GG233
GUIDE

ENVIRONMENTAL
TECHNOLOGY
BEST PRACTICE
PROGRAMME

REDUCING WATER AND EFFLUENT COSTS IN POULTRY MEAT PROCESSING

GOOD PRACTICE: Proven technology and techniques for profitable environmental improvement

Foreword from the British Poultry Meat Federation Ltd

'This well-presented Guide provides practical and responsible advice for poultry processors which will save significant costs and at the same time benefit the overall environment by reducing water use. I fully commend this Guide, and the others in the series, to all processing companies.'

Peter Bradnock
Chief Executive
British Poultry Meat Federation Ltd

REDUCING WATER AND EFFLUENT COSTS IN POULTRY MEAT PROCESSING

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SUMMARY

Poultry meat processors use large quantities of water and generate equally large volumes of wastewater with a high chemical oxygen demand (COD) and suspended solids content. Evisceration, cleaning and washing operations typically account for more than 60% of total water use and effluent volume.

How much money are you pouring down the drain? On average, poultry processors that adopt a systematic approach to reducing water use can reduce their water and effluent bills by 10 - 15% 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 poultry processor with a trade effluent bill of £79 200/year could save £33 200/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. In addition to increasing costs, implementation of the Integrated Pollution Prevention and Control (IPPC) Directive will increase the pressure on poultry processors 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:
  - delivery of birds to your site?
  - your process operations?
  - your cleaning operations?
  - your effluent treatment?

There are Industry Examples throughout the Guide that 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?

Poultry processors 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 for poultry processors;
- 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 poultry processors 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 poultry processors. 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, poultry processors 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.

Poultry meat processors use large quantities of water and generate equally large volumes of wastewater with a high chemical oxygen demand (COD) and suspended solids content. Evisceration, cleaning and washing operations typically account for more than 60% of total water use and effluent volume.

Water use in poultry processing is intrinsically high because of the need to meet the stringent requirements of UK and EC meat hygiene legislation[1]. However, it is important to control water use closely so that, as far as possible, it does not become a vehicle for spreading contamination. If too much water is used, the very humid environment, together with the constant movement of machinery and the proximity of the carcasses to one another on the processing line, can make it easy for contamination to spread through direct splashing and aerosols.

[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 poultry meat plants 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 455408.

1.2 USING MORE WATER THAN NECESSARY

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 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, while still maintaining hygiene standards. 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. High pressure low volume (HPLV) sprays are not used in meat processing areas, either during processing or when meat is present, due to the risk of spreading contamination via the atomised water. Poultry processors 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, poultry processing companies that adopt a systematic approach to minimising water use can reduce their water and effluent bills by **10 - 15%** 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 poultry processor with a trade effluent bill of £79 200/year to achieve cost savings of £33 200/year.

1.4 COMPLYING WITH IPPC

Implementation of the Integrated Pollution Prevention and Control (IPPC) Directive in the UK will increase the pressure on poultry processors 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.

1.5 HOW CAN THIS GUIDE HELP?

This Guide describes a step-by-step approach to help poultry processors 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.

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 bird

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

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

Type of bird	Specific water consumption
Chicken	8 - 15 litres/bird
Turkey	40 - 60 litres/bird

Table 1 Good practice for specific water consumption[4]

When assessing your water costs, start by:

- Calculating your specific water consumption based on the number of birds 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;
  - 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 typical turkey processor.

[4] Based on discussions with equipment suppliers and visits to a number of poultry processors.

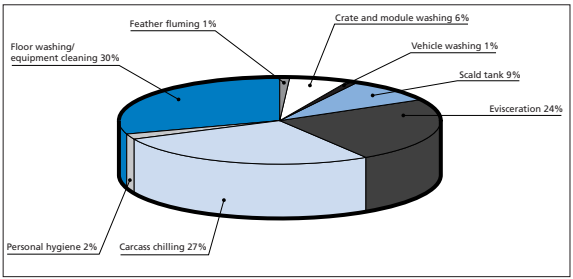

Fig 1 Breakdown of water use by different process areas at a turkey processor

Relative use of hot and cold water

At most poultry processors, about half 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 costs typically 16 pence/m^3 for water heated by gas or 47 pence/m^3 for water heated by electricity[5]. Heating costs are on top of a typical cost of 70 pence/m^3 for mains water (1999 prices) or over £1.00/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 turkey processor featured in Fig 1.

