

# Health & Safety Issues

## Mid-Atlantic Better Composting School



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# *MOTIVATION*

- Safety is good business
  - allows workers to concentrate and do good work
  - avoids expensive workers compensation premiums and equipment damage
  - improves morale
  - avoids unnecessary pain, illness, and/or lost wages
- OSHA standards apply to composting and mulching industry
  - Agriculture
  - Fertilizers, mixing only (SIC code 2875)

# MICROBIOLOGICAL RISKS

- High concentrations of bacteria & fungi key to successful composting
- Most human pathogens like fecal coliforms should be killed off by high temperatures
  - Pathogen = organism that causes disease through infection-the invasion and growth of microorganisms in tissue
  - Inadequate composting can lead to survival of pathogens in cooler layers of compost
    - Example: *E. coli* O157:H7 can survive for several days in soil
- Prions are not inactivated by heat generated during composting

# Guidelines for Achieving Thermal Inactivation of Pathogens

- taken from "the 503 rule" [Federal Register 58(32):9248-9415, Standards for the Use or Disposal of Sewage Sludge]
- based on inactivation of indicator organisms (fecal coliforms and *Salmonella*)

## Class A (unrestricted) Biosolids Pathogen Criteria:

1000 MPN per g of fecal coliforms

OR

3 MPN per 4 g of *Salmonella*

- Analyze at time of disposal or distribution (allow time to obtain results [up to 2 weeks for commercial labs])

## Class A (unrestricted) Biosolids Process Criteria:

For in-vessel or static aerated piles:

- Maintain 55°C (131°F) or higher for 3 consecutive days

For windrows:

- Maintain 55°C (131°F) or higher for at least 15 days
- Windrow must be turned  $\geq 5$  times during this period after being at 55°C for 3 d
  - Turning ensures heating occurs throughout the pile
  - Frequent turning may make it difficult to sustain high temperatures needed for pathogen inactivation
  - Must follow specified turning regimen for biosolids

## Class A (unrestricted) Biosolids Process Criteria:

### Static piles and Windrows:

- Measure daily at "toes" and at 10 to 15 ft intervals (use a variety of depths)
- Early, frequent measurements help determine whether self-heating is occurring

Image:

<http://organic.tfrec.wsu.edu/compost/ImagesWeb/CompSys.html>

QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.

# BACTERIAL PATHOGENS

- May be present in sewage sludge or feedstocks of animal origin
- Bacteria associated with gastrointestinal illnesses (stomach bugs):
  - *Escherichia coli (E. coli)* - Many animal hosts
    - Enterohemorrhagic O157:H7 and related strains are of greatest concern
  - *Salmonella* strains - Animal and poultry hosts
  - *Campylobacter* strains - Cattle and sheep
- *Listeria monocytogenes* - Animals, birds, and soil, causes encephalitis
- *Leptospira interrogans* - Weil's Disease
  - Spread by contamination with rat urine. Causes human infections via skin abrasions and mucous membranes

# OTHER PATHOGENS IN ANIMAL PRODUCTS/SLUDGE

## Helminths and Protozoa (Parasites):

*Giardia lamblia* - Animals - Giardiasis

*Cryptosporidium parvum* cysts - Animals, especially calves

Round worm (*Ascaris*) eggs - Swine

## Viruses:

Rotavirus - groups A and B - bovine, swine

Hepatitis E - swine and rats

Myxovirus - swine and poultry

# Prions

## PATHOGENS

- Small, abnormally-folded, infectious proteins
  - may be found in animal carcasses and meat processing wastes
- Some are associated with transmissible spongiform encephalopathy (TSE) diseases
  - Chronic Wasting Disease (CWD) - deer, elk, moose
  - BSE ("Mad Cow Disease") - cattle
  - Scrapie - sheep
  - variant Creutzfeldt-Jakob disease - humans
- Composting is not appropriate for disposal of animal carcasses or products in which TSE is known or suspected to be present



[http://www.cdfa.ca.gov/ahfss/ah/Scrapie\\_info.htm](http://www.cdfa.ca.gov/ahfss/ah/Scrapie_info.htm)

# TOXIC AND ALLERGENIC MICROORGANISMS

- Most microbes in finished compost also found in "normal" outdoor air and materials
- We all inhale these "normal" microorganisms-usually without ill effects
  - At high concentrations, repeated exposure to some of these microorganisms can cause harmful effects

Toxin: A substance that disturbs a normal bodily function

Allergen: Triggers an immunological response that causes body to be sensitized or to over-react to the substance

# *Aspergillus fumigatus* and related strains

- tolerate high temperatures (125°F)
- allergenic fungi - cause aspergillosis

symptoms range in severity:

mucous membrane irritation,  
asthma, severe lung damage

(Allergic Bronchopulmonary Aspergillosis)

- opportunistic pathogen

-Most individuals can inhale several hundred *Aspergillus fumigatus* spores per day without infection

-Can cause severe and sometimes fatal infection in certain individuals

-prior infection with tuberculosis

-immunocompromised individuals



- Component of cell wall of certain bacteria
- Widespread in the environment (and in house dust)

### Short term Health Effects Depend on Concentration

#### Endotoxin

#### Concentration (ng/m<sup>3</sup>)

#### Condition

20-50	mucous membrane irritation
100-200	acute broncho constriction
1000-2000	organic dust toxic syndrome (acute flu-like symptoms)

- 236 to 374 ng/m<sup>3</sup> measured in enclosed facility during compost screening
- Long-term exposure may lead to:
  - chronic bronchitis and pulmonary disease & reduced lung function
  - reduced risk of lung cancer

# MICROBIOLOGICAL RISKS

- Two main routes of exposure to compost microorganisms

ingestion - main route of infection - can be controlled by good hygiene

inhalation of bioaerosols - unlikely to cause infection, major route of exposure to allergens and toxins

