GG234
GUIDE

ENVIRONMENTAL
TECHNOLOGY
BEST PRACTICE
PROGRAMME

REDUCING WATER AND EFFLUENT COSTS IN RED MEAT ABATTOIRS

GOOD PRACTICE: Proven technology and techniques for profitable environmental improvement

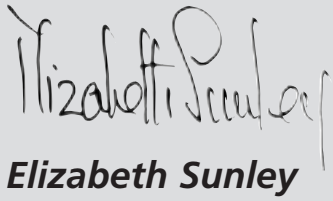
Foreword from the British Meat Federation

'At a time when abattoir costs are under immense pressure but continuing to rise, it makes excellent sense to look closely at every option for reducing them. This Good Practice Guide has been prepared in co-operation with a number of our members, and we are happy to commend it to all our members to help reduce costs and improve margins.'

Peter Scott
General Secretary
British Meat Federation

Foreword from the British Meat Manufacturers' Association

'The British Meat Manufacturers' Association is very pleased to endorse this Guide, which has been trialled at two BMMA member sites. We believe that, if followed, the advice detailed in the Guide must effect a reduction in the volume of waste effluent and can contribute considerable cost savings.'



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REDUCING WATER AND EFFLUENT COSTS IN RED MEAT ABATTOIRS

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Prepared with assistance from:

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SUMMARY

Red meat abattoirs use large quantities of water and generate equally large volumes of wastewater with a high chemical oxygen demand (COD) and suspended solids content. Cleaning and carcass washing operations typically account for more than 80% of total water use and effluent volume.

On average, red meat abattoirs that adopt a systematic approach to minimising water use can reduce their water and effluent bills by 15 - 20% at little or no cost to the business. If projects with paybacks of up to two years are included, savings of 30% or more can be achieved. For example, a small red meat abattoir with a trade effluent bill of £44 600/year could save £18 900/year by reducing effluent volume, suspended solids content and COD, all by 25%.

This Good Practice Guide describes a range of cost-effective measures to help companies of all sizes save money while continuing to clean and wash just as effectively and without compromising hygiene standards. Implementation of the Integrated Pollution Prevention and Control (IPPC) Directive will further increase the pressure on red meat abattoirs to reduce both water use and the generation of effluent.

For many companies, improvements can be made in both process and cleaning operations. The Guide shows you how to achieve cost savings by adopting a systematic approach to reducing water use and effluent generation. This step-by-step approach is based on the answers to the following questions:

- What are the volumes and costs of your water and effluent?
- How should you go about making improvements?
- How can you improve:
  - transport and lairage arrangements?
  - your process operations?
  - your cleaning operations?
  - your effluent treatment?

Industry Examples throughout the Guide describe the cost savings and other benefits already achieved by companies without compromising hygiene standards.

CONTENTS

1 WHY LOOK AT WATER USE AND EFFLUENT GENERATION?

Red meat abattoirs will benefit from taking a closer look at their water use and effluent generation because:

- water and effluent charges are significant and rapidly-rising costs;
- most companies are using more water than they need - even taking full account of hygiene requirements;
- simple measures can reduce volumes and costs significantly;
- of the impact of the new Integrated Pollution Prevention and Control (IPPC) regime (larger companies only).

This Good Practice Guide describes cost-effective measures to help red meat abattoirs use less water to clean and wash effectively, without compromising hygiene standards. The practical advice given in the Guide is based on a systematic approach to minimising water use and effluent generation, and is suitable for companies of all sizes.

1.1 INCREASES IN WATER AND EFFLUENT COSTS

Water and effluent charges represent significant business costs to red meat abattoirs. Moreover, these costs are increasing faster than inflation. For example, in the four years since 1994/95, average costs increased by 18% for water and by 28% for trade effluent.

In some areas of the UK, red meat abattoirs have seen their effluent charges increase by more than 50% in the past 18 months. Effluent charges are expected to increase still further as water companies seek to recoup the massive investment needed to upgrade their sewage treatment plants to meet the requirements of the EC's Urban Waste Water Treatment Directive.

Red meat abattoirs use large quantities of water and generate equally large volumes of wastewater with a high chemical oxygen demand (COD) and suspended solids content. Cleaning and carcass washing operations typically account for more than 80% of total water use and effluent volume.

1.2 ARE YOU USING MORE WATER THAN NECESSARY?

Water use in red meat abattoirs is intrinsically high because of the need to meet the stringent requirements of UK and EC meat hygiene legislation.[1]

Even allowing for hygiene requirements, many companies are using - and paying for - more water than they actually need. Excessive use is generally due to:

- Lack of awareness of the volumes used and discharged, and the cost to the business.
- A wide 'safety margin' to ensure that hygiene requirements are met. This factor is compounded by a lack of awareness of what can be achieved without compromising cleanliness.

The Guide describes how cleaning and carcass washing can be performed in a more efficient, cost-effective and environmentally responsible way. The Guide takes note of hygiene requirements, but does not give advice on specific hygiene standards. For example, regulations require that potable water must be used for most operations, and that knives and other hand tools must be sterilised using water at 82°C (or an equivalent procedure). Although high pressure low volume (HPLV) sprays can be used to clean lairage areas, they are not permitted in meat processing areas (either during processing or when meat is present) due to the risk of spreading contamination via the atomised water. Red meat abattoirs are also not allowed to re-use wastewater in certain areas.

This Guide will help you to:

- assess the true overall cost of water and effluent at your site;
- identify ways in which savings can be achieved without compromising hygiene.

Before making any changes to your cleaning and washing regime, you must ensure that all relevant hygiene standards will be met.

1.3 COST SAVINGS FROM SIMPLE MEASURES

On average, red meat abattoirs that adopt a systematic approach to minimising water use can reduce their water and effluent bills by **15 - 20%** at little or no cost to the business. If projects with paybacks of up to two years are included, savings of 30% or more can be achieved.

How much money are you pouring down the drain?

Reducing the volume, COD and suspended solids content by 25% would enable a small red meat abattoir with a trade effluent bill of £44 600/year to achieve cost savings of £18 900/year.

1.4 COMPLYING WITH IPPC

Implementation of the Integrated Pollution Prevention and Control (IPPC) Directive in the UK will increase the pressure on red meat abattoirs to reduce both water use and the generation of effluent and other wastes.

For the latest advice on how IPPC and other environmental legislation will affect your company, contact the Environment and Energy Helpline on freephone 0800 585794.

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[1] For information on rules and procedures relating to meat hygiene, contact your Official Veterinary Surgeon or see the Meat Hygiene Services Operations Manual. Most red meat processors will already have a copy of this manual, but copies can be purchased from the Meat Hygiene Service, Room 251, Foss House, Kings Pool, 1-2 Peasholm Green, York YO1 7PX. Tel: 01904 455508.

1.5 HOW CAN THIS GUIDE HELP?

This Guide describes a step-by-step approach to help red meat abattoirs use less water and thus generate less effluent. Improved management of water, cleaning chemicals and effluent will result in cost savings and improve your company's image.

The Guide's approach is based on the answers to the following questions:

- What are the volumes and costs of your water and effluent?
- How should you go about making improvements?
- How can you improve:
  - transport and lairage arrangements?
  - your process operations?
  - your cleaning operations?
  - your effluent treatment?

Practical advice is provided, together with Industry Examples[2] that illustrate how companies have already achieved worthwhile cost savings without compromising hygiene standards. An Action Plan in Section 8 summarises in a checklist the advice given in the Guide. Contact details for suppliers of equipment mentioned in the Guide are available from the British Meat Federation[3] and the British Meat Manufacturers' Association.[4]

1.5.1 A systematic approach to waste minimisation

A systematic approach that reduces waste at source is the most effective approach to take and will also add to your company's bottom line. If you would like to know more about saving money through waste minimisation, there is a wealth of free material available from the Government's Environmental Technology Best Practice Programme. Useful publications for red meat processors include:

- Good Practice Guide (GG26) *Saving Money Through Waste Minimisation: Reducing Water Use.*
- Good Practice Guide (GG67) *Cost-effective Water Saving Devices and Practices.*
- Good Practice Guide (GG109) *Choosing Cost-effective Pollution Control.*
- Good Practice Guide (GG152) *Tracking Water Use to Cut Costs.*
- Good Practice Guide (GG154) *Reducing the Cost of Cleaning in the Food and Drink Industry*.
- Good Practice Guide (GG220) *Low-cost Process Control in Food and Drink Processing.*

Contact the Environment and Energy Helpline on freephone 0800 585794 to obtain free copies of these publications.

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[2] Wherever possible, examples are taken from red meat abattoirs. Where the techniques are identical, some relevant examples are taken from poultry processors.

[3] 12 Cock Lane, London EC1A 9BU. Tel: 020 7329 0776.

[4] 11/12 Buckingham Palace Gate, London SW1E 6LB. Tel: 020 7828 1224.

2 IDENTIFYING WATER AND EFFLUENT VOLUMES AND COSTS

section 2

The first step is to find out how much water your site uses and how much effluent it generates, and then calculate the total costs. This Section:

- provides typical benchmark figures and targets for water use and related costs;
- gives simple suggestions for measuring your performance compared to the benchmark;
- recommends good housekeeping measures to manage water use;
- outlines the method used by water companies to calculate water and effluent charges.

