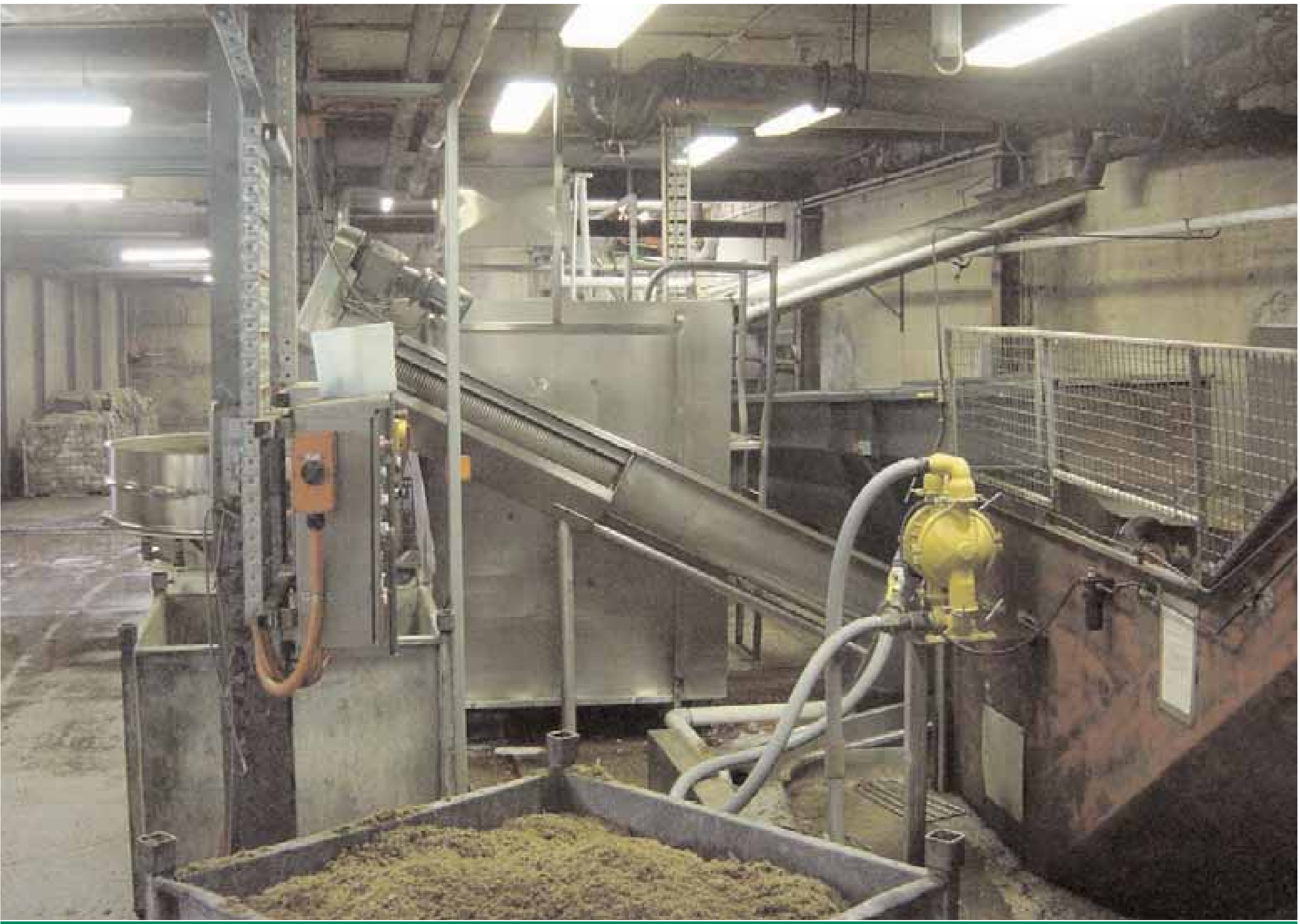

Waste solids

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Environmental Best Practice Objectives

- Achieve operation in compliance with statutory and licence conditions applicable to the plant
- Minimise the generation of solid waste and recycle or reuse where possible
- Minimise impacts on the environment associated with waste solids handling, treatment, storage and disposal.

Possible Environmental Impacts

- Soil contamination due to improper storage of waste
- Water contamination as a result of poor management of drainage water or leachate from waste stockpiles or treatment processes
- Atmospheric pollution by dust and odour from treatment operations or poorly managed stockpiles
- Unsustainable disposal of waste solids in a landfill
- Greenhouse gas production from energy consumed in treatment and transport of waste solids
- Effects on local amenity due to visual pollution from poorly located waste and redundant equipment stockpiles
- Food source and breeding ground for vermin, insects and feral animals
- Distribution of weed seeds through poor treatment processing.

Key Performance Indicators

KPI	Industry average (2003)
• Amount of solid waste to landfill • Packaging waste	• 15.6 kg/tonne HSCW

- These KPIs relate to medium to large integrated export abattoir facilities, processing > 100 t HSCW/day.

