Trials to Reduce Water and Effluent Charges in Fish Processing

Seafish Report
No.SR541

April 2003

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Seafish Technology: We promote the sustainable use of fish resources, quality, the reduction of waste and the improvement of safety through practical applied research.

ISBN No 0 903941 41 4

The Sea Fish Industry Authority

Seafish Technology

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Summary

The recent implementation of the Urban Waste Water Treatment Directive (91/271/EEC) has led to many processors facing a significant increase in trade effluent disposal charges. Aware of this problem, Seafish initially carried out a series of detailed company audits of businesses covering a wide range of industry practices. These audits were used to determine where problems occur and identify possible solutions to reduce water and effluent costs.

This report details a series of technical trials carried out in collaboration with processors to develop simple, inexpensive, practical modifications to key equipment in order to reduce water and effluent costs.

It was found that using traditional filleting benches on an empty and fill basis saved between 36% and 61% of water supply and effluent charges, when compared to using the same bench with the continually running water method.

By modifying the design of the traditional bench to prevent waste soaking in the tub and building up in the catch basket, the trade effluent disposal costs were reduced by a further 20%. A full range of modifications to improve filleter comfort and improve trimming by-product collection, ranging from simple and inexpensive to comprehensive, were trialled.

Modifications made to a Baader 417/208 white fish heading/filleting machine, consisted of a flow regulator, a separator waste chute and a conveyor transport system to remove waste. This reduced water and effluent costs by 76%.

Using a water flow regulator and modifying the waste chute of a Baader 51 skinning machine reduced the water and effluent costs by 72%.

The most effective design of drain channel cover was investigated. Simple 15mm holes proved to be effective.

A new type of drain catch basket was also developed and tested. By preventing waste soaking and being washed out by the effluent, the new basket reduced the trade effluent charges by 42% when compared to the original traditional punch plate basket.

Most of the payback periods of the different modifications (including simple filleting modifications) proved to be short, ranging from less than one week to about a year.

It is thought that the principles demonstrated in these trials could easily be adapted by other businesses and could also be applied to other types of equipment. To assist in this, technical drawings of some of the modifications have been produced and are available from the Seafish Library.

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1. Introduction

Environmental legislation is adding greatly to the cost and difficulty of disposing of waste water. This presents 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 has changed. The Urban Waste Water Treatment Directive (91/271/EEC) demanded that from the year 2001, effluent must be treated before release into the sea.

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

To identify which processing operations generate the highest charges (i.e. where the main uses of water and the strongest effluent streams occur) Seafish Technology carried out detailed audits of eleven fish processing companies, representative of the diverse range of industry practices *(Seafish Report number SR514).* It was concluded that in most cases, simple modifications to equipment or practices could significantly reduce these costs.

This report details a series of trials which were carried out to modify key fish processing and drainage equipment, to reduce water supply and trade effluent charges.

Trials were carried out to determine the most cost effective way of using traditional filleting benches. To further reduce costs, a range of modifications from simple and low cost, to comprehensive, were made to traditional filleting benches operating on an empty and fill basis. Effluent sampling was carried out to determine any reduction in trade effluent charges. Two new bench types were also designed and built from scratch, incorporating the most effective modifications derived from the development work and were put on long term test. Full technical drawings were produced and are available through the Seafish Library at Hull.

Trials were also carried out with a Baader 417/208 heading/filleting machine to reduce water and effluent costs by fitting water flow regulators, a mechanised waste conveyor and a wedge wire separator waste chute

Likewise a regulator and purpose designed wedge wire separator waste chute were tested on a Baader 51 skinning machine.

Finally a wedge wire separator drain catch basket was designed and tested, along with trials to determine the most effective types of drain channel cover.