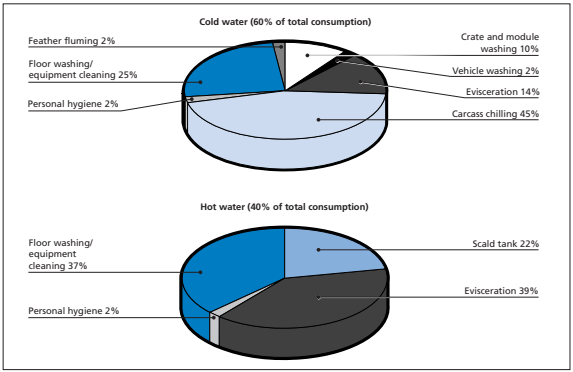

Fig 2 Hot water and cold water consumption for different process areas at a turkey processor

[5] Based on 1998 costs for small industrial users of 0.92 pence/kWh for gas and 3.95 pence/kWh for electricity (*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 poultry processors 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;
- identify water and cost saving opportunities.

Buying and fitting a meter to measure flows typically costs[6]:

- £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 use produces quick savings at Buxted Chicken

Buxted Chicken Limited is a medium-sized poultry processor producing fresh whole chickens and chicken meals. Although waste reduction had been a priority at the Company for many years, adopting a systematic approach still brought significant benefits.

The Company assessed the potential for waste reduction by:

- studying the process;
- discussing requirements with customers;
- negotiating with suppliers.

To help ensure that production targets were still achieved (and demands on staff resources minimised) during the waste minimisation programme, Buxted arranged for students from a local college to assess waste at the site as part of their studies. Projects were identified using the methods outlined above and produced total savings of £150 000/year. Implementation cost £15 000, giving Buxted a simple payback on its investment of less than six weeks.

Reducing water use was a key part of this approach. Buxted spent £3 000 fitting meters to monitor water use relative to production activities. Data were fed into a computer in the engineering manager's office; software was used to identify trends, and areas with high water consumption were targeted. This approach showed that water use could be reduced by tighter controls in certain areas of the factory. For example, six flow restrictors were installed at a cost of less than £600 to prevent water from being wasted, and water flow rates are now adjusted manually to match process requirements. Fitting a speed control to the main pumps allowed better control of the water pressure in the factory, thus reducing water use by about 10%. This project produced immediate savings of about £300/week - a payback of ten weeks on the net investment of £3 000. This did not take account of the savings from reduced effluent generation.

Buxted achieved total savings of £35 000/year through:

- education and awareness programmes;
- good housekeeping projects.

[6] 1999 prices.

2.3 CALCULATING WATER AND EFFLUENT COSTS

Ignoring ice-making and other ancillary processes, virtually all the water you buy eventually ends up as effluent. Many poultry processing plants produce large volumes of high-strength effluent. All poultry processors carry out some form of effluent treatment prior to discharge to sewer. This is a cost-effective way of reducing trade effluent charges. As a minimum, companies screen their effluent to remove feathers, meat scraps, etc. However, many larger companies treat their effluent further using more sophisticated techniques (see Section 7).

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

In 1999, typical small poultry processors screening their effluent prior to discharge paid:

- £0.70/m^3 to buy potable water;
- £2.60/m^3 for effluent disposal.

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 effluent you will have to pay for to dispose of.

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,[7] 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 water use is reduced, leading 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.

[7] 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 poultry processing plant discharges 30 000 m^3/year of trade effluent with an average COD of 4 100 mg/litre and an average TSS content of 2 300 mg/litre. The poultry processor pays the local water company a total of £79 200/year in trade effluent charges[8].

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%	1 950	2%
2 Effluent TSS reduced by 25%	6 400	8%
3 Effluent COD reduced by 25%	11 400	14%
4 Effluent volume, TSS and COD all reduced by 25%	33 200	42%

Table 2 Example cost savings from reducing effluent volume and strength[9]

[8] 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.

[9] 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

section 3

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:

- before and after the delivery of birds to your site (see Section 4);
- to minimise downstream clean-up requirements and reduce water costs in your processing operations (see Section 5);
- to minimise downstream effluent treatment requirements and reduce water costs in your general cleaning operations (see Section 6);
- to optimise cleaning performance of screening equipment (see Section 7).

