Meat Processing

Introduction to the red meat processing industry

TABLE OF CONTENTS

MEAT LANGUAGE

Term	Definition
AQIS	Australian Quarantine Inspection Service
AUS-MEAT	Authority for Uniform Specification of Meat and Livestock: is the national industry owned organisation responsible for the objective description of Australian meat and livestock. AUS-MEAT also provides monitoring and accreditation of quality assurance systems for livestock producers, abattoirs, feedlots and wholesalers.
BOD	Biochemical oxygen demand: a measure of the quantity of dissolved oxygen consumed by micro-organisms that breakdown the biodegradable constituents in wastewater
Boning Room	The physical area where carcase meat is cut down into smaller portions and prepared for packaging
By-product	A secondary or incidental product made as a result of manufacturing an original product. In the meat industry 'by-product' often refers colloquially to the products of the rendering plant.
Carcase	The name given to an animal after it has been slaughtered and dressed
Carcase dressing	The process of removing the hide/skin and viscera from an animal following slaughter and its subsequent trimming and presentation for further processing for human consumption
Carcase specifications	The means of describing required carcase characteristics when ordering meat
COD	Chemical oxygen demand: a measure of the quantity of dissolved oxygen consumed during chemical oxidation of wastewater
Cross contamination	When contamination is passed from one surface to another. Examples include carcase to carcase and worker to carcase contamination.
DAF	Dissolved air flotation, a type of wastewater treatment technology
Electrical stimulation	Electrical stimulation is the application of an electric current to a carcase soon after slaughter. Its main benefit is to reduce meat toughness as a result of carcases with 'active' muscles being placed in very cold chillers. Other benefits include improved bleeding of the carcase, improved meat colour and reduced amount of 'drip' from meat cuts.
Hide	The outer skin of cattle removed after slaughter
Livestock	Animals kept on a farm, and would commonly include sheep, cattle, pigs, goats, deer, alpaca
Meat processing plant	The 'factory' where the animals are processed resulting in meat and meat by-products. In Australia, meat processing plants are also commonly referred to as meatworks or abattoirs.
Mutton	An older sheep, defined by having one or more (up to 8) permanent incisor teeth
Offal	Edible internal parts of an animal, eg: heart, liver, kidney
Paunch	The stomach and its contents in sheep and cattle
Portion Control	The preparation of specific cuts of a given weight and cost, particularly for the food service trade, allowing uniformity of serves and determination of cost per portion
Potable water	Water suitable for human consumption
Race	Narrow walkway or passage
Rendering	The process undertaken to convert by-products (secondary meat and animal products) into value added products such as tallow, meatmeal and bloodmeal
Saveall	A device for physically separating solid and floating phases from wastewater
Service kill	Slaughter and processing of animals for a third party
Skin	The outer skin and wool combination removed from a sheep or outer skin and hair combination removed from a goat after slaughter
Slaughter Floor	The physical area in an abattoir where an animal is slaughtered and processed to a carcase
Stickwater	The liquid waste from rendering plants; particularly the water-rich stream from tallow polishing centrifuges. Blood stickwater refers to the liquid phase after steam coagulation of blood.
Stunned	Rendered unconscious
Tallow	Refined fat produced from beef animals
tHSCW	Tonnes Hot Standard Carcase Weight as determined using the AUS-MEAT standard
Veal	Meat produced from a calf
Viscera	The digestive tract of an animal

1.0 Overview of the Red Meat Processing Industry

Many products of the red meat industry are used daily in nearly all aspects of our lives. While many enjoy a BBQ and wear leather shoes, few have an understanding of the process undertaken between the farm and retail shop, or of the scope of the industry that produces these products.

While meat is derived from a number of sources, this module focuses on the processing of:

- beef and veal
- sheepmeat and lamb
- goatmeat

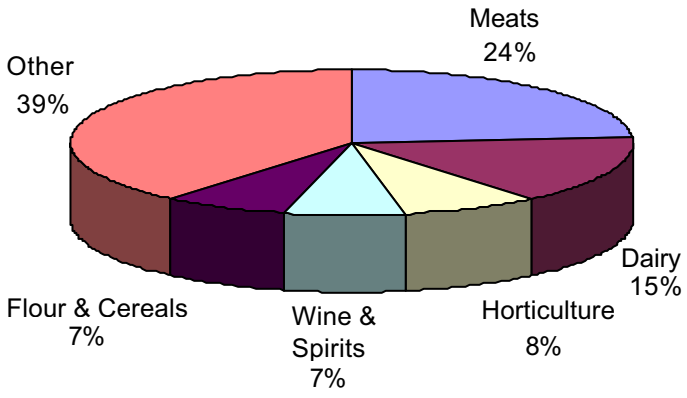
This module provides an introduction to the red meat processing sector, an overview of the industry, including the processes undertaken; and the various challenges it confronts, particularly environmental challenges.

1.1 Industry value

The red meat processing sector is one of the largest sectors within Australia's food processing industry and is a large employer, dominating the scape of many regional cities and towns. In 2000/01 the red meat processing sector:

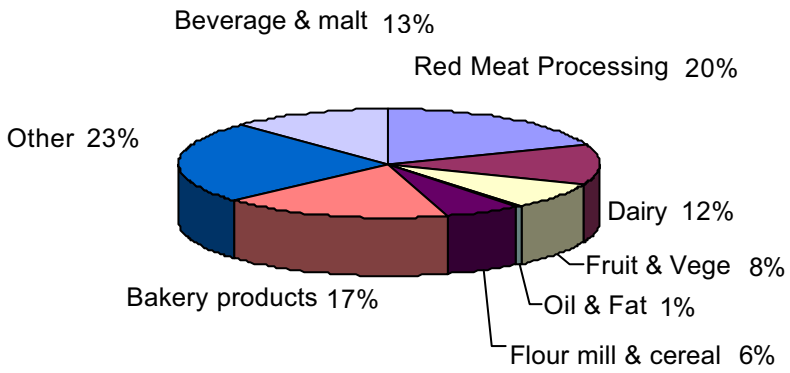
- accounted for around 24% of total economic value within Australia's food processing industry; and
- employed approximately 28,000 people.

Figure 1: Value of meat within the food processing sector (2000-01 data)



Source: Australian Food Statistics 2003, AFFA

Figure 2: Employment in the Australian processed food industry (2000/01)



Source: Australian Commodity Statistics 2003, ABARE

As well as supplying quality meat to domestic consumers the Australian red meat industry exports to over 100 countries around the world. Exporting is vital to the Australian red meat industry with Australia rated as the largest meat and livestock exporter in the world, despite being a relatively small producer overall – only producing 9% of the world's lamb and mutton supply and 4% of the world's beef and veal supply.

