Reducing the production and discharge of effluent from an abattoir/cutting facility should be a key target for all companies. The government are tightening restrictions on effluent by increasing financial and regulatory controls. According to the Environment Agency (EA), the production of effluent linked to water usage is one of the significant environmental impacts of meat processing and thereby is a substantial challenge in terms of resource management.

Regulatory Issues

The EA defines 'trade effluent', as any liquid waste 'produced in the course of any trade or industry' which is discharged to the waste water system. It includes water used in production, washing or cooling facilities, and covers both large and small premises.

Any company with a significant trade effluent discharge must obtain a trade effluent consent, which is a legal document that sets limits on the volume and nature of the discharge.

Most water companies carry out sampling of consented discharges to monitor whether the discharge complies with these limits, and follow an enforcement procedure in the event of serious breaches of the consent conditions. Smaller discharges may be controlled by issuing a Letter of Authority.

To discharge treated effluent into a river, stream, estuary or the sea, a discharge consent is required from the EA which is described in Schedule 10 of the Water Resources Act 1991. More abattoirs are being targeted and are being made to improve the 'quality' of their effluent. These new controls can include both a volume and contaminant concentration target.

The Make Up of Effluent and its Disposal

Cleaning and other hygiene-related activities require the greatest amount of water and contribute the highest contaminant loads into the effluent streams.The survey found that between 80% to 105% of water used in slaughterhouses is discharged as effluent. A figure of over 100% discharge is due to rainwater entering the effluent drain, much of it contaminated with blood, fat, manure, undigested stomach contents and cleaning agents. As such, the effluent typically is characterised by:

- high organic loads resulting from animal by-products and waste
- long-chain fatty acids and glycerol, collectively known as fats, oils and greases (FOG)
- nitrogen from manure and blood
- phosphorus and salt are present in effluent as a result of manure, emptying stomach contents in gutroom and hide salting

"Falling screen" separator to extract solids from effluent using gravity • kindly supplied by G & C Food Equipment

A survey by the EA found that around half of the permitted installations have no on-site effluent treatment plant, and discharge effluent to foul sewer after only basic screening.

Other sites are unable to either treat or discharge and have to get their effluent collected in large tankers at considerable expense (although for small/medium plants this may be a lower cost than having to find the capital for full treatment plant that can cost upwards of £250,000). Some abattoirs stated that their effluent was requested untreated as this helped the water authority balance the incoming effluent from all sources at the treatment plant.

The water companies use the Mogden formula to calculate the charges to industry for the conveyance and treatment of their effluents discharged to sewer. The effluent invoice details a number of coefficients relating to volume, Chemical Oxygen Demand (COD) and suspended solids (SS) discharged to sewer.

Recent surveys showed that managing effluent output is still in its infancy in much of the meat industry and few companies had a breakdown to establish the exact quantities/volumes of effluent produced. Total average discharges were estimated at 3.09 m^3 per tonne in cattle plants (abattoir/cutting) and 2.06 m^3 per tonne in sheep plants. Many plants do not sub-meter effluent but rely on quarterly bills from their water company. It was seen that the effluent volume was on average similar to the incoming clean water volume.

The Make Up of Effluent and its Disposal *(cont'd)*

By taking control of the factors that make up effluent and reducing them an abattoir can reduce what it pays in effluent charges. However, the surveys showed that very few (a minority of the IPPC registered plants) seemed to be monitoring their out-going water, or were able to report on effluent figures COD, SS and biological oxygen demand (BOD).

Some abattoirs have good primary and secondary effluent treatment methods, which enable them to reduce the amount of mains water they use as they are able to re-use their cleaned 'effluent' for less sensitive areas such as lairage, lorry washes and yard cleaning. Other abattoirs have effluent that is 5–10% more than their usage which means they are allowing the rainwater go down the effluent drains, thereby increasing their costs.

The difference in percentage discharges was a good measure of how much recycling was carried out. A factory reusing 20% of its water could be saving water and effluent costs. In truth there are very few abattoirs recycling any water. The difference can also be accounted for by water in the blood tank and animal by-product tanks.

Some of the larger abattoirs have installed biological treatment plants that convert soluble and colloidal materials into bio-solids. These are usually one of the following:

- activated sludge plants (either high-rated or conventionally loaded), preceded by sedimentation or dissolved air flotation (DAF)
- extended aeration plants
- oxidation ditches treating screened effluent

Bio-solids produced by the treatment plant may be dewatered prior to land spreading as a soil conditioner or digested to yield biogas.

