Results for today; Ideas for tomorrow

Meat Technology Update

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Composting of slaughterhouse waste material and dead stock

Disposal of the waste from slaughtering and from butcher shops can be a problem for smaller country meat processors. It can be uneconomical for a contract renderer to collect the materials and there are potential environmental hazards due to leaching from burial pits. The University of Southern Queensland has developed a system of 'dry composting' for stabilisation of this material as the first stage in an overall solid waste management strategy called Agwise. Agwise was funded by the Natural Heritage Trust in partnership with Millmerran Meat Holdings, and with assistance from a forensic scientist from the University of Queensland.

Figure 1. Waste material after 8 weeks dry-composting.

A country slaughterhouse, processing about a dozen cattle and 20 to 30 small stock each week for a butcher shop and private customers, generates about 4 m^3 of solid waste, including butcher shop bones, weekly. If this is buried it could contaminate the land for many years. This material can be converted to a usable by-product in an environmentally friendly manner using a two-stage composting process. Composting also provides an option for disposing of dead stock as an alternative to rendering.

This newsletter discusses the steps in the dry composting process and the subsequent conventional wet composting stage.

Dry composting

The intent of the dry composting stage is to reduce the volume and mass of the waste material as quickly as possible without causing odour or leachate.

Basic requirements

The basic requirements for dry composting are:

- a roofed shed with three or four bays;
- a compacted earthen pad or concrete floor for all-weather access and to prevent leaching into the ground;
- a tractor with a bucket, able to lift up to one metre high or more;
- pine bark or wood chips;
- sawdust.

The shed should be sized to suit the amount of waste to be processed. For the weekly throughput at Millmerran, a shed with four bays each 9

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m long by 3 m wide proved suitable. Each bay was filled to a depth of one metre over an 8-week period. The bays can be formed by constructing solid walls or, as was the case for the trial, second-hand conveyor belting supported by C-purlins was used.

If the shed does not have a concrete floor, a compacted earthen pad should be constructed in accordance with the Queensland Department of Primary Industries technical note titled 'Earthen Pad Preparation Requirements' (www.dpi.qld.gov.au/pigs), or see other relevant state authorities for guidelines on construction.

Preparation and management

A base layer of bark or wood chips is laid down to a depth of about 200 mm. The bark improves aeration at the base of the pile and provides a target layer for the bucket of the front-end loader used to clear out each bay. A 200–300 mm layer of dry sawdust is placed on top of the bark and is used to absorb any seepage from the solid waste.

After each day's processing, the solid waste is placed on top of the sawdust base. Ideally bones, hooves and heads should be placed first with the moist viscera on top. The air spaces provided by the bones should improve the aeration around the soft material. Aeration is needed to favour the activity of 'non-vermin' insects that are responsible for the breakdown of the soft tissues.

A layer of sawdust is then placed on top of each successive layer of waste. The sawdust should absorb any odour that is generated. There may be some anaerobic sites within the pile which may release unpleasant odours during the process; however, the activity of the beetles should reduce the likelihood of anaerobic pockets developing. The top sawdust layer should be of a sufficient depth to cover all waste material and ensure that no nuisance flies or vermin are attracted to the pile.

It will take approximately eight weeks to fill a bay to a depth of one metre. When the bay is full, it can be closed off by stacking hay bales across the entrance. A sheet of hessian can then be laid over the completed pile to minimise dust generation and the activity of crows. The compost pile is then left to decompose for 8 to 10 weeks after the last addition of solid waste, during which time it should not be disturbed (Figure 1). No turning is needed as insects do the work; and no water is required as enough moisture is present in the waste material.

After 8 to 10 weeks of decomposition, only bones and skin should remain. The only odour should be musty and organic – associated with blackened lumps of sawdust composted with any seepage. Any sawdust that has not combined with the waste can be reused in the next bay. The bone, skin and composted sawdust clumps are removed from the bay and transported to a compacted earthen pad for conventional wet composting. At this stage the bones and skin will be relatively fragile.

The dry composting process is also suitable for disposal of dead stock from piggeries and culled spent hens from egg production. Similar systems have been described in the United States for disposal of dead animals. The process is a practical means of disposing of dead stock provided that the compost piles are well covered with sawdust to prevent the escape of odours. Sheep and cattle cadavers can be composted although whole cattle bodies may take longer to break down.

