Composting for **Emergency Disposal of Poultry and Livestock Mortalities**
Learning Objectives

- Emergency disposal scenarios that favor use of composting
- Which composting system works best for emergency disposal?
- Construction procedures & recommended cover materials for emergency composting
- Rules of thumb for sizing emergency composting system and estimating cover material quantities
Mortality Disposal Concerns in Iowa

- Iowa has some of the largest poultry and livestock populations in the U.S.
  - #1 in swine .... population ~15,000,000 head
  - #1 in laying hens ... ~55,000,000 birds
  - #7 in cattle & calves ... ~3,800,000 head
Mortality Disposal Concerns in Iowa

- Large scale death losses happen!
  - Fire
  - Ventilation failure
  - Heat stress
  - Less frequent but MORE serious
    - Contagious disease outbreaks
      - 2001 foot-and-mouth disease outbreak in Great Britain required disposal of nearly 6,000,000 animals
      - 2004 avian influenza outbreak in Canada
    - Agro-terrorism – a new concern
Emergency Disposal Concerns

- Rendering
  - Only 5 major plants in Iowa
    - Will there be sufficient rendering capacity to handle regional scale emergencies caused by heat stress or disease?
    - Are rendering firms willing to handle emergency losses if caused by a disease (such as avian influenza) that is transmissible to humans?
    - Cost & biosecurity risks associated with transport of diseased carcasses to rendering plants?
Emergency Disposal Concerns

- Incineration
  - Requires high-temperature / high-capacity equipment to avoid serious air pollution .... open pyre incineration is not permitted by Iowa DNR
  - Takes time to locate and transport portable incinerators
  - Requires large amounts of fuel
  - Cost & biosecurity risks associated with transport of diseased carcasses to central incinerator locations
Emergency Disposal Concerns

- On-farm burial
  - Poses groundwater pollution concerns
    - Approximately 22 lbs of nitrogen and 8 lbs of phosphorus in every 1,000 lbs of carcasses
    - Nitrogen loading rates imposed by high density emergency burial practices can exceed 20,000 lbs/acre
    - 30-40% of Iowa has shallow bedrock or shallow water table
Emergency Disposal Concerns

- Landfills
  - At present, no consistent policy on acceptance of mortalities .... some will... some won’t
  - Cost & biosecurity risks associated with transport of diseased carcasses to central location
Consider Composting for Emergency Disposal

When:
- Rendering plants are too far away or rendering plant capacity is likely to be exceeded
- High-temperature high-capacity incinerators & large quantities of fuel are not readily available
- Shallow groundwater or bedrock, or frozen soil, make burial unwise or impractical
- Landfills are too far away or will not accept mortalities
- Animal death is caused by contagious disease .... transport to off-farm disposal sites may increase bio-security risks
What Does On-farm Emergency Composting Offer?

- **Immediate carcass containment** .... reduces air pollution and disease transmission potential

- Produces heat that kills pathogens....has been used for many years in poultry and swine industries without reported incidents of disease transmission

- Can be done on the farm using common farm equipment and agricultural products (cornstalks, silage, straw)

- Easier than burial when ground is frozen

- More environmentally friendly than burial, keeps potential water pollutants above or near surface of ground .... further from groundwater resources
History of Emergency Mortality Composting

- Examples of successful use of composting for emergency disposal
  - Massive poultry losses caused by flooding in Missouri (1993), and heat wave in Iowa (1996)
  - Iowa Dept. of Natural Resources sanctioned use of composting for swine losses caused by barn fire in north central Iowa in 2003
  - Canadian Food Inspection Agency used composting during avian influenza outbreak in British Columbia in 2004
Bin vs Windrow Composting Systems

Roofed bin systems ... are recommended for **routine** disposal of small/medium sized species in Iowa

- Roof prevents excessive moisture
- Walls limit rodent & insect access
- Requires less cover material than open piles

**BUT** bin systems are NOT well suited for **emergency** disposal

- Typically sized for **average daily loss rates** ... NOT for loss of whole herd or flock
- Would take too long to construct in an emergency
- Expensive for large species

**NOTE:** For more info on bin composting systems see companion presentation in this series .... “Composting for routine disposal of poultry and livestock mortalities”
Windrow Composting Systems

- Well suited for emergency disposal
  - Can be sized to fit varying quantities and sizes of carcasses
  - Can be constructed quickly using on-farm equipment and materials
  - Low capital and operating cost

Developed by Dr. Tom Glanville and Dr. Jay Harmon, Department of Agricultural & Biosystems Engineering, Iowa State University, for ISU outreach program on Poultry & Livestock Disposal in Iowa, sponsored by Iowa Department of Natural Resources.
Windrow Composting Procedures

- Step 1 - Lay down 18-24 inch thick absorptive base layer
  - Retains contaminated leachate caused by:
    - Heavy precipitation
    - Water in carcasses
      - Each 1,000 lbs of carcasses contains ~ 600 lbs of water!

