Compost Processing: Odor Management

Common Nuisance Conditions

- Odors
- Traffic
- Dust
- Noise
- Safety, Fire potential, Storms
- Insects, Birds, Rodents, Snakes
- etc.

Odors

- All living system produce odorous molecules almost continuously
- Animals use odors for recognition, sexual attraction, territory, finding food, and defense
- Plants use odors to attract pollinating insects, fight diseases, interact with microbes, and provide defense

Human Odor Receptor

- Perceived by olfactory (nose) system
- Odor perceptions varies widely
- Degree related to concentration
- Most “bad” odors - anaerobic conditions
- Nuisance odors do not “generally” cause long term health effects
- MN does not have odor regulations

Human Odor Receptors

- People smell with their eyes!
- People smell with their past experiences

Compost Facility Closures

- After economics, the main reason compost facilities are forced to close!

Odors!

- By far the most difficult problem to address!

- Odor management begins with knowledge, planning, design, construction, operation, evaluation and continuous improvement!

Odors

- Every compost feedstock give off odors
- Some are more offensive to the human sense of smell than others
- Even feedstocks that produce little odor may be offensive due to biochemical metabolism in the degradation process

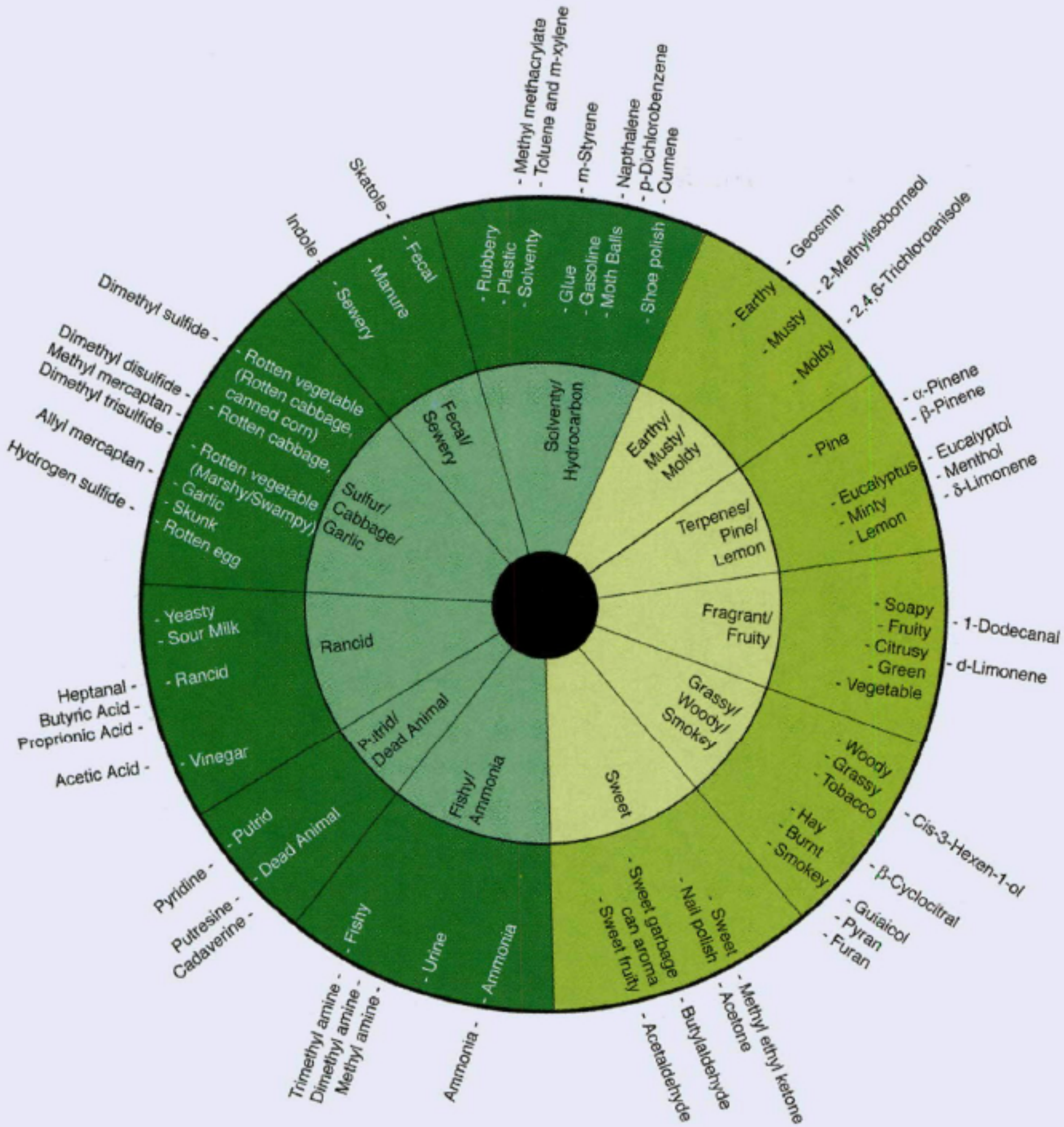

Figure 1. Composting odor wheel

Source: "Sensory Assessment and Characterization of Odor Nuisance Emissions during the Composting of Wastewater Biosolids," *Water Environment Research*, Volume 81, Number 7