2. Common Experimental Equipment and Methods

2.1 Equipment Fabrication

The modifications to existing fish processing equipment and fabrication of new prototypes to Seafish designs were principally carried out by:

Gallagher Engineering
Unit 4, Central Park
Cornwall Street
Hull
HU8 8AF

Tel: 01482 328884

A & M engineering (Hull) Ltd
Unit B1
Kingston Way
Stockholm Road
Hull
HU7 0XW

Tel: 01482 820806

The wedge wire used in the trials is currently thought to be manufactured by only two UK companies. The wedge wire was purchased or kindly provided free of charge by:

Screen Systems Ltd.
P O Box 237
The West Site
Britannia Works
Brewsey Road
Warrington
WA5 5JS

Tel: 01925 659906

Optima International
Optima House
Askern Road
Toll Bar
Doncaster
DN5 0QY

Tel: 01302 874128

2.2 Effluent Sample Analysis

The effluent samples were collected in 1 litre plastic bottles with an airtight lid. Samples were then stored chilled until collected (daily) by courier. All samples were analysed for settled chemical oxygen demand (sCOD) and samples collected from the Anglian Water and Yorkshire Water regions were analysed for total suspended solids (TSS) and settleable solids (SS), respectively. These values were then applied to the Mogden Formula to calculate trade effluent disposal charges in the Anglian and Yorkshire Water areas where the work was carried out (see table 1). Charges for the Anglian Water area were calculated using the Blue Tariff. The latest water and trade effluent disposal charges can be obtained from the respective area providers

Table 1 – The Mogden Formula and Water Supply Charges

The Mogden formula for trade effluent charges

$$C = R + V + \left[B \frac{Ot}{Os} \right] + \left[S \frac{St}{Ss} \right]$$

			Cost (pence)		
			Anglian Water (Blue Tarrif)		**Yorkshire Water**
			2000/1	2001/2	2000/1
C	=	The calculated effluent charge (pence/m^3)	--	--	--
R	=	The reception and conveyance charge for using system (pence/m^3)	12.35	12.85	20.48
V [or P]	=	The volumetric/preliminary/primary treatment charge (pence/m^3)	23.07	24.00	20.22
B	=	The biological secondary treatment charge (pence/m^3)	16.90	17.79	19.86
S	=	The solid waste treatment and disposal charge (pence/m^3)	11.40	11.83	11.30
Ot	=	sCOD of the discharge (mg/l after 1 hr settlement) *(from effluent sample)*	--	--	--
Os	=	Mean sCOD of sewage in the region (mg/l after 1 hr settlement)	419.00	424.00	905.00
St	=	Suspended solids of the discharge (mg/l) *(from effluent sample)*	--	--	--
Ss	=	Mean suspended solids of sewage in the region (mg/l)	402.00	401.00	314.00
		Water Supply Charges (m^3)	**55.00**	**57.00**	**72.00**

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3. Trial I – Determining the Most Cost Effective Operation of Traditional Filleting Methods

3.1 Background and Purpose

In small to medium sized UK businesses, manual filleting is commonly carried out using traditional filleting benches. A typical bench consists of a central tub containing the fish and water, with cutting boards positioned on either side of the tub, on which the fish are filleted. Water is usually supplied to the bench through a ½ inch or ¾ inch hosepipe immersed in the tub.

Filleting benches are usually fabricated by local engineering companies. The design of the benches varies significantly and often between benches within the same processing business. Typically, tub capacities range from 100 litres to 300 litres. Similarly, the method of water usage also varies. In some companies the filleters predominantly use continuously running water with water continually entering the bench and overflowing onto the floor, either over the top of the tub or via a purpose built overflow. Overflows typically consist of a small bore (25mm) sliding pipe in the bench bung to control water depth. In operation two or three boxes of fish (total 90kg – 120kg) at a time are tipped into the bench. This can result in approximately 50-75% of the water being displaced. In this type of operation the bench is typically emptied once at lunch time and again at the end of the working day.

The other type of working practice is the empty and fill method. The fish are added to an empty tub and then the bench is filled with water. When the tub is full the water is switched off. This cycle is then repeated. The water is drained after the fish are filleted, then a new batch of fish is added and so on.