A DAF plant • kindly supplied by G & C Food Equipment

Processing facilities that discharge directly into navigable waters (for which a National Pollutant Discharge Elimination System permit is required) must provide primary and secondary treatments and, in some cases, tertiary treatment as well.

The Effluent Bill

The first place a lot of processors find out about their effluent is the Effluent Bill. The costs charged are based on volumes and strengths of contaminants.

The contaminants that are measured are listed below with a description.

The simplest way to reduce effluent costs is to reduce effluent volume by using less water.

- Effluent volume is dependent on the volume of water, minus the sanitary, cooking and usage allowances. See factsheet 2 on how to minimise water use
- Reduce the COD, which is a measure of the quantity of oxygen consumed during the decomposition of organic matter and the oxidation of inorganic chemicals such as ammonia and nitrite. COD measurements are commonly made on samples of waste waters or of natural waters contaminated by domestic or industrial wastes. Blood has the highest COD (400,000–900,000 mg/l) of all effluents produced from abattoirs. The current TSE regulations prevent raw blood entering the public sewer system. It is worth reducing the amount of drips that will enter the effluent system. Gut washing also produces effluent with high COD at about 80,000mg/l; nitrogen and BOD can be decreased by the reduction of total solids (TS) in the wash water; this will also reduce odours
- Reduce the BOD, which is a measure of the quantity of dissolved oxygen consumed by microorganisms due to the breakdown of biodegradable contents in wastewater. Blood is also the highest contributor of about 100,000–200,000mg/l to BOD too
- Reduce the amount of SS that go down the drain. It is important that the abattoirs separate as much total solids, blood, gut contents and manure from the wash water as possible. These solids contain meat scraps, intestinal contents, manure, hair and dirt, and they can be easily removed by using a mechanical separation device such as a drain cover (6mm minimum or the EA recommended 4mm), filter or screen with a fine mesh

Managing Effluent Strength

These can be managed by implementing an environmental management system (EMS), such as adopting ISO 14001, as detailed in factsheet 1.

Processors have two options for reducing effluent costs: They can reduce the strength or volumes of the effluent. We have discussed reducing the volume in the Water factsheet.

Reduce strength

- Have ample bleed-time; trap and contain all blood with drip pans going-in and coming-out of the blood tunnel or room, even in the evisceration area. Ensure the edges are raised to avoid transfer of blood to the general effluent
- Good blood collection systems where a hollow knife vacuum system is used to suck blood from the carcase and reduce further drips also significantly reduce wastewater BOD. The blood is either collected, stored in tanks and transported to specialised processing facilities, which prepare it for use in emulsifiers, stabilisers, and fertilisers instead of being rendered as category 1. Note blood can go as Category 3, instead of Category 1, which does not have as high a rendering cost
- Dry clean the blood that spills on plant floor; use a shovel and squeegee to clean the whole area before cleaning with water. It is important to minimise the water going in to the blood collection tanks for rendering. Costs do vary but you could pay £60 per tonne rendering costs vs £3.50 per tonne effluent costs
- Discourage washing blood down the drains, especially off the drip pans. All drip trays should be fitted strategically for collection of blood drips along the slaughterline and in the packing plant. When a tray is full, the contents should be transferred to a container for Category 3 raw material for rendering
- The objective is to drive down the BOD to specified levels. In general, removal of fats, oils and greases (FOG) from the effluent is critical to achieving low BOD. Fit collection trays to catch scraps falling from machinery and collect the floor fat / meat in strainers or ‘fat traps’, thus it can be handled as a solid waste for rendering
- Effluent from the lairage is high in nutrients and can be collected for agricultural use as a fertiliser, provided specific conditions explained in the code of good agricultural practice called "Protecting our water, soil and air", DEFRA 2009 (Sect 5.4), are met. The preliminary step should involve dry collection of manure which should reduce the washing down water
- While manure and stomach contents do not impact BOD levels as greatly as blood, they can significantly affect the waste water. They should be handled carefully and treated as a hazardous waste product. All efforts should be made to ensure that stomachs are emptied and all the contents collected in a container and not let go straight to drain. In the lairage manure should be collected and floors brushed before the hoses are used
- Effluent intended for reuse typically requires extensive treatment, but studies have shown that countercurrent flow of water may reduce waste discharge to one-third or less of previous volumes. Nonetheless, it's worth noting that wastewater reuse is heavily regulated in processes involving consumer products, and in the case of meat must be limited to activities that do not expose the product itself to reused water. Accordingly, the treated water can be used to wash livestock lorries and the lairage, but not to steam-clean the slaughter hall