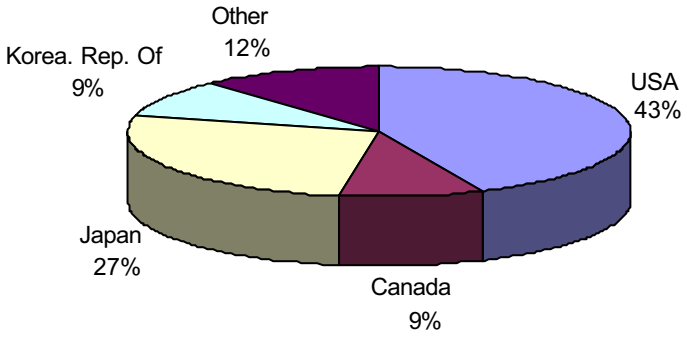
QUICK FACTS

- *The total value of Australia's off-farm beef and sheepmeat industry was $14.5 billion (2002/03 figures - MLA estimates and ABS statistics).*
- *The total value of domestic consumer expenditure for beef and sheepmeat is approximately A$7.7 billion (2003 figures - MLA estimates).*
- *The total value of Australian beef and sheepmeat exports is A$4.2 billion (2003 figures - DAFF volumes, ABS unit values).*
- *The total value of other products associated with the red meat industry is A$2.6 billion (2003 figures - DAFF volumes, ABS unit values).*

Over 60% of Australian beef production is exported (893,300 tonnes in 2002/03). The largest customers for Australian beef in recent years have been:

- United States of America (USA)
- Japan
- Republic of (South) Korea.

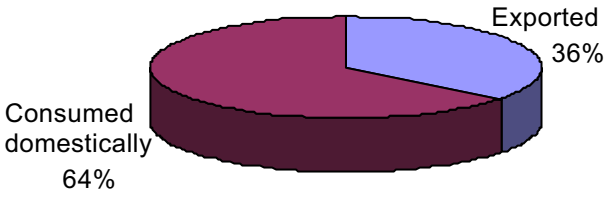
Figure 3: Export markets for Australian Beef



Source: Australian Commodity Statistics 2003, ABARE

Although 68% of lamb and 38% of mutton produced in Australia are consumed domestically, Australia is the world's largest exporter of mutton and the second largest exporter of lamb.

Figure 4: The export and domestic disappearance of Australian lamb and sheepmeat



Source: Australian Commodity Statistics 2003, ABARE

Australia is a relatively small producer of goatmeat but in 2002/03 was the largest exporter. Australian goat slaughter in 2002/03 was around 1.1 million head, with approximately 15,000 tonnes of goat meat exported to key markets, including:

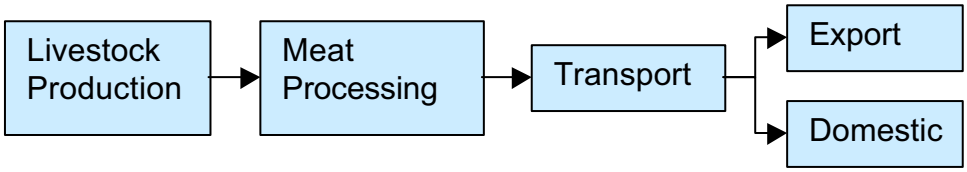
- USA
- Taiwan
- Canada.

The value of Australian goatmeat exports in 2002/03 was valued at over $46.9 million.

1.2 Industry structure

The meat production chain consists of a series of integrated sectors, from on-farm through meat processing to final sale to consumers. The meat processing sector is the link between on-farm production and retail.

Figure 5: The meat production chain



Source: Work arrangements in the Australian Meat Processing Industry – Labour Market Report, 1998.

The red meat processing sector consists of a diverse range of establishments from small, family owned businesses processing less than five tonnes of carcase product per day, through to large corporate firms, processing over 600 tonnes of carcase product per day. These establishments vary in the:

- type of animals processed;
- proportion of production exported;
- proportion of production boned or processed on behalf of others; and
- geographic location.

Table 1: Varying characteristics of meat processing plants

Characteristic	Ways that establishments may vary
Location	• By State (differing legislative requirements)
Ownership	• Family owned vs. corporate • Australian vs. overseas
Throughput	• Ranges from less than 5 tonnes of carcase product per day to over 600 tonnes of carcase product per day
Type of service	• Service kill only • Part-service, part-own account • Own account only
Processing level	• Slaughter floor only • Boning room only • Slaughter floor plus integrated boning room • Slaughter floor, boning room plus further processing (eg portion control)
Market	• Export (licensed by country) • Domestic
Production type	• Single-species plant • Multi-species plant

CASE STUDY

The following table summarises four case studies based on actual data, demonstrating the diversity of operations within the red meat processing sector.

	Company 1	Company 2	Company 3	Company 4
Annual throughput (Estimated Tonnes Carcase Weight)	399,788	35,200	30,985	10,400
No. of abattoirs	4	3	1	1
No. of employees	4,800	250	350	60
% exported	85%	0%	100%	0%
Species processed	Beef only	Beef, sheep and pigs	Beef, sheep, deer, veal, and goats	Sheep and lamb

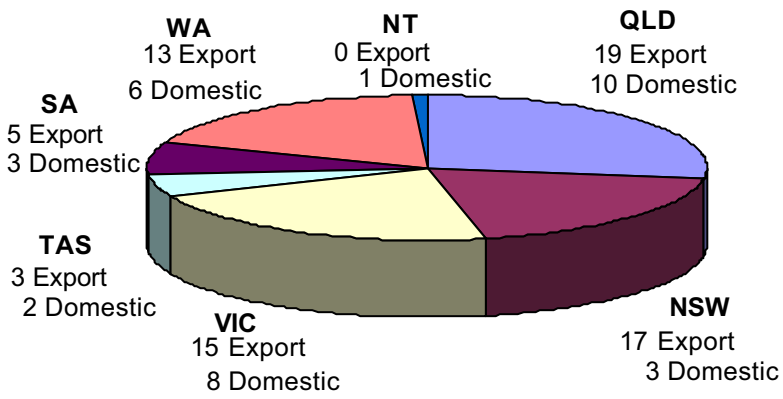
- *Company 1 is a large corporate company operating four beef processing plants, employing more than 4,800 people, and is integrated with four feedlots. The main facility processes 18,000 cattle per week and is the single largest processing establishment in Australia. They sell beef to both the export and domestic markets.*
- *Companies 2 and 3 are both multi-species processing plants with similar throughput and employees, however they target different markets. Company 3 may be subject to additional legislative requirements if the country that it exports to has requirements over or above the Australian Standard.*
- *Company 4 is a small family operated business targeting the domestic market only.*

Like many other agricultural industries in Australia, the red meat processing industry operates in highly competitive domestic and international markets. It has seen a considerable number of plant closures and a trend towards consolidation over recent years.