In both methods of water use, the fillet trimmings (and occasionally lugs) are flicked into the tub and remain soaking until the bench is emptied. Whilst soaking, soluble materials in the fish (blood, proteins etc.) dissolve in the water and small solid pieces become suspended, increasing the effluent strength and hence the cost.

Typically these trimmings fall into a box or basket positioned under the tub drain when the bench is emptied. This trimming collection basket typically consists of either a fish box or a shellfish basket with 20mm x 20mm holes, or 100mm long by 10mm wide slots. The baskets are emptied infrequently and so the water washes through the waste whilst draining.

Trials were carried out to determine which of the two water usage/filleting methods was the most cost effective in terms of water supply and trade effluent charges. One filleting bench from each of four different commercial processors was used, firstly on an empty and fill basis and then on a continuous basis. Water use and effluent strength were monitored in order to provide a direct comparison. Samples were also taken before and after the trimming collection basket to determine whether the basket had any effect on effluent strength.

3.2 Method

A mechanical cumulative water meter and a UCI electronic flow meter were installed into the pipe supplying water to the bench. Two filleters were operating the bench on an empty and fill basis and two boxes of (weighed) fish, (either cod or haddock) were added for each batch. One litre samples of effluent were collected when draining the tub, directly into the bottle (under the tub drain) and by using a tray or plastic bag under the catch basket, this being the last point before the effluent hit the floor when the bench was emptied. Sampling was repeated for up to four batches.

The bench was then emptied and cleaned and used on a continuous basis, with two boxes fish being added as the bench became empty. One litre effluent samples were collected every 30 minutes from the point at which the effluent overflowed from the bench.

The amount of fish processed, the water flow rate and the volume used were recorded and the effluent samples sent for analysis. The trial was then repeated with similar benches in a further three factories. In addition, clean water was also passed through the catch basket to determine any effect on effluent strength and cost. The water and effluent costs were calculated using Anglian Water 2000/01 Trade Effluent Charges.

Table 2: Overall Effluent Cost Comparison between continuously running water and empty/refill methods. **(including catch basket)**

Company	Continuous							Empty and Fill					
	Weight of fish filleted (kg)	Water flow rate	Time	Total water use	sCOD (mg/l)	TSS (mg/l)	Effluent cost £/m^3	Total weight of fish filleted (kg)	Batch No.	Water used per fill (ltr)	sCOD (mg/l)	TSS (mg/l)	Effluent cost £/m^3
1	304.00	22	9:15	2420	17	3	0.36	152.00	1	110	1898	1120	1.44
			9:45		137	72	0.43		2	110	2775	1580	1.92
			10:15		410	100	0.55						
			10:45		572	88	0.61						
			11:05		270	80	0.49						
				Average	**281**	**69**	**0.49**		**Average**	**110**	**2336**	**1350**	**1.68**
2	406	17	12:17	2550	1665	440	1.15	101.00	1	120	1200	362	0.94
			12:47		173	98	0.45		2	120	3803	1010	2.17
			13:17		357	140	0.54						
			14:20		613	240	0.67						
			14:50		591	212	0.65						
				Average	**680**	**226**	**0.69**		**Average**	**120**	**2501**	**686**	**1.56**
3	203	15	11:10	750	574	260	0.66	101.00	1	150	3420	1550	2.17
			11:27		482	150	0.59		2	150	4635	3010	3.08
			11:33		641	220	0.68		3	150	3023	1280	1.94
			12:00		353	140	0.54		4	150	2438	510	1.48
				Average	**513**	**193**	**0.62**		**Average**	**150**	**3379**	**1588**	**2.17**
4	152	25	09:00	2250	491	164	0.60	152.00	1	80	2363	420	1.43
			09:30		1178	204	0.89		2	80	3780	596	2.05
			10:00		317	160	0.53		3	80	4433	673	2.33
			10:30		98	28	0.40		4	80	1710	352	1.14
				Average	**521**	**139**	**0.60**		**Average**	**80**	**3071**	**510**	**1.74**

