Managed composting of deceased farm animals can be an effective and safe mortality disposal alternative. The key word in that statement is managed. Control of composting variables is not rocket science but attention to detail can improve the efficacy of degradation, assure one’s future ability to choose composting as a dead stock disposal alternative, and minimize bio-security risks.

Livestock producers often select a farm mortality disposal alternative after considering several issues. Costs associated with carcass disposal, labor and equipment requirements and farm bio-security risks are a few of these considerations. Presently for sheep producers rendering is no longer a disposal option, so producers are left to choose between the remaining acceptable options of composting; burial, which can require equipment and preplanning especially for winter months; incineration; or land filling. Each of these disposal alternatives may be appropriate under certain conditions and circumstances. Composting has been viewed as a natural disposal option and has become popular because it has been seen as a way to recycle farm nutrients, reduce disposal costs, and if done correctly, not jeopardizing farm bio-security.

Composting as a mortality disposal option is not new to some livestock industries. Poultry and swine producers in some states have been successfully composting mortalities for a considerable number of years. State Extension Services in leading hog and poultry states have developed very good publications articulating the correct steps and parameters associated with successful mortality composting. “How to” composting publications can usually be found on their Web sites.

The technologies associated with successful mortality composting have been well documented and supported by Wisconsin’s regulatory agencies. Both the Wisconsin Department of Agriculture’s Division of Animal Health and the Solid Waste Division of the Department of Natural Resources have recognized properly managed mortality composting as a disposal option for Wisconsin livestock farmers. But producers are well advised to manage mortality compost facilities correctly to assure continued approval by these permitting and regulatory authorities. Prior to establishing an on farm composting facility producers should check to see if a local ordinance exists that would regulate your on-farm mortality composting efforts and familiarize yourself with NR 500.03 and Wisconsin statutes 95.5 “Disposition of Carcasses”. The Wisconsin Department of Natural Resources and the Wisconsin Department of Agriculture Trade and Consumer Protection, Division of Animal Health are the granting authorities’ under whose permission and conditions producers compost mortalities. A copy of NR 500 is available from the Department of Natural resources Web site http://org/aw/wm/information/wiacsss.htm., and Wisconsin statute 95.5 is available at www.legis.state.wi.us/.../rsb/stats.html. As it basically stands today, livestock producers are able to compost on their farm, mortalities that originated from their farming operation, if they adhere to the performance, environmental and nuisance standards specified in NR500.03 and comply with the issues identified in 95.5 of the Wisconsin disposition of carcasses Statutes.
The composting process is nothing more than the biological decomposition of organic wastes under controlled conditions. Bacteria, and other organisms, thriving in this controlled environment attack the proteins, fats, and eventually the more cellulitic material to produce a stabilized organic matter, while giving off carbon dioxide, water, and heat as the process by-products. What differentiates mortality composting from strictly vegetative composting is that during the initial degradation of carcasses during mortality composting there is an anaerobic process releasing liquids and gases into the aerobic zone where composting is completed. A thorough mixing of the pile at a later date to improve homogeneity and oxygen levels aids in the development of a safe, mature, and stable compost.

Novice composters should monitor and learn to control the key process variables that provide for an efficient and successful system. Key variables such as establishing the correct Carbon to Nitrogen ratio (C:N) and moisture content of selected feedstocks are most important. Obtaining a pre-composting C:N ratio of 30:1 is your nutrient balance goal. And a composite moisture content of the pile between 50 - 60% is most desirable. Composting mortalities can be as sophisticated or as simple a process as you want to make it. Composters selecting complimentary feedstocks, even ones that livestock producers may already have “on farm”, reduces some of the concerns and complexity about composting management. An example would be if sawmill sawdust (not dried/baled shavings) is chosen as a supplemental carbon feedstock source. Sawdust, when mixed appropriately with manure, cornstalks, straw, or wood chips, could provide the necessary nutrient balance and a combined pile moisture within the acceptable operating range. Producers can achieve these variable parameters with very rudimentary calculations and assure themselves that the C:N ratio and moistures are within operating standards.

A third variable that requires monitoring during compost pile preparation is the physical structure of your feedstock. Particle size and shape can alter aerobic conditions of the pile and therefore impact pile odors and temperatures. Adequate feedstock porosity is necessary for air to move throughout and keep the pile aerobic. A goal of 40% porosity permits adequate air flow without reducing the pile temperatures. Pile symptoms of an inadequate air flow can be slow decomposition rates, low temperatures, and odors.