Despite a significant reduction in their number over the past decade, red meat processing establishments remain widely distributed throughout Australia. The majority of AUS-MEAT accredited abattoirs in Australia are located within the grain-livestock belts of Victoria, New South Wales and southern Queensland.

An abattoir that has accreditation through AUS-MEAT has systems in place and can provide assurances on the quality of the product. The labelling and description of the product is a standard system used domestically and internationally for Australian product. AUS-MEAT accredited abattoir systems are audited by AUS-MEAT.

Figure 6: Number of AUS-MEAT approved processing plants in Australia



Source: AUS-MEAT Accreditation List 2004

FURTHER INFORMATION

- *An up-to-date list of plants is available from AUS-MEAT or on their website www.ausmeat.com.au*
- *Information about the highest trade value abattoirs is available in the Feedback Magazine 'Top 25 Processors', Meat and Livestock Australia, 2004* [7]

1.3 Meat processing and hygiene

Meeting community expectations for environmental management as well as food safety is a particular challenge for the red meat processing industry. A conflict often arises between the requirements for safe food production and good environmental management.

Two examples of the contradiction between safe food production and environment are:

- Meat is required to be refrigerated to minimise growth of spoilage / health risk organisms, however refrigeration is a tax on energy consumption.
- The preparation of safe product during processing is aided by the use of water to wash contaminants from carcases. This procedure however, while important for food safety, places a high demand on water resources.

The red meat processing industry is faced with ever increasing environmental pressures, such as:

- stricter wastewater quality requirements
- tighter environmental emission regulations
- higher community expectations.

Environmental efforts in the red meat processing industry have focussed on the:

- reduction of water consumption

- effective treatment and utilisation of wastewaters
- utilisation of animal by-products
- reduction of energy consumption
- reuse of waste solids
- reduction in odour
- reduction in noise.

To ensure that meat and meat products for human consumption comply with food safety requirements and are wholesome, strict regulations govern the meat processing industry, including:

- All processing plants must be licensed and meet the requirements of the *Australian Standard for the hygienic production and transportation of meat and meat products for human consumption (AS 4696-2002)*.
- To be eligible to produce meat for export to specific countries, processing plants must be licensed by AQIS and accredited by AUS-MEAT.

The need for high levels of sanitation and the need to keep the product cool results in meat processing plants using very large quantities of water and energy to ensure food safety requirements are met. The ability of a meat processing plant to reduce usage of these resources or to improve efficiency is often limited by the stringent food safety regulations in place, rather than a plants' willingness to improve their environmental performance. Examples of options that could be adopted to improve efficiency of resource use may be water reuse and recycling.

Boot washing facility

FURTHER INFORMATION

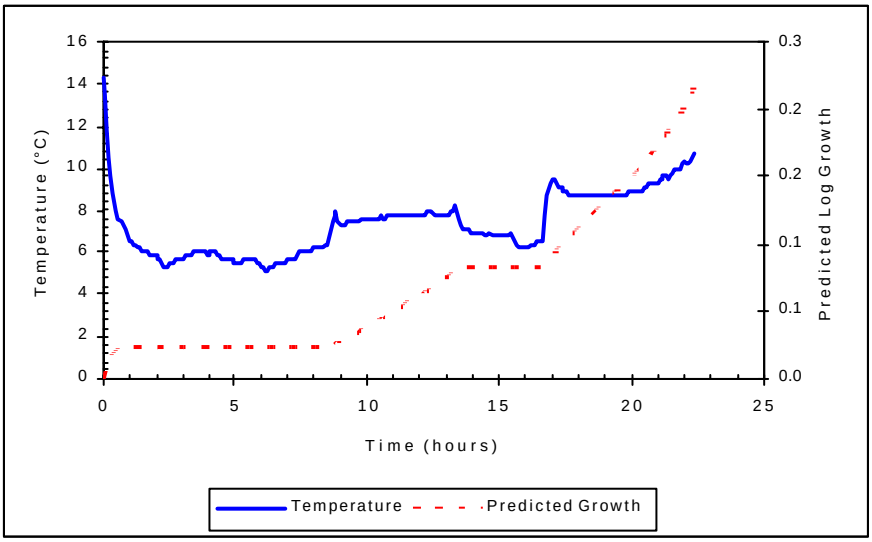
For further information, please refer to:

- *Australian Standard for the hygienic production and transportation of meat and meat products for human consumption (AS 4696-2002)*[2]

Predictive modelling is used as a means to monitor food safety. The Australian Standards impose requirements on temperature over time to minimise the amount of microbes on meat product. Figure 8 shows the predicted growth of *E.coli* using

time and temperature data.

Figure 7: Example of predicting *E.coli* growth using time and temperature information



Source: Calculation using E.coli Predictive Model developed by the University of Tasmania.

To avoid carcase contamination hygienic practices, such as regular hand washing, and the washing and sterilising of equipment are undertaken. Commonly known terms in the Australian meat processing industry today are those of Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP). GMPs and GHPs take a common-sense approach to discern whether an action or stage of a process will influence the food safety aspect of a product. The Australian Standard requires:

- Hand, apron and boot wash areas located at entrances to all 'clean areas', where staff are to wash their hands, aprons and boots before entering and exiting. Hand wash stations are also located throughout process areas.
- Knives, steels and other equipment used in processing, to be washed and sterilised regularly, and whenever chance contamination has occurred.
- Any hooks, rollers, skids or gambrels used during slaughter, dressing and chilling are to be cleaned or sterilised between uses on dressed carcases.
- Head hooks are to be sterilised between heads.
- Water for sterilisation of equipment to be 82 C or above.

Hand-washing and sterilisation unit

1.4 Product outputs

While the major product from beef cattle, sheep and goat production is meat for human consumption there are many by-products that result. The nature of meat processing means that for every unit of meat produced there is a proportional amount of other materials produced, such as:

- offal
- hides/skins
- fat
- blood
- manure
- paunch contents.

By-products are often a forgotten part of meat production, but they are significant, both in terms of their value ($A2.6 billion in 2003) and their use in nearly all aspects of our daily lives.