Note: white leachate capture troughs are for research purposes …. not normally included in on-farm mortality composting.
Windrow Composting Procedures

- Step 2 – place carcasses on base

NOTE: use of pallet fork on loader facilitates placement of large carcasses without damaging base layer
Carcass Placement
For Large Carcasses (e.g. cattle or horses)

- Single layer recommended
  - Stacking large carcasses can cause:
    - Excessive pile settling .... carcass exposures ..... need for frequent addition of cover material
    - Leachate release ..... every 1,000 lbs of carcasses contains ~ 600 lbs of water

![Diagram of carcass placement]

- Minimum 18-inch cover to retain heat, absorb odor, & absorb excess precipitation.
- Minimum 24-inch base layer to absorb leachate.
Carcass Placement
For Small carcasses (swine, sheep, calves, poultry)

- Limited stacking of small carcasses is OK
  - Less settling due to smaller size & distributed weight
  - Greater opportunity to retain water from carcasses
    - Place 3-6 inches of cover material between carcasses in the same layer
    - Use 6-9 inches of cover material between layers

Minimum 18-inch cover to retain heat, absorb odor, & absorb excess precipitation.
Minimum 24-inch base layer to absorb leachate.
Windrow Composting Procedures

- **Step 3 - Cover carcasses with 18-24 inches of envelope material**
  - Retains heat and moisture .... both are essential for bacterial activity
  - Absorbs excess precipitation
  - Absorbs and retains odorous gases

*NOTE: grey tubing shown in photos above is for research purposes….not normally used in routine practice.*
Windrow Composting Procedures

- Expect **substantial** settling, particularly during warm seasons
  - Can lead to pile cracking ... need for occasional repair ... stockpile extra cover material for this purpose

day 1 – 7 ft pile height

day 45 – 4 ft pile height
Windrow Composting Procedures

What about windrow turning?

- **Pros**
  - Speeds up decay by introducing oxygen and redistributing moisture and nutrients
  - Helps insure that all materials in pile are exposed to high heat

- **Cons**
  - Chills the pile if done during cold weather ... dries the pile if done during hot/dry weather
  - Releases serious odors if done too soon
  - Requires additional material to re-cover un-decomposed materials ... prevent fly problems
  - Releases pathogens if done before pathogens are inactivated
  - Time consuming
Windrow Composting Procedures

- Is frequent turning essential?
  - No... most on-farm mortality compost is turned only once ... some not at all
  - If death is caused by disease ... turning not recommended until carcasses are fully decayed

- During 3-year study by Iowa State University ....
  54 tons of 1,000-lb cattle carcasses were composted in unturned windrows
    - If begun during cold weather – complete soft tissue decomposition occurred in 10 to 12 months
    - If begun during warm weather – 4 to 6 months
    - Smaller carcasses will decay more quickly
Windrow Composting Procedures

How does composting work without turning?
- Use of porous (air-permeable) and adsorbent envelope materials is the key!
  - Allows diffusion of oxygen into windrow
  - Temporarily absorbs excess moisture
  - Permits evaporation of excess moisture
  - Lets decay gases escape
During 3-year study sponsored by Iowa DNR, three materials were tested in emergency windrows.

- Corn silage
- Ground cornstalks
- Ground straw or hay
- All worked reasonably well for both base layer and cover material

Corn silage considered best for disease-related emergencies
- Produces high temperatures quickly & sustains them
- Best potential to kill pathogens quickly

Ground cornstalks or ground straw
- Produces heat more slowly, temperatures lower than silage
- Well suited for non-disease emergencies
  - Fire, flood, ventilation failures
NOTE: Use of un-ground cornstalks in the cattle mortality composting windrow shown above (left) led to bridging, poor heat retention, serious downwind odor, & heavy fly infestation (center and far right) (photos courtesy of Dan Olson, Iowa DNR)
Cover/Base Material Quantities

- Requires about 12 cubic yards of loose cover/base material per 1,000 lbs of large carcasses
  - Estimate cover material tonnage using:
    - Corn silage - 3.2 tons / 1,000 lbs of carcasses
    - Ground cornstalks - 1.4 tons / 1,000 lbs of carcasses
    - Ground straw - 1 ton / 1,000 lbs of carcasses