The dry composting stage has now biologically stabilised the potentially putrescent wastes. If no further treatment is carried out, the bones and skin pieces could persist for a very long period. Before the material is utilised as an organic fertiliser or for some other purpose, it should undergo further treatment in a wet composting stage.

Wet composting

Conventional composting can be done in a variety of ways. These methods include static windrows, turned windrows, aerated static piles and a range of in-vessel systems. The aerated static pile and in-vessel systems require significant capital investment in equipment and, although they provide potentially greater control over the process, are not necessary for this application to achieve satisfactory outcomes.

A static pile, where the material is left to aerate naturally, is sometimes used for composting; however, without sufficient moisture and attention to aeration, the production of a satisfactory material is unlikely.

Basic requirements

Turned windrow composting is the most suitable method. It requires more management than a static pile, but the finished product will be of a higher quality with more potential applications. The basic requirements for a turned windrow composting operation are:

- a compacted earthen pad with bunding or spoon drain to divert overland flow away from the pile and contain any leachate from the pile;
- a front-end loader or tractor with a bucket for forming and turning the pile;
- a watering system to supply moisture to the windrow as required;
- a screening system (if a higher quality product is required).

Raw materials mix

In order to produce a good quality compost with a balanced nutrient availability, raw materials must be mixed in the correct proportions. If the nitrogen content of the initial mix is too high, it is likely that nitrogen will be lost to the atmosphere as ammonia and there is the potential to generate offensive odours.

A carbon to nitrogen ratio of between 15:1 and 30:1 is normally required for good composting results.

Table 1: The range of characteristics of some materials suitable for composting

Material (fresh)	C:N Ratio	%N	%P	%K	% Lignin	Bulk Density (kg/m³)	% Water by wt
Dairy manure	11 – 18	2.7 – 4.0	0.5	1.7 – 2.4	8.1	460 – 582	67 – 87
Feedlot manure	6 – 14	1.7 – 4.0	0.5 – 1.0	1.8 – 2.3	8.1	460 – 582	67 – 87
Pig manure	7 – 24	1.9 – 5.6	0.4 – 1.2	0.1 – 4.8	2.2	272	65 – 91
Poultry manure	2 – 24	1.6 – 10	1.1 – 2.3	1.7 – 2.2	3.4	263 – 563	22 – 75
Abattoir waste	14 – 17	8 – 11	3.0 – 3.5	2.0 – 2.5	n.a.	507	80 – 85
Grass clippings	9 – 25	2 – 6	1.1	2.0	2 – 7	104 –278	82
Grain dust	23 –33	1.6 – 2.1	n.a.	n.a.	2 – 5	n.a.	8 – 10
Cotton trash	30	1.3	0.45	0.36	15	112	n.a.
Peanut shells	n.a.	0.8	0.15	0.5	23	n.a.	n.a.
Corn stalks	60 –73	0.8	n.a.	0.8	11	11	12
Wheat straw	100 – 150	0.3 - 0.5	0.15 – 0.26	0.6 – 1.02	7 – 18	20 –131	4 – 12
Sawdust	200 – 511	0.1	0.01 – 0.5	0.04 – 1.4	15 – 28	122 – 156	19 – 65

Materials, such as abattoir waste and fresh manures, which have a high nutrient and moisture level and high bulk density need to be mixed with other wastes that have a high carbon content to provide a balanced mix with adequate porosity. These additional materials, known as bulking agents, must be able to absorb excess moisture and be able to improve the passive air exchange throughout the windrow during the wet composting process. Other wastes that could be mixed with the dry composted abattoir waste include:

- manure from yards;
- poultry manure;
- grass clippings;
- green yard waste;
- cotton trash;
- peanut shells;
- wheat straw;
- sawdust;
- woodchips;
- bark.

The characteristics of some rural wastes are given in Table 1. Information such as C:N ratio can be used to assist in formulating a mix to the optimum final C:N ratio. Bulk density (weight per unit volume) and moisture provide an indication of the ease of aeration of the material. Materials, such as fresh manure, with a high bulk density and moisture have the potential to produce foul odours. They need to be mixed with a lighter material to improve aeration and prevent the formation of anaerobic pockets within windrows.

