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Troubleshooting Poultry Mortality Composters

*Eldridge R. Collins, Jr.**

Introduction

Composting of poultry carcasses has become the method of choice for disposal of normal mortality losses on many Virginia poultry farms. Principles of dead poultry composters are presented in VCE Publication 442-037, available from your local VCE Office. There are several different versions of composters available, but they must all meet the following requirements:

- Must be practically odorless.
- Must operate at temperatures high enough to destroy pathogenic bacteria (150° F).
- Must provide for complete decomposition of carcasses—only minimal amounts of feathers and bones remaining.
- Must be adequately protected from flies so that larvae are not a problem.
- Must keep out vermin, wild, or domesticated animals
- Must reduce risk of disease spread

A common complaint about dead bird composters is that one or more of the above requirements is not being met. Usually such problems can be easily solved by observation and reapplying the principles of good composter design and management.

Indicators That A Composter Is Not Performing Well

Dead poultry composters may function at a reduced level without the operator noticing that there is a problem. But, the composter may be creating conditions that are unpleasant, or which present an environmental risk because of operating at an inefficient level. Some key indicators that your composter is not operating at optimum level are:

- Failure of bins to heat to a core temperature of 140-150°F
- Production of considerable odor
- Discharge of dark colored liquid around the base of the compost bins
- Presence of large numbers of larvae and flies on and around the composter bins
- Presence of whole or partial rotten carcasses when "completed" bins are opened.

Failure of Bins to Heat

Failure of bins to heat is usually related to "water":

- Too much water takes up pile air spaces in the pile and deprives the system of oxygen;
- Too little water will not promote the growth of the proper bacteria and fungi in the composting system.

Moisture content largely determines whether the composting process will be "anaerobic" (without oxygen) or "aerobic" (with oxygen). For dead bird disposal, aerobic systems are preferred because they are faster and produce fewer odors and other objectionable characteristics. Ideal moisture content for aerobic composting is between 50 and 60 percent. Above this level, the process becomes anaerobic. A moisture content below 50 percent will slow down the composting process. High moisture levels can be controlled when working with a wet waste by using a little extra straw, litter, or other bulking agent. This approach can also be taken if the compost mix is too wet and needs to be drier. Sprinkling the pile with a measured amount of water, and turning to mix the water throughout the pile can increase moisture content.

Bin heating may also be related to improper mixing of ingredients. This can result in a mix that does not have the proper Carbon-to-Nitrogen Ratio (C:N Ratio). Also, insufficient bulking agents may allow the pile to settle too quickly, thereby reducing pore space in the pile and causing lack of air (oxygen) to "starve" composting

*Extension Agricultural Engineer, Virginia Tech

Virginia Tech
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organisms. Best C:N ratios for composting range from 20:1 to 30:1. Lower ratio mixes will produce more free ammonia, and higher ratio mixes will compost more slowly. The recommended "recipe" for composting dead birds shown in Table 1 should get you in the "ball park."

Table 1.
Typical recipe for composting dead poultry

Ingredient	Parts by Weight
Caked litter or manure	1.5 to 3
Dead birds	1.0
Straw[a]	0.1
Water (added sparingly)[b]	0 to 0.5

[a] Other carbon sources may also be used such as peanut hulls, sawdust, or shredded cellulose paper. However, straw has been shown to be an excellent material for this purpose.

[b] The requirement for water will vary depending on moisture content of straw, litter, and other factors. Too little moisture or too much moisture may each adversely affect composting. The mixture should be damp, in the range of 40-60 percent moisture. If moisture is required, it should be added to each element during the layering process while building the compost stack.

Producers often develop a loading method that works well for them. However, the following arrangement offers a good starting procedure.

Determine the weight of a day's supply of dead birds. Ingredients can be weighed out according to the recipe, weighing them in buckets on scales at first, then using a loader once the weight of a full loader bucket is determined for each ingredient. Depending upon needs — mortality and bird weight — you may add partial layers, full layers, or entirely fill primary compost bins. Ideally, composter bins should be sized so that an average day's mortality will equal one layer of dead birds. Each successive day the birds should be layered in the bin with other elements added: straw, birds, litter. Water may, or may not be necessary. Use water sparingly at first for the reasons noted earlier; if oxygen is excluded, anaerobic conditions will develop resulting in heating failure and high odor production.