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 in 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 poultry processing 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 birds to site	Washing crates and vehicles	■ Optimise time between last feed and kill ■ Install metered water dispenser
↓		
Slaughter of birds		■ Improve stunning ■ Improve blood collection
↓		
Evisceration and processing	Carcass washing Spray cooling	■ Fit directional spray nozzles ■ Control water use ■ Maintain nozzles
↓		
General cleaning operations	Clean-up of meat scraps Area washdown Conveyor cleaning	■ Collection and dry clean-up ■ Use of cyclonic vacuum cleaners ■ Use appropriate cleaning methods ■ Make appropriate use of cleaning chemicals
↓		
Effluent treatment		■ Maintain screens to optimise performance

Key: Process operations Cleaning operations

Table 3 A step-by-step approach to reducing water use and effluent generation in poultry processing

4 IMPROVING DELIVERY OF BIRDS TO SITE

It is essential that crates, modules and vehicles used to transport birds are cleaned thoroughly between collections to reduce the spread of any infection that might be present. Apart from a few exceptions[10], poultry processors are required by the Poultry Meat, Farmed Game Bird Meat and Rabbit Meat (Hygiene and Inspection) Regulations 1995 to provide separate facilities for cleaning and disinfecting crates, modules and vehicles.

The following subsections describe how medium-sized and large poultry processors can achieve significant water and effluent savings by:

- optimising the time period between last feed and kill;
- installing a metered water dispenser to control the amount of water used for vehicle and module washing.

section 4

4.1 OPTIMISING THE TIME PERIOD BETWEEN LAST FEED AND KILL

If birds are fed immediately before they are loaded onto vehicles, they will discharge larger quantities of faeces during transportation. This will increase the volume and strength of effluent from subsequent crate and vehicle washing. To reduce effluent volumes while maintaining adequate levels of bird welfare, poultry processors should allow 6 - 10 hours between last feeding and kill. In addition to reducing faecal contamination during transportation, this will also reduce crop and intestinal tract contents and, therefore, the amount of waste produced during evisceration.

4.2 INSTALLING A METERED WATER DISPENSER

By law, vehicles must be washed after delivery to a poultry processor. 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, poultry processors 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 poultry processors 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 poultry processors have installed vehicle wash meters which 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 poultry processor.

[10] Poultry processors are not required to provide a separate location and facilities for cleaning and disinfecting vehicles and crates, if alternative facilities approved by the official veterinary surgeon are available, or for cold stores that only receive and store hygienically-packaged fresh meat.

5 IMPROVING PROCESS OPERATIONS

Bird slaughter and evisceration are the two main process operations affecting water use in poultry processing. Blood splattered during slaughtering needs to be washed down and can be a major cause of high effluent strength. Evisceration, cleaning and washing operations typically account for over 60% of total water use and effluent volumes at poultry processors (see Fig 1 in Section 2.1.2).

Poultry blood has an average COD of about 200 mg/litre. Blood that is allowed to enter the wastewater stream can typically lead to a doubling of effluent strength.

The following subsections describe how medium-sized and large poultry processors can significantly reduce their water and effluent costs by:

- ensuring that birds are appropriately stunned prior to slaughter;
- optimising blood collection;
- 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 STUNNING OF BIRDS

For adequate welfare, all birds should be adequately stunned. Stunning also helps to reduce body movement during poultry killing which, in turn, reduces the amount of blood that may splatter onto the conveyor mechanism, outside the bleeding area or onto the feathers of adjoining birds. Blood on feathers will be washed off during the scalding process and enter the effluent stream, thus increasing its COD.

The voltage of the stunning bath should be adjusted to take account of the frequently significant variation in average body size between deliveries of birds from different poultry producers.

5.2 OPTIMISING BLOOD COLLECTION

To reduce effluent COD, it is essential to prevent blood from entering the effluent stream.

- Check that the design of the tunnel walls around the conveyor bleeding area ensures that all spurting blood from freshly killed birds is collected and drained into the blood tunnel.
- The blood tunnel 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 tunnel 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 tanker.
- To reduce wash-down requirements, any residual, partially congealed blood in the tunnel during the day should be shovelled or scooped for pumping into the tanker.

5.3 WASH WATER CONTROL

On many automated and semi-automated poultry processing 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 shackle washers and belt washers.