Current Legislation and Regulation	
Commonwealth http://scaleplus.law.gov.au/	• Environmental Protection and Biodiversity Conservation Act 1999 • National Environment Protection Council Act 1994
Queensland http://www.legislation.qld.gov.au/Legislation.htm	• Environmental Protection Act 1994 • Integrated Planning Act 1997 • Environmental Protection (Waste Management) Policy 2000
New South Wales http://www.legislation.nsw.gov.au/	• Protection of the Environment Operations Act 1997 • Environmental Planning and Assessment Act 1979 • Local Government Act 1993 • Waste Avoidance and Resource Recovery Act 2001
ACT http://www.legislation.act.gov.au/	• Environment Protection Act 1997 • Land (Planning and Environment) Act 1991
Victoria http://www.dms.dpc.vic.gov.au/	• Environment Protection Act 1970 • Health Act 1958 • Catchment and Land Protection Act 1994 • Planning and Environment Act 1987
South Australia http://www.parliament.sa.gov.au/dbsearch/legsearch.htm	• Environment Protection Act 1993 • Development Act 1993 • Public and Environmental Health Act 1987
Western Australia http://www.slp.wa.gov.au/statutes/swans.nsf	• Environmental Protection Act 1986 • Soil and Land Conservation Act 1945
Northern Territory http://www.nt.gov.au/lant/hansard/hansard.shtml	• Environmental Assessment Act 1982 • Environmental Assessment and Penalties Act 1996 • Waste Management and Pollution Control Act 1998
Tasmania http://www.thelaw.tas.gov.au/index.w3p	• Environmental Management and Pollution Control Act 1994 • Land Use Planning and Approvals Act 1993

Environmental Best Practice Overview

Waste management plan

Develop a waste management plan that includes:

- waste types and quantities generated
- waste management solutions
- opportunities for minimising waste
- staff training.

Reduce waste

- Consider lifecycle issues when purchasing an item
- Consider processing and packing procedures that minimise waste material.

Reuse/recycle

- Consider purchasing items made from recycled material
- Separate recyclable material from general waste
- Encourage/educate staff to separate recyclables
- Convert organic wastes into usable products.

Minimise waste to landfill

- Monitor & report amount of waste sent for landfill
- Eliminate recyclables from landfill waste.

Processing wastes on site

If processing organic solid wastes on site:

- consider the proximity of neighbours and the property boundary; and
- ensure processing does not contaminate the surrounding environment.

Compliance

- Ensure activities comply with regulatory requirements.

Best Practice Information

Operations at meat processing plants result in the production of a range of solid wastes. Some of these, such as manure and paunch contents, are an unavoidable result of the process, but the impact of others like packaging and equipment can be minimised by judicious purchasing and recycling.

The storage, processing and disposal of waste solids have the potential to lead to environmental degradation if not done correctly. The management of all waste solids should follow the cleaner production hierarchy below:

Cleaner production hierarchy

Most preferred option	**Avoid** – take measures to avoid the waste problem **Reduce** – try to reduce the amount of waste produced
	Reuse – try to reuse the waste for the same or a different purpose **Recycle or reclaim** – reprocess the waste into a new product
Least preferred option	**Treat** – treat the waste to reduce environmental impact **Dispose** – use only as a last option

The environmental management system (EMS) should include a waste management plan to assist with identifying and dealing with waste issues. The key steps in developing a waste management plan are to describe:

- the activities that generate the waste
- types and amounts of waste that may be generated
- how the waste will be dealt with
- procedures for identifying and implementing opportunities to minimise the amount of waste generated

- procedures for dealing with accidents, spills and other incidents that affect waste management
- details of management system employed to deal with the waste
- how often the performance of the management practices will be assessed
- indicators or other criteria on which the performance of the waste management practices will be assessed; and
- staff training.

Waste exchange databases are maintained in some Australian States. These are facilities that allow generators of waste to contact potential recyclers with the aim of reducing the amount of waste that is deposited in landfills. An example is the program developed by the Victorian EPA and the Victorian Waste Management Association which can be accessed through:

http://www.wastepro.com.au/welcome_exchange.asp

Further Information

- *Environmental Management Systems* [1]
- *Guidelines for the preparation of waste management plans* [2]
- *Environmental Protection (Waste Management) Policy 2000* [3] *http://legislation.qld.gov.au*

Screw presses achieve excellent moisture reduction in paunch solids

1.0 Organic Solid Wastes & Their Characteristics

A range of readily biodegradable organic wastes is produced as a result of meat process operations. Where a plant has sufficient land available and is not located adjacent to a sensitive population, these can be treated on-site to produce a useful and saleable by-product. For plants on sensitive sites, it is best to either transport it to another company-owned site for processing or engage a contractor to transport and process the material.

Typical characteristics of the organic solid wastes generated by meat processing plants include:

- **The quantity generated is directly proportional to animal throughput** and factors such as feed history of the animals, etc. In most instances this cannot be varied significantly due to animal welfare constraints.
- **Biodegradability**. The organic waste solids are very suitable for biological treatment (for example by composting) to produce stable, useful products. Good management of the process is required to minimise problems such as nutrient-rich leachates, odour and vermin.
- **Very wet**. Waste solids produced tend to have very high moisture contents (>85%). This makes them vulnerable to microbial activity and odour production. Care is also necessary to avoid contaminated liquid spilling during transport and processing.
- **Nutrients**. The organic wastes contain nutrients such as nitrogen and phosphorus. These are valuable for reuse. Good management is needed to prevent their loss through leachate and volatilisation.
- **Microorganisms**. The organic wastes contain high levels of microorganisms, potentially including pathogens. A well managed treatment process is essential to ensuring that the final product is safe for use.
- **Toxic compounds & heavy metals**. Meat processing waste solids arise from food manufacture and contain negligible levels of these compounds due to strict control of the supply chain.