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Table 3: Overall Summary of the Water Supply and Effluent Costs to Fillet 1 Tonne of Gutted Fish (including catch basket)

Company	Continuous			Empty and Fill			% Difference
	Water supply costs (tonne of fish)	Effluent costs (£/tonne of fish)	Total cost (£/tonne of fish)	Water costs (£/tonne of fish)	Effluent costs (£/tonne of fish)	Total cost (£/tonne of fish)	
1	4.37	3.90	**8.27**	0.79	2.43	**3.22**	61
2	3.45	4.33	**7.78**	1.30	3.70	**5.00**	36
3	2.03	2.29	**4.32**	3.26	12.89	**16.15**	-274
4	8.14	8.88	**17.02**	1.44	4.57	**6.01**	65

Table 4: Effect of the Catch Basket on Effluent Strength and Cost

		Before Catch Basket			After Catch Basket			% Increase in Effluent Strength
Filleting method	% Full of Waste (Approximate)	sCOD (mg/l)	TSS (mg/l)	Cost £/m³	sCOD (mg/l)	TSS (mg/l)	Cost £/m³	
Empty and Fill	0	3735	1300	**2.32**	3420	1550	**2.26**	**-2.5**
	0	2647	2270	**2.15**	3022	1280	**2.01**	**-6.3**
	20	2587	1100	**1.78**	2437	1510	**1.84**	**3.3**
	40	2730	1840	**2.06**	4635	3010	**3.20**	**55.6**
Continuous	0	4620	1200	**2.66**	5070	1010	**2.79**	**5.0**
	30	360	80	**0.54**	963	336	**0.87**	**60.5**
Clean Tap Water	20	0	0	**0.37**	2010	910	**1.48**	**300.1**
	30	0	0	**0.37**	3120	1040	**1.98**	**436.4**

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3.3 Results

The overall results of the trial are shown in Table 2 and the costs have been summarised in Table 3. The particular effects of washing through and the trimming collection basket are shown in Table 4.

In companies 1,2 and 4 it was found that the empty and fill method of filleting was between 36% and 61% cheaper in terms of water usage and effluent costs, than using the continually running water method. In company 3 the continuous water use filleting method was more cost effective.

For both types of filleting operation, passing effluent through a trimmings collection basket containing waste, significantly increased the strength and cost of the effluent.

3.4 Discussion and Conclusions

In 3 out of the 4 companies, using an empty and fill method significantly reduced the water and effluent charges by between 36% and 61%. Although this method increases the strength and hence the unit cost of the effluent produced; overall the greatly reduced water supply costs and effluent volumes outweigh this factor.

Company 3 demonstrated that empty and fill is not always the most effective method. However, this company used very large 250 litre tubs and so a large volume of water was used and a high volume of effluent produced in the empty and fill method, attracting higher charges. This company should consider adding more fish or using sensibly sized, smaller filleting tubs.

Trimming catch baskets should also be emptied regularly. Allowing the effluent to wash through waste can significantly increase its strength and hence the cost (up to 60%). This is particularly marked with lower strength effluent or clean water for which the disposal costs can increase over 4 times.

It is clear that the savings accorded by the empty and fill method could be further improved by redesigning the filleting bench to keep waste out of the tub, by collecting the trimmings separately. This would also prevent them building up in the waste basket below the tub and hence prevent the washing through effect increasing the effluent strength.

Businesses which use the empty and fill method do not necessarily have a reduced efficiency in terms of filleting rate as most filleters continue filleting whilst the tub is emptying and filling up. Hence, most businesses currently operating on a continual running water could make considerable savings by converting to the empty and fill method.