- NOTE: Cover material quantities for emergency windrow composting are substantial
  - Cover materials should be stockpiled (or pre-contracted for quick accessibility) if composting is included in your emergency disposal plan
Rules of Thumb for Emergency Windrow Systems

- **Windrow base width**
  - Less than 20 ft .... for acceptable oxygen penetration into core of pile
  - Wider piles not recommended ... core area may not receive sufficient oxygen for good composting
Rules of Thumb for Emergency Windrow Systems

- Carcass loading density
  - For mature cattle or similar large species
    - Two 1,000-lb carcasses (1 ton total) per every 8-ft length of windrow
  - For smaller carcasses
    - No more than 1 ton per each 8 ft of windrow length
      - Examples
        - 4-500 lb sows or calves
        - 8-250 lb pigs

- To estimate windrow length
  - length (ft) = number of mature (1,000 lb) cattle X 4
  - length (ft) = lbs of small carcasses / 250
Rules of Thumb for Emergency Windrow Systems

○ To make construction, maintenance, and tear down easier
  ● Space parallel windrows 2-3 loader lengths apart

composting windrows

3 X LL

Loader Length (LL)
Compost Use

- Land application is most common end-use
  - Cattle mortality compost contains large bones that may not break down quickly
    - May interfere with tillage or planting
    - Use of spreader with hammer mill-type discharge (shown above) helps to break them up
Compost Use

- Iowa rules allow mortality compost to be applied to **cropland** or **pastureland** without a permit
  - Application to other types of land requires IDNR approval
- Nutrient content typically low
  - Often less than 1% total N and total P
  - Varies with type and amount of cover material used with carcasses
  - Test before applying, follow acceptable nutrient management plan
Most Common Cause of Composting Problems?

- Skimping on cover materials .... leads to:
  - inadequate water retention .... pile saturation
  - low temperatures .... inadequate “insulation”
  - carcass exposures .... biosecurity concerns
  - odor releases

- For more info on diagnosing and solving composting problems see companion presentation in this series .... “Troubleshooting Mortality Composting”
Review

Three scenarios favoring use of composting for emergency livestock mortality disposal?

1.

2.

3.
Three scenarios favoring use of composting for emergency livestock mortality disposal?

1. Rendering plant too far away, or inadequate rendering capacity
2. Burial ill-advised due to shallow water table
3. Biosecurity concerns associated with off-farm transport of diseased carcasses
True or False?

Bin composting systems designed for routine disposal typically have sufficient capacity to handle whole-herd emergency disposal.

___ True
___ False
True or False?

Bin composting systems designed for routine disposal typically have sufficient capacity to handle whole-herd emergency disposal.

___ True

X False
Review

Three practical cover materials that have performed adequately during emergency mortality composting tests in Iowa?

1.

2.

3.
Review

Three practical cover materials that have performed adequately during emergency mortality composting tests in Iowa?

1. Corn silage
2. Whole cornstalks
3. Ground straw
Review

Three practical cover materials that have performed adequately during emergency mortality composting tests in Iowa?

1. Corn silage
2. Oops! Whole GROUND cornstalks
3. Ground straw
Review

Problem:
- Accidental spillage of poison into a cattle feed mixture
  - Resulted in death of 100 feeder cattle weighing an average of 1,000 lbs each
  - Space limitations near feedlot require that windrows are no longer than 100 ft.

Estimate:
- Length and number of windrows
- Volume and tonnage of envelope material if ground cornstalks are used
Review

Problem:
Total mass of losses = 100 cattle X 1,000 lbs = 100,000 lbs

Windrow length (ft) = 4 X number of Mature Cattle = 400 ft.

Number of windrows = total length / individual length
= 400 / 100 = 4 windrows

Volume of loose envelope material = 12 cu yds / 1000 lbs of carcasses
= 12 X 100 = 1200 cubic yards

Tons of ground corn stalks = 1.4 tons per 1,000 lbs of carcasses
= 1.4 tons X 100 = 140 tons ground stalks
Development of this educational presentation has been funded in part by the Iowa Agricultural Experiment Station, Iowa State University Extension, and by the Iowa Department of Natural Resources through a grant from the U.S. Environmental Protection Agency under the Federal Nonpoint Source Management Program, Section 319 of the Clean Water Act.

Technical review of this presentation was provided by: Kathleen A. Lee, Senior Environmental Specialist, Emergency Response and Homeland Security Unit, Iowa Department of Natural Resources; Alex Moon, Environmental Program Supervisor, Energy & Waste Management Bureau, Iowa Department of Natural Resources; and Kapil Arora, Field Specialist – Agricultural Engineering, University Extension, Iowa State University.

revised February 2008