A fourth key variable to monitor is the pile temperature. As bacterial activity increases, pile temperatures rise. Mortality compost temperatures need to achieve at least 131 degrees Fahrenheit for a minimum of three days. This temperature and time relationship destroys weed seeds, insect eggs, and renders most on-farm pathogens harmless. It is important to mention at this point that the prions associated with Chronic Wasting Disease (CWD) in deer and scrapie in sheep are not likely destroyed by the temperatures generated during composting. Therefore until we have more complete research about these altered proteins, no mortalities known to contain infective prions should be composted.

Producers have several choices to make regarding compost facility operation and design. Some producers have chosen to implement static pile and bin composting systems because of minimal construction costs, ease of operation, and little extra equipment needs associated with the management of these types of systems. Static piles should be constructed in a conical shape to shed water and aid in air flow and should not be more than 6 feet high. Static pile composting usually takes a little longer than in-vessel or bin composting systems to accomplish the same level of decomposition because many static pile compost operators choose not to turn (mix and re-oxygenate) the pile.

Many other livestock producers are using a bin composting system. Bin systems need to be planned and are often designed to accommodate the number and size of planned mortalities. As a minimum, bins should be sized to be wide enough to accommodate the width of your loader bucket so you
can deliver animals to the unit, mix the pile, and remove composted materials later. Producers utilizing a three bin system place mortalities into bin A for the first 90 days and then begin to fill bin B. After 90 days of filling bin B, they mix bin A, and begin filling bin C. After 90 days of filling bin C (a total of 270 days of elapsed time from the entry of the first animal into Bin A) bin A is hauled out to the field. If any large bones remain they can be sorted out and be added back to the new bin or buried. At this point, you may also want to save some of the mature compost. You can recycle up to 30% of composted material and reuse it with other feedstocks (30% recycled: 70% new) when starting a new bin. Inoculating your new bin with active bacteria is not necessary but probably speeds up development of bacteria colonies. In some instances the carbon contained in the primary feedstock may not be used up during the initial composting. Recycling some of this mature compost avoids having to haul out and onto fields compost that contains large amounts of organic carbon which can tie up nitrogen. Reusing some composted material increases the opportunity for the bacteria to fully utilize the carbon.

As a sidebar comment; skid loader and tractor buckets utilized for manure removal, dead stock removal, compost bin mixing and other such similar activities, should not be used for feed preparation or feeding without adequate cleaning. It is a good common sense bio-security measure.

Some producers have told me that the wool does not decompose as rapidly as the rest of a sheep carcass. Several reasons can be given but I would not worry about some wool that had not yet decomposed. Yes, this can be messy when windblown around the farm but to the best of my knowledge this wool poses little additional bio threat. If you detect large amounts of wool remaining in finished compost it may be due to not managing the pile variables carefully or insufficient composting time in your system.

**Composting Basics Summary:**

**Locate the compost facility:**
- Where easily reached during all times of the year
- Where it accomplishes bio-security goals
- Out-of-sight?
- Where it protects the environment (adequate distance to ground and surface waters)
- Secure the facility from critters (fenced)

**Feed Stock Selection:**
- Nutrient balance (C:N ratio)
- Structure (porosity, moisture holding capacity, carbon solubility)
- Availability and costs

**Loading compost facility:**
- It is best to not let deads freeze prior to adding to the composter, and if possible start new compost bins before cold weather
- place sufficient feedstock on ground/concrete surface to absorb leachate and permit bacteria entry
- place smaller animals in layers
- leave some room between deads
- leave 6” between walls and carcasses
- cover adequately to absorb odor, maintain heat
- do not add frozen carcasses
Sources for more information:

“Composting Dead Livestock”, Iowa State University-University Extension Publication; May 1994
www.extension.agron.iastate.edu.sustag/pubs/pubs.html


“Composting Animal Mortalities”, Minnesota Dept. of Agriculture Ag Development Division in
cooperation with Minnesota Board of Animal Health and University of Minnesota Extension Service.
www.mda.state.us

“Ohio’s Livestock and Poultry Mortality Composting Manual”, Ohio State University Extension,
www.ohioline.osu.edu/aex-fact/0712.html

www.nppc.org
SUMMARY: This document summarizes portions of chs. NR 500, 502, & 518, Wis. Adm. Code that apply to composting and landspreading the following types of source separated solid waste:
- Yard waste, clean chipped wood, and vegetable food waste, and
- Agricultural wastes including: crop residue, manure, and animal carcasses.

