final report

Project Code: AMT.031

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Date published: June 2008

PUBLISHED BY
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Composting of NVC Skins

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government and contributions from the Australian Meat Processor Corporation to support the research and development detailed in this publication.

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Abstract

The increasing focus on environmental issues makes it inappropriate to dispose of NCV sheep skins in burial pits.

A trial was conducted to assess the potential of composting as a means of disposal of NCV sheep skins. The trial was conducted in two stages. Stage one comprised a series of four preliminary trial piles designed to assess the performance of four different treatments. This was followed by stage two consisting of a larger commercial pile based on the optimal treatment from stage one. Skins were composted together with waste paunch solids and pine bark; the latter being used as a bulking agent.

Samples of compost were analysed to determine their quality at different stages throughout the trial. Odour assessments were done subjectively to determine potential odour problem risks. These odour assessments were supplemented by an odour sampling and analysis study.

The trial demonstrated that a properly mixed and managed compost pile will mature in optimal time, with or without the skins being pre-shredded. Odour problems did not arise.

The compost was found to be suitable for use in a range of applications.

Executive Summary

Introduction

The disposal of sheep skins that are of no commercial value (NCV) is a problem for sheep processors when the market for skins is depressed. This situation occurs on a cyclical basis. In addition to the cyclical increase in NCV skin numbers, there is the ongoing problem of disposal of skin pieces and damaged skins.

NCV skins have in the past been disposed of by burial. This option is no longer viable given the growing concern for environmental issues.

Objective

To assess the potential for incorporating NCV sheep skins in a compost operation together with other waste solids including paunch contents.

Methodology

A trial was conducted in two parts as follows:

- Preliminary trial to assess four composting options
- Production trial to further assess the most viable composting option

Samples of compost were analysed during the trial to determine the value of the compost as a soil conditioner for nurseries and other areas of the horticulture sector. Odour assessments were undertaken to determine the potential for environmental (odour) problems and the suitability of the compost for packaging and retail sale.

Results

The ability to compost NCV sheep skins together with other solid waste such as paunch material was proven.

There is no need for the sheep skins to be pretreated in any way, eg. by shredding, in order to optimise the composting process. The composting process was equally successful irrespective of whether the skins were shredded or not.

The important aspects of a composting operation are control of the compost formulation, together with management, including scheduled turning and watering of the compost piles to ensure optimum maturity in minimal time.

The compost operation described in this report will produce a mature compost that is suitable for several commercial disposal options up to and including retail sale.

Main Report

Background and Industry Context

The value of sheepskins varies considerably. Skin value at any time will depend on two specific factors:

a) Market conditions for sheepskins generally, and

b) Market for skins with different wool lengths.

In the case of (b) above, the value of skins with wool may determined purely by the value of the wool alone.

Whatever the skin price circumstances, there are often occasions when a sheep processing operation has on its hands, large numbers of skins that are of no commercial value (NCV)

On many plants, NCV skins are buried. In recent times, the practice of burying skins has become less acceptable, given new environmental constraints, especially in relation to the problems and costs associated with contaminated site remediation. Skins degrade relatively slowly in burial pits and recent studies have indicated that skins can remain largely intact for in excess of twenty years.

It has been reported that NCV sheepskins will decompose in a crude aerobic composting environment. It was subsequently suggested that a more precisely designed and managed composting operation may be an effective means of disposing of unwanted sheepskins.

Objectives

To study the potential for composting as a means of disposing of unwanted sheepskins. Base the study on a practical meatworks composting operation to the extent that skins of no commercial value could be sourced from the meatworks.

- Determine optimum composting conditions for the disposal of NCV sheepskins.
- Develop a practical composting operation that will be capable of effectively disposing of NCV sheepskins.
- Assess the value of the compost as a marketable item on the basis of a benefit-cost analysis based on the results of the trials.

Methodology

An initial visit to the site was made in the company of Mr Albert van Oostrom of the Meat Research Institute of New Zealand (MIRINZ), a recognised expert in the field of composting abattoir waste. This visit was undertaken to inspect the available materials and composting site and to develop a series of composting treatments for the evaluation.

Composting treatments included skins that were shredded as well as whole skins and skin pieces, in order to assess the potential benifit or otherwise of shredding. A Brentwood Shredder was purchased for the project and installed in the skin shed.

Provision was also made for the application of water to the trial composting piles. This was achieved by installation of a water supply and storage tank on the composting site.

Four trial compost piles were established at the plant's solid waste treatment site on a cleared area adjacent to an existing solid waste composting operation. The four treatments used for the trial compost piles were as follows:

Pile 1

Composition

Skins (shredded)	4 to 5 m^3
Paunch	4 to 5 m^3
Bulking agent	4 to 5 m^3

Treatment

Weeks 1 to 3	Turn 2 times per week
Weeks 4 to 6	Turn once per week
Weeks 7 to 10	Turn every 2 weeks

Water applied during turning

Pile 2

Composition

Skins (**NOT** shredded)	4 to 5 m^3
Paunch	4 to 5 m^3
Bulking agent	4 to 5 m^3

Treatment

Weeks 1 to 3	Turn 2 times per week
Weeks 4 to 6	Turn once per week
Weeks 7 to 10	Turn every 2 weeks

Water applied during turning

Pile 3

Composition

Skins (shredded)	4 to 5 m^3
Paunch	4 to 5 m^3
Bulking agent	4 to 5 m^3

Treatment

NOT TURNED

Water applied by hosing for the same length of time as for turned piles.

