# The Results of a Water and Effluent Study carried out at Scotprime (Grimsby) Limited in October 1997

**Confidential Report No. CR135**

December 1997

SEAFISH

# The Sea Fish Industry Authority

## Seafish Technology

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# Summary

In the near future new environmental legislation will add greatly to the cost and difficulty of disposing of waste water. This will present a significant problem to the fish industry. Seafish has commissioned a number of water audits in fish processing companies, looking at water usage and effluent production with a view to minimising both. This report is concerned with the audit of Scotprime Ltd in Grimsby.

Water is used throughout the factory, in a number of different processes but primarily in defrosting and filleting. The total volume of water used during the four days of the audit was 147m$^3$, generating approximately 134m$^3$ of trade effluent for 32 tonnes of fish product.

Composite samples obtained from the drain which receives effluent from the filleting and skinning processes and knowledge of the effluent produced from dogfish preparation in other businesses, indicate that the effluent from the overall site has a COD of 4,728 mg/l and TSS of 997 mg/l. This would result in an increase in the future trade effluent charge from the current cost of £0.18/m$^3$ to £2.37/m$^3$, when calculated using the Mogden formula.

Opportunities for minimising water use and effluent strength were identified, many of which may be carried out at little or no cost.

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# 1. Introduction

In the near future new environmental legislation will add greatly to the cost and difficulty of disposing of waste water, which will present a significant problem to the fish industry. Fish processing requires large volumes of water and similarly produces large volumes of effluent, which can have a high level of organic contamination. Traditionally, the effluent in UK coastal regions, where the fish processing industry largely remains, has been pumped out to sea at negligible cost but this will change as the Urban Waste Water Treatment Directive (91/271/EEC) demands that by the end of 2001 effluent must be treated before release into the sea.

In the future, coastal businesses will be charged on the volume and strength of their effluent; the greater the quantity and the stronger the effluent, the higher the treatment costs. These new trade effluent charges will be calculated using the full Mogden formula which includes a component for the biological treatment required to meet the strict standards set by the Directive. This will bring coastal companies into line with charges already faced by most inland businesses.

In some areas the fish industry causes contamination far in excess of the human population and will, inevitably, pay the bulk of the sewerage costs in those areas. This may involve financing the construction of new treatment plants/pipelines. Alternatively the water industry may set very low consents to discharge to the public sewers and so the fish industry would have to take on responsibility for treating its own effluent. These unavoidable increases in costs will ensure that waste management becomes an issue of major commercial importance to all and a survival issue for many.

To find solutions to these water and effluent problems, Seafish has been working with Yorkshire Enterprise Ltd and technical consultants to carry out an ERDF funded project in the Humber region. With assistance from the Hull and Grimsby Fish Merchants' Associations, 40 small to medium sized fish companies agreed to have a preliminary waste audit carried out in their premises. From the findings of these audits 7 fish processing companies, representative of the diverse range of industry practices, were chosen. Detailed water audits have been carried out in these companies. The results will be used to develop comprehensive guidance documentation for industry, which will provide detailed advice on carrying out a water audit and how to minimise water use and reduce effluent strength.

This report is concerned with the audit of Scotprime in Grimsby. Water usage and the effluent produced were investigated and monitored within the factory. Areas for reducing water consumption and effluent strength are identified.

# 2. The Preliminary Waste Audit

A preliminary waste audit, carried out at the company on 4th March 1997, highlighted some general problems with water usage and effluent production in the process areas. The water consumption in the filleting operations was considered to be substantial. The drainage system was classed as ineffective at preventing the discharge of solids into the main drain.

# 3. The Company

Scotprime is part of the Booker group and is jointly owned by Bluecrest. The Scotprime (Grimsby) site employs 40 personnel. The main activities undertaken at the site are whitefish filleting, dogfish preparation, smoking, glazing and freezing. The main species of fish processed at the site are; cod, haddock, plaice and dogfish.

## 3.1 Site Description

The audited site is situated on Murray Street in the Fish Dock area of Grimsby. A plan of the factory is shown in Figures 1 to 3. The site was originally two separate factories but these have been combined to create the existing premises. The site consists of five main areas; the dogfish preparation area, flatfish and main filleting areas, a small smoking area and a glazing area situated on the first floor.

The majority of the water usage and effluent production occurs in the filleting and dogfish preparation areas. The dogfish preparation area houses six filleting benches, the flatfish area has three filleting benches and the whitefish area seven benches. Two brining tanks are located in the smoking area. The glazing area contains a large tank for dip-glazing frozen fillets.

A Baader 51 skinning machine, located in the whitefish area, is used to skin fillets when required. Chill stores are located throughout the site. An ice machine is situated between the main and flatfish areas.

## 3.2 Factory Water Points and Drainage

A plan of the factory water points and drainage system is included in Figures 1 to 3. A combination of wall and ceiling mounted hoses are used to supply water for the individual processes.

In the main and flatfish processing areas, 190mm x 190mm drains collect effluent from the factory floor. Large solids are prevented from entering the drains by covers with 25mm x 25mm holes. A 180mm diameter strainer, drilled with 5mm holes can be located under the drain cover to stop small pieces of fish entering the drain. However, these are not used as they quickly block.

Drains in the dogfish preparation area consist of a 260mm x 260mm housing holding a 190mm x 190mm x 190mm catch basket, drilled with 13mm holes. A drain cover with 15mm x 240mm slots is used.