GUIDANCE MANAGER: Solid Waste Team. If you have questions regarding this document, contact Gretchen Wheat (608-267-0557).

MORE INFORMATION

Rule copies can be obtained from the Wisconsin Department of Administration, Document Sales (608-266-3358). Rules can be viewed at the Wisconsin Revisor of Statutes Website (http:www.legis.state.wi.us/rsb/code/).

Manure management information for large scale animal operations can be obtained from your local WDNR office Watershed Management Program.

Composting and landspreading information for solid waste can be obtained by from your local WDNR office Waste Management Program, or Gretchen Wheat (608-267-0557)

NOTICE: This document is intended solely as guidance and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

COMPOSTING

DEFINITIONS - s. NR 500.03(44), (45) & (253)

COMPOSTING must be aerobic decomposition by microorganisms or soil invertebrates. Materials must be reduced into component compounds, with primary by products of carbon dioxide & water.

COMPOST must be decomposed by composting to the extent that the material will not reheat due to action of microorganisms when subject to optimum oxygen, moisture, nutrients & temperature.

VEGETABLE FOOD WASTE is raw or cooked vegetable or fruit food waste, from residences, cafeterias, restaurants & food processors.

Includes vegetable & fruit food containers which are composed entirely of readily biodegradable materials, if the containers have been used for & contaminated with food.

Note: Vegetable food waste does not include agricultural crop residue, animal products or by-products, food containers composed of nonreadily biodegradable materials, or process wastes from food container manufacturing.
HOUSEHOLD COMPOSTING is exempt from Waste Management Program rules, if all the following are met:

- Solid waste from only a single household is managed in the composting.
- A member of the household is the owner or occupant of the property.
- The composting is operated in a nuisance free & environmentally sound manner.

YARD & VEGETABLE FOOD WASTE COMPOSTING WITH 50 CY OR LESS total materials on site at one time are exempt from all other Waste Management Program rules, if all the following are met:

- Only the following feedstocks can be accepted: yard waste, clean chipped wood, vegetable food waste, & manure.
- Operate nuisance free & environmentally sound, & meet performance standards in s. NR 502.04(1) & closure requirements in s. NR 502.04(3)(a) & (b).

ON SITE FARM CROP RESIDUE, MANURE OR ANIMAL CARCASS COMPOSTING at the farm site where the wastes are generated is exempt from all other Waste Management Program rules, if all the following are met:

- Operate nuisance free & environmentally sound, & meet performance standards in s. NR 502.04(1).
- The compost is landspread in compliance with s. NR 518.04(1)(b) or (i).

If composting animal carcasses, comply with s. 95.50(1), Stats. & meet minimum operation & design standards in s. NR 502.12(10) & (11).

If yard waste or clean chipped wood are accepted from off site, meet all the following:
- Mix the yard waste & clean chipped wood with the farm wastes to increase the carbon to nitrogen ratio & porosity.
- Meet minimum operation & design standards in s. NR 502.12(10) & (11).
- Do not exceed 10,000 c.y. at one time, total combined wastes & compost.

Note: S. NR 502.12(5)(d) describes on site farm composting as follows: “All the farm wastes composted are generated from agricultural operations either under common ownership or management, or adjacent farm property.”

YARD WASTE COMPOSTING WITH 20,000 CY OR LESS & VEGETABLE FOOD WASTE COMPOSTING WITH 500 CY OR LESS total materials on site at one time are exempt from plan submittal requirements of the Waste Program rules, if all of the following are met:

- Performance standards, initial site inspection & closure in s. NR 502.04(1) & (2) & (3)(a) & (b); & locational criteria in s. NR 502.12(8);
- Minimum operation & design standards in s. NR 502.12(10) & (11);
- Obtain an operating license;
- Landspread the compost in compliance with the exemption in s. NR 518.04(1)(i).