Pile 4

Composition

Skins (shredded)	approx. 6 m^3
Paunch	approx. 6 m^3

NO BULKING AGENT

Treatment

Weeks 1 to 3	Turn 2 times per week
Weeks 4 to 6	Turn once per week
Weeks 7 to 10	Turn every 2 weeks

Water applied during turning

Pile temperatures were measured at intervals during the composting period and the results recorded on data sheets. Date of turning each pile, quantity of water added, rainfall, odour and any other relevant comments were also recorded.

After a ten week composting period and again after twelve months, samples were collected from each pile for analysis. A subjective assessment was also made of the odour of each compost sample collected after 12 months composting.

Based on the analytical results, compost appearance and the comments of the compost site operators on the potential commercial value of the compost, the decision was made to proceed with a larger production scale trial and the best of the four trial composting scenerios was selected for a full-scale compost pile.

Production Trial

A larger scale pile of approximately 20 m^3 was prepared and at the completion of the project, samples were collected for analysis. Given the need to finalise the project by 30 June 1998, it was necessary to sample the production trial pile after only 8 weeks composting.

As odour problems have lead to closure of composting operations in the past, an investigation was carried out to determine the odour level at the surface of the trial composting pile and compare this with the odour at the surface of the piles from the plant's normal composting operation. This study was undertaken by odour consultants, CH2M Hill Australia Pty Ltd.

Results and Discussion

Phase 1 - Trial Piles

Construction of the first of the four trial piles did not commence until 13 February 1997 due to delays in getting water to the site and availability of skins. At the time the project was initiated, approximately 5 m^3 of NCV sheepskins were discarded each day. In the subsequent months, the market for sheepskins improved and alterations to equipment and procedures on the slaughter floor resulted in much less damage to the skins. These factors combined to result in many fewer skins being declared NCV. Instead of a truckload of skins being dumped each day, only a small skip of about 1 m^3 was available for composting.

It was originally envisaged that all four piles would be constructed in one week and the monitoring would be carried out simultaneously. Due to the shortage of skins it was necessary to construct one pile at a time. This made management of the piles more difficult, however every effort was made to standardise methodology to eliminate the effect of the staggared start on the outcome of the trial.

The skins for piles 1, 3 and 4 were shredded (Figure 1) to assist mixing and breakdown. The skins were shredded in a Brentwood AZ15 Shredder. This machine performed very well. Skins were loaded into the shredder manually throughout the trial however this task would be automated if shredding was practiced on a large scale.

Skins were transported to the composting site each day and mixed with fresh paunch contents from cattle and sheep and a bulking agent where applicable (Figure 2). The pile construction process continued for approximately two weeks until 12 to 15 m^3 was accumulated. The turning and watering process then commenced according to the schedule above.

It had been planned to utilise chipped garden waste from the local council as a bulking agent for piles 1, 2 and 3. As this material was unavailable, a load of pine chips was obtained and used for the trials.

Water was added to each pile during the turning procedure (Figure 3). The water was added at the rate of 51 litres per minute for 15 minutes on each occasion. There was no rainfall at the site for the first 11 weeks of the trial but 40 mm fell during the final four weeks prior to the first sampling.

The temperature of each pile was measured at intervals of approximately four weeks using a portable electronic thermometer with a 1.6 m long probe designed to reach the centre of the pile (Figure 4). The temperature measured in each pile was within the expected range of 45°C to 65°C. The temperature in piles 1, 2 and 3 was normally in the range of 55°C to 60°C whereas pile 4 (no bulking agent) was slightly cooler at 45°C to 50°C. This was most likely due to less effective aeration when no bulking agent was added.

Shredding the skins did not appear to accelerate the breakdown process nor significantly improve the handling and mixing procedure. The skins broke down rapidly in the compost piles although wool fibres were still evident when sampled after 3 months. However wool fibres did not cause a problem during screening and could easily be broken apart.

Odour from the trial piles was generally not offensive. There was a smell of rotting skins when the piles were first formed and during the first turning operation. Subsequently the was negligible odour unless the piles were opened. There was a slight ammonia odour when the piles were turned during the first few weeks but this was replaced by a strong composting odour as the trial progressed. The piles with the pine chip bulking agent had a less offensive odour than the pile without the bulking agent. None of the piles developed the earthy odour characteristic of mature compost during the trial period up to the first sampling.

The trial piles were sampled at two intervals. The first was approximately 3 months after commencement and the second after 12 months. The piles were sampled at 3 months by collecting a front-end loader bucket of material and passing it over a 20 mm screen to remove gross solids such as stones and large pieces of wood chips. Grab samples were collected from the outfeed conveyor (Figure 6) to make up a make up a total sample of about 2 kg. The samples at 12 months were collected manually by digging about 400 mm into the piles with a shovel at about six sites to collect a composite sample. The samples were delivered to Netherwood Horticultural Consultants Pty Ltd for analysis.

Results of Sampling at 3 Months

The results of the analysis of the composts from the four trial piles are presented in Table 1. A report on the results of the analyses was prepared by Netherwood Horticultural Consultants and the relevant comments from this report are as follows:

The composts are reasonably similar to one another in most properties. All are alkaline, with high salt contents, high ammonium content and essentially zero nitrate content. According to the Australian Standard for composts, this ammonium-nitrate difference means that they are to be classified as being fresh composts. They will therefore be ideal as materials for improving the structure of soils to which they are applied.