Table 2: By-products of meat processing

By-product	Possible uses
Hides and skins	• Leather for goods like shoes, handbags, jackets and furniture; wool
Fat	• Edible tallows (eg frying fats, shortening for baking, oil for use in bakery products, confectionery and industrial margarine); inedible tallows (eg soap and cosmetics, lubricants, leather dressings, candles and tallow for tanning leather)
Blood	• Dried for use as fertiliser; manufacture of high value therapeutics; the various components of blood such as albumin, fibrinogen and blood cells may be collected separately, mainly for use in laboratory procedures
Lungs, liver, kidney and heart, tongue and brains	• Trimmed and packed for human consumption; pet food; rendered into meat meal
Horns and hooves	• Glue and Neatsfoot oil
Bone	• Bonemeal for production of fertiliser, glue, bone china and bone charcoal
Intestines	• Smallgoods casings and strings for musical instruments
Hair	• Artists' brushes; as a binder in asphalt paving and plaster
Manure	• Sold as is or combined with other materials, such as sawdust, green waste, paunch manure and no commercial value (NCV) skins, in a composting process. Suitable for agriculture, landscaping, home lawns and gardens
Ovaries	• Oestrogens and progesterone
Pancreas	• Insulin and trypsin
Pituitary	• Adrenocorticotropic hormone (ACTH)
Testes	• Hyaluronidase

The conversion of by-products into saleable product reduces environmental burdens by diverting waste away from landfills. However meat processors must manage other subsequent environmental impacts.

For example, rendering, while it recovers tallows and meal for beneficial use, greatly increases the pollutant load of wastewater and risk of odour emissions. Similarly, other by-product recovery processes such as offal recovery and hide treatment increases wastewater generation. Other environmental impacts, such as increased energy consumption and odour generation, may also be associated with by-product recovery processes.

2.0 The Process

The main stages of meat processing are:

- Preparation for slaughter
- Slaughter
- Hide/skin removal
- Removal of internal organs
- Trimming and carcase washing
- Weighing and grading
- Chilling
- Boning
- Packaging
- Freezing or cold storage
- Plant cleaning.

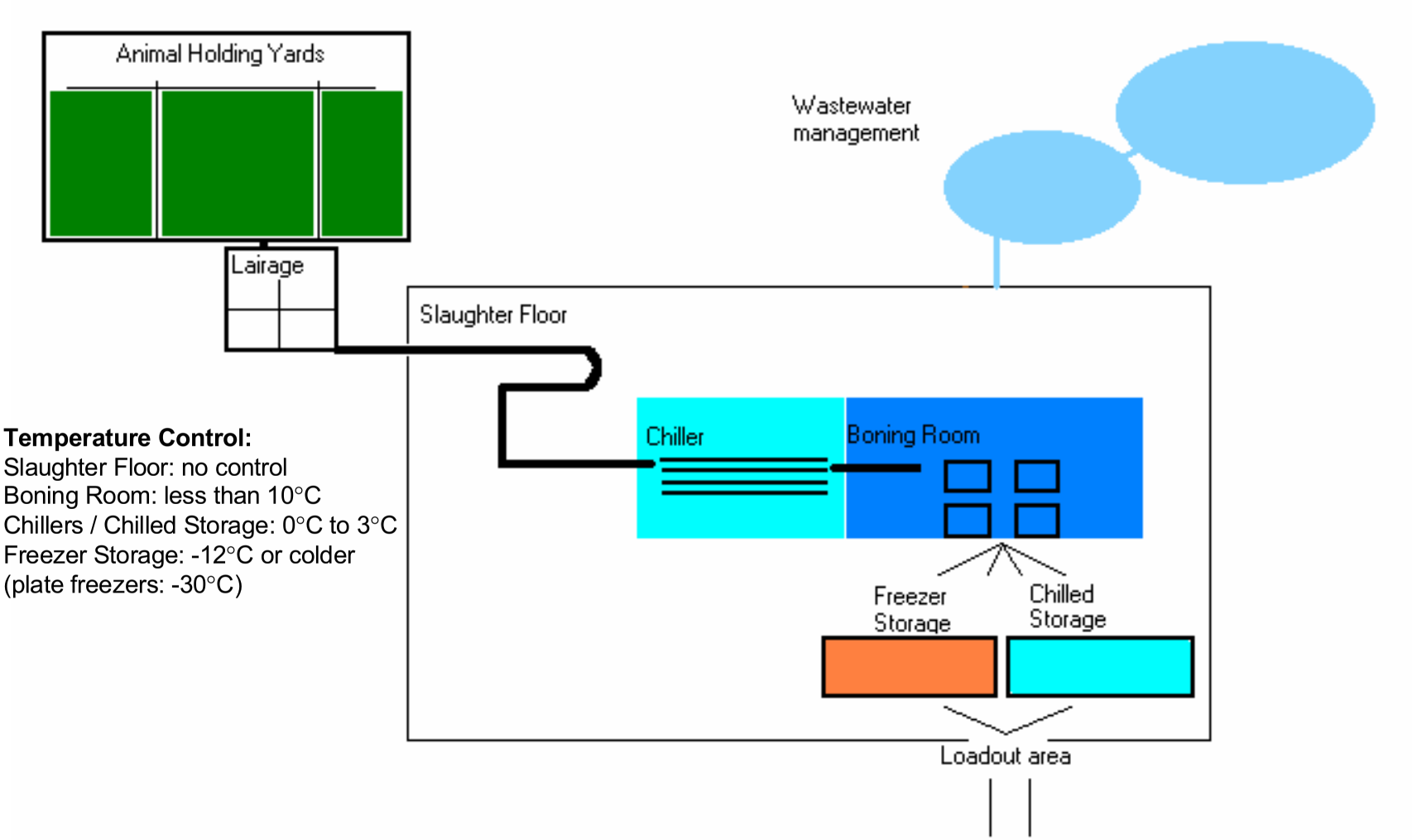
In addition to these generic processes, some establishments may also undertake other activities, such as:

- Rendering
- Hide and skin processing
- Blood processing.

Other operations that are undertaken at a meat processing establishment include:

- Water pre-treatment
- Paunch processing
- Wastewater treatment and discharge.

Figure 8: Overview of a processing plant



Temperature Control:
Slaughter Floor: no control
Boning Room: less than 10°C
Chillers / Chilled Storage: 0°C to 3°C
Freezer Storage: -12°C or colder
(plate freezers: -30°C)

The following sections discuss the main stages of meat processing and highlight the environmental issues associated with each stage.

2.1 Preparation for slaughter

When livestock arrive at the meat processing plant they are unloaded from trucks into lots according to their different vendors, and placed in holding yards. If the plant is located close to residential areas or other noise-sensitive receptors, the noise generated from various items of equipment and the manoeuvring of trucks delivering livestock can cause a nuisance.

