Pros & Cons of Swine Mortality Disposal Options

What's New ?

- For Stabilization & Extended Storage (prior to rendering)
  - Fermentation (requires grinding & fermentable carbohydrate)
  - Acid preservation (requires grinding, sulfuric or phosphoric acid [safety concerns])
  - Refrigeration – used by slaughterhouses in Netherlands during FMD outbreak in 2001

- For Disposal
  - Alkaline hydrolysis (biological material dissolved in alkaline hydroxides under heat and pressure) – currently used by NADC and university veterinary research labs
  - Anaerobic digestion – biological decomposition in heated anaerobic vessel
  - Gasification – bio materials heated to produce synthetic gas that is burned

- In general, these new methods not currently widely used
  - Higher capital & operating costs
  - Some are quite complex
  - Some suited for large or highly specialized operations

What's New ?

Commercial Developments & University Research

- Biovator rotating mechanical composter
  - Automated processing of routine mortalities
  - Frequent turning promotes rapid decomposition

- ISU Research on Emergency Composting
  - Windrow composting for emergency disposal
  - Studied effects of seasonal weather conditions & type of cover material on performance
  - Sponsored by Iowa DNR and USDA

- ISU Research on Bio-secure swine mortality composting
  - Use of plastic envelope to reduce risks of pathogen escape
  - Sponsored by Canadian Food Inspection Agency and Canadian Research & Technology Initiative

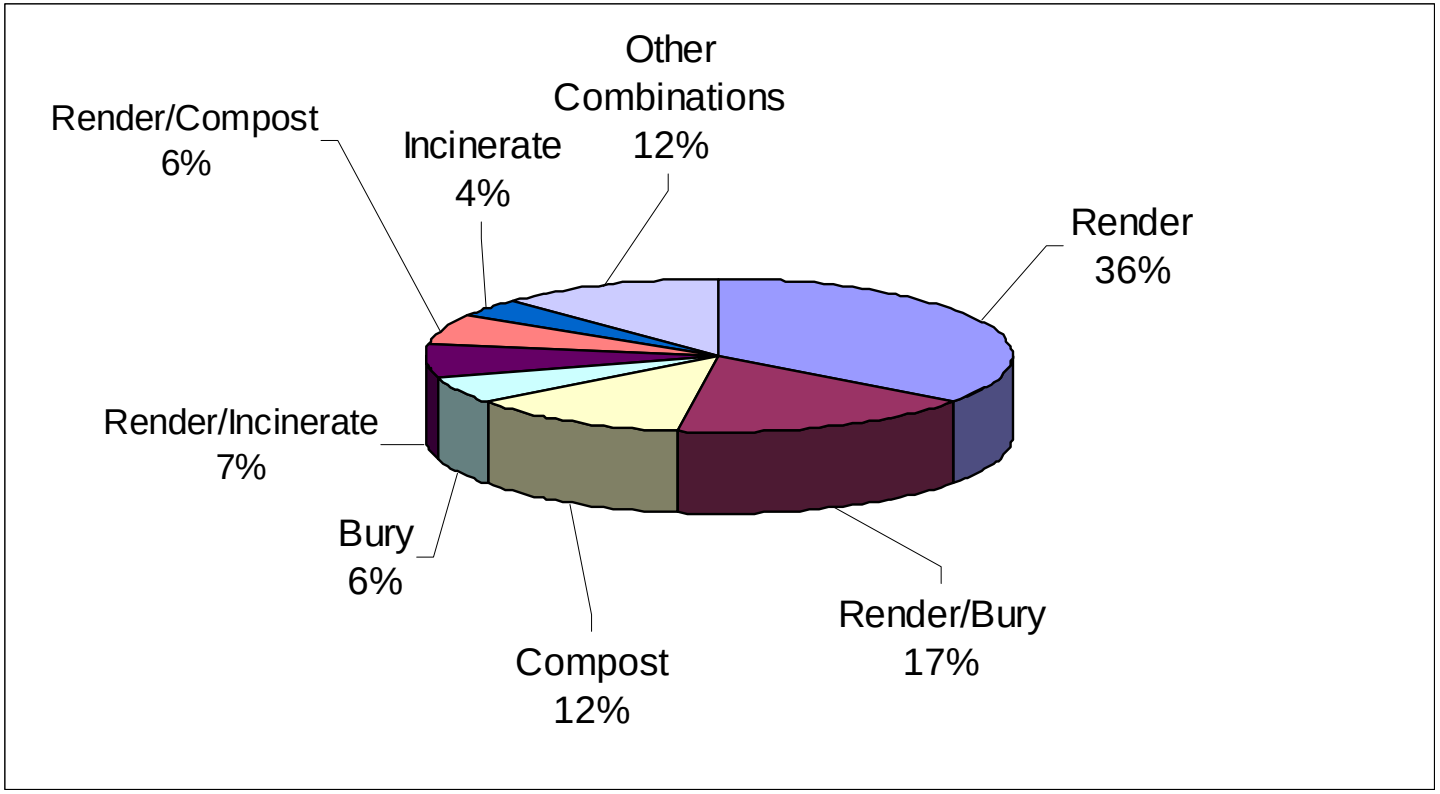
Traditional Methods

Rendering, Burial, Incineration, Composting

- Not perfect solutions, but are widely used because:
  - Work reasonably well, historically accepted
  - Relatively simple (not necessarily easy)
  - Timely – most can be done on the farm
  - Reasonably affordable