4. Trial II – Low Cost Modifications to a Traditional White Fish Filleting Bench to Reduce Trade Effluent Charges.

4.1 Purpose

This trial was carried out to investigate simple, low cost modifications to a traditional white fish filleting bench operated on an empty and fill method, to determine if the effluent costs could be reduced further. The bench was modified by lowering the cutting board support brackets in order to use the bench frame to create a trimming guard to keep waste from entering the tub. The cutting boards were mounted away from the tub to create a gap for waste to fall into. Below each gap, simple chutes were added to direct the trimmings into a standard fishbox. Adjustable feet were then added to allow the bench to be adjusted to a comfortable working height. Effluent samples were taken from both an unmodified bench and the modified bench to determine any difference in operating costs.

4.2 Equipment and Method

The modified and unmodified filleting benches are shown in Figures 1 and 2 respectively.

Figure 1: Unmodified Filleting Bench

Figure 2 - Modified Filleting Bench

The existing cutting board support brackets were replaced by brackets made from 25mm x 25mm angle with a strengthening brace as shown in Figure 2.

Two mounting bolts were welded to the bench frame and each bracket was drilled to allow adjustment of the cutting board from level with the top of the tub down to a maximum of 80mm, in 20mm increments. The cutting board brackets were bolted into position 40mm below the top of the tub to create a 40mm high trimming guard. The cutting board itself was located on 8mm pins (welded to the brackets) and positioned to give a 60mm gap (Figure 3).

Figure 3: Trimming Guard and Gap

A simple chute, fabricated from bent sheet was welded to the cutting board brackets to direct waste falling through the gap into a box below. A sliding pipe type overflow was used in the tub drain with its maximum length ensuring that the maximum water level was 40mm below the top of the tub. Height adjustable feet were welded onto each leg. The work was carried out by a local fabricator at a cost of £200.

With the height of the bench adjusted to suit the filleters, two boxes of haddock (90kg)were placed in both the modified bench and the standard bench. The tubs were then filled until the water level was approximately 50mm from the top of the tubs. On emptying the tubs one litre samples of effluent were collected directly from below the tub drains. This procedure was repeated three more times and the samples sent off for analysis.

4.3 Results

The results of the effluent sampling are illustrated in Table 5:

Table 5 - Effluent Strengths and costs from the Standard and the Modified Benches

	Standard Bench			Modified Bench		
	sCOD (mg/l)	SS (mg/l)	Trade Effluent Charge £/m^3	sCOD (mg/l)	SS (mg/l)	Trade Effluent Charge (£/m^3)
	2960	823	1.85	1820	571	1.72
	5280	1620	3.06	3460	1370	2.22
	3650	1690	2.40	1030	422	0.93
	1540	510	1.17	----	----	--.--
Average	**3357**	**1160**	**2.12**	**2103**	**787**	**1.48**

--- Samples lost in transport

The sCOD and SS of the effluent were reduced by 37% and 32% respectively. This resulted in the average Mogden calculated trade effluent charge (Anglian Water 2001-2002 Blue Tariff) being reduced from £2.12/m^3 to £1.48/m^3

The chutes worked effectively and directed all the trimmings into the collection boxes. The 40mm high trimming guard proved to be effective, with only scales remaining in the tub after emptying.

4.4 Conclusion

The modifications significantly reduced the strength and hence the cost of the effluent produced by 30%. The payback period for these modifications was estimated at 100 days (based on 8 hours use per day). Using standard fish boxes to collect the waste reduced the additional fabrication costs associated with using a tray to collect the waste. The large capacity of a fish box would also reduce the frequency of emptying and the need to tip the trimmings into a suitable container for sale. However, if the trimmings are to be sold for human consumption, the box must be held off the floor. This could be achieved by either standing the box on an upturned box, or by welding brackets to the bench legs to support the box.