PERFORMANCE STANDARDS - s. NR 502.04(1)

A composting facility may not locate where there is reasonable probability the facility would cause any of the following:
- Detrimental effect on surface water,
- Adverse impact on wetlands,
- Detrimental effect on groundwater, or
- Adverse impact on critical habitat.
**SUMMARY OF LOCATIONAL CRITERIA - s. NR 502.12(8) & (9), Table 1**

<table>
<thead>
<tr>
<th>FACILITY SIZE &amp; TYPE</th>
<th>g.w.</th>
<th>public wells</th>
<th>private wells</th>
<th>lake</th>
<th>river</th>
<th>property line</th>
<th>highways</th>
<th>airports</th>
</tr>
</thead>
<tbody>
<tr>
<td>20,000 cy or less yard waste</td>
<td>5</td>
<td>1200</td>
<td>250</td>
<td>250</td>
<td>100</td>
<td>1000</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>500 cy or less vegetable food waste</td>
<td>5</td>
<td>1200</td>
<td>250</td>
<td>250</td>
<td>100</td>
<td>1000</td>
<td>5,000 &amp; 10,000</td>
<td></td>
</tr>
<tr>
<td>greater than 20,000 cy yard waste</td>
<td>5</td>
<td>1200</td>
<td>250</td>
<td>500</td>
<td>250</td>
<td>1000</td>
<td>none</td>
<td></td>
</tr>
<tr>
<td>greater than 500 cy vegetable food waste</td>
<td>5</td>
<td>1200</td>
<td>250</td>
<td>500</td>
<td>250</td>
<td>1000</td>
<td>5,000 &amp; 10,000</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Floodplain locations are prohibited. Locational criteria do not apply to:
- single family;
- on site farm crop residue, manure or animal carcasses; or
- yard & vegetable food waste composting of less than 50 cubic yards (cy) at one time.

**SUMMARY OF APPLICABLE REQUIREMENTS - s. NR 502.12, Table 2**

<table>
<thead>
<tr>
<th>FACILITY SIZE &amp; TYPE</th>
<th>GENERAL, s. NR 502.04</th>
<th>OPERATING LICENSE</th>
<th>MINIMUM OPERATION &amp; DESIGN, s. NR 502.12(10) &amp; (11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single family</td>
<td>none</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>50 cy or less yard &amp; vegetable food waste</td>
<td>sub. (1)</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>On site farm crop residue or manure</td>
<td>sub. (1)</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>On site farm animal carcasses</td>
<td>sub. (1)</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>20,000 cy or less yard waste</td>
<td>subs. (1), (2), (3)(a) &amp; (3)(b)</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>500 cy or less vegetable food waste</td>
<td>subs. (1), (2), (3)(a) &amp; (3)(b)</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

**NOTE:** Plan submittal, additional operation & design standards, construction documentation, & monitoring & reporting requirements apply to: yard waste composting greater than 20,000 c.y.; & vegetable food waste composting greater than 500 c.y.

**INITIAL SITE INSPECTION - s. NR 502.04(2)**

An initial site inspection request letter must identify all of the following:
- Applicant & authorized contact;
- Type of facility & operation proposed; &
- Property ownership & location by quarter by quarter section.

Technical procedures, visuals, table of contents & appendix must meet ss. NR 500.05(5) to (8).

Include a letter from DNR Bureau of Endangered Resources (identify any critical habitat areas & state or local natural areas within 1 mile).

Include a letter from Wisconsin State Historical Society (identify any historical, scientific or archaeological areas within the vicinity).

**MINIMUM OPERATIONAL STANDARDS - s. NR 502.12(10)**

Wastes must be source separated at the point of generation; sort further if needed.

Debag wastes within 24 hours.

Grass clippings, manure, & food waste from processing: incorporate within 72 hours.

Animal carcasses & other food waste:
- Incorporate on the same day as received;
- Cover with at least 6 inches of high carbon material upon incorporation; &
- Prevent animals from reaching animal carcasses & food wastes.

Size reduce for adequate particle surface area. Mix & aerate for adequate oxygen at all times.
Minimum C:N ratio of 12:1 (optimum is 20:1 to 40:1). Maximum windrow size & minimum spacing according to equipment capability.

Wet for dust control & efficient composting (optimum moisture is 50 to 60% by wt.).

Stabilize compost to eliminate pathogenic organisms & ensure materials don’t reheat.

Compost must be free of sharp particles & toxins.

**MINIMUM DESIGN STANDARDS - s. NR 502.12 (11)**

Use slope, vegetation, ditches & retention basins to minimize erosion. Slope area to prevent ponding, & use berms or ditches to prevent run on. Discharge run-off to a gently sloped grassed area.

Size operations based on the process residence times.

**ADDITIONAL REQUIREMENTS FOR NEW OR EXPANDED NONEXEMPT COMPOSTING FACILITIES**

**ADDITIONAL OPERATIONAL & DESIGN STANDARDS - s. NR 502.12(12):**

Collect waste contact run-off in a lined basin or tank (manage as leachate).

Feedstock storage, composting & compost storage on a low permeability pad.