When well managed, the organic solids from the meat processing industry are a valuable source of organic carbon and nutrients for many users.

Further Information

- *Waste assessment of contaminants in waste solids from meat processing wastewater streams* [4]

2.0 Organic Wastes Sources

The main types of organic solid waste generated during meat processing and an estimate of their typical (wet weight) quantities recovered is provided in Table 1.

Table 1 Organic Waste Solid Sources

Waste type	Typical quantity (kg/t HSCW)	Range (kg/t HSCW)	Source
Manure (cattle) Manure (sheep) Manure (lambs) Manure (truck wash)	10 per day 9 per day 5 per day	4 – 13 5 – 12 3 – 7 1 - 5	Cattle yards Sheep pens Lamb pens Truck wash
Paunch contents	45	25 - 70	Paunch emptying & washing
Gut contents		15 – 30	Mechanical gut cutting
Solids from primary treatment		150 - 300	Screenings, DAF float, bottom solids
Biological sludges from wastewater treatment	135	70 – 200	Waste activated sludge (10-15% solids)
Dead animals			Stock trucks, yards
NCV Skins			Slaughter floor
Human wastes			Septic tanks

The main quantities produced vary between different plants, but are typically:

- Manure & paunch contents
- Biological sludges, especially where modern aerated wastewater treatment is installed.

Bin of dewatered paunch solids

3.0 Best Practice Management of Organic Solid Wastes

3.1 Manure

Collection

It is preferable to collect manure dry to reduce the solids and nutrients entering the wastewater treatment system from animal holding yards. In unsealed yards, where collection is required, it can be done using a tractor with a front bucket attachment or a front-end loader.

When cattle are in paved holding yards, preliminary animal washing is normally carried out either with fixed sprays or hand-held hoses. Therefore manure and soil is washed away. This stream should be screened as soon as possible or directed to the paunch stream for screening.

Further Information

- *Best Practice Wastewater Treatment, Meat and Livestock Australia* [5]

The use of elevated pens with either mesh or slatted floors for smallstock, allows droppings to fall through to a paved area below. The manure can then be collected dry as necessary.

Manure under the floor of a sheep shed

The wastewater stream from the truckwash is normally combined with the yard washdown stream before primary screening to remove manure and solids.

Storage

The short-term storage of manure should not create a nuisance as long as it is done in an appropriate manner. Wet manure is best stored in a 3-sided bunker with a sealed floor and drainage that can be collected and directed to the sewer or effluent treatment system. Dry manure may be stockpiled on the ground but the area should be bunded to collect leachate in case of heavy rain.

3.2 Paunch contents

Collection

Cattle paunches are the major source of solid wastes from meat processing plants. The manner in which it is collected can have a large effect on the nutrient load of the effluent. Dry dumping of paunches has been advocated for many years and is now gaining wider acceptance in Australia. One study showed that conversion to dry dumping reduced the fraction of the total phosphorus load for the whole plant, generated by paunch processing, from nearly 50% to 16%.

The dry-dumped material can be of variable moisture content depending on the recent animal feed regime and this can pose a challenge when conveying it. Screw conveyors may be used over short distances and pneumatic or positive displacement pump systems over longer distances.

Dry dumping of beef paunches

Further Information

- *Evaluation of beef paunch contents handling practices* [6]
- *An assessment of dry paunch dumping in red meat processing plants* [7]

Paunches from a dry dumping operation will still require washing to remove the remaining material and the effluent from this process should be screened to collect the solids.

Paunch material from dry dumping will require dewatering as will the material from the traditional wet dumping. Different dewatering systems will produce material of differing moisture content. Dewatering systems in order of decreasing moisture are:

- Vibrating screens
- Wedge wire screens
- Screen press
- Screw press.

However, as more moisture is removed from the paunch material, a greater amount of nutrients will be lost with the liquor. It has been suggested that instead of directing this stream to effluent, it could be collected and used to add moisture back to the latter stages of a composting operation.

The paunch material should be dewatered to the extent suited to the subsequent transport and processing.

Dewatering screw system

Transport and storage

Paunch contents are often transported some distance either within the boundaries of the processing plant or over public roads to another site for stockpiling and processing.

When transporting within the site, a suitable vehicle should be used that prevents leakage. Transport off-site will normally require a licensed operator using a vehicle that eliminates release of offensive odours, liquor and solids. Procedures must be followed to ensure that the material is disposed of correctly.

If they are not to be processed immediately, paunch contents can normally be stockpiled without causing offence. The material should preferably be stored in a bunker with a sealed floor in which any leachate or rainwater is collected and directed to wastewater treatment. Under most conditions, a cover is not normally required but if this proves unsatisfactory, the material may be covered with a layer of inert material such as bark or woodchips. If stored on the ground, a compacted earthen or concrete pad should be used to prevent leaching into the ground. Any runoff should be collected for treatment.