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 turkey processing company. 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.

section 5

Is carcass washing water switched off during breaks in processing?

5.4 DIRECTIONAL SPRAY NOZZLES FOR CARCASS WASHING

Carcass washing during evisceration typically accounts for around 24% of water use at a poultry processor.

To optimise washing efficiency while minimising water consumption, use spray nozzles to direct or focus the water. Many poultry processors use 'shower head' arrangements or pipes with drilled holes, 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. Therefore, sites that already have spray washing systems could benefit from reviewing the latest spray technology. The three main types of nozzle applicable to poultry processing operations are shown in Fig 3.

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. Poultry processors are, therefore, advised to consult an equipment supplier with an understanding of the technical aspects of your spray application.

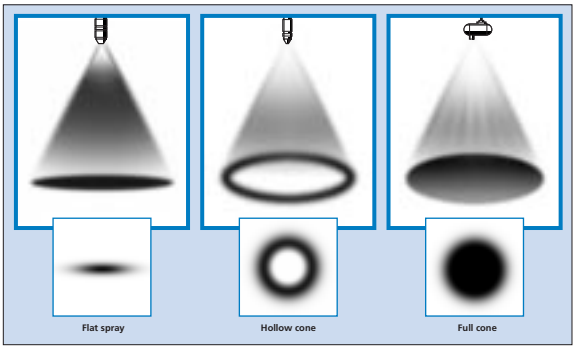

Fig 3 Spray nozzles suitable for use in poultry processing and their spray patterns

Have you considered using flat spray nozzles for evisceration operations?

5.5 APPROPRIATE NOZZLES FOR SPRAY COOLING

Spray cooling is an efficient means of cooling meats during processing. It also helps to improve moisture retention.

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 3). 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.

5.6 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. These will last about five times longer than stainless-steel nozzles in such applications.

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*[11]. 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.

The following subsection provides specific advice for poultry processors 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 poultry processors, 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 breaks down the meat to increase the COD of the effluent flow, releasing colloidal and suspended 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 evisceration and portioning areas to collect meat wastes before they enter the drains;
- fit trays to catch meat scraps and other wastes that fall from equipment;
- ensure 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.

[11] 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 water hoses as a broom to sweep meat scraps into the drains;
- reducing the number of available hose pipes 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[12].

Controls on the use of water hoses save money

At one large poultry processor, all water hoses are kept locked away during the day and specific staff are responsible for dry clean-up of particular areas. The water hoses can only be used during the day with the express permission of a process manager.

6.2 USE OF CYCLONIC VACUUM CLEANERS

Modified cyclonic vacuum cleaners can also be used to remove meat scraps from floor areas. Table 4 gives the specifications of two sizes of vacuum cleaner that have been used successfully by a number of UK meat processors. 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 4 Cyclonic vacuum cleaner specifications

[12] 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.

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 shackles 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 in areas such as evisceration and portioning, most poultry processors 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 you might expect.

Good practice with spray guns reduces water use

One meat processing company 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.

6.4 APPROPRIATE USE OF CLEANING CHEMICALS

Many different cleaning chemicals are available[13]; 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[14]. Biotechnology cleaning agents - containing naturally occurring enzymes - can be used for disinfection and cleaning equipment, floors and walls.

Biotechnology-based cleaning agent replaces sodium hydroxide

A major poultry processing company had an area soiled with faeces, blood, grease, fat and feathers, which was proving very difficult to clean, even with sodium hydroxide. After an initial trial, the company switched to a biotechnology product that removed all traces of organic matter more efficiently. There was a reduction in smell and less damage to equipment. Although the cost of the cleaning products was similar, the company benefited because cleaning took less time, was safer, and used less energy because hot water was not required.

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 of chemical required and, in some cases, improve hygiene standards.

[13] *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.

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

- **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.
- **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 one large meat processing company 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 low 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 meat processing company 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.

The following year, the company reduced its cleaning costs further by asking the cleaning chemical supplier to quote a fixed price to supply detergents to clean a specific area 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 meat processor 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.

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 will cost you less if the site produces less effluent 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, all poultry processors 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[15] are summarised below.

7.1 MECHANICAL SCREENS

7.1.1 Static wedge screen

Static wedge screens (see Fig 4) are generally cheaper, but require more maintenance than other designs.