**PLAN SUBMITTAL CONTENT REQUIREMENTS - s. NR 502.12(13):**

Location & land use within 1/4 mile. Layout drawing of operations, traffic, process flow, & property boundaries.

Brief description, area served, volumes, types of materials, & pre-processing. For each feedstock & feedstock mix (recipe) tell all the following: C, N, P, K, pH.

Methods to measure critical parameters, & methods to ensure parameters are met: C:N, temperature, moisture, pH & stability. Tell holding time, turning frequency, response to odors, & maximum size of staging, windrows, curing & finished compost.

Vehicle types for feedstock & finished compost transport to & from facility, & equipment for turning, mixing & screening.

Potential markets & quality needed, including nutrient, pH, particle size, appearance, moisture holding capacity & other pertinent specifications.

Identify noncompostable waste generated, such as bags, & the names & location of facilities for disposal of that waste.

Specify design & documentation for the low permeability pad, including materials, thicknesses & testing.

Estimate closure costs if the waste on site at any one time will exceed:
- 40,000 c.y. of yard waste & clean chipped wood; or
- 1,000 c.y. of food waste.

**CONSTRUCTION DOCUMENTATION - s. NR 502.12(14):**

Prepare according to plan approval & general submittal requirements (s. NR 500.05).

Include proof of financial responsibility for closure (if applicable), & obtain construction documentation approval before licensing & waste acceptance.
MONITORING & REPORTING - s. NR 502.12(15):

Finished compost:
- Collect samples each 1000 c.y. or 3 times/yr, whichever is more frequent; &
- Test for C, N, P, K & pH.

Leachate:
- Collect unfiltered samples quarterly for 4 quarters & annually after; &
- Test BOD, COD, field pH & conductivity, nitrates & total dissolved solids.

LANDSPREADING

LANDSPREADING EXEMPTIONS - s. NR 518.04(1)(b), (h) & (i), (2) & (7)
WASTES exempt from ch. NR 518 requirements, if used as soil conditioner or fertilizer by accepted agricultural practices, & operated & maintained safe & nuisance free manner:

Agricultural wastes (manure & crop), landspread on a farm; (Note: Large animal operations may be subject to WDNR manure management standards.)

Raw vegetable wastes from canned, frozen or preserved food processing, & raw yard wastes; &

Composted leaves, grass, brush, vegetable food waste & similar composted matter.

OPERATIONAL PRACTICES ALL LANDSPREADING SHOULD MEET:

Don't exceed plant nutrient needs. Incorporate immediately, & avoid frozen or excessively wet ground conditions. Avoid areas with slopes in excess of 12%.

Maintain the following minimum setbacks:
- 100’ from floodplains, wetlands, lakes, streams & rivers;
- 200’ from water supply wells; &

RESEARCH PROJECTS DIRECTED BY A PROFESSIONAL ENGINEER REGISTERED IN WISCONSIN, OR A SCIENTIST EMPLOYED BY THE UNIVERSITY OF WISCONSIN are exempt from the plan submittal requirements in s. NR 518.06, if the following minimum submittal requirements are met instead:

A proposal is submitted before project initiation, documenting all the following:
- Maximum 4 acre (actual landspreading area); &
- Available N & heavy metals don't exceed ch. NR 204 rates for municipal sewage sludge or those identified in literature as toxic to specific plants; &
- Developed, operated, monitored & maintained safe & nuisance free.

A final report is submitted detailing the research findings.

FISH, BUTCHERED ANIMAL REMAINS OR SIMILAR WASTES MAY RECEIVED AN EXEMPTION from requirements of ch. NR 518, if all the following are met:

Submit exemption request with analysis in accordance with s. NR 518.06(1), & tell the location, application rates, incorporation method & project duration;

Obtain a written exemption from the department.

Use the wastes as a soil conditioner or fertilizer according to accepted agricultural practices; & operate & maintain the facility in a safe & nuisance free manner.
Wisconsin Statue 95.50 Disposition of carcasses.

95.50(1)
(1) No person shall deposit or throw or allow to be deposited or thrown into any stream, lake or swale, or leave or deposit or cause to be left or deposited upon any public highway or other place the carcass of any animal; nor deposit or leave or permit to be deposited or left upon any premises under that person’s control any dead animal exposed in such manner as to be reached by dogs or wild animals for a longer period than 24 hours in the months of April to November, or 48 hours during the months of December to March. The owner of such a carcass or any other person may report to the proper county officials or the contracting private rendering plant pursuant to s. 59.54 (21) for removal and burial or other disposition of a carcass within the time specified in this subsection.