Their salinity means that they should not be applied at more than 16 litres per square metre to soils in which plants that are tolerant to salinity are growing or are to be grown. The application rate for plants that are fairly sensitive to salinity would be less than 4 litres per square metre.

The water content of Piles 3 and 4 was rather higher than that of the others. This could simply be an artefact of the sampling, it having been done simply by abstracting a front-end bucket full from each pile. The higher soil content of Pile 2 is shown by an elevated bulk density and somewhat higher aluminium and iron contents than of the other two piles.

The high ammonium content and low C/N ratio of these composts means that they are good sources of nitrogen. The phosphorus and potassium contents are modest but there will be less need for these nutrients from other sources when these composts are applied to soils.

The aluminium and iron contents indicate that there is some soil present in each of the samples, particularly from Pile 2. This soil was clearly visible when the piles were inspected. Some of it would have come from the soil on which the piles were resting.

The trace element contents will make useful contributions to plant nutrition. None is present in high enough concentrations to cause the slightest concern about excessive accumulation.

So long as their alkalinity is acceptable, and that their salinity and ammonium content are allowed for in application rates, the application of these composts should have beneficial effects on the physical structure and nutrient content of soils to which they are applied.

Table 1: **Analysis of compost samples (3 months)**

Property	Pile 1	Pile 2	Pile 3	Pile 4
Carbon (%)	8.2	14.3	22.1	17.8
Nitrogen (%)	0.79	0.94	1.38	1.42
C/N	10.4	15.2	16.0	12.5
PH of 1:1.5 V/V extract	8.63	8.64	8.25	7.9
EC of same (dS/m)	4.75	5.29	4.75	9.29
Ammonium-N in same (mg/L)	940	650	970	2,500
Nitrate-N in same (mg/L)	<1	<1	4	15
Wettability (minutes)	7	5	4	5
Bulk density dry (kg/m^3)	0.58	0.62	0.46	0.48
Bulk density as sampled (kg/m^3)	0.72	0.82	0.72	0.73
Moisture as sampled (%)	20.3	24.4	35.9	34.7
Phosphorus (%)	0.33	0.23	0.27	0.26
Potassium (%)	0.38	0.45	0.48	0.45
Sulphur (%)	0.19	0.22	0.20	0.29
Calcium (%)	1.92	0.90	1.63	1.02
Magnesium (%)	0.16	0.17	0.16	0.13
Sodium (%)	0.09	0.10	0.13	0.12
Aluminium (%)	0.87	0.95	0.81	0.73
Iron (%)	0.79	0.98	0.76	0.59
Copper (mg/kg)	11	13	12	9
Zinc (mg/kg)	33	37	41	44
Manganese (mg/kg)	107	1333	113	74
Boron (mg/kg)	4.0	4.5	4.5	6.1
Molybdenum (mg/kg)	0.3	0.2	0.2	0.3
Cobalt (mg/kg)	2.4	4.0	2.4	2.1
Chromium (mg/kg)	14	27	57	30

Results of Sampling at 12 Months

The samples collected approximately 12 months from commencement of the trial piles were again forwarded to Netherwood Horticultural Consultants for analysis and the results are presented in Table 2. Comments by the consultant on these results are as follows:

The concentration of ammonium and nitrate indicate that samples 1 and 2 had progressed to being mature composts: most of their ammonium had been converted to nitrate. This indicator of maturity is consistent with the finding of little odour in these two samples.

Sample 3 still has some ammonium, but as the concentration of nitrate is higher than that of ammonium, this sample is well on the way to being a thoroughly matured compost. Its lower maturity relative to samples 1 and 2 is consistent with its slightly higher level of odour.

Sample 4 still has all of its soluble nitrogen in the ammonium form. Not much has happened in this heap over the past several months since the last sampling. It must still be considered as being a rather immature, fresh compost. This is probably because of its higher nitrogen content. It is commonly found that as the nitrogen increases above 1.2%, there is a progressive increase in the time taken for maturity to develop. While there may have been things happening in this heap in recent months, the amount of protein nitrogen that is still present means there is continuing release of ammonium.

This discussion assumes that a mature compost is actually needed. A compost of the type represented by sample 4 would still be suitable for application to soils in situations in which the temporary dispersing of odours into the surrounding area is not going to cause problems. The rate of application would have to be low enough that the ammonium present would not cause problems. In this regard it would generally be satisfactory for the level of application to be limited to that prescribed in the Standard on the basis of the salinity of the compost.

Table 2: Analysis of compost samples (12 months)

Property	Pile 1	Pile 2	Pile 3	Pile 4
Carbon (%)	10	9.2	13	19
Total Kjeldahl Nitrogen (%)	0.97	0.82	1.1	1.7
C/N	10.4	15.2	16.0	12.5
Ammonium as N (ext) (mg/L)	48	110	390	1,500
Nitrate as N (ext) (mg/L)	890	680	540	<1.0
Phosphate as P (ext) (mg/L)	5.0	5.7	13	35

In addition to the analyses above, a subjective assessment was made of the odour from samples from each of the four piles. This was done by removing the samples from the composting site and for three people to independently score the odour level on a scale of 1 to 5 with 1 being virtually no odour and 5 being an objectionable odour. The results giving the average of the scores are presented in Table 3.