2.1 TYPICAL BENCHMARK VALUES FOR WATER USE

2.1.1 Overall water use per animal

The amount of water used per animal varies between abattoirs and depends on factors such as the type of animal, slaughter technique, carcass dressing method and degree of automation.

In general, the main factor affecting water consumption at a typical red meat abattoir is the amount of floor area used. To comply with meat hygiene regulations, all process floor areas must be washed down and sanitised at least once a day. Water consumption depends on the layout and other circumstances of individual red meat abattoirs, but the values in Table 1 represent good practice for specific water consumption (ie water use/animal).

Type of animal	Specific water consumption
Cattle	700 - 1 000 litres/animal
Pigs	160 - 230 litres/animal
Sheep	100 - 150 litres/animal

Table 1 Good practice for specific water consumption[5]

When assessing your water costs, start by:

- Calculating your specific water consumption based on the number of animals processed last year and the annual water consumption shown in your water bills.
- If your specific water consumption is higher than in Table 1, investigate:
  - how much you can achieve through improved management and control of water use;
  - how much is due to factors beyond your control, eg a large floor area.

2.1.2 Specific water use by process

The next step in making your assessment is to:

- Measure what proportion of water is used in each process or area (see Section 2.2).
- Compare your use to a typical breakdown for different process areas. Fig 1 presents a breakdown measured at a large pig abattoir.

[5] Based on discussions with equipment suppliers and visits to a number of red meat abattoirs.

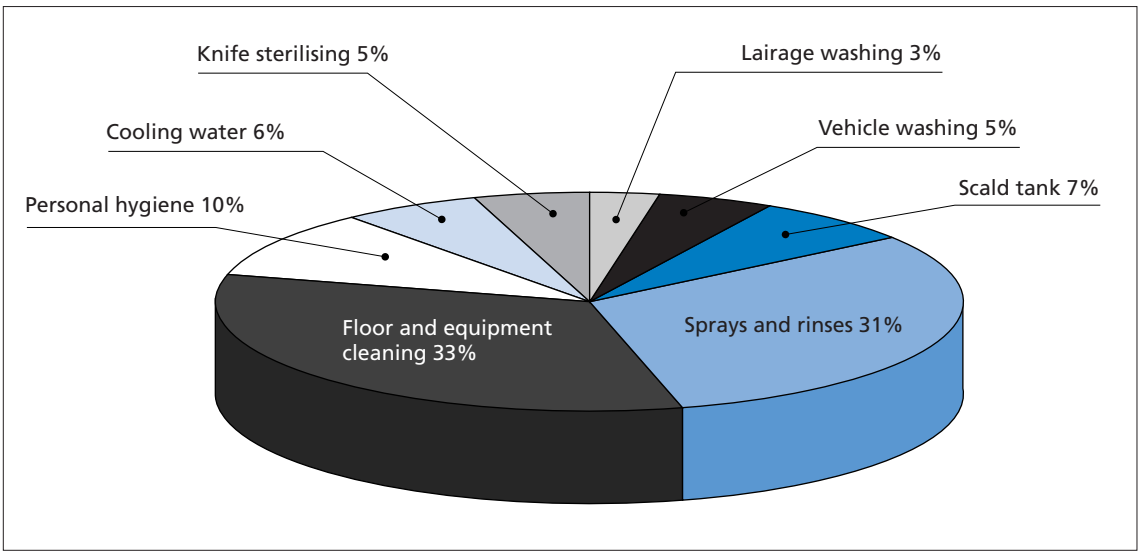

Fig 1 Breakdown of water use by different process areas at a large pig abattoir

Relative use of hot and cold water

At many red meat abattoirs, about half of the water used is heated to 40 - 60°C. Because hot water is more expensive than cold water, it is useful to separate water use into hot and cold water applications.

For every 10°C increase in water temperature, it typically costs 16 pence/m^3 for water heated by gas or 47 pence/m^3 for water heated by electricity.[6] Heating costs are on top of a typical cost of 70 pence/m^3 for mains water (1999 prices) or over £1/m^3 if on-site softening/processing is necessary before use. For more information about energy efficiency, please contact the Environment and Energy Helpline on 0800 585794.

Fig 2 shows a breakdown of hot and cold water use at the pig abattoir featured in Fig 1.

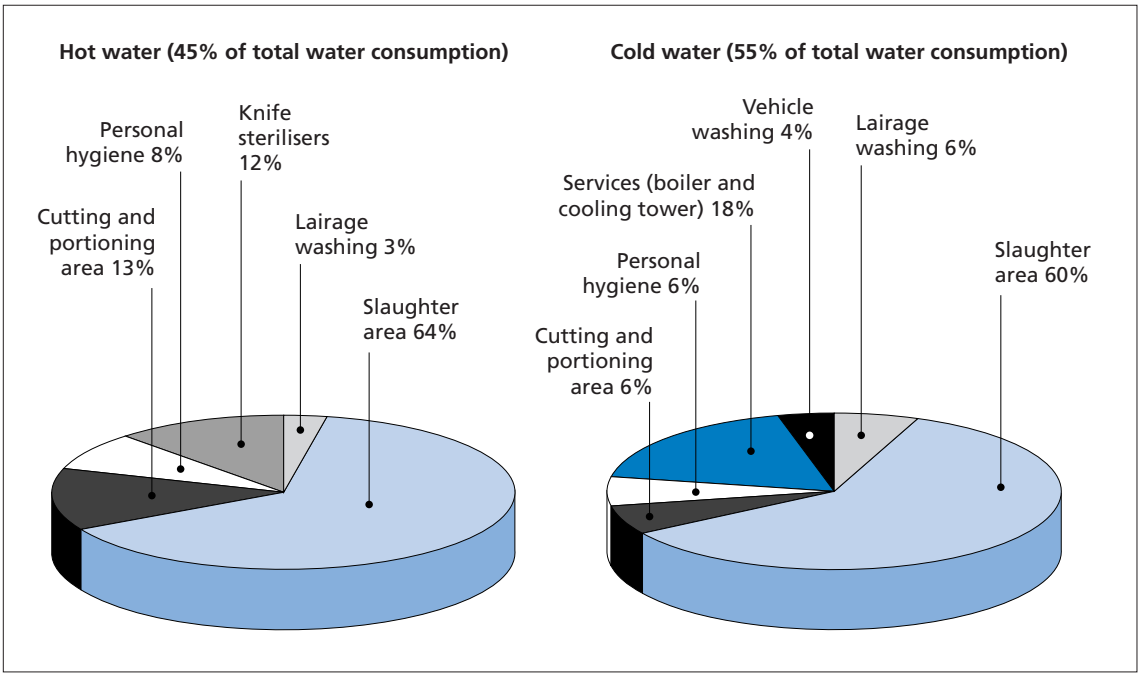

Fig 2 Hot water and cold water consumption for different process areas at a large pig abattoir

[6] Based on 1998 costs for small industrial users of 3.95 pence/kWh for electricity and 0.92 pence/kWh for gas (*Digest of UK Energy Statistics. 1999*).

2.2 MEASURING WATER USE TO IDENTIFY SAVINGS OPPORTUNITIES

A vital step towards reducing your site's use of water, detergents, energy, etc is to measure how much is used. This will allow you to:

- identify which areas have the highest costs;
- compare water use with a target value (see Section 2.1);
- focus your attention on areas with the greatest potential for improvement and cost savings;
- identify potential opportunities to reduce water use.

Simple estimates made as a 'one-off' exercise provide a good starting point and can allow you to identify ways of achieving substantial initial savings through the introduction of simple good housekeeping measures.

To sustain this level of saving, you will need to implement a regular measurement routine and to adopt a systematic approach to water reduction. This may require permanent water meters to be installed on key parts of the process. However, the savings from the typical 20 - 30% fall in water consumption are usually more than enough to justify the cost of taking regular measurements.

Remember:

If you don't measure it, you can't manage it.

2.2.1 Initial manual estimates

The simplest way to estimate the actual water use of a particular process is to time (with a stopwatch) how long a bucket or container of known volume takes to fill up from an appropriate part of the process pipework. This method is acceptable for initial estimates, but is not generally suitable for regular measurement routines. Portable meters are often useful where there are numerous measuring points.

Manual estimates can often be useful for rapid identification of leaks in your water supply system; leaks can cost your company substantial amounts of money. Good Practice Guide (GG67) *Cost-effective Water Saving Devices and Practices* contains practical information about how to monitor water use and how to set up a leak detection and repair programme. Another useful tool for identifying leaks and cost-saving opportunities is to prepare a water balance as described in Good Practice Guide (GG152) *Tracking Water Use to Cut Costs.* Both Guides are available free of charge through the Environment and Energy Helpline on 0800 585794.

The main causes of leaks include:

- damaged pipeline connections, flanges and fittings;
- worn valves;
- flooded floats (balls) on water tank or cistern valves;
- corroded pipework and tanks.

You can estimate how much leaks are costing your company using the average water supply costs quoted in Section 2.1.2.

Dedicated metering

Most red meat abattoirs are likely to achieve significant savings by implementing measures identified through a measurement routine based on permanent, dedicated water meters. Such a system will

allow you to obtain an overall view of water consumption and a breakdown of how much water is used in each process or area.

Once routine measurements have produced sufficient data, use the step-by-step procedures described in Good Practice Guide (GG152) *Tracking Water Use to Cut Costs* and Good Practice Guide (GG67) *Cost-effective Water Saving Devices and Practices* to:

- construct a water balance to show where your water goes;
- identify water and cost saving opportunities.