3.3 Effluent primary treatment screenings

Collection

Primary screening of the effluent from a meat processing plant will produce a wet product consisting of meat scraps, fat and semi-digested feed that has been washed down the drains. This can be collected in a container or trailer that drains onto a concrete pad which in turn should drain to the effluent treatment system.

The collected material is attractive to flies, so the collection vessel should be covered or sprayed to control flies during summer.

Transport

During transport to the treatment or disposal site the drains from the container or trailer should be plugged to prevent liquid leaking out.

Processing

This material can be rendered or treated along with other solid wastes. Where the rendered products are produced for certain export and domestic markets, this material must be excluded. When included with normal rendering raw materials, screenings should be processed fresh otherwise the quality of the tallow may be affected.

This highly putrescible material should not be stored for longer than one day before mixing with other material for treatment. It should be stockpiled such that any leachate is collected and directed to effluent treatment.

Gut floor
static screen

3.4 Saveall and DAF top scrapings

Collection

Recovered fat and protein is continually or periodically scraped off the top of savealls and dissolved air flotation (DAF) systems. This is normally directed straight to a vessel for pumping to the treatment plant.
In some plants hydrocyclones are used to continuously recover fresh fat from the waste water stream. This recovered material may then be included with the normal rendering raw materials without downgrading the tallow.

Processing

The recovered material is normally only about 5% solids and a wet rendering process can be used to produce a low-grade “saveall” tallow. If the material cannot be rendered on site, composting is an alternative recycling option.

3.5 Biological wastewater treatment sludges

Anaerobic lagoons are efficient at digesting biological solids and normally accumulate bottom solids at a slow rate. The rate of accumulation will depend on upstream treatment and loading. When an anaerobic lagoon is desludged, options for managing the sludge include:

- application to suitable land
- drying in on-site drying beds; and
- dewatering to produce a cake that is transported off-site or treated on site.

Some processors operate secondary effluent treatment plants, such as activated sludge systems, from which waste biological sludge must be extracted on a daily basis. As collected, the sludge has a low solids content of about 1%w/v. It is therefore desirable to thicken or dewater the sludge in order to reduce the sludge volume to be disposed of.

This can be achieved by:

- settling in a tank to generate a thickened bottom sludge, or
- mechanical dewatering with addition of a polymer. In this case, the sludge can be concentrated to 10-20% solids using apparatus such as a decanting centrifuge or belt filter press.

At about 15% or higher solids content, waste activated sludge can be stockpiled for short periods without the need for special containment. However rainwater drainage from the stockpile site should be collected for treatment.

The dewatered sludge can be incorporated with other wastes for treatment.

Belt press sludge

3.6 Slaughter and boning waste

Medium to large size meat processing establishments either have an integrated rendering plant or a collection service from a contract renderer to recycle their processing wastes to valuable co-products. However, it is not economical for some small country plants to develop their own rendering facility and they may be too remote for a collection service. This gives them limited options for disposing of these wastes.

Options in this case include:

- **Burial**. This has been a common disposal method but can result in land or ground water contamination. It is not preferred.
- **Composting**. Aerobic composting procedures can be adapted for handling these wastes. The material must be incorporated with a considerable quantity of bulking agent such as sawdust, bark or woodchips. A ratio of 1:1 (v/v) has been suggested to balance moisture and nutrient requirements. Preferably they should only form a minor ingredient of the initial compost mixture which could also include manure and paunch contents. A mechanical aeration system may be needed to ensure adequate aeration. However odour generation is still likely to be a problem.
- **Dry Composting**. This technique has been developed to handle these highly putrescible materials. Similar methods have been developed in Australia and the U.S.A. where the materials are placed on a bed of bark or woodchips and covered with sawdust to a depth of at least 300 mm and left undisturbed for about 3 months or more. By this time most of the organic matter has broken down and the bones are brittle and easily broken. The operation should ensure that material remains well covered with sawdust to discourage birds and vermin. The pile may need to be covered with Hessian or similar material to ensure the sawdust cover remains intact.

This has been called ‘dry composting’ as no water is added or mixing done at this stage. The material can then be shredded and spread or further composted with manure and paunch material using turned windrows.

Further Information

- *Rotational bunker system composts sheep offal* [8]
- *Alternative waste management for country meat processors*, http://www.ncea.org.au/. [9]
- *Meat by-products as composting feedstocks* [10]
- *AGWISE Project, Book 2* http://www.ncea.org.au/,
- *Food Science Australia Meat Technology Update 02/5*
- *Cornell Waste Management Institute*, http://cwmi.css.cornell.edu/

3.7 NCV sheepskins

Depending on skin and wool prices, bare shorn pelts, predominately from merino cast-for-age ewes, may have little or no commercial value (NCV). It was the practice to bury these in deep pits with a covering of lime. However it was found that they sometimes took up to 20 years to degrade as they were buried in too great a concentration.

In the early to mid 1990s, when the problem of NCV skins was most severe, the Meat Research Corporation funded several projects to develop alternative uses for merino sheepskins and investigate more environmentally sustainable disposal methods. The recommendations for disposal of NCV skins were:

Rendering

Provided quantities were small and the wool short, sheepskins and skin pieces could be included with other raw materials for rendering. Whole skins may need to be manually cut into smaller pieces. If too much wool is included in the standard rendering process, the value of the meal will be reduced.