Some producers experience difficulty in getting bins to heat in winter, especially when flocks are young and quantities of mortality are not generated quickly. This is generally due to inability to build a compost pile quickly and deeply enough to generate and hold sufficient heat for good composting action. This problem can usually be overcome by subdividing a compost bin using a wooden pallet, or other temporary partition so that layers can be generated more quickly when flocks are very young. Another approach is to install small "mini-composter" bins in the poultry house, usually in one or more corners. The small size of the mini-composters, plus the relatively warm indoor temperature, helps these units retain their composting temperature better than if they were outdoors.

Odors From Composter

Odors are potentially a big concern for any type of composting operation. Odors can attract the attention of neighbors quickly, and once someone is "offended", it may be difficult to satisfy them that you are not creating a serious environmental problem. The best defense against odor is to do everything possible in your management to prevent it.

There are three primary sources of odors at a mortality composter:

- The raw materials (carcasses) and/or wet litter
- Ammonia lost from high nitrogen materials (improper mixture that is short on carbonaceous materials)
- Anaerobic conditions within the compost stacks

Dead poultry composters should be, as noted above, aerobic. However, if the recipe mixture is too wet, the pile air spaces will be taken up with water. Or, the heavy nature of the pile will cause it to settle more, also reducing air pore space. Then, because of the lack of oxygen, anaerobic conditions will be established, which in turn will generate objectionable odors. Minimize anaerobic conditions by using a good mix of raw materials (as discussed above), avoiding overly wet materials, monitoring pile temperature, and turning or mixing the piles on a regular basis.

Raw Materials Management:

Do not allow bird carcasses to lie exposed to the environment. Not only does this violate dead poultry disposal regulations, but it also provides perfect conditions for fly breeding, rotting of carcasses, and other related problems.

Quickly arrange the various ingredients into compost bins, always providing the recommended cover on bird carcasses. Proper turning or "re-aeration" of piles is important to the composting process, and to reducing odors throughout the process. When temperature peaks

and begins to drop, it is generally due to exhaustion of the oxygen in the pile. This is frequently because the stack settles over a period of several days, so the oxygen-occupying pores are lost, and the original oxygen has been used up by the composting bacterial and other organisms. Unfortunately, many farmers are tempted to reduce turning frequency because some odors will usually be released at the first turning. Do not try to reduce odors by reducing the turning schedule! This will slow completion of the composting process, and will usually result in the presence of incompletely composted, rotten carcasses later when the pile is disturbed. Piles should be turned frequently early in the process, despite some minimum short-term odor. If the odor is too bothersome, it may be that the composter is loaded too heavily, and that the recipe needs to be adjusted.

Ammonia:

Even though moisture content is optimal, and oxygen is readily available to the composting process, some composters may generate unusually high amounts of pungent-smelling ammonia. This is generally related to an improper recipe mixture of birds, litter, and carbonaceous materials.

Raw poultry litter can be easily composted, but because the C:N ratio is ordinarily in the 8:1 to 12:1 range, large amounts of ammonia will be released from the process. If ammonia odor is very strong around your dead bird composter, it can be reduced by increasing the amount of carbon in the mixture. This may be in the form of straw or wood chips, or other carbonaceous materials (even shredded paper!).

Release of ammonia is also strongly related to pH levels above 8.5. This is usually not a major problem with dead bird composters, especially if proper recipe mixes are used (i.e., proper C:N ratio). The addition of superphosphate to dairy manure has been used to conserve nitrogen during composting, and could help reduce ammonia release from dead bird composters if recipe adjustment does not achieve the desired results. Use 2-5% of the estimated weight of the dead birds and poultry litter used in the mixture.

Discharge from Composting Bins

An often noticed "failure" of dead bird composters is liquid discharge from bins. This is usually related to some of the same problems noted above. More specific reasons will be given here.

Bins that are overloaded with bird carcasses will contribute a larger proportion of water to the total bin recipe mix than when the bin is loaded normally. A typical broiler carcass will have a water content of about 65 percent. Larger carcasses may contribute even more. Therefore, adjustments must be made in the numbers of carcasses added to each composting bin depending on seasonal changes in mortality, and age and size of birds.

Other typical sources of too much water include blown-in rain or snow, and too much water added in the initial recipe mix. If blowing rain and snow is a continual problem, modifications should be made to shield the compost bins from this source and direction of unwanted water. Bins that are overwatered or become wet from outside water sources can be "dried" by the mixing of dry litter or other materials when the bin is turned.