Some of these materials may not be suitable for a variety of reasons. For example, pine bark is probably too expensive for this application and there is a risk of pesticide residues in household yard trimmings. However, in most rural areas some waste should be available for little more than the cost of transporting them to a suitable site. Bulking agents can be used singly or in combination; and if a coarse bulking agent such as woodchips is used, it may be screened from the compost and re-used.

Windrow management

Mixing and pile formation

The abattoir waste and bulking agent are mixed in a ratio that ensures the composting material has an open structure to facilitate aeration of the compost pile, and confers a suitable structure to the finished product. Experiments can be conducted by mixing small volumes of the selected ingredients in a bucket, until the mix appears suitable. A low bulk density for the final mix will aid aeration and reduce the amount of turning.

Mixing can be done with a front-end loader on a concrete or compacted earthen pad. If the waste to be composted have been stabilised by the dry composting process, mixing and pile formation can be done periodically when the material becomes available; however, if material to be included in the mix is likely to create a nuisance if stored, then mixing and pile formation may need to be done on a weekly or daily basis.

When mixed, the waste is formed into a windrow 1.5 to 2.0 m high and 3 to 4 m wide at the base depending on the capacity of the front-end loader. The windrows should be formed on the compacted pad and may be progressively extended in length to the space available. Sufficient space should be left between windrows to provide access for turning.

Turning and watering the windrows

In order for the composting process to proceed, sufficient moisture must be available. If the newly formed windrow is dry, it should be watered to field capacity. In practice, field capacity is when the mixture holds sufficient water that when squeezed in the hand, water will flow but under gravity alone, no water will flow. One method of watering is to place a soaker hose with holes face down, along the apex of the windrow. Watering can be timed at hourly intervals and the pile checked to estimate the time for the centre to reach field capacity. Do not over-water as any leachate will carry away nutrients and become a potential source of pollution.

Following watering, the pile should start to heat up, to between 50ºC and 60ºC, within seven days depending on the materials being composted. If a large amount of uncomposted sawdust or gin trash is used, it may take longer – even up to 2 weeks. Digging towards the centre of the pile will give an indication of the temperature rise. Alternatively a long-stemmed thermometer can be used and inserted into the pile in several positions along the length of the windrow to obtain an accurate estimate of the pile temperature. If the compost becomes too hot (>65ºC) some of the beneficial organisms may be killed off. Overheating can be preventing by reducing the height of the pile and turning more often. Turning during the high temperature phase will improve the chances of all the material being exposed to the elevated temperatures, killing pathogenic organisms.

A minimum of three turns during the first six weeks of composting is recommended. After each turning, the windrow should be watered to field capacity. A strong temperature rise after turning and watering indicates that the compost is still biologically active. When the temperature does not respond to the same extent, the compost is approaching maturity and watering may be discontinued and the material either left to cure in the windrow or the composted windrows can be consolidated into a curing pile. The active composting period may be 3 months or more depending on the mix. The compost should be stored in the curing pile for at least another month during which time the moisture level is allowed to fall to a point where the material can be more easily handled and screened if necessary.

Compost applications

Compost is a useful soil additive and can be spread on paddocks as a slow release organic fertiliser. Compost also improves both the physical and chemical properties of soils and can aid in suppressing soil-borne plant pathogens.

There is also the potential to sell the compost to wholesale nursery suppliers for production of soil blends and in formulation of potting mixes. When used for these purposes, the cured compost would need to be screened to provide an even texture and remove stones and other larger contaminants such as bone fragments. Screenings such as bone or bark chip can be recycled into new composting windrows. The quality of the compost may also need to conform to the Australian Standard AS 4454-1999:*Compost, soil conditioners and mulches*. See also Draft Standard DR 01337, 2001.

Further reading

AGWISE Project, Book 2 http://www.ncea.org.au/

For more information, contact one of the Meat Industry Services staff listed below.

Food Science Australia Meat Industry Services Section
The Meat Industry Services (MIS) Section of Food Science Australia is an initiative supported by Meat and Livestock Australia (MLA) and the Australian Meat Processor Corporation (AMPC) to facilitate market access for, and support world-class practices in, Australia 's meat industry.

Need additional information help, information or advice? Contact any of the following

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