Iowa Swine Mortality Management Survey

% of Iowa Swine Operations Using Each Method



From 2001 IPPA / ISU survey of Iowa swine producers

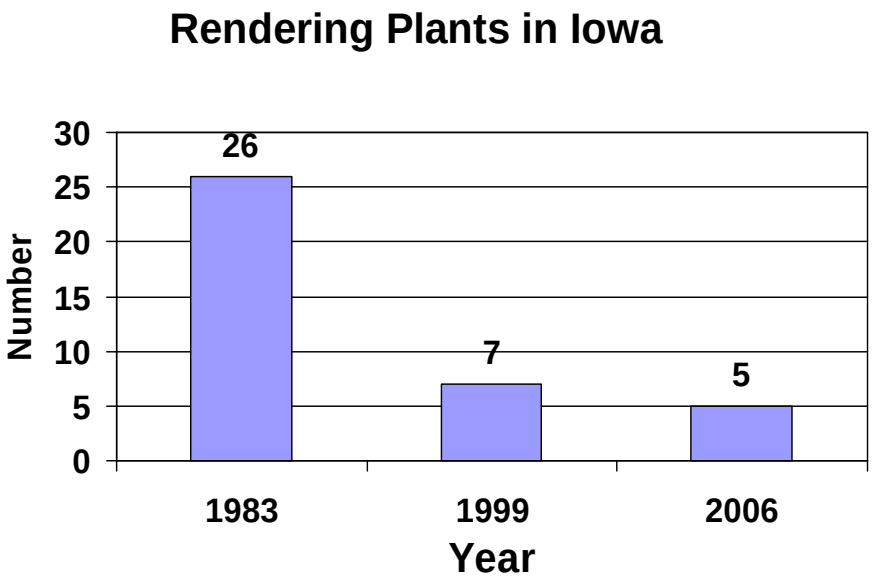
Pros & Cons of Disposal Methods

Key Factors / NEW Info

- Time/Delays
- Bio-security Risks
- Environmental Risks
  - Air pollution - odor
  - Soil/water pollution
- Costs
  - Fixed - facilities & equipment
  - Variable - fuel, services, maintenance

Time Delays

- Rendering
  - Number of rendering plants decreasing in U.S.
    - Iowa lucky to have several
    - Only one plant serves all of the New England states!
  - Fewer plants mean greater haul distances (potential for delays)
  - Most frequent Iowa producer complaint about rendering
    - NOT lack of availability
    - Lack of Timeliness
      - (2001 IPPA / ISU survey of swine disposal practices in Iowa)
  - Management Practice
    - Consider refrigerated storage if delays are a frequent problem



Time Delays

- Burial
  - Primary Cause
    - Weather-related delays
      - Frozen soil
      - Muddy conditions
  - Management Practices
    - Schedule excavation during warm/dry weather
    - Locate burial sites in well drained soils

Time Delays

- Incineration
  - Delays Primary Due To
    - Fixed capacity ….. inadequate at times of peak loss
    - Difficult to expand capacity
    - Note: A natural tendency to overload incinerators during periods of high losses ….. can lead to <u>serious</u> odor emissions
  - Management Practices
    - Use composting or rendering when incinerator capacity is exceeded

Time Delays

- Bin Composting
  - Primary Cause
    - Some delays if bin capacity is exceeded
  - Management Practices
    - Use windrow composting methods to provide extra capacity (more about methods later)

Bio-security

- Rendering
  - Process itself
    - Good bio-security
    - High rendering temperatures destroys pathogens
  - BUT, movement of rendering trucks from farm-to-farm is often mentioned by producers as a bio-security concern
    - Not much scientific work on this topic, but one recent study supports this concern
      - Published in JAVMA, McQuiston et.al. 2004 claimed strong evidence of farm-to-farm transmission of avian influenza by rendering trucks during 2002 outbreak in state of Virginia.
  - Management practices
    - Keep rendering vehicles away from production barns

Bio-security

- Burial
  - Long considered to pose “low risk”
    - One study (Davies & Wray, 1996) reported that cattle burial caused extensive pathogen contamination in the soil and a nearby drainage ditch
    - Anthrax spores - have long-term survival in soil, and may reach soil surface (Turnbull, 2001)
  - Management Practices
    - Bury promptly after death
    - Use care when transporting carcasses
    - Observe recommended burial depths and separation distances to wells, streams, & embankments.

Bio-security

- Incineration
  - Very low risk, extreme heat kills pathogens
  - Management practices
    - Incinerate promptly following death
    - Use care when transporting or storing carcasses

Bio-security

- Composting
  - Moderately low risk
    - Heat and other stressors (pH, drying, antimicrobial chemicals) reduce pathogen populations
    - But lack of temperature uniformity (cool zones near edges) can allow pathogens to survive
- Management Practices
  - Avoid use of small bins or piles (< 1 m^3)
    - Cannot retain heat
  - Keep carcasses away from edge of bin or pile (cool zone)
    - Temperatures much higher 2 ft or more from edge of pile

Environmental Risks

- Rendering
  - Very little air or water pollution risk on the farm
  - Occasional odor complaints near rendering plants

Environmental Risks

- Burial
  - High risk - nitrogen pollution of soil & groundwater
    - Every 1000 lb of carcasses contains 22 lb of nitrogen
      - High density burial of carcasses (carcasses touching each other) can lead to N loadings of 25,000 lb/acre or greater !
      - Carcasses buried in wet soils can take 10 years or more to decompose
  - Management Practices
    - Avoid high density burial – especially if groundwater is shallow
    - Locate all burial sites at least 1000 ft meters from wells, and streams