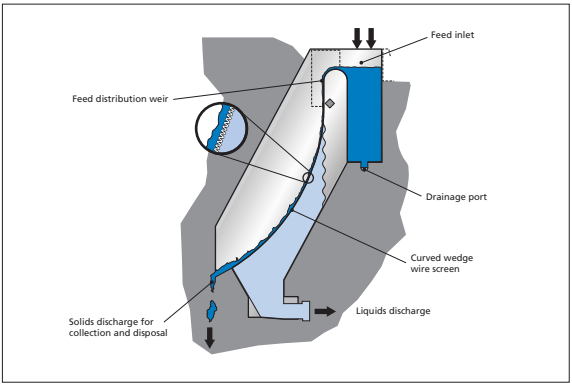

Fig 4 Typical static wedge screen

[15] For more information about the different types of screen available, contact the Environment and Energy Helpline on 0800 585794 or the British Poultry Meat Federation Ltd on (020) 7240 9889.

Regular cleaning ensures optimum screen performance

At one meat processor, 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 5) removes gross debris from the screen. Chemical cleaners should be used periodically to dissolve the fats that build up on the screen.

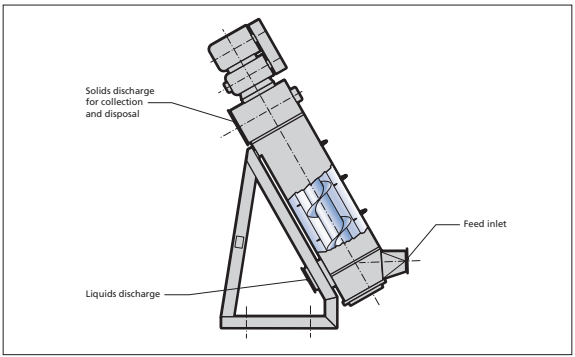

Fig 5 Typical inclined screw press

7.1.3 Rotary drum screen

Rotary drum screens (see Fig 6) 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.

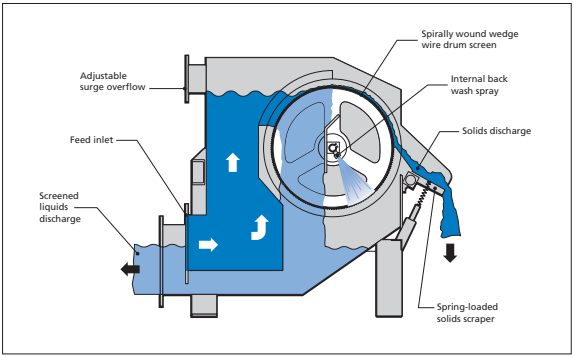

Fig 6 Typical rotary drum screen

7.2 ADDITIONAL TREATMENT PLANT

section 7

Despite the use of mechanical screens, trade effluent charges paid by poultry processors 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 poultry processors 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.

As effluent discharge costs increase, medium-sized poultry processors 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 5 summarises the advice given in this Guide as an ordered list of actions you should consider to achieve costs 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 specific water consumption 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 consumption 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 delivery of birds to site? (see Section 4)	☑ Allow 6 - 10 hours between last feeding and kill to reduce the effort needed to clean crates and vehicles.
	☑ Consider implementing a token or coin operated system to dispense water for vehicle and module washing.
How can you improve your process operations? (see Section 5)	☑ Ensure that all birds are adequately stunned to reduce blood splattering from excessive body movement during killing.
	☑ Check that tunnel walls are adequate to ensure all the spurting blood from freshly killed birds is collected.
	☑ Fit appropriate controls to ensure that carcass washing water is switched off during breaks in processing. Also fit controls to shackle and belt washers.
	☑ Install water-efficient directional nozzles for use in carcass washing during evisceration, wash-down activities, conveyor cleaning and spray cooling.
	☑ Maintain nozzles appropriately for carcass washing, spray cooling, and other uses.

Area	Action
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. ☑ Dry collect as much of the meat scraps as possible at the end of shifts using squeegees or cyclonic vacuuming. ☑ 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 cleaning chemicals. ☑ Follow the general advice given in Good Practice Guide (GG154) *Reducing the Cost of Cleaning in the Food and Drink Industry*[16].
How can you improve your effluent treatment? (see Section 7)	☑ Maintain screening equipment to provide good cleaning performance.

Table 5 Checklist of actions to improve your water and effluent management

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).

section 8

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

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