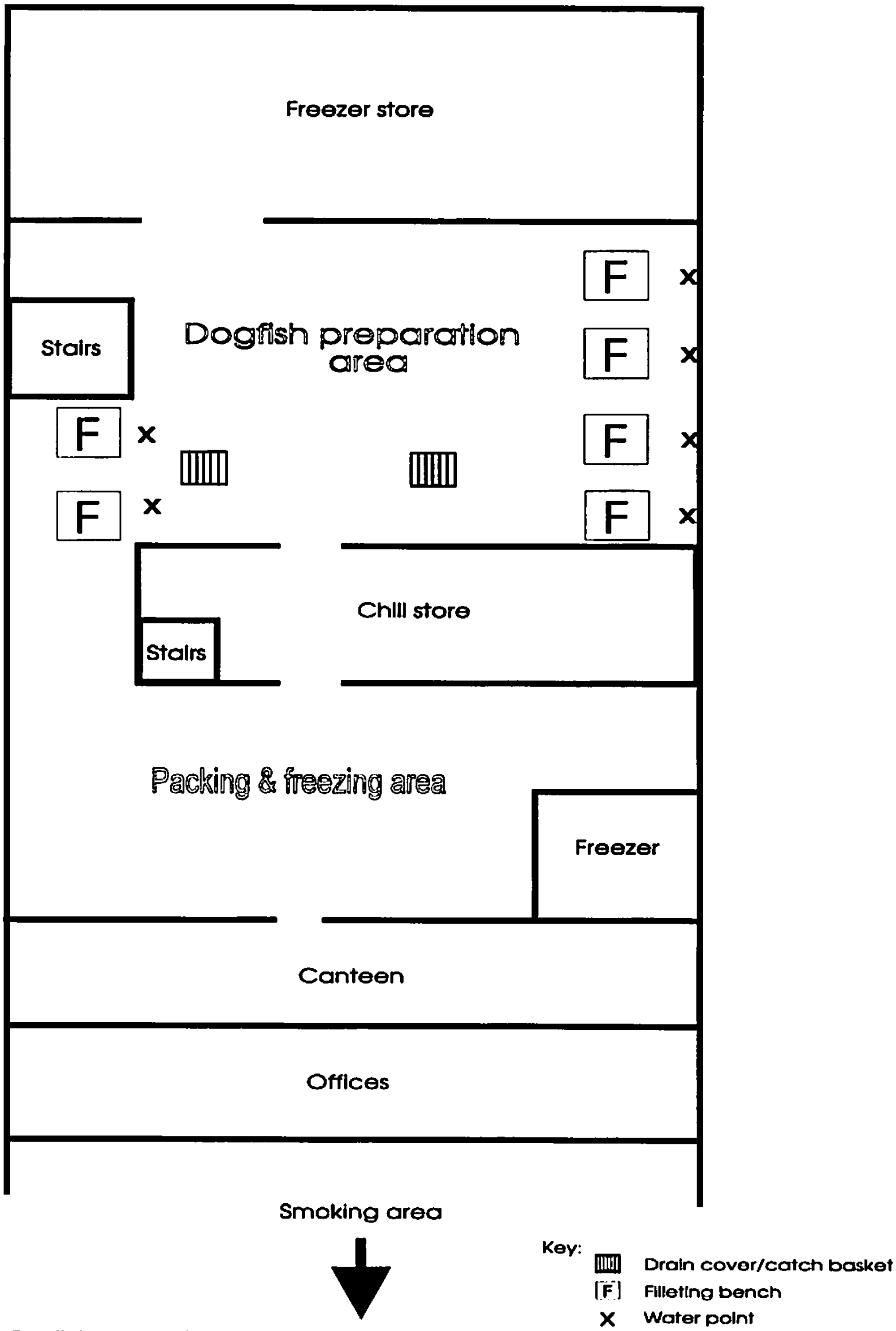


**Figure No. 1 - Dogfish preparation area**

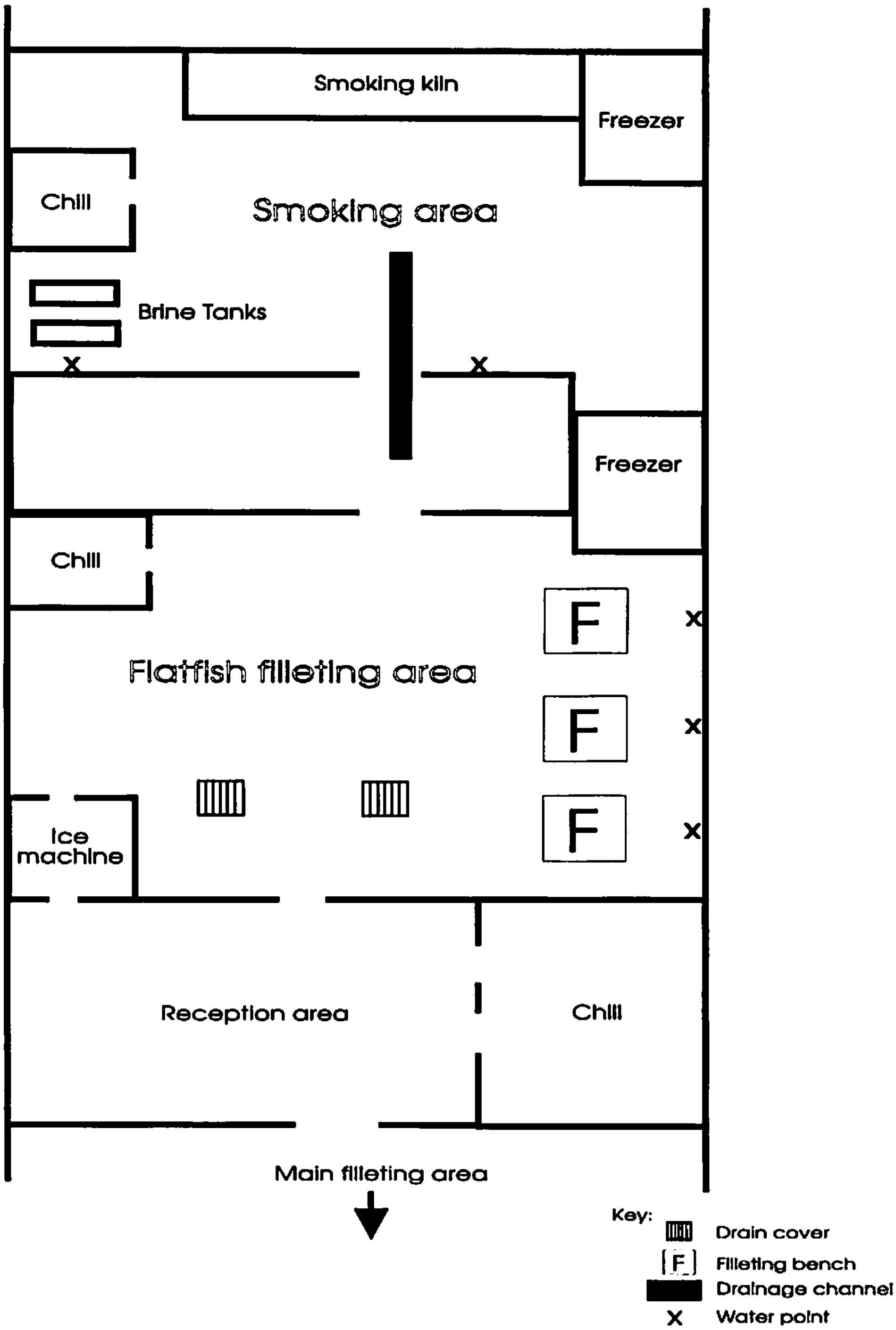


**Figure No. 2 - Flatfish filleting area**

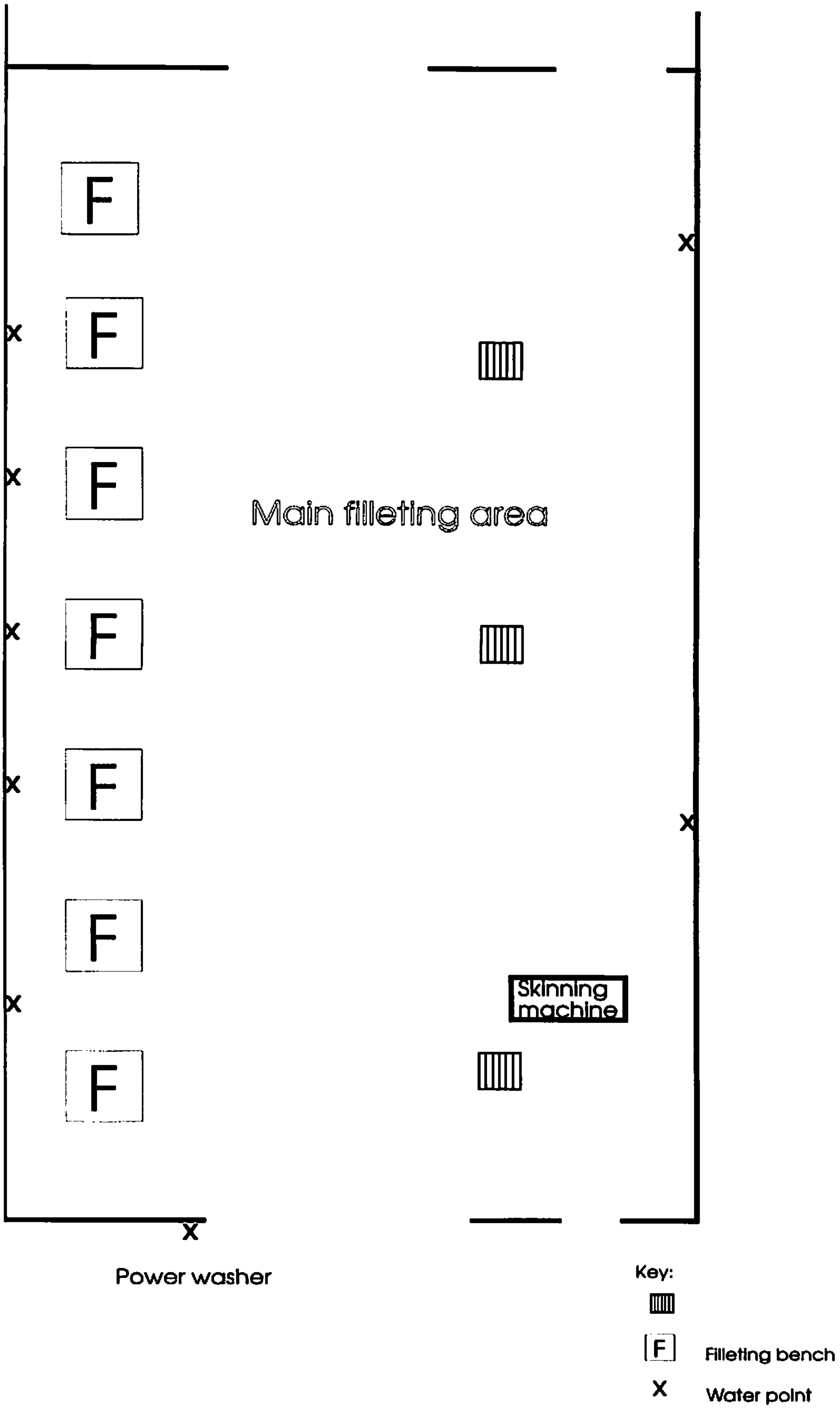


**Figure No. 3 - Main filleting areas**

# 4. The Audit Methodology

In order to investigate the use and contamination of water within the company four working days were spent on-site (27th-30th October), observing the process and determining where water was used and effluent produced.

## 4.1 Measurement of Water Usage

Due to the large number of water points it was impossible to individually meter each point. A representative number of water points in each main process area were measured and the results used to estimate the total volume of water used in that process.

Four in-line flow meters, with a 4-20mA output, were installed into four water points (supplying five filleting benches) in the main process area. A Squirrel data logger was used to record the flow rates, at two minute intervals, over the four day period.

In-line totaliser meters were installed in water supplies to the smoking area, skinning machine, two filleting benches in the flatfish area, glazing area and a filleting bench in the dogfish area. Readings were taken every two hours, from the start of the working day through to the end. The main site meter reading was also taken every two hours.

The water supply to the ice machine was monitored using a Micronics Portaflow 300, ultrasonic non-invasive meter, which recorded the flow rate at 6 minute intervals over two days of the audit.