Environmental Risks

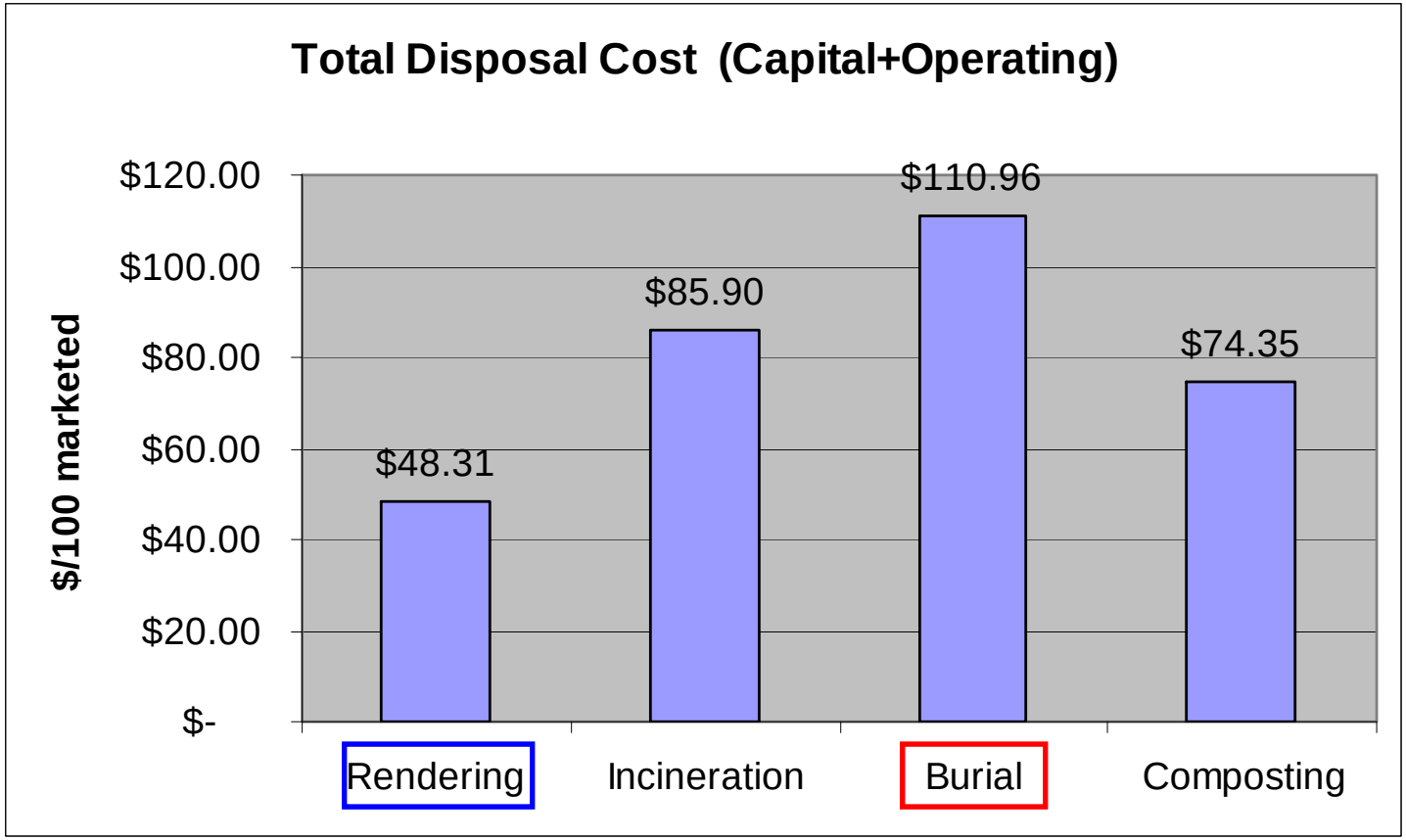
- Incineration
  - Risk of serious air pollution
    - If incinerator is loaded too heavily
      - Low operating temperatures
  - Management Practices
    - Do NOT overload incinerators
      - Better to use composting or rendering when incinerator capacity is exceeded

Environmental Risks

- Composting
  - Soil pollution
    - If done on unprotected soil
    - If bin or windrow not protected from rain
  - Management Practices
    - Place composting facilities on concrete platform
    - Place roof or plastic cover over bins or windrows

Cost

- 2001 Iowa State University Swine Mortality Management Survey



Swine Mortality Composting

Setup & Operation

- Equipment
  - Tractor/loader or skid loader
    - Haul carcasses & cover materials
    - Build, turn, unload bins
    - Manure spreader – haul / land apply compost
  - Long-stem dial-type composting thermometer
    - Check internal compost temperatures ….. useful for troubleshooting
    - Recommend 36 - 48-inch stem length
    - Approximate cost $100-$150

Swine Mortality Composting

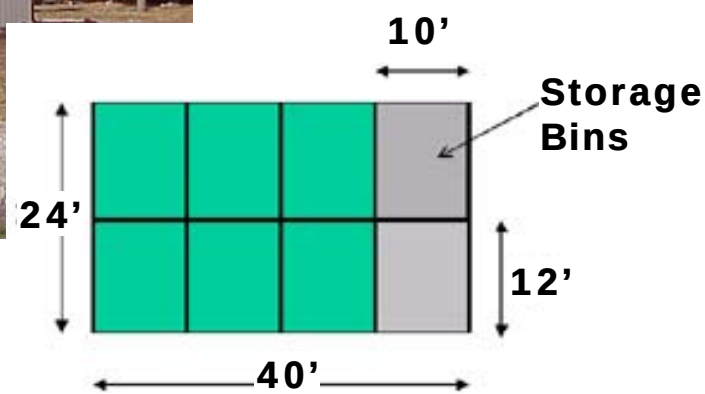
Setup & Operation

- Recommended facilities
  - Options
    - Configuration: bins vs. windrows or piles
    - Roofed vs. unprotected
  - Roofed bins recommended for swine disposal in Iowa
    - Why bins ?
      - Reduce the amount of cover material needed
      - Help retain heat in cold weather
      - Reduce problems with rodents/scavengers
    - Why roof ? Iowa receives 32 inches/yr of precipitation.
      - Causes pile saturation resulting in:
        - Leachate & odors
        - Low internal temperatures
        - Slow carcass decomposition