Common Odors at Compost Facilities

Field studies identify six odors responsible for ~80% of the odors

- 1) Dimethyl disulfide (garlic)
- 2) Dimethyl sulfide (cabbage, seafood)
- 3) Ammonia
- 4) Hydrogen sulfide (rotten eggs)
- 5) Limonene
- 6) Pinene

Putrefaction

- Is one of seven stages in the of the body of a dead animal
- The decomposition of proteins is a process that results in the eventual breakdown of cohesion between tissues and the liquefaction of most organs
- It “stinks”!

Other Odors?

- Pine, forest
- Fishy
- Garlic
- Rotten eggs
- Mothball
- Rancid butter/parmesan cheese
- Decay
- Fecal
- Faint hydrocarbon
- Rotten garbage, smelly socks

Odor Index

Odor Index = vapor pressure (ppm) / odor recognition threshold (100 %) in ppm

- Nasal ranger
- >260 compounds have been published
- Tens of thousands have **<u>not been measured</u>**!

Odor Index (in ppm)

❖ Hydrogen sulfide	=	17,000,000
❖ Dimethyl sulfide	=	14,400,000
❖ Dimethyl disulfide	=	2,760,000
❖ Pinene	=	469,000
❖ Ammonia	=	167,000

Odor Index (odor units)

- Isopropyl mercaptan = 1,000,000,000
- 1-Pentene = 376,000,000
- Ethyl mercaptan = 289,500,000
- Methyl mercaptan = 53,300,000
- Butyl mercaptan = 49,340,000
- 1- Butene = 43,480,000
- Hydrogen sulfide = 17,000,000

Feedstock Keys to look For

- Sulfides
  - Decay of both plant and <u>especially</u> of animal tissues
  - Pulping wood with the sulfate processes
- High Nitrogen
  - Grass, food waste
- High moisture content
  - Grass, food waste
- Anaerobic conditions

What is the best method of Odor Management?

AVOID!

People smell with their eyes

People smell with their past experiences

Odor Management Methods

- Facility design
- Materials Management
- Treatment

Facility Design

- Materials Flow
  - Easy access to tipping area
  - Easy access to compost windrows - especially static pile
- Landscaping/Screening
  - Berms
  - Wind breaks, shelter belts, trees
  - Flowers, shrubs & gardens
- Wind sock
  - Wind direction, intensity and turbulence
  - Air pressure and humidity

Materials Management

- Pre-qualify all feed stocks
  - Physical properties
    - Bulk density < 750 yd^3
    - Free air space 55%-75% in the pile
    - Particle size and shape distribution
  - Chemical properties
    - pH
  - Biological properties
  - Moisture content < 60%

5 most important Materials Management BMPs

- Mix materials upon receipt
- Stockpile “on site” dry high carbon amendments
- Blanket odiferous materials with a one-foot layer of dry HC/or Mature Compost
- Reject odorous loads
- Incorporate wet or odorous loads directly into actively composting windrows ASAP!

Materials Management

- Minimize turning
  - Must meet PFRP
    (process to further reduce pathogens)
- Consider processing options that add air
  - Aerated static pile
  - In-vessel
  - Vacuum option
- Reduce moisture
  - turning or adding dry materials
- Other, good record keeping

Treatment Methods

- Absorption
- Adsorption
- Oxidation
- Masking Agents (method of last resort)

Absorption

- Gas Absorption
  - Gas into a scrubbing liquid
    - Spray towers
    - Packed bed scrubbers
    - Venturi scrubbers (cyclones)
  - Oxidizing agents
    - Sodium hypochlorite, Hydrogen peroxide
  - Bases: Lime (CaO, CaOH, others)
  - Acids: Sulfuric acid

Adsorption

- A process of contacting a gas/fluid with a solid and it becomes a part of the solid (velcro)
- Activated carbon is the most widely used adsorbent for odors
- Works well on organic odors but not ammonia

…why???

Oxidation

- Chemical Oxidation
  - Ozone, etc.
- Thermal Oxidation
  - >1550 degrees F and >1.0 sec = 99.99% reduction
- Biological Oxidation
  - Activated Sludge
  - Bio-filtration

Masking Agents

- Perfume
- Vanillin
- Citrus
- Try to improve hedonic tone of odors

- With neutralizing chemicals some <u>limited</u> reductions have been demonstrated

Take Home Messages

- Facility Design
- Pre-Screen and Characterize all feed stocks
- Mix as soon as possible
  - before you leave the site
- Control moisture (40%-65%)
  - moist but never wet
- Good gas exchange, media, structure
- Follow good process controls

Producing Good Compost

- "Requires the same level of knowledge, engineering, skill and art as required to produce good wine."

- Managing odors is one of those important skills!

Lilacs and flowers are good!