95.50(2)
(2) No person shall transport, haul or drag or permit to be transported, hauled or dragged along any public highway in this state the carcass of any animal suspected of having died from anthrax, blackleg, foot and mouth disease, sleeping sickness or glanders or any other disease which the department may designate as highly dangerous. All such carcasses shall be burned or be buried at least 6 feet below the surface of the ground and shall be completely covered so as to prevent their being reached by wild animals or dogs. Whenever it is necessary to transport any such carcass across any public highway for burial, it shall be transported in such manner as not to contaminate any part of the public highway. The carcasses of animals dying from other communicable diseases may be transported to and disposed of under such regulations as are prescribed by the department. The definition of “communicable disease” in s. 990.01 (5g) does not apply to this subsection.

95.50(3)
(3) Any dead animal found upon a public highway or other public place shall, in case the owner of the animal cannot be found, be buried or otherwise disposed of at public expense by the local health department, as defined in s. 250.01 (4) (a) 1. or 3. or (b), in whose jurisdiction the animal is found. This subsection applies if a county does not exercise its authority under s. 59.54 (21).

95.50(4)
(4) In a county which does not exercise its authority under s. 59.54 (21), the owner of a carcass is obligated to dispose of it as specified in this section.

95.50 - ANNOT.

Mortality Composting in Wisconsin

Presented by Dan Short
UW-Extension/CALS

**What is Composting?**

Composting is the biological decomposition of organic wastes under controlled conditions that results in the production of carbon dioxide, water, minerals and stabilized organic matter (humus) and disposed of in an environmentally sound manner.

**Composting - A Natural Way to Recycle**

- Cost effective?
- Environmentally sound
- Destroys pathogens, weeds, seeds, insect eggs
- Needs to be managed
Composting is Bacteria Farming

- Bacteria
  - Account for 80-90% Decomposition Activity, heat
  - Sugars, starches, proteins, fat
  - Start cellulose breakdown
- Actinomycetes
  - Second step in cellulitic digestion
  - Earthy odor
- Fungi
  - Similar role as Actinomycetes
  - 3rd step in cellulitic digestion

Traditional Composting

Utilizes thermophilic bacteria and other microorganisms (actinomycetes, fungi) in largely an aerobic environment. Frequent turning/mixing allows the process to be completed quite quickly.

Mortality Composting

Characterized by a aerobic and anaerobic zones within the composting facility. The carcass degrades by anaerobic action releasing fluids and gases which diffuse into the aerobic zone and aerobic bacteria degrade these materials to CO$_2$ and water and release heat. Therefore often a secondary composting period is incorporated into the system.
Guidelines for Dead Animal Composting

<table>
<thead>
<tr>
<th>Ideal</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon/Nitrogen Ratio</td>
<td>30</td>
</tr>
<tr>
<td>Initial Moisture Content (%)</td>
<td>55</td>
</tr>
<tr>
<td>Porosity (%)</td>
<td>40</td>
</tr>
<tr>
<td>Temperature (° F)</td>
<td>120</td>
</tr>
<tr>
<td>Pathogen Control</td>
<td>131°F, 3 days</td>
</tr>
</tbody>
</table>

Controllable Composting Variables

- Organic Amendment
- Bulking Agent
- Percent Recycled Compost
- Particle Size
- Carbon/Nitrogen Ratio
- Initial Moisture
- Porosity
- Chemical pH
- Compost Temperatures
- Percent Recycled Air
- Aeration Schedule
- Stirring Frequency
- Moisture Control
- Retention Time
- Curing Time
- Inoculation
- Pile Shape
- Pile Depth

Composting Key Process Management Variables

- Pile Structure (shape, depth, volume)
- Nutrient Balance (feedstock selection)
- H₂O
- Oxygen (porosity)
- Temperature
Key process Variable (KPV) - 1

Types of Systems

- Static Pile
- Bin
- Windrow
- In-vessel
- Bagged
Construction Considerations

- Type of system
- Sizing of the system
- Environmental risks
- Bio-security risk
- Costs (construction, feedstock sources, etc.)
- Management

### KPV 2 - Nutrient Balance

#### Carbon to Nitrogen Ratio

<table>
<thead>
<tr>
<th>Material</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swine Carcass</td>
<td>5:1</td>
</tr>
<tr>
<td>Recycled Secondary</td>
<td>30-50:1</td>
</tr>
<tr>
<td>Sawdust</td>
<td>140:1</td>
</tr>
</tbody>
</table>