Bin Example

Back-to-back bins, concrete walls, includes cover material storage

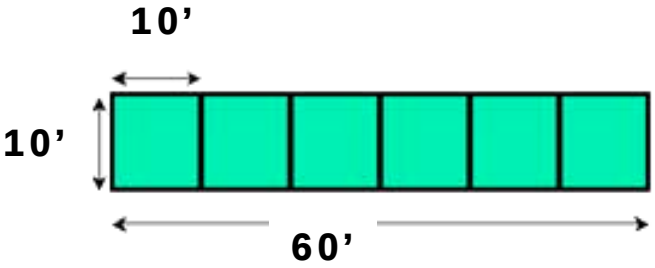
This facility sized for average daily losses of 300 sow farrow-finish operation



Bin Example

Single-row configuration, treated lumber walls

This facility sized for average daily losses of a 450 sow farrow-to-nursery operation



Facility Example

Low-cost bins, constructed in unused shed

Composting need NOT be complicated or expensive !

Bins constructed with used materials (slat panels) inside unused shed.

Photos by Kris Kohl , ISU Extension Engineering Field Specialist

Estimating Needed Bin Space

- Step 1: Estimate total annual pounds of mortalities based on operating records
- Step 2: Divide annual pounds by 365 to get average daily loss
- Step 3: Multiply daily loss by 40 to get total cubic feet of bin volume needed

Bin Dimension Guidelines

- Minimum bin width (feet) = 2X loader bucket width
  - Reduces potential damage to both loader and bin walls
- Front-to-back dimensions = 1 to 2X bin width
- Maximum sidewall height - 6 feet
  - load to 5-foot depth
  - greater depth complicates loading/unloading & reduces oxygen penetration into pile
- Loaded bin volume = width (ft) X length (ft) X loaded height (5 ft)

Estimating Number of Bins Needed

- Divide total bin volume by loaded volume of a single bin
- Round UP to nearest whole number
- IF result is an odd number, add 1 more to get an even number
  - Need an equal number of “primary” and “secondary” bins

Additional Storage Needs

- For cover materials
  - Must be sheltered to keep them dry
  - Can incorporate envelope material storage bins into composting system, or store materials in nearby shed

  - For additional details see: ISU Extension Publication Pm-1917, *Composting Swine Mortalities in Iowa*

Additional Space/Planning Considerations

- Location of composting bins
  - Convenient to production facilities
  - On a well-drained area
    - No runoff <u>onto</u> or <u>off</u> of composting area
    - Recommend construction of an all-weather surface that permits accessibility during inclement weather
      - compacted soil or granular aggregates, asphalt, or concrete
  - <u>Minimum</u> required separation from environmentally sensitive areas
    - 500 ft from residences
    - 200 ft from public wells, 100 ft from private wells
    - Outside of wetlands, 100 ft from surface water bodies

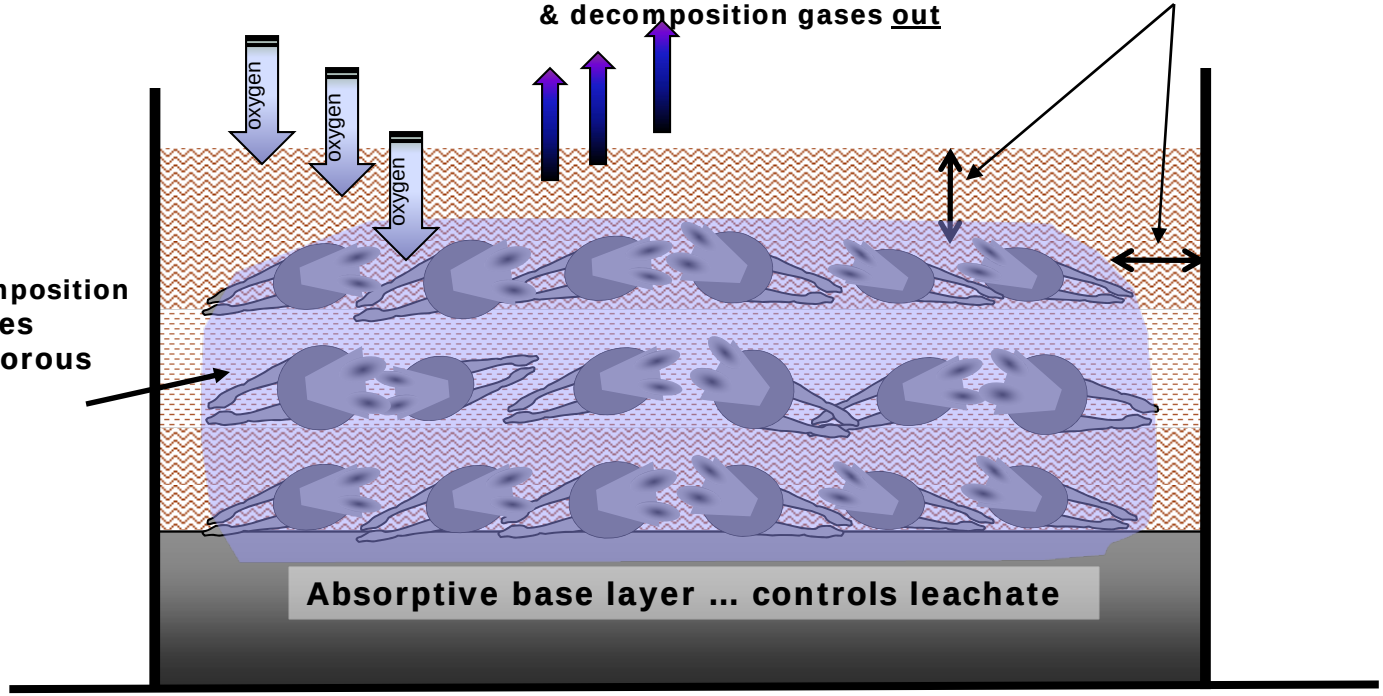
Keys to Successful Composting

Permeable (coarse textured) cover material

During cold weather …. 18 inch "insulating layer" retains heat….kills pathogens … speeds decay