Table 3: Results of odour assessment of trial pile samples

Pile 1	Pile 2	Pile 3	Pile 4
1.7	1	2.7	4.7

1 Minimal odour

5 Objectionable odour

The results of the odour assessment agree with the analytical results and indicate that piles 1 and 2 had progressed to maturity whereas pile 3, which was not turned and pile 4, to which no bulking agent was added had still not produced a mature compost even after nearly 12 months.

A summary of the results of the preliminary trial phase of the project is as follows:

1. All four trial piles produced an acceptable compost that would be suitable for improving the structure of soils to which they are applied provided the salinity level was not a concern. The maturity of the compost after three months was such that the product would not be suitable for retail sale at that stage however treatments 1 and 2 did produce a mature compost suitable for retail sale after 12 months (or less).

2. Shredding the skins prior to composting produced no improvement with respect to either rate of breakdown of the skins or ease of handling during pile construction and turning.

3. The inclusion of a bulking agent (in this case pine chips) is essential if the composting process is operating in an odour-sensitive environment. The compost will also reach maturity more rapidly and produce a product of potentially higher value.

4. The procedure and mixture used for pile 2 was selected for the larger production scale pile.

Phase 2 - Production Pile

The construction of a larger scale production compost pile commenced on 23 March 1998. This delayed commencement date was due to site-specific problems and the late starting date resulted in the pile size being restricted to about 25 m^3. The pile was turned and watered according to the schedule for trial pile 2. The composition of the pile consisted of equal quantities of:

Skins (unshredded)

Paunch

Bulking agent (woodchips)

The temperature was measured in a similar manner to that described earlier. The temperature within the pile varied from 58°C to 63°C with an average of 60°C.

The odour was similar to that experience with the trial piles. There was a odour of rotting skins during pile formation and a slight ammonia smell during turning in the early stages. After the first turn there was minimal odour from the undisturbed pile and a composting odour during turning.

Water was added by hand hosing for 30 minutes during turning. Approximately 70 mm of rain fell during the first two months prior to sampling. The pile was sampled on 28 May 1998 by collecting a bucket load with a front-end loader and processing it through the screen and collecting grab samples from the outfeed conveyor. A sample of the screened compost produced on the site for commercial sale was also collected. The samples were delivered to Netherwood Horticultural Consultants for analysis and comment. The results of the analyses are presented in Table 4 below.

Table 4: Results of analysis of samples from production pile and commercial compost

Property	Production Pile	Commercial Compost
Carbon (%)	32	24
Total Kjeldahl Nitrogen (%)	1.6	1.6
C/N	20	15
Ammonium as N (ext) (mg/L)	900	1,100
Nitrate as N (ext) (mg/L)	<1	<1
Phosphate as P (ext) (mg/L)	40	19

As expected after less than 10 weeks composting, the low nitrate and high ammonium levels indicated that the sample from the production pile would be classified as a fresh compost. Although the nitrogen and carbon levels are higher, the sample exhibited similar properties to the trial piles when sampled at the same stage. It is interesting to note that the commercial compost produced on the site was at a similar level of maturity even though it would be 4 to 6 months old. The additional turning and watering of the production pile would have improved the rate of activity compared with the commercial compost which is only turned 3 to 4 times and not watered.

Odour Sampling

Subjective assessments were made at different stages during the trial of the odour generated by the composting process. The results of these assessments are reported in the sections on both the preliminary trial and the production scale trial.

An opportunity arose towards the end of the trial to undertake a more objective assessment of the odour generated by the composting process and to characterise to some extent the odours generated. This opportunity arose due to the fact that an odour specialist firm, CH2M Hill, had been commissioned by the Meat Research Corporation to undertake a series of odour studies on rendering plant emissions.

CH2M Hill undertook a single odour assessment study at the compost site as the trial was about to be terminated.

A total of six odour samples were taken and analysed by the specialist odour assessment team.

The odour samples were taken as follows:

- Production scale compost trial pile; untumed

  turned

- Fresh works compost pile; untumed

  turned

- Mature works compost pile; untumed

  turned

The odour assessment results were consistent with observations made during the two stages of the trial. The trial pile with it's managed formulation and turning / watering regime produced a mature compost much faster and with less risk of odour problems than a "natural fall" compost with limited management input.

The sheep skins in the compost appeared to have little practical effect on either the appearance of the compost or it's odour characteristics.

A full copy of the CH2M Hill Report on the odour study at the compost site is attached to this report; Attachment 2.