Buying and fitting a meter to measure flows typically costs:[7]

- £200 for flows of 3 - 60 litres/minute;
- £300 for flows of 20 - 300 litres/minute.

You can usually decide which size of meter you need by estimating the expected consumption in each process or area, or by consulting the equipment manufacturer, or by calculating the flow from your knowledge of the process.

Measuring water uses produces quick savings at pig abattoir

Having produced a breakdown of water use (see Fig 1), the first task at a large pig abattoir was to draw a water distribution map to show where water was used at the site. The map was used to identify where to fit meters and whether any pipework modifications were necessary to enable each area's water use to be measured individually.

About 45% of the water was heated to 60°C. To obtain an accurate picture of water costs, the abattoir found it necessary to measure hot water and cold water use separately (see Fig 2). The distribution map enabled the abattoir to highlight areas for immediate improvement, eg not using hot water to wash down lairage areas.

The next task was to identify opportunities to reduce water use by comparing water consumption by particular processes or areas against a target value. To maximise the potential for cost savings, the company selected processes and areas that had the greatest costs. The company contacted the suppliers of equipment used on site to ask how much water each piece of equipment should use and identified several cases where actual water use was excessive. For example, some equipment had been fitted with 5 cm (2 inch) diameter intake pipes to account for the odd occasion when the water pressure dropped suddenly. In fact, for day-to-day operation, a 2.5 cm (1 inch) diameter intake pipe was adequate. Flowmeters were fitted at a cost of £200 each and employees were instructed to maintain the water flow rate between pre-set maximum and minimum levels.

Modifying the pipework and installing 20 meters cost a total of £30 000. However, a simple comparison of actual water consumption with recommended values allowed the company to reduce its overall water consumption by 13%. This resulted in a reduction of around £23 000/year in the company's water and effluent bill.

The training programme for new employees now covers the need to minimise water consumption, together with company procedures for reporting leaks, overflows and faulty valves. In addition, employees receive specific on-the-job training on the use of in-line flowmeters on particular equipment.

[7] 1999 prices.

2.3 CALCULATING WATER AND EFFLUENT COSTS

Virtually all the water you use eventually ends up as effluent, and many red meat abattoirs produce large volumes of high-strength effluent. All red meat abattoirs carry out some form of effluent treatment prior to discharge to sewer; this is a cost-effective way of reducing trade effluent charges. Most companies screen their effluent before discharging it to sewer, but many larger companies treat their effluent further using more sophisticated techniques (see Section 7).

In general, red meat abattoirs pay two to four times more for disposing of wastewater than for buying in potable water in the first place.

In 1999, typical small red meat abattoirs screening their effluent prior to discharge paid:

- £0.70/m^3 to buy potable water;
- £2.60/m^3 for effluent disposal (excluding screening costs).

Since there is usually little scope to reduce the unit costs of water supply and effluent disposal, the most practicable option to cut costs is to manage water use more efficiently.

Remember:

The more water you buy in -
the more you will have to pay to dispose of effluent.

2.3.1 Applying the Mogden Formula

Knowing how trade effluent charges are calculated will help you to determine which type of treatment will be cost-effective.

UK water providers charge for treating trade effluent according to the Mogden Formula,[8] which takes into account both the volume and the composition (strength) of the wastewater discharged. The main factors determining the strength of an effluent are its chemical oxygen demand (COD) and total suspended solids (TSS) content.

It is commonly believed that reducing water use alone will increase effluent costs due to higher COD and TSS levels. But even if reducing water use leads to an increase in cost per m^3 of effluent, it will be more than compensated for by lower volume charges. However, the most effective way of making cost savings is when both effluent strength and volume charges are reduced together.

Reducing either the volume or the concentration of your effluent will result in cost savings, but most savings will be achieved by reducing both together.

Many of the measures described in this Guide will result in reduced water use and effluent concentration levels. The following example illustrates the cost benefits of reducing effluent volume and/or strength.

[8] See Appendix 1 of Good Practice Guide (GG154) *Reducing the Cost of Cleaning in the Food and Drink Industry*, available free of charge through the Environment and Energy Helpline on freephone 0800 585794.

Reducing effluent costs: example

A small abattoir discharges 12 000 m^3/year of trade effluent with an average COD of 6 600 mg/litre and an average TSS content of 2 700 mg/litre. The abattoir pays the local water company a total of £44 600/year in trade effluent charges.[9]

Table 2 shows the effects on trade effluent charges of four scenarios, including the substantial savings from reducing both the effluent volume and strength.

Scenario		Annual saving (£)	Percentage reduction
1	Effluent volume reduced by 25%	800	2%
2	Effluent TSS reduced by 25%	3 000	7%
3	Effluent COD reduced by 25%	7 300	16%
4	Effluent volume, TSS and COD all reduced by 25%	18 900	42%

Table 2 Example cost savings from reducing effluent volume and strength[10]

[9] Calculated using Mogden Formula coefficients: R = 14.8 pence/m^3; V = 8.04 pence/m^3; Bv = 3.22 pence/m^3; B′ = 37.08 pence/kg; S′ = 37.40 pence/kg.

[10] See Appendix 2 of Good Practice Guide (GG154) *Reducing the Cost of Cleaning in the Food and Drink Industry* for an explanation of the calculations. GG154 is available free of charge through the Environment and Energy Helpline on freephone 0800 585794.

3 A STEP-BY-STEP APPROACH TO MAKING IMPROVEMENTS

The following Sections of the Guide explain why it is important to do things in the right order, ie aiming to 'reduce at source' first by looking at your operation and process, then considering downstream measures and ultimately effluent treatment.

Suggested no-cost and low-cost measures to reduce water use and effluent generation involve simple changes:

- to transport and lairage arrangements (see Section 4);
- to minimise downstream clean-up requirements and reduce water costs in your process operations (see Section 5);
- to minimise downstream effluent treatment requirements and reduce water costs in your general cleaning operations (see Section 6);
- to optimise the cleaning performance of screening equipment (see Section 7).

section 3

These cost-saving opportunities can be divided into improvements to process and cleaning operations (see Table 3). The Action Plan in Section 8 summarises the advice given as a checklist of actions for different areas.

3.1 REDUCTION AT SOURCE

Always review your upstream operations before considering any changes to your end-of-pipe treatment plant. Small changes in operating procedures or process plant can often reduce the volume and/or strength of waste significantly - thus reducing or even eliminating the need for expensive changes to your effluent treatment plant. Reducing the amount of water used and the effluent produced in the first place will reduce your operating costs and thus increase your profits.

Apply a systematic approach to reducing waste at source by considering the steps in red meat abattoirs shown in Table 3, which gives a selection of simple measures and the order in which to apply them.

Good Practice Guide (GG220) *Low-cost Process Control in Food and Drink Processing* describes how companies can reduce water use and effluent generation by adopting low-cost process control techniques. GG220 is available free of charge through the Environment and Energy Helpline on freephone 0800 585794.

Step	Operation	Improvement measures
Delivery of animals to site	Scheduling	■ Reduce holding times
	Lairage wash-down	■ Remove manure in solid form
		■ Consider re-using clear water for primary washing
	Washing vehicles	■ Install metered water dispenser
Slaughter of animals		■ Improve blood collection
Evisceration and processing	Pig scalding	■ Control water levels in scald tanks
	Viscera washing	■ Use a dry process to remove gut manure from cattle and sheep
	Carcass washing	■ Fit directional spray nozzles
		■ Control water use
		■ Maintain nozzles
General cleaning operations	Clean-up of meat scraps	■ Collection and dry clean-up
		■ Use of cyclonic vacuum cleaners
	Area wash-down	■ Use appropriate cleaning methods
	Conveyor cleaning	■ Make appropriate use of cleaning chemicals
Effluent treatment		■ Maintain screens to optimise performance
		■ Consider secondary treatment

Key: Process operations Cleaning operations

Table 3 A step-by-step approach to reducing water use and effluent generation in red meat abattoirs

4 IMPROVING TRANSPORT AND LAIRAGE ARRANGEMENTS

The following subsections describe how medium-sized and large red meat abattoirs can achieve significant water and effluent savings by:

- scheduling animal delivery so as to achieve continuous slaughtering operations;
- collecting lairage manure as a solid for use as a fertiliser;
- using clear water from other process areas for primary washing of lairage areas;
- constructing lairage areas to minimise manure build-up and the need for wash-down;
- installing a metered water dispenser to control the amount of water used for vehicle washing.

4.1 OPTIMISING DELIVERY TIMES

section 4

The number of cleans required depends chiefly on how dirty an area becomes. Cleans are also required during breaks in the slaughtering line. Therefore, where cleaning would not otherwise be required, production should be scheduled to minimise the number of breaks, and hence the number of cleans required during each shift. Adopting a 'just-in-time' turnover system will reduce holding periods and allow continuous slaughtering operations.

The benefits of optimising delivery times include:

- reduced build-up of manure in the lairage areas and the need for wash-down;
- reduced need for cleaning due to breaks in the slaughtering line.