Generation of Larvae and Flies, and Pathogen Control

The presence of an unusually large number of flies and maggots around a poultry mortality composter is due to some of the same problems discussed above. Flies will not generally be attracted to properly designed and operated composters. Strict adherence to good management practices is essential to control pathogenic organisms and nuisance insects. By keeping all material within the bins, fly larvae and pathogenic bacteria and viruses are destroyed through the combined effects of time and composting temperature. However, effective temperatures are not usually achieved around the edges of primary bins. For this reason, disease organisms and insect larvae may survive without the added benefits of turning and mixing in the secondary compost phase. Careless loading of carcasses against bin sidewalls generally will result in putrefaction and poor composting, and will allow access by adult flies to lay their eggs in the exposed carcasses. To prevent these problems, do not place carcasses closer than 6 inches to sidewalls or the top surface to allow composting temperatures to "work."

Common Errors in Composter Management

Most failures of dead poultry composters are related to at least one of the following conditions or management errors:

Incorrect ingredient proportions or missing ingredients:

VCE 442-037 and other similar publications offer suggested "recipes" for growers to start their composters. These are intended to help provide the correct conditions of mixture porosity, nutrients, and moisture for effective composting to take place. Individuals may vary slightly from these trial recipes, but the basic needs of the composting organisms must be met or problems will occur.

Bin mixture too wet:

Moisture is needed to support the metabolic processes of the composting microbes. The process works well as long as moisture content is maintained between 40 and 65 percent. But, if the moisture level becomes too high, water displaces air in the pore spaces of the composting materials. Wet conditions also make the composting materials heavier, and tend to cause rapid settling and reduction of pore air spaces. Both these conditions limit air movement, and lead to anaerobic conditions, which yield odors and slow breakdown of compost materials.

Careless loading and management:

Careless loading and poor management can contribute to many problems with dead bird composters. Attraction and breeding of flies, and foul odors are often related to failure to properly cover carcasses as they are placed in composter bins. To control pathogenic organisms, and fly larvae, bird carcasses must be exposed to the combined effects of time and temperature. Effective temperatures are not usually achieved around the edges of primary composting bins. Careless loading of carcasses against bin sidewalls generally will result in putrefaction, poor composting, and fly attraction.

Temperature is a good indicator that the composting process is working. Within two to four days of loading, internal bin temperature should increase to 135° to 150° F. A 36-inch probe-type dial thermometer should be used to daily monitor temperatures in bins or piles. Failure to monitor temperatures in composting bins means that the carcasses may not be receiving treatment, and may simply be "rotting" in the compost bin. Then, when the bin is broken open, raw putrefied meat is exposed along with odors and attraction for flies and vermin. By continuously monitoring temperature, an operator can quickly note when the compost process is not working, and can look for and correct factors to make the process proceed properly.

Failure to turn bins and piles appropriately:

When the composting process begins, oxygen is quickly used up. Additionally, the compost mixture tends to settle under its own weight, further limiting access by air to the interior of the bin or pile. It is necessary to resupply oxygen to the process, and in dead bird composters this is normally done by moving the compost mixture from a primary bin into a secondary treatment bin (or stacking area) using a loader bucket. To assure good turning and re-aeration, allow the primary bin material to "cascade" from the loader bucket into the secondary treatment area.

Summary

Most poultry mortality problems can be avoided by eliminating these mistakes:

- Incorrect ingredient proportions
- Mixtures too wet
- Missing ingredients
- Careless loading, and failure to cover dead birds
- Failure to monitor temperature, and turn piles appropriately
- Correcting for start-up piles which are too small (especially in cold weather)

Review of Good Loading Practices

- Determine weight of one day's supply of dead birds
- Select primary bin size so that an average day's supply will make layer of birds
- Use water sparingly
- Monitor temperature; two-four days should produce 135° to 150° F
- When last bin is filled, first should have undergone 7-10 days of primary composting
- If temperature has been continually monitored, should see a "peak," then temperature begin to fall
- "Cascade" primary bin materials into secondary bin to cause re-aeration, mixing
- Move bin batches on schedule to avoid anaerobic conditions, and production of odors and flies
- When bins are being loaded heavily, may need to load two bins on alternate days (to avoid compaction, and to maintain bin temperatures longer)