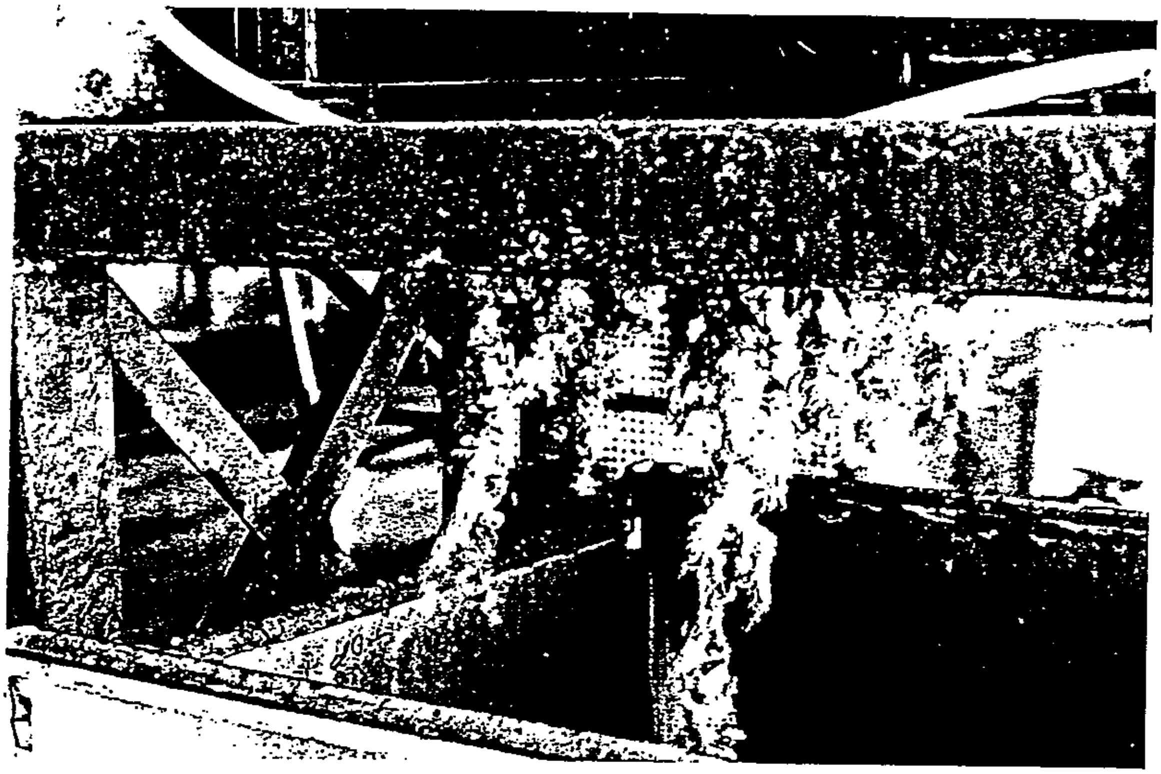
Benefit-Cost Analysis

A benefit-cost analysis has been carried out on a proposal to set up a composting operation to handle NCV sheepskins along with paunch contents and other waste from a meatworks. This has been done on the basis that there is no existing composting operation and that paunch contents are presently buried or spread on land at little cost and NCV skins are sent to a secure landfill. Discounted cash flow analyses have been done using the following assumptions:

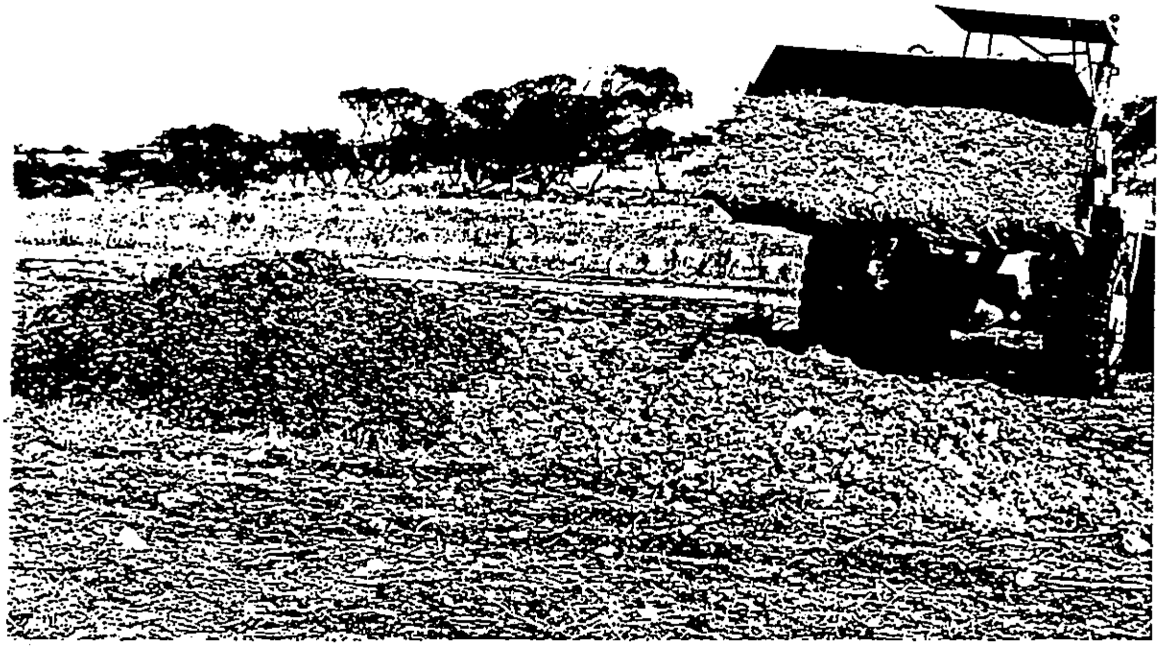
Quantity of sheepskins per day	1 tonne
Quantity of paunch etc per day	18 m^3
Capital costs (equipment, site preparation)	$60,000
Labour costs	$35,000 pa
Bulking agent	$4,000 pa
Compost sale price	$30 per tonne

The viability of a composting operation is dependent on several factors. The main factors are the capital costs, value of the finished compost and the cost of alternative disposal by landfill. The cost of secure landfill varies throughout the country from about $135 per tonne to as low as $25 per tonne.

Using the above assumptions, the payback period varies from about 21 months at landfill and transport costs for the sheepskins costs of $145 per tonne to over 40 months when landfill costs are $30 per tonne. Landfill costs would need to rise to over $300 per tonne to achieve a payback period of 12 months.