…. lets oxygen into pile,

…. and excess water vapor & decomposition gases out



Moist bio-decomposition zone … degrades carcasses & odorous byproducts

Composting Procedures

Loading the Bins

- Use **PLENTY** of Envelope Material
- Retains heat, odor, & leachate
  - 12-inch thick absorptive base layer (minimum)
  - Space between adjacent carcasses (same layer)
    - 4-6 inches - small carcasses
    - 6-12 inches large carcasses
  - Material between layers
    - Same as between adjacent carcasses
    - Cap top layer with 6-12 inches …… more during cold weather

Composting Procedures

Temperature Monitoring

- Monitor Internal Temperatures
  - Low temperatures (< 100 °F)
    - Cover material too wet, too thin, or too porous to retain heat
    - Insufficient pile size to retain heat

- High temperatures (> 160 °F)
  - Can kill beneficial composting organisms
  - Turn the pile to cool it down

Composting Procedures

Turning the Piles

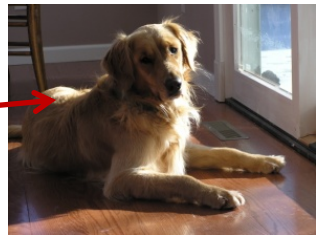
- Move compost from one bin to another midway through decomposition
  - Introduces oxygen, redistributes moisture, speeds decay

- Approximate decomposition times (depends on weather [temperature] & size)
  - 1-2 months – swine < 100 lbs
  - 2-4 months – swine > 100 lbs

Composting Procedures

Compost Utilization

- IDNR rules allow mortality compost to be applied to <u>cropland</u> without a permit
  - Application to other types of land requires IDNR approval
- Nutrients (bin compost)
  - N& P usually low – 0.5 to 1% on wet basis (unless manure is used in compost)
- Finished compost WILL contain bones
  - Dry & free of soft tissues – but may attract some scavengers
  - Not recommended to spread near to residences



Troubleshooting Mortality Composting Problems

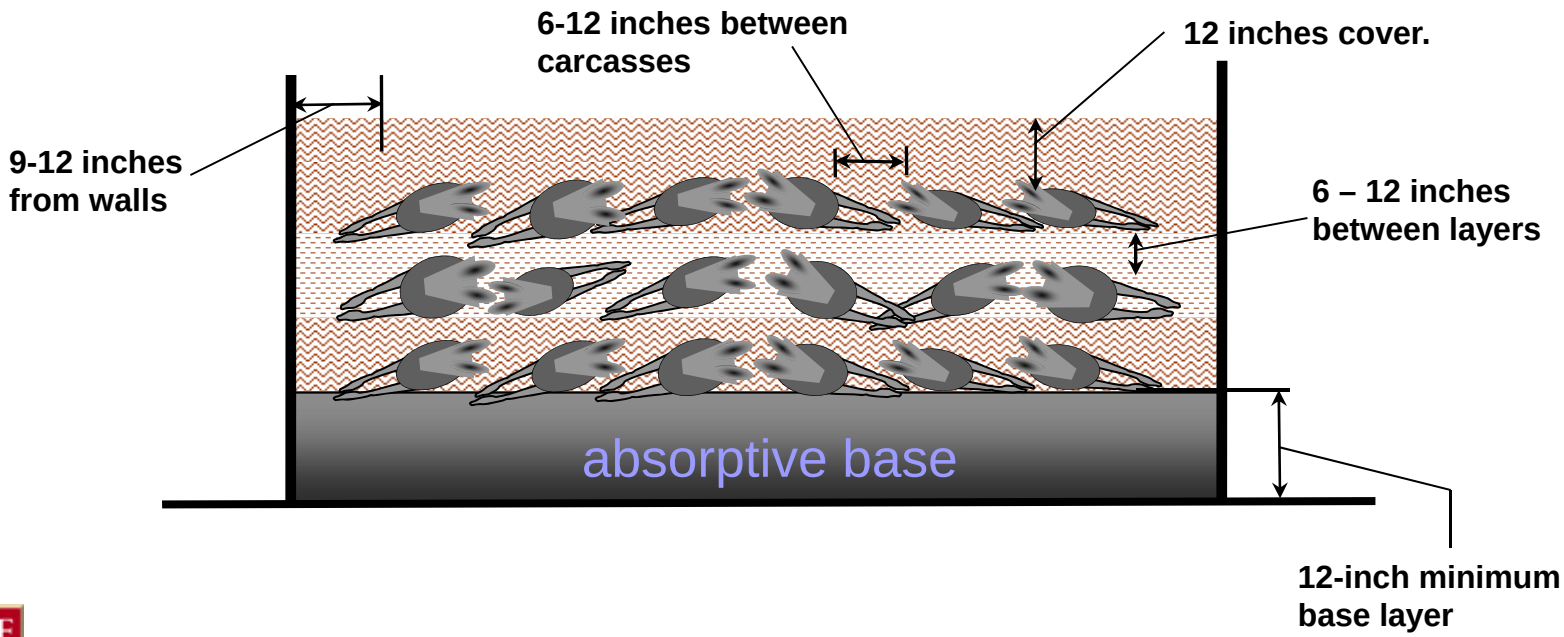
- Most Common Problems
  1. Leachate production
  2. Poor odor retention
  3. Slow carcass decay