## 4.2 Effluent Sampling and Analysis

The strength of the effluent produced by the different processes was determined by taking 1 litre samples. Spot samples were taken directly from equipment i.e. filleting tubs and the skinning machine, whilst an Epic automated effluent sampler was used to obtain composite samples. Samples (100 ml every 10 minutes) were taken over a 6 hour period, from different areas of the factory drainage system. The samples of effluent were analysed by ALControl (Analytical Services), Rotherham.

Samples were analysed for chemical oxygen demand (COD) and total suspended solids (TSS).

## 4.3 Calculating Trade Effluent Treatment Charges

The COD and TSS values of the effluent were used to estimate the future costs when the effluent will have to be treated. Costs were calculated using the 1997 Anglian Water charging rates for treating trade effluent.

**Mogden formula:**

$$C = R + V + [B\frac{O_t}{O_s}] + [S\frac{S_t}{S_s}]$$

**Charges**

| | | |
|---|---|---|
| **C** | = | Cost pence/m$^3$ |
| **R** | = | Reception charge = 11.42 pence/m$^3$ |
| **V** | = | Preliminary treatment charge = 21.23 pence/m$^3$ |
| **B** | = | Biological treatment charge = 17.63 pence/m$^3$ |
| **S** | = | Suspended solids charge = 8.38 pence/m$^3$ |
| **$O_t$** | = | Mean organic strength of the trade effluent (COD mg/l) |
| **$O_s$** | = | Mean regional organic strength of domestic sewage = 456 mg/l (BOD) |
| **$S_t$** | = | Total suspended solids (TSS) of effluent sample (mg/l) |
| **$S_s$** | = | Mean regional strength of settleable solids in domestic sewage = 383 mg/l |

# 5. Overall Water Usage and Effluent Production

This section gives an overview of water usage and effluent production. During the four days of the audit, 25.8 tonnes of whitefish fillets and 6.3 tonnes of dogfish product were produced. The individual processes are discussed in detail in Section 6.