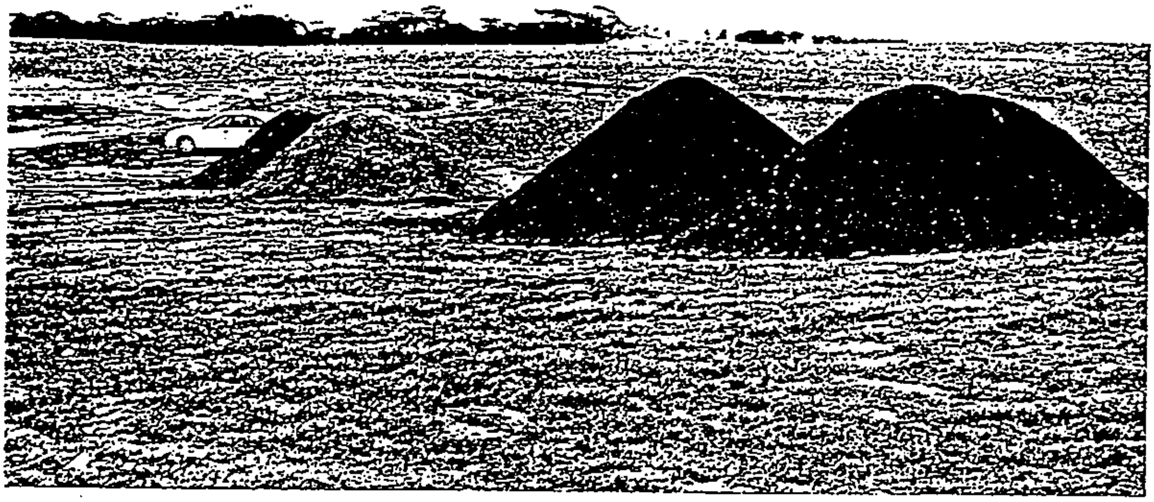
1. Shredding NCV sheepskins prior to composting



2. Compost materials (left to right): Paunch Material, Shredded Skins, Pine Chips

3. Watering and turning the trial compost piles

4. Measuring compost pile internal temperature



5. The four completed trial compost piles

6. Final compost from one of the trial compost piles

Attachment 1 - Recommended Procedure for Composting NCV Sheepskins

NCV sheepskins can be successfully composted using the turned windrow method, which involves forming the waste, mixed with a suitable bulking agent, into windrows. The windrows are normally about 2 m high on a base about 5 m wide by a suitable length of 10 to 30 m. The recommended raw materials, site and labour and equipment requirements for a composting operation are discussed below.

Raw Materials

The following raw materials would normally be available at a meatworks for composting.

- Sheepskins
- Paunch contents and other solid waste
- Bulking agent

Sheepskins

Whole sheepskins and skin pieces can be included in the compost up to about one third of the total volume. They should be transported to the composting site daily and mixed with the other wastes and a bulking agent without delay. Stockpiling of skins may create an odour nuisance and be attractive to flies.

Paunch Contents etc

The bulk of the solid wastes available from a meatworks will consist of paunch contents from sheep and cattle. Other solid and semi-solid wastes that could be included are yard and truck washings, effluent primary screenings, saveall bottom solids and other effluent sludges.

These materials which can have moisture contents in the range 70 to 90% should be transported daily to the composting site in a leakproof truck or trailer for mixing with the skins and bulking agent. paunch contents alone can be stockpiled without creating a nuisance but more highly putrescible wastes will attract flies and should be mixed without delay.

Bulking Agent

The addition of a bulking agent is essential to improve the porosity of the mixture and absorb excess moisture. Suitable bulking agents are:-

- Woodchips
- Sawdust
- Crushed pinebark or other bark with a granular structure when crushed
- Organic wastes with structural integrity such as chipped tree prunings, straw, etc.
- Recycled compost.

The bulking agents may be used singly or in combination and if coarse bulking agents such as woodchips are used, the bulking agent may be screened from the compost and reused.

Abattoirs should investigate local industries which may produce waste materials suitable for use as a bulking agent. Other factors that are important in selection of a suitable bulking agent are:-

- Availability and cost

- Product quality requirements (e.g. crushed pine bark normally produces a compost with a better appearance than when sawdust is used).

The Site

The composting site should be suitable for all-weather operation and be reasonably level and well-drained such that ponding of rainwater does not occur. Any runoff or leachate should be prevented from draining from the site.

A sealed area should preferably be provided for mixing the wastes and bulking agent and the site should be serviced with power and water.

It is very difficult to eliminate all odour, dust and noise from a composting operation, therefore the site should not be located near housing or other possible sources of complaints.

Labour and Equipment

The time involved in undertaking a composting operation would total 50 to 70 man hours per week which would include carting raw materials, mixing and turning compost windrows and screening and delivering the finished product.

The minimum equipment needed to operate would include:-

- Tipping trucks or trailers for carting raw materials and delivery of finished compost
- A front-end loader with a minimum 1 m^3 bucket and a lift height of at least 2 m
- A watering system for adding moisture to the windrows and controlling dust on roadways
- A finished compost screening plant consisting of a hopper and possibly a mill, conveyors and a 12 mm vibrating or rotary screen. The wool may blind some screens but a perforated screen has been found to operate satisfactorily.