Burial

It was considered that, although not desirable, the practice of dumping large numbers of skins in clay-lined pits had not lead to environmental harm. The skins dry and lie inert in the ground for many years, slowly degrading. The skins could also be used to rehabilitate degraded land by laying them 3 to 4 deep and covering with about 100 mm of sheep manure and then with topsoil to a depth of about 100 mm. The topsoil is seeded and the treated areas recover with no apparent odour problem and the skins break down rapidly.

Storage

The skins are salted and stored in a shed until the price of sheepskins recovers sufficiently to cover costs.

Composting

Whole NCV skins can be composted with paunch manure and other meat processing wastes. Trials indicated that best results were achieved when a bulking agent such as pine bark was included in the mix and the compost was turned regularly with the addition of water as necessary. When no bulking agent was added, decomposition was slower and higher odour levels were experienced.

Further Information

○ *Disposal of NCV Skins* [11] *and Composting of NCV Skins* [12]

3.8 Dead stock

Sometimes, stock die during transport to the processing plant, or in the yards while awaiting slaughter. Normal practice has been to either process the bodies through the rendering plant or bury them on the plant property. Burial will require approval of the local council and EPA and, due to the possibility of land or groundwater contamination, is unlikely to be approved. Also, some importing countries will now not accept rendered products that have been produced from raw materials that may include dead stock.

Rendering is likely to be the most environmentally benign method for disposing of dead stock, but if it is not an option, disposal methods may be limited to:

- **Commercial landfill.** Some councils and commercial operators will accept dead stock for 'special burial' or disposal to a lined landfill where leachate is collected. They will have a scale of fees based on animal size.
- **Composting.** Dry composting techniques have been developed for processing stock that have died on farms. If the processing plant has a suitable site available, these composting techniques can be applied to the bodies of both smallstock and cattle. It is recommended that compost from animal carcasses should not be used to fertilise grazing land or crops that will be consumed directly by people.

Further Information

o *Natural rendering: Composting livestock mortality and butcher waste* [13]

Dry composting of dead stock

4.0 Best Practice Treatment of Organic Solid Wastes

The organic solid wastes produced from meat processing are eminently suitable to biological treatment processes. Due to their high moisture content, they are not particularly suitable for thermal energy recovery processes without extensive dewatering, which is typically uneconomic. Table 2 summarises current best practice technologies. Composting is the most commonly used.

Table 2 Treatment options for Organic Wastes

Disposal method	Suitable for	Comments
Composting	All organic solids	Composting is by far the most accepted method for treating and recycling nutrients present in all organic wastes from meat processing. Several techniques may be utilised but all produce a stable final material that can be sold as a soil conditioner or ingredient in a potting mix. However the value of the compost may not fully recover the cost of production. The main problem encountered is odour complaints from neighbours in sensitive areas.
Dry composting	Dead animals Slaughter & boning wastes	The pile may need to be covered to protect from the elements and discourage scavengers. A further composting process may need to follow to produce a usable product.
Anaerobic lagoons	Paunch solids Aerobic treatment sludges	The use of an anaerobic lagoon will digest about one third of the paunch material but the lagoon will silt up more rapidly requiring expensive dredging and disposal of the sludge.
Anaerobic digestion	Paunch contents Manure	This is a more sophisticated form of an anaerobic lagoon where the waste is digested in a sealed stirred tank. Biogas is produced (approx 60% methane) which may be flared off or used as a fuel. After 10 – 30 days the solids are separated from the liquid and further stabilised or applied directly to land.
Surface spreading	Paunch contents Manure Anaerobic pond sludge	Although widely used in the past and inexpensive it will now require a permit. It is not preferred as there are environmental concerns as well as the risk of distributing weed seeds.
Sub-surface Injection	DAF sludges Paunch contents Aerobic treatment sludges	Direct soil injection can be practised with the approval of the EPA. It has the advantage of reducing the fly problem but the long term effect on the soil should be monitored.
Ensilage	Paunch contents	Trials have been conducted in the U.S. to produce a cattle feed but paunch has a low feed value and the cost of production and possible negative publicity discourage the process.
Rendering	Primary effluent screenings DAF float	The inclusion of screenings and DAF or saveall scrapings may exclude rendered products from certain markets. A low quality tallow is produced.
Vermicomposting	Manure Paunch contents Aerobic treatment sludges	Worms will readily digest manure and paunch material and the resulting vermicast is claimed to be of high value, but the process requires significant investment and management. Several operations have been successful whereas others have failed.

Composting is discussed more fully in Appendix A.

4.1 Waste to energy

A review was recently completed of technologies that may be suited to production of energy from meat industry wastes. The review considered:

- thermal
- biological
- thermochemical; and
- chemical processes.

> **Further Information**
>
> - *Review of waste solids processing and energy capture technologies* [14]

At present, application of waste to energy technologies in the meat industry in Australia is almost non-existent. This is mainly because the technologies are unlikely to provide an economic advantage over current practices. Major factors in this are the high water content of meat wastes and the comparatively low energy costs in Australia. The capital and operating costs of most waste to energy processes exceed the possible revenues obtained from sale of the electricity generated.

Experience overseas and in other industries has shown the financial viability of conventional waste to energy plants is normally accomplished through fees paid to plant operators by waste generators for disposal of wastes.