Troubleshooting - Leachate

- Cause # 1: Excessive precipitation exposure during wet seasons
  - Solution: Reduce exposure
    - Roofed bin system; or
    - Install tarp over piles

Troubleshooting - Leachate

- Cause # 2: Inadequate liquid absorption capacity
  - Solution: Use thicker envelope of absorptive material under, between, & over carcasses
  - REMEMBER! 1000 lbs of carcasses contains 650 lbs H_2O



Troubleshooting - Leachate

- Cause # 3: Use of envelope material that is too wet

- Solution:
  - Use “squeeze” test to check moisture
    - Material should feel moist … but yield only a few drops of water when squeezed (not saturated)
    - Store envelope material in dry location to avoid excessive moisture

Troubleshooting – Poor Odor Retention

- Cause # 1: Envelope material placed over carcasses too thin … or too coarse
  - Solution:
    - Use at least 12 inches of envelope material over carcasses
    - Avoid use of extremely coarse envelope materials
      - Must grind coarse materials such as cornstalks or straw (use 2-inch screen)

Troubleshooting – Poor Odor Retention

- Cause # 2: Compost turned prematurely
  - Solution:
    - Don't turn compost too soon
      - "Too soon" varies with carcass size & seasonal temperatures
        - A few days for small pigs during warm weather
        - 8-12 weeks for large pigs during cold weather
        - Experience the best teacher
      - Stockpile extra envelope material … be prepared to cap pile with more material if needed to suppress odor emissions

Troubleshooting – Poor Odor Retention

- Cause # 3: Compost too wet
  - Prevents oxygen penetration … pile goes anaerobic … produces excessive odor
  - Often accompanied by leachate release

- Solutions: Same as for leachate … easier to prevent than to fix after odor starts
  - Reduce exposure to excessive rainfall
  - Avoid overloading pile
  - Mix wet compost with drier cover materials
    - CAUTION … likely to increase odor releases during mixing …… re-cap with thick layer of material to retain odor

Troubleshooting – Slow Decay

- Cause # 1: Inadequate O_2 penetration caused by fine textured cover material
  - Solution: Use coarser cover material
    - Particles with 1/8th inch minimum dimension … obvious pore spaces between particles (below right)
    - Avoid "soil-like" materials comprised of small particles with tiny pore spaces (below left)

poor texture

better texture

Troubleshooting – Slow Decay

- Cause # 2: Inadequate O_2
  - Caused by excessive moisture
  - Often accompanied by leachate
    - Solution: Again … similar to those for leachate
      - Reduce exposure to excessive rainfall
      - Avoid overloading pile with too many carcasses and too little absorptive material
      - Mix wet compost with coarser and drier cover materials
        - Time consuming, may not work if compost is too sticky to mix

Troubleshooting – Slow Decay

- Causes # 3 : Inadequate moisture
  - Typically occurs only during very dry weather
  - Solution:
    - Add water sparingly and turn (to mix)
    - May need to repeat several times
    - Proceed slowly … very easy to over wet small sections resulting in odor and leachate

Troubleshooting – Slow Decay

- Causes # 4 : Low temperature caused by inadequate heat production or retention

  - Solution:
    - IF material near carcasses is moist … increase thickness of envelope material to improve heat retention
    - If material near carcasses is dry… add moisture to improve microbial activity & heat production
    - Note: do not put frozen carcasses into a composting system … takes extremely long time for carcasses to thaw and produce heat

Emergency Livestock Disposal Planning

By failing to prepare, you are preparing to fail.

Benjamin Franklin (1706-1790)

Why Plan?

- Catastrophic poultry & livestock death losses do happen!
  - Fire, blizzard, ventilation failures, heat stress, contagious disease, accidental or malicious poisoning, flooding

photo courtesy of Iowa DNR

Why Plan?

- During emergencies time is critical!
  - Rapid carcass containment is essential
    - Disease control
    - Odor control
    - Water and soil pollution prevention

Why Plan?

- Making decisions in haste can be frustrating and costly!
  - Options overlooked
  - Consequences not considered

- Incorrect assumptions (what <u>can</u> & <u>cannot</u> be done)
  - Can cost you time and money; and
  - Slow down recovery from catastrophic losses

Assumption

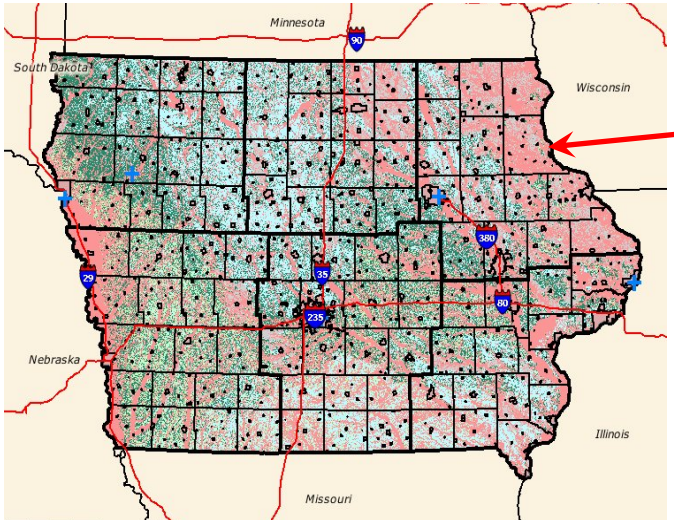
"I can always send them to the landfill"