4.2 LAIRAGE WASH-DOWN AND DRAINAGE

Lairage manure and wash water have a high nutrient content and, provided specific conditions are met,[11] can be collected for agricultural use as a fertiliser. The Waste Management Licensing Regulations 1994 require the person actually carrying out the spreading of these wastes onto agricultural land to register first with the local office of the Environment Agency (in England and Wales), the Scottish Environment Protection Agency or the Environment and Heritage Service, Department of the Environment (Northern Ireland). The Agency requires advance details, including an estimate of the quantity of material to be spread. Under the provisions of the 1994 Regulations, spreading must have agricultural or ecological benefits.

Clear water from other process areas, eg chiller water from carcass refrigeration rooms, cooling water and steam condensate, should be used for the primary wash-down of lairage areas.

Lairages often have solid concrete floors and, as a result, the manure that builds up during the day dries against the walls and floors. Substantial amounts of wash-down water are then needed to remove it. To reduce the build-up of manure and the amount of wash-down water required, lairage pens should be constructed with:

- slatted concrete floors laid to falls of 1 in 60;
- drainage to a slurry tank below the floor.[12]

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[11] *Code of Good Agricultural Practice for the Protection of Water*, Ministry of Agriculture, Fisheries and Food and the Welsh Office Agriculture Department, October 1998.

[12] *Meat Plant Design and Construction: Guideline Manual on the Buildings and Engineering Design Requirements for the Operation of Meat Plants in Great Britain*, Meat and Livestock Commission.

Do you re-use clear water for primary washing of lairage areas?

Improved scheduling increases abattoir efficiency

By monitoring variations in water consumption throughout each day (see Fig 3), one pig abattoir found that water consumption for overnight cleaning and services (eg boiler make-up and cooling tower make-up) was more or less constant and did not vary with changes in throughput. However, water consumption in the slaughtering area did vary during the day and peaked during breaks in slaughtering. This was because maintaining adequate meat hygiene standards required the slaughter areas to be washed down during breaks to prevent the build-up of congealed blood.

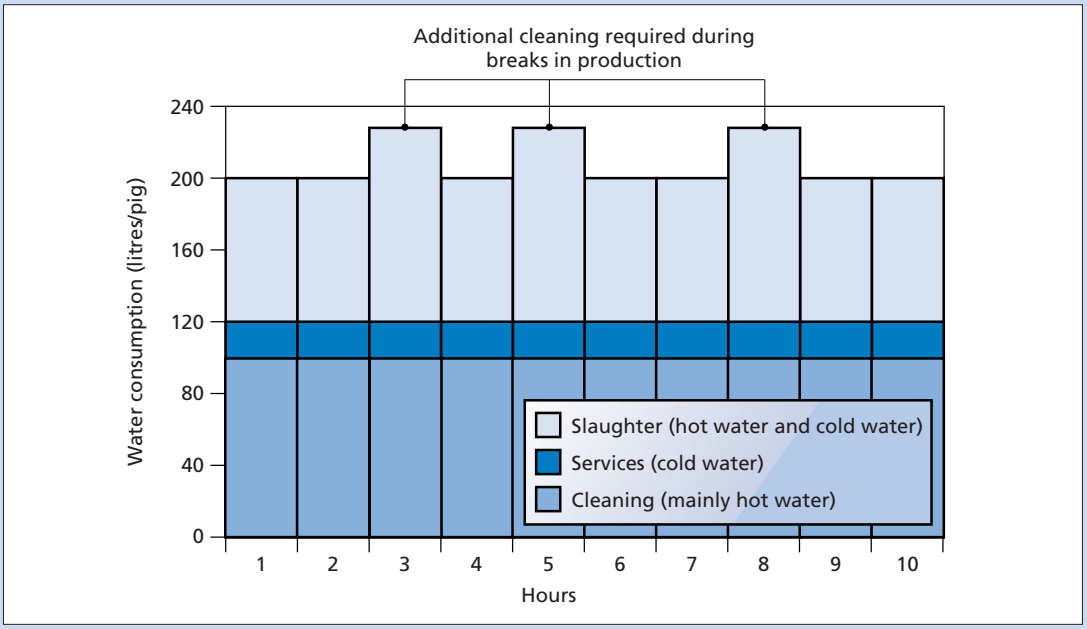

Fig 3 Measured water consumption during a ten hour shift

Phasing staff breaks and programming animal deliveries to arrive within a pre-agreed, one-hour, time window has allowed the abattoir to achieve a continuous supply of animals and continuous slaughtering operations. This avoids the build-up of congealed blood and the associated additional cleaning of the slaughterhouse area (thus reducing water, effluent and labour costs).

4.3 INSTALLING A METERED WATER DISPENSER

By law, vehicles must be washed after delivery to a red meat abattoir. Most companies provide dedicated hosepipes for this purpose. As an alternative, high pressure low volume (HPLV) sprays would seem an attractive option for reducing water consumption. However, red meat abattoirs report that delivery drivers do not generally treat the spray guns with care and, as a result, they have often been broken (eg left out in the yard where other vehicles have driven over them).

Most red meat abattoirs do not charge for vehicle washing water as they are concerned that the cost would be passed back to them in the form of increased delivery charges. However, a few red meat abattoirs have installed vehicle wash meters that dispense sufficient water to clean an average-sized vehicle. Some meters take £1 coins, while other companies issue each driver with a token on arrival. In the latter case, drivers are able to request additional tokens if they are unable to complete cleaning with the specified amount of water. However, because the meter system has raised their awareness of the amount of water they use, the drivers tend to use less water - leading to cost savings for the red meat abattoir.

5 IMPROVING PROCESS OPERATIONS

Cleaning and carcass washing typically account for over 80% of total water use and effluent volumes at red meat abattoirs (see Fig 1 in Section 2.1.2). Blood splattered during slaughtering needs to be washed down and can be a major cause of high effluent strength.

Blood has the highest COD of any effluent from meat abattoir operations. Liquid blood has a COD of about 400 000 mg/litre and congealed blood has a COD of about 900 000 mg/litre. If the blood from a single cow carcass was allowed to discharge directly to sewer, the effluent load would be equivalent to the total sewage produced by about 50 people on an average day.

Owing to its high COD, disposal of waste blood in trade effluent results in high trade effluent charges. Most abattoirs are unaware of the true costs of allowing blood to enter the effluent stream and can make substantial cost savings from improvements in this area.

Blood forces up trade effluent charges at a small mixed species abattoir

A small mixed species abattoir processes about 6 500 cattle, 65 000 sheep and 21 000 pigs each year. When the company analysed its annual trade effluent charges, it found that the costs associated with the effluent's COD content accounted for almost 65% of its total bill (see Table 4). Although about 92% of the blood was collected for disposal by tanker at a cost of £18 000/year, disposal of the remaining 8% to sewer cost £14 500/year.

The company plans to halve the amount of blood washed to the sewers (currently estimated at about 100 m^3/year of blood) through improved blood management and cleaning practices. At current prices, this would lead to a reduction in trade effluent charges of about £7 250/year. Blood tanker disposal costs would increase by £700/year, giving a net cost saving of £6 550/year.

Item	Value
Effluent volume	5 900 m^3/year
Average COD	6 600 mg/litre
COD charge applied by water company using the Mogden Formula	£2.45/m^3
Cost for COD element of effluent	£14 500/year
Total trade effluent charges	£23 000/year

Table 4 Annual effluent costs at a small mixed species abattoir

The following subsections describe how medium-sized and large red meat abattoirs can significantly reduce their water and effluent costs by:

- optimising blood collection;
- efficient scalding and water/waste management (pig abattoirs);
- using a dry process to remove gut manure (cattle and sheep abattoirs);
- ensuring wash water is controlled properly;
- using appropriate directional spray nozzles for carcass washing;
- using appropriate spray cooling nozzles during processing;
- maintaining nozzles used for spray cooling and other processing.

5.1 OPTIMISING BLOOD COLLECTION

To reduce the COD and suspended solids content of effluent, it is essential to prevent blood and meat scraps entering the effluent stream.

5.1.1 Use of bleeding troughs

It is generally cheaper to collect the blood for separate disposal.

- Efficient bleeding processes and blood collection in a blood trough are essential. Ideally, the blood trough should be long enough to provide a retention time for bleeding of at least $5^1/_2$ - 6 minutes.

Rerouting drains stops blood entering the sewer

Owing to increased throughput, the blood trough at one abattoir is now too short and considerable amounts of blood drain from the carcasses in the first 4 - 5 metres after the trough. The company plans to reroute the floor drains in this area so that they can be directed straight into the blood tanker.

- The blood trough should be pitched and curved to facilitate squeegeeing before washing.
- The blood trough should be fitted with a double drain - one to allow the blood to be pumped to a tanker for disposal and the other for wash-down water. When not in use, the drain openings should be sealed with a removable plug.
- Before wash-down, the blood trough should be sluiced with a few litres of water and a rubber-bladed squeegee used to transfer the concentrated blood solution into the drain for pumping to the blood tanker.
- To reduce wash-down requirements, any residual, partially congealed blood in the trough during the day should be shovelled or scooped for pumping into the blood tanker.

5.2 PIG SCALDING

Traditionally, the bled carcass is immersed for 5 - 8 minutes in scalding tanks filled with hot water at 58°C - 61°C. An alternative is showering the carcasses with re-circulated hot water in shower cabins. Shower scalding uses large amounts of water and energy, and is not widely used.