**Target 30:1**

- **Too LOW C/N**
  - NH₃
  - Other odors
- **Too HIGH C/N**
  - Low decomposition rate
  - Low temperature
Key Variable - Nutrient Balance

General C:N Equation

\[ R = \frac{Q_1(C_1 x (100 - M_1)) + Q_2(C_2 x (100 - M_2)) + \ldots}{Q_1(N_1 x (100 - M_1)) + Q_2(N_2 x (100 - M_2)) + \ldots} \]

KPV 3 - Moisture

<table>
<thead>
<tr>
<th>Swine Carcass</th>
<th>65%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycled Secondary</td>
<td>40-50%</td>
</tr>
<tr>
<td>Sawdust</td>
<td>20-50%</td>
</tr>
</tbody>
</table>

Target 55%

- Too LOW Moisture
  - Low decomposition
  - Low temperature
  - Odors
- Too HIGH Moisture
  - Putrid odors
  - Flies

KPV 4 – Porosity/Oxygen

Goal:

- Achieve good oxygen flow into the pile.
- Maintain oxygen level above 5%
- Avoid over cooling pile due to too much air infiltration

Target 40%

- Low decomposition rate
- Low temperatures
- Odors
**KPV 5 - Temperature**

- Best decomposition rates @ 110-150°F
- Bacterial death occurs @ >160°F
- Most pathogens (insects weed-seeds) destroyed @ 131°F for 3 days

---

**Microbial Population Dynamics During Composting**

<table>
<thead>
<tr>
<th>Temp (ºC)</th>
<th>Log # cfu/g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bacteria</td>
</tr>
</tbody>
</table>

Midwest Composting School

F = C * x 1.8 + 32

---

**Important Disease Control Characteristics of Compost Piles**

- Reach temperatures of 130º to 150º F
- Temperatures about 130º F for 3 days
  - Destroy most pathogens
  - Destroy insect larvae
  - Weed seeds
- Two-stage system allow mixing
  - Ensures most pathogens are destroyed
- Organic acids produced
  - Aid pathogen destruction

Midwest Composting School
**KPV - Temperature**

<table>
<thead>
<tr>
<th>Microbe</th>
<th>Temp</th>
<th>Time</th>
<th>Temp</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmonella Sp.</td>
<td>55ºC</td>
<td>60 min.</td>
<td>60ºC</td>
<td>20 min.</td>
</tr>
<tr>
<td>Brucella Abortis</td>
<td>55ºC</td>
<td>60 min.</td>
<td>62.5ºC</td>
<td>3 min.</td>
</tr>
<tr>
<td>Escherichia Coli</td>
<td>55ºC</td>
<td>60 min.</td>
<td>60ºC</td>
<td>20 min.</td>
</tr>
<tr>
<td>Prions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRRS</td>
<td>50ºC</td>
<td>6 min.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erysipelas</td>
<td>55ºC</td>
<td>10 min.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Some types Salmonella survive a wide range of environmental conditions.

Taken from NRC/Composting school, AMEL, USDA, NASS/TIP and NPPC.
Who regulates composting in Wisconsin?

1. Local or county ordinances?
2. WDNR - NR500.03 Bureau of Waste Mgt..
3. WDATCP - Division of Animal Health
   Wisconsin statute 95.5 Disposition of Carcasses

Site Selection Objectives

- Protect ground and surface water resources
- Maintain air quality
- Reduce risk of disease transmission
- Control flies, vermin and scavenging animal problems

Site Checklist for Compost Facilities

- Avoid wet areas; the facility must be high & dry
- Divert clean water.
- Locate at least 3 ft. above high water table.
- Locate at least 300 ft. from streams, ponds, or lakes in the same drainage area.
- Provide for runoff collection & treatment or storage areas.
- Ensure all weather access.
- Maintain suitable access to sawdust storage.
- Locate safe distance from buried & overhead utilities
- Consider other farm traffic.
- Provide limited or appealing view to neighbors or passing motorists.
- Consider prevailing winds.
- Maintain biosecurity precautions.
- Consider aesthetics and landscaping.
**Water Quality**

- Locate away from waterways and ponds.
- Collect/store or treat all runoff and leachate.
- Avoid flood-plains.
- Low permeability soil base maintained 3 feet about the high water table.
- Gravel/filter fabric base necessary for static piles or windrows without roofs.