Blood collection

The Treatment of Effluent

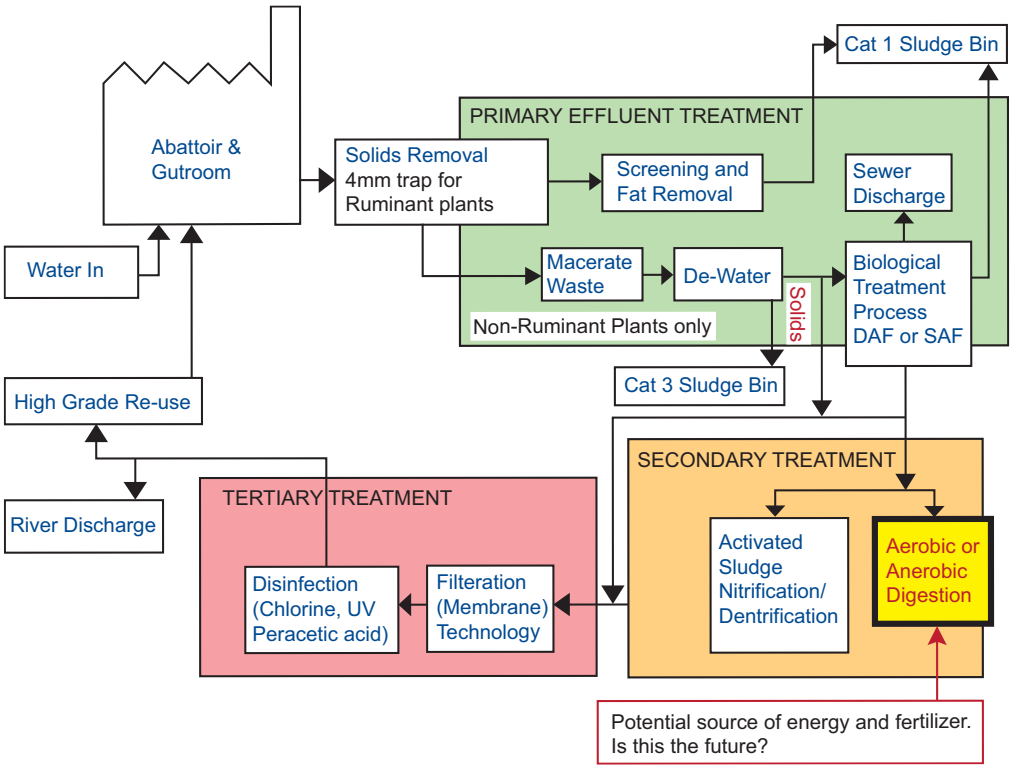
Treatment of effluent falls into three exclusive categories which increase the degree of cleanliness

1 **primary treatment** — the removal of total suspended solids, fats, oils and greases (FOG) and partial BOD loads carried out using screens and filters, settling tanks, catch basins or DAF plants.

2 **secondary treatment** — the removal of most organic matter, usually in the form of soluble organic compounds – typically employ aerobic and anaerobic processes, which use microorganisms to reduce organic loads. Nitrification and denitrification are important processes for abattoir effluent, removing ammonia and nitrogen from effluent using activated sludge.

3 **tertiary treatment** — any method extending beyond secondary methods to remove nitrogen, phosphorus, suspended solids or some combination of the three – such advanced filtration using membranes or reverse osmosis (RO) which can produce water of drinking water quality which is suitable for reuse on site.

The diagram illustrates the treatment of effluent, divided into primary, secondary and tertiary treatments



Treatment process suitability for specific contaminants

Treatment	Biological Oxygen Demand (BOD)	Suspended Solids (SS)	Total Disolved Solids (TDS)	Fats, Oils and Greases (FOG)	Phosphorus	Nitrogen
Primary Treatment Physical / Chemical Systems	Partial 40% to 80%	Good	Virtually nil removal	Good	Good with chemical precipitation	Only removes N in protein form
Secondary Treatment Biological Systems	Excellent	Generator of SS	Removal of organic only	Will process with time. Hinder bio process	Required for biomass	Can be designed to remove within limits
Tertiary Treatment Membrane Systems	Partial cause problems	Excellent microfiltration	Excellent with reverse osmosis (RO)	No – will cause problems	Good with precipitation	Excellent if oxidised