For an abattoir processing about 100 pigs/hour, the dimensions of the scald tank are typically around 4 metres long, 1.7 metres wide and 0.8 metres deep. Such a tank contains around 5.5 m^3 (5 500 litres) of water. Some larger abattoirs use a conveyor system to drag the carcass through a longer tank equipped with countercurrent water filtration and recycling.

5.2.1 Controlling the tank water level

Scalding tanks are often refilled by leaving the water supply running until it is switched off by the cleaning staff or letting it run overnight and allowing excess water to spill over into the drain.

- Installing a simple ball valve or other level sensing device to switch off the water supply when the tank is full will reduce water consumption significantly.

Is the water level in the scald tank controlled effectively?

5.2.2 Steam scalding

A more efficient method of scalding that is used in a number of European countries uses humidified air to transfer heat to the carcass surface through the condensation of steam. Heat and moisture are transferred to the scalding air by atomisation of hot water in a circulating air flow. This process can maintain a constant temperature and 100% humidity under varying loads - factors crucial for good scalding performance. Measurements of hair and toe-nail loosening[13] suggest that the scalding quality of a steam condensation system is comparable to that achieved with a traditional vat scalding system.

The advantages of steam condensation compared to vat scalding include:

- no water in the lungs and no water penetration in the sticking wound;
- low water and energy consumption;
- short start-up time and reduced risk of over-scalding during stops on the slaughter line.

5.3 VISCERA WASHING

5.3.1 Gut washing

Most cattle and sheep abattoirs clean the paunch (rumen), manyplies (omasum) and reed (abomasum) for sale to butchers for use in pet foods. Common industry practice is to cut the paunch open on a table and use a flow of water to push the manure over a mechanical screen before it is pumped to a holding area. However, this practice produces effluents with a high COD content, as gut manure has a COD of over 100 000 mg/litre and some 80% of this typically dissolves in the washing water.

Significant reductions in water and effluent costs can be achieved by switching to dry gut cleaning. In this process, the paunch is opened without water and the manure is transported to a trailer by a pneumatic hopper system or screw conveyor.

Most abattoirs use compressed air to power equipment such as pelt pullers, hoists and brisket saws. The compressed air ring main can also be used to power the pneumatic hopper system, which typically operates at 100 - 275 kPa (15 - 40 psi), to blow the paunch manure into the trailer. Providing the transport pipe is wide enough (a 15 cm (6 inch) diameter pipe is adequate for most abattoirs), no water will need to be added to the paunch manure. The paunch manure should already be damp enough for pneumatic transport; adding more water will only reduce the system's efficiency.

A piston compactor can be used to reduce the volume of the manure and thus make handling easier. After manure removal, the paunch should be washed in running or recirculated water according to Meat and Livestock Commission guidelines.[14]

Do you use a dry process to remove gut manure?

[13] Carried out by the Danish Meat Research Institute, Maglegaardsvej 2, PO Box 57, DK-4000 Roskilde, Denmark.

[14] *Meat Plant Design and Construction: Guideline Manual on the Buildings and Engineering Design Requirements for the Operation of Meat Plants in Great Britain*, Meat and Livestock Commission.

5.3.2 Intestine washing

Except for those deemed to be Specified Risk Material, the small and large intestines of red meat animals are usually squeezed and washed for use in casings.[15]

To reduce water use and effluent production, intestine washing should be carried out in two stages, ie a primary wash in a water bath with continuous water filtration and recirculation, followed by a final rinse in clean potable water.

For the remaining offal, you should consider installing macerator equipment to chop, wash and spin dry it prior to supplying it to the rendering company. Macerators usually consist of hook-shaped blades that are set to counter-rotate against themselves or to rotate against fixed anvils. The cut offal is then washed in a rotating mesh drum. The hasher machine should be maintained regularly to ensure that the blades are in good condition and to optimise their speed and separation. This will optimise the efficiency of the cutting operation and reduce the amount of waste offal that becomes mixed with the wash water.

The cost savings from reducing the offal volume by over 50% usually outweigh the increased energy and effluent costs associated with intestine washing. At present, the cost benefits of this approach result from reduced volumes for waste disposal. As the market for tallow improves, the main benefit of cutting and washing offal will be to increase its sale value by reducing tallow colouring during rendering.

5.4 WASH WATER CONTROL

On many automated and semi-automated slaughter lines, carcass washing water is applied continuously even when processing operations have ceased temporarily or there are gaps between carcasses on the conveyor.

- If wash water flows continuously, consider:
  - installing solenoid-operated valves or timer switches linked to the conveyor starter motor to regulate the wash water;
  - using photoelectric cells to turn on water when the product is in the washing position.
- Fit similar controls to washing systems for meat hooks and conveyors.

Is carcass washing water switched off during breaks in the slaughter line?

Manual switching during start-up and shutdown

A less efficient alternative to fitting controls - but one involving no capital expenditure - is used at a large red meat abattoir. A member of staff is responsible for walking in front of the first carcass on the processing line during start-up to switch on all rinses, scalds, etc. Similarly, this person is responsible for switching off all water flows after the last carcass on the processing line, during shutdown, and if the line stops during the shift.

[15] Sheep produce about 27 metres of tender casings, which are used for sausages. Pigs produce about 19 metres of rougher casings, which may be eaten or removed before consumption of the product. Cattle produce about 34 metres of tough, strong casings, which are usually removed before consumption of the product.

5.5 DIRECTIONAL SPRAY NOZZLES FOR CARCASS WASHING

Sprays and rinses typically account for about 30% of water use at red meat abattoirs (see Fig 1). To optimise washing efficiency while minimising water consumption, use spray nozzles to direct or focus the water.

Many red meat abattoirs use 'shower head' arrangements or pipes with drilled holes for carcass washing, leading to excessive water use. Excessive washing - especially with hot water - removes fluids and tissues from the product, flushing them into the effluent streams. Considerable savings can be achieved by using more efficient flat spray nozzles, which should typically be rated at 415 - 690 kPa (60 - 100 psi). With improved direction and angling of the sprays, the desired level of washing can be maintained using a lower water pressure.

Typically, **a reduction in water use of 20%** can be achieved by:

- upgrading spray systems;
- installing and maintaining efficient directional nozzles for washing operations.

Recent improvements in spray technologies have made spray nozzles less susceptible to blockage. New designs are available with improved water efficiency coupled with a similar or often improved washing effect. Sites that already have spray washing systems could, therefore, benefit from reviewing the latest spray technology. The three main types of nozzle applicable to red meat abattoir operations are shown in Fig 4.

When selecting a nozzle for washing operations, you need to consider flow rate, pressure drop, spray pattern, the material to be cleaned, spray impact and droplet size. Therefore, red meat abattoirs are advised to consult an equipment supplier with an understanding of the technical aspects of their spray application.

Have you considered using flat spray nozzles for carcass washing operations?

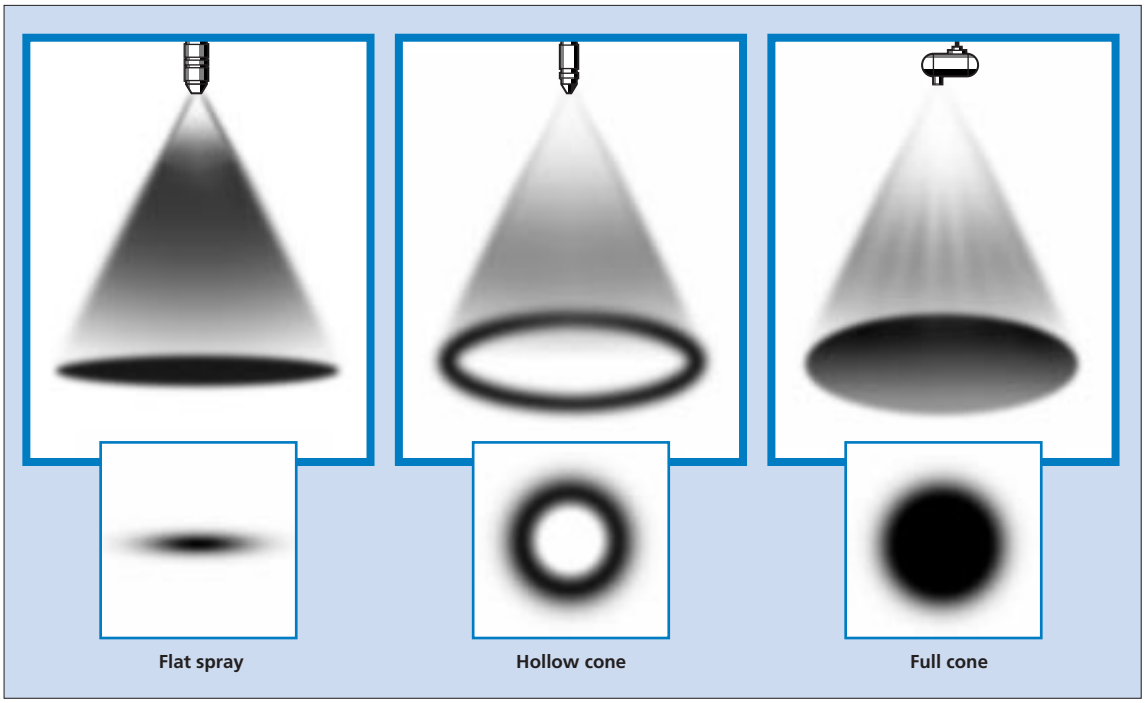

Fig 4 Spray nozzles and their spray patterns suitable for use in red meat abattoirs

5.6 APPROPRIATE NOZZLES FOR SPRAY COOLING

Spray cooling is an efficient means of cooling meats during processing. It also helps to improve moisture retention. Hollow cone nozzles (see Fig 4) should be used for brine cooling units. Brass nozzles are adequate for spraying sodium chloride solutions, but harder wearing steel or stainless-steel nozzles should be used for calcium chloride solutions.