Livestock holding yards

Prior to slaughter animals may be treated to remove any visible dirt from their hides or pelts. Cattle are normally washed, either manually or with fixed sprays. The amount of water used for washing depends on the type and cleanliness of the stock, increasing significantly if they are received in a dirty condition. An extra 80-100 litres/head can be used for the additional washing of dirty stock. Some plants impose an extra charge to process dirty cattle or offer an incentive for the delivery of clean cattle.

Although not washed, it is preferred that sheep and lambs arrive at an abattoir for slaughter having been crutched, to remove any faecal or urine stained, dirty or mud caked wool.

Washing cattle to clean hides of visible dirt

Stock delivery trucks and holding yards are washed to keep them clean from urine and manure. Animal manure adds to the pollutant load of wastewater, containing:

- phosphorous
- nitrogen
- organic carbon.

Manure can be collected prior to wash-down to reduce the amount lost to wastewater however the ease of collection varies considerably from one site to the next.

2.2 Slaughter

In Australia, animals must be slaughtered humanely. Animals are moved down a race, restrained to control their movement and stunned so that they are unconscious prior to the start of the slaughter process. This process is undertaken to meet the requirements of Animal Welfare Codes of Practice and relevant State legislation. Some abattoirs will slaughter animals to meet various religious requirements, including Halal. From slaughter, an animal is then processed to the carcase stage by a series of procedures, this series being commonly referred to as the 'slaughter chain'.

A restraining unit at slaughter

Animals are bled immediately after stunning, while still unconscious, to stop the blood supply to the brain and to remove blood from the carcase before further dressing procedures commence. This bleeding process is commonly referred to as ‘sticking’.

Blood is valuable if recovered for processing, but is a highly polluting substance. Therefore the efficient recovery and segregation of blood is an important means of reducing the pollutant load in wastewaters.

2.3 Hide/skin removal

After slaughter the carcase is moved to a legging stand where the skin is opened and the hocks and hooves, hide/skin and head are removed. Mechanical pullers are normally used to remove the hide/skin.

The entire process of slaughter and hide/skin removal must be undertaken hygienically to avoid contamination of edible meat product with microorganisms that may reduce shelf life or be harmful to consumers.

2.4 Removing internal organs

The process of opening the carcase and removing the internal organs is called ‘evisceration’. Once removed, the internal organs are placed on a table known as the ‘viscera table’, where qualified inspectors inspect them. The viscera table is sterilised between viscera inspection to avoid cross contamination.

Some modern viscera tables incorporate systems that turn wash sprays on only as the table moves forward, however older stye tables may run continuously, increasing hot water usage. Alternatives to the use of hot water at this point are limited due to the strict hygiene standards in place.

The internal organs that are removed are referred to as offal. Offal products include:

- heart
- liver
- lungs
- kidneys
- thick/thin skirts (diaphragm)
- paunch/tripe (stomach)
- runners (intestines)
- pancreas
- brain
- testes

Small stock evisceration table

These products are transferred to a separate production area. Here edible offal products are:

- segregated
- trimmed to specification
- washed
- packaged

Hand-washing offal

Offal cleaning and washing machines use large volumes of both hot and cold water.

Other edible offal products, such as paunch and runners, require their contents to be emptied before they are washed, trimmed to specification and packaged. In most plants the paunch contents are washed out of the rumen then recovered from the effluent stream by screening. Paunch contents are disposed of by composting.

Any inedible offal, condemned products and trimmings are collected and turned into useful products via the process of rendering.

2.5 Trimming and carcase washing

Trimming occurs to remove excess fat, bruising or visible contamination. Meat processing plants attempt to collect fat and meat tissue trimmings to avoid these materials being lost to the wastewater stream. Fat is dropped into bins, chutes or conveyors and transported to rendering facilities for either edible or inedible product.

Following trimming, carcases are often washed, either manually or by using automatic carcase wash systems, to remove bone dust generated during carcase splitting. Some processing plants have, however, moved away from full carcase washing, relying on the trimming process and spot cleaning with steam-vacuum systems instead. In most cases however, food hygiene targets, rather than water consumption considerations, will dictate the preferred techniques for carcase cleaning.

2.6 Weighing and grading

Following trimming the carcase is weighed and graded, although additional grading may occur after chilling. Producers are often paid on carcase weight and grade so these must be accurate and consistent between processing plants. A standard (AUS-MEAT) is used to ensure processors trim and prepare the carcases to the same level before weighing and grading.

2.7 Chilling

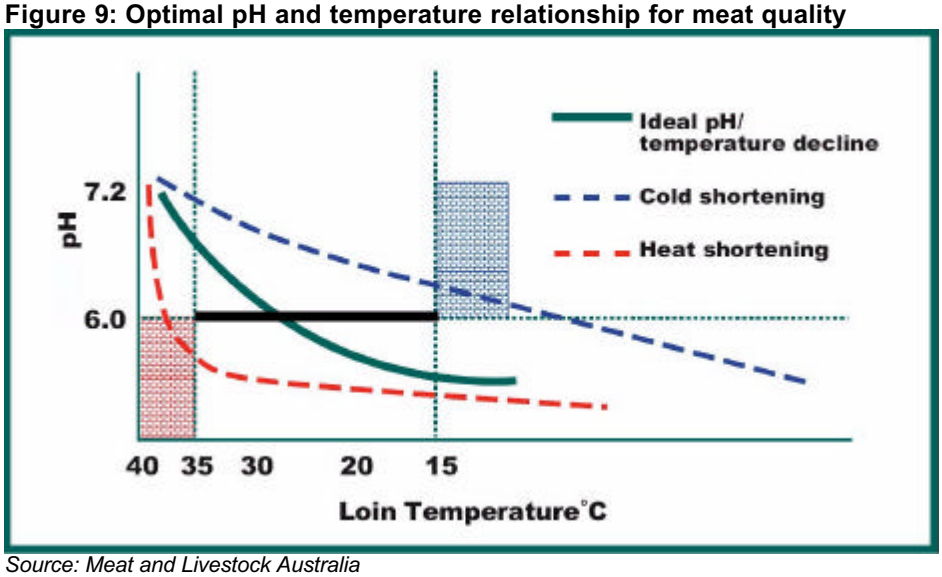
After weighing, the carcase is refrigerated in a large cold room, known as the 'chiller'. The perishable nature of meat products means that they need to be chilled, frozen or cooked in order to preserve them. This involves the use of electricity for refrigeration and heat for cooking (at plants that undertake further processing).

To achieve food safety requirements, meat needs to be chilled to 4°C or colder within 12 hours from slaughter.

The temperature of meat products is critical to food safety. Research has defined the best temperature range over time to achieve requirements for safe food and product quality. Once again, balancing the challenges of food safety, product quality and environmental requirements becomes an issue. The food safety aspect requires product to be chilled to lower temperatures in a quicker time than would be required from a meat quality perspective, where steadier chilling will result in a higher quality product. However, in consideration of the environment, less chilling time means less energy is used.