However, if there is some future development in Australia, such as a BSE outbreak, and the present practices of rendering and composting cannot be continued, more expensive technologies, such as waste to energy, may have to be applied. Technologies that appear to be most suitable for wet meat wastes include:

- thermal pressure hydrolysis; and
- thermal depolymerisation and chemical reforming.

4.2 Choice of technology

Considerations regarding the choice of technology to handle meat industry solid wastes include:

- Capital and operating costs
- Availability of processing site, equipment and skills required for the process
- Potential adverse effects on the environment
- Opportunities to outsource the technology
- Regulatory constraints
- Quantity & characteristics of the product
- Product market and value.

Gas engine, running on biogas

5.0 Best Practice Management of Packaging Wastes

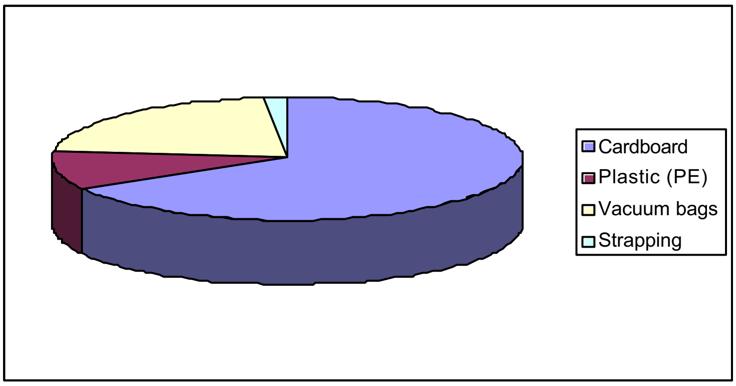
Relative to other industries, the meat industry is a heavy user of packaging materials. Recycling rates for many of the packaging components can be low. Best practice management of packaging wastes involves full use of cleaner production hierarchy principles to achieve the best environmental outcomes.

Estimated total usage of packaging materials and waste produced is summarised in Table 3 and Figure 1 from a 1996 report to MLA.

Table 3 Estimated quantities of major packaging materials used by the Australian meat industry

Packaging	Domestic (tonnes)	Export (tonnes)	On-plant waste (tonnes)	Total (tonnes)
Cardboard	14,191	28,568	985	43,745
Plastic (PE)	232	2,471	141	2,735
Vacuum bags	1,607	1,681	320	3,608
Strapping	375	781	23	1,179

Figure 1 Estimated proportions of packaging wastes



Best management of packaging wastes is detailed below for the major materials.

5.1 Cardboard

Waste cardboard occurs from packaging for consumables and equipment delivered to the site and as waste from the packaging of the meat products. Most cardboard can be readily recycled.

Avoid/Reduce

- Do not use or purchase items in waxed cardboard as it is difficult to recycle
- Ensure that new fibreboard packaging is not damaged on arrival and during storage
- Use handling procedures that do not damage cartoned meat to minimise re-packing
- Consider automated carton assembly, as there is up to 50% less packaging waste than with manual assembly due to reduced rejects.

Further Information

- *Trends and future regulatory issues concerning packaging material used in the Australian meat industry* [15]

Reuse/Recycle

- Provide recycling bins for waste cardboard and paper in a convenient position and ensure that all appropriate waste is deposited there
- Purchase fibreboard cartons that have been made from predominately recycled material
- Utilise reusable packaging systems, such as Pallecons, for transport of meat.

Treat/Dispose

- Try to avoid depositing waste cardboard and paper in with general rubbish.

Recycling – cardboard bales

5.2 Plastic

A high percentage of the plastic waste from meat processing plants results from the packing process and consists largely of plastic bags and strapping.

Avoid/Reduce

- The amount of waste from the vacuum packing can be reduced by:
  - choosing the correct bag size to reduce off-cut
  - using a supply of bags on perforated rollstock rather than loose bags that may be dropped on the floor
  - installing equipment that produces bags to length from continuous tube stock.
- Where possible seal cartons using automated gluing machines rather than strapping to reduce waste strapping.

Reuse/Recycle

- Some plastics such as shrink and stretch wrap and bags and liners are made from polyethylene. Provided these are not contaminated with blood, they can be collected in a separate bin for recycling.

Treat/Dispose

- Vacuum bags are made from multiple layers of different plastics co-extruded to form a film and are not readily recyclable
- Heat sealable strapping used in the meat industry is made from polypropylene and is not readily recyclable
- Landfill is currently the only acceptable method for disposal of most plastic film and strapping.

Further Information

- *Trends and future regulatory issues concerning packaging material used in the Australia meat industry* [15]
- *MLA Packaging advisory package* [16]

5.3 Drums

Meat processing plants receive cleaning chemical, lubricants, etc in either plastic or steel drums.

Avoid/Reduce

- When purchasing these items, consider buying the largest containers practicable where compatible with OH&S practices. It is easier to deal with one empty 50 L container than 5 empty 10 L containers.