- Some landfills accept carcasses … and some do not … have you checked with yours?
  - Small landfills often do not !
  - If a human disease risk … service may be denied
    - During avian influenza outbreak in British Columbia in 2004 … public landfills closed their gates to poultry producers

Assumption

"I can always bury them on-farm"

- Not always … emergency burial of catastrophic mortalities requires <u>prior approval</u> by Iowa DNR
  - About 30% of Iowa is mapped as "<u>restricted"</u> for burial of large quantities of poultry and livestock
    - Why? … Shallow bedrock, steep slopes, shallow groundwater, wetlands, streams, public wells



Iowa DNR Animal "Burial Zone" Map
Pink = areas where mass burial is restricted

Assumption

"I can always bury them on my farm"

- IF emergency burial is approved … consider this
  - 1,000 lbs of carcasses contains 20 lbs of nitrogen
  - High density mass burial practices like this … can be equivalent to applying 25,000 lbs of N per acre !!
    - Threatens shallow groundwater
    - Pollution persists for many years
    - Iowa DNR requires
      - Mass burial sites to be recorded on property deed
      - Installation of groundwater monitoring wells

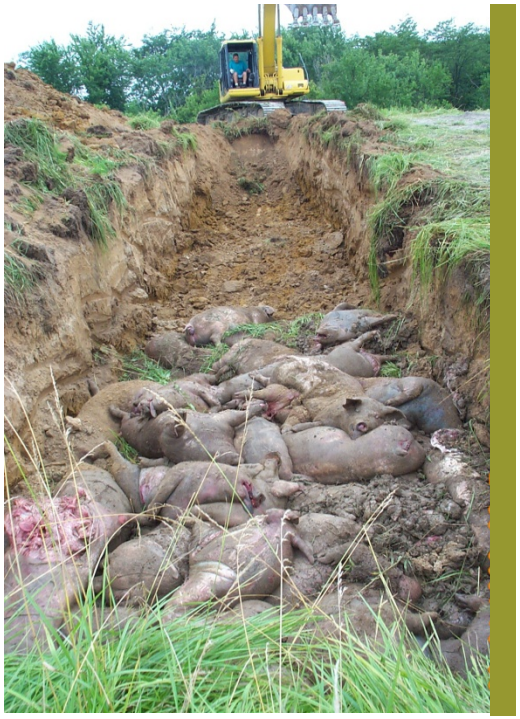


photo courtesy of Iowa DNR

Assumption

"I can always burn them on my farm"

- Open pyre incineration during foot-and-mouth disease outbreak in Great Britain (2001) created serious air pollution.
- Iowa DNR prohibits carcass incineration in open fires.
- Air-curtain incinerators (below right) produce much less air pollution, but this specialized equipment is not commonly found in Iowa.

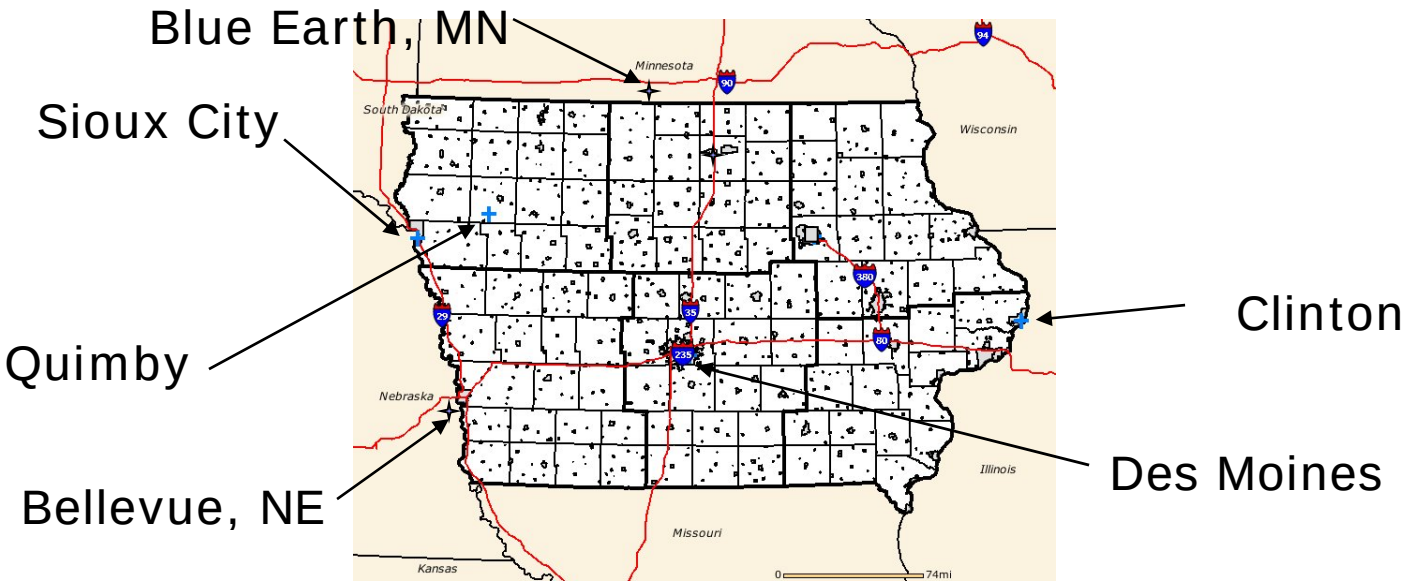
Source: BBC
http://news.bbc.co.uk/hi/english/sci/tech/newsid_1260000/1260776.stm