Figure 9 below shows the optimal meat quality pH and temperature relationship over time.

Figure 9: Optimal pH and temperature relationship for meat quality



Source: Meat and Livestock Australia

Carcases hanging in a chiller

2.8 Boning

After the meat has been chilled, it can either be sold as a whole or part carcase, or cut into smaller pieces, called primals. This process is known as ‘boning’. Examples of primals include a whole rump or set of ribs.

Half and quarter carcases are generally bought by large meat wholesalers or butchers, who then do their own boning. Some meat processing plants have their own boning rooms where carcases are further processed.

In the boning room, people called ‘boners’, cut the meat down into primal cuts and then ‘slicers’ trim and prepare the primal cuts for packaging.

Any trim and bones that result from this process are collected for rendering.

2.9 Packaging

Meat is packaged in a variety of ways for ease of handling and transportation for both export and domestic markets.

Cardboard is the largest packaging input and the largest packaging waste item. The other important packaging material is plastic, which is used for vacuum pack bags, plastic sheeting, and strapping.

In relation to the type of packaging used, meat plants are generally constrained by customer specification, particularly in export markets. Plants do however have control over the wastage of packaging materials.

2.10 Freezing or cold storage

Once packaged, cartons can either be:

a. stored in cold storage (0-4 C); or
b. frozen (<-18 C)

Meat is frozen to extend shelf life if it is to be held for extended periods of time.

The process of chilling and/or freezing product, together with refrigerated storage is the largest consumer of electricity in a meat plant.

Plate freezers stack, freeze and store product

2.11 Plant cleaning

Plant cleaning takes place both during and at the end of production, but most of the cleaning effort occurs at the end of the production day.

Dry cleaning of plant and equipment prior to wash-down is widely practiced in the industry, which can reduce water used by 20-30%. Dry cleaning also reduces the solids and pollutant load of the wastewater.

The Australian Standard requires:

- Cleaning compounds (eg detergent and sanitisers) to be approved for use in meat processing premises.
- Any chemical residue to be removed from surfaces likely to contaminate edible product by thorough rinsing with potable water before the area or equipment is used for handling edible product (except when approved for use without a final rinse).

The Australian Quarantine Inspection Service (AQIS) requires that chemicals used on a plant are approved for use, to ensure that meat product is not contaminated and against requirements for export customers.

2.12 Rendering

Rendering is the process undertaken to convert by-products into value added products such as tallow, meatmeal and bloodmeal. Abattoirs have been considered to be the original recyclers. Rendering is coming under increasing pressure from environmental authorities to eliminate, or at least severely reduce, the release of

undesirable odours into the atmosphere – especially where a plant is located near residential developments. The effluent from rendering also significantly increases the pollutant load of wastewater.

External view of the rendering facility at an abattoir

2.13 Hide and Skin Processing

Skin preservation by dry salting is a common procedure at processing plants that export skins for tanning. After salting, skins are left to dry for a minimum of 5 days. During this period, the salt draws the moisture out of the skin and wool, together with the protein-filled fluids contained in the attached flesh.

The effluent from drying sheds is therefore highly saline and has a very high biochemical oxygen demand (BOD).

Many hides from cattle are left 'green' and only chilled at the processing plant, before going to the manufacturer for production.

2.14 Blood Processing

The efficient recovery and segregation of blood is an important means of reducing the pollution loads in wastewaters, since blood is a highly polluting substance. An operation with an efficient blood recovery system will have a lower polluting load than one that allows blood to flow to the wastewater stream.

3.0 Resource Use

The main resource inputs in meat processing are water, energy, packaging materials and chemicals.

While these resources are typical of many food processing sectors, meat processing plants use very large quantities of water and energy due to the:

- highly perishable nature of the product;
- need for high levels of sanitation;
- need for high temperatures for hand-washing (42°C) and sterilisers

(82°C);
- need to keep the product cool.

The following table presents a summary of the red meat processing industry averages for water and energy use in 2003.

Table 3: The approximate quantities of water and energy consumed at a meat plant

KPI	Score 2003	Units
Water		
Raw Water Usage	10.6 (sheep and cattle)	kL/tHSCW
	1,480 (cattle only)	L/head
Wastewater Generation	10.0 (sheep and cattle)	kL/tHSCW
	1,400 (cattle only)	L/head
Energy		
Energy Usage	3390 (sheep and cattle)	MJ/tHSCW
	463 (cattle only)	MJ/head

Source: MLA, Industry Environmental Performance Review 2003

kL = kilo litres MJ = megajoules L = litres

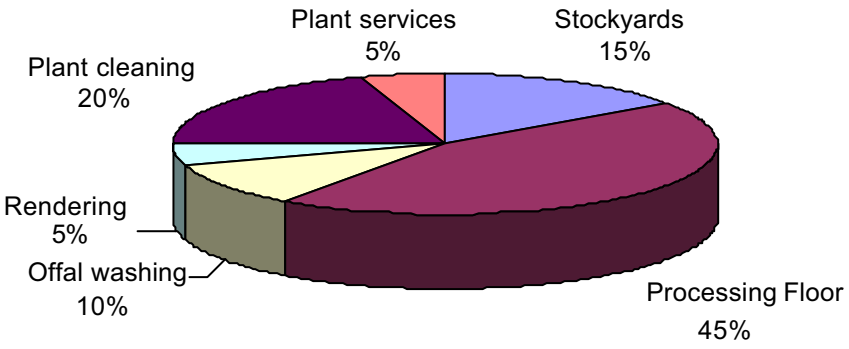
3.1 Water

Water is a very important input for meat processing. The need to maintain strict food safety standards means that it is used in considerable quantities for the washing of livestock and products and the cleaning and sanitising of plant and equipment.

Daily water usage of a typical meat processing plant[1] is shown in the following figure.

[1] NOTE: In this example a 'typical meat plant' is defined as a plant processing approximately 150 tonnes HSCW per day, which is equivalent to 625 head of cattle per day, based on a conversion rate of 240kg/head. Production is assumed to take place 5-days per week, 250 days per year, and boning and rendering takes place. Water usage can vary considerably from one plant to another, so this should be regarded as an example only.

Figure 10: Water use at a typical meat plant



Source: Adapted from the Eco-efficiency manual for meat processing 2002

Water usage varies considerably from one plant to another depending on their circumstances. For example, modern plants may be easier to clean due to improved plant layout and equipment design. Since water use is also dependent on operator practices staff awareness and supervisor vigilance have a large bearing on consumption.