Reuse/Recycle

- When purchasing, look for the drumMUSTER logo or drums that can be recycled or reused. These can be collected and recycled by your local agent or delivered to a recycling depot. drumMUSTER is a national program aimed at farm chemical containers and supported by chemical suppliers, the National Farmers Federation and the Australian Local Government Association for the collection and recycling of used chemical containers. Suppliers of pest control chemicals may be a member of drumMUSTER.
- Containers without the drumMUSTER logo may also be able to be recycled.
- Before containers are returned for recycling, they should be rinsed properly to remove any chemical residue.
- Drums should be stored in a suitable location prior to recycling or disposal. Particular care needs to be taken to ensure that chemical or petroleum residue does not contaminate the surrounding area.

Treat/Dispose

- Avoid disposing of plastic or metal chemical containers to landfill.

Further Information

- *Refer to the drumMaster website:* http://www.drummuster.com.au [17]
- *Method to properly rinse containers* [18]

6.0 Best Practice Management of Inorganic Solid Wastes

6.1 Boiler ash

Many Australian meat processing plants operate coal-fired boilers to produce steam for rendering and production of hot water. In many parts of the country, coal is the cheapest form of energy but ash handling and disposal is an added cost.

- To eliminate coal and ash handling consider converting to clean burning, gas-fired boilers
- Coal can have an ash content from as low as 3% to over 20%. If convenient and suited to the boiler, purchase coal with a low ash content
- Collect ash in a properly designed bunker or hopper. This should contain the ash so that no dust is generated either during storage or during collection for removal
- Boiler ash can be blended in with other waste materials at an on-site composting operation
- Any storage at the composting site should be done in a manner that minimises dust
- Ash may be collected by a contractor for disposal or use or treatment off-site.

Fly ash

Further Information

- *An experimental study of the effect of coal blending on ash deposition* [17]

6.2 Redundant plant and equipment

Most meat processing plants have an equipment ‘graveyard’ where redundant items are stored until they are either reused or scrapped. If not managed properly, this area can become unsightly and be a haven for vermin.

If it cannot be remotely located, the area should be surrounded by a solid fence and kept tidy by regular mowing and weed and vermin control.

7.0 Best Practice Management of Other Wastes

7.1 Paper towels

A large quantity of paper towel waste is generated at personnel wash stations at entry and exit from processing areas. If this waste can be kept separate from other wastes such as plastics, rubber and general waste, it can be collected for recycling or incorporated in a composting operation.

- Consideration should be given to providing separate bins with appropriate signage for paper towels
- Personnel should be encouraged and educated to use them correctly.

7.2 Office paper

Most offices will produce significant quantities of clean waste paper and shredded paper.

- Where suitable recycling collections are available, bins should be provided for exclusive collection of this paper
- Staff should be encouraged to deposit paper in recycling bins rather than with general rubbish
- If recycling facilities are not available, consideration could be given to including shredded paper in an on-site composting process.

7.3 Canteen wastes

Wastes produced in staff amenities include food scraps and packaging as well as recyclables such as aluminium cans and PET and cardboard drink containers.

- Where suitable recycling collections are available, suitably labelled separate bins should be provided for:
  - Aluminium cans, and
  - Plastic bottles.
- Staff should be encouraged to deposit recyclables in the appropriate bins rather than in general rubbish.

7.4 Human wastes

Due to their location, the majority of meat processing plants are not connected to a municipal sewerage system. Human wastes are normally treated in a septic system and the sludge from septic tanks may need to be pumped out at regular intervals.

- The septic system should be pumped out by a licensed contractor using suitable equipment with a sealed vessel
- The septic sludge should be removed from the site and not mixed with meat processing wastes.

8.0 Monitoring & Reporting

Quantities of solid waste to landfill and the quantity of packaging waste generated should be recorded in order to gauge whether plant performance is in line with reported industry averages and whether improvement is being made. The results of monitoring should be regularly reported to plant management.

Presented below are suggested methods of recording:

- amount of solid waste to landfill; and
- packaging waste.

8.1 Amount of waste to landfill

The amount of waste to landfill can be estimated from the volume and number of bins filled. This should be expressed as weight to landfill against production (ie kg/t HSCW). The two most recent surveys conducted by MLA revealed widely varying quantities of waste to landfill between the plants and for the same plants between surveys. The 1998 survey suggested a benchmark of 5 kg per tonne HSCW for solid waste to landfill whereas the 2003 survey recorded a score of 15.6 kg/t HSCW.

The aim should be to continually reduce the amount of waste to landfill in proportion to production.

Further Information

- *Benchmarking of environmental performance* [20]
- *Industry environmental performance review of integrated meat processing plants in 2003* [21]

8.2 Packaging waste

Packaging waste falls into two categories; wastes that can be recycled, such as cardboard and uncontaminated polyethylene and non-recyclables, such as vacuum bags and strapping. Recording and monitoring the quantities (kg/t HSCW) of these wastes may give an indication of operational problems in parts of the plant.

9.0 Contingency

Contingency plans should be formulated to ensure that solid wastes from the processing plant do not lead to public nuisance or damage to the environment due to events such as:

- equipment failure
- transport breakdowns
- accidents
- extraordinary rainfall.

10.0 References

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Appendices

Appendix A: Composting

Composting can be defined as a biological process in which organic matter is broken down under aerobic and thermophilic conditions into a humus-type end product with by-products of carbon dioxide, water and heat.

A wide range of organic waste materials produced by meat processing plants are suitable for composting.

A variety of composting methods are available. These include:

- static windrow
- turned windrows
- aerated static pile
- in-vessel systems.