For chill rooms and quick cooling before refrigeration, use a directional nozzle that provides a gentle spray of large drops in a hollow cone pattern (see Fig 4). The larger drops produced by this type of nozzle give efficient cooling but without the mist of fine droplets commonly associated with chill-room nozzles. Less misting leads to less icing on refrigeration coils and reduced airborne contamination.

Fine spray nozzles should be used to provide cooling in lairage areas. Such nozzles provide a wide, hollow cone spray pattern with a very fine drop spray - even at low pressures.

5.7 NOZZLE MAINTENANCE

In hard water areas, it is good practice to have a stand-by set of nozzles so that the duty set can be descaled each month and thus maintain the required washing efficiency.

In soft water areas, you should check your spray systems periodically for worn spray nozzles. As well as using more water, a worn nozzle will give poor washing performance as the spray will have reduced pressure and a smaller angle of coverage.

For high pressure spraying applications, consider using stainless-steel nozzles. Although stainless-steel nozzles are more expensive, they will maintain their rated performance three to four times longer than brass nozzles. For pressures greater than 2 070 kPa (300 psi), consider using hardened stainless-steel nozzles which will last about five times longer than stainless-steel nozzles.

6 IMPROVING CLEANING OPERATIONS

General advice on how to cut cleaning costs without compromising hygiene standards is given in Good Practice Guide (GG154) *Reducing the Cost of Cleaning in the Food and Drink Industry*.[16] The Guide explains how you can control your cleaning costs by:

- working out what are your real costs of cleaning;
- working out what your costs could be;
- improving your control and management of cleaning operations;
- minimising consumption of cleaning chemicals and water;
- reducing effluent contamination;
- choosing the appropriate technology for your cleaning process.

Cleaning and carcass washing operations typically account for more than 80% of an abattoir's total water use and effluent volume. The following subsections provide specific advice for red meat abattoirs on how to reduce water and effluent costs associated with cleaning operations by:

- interception and dry clean-up of meat scraps;
- use of cyclonic vacuum cleaners;
- use of appropriate cleaning methods;
- appropriate use of cleaning chemicals.

It remains the responsibility of companies taking action to ensure that hygiene standards are being met in individual cases.

section 6

6.1 COLLECTION AND DRY CLEAN-UP OF MEAT SCRAPS

Effluent treatment and disposal are expensive and it is cheaper to keep meat wastes out of the wastewater stream in the first place.

At many red meat abattoirs, it is common practice during cleaning for staff to remove the grates covering floor drains and flush meat scraps directly down the drain in the belief that a subsequent screen or catch pit will trap all the solids. However, the turbulence, pumping and mechanical screening that these scraps encounter in the effluent stream break down the meat, increasing the COD of the effluent flow and releasing fats and solids. Subsequent effluent treatment and disposal to sewer is expensive.

It is simpler and cheaper to implement good housekeeping practices designed to collect the meat wastes and keep them out of the effluent stream in the first place, eg:

- look for opportunities in the cutting and trimming areas to collect meat wastes before they enter the drains;
- fit trays to catch meat scraps and other wastes that fall from equipment;
- ensure that fine mesh covers are in place to stop meat scraps and other solid wastes from entering the drains;
- instruct cleaning staff to empty drain traps into another collection container before beginning to clean an area.

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[16] Available free of charge through the Environment and Energy Helpline on freephone 0800 585794.

Dry clean-up of any meat scraps that do fall to the floor should be encouraged by:

- providing sufficient waste bins of a suitable design;
- urging staff to use plastic shovels and squeegees with rubber blades to scoop up wastes;
- explaining the consequences of using a water hose as a broom to sweep meat scraps into the drains;
- reducing the number of available hosepipes or making them less accessible for general use.

Waste bins should be emptied and cleaned regularly to ensure that hygiene standards are met.

To avoid excessive water consumption when hoses are used, consider installing automatic shut-off valves and/or trigger-action guns on the hoses.[17]

6.2 USE OF CYCLONIC VACUUM CLEANERS

Modified cyclonic vacuum cleaners can also be used to remove blood and viscera from slaughterhouse floors.

Table 5 gives the specifications of two sizes of vacuum cleaner that have been used successfully in several UK cattle abattoirs. These cyclonic vacuum cleaners are designed for easy emptying into waste bins, but it is important to clean them regularly.

	Large	Medium*
Suction tool	Curved - with open front attached to rubberised, smooth-bore hose (7.6 cm diameter).	Open-ended - attached to rubberised, smooth-bore hose (5 cm diameter).
Ease of cleaning	60-litre, stainless-steel drum that can be lifted out.	35-litre, stainless-steel drum that can be lifted out.
Method of emptying drum contents	Rubberised, smooth-bore drain hose (10 cm diameter).	Tipping chassis
Approximate dimensions	1.1 m high by 0.6 m wide	0.9 m high by 0.5 m wide
Voltage	240 or 110 volts	240 or 110 volts
Approximate cost	£800	£650

* Also available as a battery-powered unit.

Table 5 Cyclonic vacuum cleaner specifications

Vacuum cleaner helps to reduce water use in Danish abattoir

As part of a package of measures, a Danish cattle abattoir decided to use a vacuum cleaner in its slaughter hall during the day to remove blood and offal from floor areas prior to wash-downs. Separation between blood and cleaning water was also improved by constructional changes in certain areas. In addition, a number of taps and showers were equipped with automatic switches or timers and the water flow rate was djusted.

These measures reduced the abattoir's water consumption by 170 litres/animal (equivalent to a 15% saving in water use) and the effluent COD was reduced by 0.4 kg COD/animal, a reduction of 7%.[18]

[17] See Good Practice Guide (GG67) *Cost-effective Water Saving Devices and Practices*, available free of charge through the Environment and Energy Helpline on freephone 0800 585794.

[18] For further information contact the Danish Meat Research Institute, Maglegaardsvej 2, PO Box 57, DK-4000 Roskilde, Denmark.

6.3 USE OF APPROPRIATE CLEANING METHODS

Low pressure spray guns fitted with flat spray nozzles - up to 1 720 kPa (250 psi) - are ideal for wash-down operations.

Flat sprays should also be used for conveyor cleaning of smaller items, eg wash stations built around sections of an overhead conveyor so that meat hooks can be cleaned as they pass through. Cone nozzles should be used for larger items as they give more thorough coverage with fewer nozzles.

To improve hygiene, by reducing the potential for airborne contamination in areas such as slaughtering, cutting and portioning, most red meat abattoirs have switched from high pressure low volume (HPLV) spray guns to low pressure spray guns. Provided the spray system is designed and operated carefully, this change will not increase water consumption as much as might be expected.

Good practice with spray guns reduces water use

One red meat abattoir was able to halve water consumption by reviewing the operation of its spray guns and converting from 2 cm diameter hoses to 1.25 cm diameter hoses. The amount of water used was still sufficient to rinse off detergents thoroughly so that there was no tainting and/or damage to metal surfaces.

6.4 APPROPRIATE USE OF CLEANING CHEMICALS

Many different cleaning chemicals are available;[19] some are formulated to handle specific or difficult cleaning problems while others are intended for general purpose use.

Alternatives to conventional cleaning chemicals are now available based on the use of biotechnology.[20] Biotechnological cleaning agents - containing naturally occurring enzymes - can be used for disinfection and for cleaning equipment, floors and walls.

It is not the aim of this Guide to recommend which cleaning chemicals to use. However, there are a number of general issues that should be considered. In all cases, only food-grade cleaning chemicals should be used.

- **Is the most suitable chemical being used?** Review your cleaning chemicals to ensure that the most suitable chemical is used for each application. Changing to a more appropriate chemical can reduce the amount required and, in some cases, improve hygiene standards.
- **Is the concentration correct?** Overuse of chemicals is common, particularly with manual dosing. Overuse of chemicals can be avoided by:
  - staff training;
  - good management;
  - regular checks of chemical concentrations (particularly with manual dilution);
  - use of automatic chemical dosing systems.
- **Is it more economical to buy higher concentration chemicals?** Purchasing chemicals in higher concentrations saves packaging, reduces the amount of chemical 'fillers' and can be cheaper. If higher concentration chemicals are used, then adequate equipment and training should be provided to dispense and/or control them safely and to avoid overuse and waste.

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[19] *An Environmental Guide for Public Authorities and Purchasers* from the Soap and Detergent Industry Association (Tel: 01444 441153) gives advice on how to reduce the environmental impact of detergents.

[20] Contact the DTI's BIO-WISE Helpline on 0800 432100 for further information and a list of companies supplying biotechnology cleaning products.

- **Is adequate training provided?** Staff should be trained in efficient and safe cleaning techniques. Contact your cleaning chemical supplier to find out what training facilities can be offered.
- **Could you benefit from reviewing your contract with your detergent supplier?** Reviewing your contract with a view to optimising the use of cleaning chemicals and reducing water consumption could produce significant cost and other benefits.