## 5.1 Water Usage

Water is used throughout the site in a number of different processes. The water consumption of a representative part of each main process was measured. Using this as a basis, the total volume of water used in each process was estimated, see Table 1.

**Table 1 - The estimated water usage in each main process/activity during the audit**

| Process/Activity | Total estimated water consumption during the audit ($m^3$) |
|---|---|
| Whitefish filleting | 94.8 |
| Ice production | 14 |
| Flatfish filleting | 11.4 |
| Dogfish preparation | 9.6 |
| Skinning | 6.7 |
| Cleaning | 6.0 |
| Glazing | 2.3 |
| **Total** | **144.8** |

The total volume of water used during the audit was 147m$^3$, according to the main site meter. Approximately 2% of this was unaccounted for during the audit, which was primarily used in non-processing areas such as the kitchen and toilets.

Using the total volume of water used and the weight of fish processed during the audit, it is calculated that approximately 5m$^3$ of water is used to produce 1 tonne of whitefish fillets (includes filleting, skinning, glazing, ice production and cleaning) and 1.5m$^3$ to produce one tonne of prepared dogfish (including belly flap skinning).

## 5.2 Effluent Production

It was impossible to obtain an overall effluent sample for the site as a number of drains exit the factory. The composite samples taken from the main effluent streams in the factory and results from similar work elsewhere were used to estimate the strength of effluent leaving the site. The source, strength and estimated future costs of the main effluent streams are shown in Table 2. The future trade effluent charges can be compared to the current charge of £0.18/m$^3$.