- Compost microorganisms can be aerosolized during shredding, turning, & screening
- Control of bioaerosol inhalation is complex



# *PREVENTIVE MEASURES - INFECTION*



- Practice good hygiene

- Wash hands with soap under running water

- before eating, drinking, or smoking

- before entering any offices or other 'clean' rooms

- Wear gloves for handling feedstocks/unfinished compost

- Never eat, drink, or smoke on site, except in 'clean' areas

- Immediately wash and disinfect any cuts or skin abrasions & cover with waterproof dressings

- Change from work clothes before leaving the site & clean work clothes on regular basis

- Control rat populations and other vermin

# PREVENTIVE MEASURES - ALLERGENS AND TOXINS

- Minimize the production of dust by:

- Controlling moisture:

- by avoiding over-drying during pile/windrow teardown

- during screening (40-60% ideal)

- Keeping hard surfaces damp and clean <http://organic.tfrec.wsu.edu/compost/ImagesWeb/CompSys.html>

- Avoiding dry sweeping and use of compressed air to clean equipment

- Wear dust mask or half-mask respirator (requires fit test & training)

- Use filters or air conditioning in cabs of front-end loaders etc. and keep windows closed



# CHEMICAL RISKS

- Little information on fate of individual chemicals in compost operations
- Pesticide concentrations in finished compost are generally low
  - Organochlorine insecticides (including chlordane and other banned chemicals) most common
  - Organophosphates, carbamate insecticides, and most herbicides are rarely detected
- Fate of most pesticides in compost similar to that in soil
- Early research suggests antibiotics and hormones are transformed during compost process
- Land application of PCBs and heavy metals in compost may be limited as for sewage sludge

## *PREVENTIVE MEASURES - PESTICIDES AND OTHER CHEMICALS*

- Avoid composting feedstocks containing high concentrations of pesticides and other harmful chemicals
- Follow recommended composting procedures to maximize pesticide breakdown
- Follow good hygiene practices

## *COMPOST FIRES*

- Seldom a problem outdoors
- Unless piles:
  - become too dry (~25-45% moisture)
  - are too large (over 12 ft high)
- Piles that are too large and dry can spontaneously combust



## *PREVENTIVE MEASURES*

- Follow good composting guidelines
  - Maintain appropriate moisture levels and pile sizes
  - Monitor temperature and turn piles between 150-160°F
- Maintain adequate water supply and delivery system
- Smoke only in designated areas

# EXAMPLES OF INJURY RISKS AT COMPOSTING SITES

- Musculoskeletal injury from manual handling of material



- Falls from ladders and on spilled materials

- Trauma or death due to contact with moving parts
- Injury due to ejection of foreign matter during windrow turning or grinding
- Hearing loss due to noisy machinery

# *SEVERE INJURIES INVOLVING MACHINERY MOST OFTEN DUE TO:*

- absence or inadequacy of guards
- removal of guards to clear blockages or maintenance
- failure to isolate machine adequately when clearing blockages or maintenance (lockout)
- falling during cleaning and maintenance

# PREVENTIVE MEASURES - INJURY RISKS

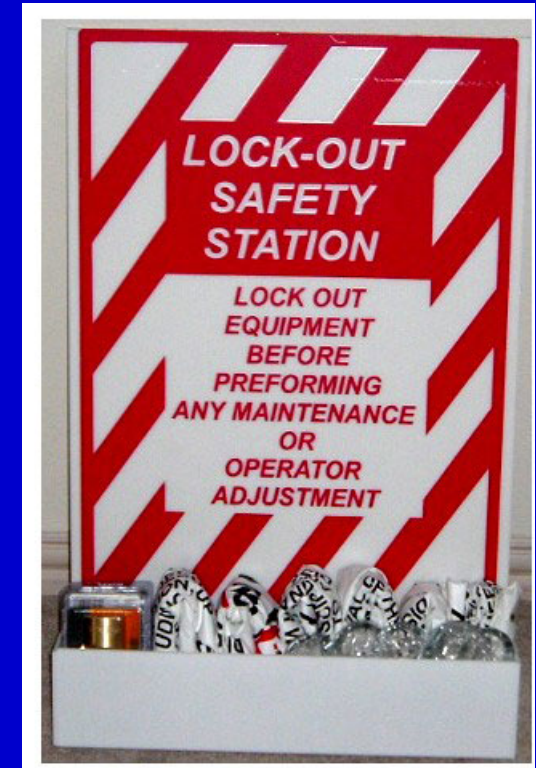
- Become familiar with, and follow, OSHA requirements

★ Ensure equipment is isolated from energy source and inoperative before being serviced (lockout/tagout) ★

- Guard moving parts on screeners, turners, tractors, tub grinders, mixers, shredders etc.

- Provide railings and steps for all raised platforms

- Keep aisle and passage ways clear



# *PREVENTIVE MEASURES - INJURY RISKS*

- Maintain a hazard communications program
  - List of chemicals
    - provide Material Safety Data Sheets
  - Label hazardous materials
- Use/provide appropriate personal protective equipment
  - Possibly hard hats, gloves, hearing protection, eyewear, and respiratory protection



- OSHA standards most frequently cited during last year:

- Abrasive wheel machinery

- Mechanical power-transmission apparatus

- Hazard communication

- Guarding floor and wall openings and holes

- General requirements for all machines

- The top two in \$\$\$ fined were:

- Control of hazardous energy (lockout/tagout)

- Mechanical power-transmission apparatus

# GOOD HYGIENE & GOOD HOUSEKEEPING...

- Present a professional image
- Provide a worker safety benefit

QuickTime™ and a  
TIFF (Uncompressed) decompressor  
are needed to see this picture.

# QUESTIONS?

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