator may not be able to stop the arrival of incoming loads that already smell,



But

The operator can blend and process incoming materials promptly!


The operator can process materials to reasonable maturity prior to screening!

The operator can limit turns to situations where the materials and microbes need assistance.



Solutions

Bio-chemical and chemical problems can largely be solved with proper C/N (Carbon to Nitrogen) ratio, additives when required, and the elimination of unnecessary disruptions!

A vertical strip on the left side of the slide shows a thin, dark brown branch with several dried, brownish leaves. The leaves are elongated and have a slightly curled appearance, suggesting they have been preserved or dried.

The Result will be

More Microbes

More Types of Microbes

and MUCH LESS ODOR!

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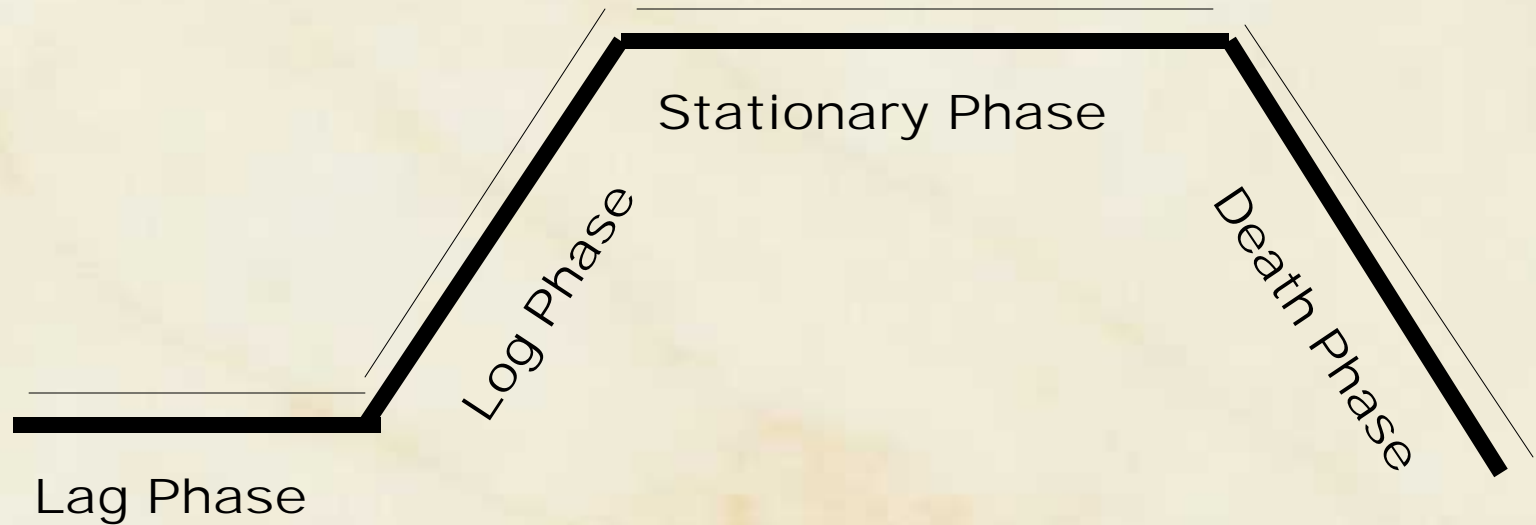
***Microbial Diversity
is a CRITICAL Factor
In Odor Control !***

Phases of Bacterial Replication

- **Lag Phase (Location and Preparation)**
- **Log Phase (Exponential Growth)**
- **Stationary Phase (Maintenance)**
- **Death Phase (Exponential Cessation)**

Bacterial Life Cycle

Variable Time Units (Minutes, Hours, Days)
Determined by
Stress Factors Encountered



Bacterial Life Cycle Activities

- **Lag Phase – No Reproduction**
- **Log Phase – Exponential Reproduction Rates**
- **Stationary Phase- Sustaining (Maintaining) Reproduction Rates**
- **Death Phase – Exponential Death Rates**



What Causes Lag Phase?

Time Needed to

- Repair Tissue and Cell Wall Damage**
- Adapt to New Surroundings**
- Locate Acceptable Food**
- Produce Appropriate Enzymes**
- Collect Co-Factors (Co-Enzymes)**



What Causes Death Phase?

- **Depletion of Nutrients and Energy**
- **Depletion of Water**
- **Excessive Temperature**
- **Unsuitable pH**
- **Toxins**
- **Damage During Physical Relocation**



How Do We Promote Log Phase?

- **Energy and Nutrients**
 - **Maintain available Carbon**
 - **Maintain available Nitrogen**
- **Limit abrupt temperature spikes**
- **Limit tissue damaging relocation events**
- **Avoid drastic changes in moisture level**
- **Maintain suitable pH levels**

End Part 1