**Table 2 - The source, strength and estimated future costs of the samples taken from the main effluent streams at the factory**

| Source | Strength | | Mogden calculated trade effluent charges (£ per m³) | Volume produced during audit (m³) | Mogden calculated trade effluent charges for the 4 days of the audit |
|---|---|---|---|---|---|
| | COD (mg/l) | TSS (mg/l) | | | |
| Composite - whitefish & flatfish filleting | 1730 | 398 | 1.08 | 104 | £112.54 |
| Dogfish preparation * | 49,700 | 10,000 | 21.00 | 9.6 | £201.00 |

* based on similar work elsewhere

The overall effluent sample for the site is estimated to have a COD of 4,728mg/l and TSS of 997mg/l. When future Mogden calculated trade effluent charges are applied the cost of disposing of this strength effluent would increase from £0.18/m³ to £2.37/m³. At current rates the disposal cost of the effluent produced during the four days of the audit is £24.12. This would increase to £317.58 when calculated using the Mogden formula.

# 6. The Main Operations

## 6.1 The Filleting Areas

The main operations carried out are whitefish and flatfish filleting and dogfish preparation (skinning, gutting and trimming, including belly flap preparation).

The dogfish area houses six filleting benches, each with a maximum tub capacity of 215 litres. Only four benches were in use during the audit. The flatfish area houses three filleting benches, each with a maximum tub capacity of 164 litres. Seven filleting benches are located in the whitefish area, however, only six were in use during the audit. There are currently two different white fish tub sizes in use; 164 litres and 210 litres.

The filleting benches are all made to traditional design, with a central tub separating two cutting boards, enabling a pair of filleters to work facing each other. Different types of catch basket are located underneath each drain plug to catch pieces of fish when the tubs are emptied. When in use, the tub drains are blocked with tight fitting plugs.

### 6.1.1 Water Usage

Dogfish preparation is carried out without the use of water. Water is primarily used for washing down benches and the floor. During the audit, 2.4$m^3$ of water was used by the metered filleting bench in the dogfish area. It is estimated that a total of 9.6$m^3$ was used in dogfish preparation during the audit.

Both flatfish and whitefish filleting use water, which is supplied to each bench. Filleters were observed to use water in different ways i.e. some filleters use a continuous supply of water throughout the day, whereas the remainder fill the tubs and fillet until the water is considered to be 'dirty'. The tubs are then emptied and refilled.

The volume of water used by the two metered benches in the flatfish area varies significantly (2.9$m^3$ and 4.7$m^3$). This averages 3.8$m^3$ for each bench, resulting, in the total amount of water used in flatfish filleting being 11.4$m^3$ during the audit.

The volume of water used by the four metered water points (supplying 5 benches) in the whitefish area ranged from 14.3$m^3$ to 23$m^3$. This averages 17.3$m^3$ for each bench. It is estimated that 94.8$m^3$ of water was used in whitefish filleting during the audit.

The flow rates to the filleting benches vary significantly from 10 l/m to 73 l/m. The fluctuation in flow rates is due to different filleters adjusting the water flow to suit themselves.

### 6.1.2 Effluent Production

During dogfish preparation a significant proportion of the guts fall onto the floor. Fish boxes are sometimes placed underneath the benches to catch the falling waste but these catch only a small proportion of the material.

The waste material from dogfish filleting consists of approximately 50% soft solids, greater than 20 mm in size, such as liver, yolk sacks and baby dogfish and 50% a viscous slime, resulting from burst yolk sacks, liquid gut tissue, blood and ice etc. The waste material tends to remain around the feet of the filleters, being constantly broken up underfoot. At the end of the day the solid material is shovelled into the offal bin. The liquid material which remains on the floor is washed into the drain. Based on work undertaken in a similar operation, the effluent produced during dogfish preparation had a COD of 49,700mg/l and TSS of 10,000mg/l.

During dogfish preparation the guts and trimmings are thrown into the offal containers, however, a significant amount of waste misses the containers and ends up on the floor. Much of this material is shovelled into the offal container, however, a significant amount is washed or brushed down the drain. At the end of the clean down period the catch baskets in the drains are emptied into the offal bin.

During whitefish and flatfish filleting, small pieces of fish are trimmed off the fillets and usually thrown into an offal container or flicked into the water. As the trimmings are thrown towards the offal container, a significant amount of material misses and ends up on the floor where it is broken up underfoot. At the end of the day the majority of the material on the floor is shovelled up. Any pieces of fish which are left on the floor are swept into the drain.

The trimmings flicked into the water accumulate at the bottom of a tub (Figure 4). When the tub is emptied the material is caught in a catch basket. Samples of effluent were obtained immediately after the passing through the catch basket. The COD was 8070mg/l and the TSS was 1010mg/l.Composite effluent samples were taken from the drain in the main process area. The COD and TSS were 1730mg/l and 398mg/l respectively.