Static windrows rely on passive aeration to provide oxygen. Air enters the pile through a combination of diffusion and convective movement through the compost. The size of the windrow and the porosity of the material affect how well this works.

Static windrow composting is suitable only for wastes with a low content of readily biodegradable substrate and an open structure. Wastes with a greater oxygen demand may be diluted with a coarse, porous inert bulking agent.

With static windrows, anaerobic conditions and sub-optimal temperatures are unavoidable and stabilisation periods may range from 6 months to 2 or more years.

Turned windrows are aerated by periodically turning or agitating the compost. This also loosens the structure of the material to facilitate passive aeration and heat removal. A front-end loader or a specialised turning machine is commonly used.

Wastes with higher oxygen demand can be composted and larger windrows can be used than with static windrows. The frequency of turning required to prevent nuisance odours and achieve rapid stabilisation will depend on the waste's oxygen demand and porosity. Stabilisation periods of less than three months are achievable for some wastes.

Aerated static pile composting uses a fan and air distribution system to provide oxygen to the compost. The windrow can be formed over an aeration base and air distribution system or the material can be partially enclosed in a bin with a perforated floor.

Temperature-controlled aeration has been found to give good results where air is supplied to maintain a maximum compost temperature of about 60°C. Forced aeration is normally used but induced aeration has also been applied.

Aeration is normally applied for 3 – 4 weeks during which most of the readily biodegradable material is broken down. This is followed by curing in non-aerated piles for several more weeks, with periodic turning to promote additional stabilisation and ensure a uniform structure and moisture content.

Temperature-controlled forced aeration composting is best suited to stabilising organic wastes that contain highly biodegradable material that have the potential for high oxygen demand.

In-vessel systems utilise a higher degree of control again than aerated windrows. In these systems the compost is normally agitated by rotating the vessel into which air is injected at a rate to control the temperature and provide sufficient oxygen.

This is a highly capital-intensive system best suited to large municipal or commercial composting organisations.

Immature compost row

Composting site

It can be difficult to compost meat processing wastes without generating some odour or dust. Therefore, it may be best for plants located in a sensitive area to transport wastes off-site for processing. If composting on-site, the siting of the composting operation should take into account, the position of neighbours, the position of the office and edible operations, prevailing winds and the distance from property boundaries.

Approximately one hectare of land will be required for every 60 m^3 of waste solids processed per week. The site should be suitable for all-weather operation and be reasonably level and well-drained such that ponding of rainwater does not occur. Runoff should be collected and directed to the effluent treatment system.

A sealed area should be provided for mixing the wastes and bulking agent if used and suitable storage facilities supplied for wastes delivered to the site. A three-phase power supply may be required if a screening plant is provided and a water supply (not necessarily potable) should be provided to allow addition of moisture to windrows and for use in dust suppression.

Further Information

- *Recommended techniques for composting meatworks wastes*
- *Organic waste management strategy M.682*
- *AS 4454-2003, Composts, soil conditioners and mulches*
- *AS 3743-2003, Potting mixes*

Labour and equipment

The labour requirement for a plant processing 500 cattle per day would be about 4 man-hours per day for the collection and composting of wastes.

The minimum equipment suggested for a forced aeration composting operation is:

- A front-end loader with a 1 m^3 bucket and a lift height of 2 m.
- In the case of the aerated static pile method:
  - Three aeration bases with suitable ducting.
  - Three fans and control units.
- A finished compost screening plant.

Compost quality

The compost operator should aim to produce a consistent product, especially in relation to:

- moisture
- pH
- colour
- odour
- particle size.

This may require a consistent raw material and regular monitoring of the process. The finished product should be regularly analysed for pH, moisture and nitrogen.

There may be marketing advantages in producing a product to Australian Standard AS4454-2003 Composts, soil conditioners and mulches.

Marketing

Compost from abattoir wastes can be sold as a soil conditioner, organic fertiliser or ingredient in a potting mix. Value may be added by bagging the product or tailoring to specific markets by screening to a specific size or supplementing with inorganic nutrients.

A recent study showed that meat industry wastes from which composts are produced contained negligible quantities of contaminants such as heavy metals and pesticides.

A study of the Australian market for abattoir compost in 1995 estimated that approximately 17 million cubic metres per year could be produced from Australia's abattoirs. Potential markets for the compost were the urban, horticultural and agricultural segments. The urban and horticultural markets were likely to provide the best return but in order to market all the potential compost, the agricultural market would need to be developed.

A meat processor should develop a marketing plan for the product before establishing a composting operation. The main information required to develop a marketing plan is presented below.

- Identify the main markets within a reasonable distance (say up to 50 km) of the abattoir
- Estimate the quantity and quality of the compost that can be produced
- Match the estimated production with the main potential markets, to ensure that the abattoir can meet the needs of the local available market
- Identify sources of bulking materials for producing the compost
- Determine the market size and price for the compost
- Identify competing products.

In many cases the meat processor may not be interested in producing and marketing the compost. It may be better to engage a contractor, who has an existing marketing network, to collect the wastes and produce the compost.

No matter which marketing method is used, it is likely that full cost recovery is not possible; only an environmentally acceptable and lower cost disposal route for solid waste.

Further Information

- *Organic waste management strategy* [22]