Attachment 2 - Odour Sampling Report; CH2M Hill

AUSTRALIAN MEAT TECHNOLOGY

COMPOSTING FACILITY ODOUR STUDY

METRO MEATS, MURRAY BRIDGE, SOUTH AUSTRALIA

FINAL

19 June 1998

Ref. No.: 101044/3

Introduction

CH2M HILL was engaged by the Australian Meat Technology (AMT) to collect six air samples from the Metro Meats abattoir composting facility at Murray Bridge. The air samples were analysed for odour and chemical composition. The objective of this study was to assess and compare the odour emission rates from traditionally composted abattoir wastes and a trial method for composting abattoir wastes.

The results indicated that the trial compost produced equivalent or reduced amounts of odour than the compost that had been processed in the conventional manner over a six month period. The fresh compost when being turned produced the most amount of odour, but when left to form a crust, little odour was released from the surface, as with the other composts.

This investigation will provide AMT with information on odour emission rates from abattoir waste compost, the principal chemicals that are responsible for the odour, and a comparison between odour generation from traditionally composted wastes and new composting methods.

BACKGROUND

The usual method for disposing of abattoir wastes is underground burial. The high cost of abattoir waste disposal has prompted AMT to investigate the use of the waste as a resource used in composting mixture of straw, soil and other organic material. The waste can be degraded in a compost mixture at a considerably faster rate than in the soil. Once this compost and waste has matured, it produces a suitable medium for plant growth.

The objective of this odour survey is to provide a picture of the general odour emissions from an abattoir waste composting facility. The odour survey provides odour emission rates from composting material of different ages and different composition. It will provide an understanding of their contribution to the overall odour impact from such a facility.

ODOUR SAMPLING

In May 1998, representatives from Australian Meat Technology, Metro Meats and CH2M HILL visited the Metro Meats composting facility at Murray Bridge, South Australia.

Six representative air samples were collected from the different composting windrows under varying conditions. The samples were collected using the odour flux hood method which is the standard method for collecting odour samples from liquid or solid surfaces.

Results of olfactometry conducted the odour samples provided quantitative information on odour concentrations from the identified sources. Together with flow rates, odour emission rates can be calculated, providing data for odour dispersion modelling.

Field Sampling Protocols and Program

Sampling was performed on the 4th May 1998 by CH2M HILL's qualified field sampling officer and undertaken in accordance with the QA/QC procedures and requirements of CH2M HILL Odour Services.

A brief discussion of the hood sampling procedure follows:

Sampling of solid surfaces using the hood comprises the hood being placed on the odorous surface, and odour free air being forced through it. The odour free air strips odours from the surface. The odour is then collected for analysis, and a volumetric flow rate across the surface recorded. Air flowing over the odorous surface is controlled and represents the wind flow at which most nuisance odours are removed from a surface. The following paragraph describes the method for collecting the odours.

A fan forces ambient air through an activated carbon filter. The carbon filter cleanses and deodorises the air. From the carbon filter, the air blows into the odour flux hood via odour free air conditioning ducting. In the hood baffles distribute the air evenly over the odorous surface.

The air is channelled to a small outlet. The outlet is directed downwind. This allows sample to be collected from the outlet before mixing with ambient air ensuring that there is no contamination of the sample air with ambient air. The exit velocity of the air from the hood is measured using a calibrated hot wire anemometer, hence a volumetric flow rate over the odorous surface can be calculated.

A Teflon tube was held at the hood outlet or within the source flow. The tube was connected to a single use, odour free nalophan sample bag inside a portable drum. A vacuum was created in the drum by expelling the air inside the drum. This drew sample air into the sampling bag. When the sample bag was filled, it was removed from the drum and placed in a cool shaded area, until arrival at the laboratory. The sample retains its original character if stored in a cool dark place. Samples were transported back to the odour lab and analysed within 24 hours of sampling

results

ODOUR RESULTS

To calculate odour emissions, odour concentration is converted into an odour emission rate per unit area known as a Specific Odour Emission Rate (SOER). To gain an overall Odour Emission Rate (OER), the SOER is multiplied by the surface area of the source.

Table 1 shows the SOERs of the different composts under varying conditions.

Table 1: Odour Emission Rates For Abattoir Composting Facility

Source	CHOS Sample Number	Raw Data (OU/m^3)	SOER (OU/m^2/second) (adjusted to 0.05 m/s wind velocity)
New compost - surface	8456	125	2.4
New compost - freshly turned	8457	1580	30.6
Trial compost - surface	8458	237	5.0
Trial compost - freshly turned	8459	478	11.4
Old compost - surface	8460	250	5.5
Old compost - freshly turned	8461	896	19.8

CHEMICAL RESULTS

Table 2 shows the chemical analysis of the odour samples. The samples were analysed using a GC/MS by Dr David Stone at ANSTO, NSW. The results show that the alcohols and aldehydes were the major constituents of the gaseous emissions.