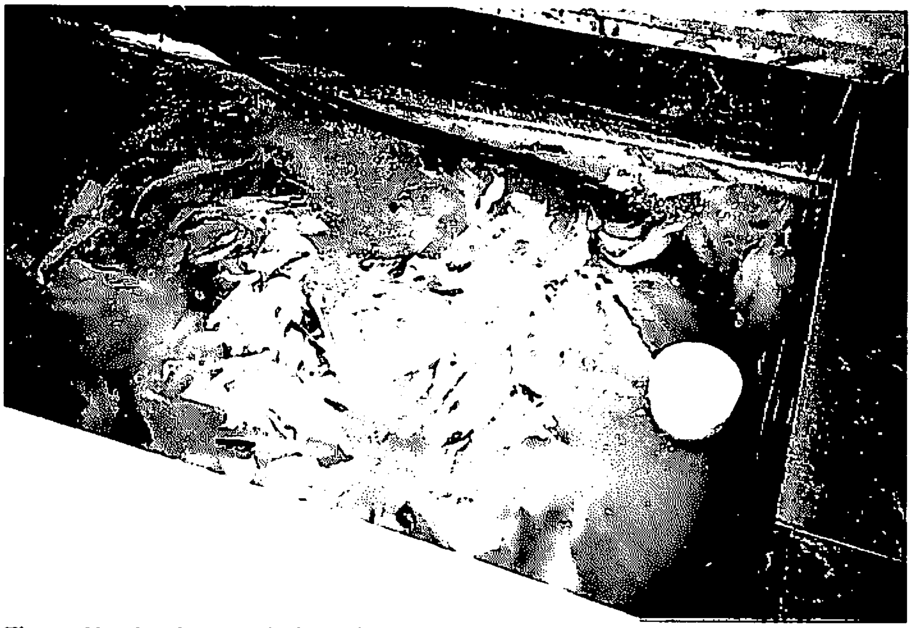

**Figure No. 4 - Accumulation of material at the bottom of a filleting tub**

### 6.1.3 Conclusions and Recommendations

The volume of water used in filleting is considerable. The water consumption and flow rates to the different benches vary significantly and it is important to try and control them. A change in management practices, such as a more structured policy on water usage should be introduced and enforced. Particular attention should be given to preventing the use of continuously running water. Flow regulators can be fitted (approximate cost £10 excluding installation) to control the flow of water to each bench.

Clean water supply to a filleting bench is essential to maintain hygiene but the traditional tub type benches are often wasteful in water usage. It is undesirable to leave fish soaking in the water and particularly to wash fillets in that same water. Alternative systems are available in which the fish is washed / de-iced separately prior to filleting and a controllable water spray is used on the filleting bench to lubricate the knife, maintain cleanliness and wash the fillets.

The current method of dogfish preparation produces a significant volume of very high strength effluent. From work undertaken in a similar operation, calculations indicate that future trade effluent charges associated with this process could increase from the present cost of £0.18/$m^3$ to £21/$m^3$ based on the typical strength of this type of effluent. To keep future Mogden calculated trade effluent charges to a minimum this effluent must be prevented from entering the drainage system.

The dogfish filleting benches should be modified so that the dogfish guts are caught before they fall onto the floor. A simple catch tray could be used (Figure 5). Education is also required to ensure filleters throw offal into the fishmeal container to prevent it ending up on the floor.

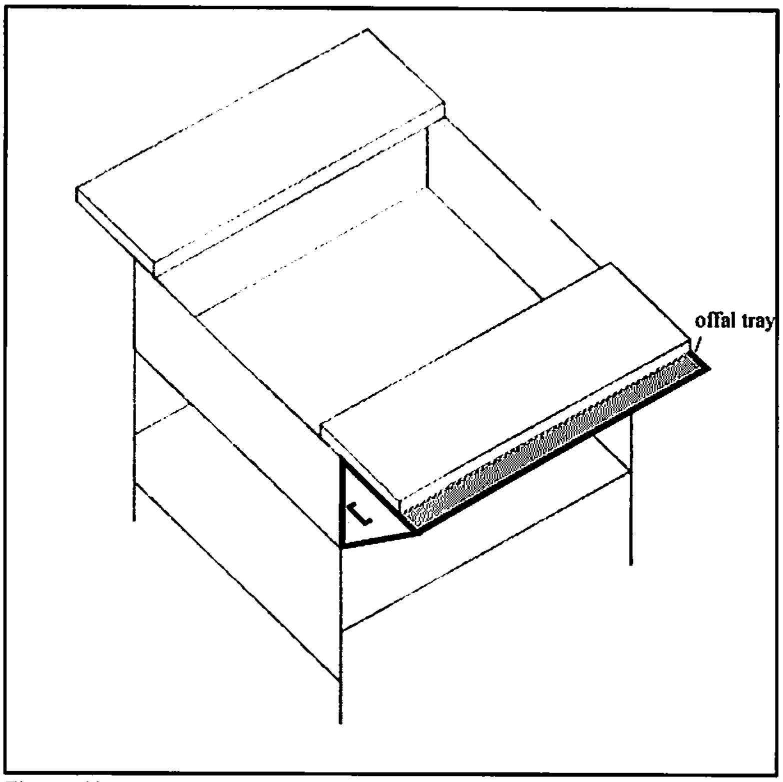


**Figure No. 5 - Possible filleting bench modification**

Based on the strength of the composite effluent sample taken from the drain which receives effluent from the main process area, the future Mogden calculated disposal charges would increase from £0.18/m$^3$ be £1.08/m$^3$. To keep future Mogden calculated trade effluent charges as low as possible it will be important to try and prevent material from entering the drainage system.

Waste such as the fillet trimmings should not be flicked into the filleting tub as this significantly increases the strength of the effluent. It is advisable to empty tubs regularly throughout the day to prevent a build up of waste material. Alternatively, whitefish filleting benches should be modified in the same way as the dogfish filleting benches (Figure 5). Trimmings should be scraped into the tray, which can be emptied into the main offal bin at the end of each day.

The sample of effluent taken immediately after passing through the catch basket is particularly high strength. The Mogden calculated trade effluent charge would be £3.67/m$^3$. To minimise this cost, catch baskets should be emptied before the filleting tub is emptied and thoroughly cleaned at the end of each day.