Significant cost savings follow review of cleaning supplier contract

Changing its arrangements for buying cleaning chemicals has enabled a major UK abattoir to reduce its annual site cleaning costs by 30%. The company reviewed the cleaning performance of chemicals supplied by its existing detergent supplier and found that:

- chemical formulations and application equipment were inappropriate;
- chemical consumption was excessive, giving poor cleaning performance and high costs;
- technical back-up was minimal.

These findings prompted the company to invite a local cleaning chemical supplier to survey the site and conduct trials in each production area for a three-month period. The trials were carried out free of charge by the chemical supplier and required little management effort from the abattoir to organise. Cleaning costs across the site were reduced and cleaning performance was improved by the better chemical formulations, correct application equipment, training and regular technical service provided by the new contractor.

Service contract reduces chemical costs and water consumption

Another red meat abattoir reduced its annual cleaning costs by 15% by asking its detergent supplier to quote a fixed price to supply detergents to clean a specific area (eg the slaughter line) for a year. As part of the service, the chemical supplier is responsible for training the company's cleaning staff to follow its recommended cleaning procedures. The chemical supplier also provides detergent dosing equipment to ensure correct make-up of cleaning solutions and foams. The supplier is responsible for ensuring that hygiene levels are met and that water is used efficiently. The quality of the chemical supplier's service is judged by regular hygiene swabs of the area.

This form of contract places the onus on the supplier to use the most appropriate detergent to clean the area and to optimise cleaning costs. In addition to lower annual purchase costs for detergents, the abattoir has also benefited from the reduction in the amount of water used and cleaning effluent produced. The latter requires subsequent treatment in the company's effluent treatment plant.

Have you reviewed your contract with your detergent supplier to optimise use of cleaning chemicals and water?

6.5 RING MAINS WATER SUPPLY

Rather than operating a number of mobile water heating units, many red meat abattoirs have found it more efficient to install a ring main to supply hot water for cleaning process areas.

Significant benefits from installing hot water ring main

A red meat abattoir previously used mobile pressure washing machines with diesel-powered water heaters to clean its plant. However, the diesel fumes created pollution and time was wasted relocating steam cleaners and moving hoses around the plant.

In view of these limitations, the company decided to overhaul its cleaning operations. A new system was chosen with a pressurised hot water ring main, with eight points where cleaning guns could be connected. The benefits of the new system included:

- more efficient use of water leading to a 17% reduction in water consumption during the first three months;
- reduced downtime for cleaning operations;
- improved cleaning standards;
- no need to move heavy machinery around the site.

7 IMPROVING EFFLUENT TREATMENT

Producing less effluent in the first place will save money by reducing the demand for on-site effluent treatment and reducing trade effluent charges. When all the possibilities for minimising the amount and strength of your effluents have been investigated, effluent treatment techniques should be reviewed and optimised.

Effluent treatment and disposal are expensive. It is much cheaper to keep meat wastes out of the wastewater and reduce water use in the first place. Significant cost savings can be achieved by reducing both the amount and strength of the raw effluent requiring treatment.

To reduce trade effluent charges, most red meat abattoirs screen their effluent to remove larger solids. Appropriate maintenance is essential to provide good cleaning performance and thus reduce the disposal costs or, for larger companies that treat their effluent further, the load on the effluent treatment plant. Key features of the most common mechanical screens[21] are summarised below.

7.1 MECHANICAL SCREENS

7.1.1 Static wedge screen

Static wedge screens (see Fig 5) are generally cheaper, but require more maintenance than other designs.

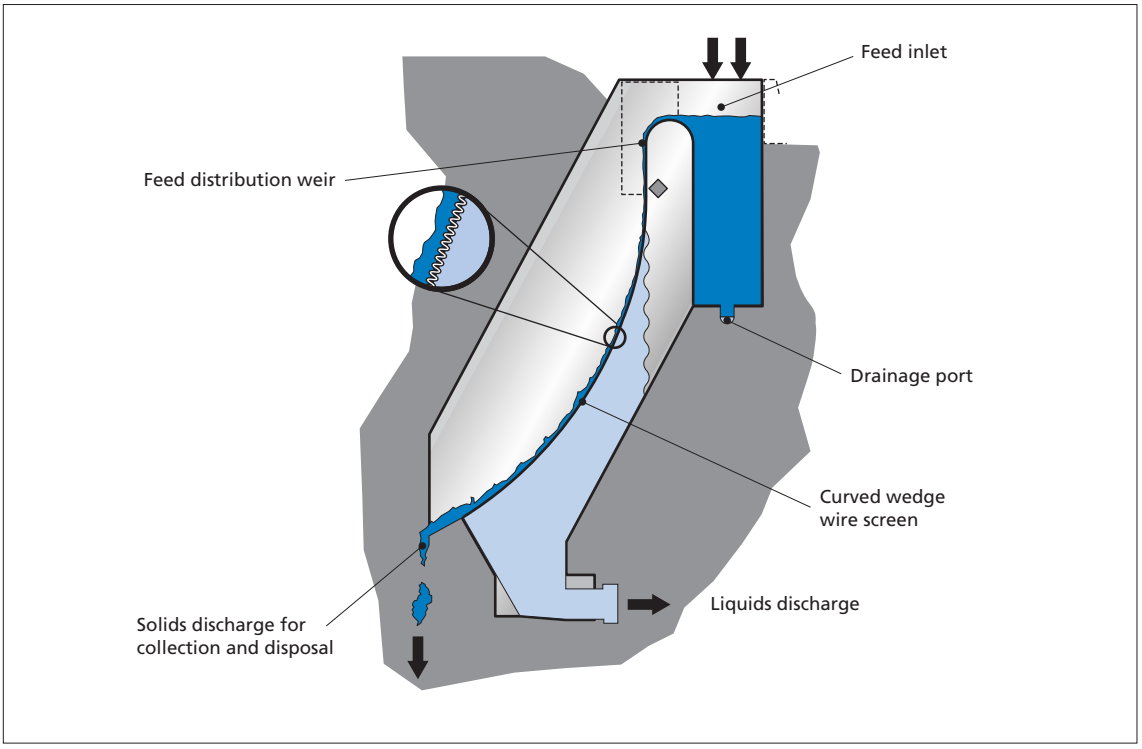

Fig 5 Typical static wedge screen

[21] For more information about the different types of screen available, contact the Environment and Energy Helpline on 0800 585794, the BMF on 020 7329 0776 or the BMMA on 020 7828 1224.

Regular cleaning ensures optimum screen performance

At one meat abattoir, the static wedge screen is cleaned three times a day using high pressure hoses to remove the build-up of gross debris, and once a day with a small amount of chemical cleaner to dissolve any remaining fats.

7.1.2 Inclined screw press

Inclined screw presses are generally more expensive to buy than static wedge screens, but the action of the screw brushes in the inclined screw press (see Fig 6) removes gross debris from the screen. Chemical cleaners should be used periodically to dissolve the fats that build up on the screen.

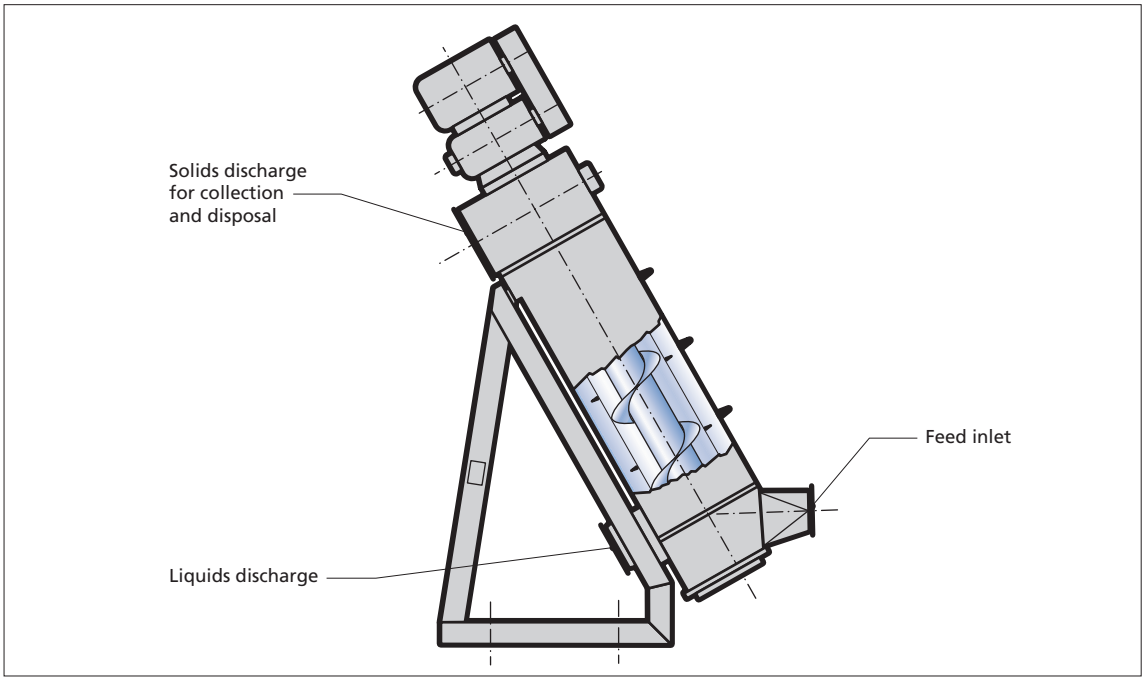

Fig 6 Typical inclined screw press

7.1.3 Rotary drum screen

Rotary drum screens (see Fig 7) are typically 2 - 3 times more expensive to buy than static wedge screens, but have the benefit of being essentially self-cleaning and generally requiring less maintenance.

