Controlling Dust and Odor From Open Lot Livestock Facilities
Introduction

Dust and odor events associated with OLLFs are driven principally by the effect of short-term weather patterns on the moisture content of the manure pack on the corral surface.
Nuisance Condition

Any condition that inhibits the reasonable use or enjoyment of property
Nuisance Condition

Odor
The FIDO Factors in Odor Assessment

**F**requency (events/yr)

**I**ntensity (dilutions to threshold)

**D**uration (hrs/event)

**O**ffensiveness (subjective)
Sources of Odor in an OLLF

- Open lots
- Manure stockpiles
- Disposal pits
- Land application areas
- Runoff holding ponds
- Anaerobic lagoons (liquid manure handling)
Odor Management Techniques

• Managing manure moisture
  – Corral design
  – Corral maintenance
  – Manure harvesting techniques

• Manure and mortality treatment
Odor Management Techniques (continued)

- Atmospheric dispersion
  - Facility design
  - Timing of land application
  - Vegetative buffers
Managing Solid Manure for Odor Control

- Collect manure frequently.
- Store under roof (long axis E-W).
- Divert rainfall and runoff.
- Provide adequate storage area.
- Mix wet material quickly with drier material.
- Compost.
Managing Mortalities for Odor Control

- Limit exposure to the elements.
- Perforate or cleave thoracic cavity and cover carcass with 1-2 inches of dry, organic material.
- Compost.
Dust Emissions

Open lot dust emissions are a function of

- Loose manure depth on the corral surface.
- Moisture content of the loose manure.
- Hoof action arising from cattle activity.
Driver #1: Loose Manure Depth

Deep and soft

Thin and well compacted
Manure not yet harvested, > 2” deep

Manure harvested within previous 3 days, < 1” deep
Dust Emissions

Loose manure depth is a function of

- Stocking density (animals per unit area).
- Animal liveweight.
- Number of days on feed.
- Corral surface condition (e.g., wallows, “dust pots”).
- Manure harvesting frequency.
Dust Emissions

Corral surface moisture is a function of

- Stocking density.
- Wind.
- Solar radiation.
- Temperature.
- Effective precipitation.
- Humidity.
- Pen aspect.
- Shading.
- Pen drainage.
Driver #2: Cattle Behavior
Dust Emissions

*Cattle activity* is a complex function of

- Stocking density (animals per unit area).
- Feeding regime (frequency, timing).
- Breed and sex.
- Local weather conditions.
- Corral size, shape, and bunk space.
Driver #3: Manure Moisture Content
Moisture Dynamics Vary Within Corrals

Feed apron

1. High activity; High moisture
2. Water trough

3. Low activity; Low moisture
4.
Moisture Dynamics Vary Within Corrals (continued)

Feed apron

1  2  3  4

Water trough

High activity; High moisture  Low activity; Low moisture
Application of Supplemental Moisture

- Tanker trucks
- Reel mount sprinklers
- Solid-set sprinklers
- Increased stocking density
Guidelines for Sprinkler Design and Use

- Capacity should be 0.5 inches/day unless additional management strategies in place
- Exclude region within 15-20 ft of feed bunk
- The deeper the loose manure, the greater the H₂O demand
- Large droplets: less drift, greater compaction
Guidelines for Sprinkler Design and Use (continued)

• Best to put water out just before evening peak, if practical and winds not excessive

• Prioritize areas: where is water needed most?
Take Home Message: Dust/Odor Control

- Applying water to the feedyard surface, either passively or actively, is not a cure-all.

- Prioritize water application within the yard and the corral.
Take Home Message: Dust/Odor Control

- Frequent scraping and removal of manure has greatest impact on odor and dust control.

- Develop manure handling plan to addresses these issues.

- Frequent scraping and removal of manure has greatest impact on odor and dust control.
Composting Manure and Mortalities
What is composting?

- **Composting**
  - Biological decomposition and stabilization of organic substrates, under conditions that allow development of thermophilic temperatures as a result of biologically produced heat, to produce a final product that is stable, free of pathogens and plant seeds, and can be beneficially applied to land (Haug, 1993).
What are advantages to composting?

- Public Perception
- Improved Product
  - Stable for Storage
  - Easier to Haul
  - Uniform Spreading
  - Reduced Odors
- Kills Weed Seeds
- Destroys Pathogens
- Reduced Volume to Transport
- Excellent Soil Conditioner
- May Reduce Soilborne Plant Diseases
What are disadvantages to composting?

- Land Requirement
- Weather
- Equipment Costs
- Labor & Operating Costs
Primary Factors Affecting Composting Rate

1. Carbon to Nitrogen (C:N) Ratio
2. Moisture Content
3. Oxygen Concentrations
4. Temperature
Aeration

- Methods of Aeration
  - Compost Pile Can be Turned by Means of Mechanical Equipment
    - Turning Frequency Decreases As Composting Progresses
  - Forced-Air System
    - Air Can Either be Blown or Drawn Through the Compost
    - Aeration Rates Are Reduced as Composting Progresses
Nutrients

1. Carbon/Nitrogen (C/N) Ratio
   A. Ideal Range = 20-30 : 1
   B. Manure = 5 – 15 : 1
   C. Crop Residues = 100+ : 1
Composting Systems

1. Windrow Operations

2. Aerated Windrow Composting

3. Aerated-Bin Composting
Controlling Dust and Odor from Open Lot
Manure Composting

- Compost is a very stable product
- Slower release of nutrients than manure
- No significant losses when surface applied
Manure Composting

- Not Stockpiling
- Does not incorporate oxygen
- Somewhat stable product but does not get hot enough to kill weed seeds and pathogens
- Still will undergo “hot” microbial breakdown when soil applied
Manure Composting

Simple steps to making compost
- Make piles or windrows
- Manure will heat to 150-190° F
- When it comes back down to 120°, turn to refresh oxygen levels
- If no thermometer, turn every 10 days
- Should be composted after 5 turns
Manure Composting

Simple steps to making compost

- Should be composted after 5 turns
- If cooler weather, then slow things way down
- Best if done during the summer months
Composting Mortalities
Compost Set-Up

- Simple steps to composting mortalities or butcher waste
  - Make 2 foot base layer of high carbon source—wood chips, straw, corn silage
  - Place animal or waste on base
  - Cover with at least 2 more feet of carbon source material
Compost Pile Side View

Dept. of Agricultural & Biosytems Engineering, Iowa State University
Compost Pile Management

- Univ. of Maine research showed best results if you let pre-compost for about 30 days
- After pre-composting, grind or turn
- Turn every ten days a total of three to four times
- If made in winter, monitor temperatures and don’t turn until spring if process can’t get started
Composting Mortalities

- Proven alternative to burying or burning
- Recycling of nutrients
- Pathogens controlled when managed properly
- Easily incorporated into farm or business management system