A significant amount of material which falls onto the floor is washed into the drain, which will increase the strength of the effluent. In order to prevent this, changes in practices i.e. ensuring material is put into the offal bin, will be necessary. The change in bench design, to incorporate a catch tray, will assist in preventing material from ending up on the floor.

## 6.2 Skinning

A Baader 51 skinning machine is in daily use. The machine is connected to the water supply by a flexible hose. The water supply is turned on or off by either a manually operated valve on the wall or on the machine itself. The skins are collected in a fish box placed underneath the waste chute of the machine.

### 6.2.1 Water Usage

The water flow rate to the skinning machine varied from 10 l/min to 73 l/min. The average flow was 20.6 l/m. The machine used 8.5m$^3$ of water during the audit. On a number of occasions it was observed that the water was left on when the machine was not in use.

### 6.2.2 Effluent Production

Effluent is produced as a result of the skinning process. Effluent samples were taken but lost due to a faulty sample bottle. However, the typical COD and TSS of effluent produced by a Baader 51 in other businesses is approximately 2200 mg/l and 800 mg/l respectively.

A significant amount of waste material is generated by the skinning process. It was observed that the catch basket is rarely emptied (Figure 6). As such, fish skins and small pieces of fish accumulate in the catch basket until they eventually spill over on to the floor.

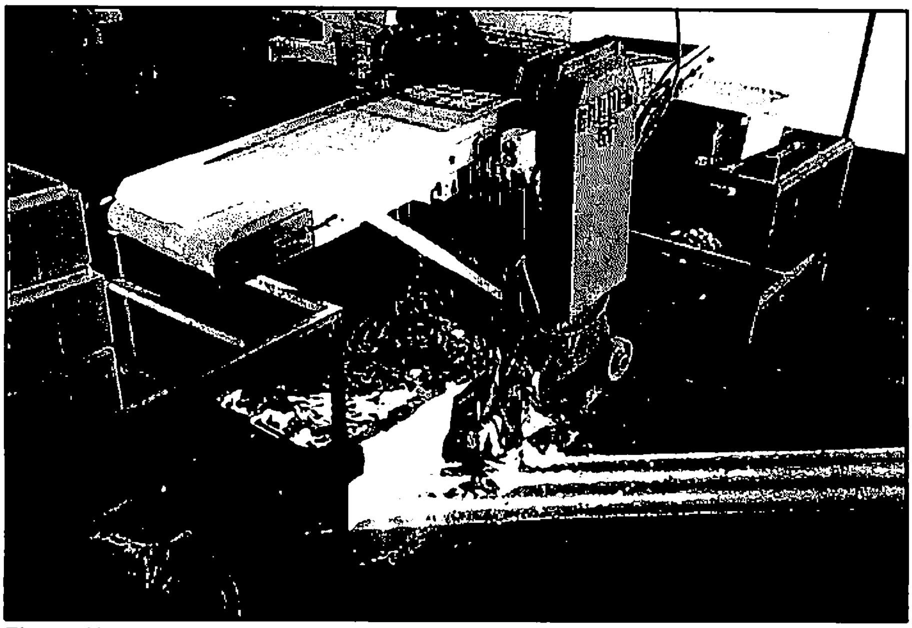

**Figure No. 6 - Waste generated by the skinning machine**

**6.2.3 Conclusions and Recommendations**

There is scope for reducing both water consumption and effluent production from the skinning process.

As the water pressure available to the skinning machine changes with the demands of other water uses on the system, a flow regulator should be installed. This should be set to regulate the flow to the lowest level (typically 10-15 l/min) at which the machine still works effectively. An automatic valve could be used to switch off the water to the machine when not in use.

Calculations indicate that future effluent charges associated with skinning could increase from the current cost of £0.18/m$^3$ to £1.35/m$^3$. It is known that allowing the effluent from the skinning machine to wash over the skins in the catch basket/box washes out small pieces of fish which significantly increases the strength of the effluent. To prevent this, the waste chute of the machine could be modified to incorporate a section of wedge wire. The water should pass through the wedge wire, diverted away from the skins which fall into the box. The catch basket should be emptied regularly, ideally after each use of the machine.

## 6.3 Cleaning

The main source of organic material on the floor comes from the filleting processes and dogfish preparation.

After all the fish have been processed, waste material around the filleting benches is hosed or scraped into the middle of the floor. The majority of the waste is then shovelled into a fish meal bin or into boxes, along with the pieces of fish collected from catch baskets below the filleting benches. This is sold to a fish cake manufacturer. The remaining material is then washed down the drain. On one occasion the drain cover was lifted to make this task easier.

During the cleaning of the flatfish filleting area, a tap was left running onto the floor and a hose pipe was used to wash all the waste on the floor into a pile (Figure 7). In the main process area a large tub is usually filled and used to swill down the floor.

**Figure No. 7 - A hosepipe is used to collect waste material together**

A night cleaner cleans and sanitises the equipment and surfaces. Although this operation was not observed it is estimated that about $3m^3$ of water was used per night.

### 6.3.1 Conclusions and Recommendations

To keep future effluent treatment charges as low as possible it is important to prevent solid material entering the drain.