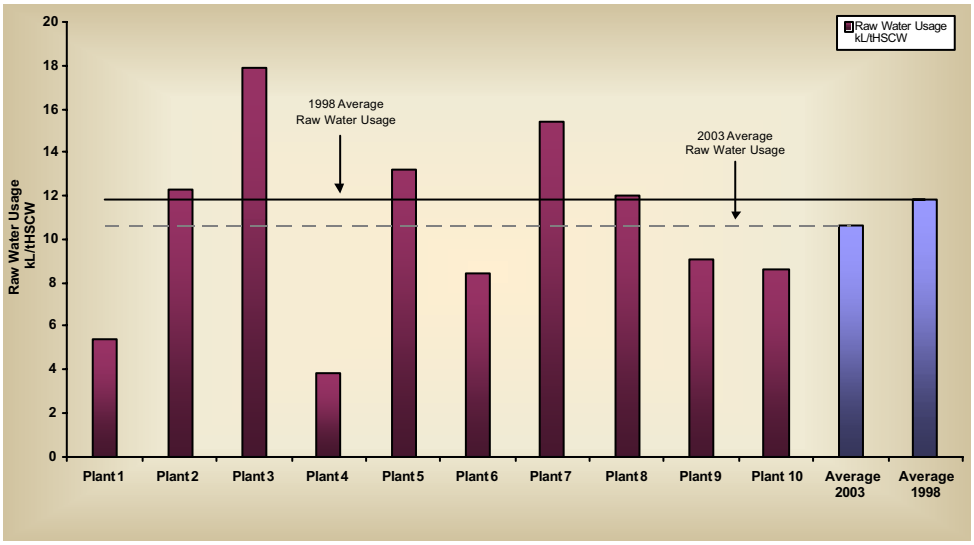
Findings from the 2003 Industry Environmental Performance Review indicate that the red meat industry in Australia has made good progress in reducing overall raw water usage.

FURTHER INFORMATION

For further information, please refer to:

- *The Eco-Efficiency Manual* [19]
- *Industry Environmental Performance Review, 2003* [10]

Figure 11: Raw water usage 1998 vs 2003



Source: MLA, Industry Environmental Performance Review 2003

A food safety issue arises in that only potable water can be used when it will come in contact with edible product, as water being reused may be a source of product contamination. The red meat processing industry is currently investigating potential opportunities for water reuse, taking into consideration food safety requirements.

3.2 Energy

The use of energy for refrigeration and equipment sanitation is important for ensuring good quality meat products. E nergy consumption depends upon the:

- age and size of the plant
- level of automation
- range of products manufactured

Thermal energy, in the form of steam and hot water, is used for cleaning, heating water, sterilizing and rendering. Steam and hot water is typically produced from boilers powered by coal, oil, gas or electricity.

Electricity is used for the operation of machinery and for:

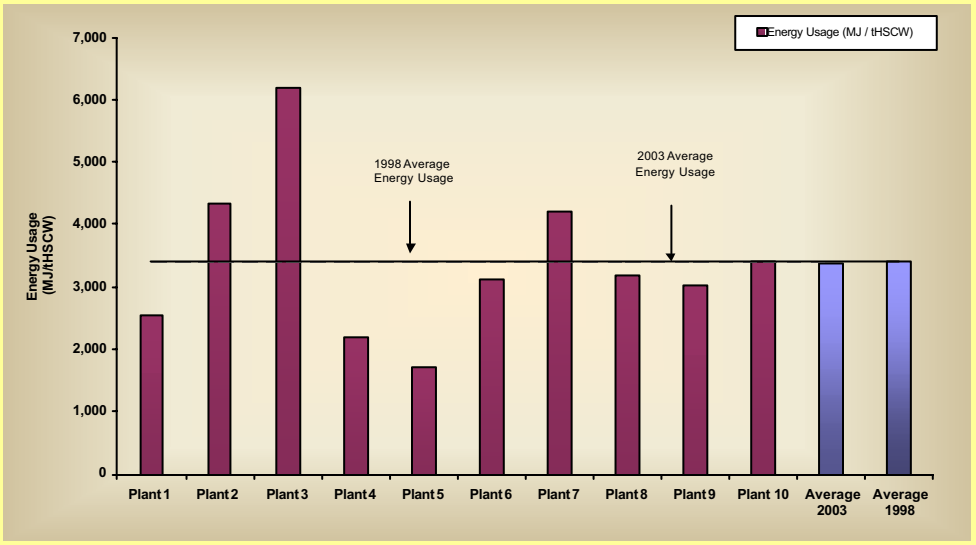
- refrigeration
- ventilation
- lighting
- the production of compressed air

Refrigeration plant room

Refrigeration is the largest user of electricity at meat plants. The other large usage areas are the multitude of motors that drive pumps, fans, conveyors, and hydraulic systems.

While energy is an area where easy financial savings are possible, findings from the 2003 Industry Environmental Performance Review suggest the industry has made limited progress in reducing the amount of energy used in the production process.

Figure 12: Energy consumption 1998 vs. 2003



Source: MLA, Industry Environmental Performance Review 2003

In time it can be expected that government and regulatory authorities will place greater emphasis on reducing energy usage and greenhouse gas emissions.

3.3 Packaging materials

Governments around the world are trying to reduce packaging waste through increasingly stringent regulations. These take many different forms, from mandatory recycling together with minimum recycled content laws through to complete landfill bans.

For the meat industry, packaging must be designed to minimise waste (less packaging) and enable recycling, reuse or recovery (incineration with energy recovery), while ensuring a hygienic meat product that is delicious to eat. Value added products would generally use a higher proportion of packaging material.

3.4 Chemicals

Chemicals are only used for cleaning, sanitising, hook cleaning, and in some cases water and wastewater treatment.

Many large meat processing plants use automatic dosing systems, which dispense the correct amount of cleaning agent. Small plants however may opt for manual dosing, which requires close attention to the recommended chemical dosage rate.

Increasingly, environmentally friendly cleaning and sanitising agents are becoming available. These are proven to be as effective as conventional products, but are generally less hazardous to the receiving environment and staff.

4.0 Waste Generation

The main wastes from meat processing operations are:

4.1 Wastewater

Wastewater from meat processing contains high levels of:

- biodegradable organic compounds
- fats
- nutrients, especially nitrogen and phosphorus
- and microorganisms

Due to their location at the fringes of urban centres and the volume of wastewater, many meat processing plants either treat their own wastewater, or provide pre-treatment prior to sewer discharge. The wastewater is well suited to treatment by biological methods and is frequently reused by irrigation to land. There are negligible amounts of substances that persist in the environment.

Recycling of treated effluent back to the factory is generally prohibited by food safety regulations and there are only very restricted opportunities for recycling. There is, however, increasing third party reuse.