Table 2: Chemical Analysis of Odour Samples

Meat Research Project Metro Meats	New Compost - Surface CHOS8456	New Compost - Freshly Turned CHOS8457	Trial Compost - Surface CHOS8458	Trial Compost - Freshly Turned CHOS8459	Old Compost Surface CHOS8460	Old Compost - Freshly Turned CHOS8461
component (ppb)						
hydrogen sulphide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
carbonylsulphide	3.5	7.4	4.4	5.0	3.0	6.3
sulphurdioxide	0.2	0.2	0.4	0.7	0.7	1.0
methylmercaptan	0.1	121	15	18	16	10
dimethylsulphide	0.7	7.3	0.1	0.8	0.1	5.7
carbondisulphide	1.7	2.0	1.5	1.1	1.9	1.3
ethylmercaptan	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
propylmercaptan	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
methylethylsulphide	<0.1	0.1	<0.1	<0.1	0.02	0.04
methyl-i-propylsulphide	0.1	0.1	<0.1	<0.1	<0.1	0.1
methylpropylsulphide	<0.1	0.8	0.2	0.2	<0.1	<0.1
dimethyldisulphide	15.2	299	26.3	5.7	4.3	19.2
dimethyltrisulphide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
acetaldehyde	27.0	35.6	51.8	13.0	21.4	32.4
2-methylpropanal	1.2	0.7	0.6	4.1	0.5	8.7
2-methylpropenal	1.2	1.1	0.9	0.5	1.2	2.5
2-methylbutanal	2.8	9.4	3.2	4.5	1.5	18.8
3-methylbutanal	3.6	9.4	7.4	28.6	6.8	36.5
hexanal	46.4	86.7	28.6	49.8	28.2	347
heptanal	13.3	26.0	5.7	12.5	3.8	148
acetic acid	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
methanol	129	291	234	440	385	759
ethanol	434	384	507	439	326	364
i-propanol	25.4	137	35.0	330	20.7	747
propanol	8.1	249	9.1	78.8	32.2	299
t-butanol	1.5	0.7	0.7	0.5	0.7	1.2

i-butanol	0.9	4.4	2.1	21.9	2.1	77.0
2-butanol	3.3	14.0	19.5	13.5	0.3	229
butanol	116	97.3	7.1	45.0	12.6	58.6
3-methylbutanol	0.9	4.1	0.8	1.1	0.8	13.9
acetone	68.5	129	184	344	223	619
2-butanone	3.3	4.7	77.7	11.3	3.2	83.2
3-buten-2-one	2.5	1.1	0.9	0.4	0.5	2.4
2,3-butanedione	15.6	15.1	19.0	12.7	10.0	6.6
methylisobutylketone	9.4	10.7	11.3	15.3	3.0	21.5
ethylacetate	28.5	38.8	28.4	23.8	10.6	23.6
benzene	1.8	0.9	0.9	0.9	1.9	1.7
toluene	21.9	50.2	19.7	23.0	27.1	21.0
ethylbenzene	1.2	1.9	1.0	1.6	1.4	1.6
m,p-xylene	3.3	6.6	2.9	3.7	4.9	4.1
o-xylene	1.1	2.5	0.9	1.4	1.7	1.5

Meat Research Project	New Compost - Surface	New Compost - Freshly Turned	Trial Compost - Surface	Trial Compost - Freshly Turned	Old Compost Surface	Old Compost - Freshly Turned
Metro Meats	CHOS8456	CHOS8457	CHOS8458	CHOS8459	CHOS8460	CHOS8461
component (ppb)						
dichloromethane	5.8	9.0	8.9	10.9	7.0	4.0
chloroform	1.9	8.0	12.3	9.6	6.2	2.9
1,1,1-trichloroethane	0.2	0.7	1.0	0.3	0.3	0.2
trichloroethylene	2.0	3.9	17.4	1.5	1.3	1.3
tetrachloroethylene	0.1	0.7	0.5	0.02	0.2	1.4
methylcyclopentane	3.1	8.8	3.0	0.9	3.2	10.4
methylcyclohexane	1.3	72.0	1.5	1.6	9.4	8.2
cyclohexane	1.3	76.4	2.1	3.1	12.0	16.2
2-methylpentane	5.2	3.2	4.4	8.5	2.3	7.9
3-methylpentane	3.9	3.5	0.7	0.8	0.8	2.7
hexane	10.5	48.2	37.6	17.3	8.8	51.5
methylhexanes	4.9	64.7	1.7	2.5	5.9	21.7
heptane	4.2	38.0	4.7	5.1	5.0	28.8
Sum Sulphurs	21	438	48	31	26	43
Sum Aldehydes	96	169	98	113	63	594
Sum others	892	1,624	1,209	1,870	1,107	3,379
TOTAL ppb	**1,009**	**2,231**	**1,355**	**2,015**	**1,196**	**4,017**

DISCUSSION

The odour and chemical results indicate that there is not a large difference in odorous emissions from the surface of the three composts. This may be expected once a "crust" has formed on the compost, minimising gaseous emissions.

The results do show that there is a substantial difference in the traditional compost method compared with the new method. It is clear that the new method of composting produces less odours compared to both the fresh traditional composting method and the matured traditional composting method.

Attachment 3 - Budget Report

The project was completed within budget in terms of both fees and expenses. The percentage utilisation of the overall budgeted funds was 77%. Details are as follows:

Project Budget:	Fees		$39,900	
	Expenses	General	$37,400	
		Equipment*	$28,880	
		Total	$66,280	
Total Budget:			**$106,180**	
Project Expendature:	Fees		$32,500	(81%)
	Expenses	General	$13,242	(35%)
		Equipment*	$28,880	
		Odour work	$ 6,815	
		Total	$48,937,6	
Total Expendature:			**$81,437**	(77%)

There were several reasons why the allocated expenses were not fully used. The main reasons were:

- Metro Meat International did not bill the project for the Front End Loader hire. The pile turning was done as part of the normal operation of the composting activity.
- The curtailment of phase two of the project cut short the length of time available for the development of the production scale pile. The expenses associated with managing phase 2 were therefore reduced.

* Brentwood shredder used to shred sheep skins for phase 1 on the trials.