The sieve plates must be used to prevent small pieces of fish entering the drain. By minimising the amount of waste ending up on the floor, the tendency for this arrangement to block should be reduced. The design of the drain could be improved by replacing the drain cover with a flush fitting punch plate (aperture 6mm) or small aperture wedge wire screen. This would make the strainer plate redundant. The design should also incorporate a simple locking mechanism to ensure drain covers cannot be lifted by general staff. The catch baskets in the dogfish preparation area should be redesigned and made from small aperture punch plate or wedge wire. This would result in a greater surface area for filtration and reduce the tendency to block. Catch baskets must be emptied regularly, at least once each day, as even clean water washing through a full catch basket can significantly add to the effluent strength.

Any pieces of fish which have been in direct contact with the floor may be contaminated and must not be sold for use in the manufacture of fish cakes.

A significant amount of water is wasted in the cleaning process. Hosepipes should not be used to wash waste material into a pile and taps should not be left running to rinse down floors. A cleaning schedule will help to reduce such wastage.

## 6.4 Glazing

The current method of glazing involves dipping a crate of frozen fillets into a tank of water. The tank has a maximum capacity of 800 litres.

### 6.4.1 Water Usage

The tank is usually filled up in the morning and topped up throughout the day if necessary. During the audit, 2.3m$^3$ of water was used.

### 6.4.2 Effluent Production

An effluent sample was taken from the tank at the end of a day. The COD was 242mg/l and the TSS 54mg/l.

### 6.4.3 Conclusions and Recommendations

The volume of water used in glazing is not great, however, it may be worth considering if a reduction in the volume of water used can be achieved.

Calculations indicate that future effluent charges associated with glazing could increase from the current cost of £0.18/m$^3$ to £0.43/m$^3$ based on the strength of the sample taken during the audit.

The bulk of the water used in glazing is incorporated into the product which leaves the factory. As it does not go down the drain, trade effluent charges should not be paid for the volume of water used in glazing. Based on the amount of water used during the audit, it is calculated that approximately £88 per year could be saved at current charges.

As the water consumption in the glazing process varies weekly, a totaliser water meter should be fitted to the water input to the glazing tank. The amount of water used over a longer period could then be determined accurately and the information used to try and claim an allowance from the landlord Associated British Ports who in turn will deal with Anglian Water. It will become particularly important to claim an allowance when future charges apply, as the increased costs of disposal will apply to the total volume of water used on-site.

## 6.5 Ice Production

A flake ice machine is used to supply ice for the site.

### 6.5.1 Water Usage

The typical water consumption over a 1 hour period was 0.3m$^3$. Over a 24 hour period the typical water consumption was 3.5m$^3$.

### 6.5.2 Conclusions and Recommendations

The ice produced on-site is generally packed and sent out with the fish. As it does not go down the drain, trade effluent charges should not be paid for the volume of water used in ice production. Based on the amount of water used during the audit, it is calculated that approximately £155 per year could be saved at current charges.

As ice consumption varies weekly, a totaliser water meter should be fitted to the water input to the ice machines. The amount of water used over a longer period could then be determined accurately and the information used to try and claim an allowance from the landlord, Associated British Ports, who in turn will deal with Anglian Water. It will become particularly important to claim an allowance when future charges apply, as the increased costs of disposal will apply to the total volume of water used on-site.

# 7. Overall Conclusions and Recommendations

When Mogden calculated trade effluent charges are introduced, the company is likely to face a significant increase in trade effluent disposal costs. It is estimated that the effluent leaving the site has a COD of 4,728mg/l and a TSS of 997 mg/l. This would result in trade effluent treatment charges increasing from the current rate of £0.18/$m^3$ to £2.37/$m^3$. Fortunately, some low cost or no cost changes in practices or equipment can be implemented to reduce this cost.

- The current method of dogfish preparation and whitefish/flatfish processing results in a large volume of high strength effluent finding its way into the drains. The filleting benches should be modified to incorporate a catch tray, to prevent waste entering the benches or falling on to the floor.

- Drain covers and catch baskets were found to be ineffective or absent, allowing waste to easily enter the drain. Drain covers and catch baskets should be redesigned and replaced to prevent this problem. Where present, catch baskets should be emptied more frequently and cleaned thoroughly. Catch baskets should be installed into all drains.

- The high strength effluent stream produced by the skinning machine could be significantly reduced by incorporating a section of wedge wire in to the waste chute to divert water away from washing over the skins collected in the catch basket. In particular, the catch basket should be emptied more frequently.

Reducing water use will be as important as reducing effluent strength, as diluting strong effluent increases the volume of water used, which will result in increased effluent charges.

It is calculated that approximately 5$m^3$ of water is used to produce 1 tonne of whitefish fillets (includes filleting, ice production, skinning and cleaning) and 1$m^3$ of water used to produce 1 tonne of dogfish product. As a result of the observations there appears to be scope for further reducing water usage.

- It is likely that the volume of water used in filleting can be controlled and significantly reduced by installing flow regulators and by major changes to current practices. More stringent management should also be applied.

- Water is wasted in other areas, such as leaving water on unnecessarily in skinning and cleaning. Changes in practices should be introduced.

It is advisable to inform and educate staff about the future costs associated with effluent and water use. Water usage should be continually monitored. Staff should be involved and encouraged to identify further opportunities for making reductions in water use and effluent production. Any measures which change working practices must be properly managed to ensure staff do not revert back to old ways.

Anglian Water have not formalised their plans, with regards to a date for introducing the new trade effluent charges. However, they suggest that the latest date would be sometime in the year 2000. With this in mind it is recommended that the company starts to introduce changes, with regards to reducing water usage and effluent production, as soon as possible in preparation for the inevitable increases in costs in that year.