Source: Air Burners LLC
http://www.airburners.com

Assumption

"The rendering plant will take them"

- Maybe … Iowa is fortunate to have access to 6 major plants
- But haul distances can be long (costly)
- And a plant may not always have sufficient capacity to handle a large surge during an emergency



Assumption

"I can always compost them"

- Maybe…
  - Emergency composting requires LARGE volumes of cover material
    - 8-12 cubic yards of cover materials per 1000 lbs of carcasses
    - Cornstalks or straw need to be ground before use
    - Unless stockpiled … difficult to acquire in a hurry
  - State veterinarian may not approve IF death caused by highly contagious disease

Developing an emergency disposal plan … before the emergency … allows time to

- Consider all alternatives
- Collect & record important contact information
- Acquire equipment, stockpile materials
- Identify important service providers
  - Transportation
  - Excavation
  - Cover material suppliers
- Document emergency plan & inform employees

If you plan to rely on rendering for emergency disposal …

- Contact nearest rendering service providers to determine
  - Ability to accept your entire flock/herd
  - Disposal cost
  - Will the rendering firm supply transportation

If you plan to rely on land filling for emergency disposal …

- Contact local landfill(s) to determine
  - Will they accept carcasses … under what conditions … at what disposal cost

If you plan to rely on Incineration for emergency disposal …

- Contact emergency service provider that can provide high capacity/high temperature incineration
  - If incineration service is mobile, establish standing contract for emergency service

If you plan to rely on On-farm burial for emergency disposal …

- Determine if there is unrestricted area on your property for emergency burial
- Check Iowa DNR "Livestock Burial Zones" map on WWW
  - http://csbweb.igsb.uiowa.edu/imsgate/introduction/home.asp
    - Click on "Livestock Burial Zones"
    - Zoom in on your location
    - Pink colored areas are restricted, mass burial not permitted

If you plan to rely on On-farm burial for emergency disposal …

- Print burial zone map for your property
  - Outline unrestricted areas on the map that you plan to use for burial
- Be sure to check records for underground utilities in proposed burial area
  - Contact Iowa One Call 1-800-292-8989
  - NOTE: Iowa law requires that Iowa One Call be notified 48 hours prior to any excavation within the State
- Burial sites of any size must be at least
  - 50 ft from property line
  - 100 ft from private well or stream
  - 200 ft from public well
  - 500 ft from a residence

If you plan to rely on On-Farm Burial for emergency disposal …

- Identify 2 or more earthmoving contractors having sufficient equipment & capacity to quickly excavate burial pit
- NOTE
  - Emergency burial of catastrophic mortalities requires prior approval by Iowa DNR
  - IDNR 24-hour emergency phone number 515/281-8694

If you plan to rely on On-Farm Composting for emergency disposal …

- Estimate required quantity of cover material needed for your total herd/flock
  - 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

- Stockpile the cover material, or establish a contract with suppliers

If you plan to rely on On-Farm Composting for emergency disposal …

- Cornstalks and straw require grinding prior to use
  - Locate 2 or more portable grinding service providers

For all off-farm disposal methods land filling, rendering, off-site incineration

- Rapid and reliable transport is essential
- Contract with 2 or more local trucking firms
  - Must be properly equipped to haul carcasses in accordance with Iowa law
    - Watertight box, enclosed, or covered with tarpaulin

Benefits of Emergency Disposal Planning

- Answers important questions before disaster strikes
- Helps avoid costly mistakes due to misinformation & inaccurate assumptions
- Documents important service providers and critical contact info for them

Put your plan in writing

- Give yourself & your employees an emergency response “road map”
  - For each disposal option … record important names & phone numbers
    - Include “after hours” numbers
    - Regulatory Agencies
      - Iowa DNR
      - State Veterinarian, Iowa One Call
    - Available Disposal Services
      - Rendering plant manager
      - Landfill manager
      - Incineration service
    - Transportation - trucking companies
    - On-site disposal
      - Excavation contractors
      - Hay grinding contractors

Put your plan in writing

- It documents your good faith effort to do things right
  - May help to avoid potential legal problems relating to environmental pollution, disease transmission, worker safety

Don’t forget “Plan B”

- If livestock losses are regional
  - Heat stress, disease, flooding, blizzard
- Transportation and disposal services will likely be in short supply
- Plan 2 (or more) emergency disposal alternatives
  - At least one on-farm, and one off-farm disposal option

For Additional Assistance Information

- Regional Offices – Iowa Department of Natural Resources
  - Emergency burial site approval
  - Assistance locating emergency composting cover materials
- State Veterinarian's Office - Iowa Department of Agricultural & Land Stewardship
  - Must be consulted on disposal of animals known to have died from disease.

Need Detailed or Updated Information ?

- Dr. Tom Glanville
  - Ag & Biosystems Engineering, Iowa State University
  - Phone: 515/294-0463 Email: tglanvil@iastate.edu
  - Research & Demonstration websites:
    - Swine composting demo : http://www.abe.iastate.edu/pigsgone/
    - Emergency composting: http://www.abe.iastate.edu/cattlecomposting/

- New Publication: CAST Issue Paper # 39, *Swine Carcass Disposal Options for Routine and Catastrophic Mortality*, by Harper, DeRouchey, Glanville, Meeker, and Straw
  - http://www.cast-science.org/displayProductDetails.asp?idProduct=155

- Upcoming Research & Policy Meeting: *3rd International Symposium on Management of Animal Carcasses, Tissue & Related By Products*, UC-Davis, July 21-23, 2009
  - http://extension.umaine.edu/ByproductsSymposium09/