**Disease Risk in Leachate**

- Research indicates survivability -
  - up to 5 days
  - but no past 7 days

**Biosecurity**

- Eliminate off-farm vehicle entry.
- Prevent scavenging animals in the compost area.
- Maintain appropriate carcass cover to allow pathogen destruction.
Important Biosecurity Measures for Composting Operations Part 1

- Facility siting
  - Locate facility away from production facilities
  - Locate down-wind, if possible
  - Haul finished compost material away from production facilities, if possible

- Vehicles and equipment
  - Maintain cleanliness between production unit and compost pile.

Important Biosecurity Measures for Composting Operations Part 2

- Scavenging animals, birds and vermin
  - Maintain adequate cover over carcasses.
  - Construct fencing if problems persist.
  - Spread finished compost away from the site.

- Personnel
  - Identify a manager for the pile.
  - Shower/clean clothes when entering a production facility

Bin/Pile Management Basic

- Loading
  - 1-2’ base feedstock
  - Layer carcasses and > 1’ from edges
  - Cover with 1’ or more feed stock
  - Leave minimum 6” between carcasses
### Arlington Ag Research Station

**Mortality Composting Demonstration Center**

<table>
<thead>
<tr>
<th>Cell 1</th>
<th>Cell 2</th>
<th>Cell 3</th>
<th>Cell 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawdust Feedstock Pile</td>
<td>Cow Straw Treatment</td>
<td>Cow Sawdust Treatment</td>
<td>Calf Bin Mixing Area</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Cell 1
- Cell 2
- Cell 3
- Cell 4
Arlington - Cow Compost Pile

**Sawdust Treatment**

<table>
<thead>
<tr>
<th>Dates</th>
<th>Temperature (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/7</td>
<td>123</td>
</tr>
<tr>
<td>8/17</td>
<td>140</td>
</tr>
<tr>
<td>8/27</td>
<td>148</td>
</tr>
<tr>
<td>9/6</td>
<td>140</td>
</tr>
<tr>
<td>9/16</td>
<td>130</td>
</tr>
<tr>
<td>9/26</td>
<td>145</td>
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<tr>
<td>10/6</td>
<td>134</td>
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<tr>
<td>10/16</td>
<td>144</td>
</tr>
<tr>
<td>10/26</td>
<td>131</td>
</tr>
</tbody>
</table>

**Calf Compost Bin**

<table>
<thead>
<tr>
<th>Dates</th>
<th>Temperature (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/31</td>
<td>110</td>
</tr>
<tr>
<td>8/10</td>
<td>120</td>
</tr>
<tr>
<td>8/20</td>
<td>130</td>
</tr>
<tr>
<td>8/30</td>
<td>140</td>
</tr>
<tr>
<td>9/9</td>
<td>150</td>
</tr>
<tr>
<td>9/19</td>
<td>110</td>
</tr>
<tr>
<td>9/29</td>
<td>120</td>
</tr>
<tr>
<td>10/9</td>
<td>130</td>
</tr>
<tr>
<td>10/19</td>
<td>140</td>
</tr>
<tr>
<td>10/29</td>
<td>150</td>
</tr>
<tr>
<td>11/8</td>
<td>110</td>
</tr>
</tbody>
</table>

**Precip (inches)**

- 0
- 0.2
- 0.4
- 0.6
- 0.8
- 1
- 1.2
- 1.4

5/10/01
Sources for Mortality Composting Information

- Composting Module - NPPC
  www.nppc.org
  (515) 223-2600
- OSU - Composting Livestock and Poultry
  A - Trainer’s Manual
  B - Participants Manual
- www.composting.org

Leachate Collection (gals)

<table>
<thead>
<tr>
<th></th>
<th>8/10</th>
<th>8/31</th>
<th>10/4</th>
<th>11/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(C1) Control</td>
<td>47</td>
<td>60</td>
<td>62</td>
<td>22</td>
</tr>
<tr>
<td>(C2) Empty</td>
<td>49</td>
<td>66</td>
<td>68</td>
<td>45</td>
</tr>
<tr>
<td>(C3) Cow</td>
<td>65</td>
<td>105</td>
<td>108</td>
<td>51</td>
</tr>
<tr>
<td>(C4) Calf Bin</td>
<td>69</td>
<td>125</td>
<td>132</td>
<td>72</td>
</tr>
</tbody>
</table>

Dates      8/10-8/31  8/31-10/4  10/4-11/2
Precipitation 2.11  3.37  0.48