Troubleshooting Guide For Bird Mortality Composters

CONDITION	POSSIBLE REASON	OTHER CLUES	SOLUTION
Bin fails to heat	Bin contents too dry	Litter, bin layers dry and dusty	Add water or wet ingredients, remix by turning contents into another bin
	Bin contents too wet	Contents look or feel soggy; liquid oozes from bin; moisture content greater than 60%	Add dry amendments, remix by turning into another bin
	Not enough nitrogen (litter and carcasses), or slowly degrading or stable materials	C:N ratio greater than 50:1; large amount of carbonaceous materials	Add high-nitrogen ingredients; change composting recipe
	Poor structure	Bin contents settle quickly; few large particles (straw or wood chips); not excessively wet	Add bulking agent
	Cold weather and shallow bin layers	Bin height less than 3.5 feet	Divide bins with temporary partitions to enable increasing contents height and bin mass more quickly. Utilize mini-composters in poultry houses.
	pH excessively low	pH measures less than 5.5; garbage-like odor	Add lime or wood ash and remix into another bin/pile.
Bin/pile temperatures fall consistently over several days	Low oxygen; need for aeration	Temperature declines gradually rather than sharply	Turn or aerate bin
	Low moisture	Cannot squeeze water from bin/pile material	Add water
Uneven temperatures or varying odors in bin(s)	Poorly placed recipe materials in bin(s)	Visible differences in the bin moisture and materials	Turn or remix bin(s)
	Materials at different stages of compost maturity	Temperature varies throughout the bin	None required
Gradually falling temperatures; bin/ pile does not reheat after turning or aeration	Composting nearing completion	Approaching expected composting time period; adequate moisture available; C:N ratio less than 20:1	None required
	Low moisture	Cannot squeeze water from materials	Add water while turning bin contents
Bin overheating (temperature greater than 150° F)	Insufficient aeration for heat removal	Bin contents seem moist	Turn bin contents to re-aerate
	Moderate to low moisture; limited evaporative cooling	Bin contents feel damp, but not excessively wet or dry	Add water; continue turning to aerate to control temperature
	Pile is too large	Height greater than 8 feet	Decrease the pile size
Extremely high temperatures (greater than 170° F) in bin or curing/storage pile	Pyrolysis or spontaneous combustion	Low moisture content; bin or pile interior looks or smells charred	Decrease pile size; maintain proper moisture content; add water to charred or smoldering sections; break down pile, combine with other piles. *FIRE HAZARD!!*
High temperatures or odors in curing or storage pile	Compost is not stable	Short active composting period; temperature and odor change after mixing	Manage pile for temperature and odor control, turn piles as necessary; limit pile size
	Piles are too large	Height greater than 8 feet; width greater than 20 feet	Decrease pile size
Ammonia odor coming from composting bins or piles	High nitrogen level	C:N ratio less than 20:1	Reconsider recom-mended recipe; Add litter, straw, wood chips, or other high-carbon amendments
	High pH	pH greater than 8.0	Lower pH with acidic ingredients and/or avoid alkaline ingredients
	Slowly available carbon source	Large woody particles; C:N ratio less than 30:1	Use another carbon amendment or increase the carbon proportion

CONDITION	POSSIBLE REASON	OTHER CLUES	SOLUTION
Rotten-egg or putrid odors continually coming from composting bins/piles	*Anaerobic conditions*	Low temperatures	
	Materials too wet		Add dry amendment
	Poor structure		Add bulking agent
	Bin or pile compacted		Turn bin or pile and add bulking agent if necessary
	Insufficient aeration		Turn bin or pile to increase aeration
	Anaerobic conditions	High temperatures	
	Pile too large		Decrease the pile size
	Air distribution uneven		Remix pile; change recipe
Odors generated only after turning	Odorous raw materials	High temperatures	Frequent turnings; increase porosity; add odor-absorbing amendment
	Insufficient aeration; anaerobic interior	Falling temperatures	Shorten time interval between turnings; increase porosity
Site-related odors (bins/piles not odorous)	Raw materials (carcasses spoiled)	Odor is characteristic of the raw material	Place carcasses in bins promptly, prepare and cover.
	Nutrient-rich puddles because of poor drainage	Standing puddles of water; ruts near composter	Divert runoff away; provide paved apron in front of bins.
Fly or mosquito problems	Flies breeding in compost bins/piles	Fresh manure or food material at bin/pile surface; flies hover around bins/piles	Turn bins every 7-10 days; maintain min. 6 inches between carcasses and bin sides; maintain min. 6 inches of litter cover on each layer of carcasses.
	Flies breeding in raw materials (litter)	Wet raw materials stored on site more than four days	Handle raw materials promptly; protect from precipitation.
	Mosquitoes breeding in stagnant water	Standing puddles of water.	Grade site properly; maintain pad surface; eliminate puddle areas.
Compost contains clumps of materials and large particles; texture is not uniform	Poor mixing of materials or insufficient turning	Original raw materials discernible in compost	Improve initial turning procedures
	Active composting not complete	Curing piles heat or develop odors	Lengthen composting time or improve composting conditions