Aerial view of a processing plant and wastewater treatment

4.2 Waste solids

Large quantities of waste solids are generated by meat processing. Most of the parts of the animal that cannot be directly sold are rendered to generate valuable tallow (fat), meatmeal and bonemeal which are protein-rich. Some waste solids, however, are unsuitable for reuse in this manner and include:

a. yard manure;
b. paunch (stomach) contents consisting of partially digested grass or grains;
c. waste solids recovered from the effluent by screens or other devices;
d. skins with no commercial value;
e. packaging wastes, which consist mainly of plastic and cardboard.

Land disposal by spreading or burial has been the traditional method of disposing of solid and semi-solid wastes. However, composting systems are now widely used to permit reuse of the nutrient-rich organic material. Plastics, metal and cardboard are often recycled where possible or sent to landfill.

A mature pile of compost

4.3 Odour and air quality

Unpleasant odour emissions have characterised the meat processing industry in the past. These arise mainly from:

a. rendering and skin processing operations within the facility;
b. effluent storage and treatment operations;
c. animal holding pens.

To minimise emissions, the industry has adopted a variety of odour minimisation strategies coupled with air capture from particularly high-risk areas and treatment using recognised and effective odour treatment technologies.

An important factor in preventing community nuisance from meat processing operations is ensuring that Councils maintain adequate buffer distances between operating meat processing plants and new housing developments.

Other air quality impacts include boiler stack emissions, drier exhausts and dust from animal or vehicle movements on-site. These are typically managed in accordance with licence requirements.

FURTHER INFORMATION

Further information on wastewater treatment and odour management is available in the CSIRO/University of Queensland publication, 'Abattoir Waste Water & Odour Management' [16]

5.0 Industry Best Practice

The main environmental concerns of the red meat processing industry can be categorised as follows:

a. Waste solids generation and disposal
b. Waste water treatment and disposal
c. Odour and associated air impacts
d. Energy management

The Meat Processing Industry Best Practice Guideline consists of several modules covering each of these key aspects. Including this document, Introduction to the Red Meat Processing Industry, the other Guideline modules are titled:

- Wastewater Treatment
- Odour and Air Quality
- Waste Solids
- Energy Management
- Effluent Irrigation

These modules are designed to give you further information regarding the application of, and the commitment by the industry to current best practice to minimise undesirable environmental impacts of meat processing and maximise positive environmental outcomes for Australia.

6.0 References

1. ABARE, 2003, *Australian Commodity Statistics 2002,* Canberra, Australia.

2. Agriculture and Resource Management Council of Australia and New Zealand, 2002, *Australian Standard for the hygienic production and transportation of meat and meat products for human consumption (AS 4696-2002)*, CSIRO Publishing, Victoria, Australia.

3. AUS-MEAT Limited, 2004, AUS-MEAT Accredited Establishments Listing' available at http://www.ausmeat.com.au/standards/accreditation/default.asp, accessed on 9 August 2004.

4. Australian Bureau of Statistics, AUSSTATS, *Australian Yearbook – Agriculture; Meat Production and Slaugtherings*, available at http://www.abs.gov.au/Ausstats/abs@.nsf/0/46c7036fc70f6e4fca256dea000539dd?OpenDocument, accessed on 27 August 2004

5. Department of Agriculture, Fisheries and Forestry, 2004, *Australian Food Statistics 2004 – Interim*, Canberra, Australia.

6. Falepau, D. 2004, '*Survey to sort out the facts on goats*', p3, Feedback – Meat & Livestock Industry Journal, August 2004, Meat & Livestock Australia.

7. Golding, C. (ed) 2004, 'Australia's Top 25 Red Meat Processors – Calendar year 2003', pp i-xii, Feedback – Meat & Livestock Industry Journal, August 2004, Meat & Livestock Australia.

8. Gutheridge, Hastings & Davey Pty Ltd, 1998, *'Best practice wastewater treatment RPDA.308B – 1998'*, Meat & Livestock Australia, Sydney, Australia.

9. Martin, C, *'Red meat industry challenged to be "best by any measure'*, Meat & Livestock Australia, 6 August 2004, available at http://www.mla.com.au/content.cfm?sid=25&newsid=4227, accessed on 6 August 2004.

10. Meat & Livestock Australia, 2004, *'Summary Report – Industry Environmental Performance Review',* Sydney, Australia.

11. Meat & Livestock Australia, 2001, '*FastFacts – Australia's Sheepmeat Industry'* Sydney, Australia.

12. Meat & Livestock Australia, 2004, ''*Wastewater and Effluent Treatment and Disposal'*, available at http://www.mla.com.au/cotent/cfm?sid=109, accessed on 6 August 2004.

13. Meat & Livestock Australia, 2004, '*Processing*', available at http://www.mla.com.au/cotent/cfm?sid=105, accessed on 6 August 2004.

14. Meat & Livestock Australia, 2004, '*Packaging and recycling'* available at http://www.mla.com.au/content.cfm?sid=406 accessed on 6 August 2004.

15. Meat & Livestock Australia, 2004, *'Waste'* available at http://www.mla.com.au/content.cfm?sid=748 accessed on 6 August 2004.

16. McDonald, B. (ed.), '*Abattoir Waste Water & Odour Management'* CSIRO Meat Research Laboratory, Queensland, Australia.

17. Murphy, N & McCraken, C. 2004, Waste Reduction Resource Center, *Meat Processing: Environmental Impacts*. Available at

http://wrrc.p2pays.org/p2rx/subsection.cfm?hub=449&subsec=15&nav=15&CFID=32241&CFTOKEN=62756019 accessed on 24 August 2004. Last updated 30 August 2004.

18. N. Jahan, P Smith & G. Rodriguez, 2003, '*Agribusiness Review - Vol. 11 – 2003 - Paper 2; An analysis of the growth of the Australian dairy and meat processing sectors*' ISSN 1442-6951 Available at http://www.agribusiness.asn.au/Review/2003V11/Jahan.htm 20/08/04

19. Pagen, R. Renouf, M & Prasad, P. 2002, *Eco-Efficiency Manual for Meat Processing*, Meat & Livestock Australia, Sydney, Australia.

20. Productivity Commission, 1998, '*Work arrangements in the Australian Meat Processing Industry – Labour Market Research Report, 1998'* available at http://www.pc.gov.au/research/labmarket/meat/#publsh accessed on 9 August 2004.

21. University of Queensland, The UNEP Working Group for Cleaner Production in the Food Industry, 2004, '*Fact Sheet 7: Food Manufacturing Series'*, available at http://www.geosp.uq.edu.au/emc/CP/Res/facts/FACT7.HTM, accessed on 17 August 2004.