7.2 ADDITIONAL TREATMENT PLANT

Despite the use of mechanical screens, trade effluent charges paid by red meat abattoirs have increased considerably in recent years. Some companies have seen their charges increase by over 50% within 18 months. Effluent charges are expected to increase still further as water providers seek to recoup the investment needed to upgrade their sewage treatment plants to meet the requirements of the EC's Urban Waste Water Treatment Directive.

Many larger red meat abattoirs have found it cost-effective to install additional treatment plant, eg dissolved air flotation (DAF), to reduce the COD and suspended solids content of their effluent.

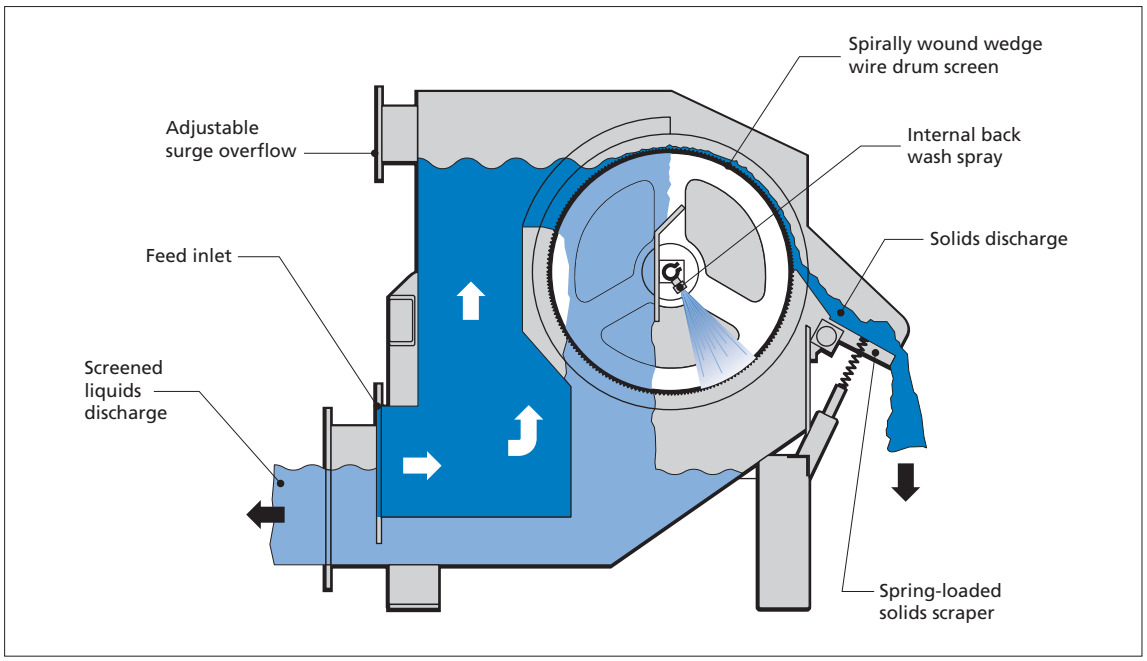

Fig 7 Typical rotary drum screen

DAF units significantly reduce effluent strength

In addition to rotary drum screens, one large group of abattoirs has installed DAF units at all of its sites. The resulting cost savings from reduced trade effluent charges have more than justified the capital expenditure. The DAF units reduce the effluent COD from typically 2 900 - 3 800 mg/litre to less than 600 mg/litre. Suspended solids are reduced from about 1 500 mg/litre to less than 100 mg/litre.

As effluent discharge costs increase, medium-sized red meat abattoirs may also find it cost-effective to install and operate additional treatment equipment. Comparing the potential savings from reduced effluent charges with the capital and operating costs of this equipment will enable you to decide whether the payback period is acceptable.

Good Practice Guide (GG109) *Choosing Cost-effective Pollution Control* provides a step-by-step approach to choosing the most suitable effluent treatment plant for your site as part of an overall waste management strategy. GG109 is available free of charge through the Environment and Energy Helpline on freephone 0800 585794.

8 ACTION PLAN

Table 6 summarises the advice given in this Guide as an ordered list of actions you should consider to achieve cost savings by improving your water and effluent management.

Area	Action
What are your water and effluent volumes and costs? (see Section 2)	✓ Examine your most recent water and effluent bills to find out how much water and effluent cost your company per year and per m^3.
	✓ Compare the amount of water used per animal at your site with good practice levels. If your water consumption is higher, investigate how much you could reduce this through improved management and control.
	✓ Install water meters to measure use of hot and cold water in each process area.
	✓ Use these data to calculate the cost of water in each process area and identify target areas with the greatest potential for improvement.
	✓ Compare the water use in target areas with the expected water consumption based on the equipment manufacturer's recommended levels and/or knowledge of how the process is designed to work.
	✓ Identify and implement no-cost and low-cost measures, after ensuring hygiene standards will not be adversely affected.
	✓ Investigate other opportunities for reducing water and effluent costs. Assess which of these are economically, technically and practically feasible. Ensure that hygiene standards will be met.
	✓ Implement a leak detection and repair programme for valves, pumps and piping equipment.
How can you improve transport and lairage arrangements? (see Section 4)	✓ Consider adopting a just-in-time delivery system to reduce holding periods and ensure continuous slaughtering operations.
	✓ Where practical, remove manure from lairage in solid form rather than washing it out.
	✓ Consider re-using clear water (eg chiller water from carcass refrigeration rooms, cooling water and steam condensate) for primary washing of lairage areas. Ensure hygiene standards will be met.
	✓ Consider using high pressure low volume (HPLV) hoses for final washing of lairage areas with potable water.
	✓ Consider implementing a token or coin operated system to dispense water for vehicle washing.

Area	Action
How can you improve your process operations? (see Section 5)	Segregate blood from effluent treatment streams where possible to minimise effluent COD.
	Ensure bleeding times are maximised over the blood trough.
	Squeegee blood for pumping to blood tanker before washing down blood trough.
	For pig scalding, ensure effective control of scald tank water level. Consider switching to steam scalding.
	Use dry gut manure removal systems for washing of cattle and sheep viscera. Where possible, use pneumatic gut blowing systems.
	Fit appropriate controls to ensure that carcass washing water is switched off during breaks in processing.
	Install water-efficient directional nozzles for use in carcass washing during evisceration, wash-down activities and conveyor cleaning.
	Maintain nozzles appropriately for carcass washing, spray cooling and other uses.
How can you improve your cleaning operations? (see Section 6)	Check that trays are in place to catch meat scraps and other waste that fall from equipment.
	Check that fine mesh covers are in place to stop meat scraps and other waste from entering the drains.
	Ensure that cleaning staff empty drain traps into another container before beginning to clean an area.
	Use squeegees or cyclonic vacuuming at the end of shifts to dry collect as much blood and viscera as possible from slaughterhouse floors, and blood and meat scraps from other processing areas.
	Provide sufficient waste bins. Ensure the bins are emptied and cleaned regularly.
	Clean with potable water only after all possible waste has been collected.
	Consider reducing the number of hoses and installing automatic shut-off valves and/or trigger action controls on remaining hoses.
	Review the service contract with your detergent supplier to optimise the use of water and food-grade cleaning chemicals.
	Consider installing a pressurised ring main to supply hot water for cleaning process areas.
	Follow the general advice given in Good Practice Guide (GG154) *Reducing the Cost of Cleaning in the Food and Drink Industry*.[22]
How can you improve your effluent treatment? (see Section 7)	Maintain screening equipment to provide good cleaning performance.
	Consider installing secondary effluent treatment equipment to further reduce COD levels prior to discharge.

Table 6 Checklist of actions to improve your water and effluent management

[22] Available free of charge through the Environment and Energy Helpline on freephone 0800 585794.

If necessary, obtain help.

The Environment and Energy Helpline (0800 585794) can:

- Provide further advice and suggest other sources of information about the techniques described in this Guide.
- Tell you about relevant environmental and other regulations that could affect your operations.
- Send you copies of relevant Environmental Technology Best Practice Programme publications.
- Arrange for a specialist to visit your company free of charge if you employ fewer than 250 people (at the discretion of the Helpline Manager).

The Environmental Technology Best Practice Programme is a Government programme managed by AEA Technology plc.

The Programme offers free advice and information for UK businesses and promotes environmental practices that:

- **increase profits for UK industry and commerce;**
- **reduce waste and pollution at source.**

To find out more about the Programme please call the Environment and Energy Helpline on freephone 0800 585794. As well as giving information about the Programme, the Helpline has access to a wide range of environmental information. It offers free advice to UK businesses on technical matters, environmental legislation, conferences and promotional seminars. For smaller companies, a free counselling service may be offered at the discretion of the Helpline Manager.

FOR FURTHER INFORMATION, PLEASE CONTACT THE ENVIRONMENT AND ENERGY HELPLINE

0800 585794

world wide web: http://www.etbpp.gov.uk

e-mail address: etbppenvhelp@aeat.co.uk