The sliding overflow pipe is effective at controlling water in the tub if the water is accidentally left running but, however well managed, it is not uncommon for filleters working on an empty and fill basis to add boxes of fish to a bench already full of water. It is clear that in these circumstances the sliding pipe overflow is not adequate to handle the large amount of water displaced (approximately 100 litres). This water is then likely to end up washing through the trimmings, increasing the effluent strength and hence cost. The possibility of including a high capacity overflow design should be considered.

5. Trial III – Further Modifications to a Traditional White Fish Filleting Bench to Control Displaced Water

5.1 Purpose

The previous trials indicated that controlling displaced water and preventing the build up of waste in the catch basket may further reduce costs.

This trial was carried out using a second traditional bench. The basic modifications as detailed in the previous trial were made but in addition, high capacity overflows were added to the bench ends to collect, control and improve the collection of any displaced or overflowing water. The effluent from the overflows and the tub drain was then piped into punch plate baskets to retain any small pieces of waste. Both the cutting boards and the tub were made fully height adjustable for filleter comfort. To allow the filleting of larger fish without risk of catching the knife tip on the trimming guard, the trimming board gap was also adjustable. Importantly, a narrow width side frame design was incorporated, to minimise the distance required for the filleters to reach into the tub. The modifications also included a frame to hold standard fish boxes as waste collectors below the cutting board gap and off the floor.

Effluent samples were taken to compare the effectiveness of the modifications and feedback was obtained from the filleters on the practicality of the design.

5.2 Equipment

The unmodified and modified benches are shown in Figures 4 and 5 respectively. The unmodified bench used a 145 litre tub and a catch basket with 10mm x 10mm holes positioned below the tub drain.

Figure 4 - The Unmodified Bench

Figure 5 - The Modified Bench

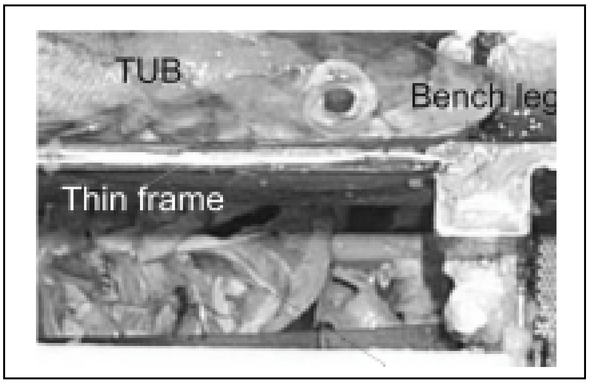

Figure 6 – Top View showing Reach

On the modified bench the 40mm square tub side frame of the original bench, adjacent to the cutting board, was replaced by a 10mm x 90mm bar (Figure 6) to

Figure 7a - High Capacity Overflow Arrangement

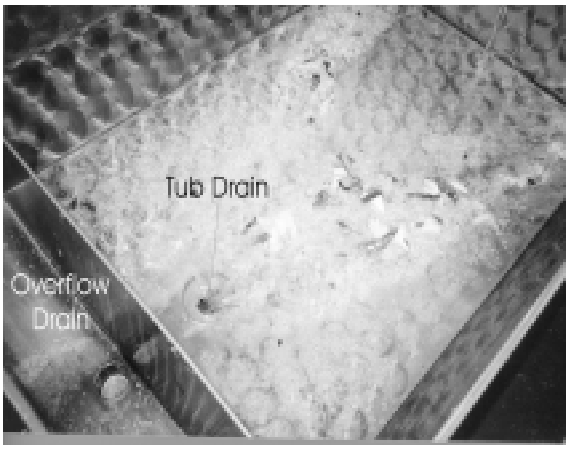

Figure 7b – Top View of the Bench Tub and Overflow

minimise the distance the filleter has to reach. This reduced the additional reach created by the trimming gap by 30mm.

The original end frames were removed from the tub and the tub was extended by 120mm at each end to form high capacity overflows (Figure 7a and 7b). The upper edge of the overflow was reinforced with 10mm x 90mm bar to protect the tub from box impact damage when fish are added. The original tub end wall was folded over to form a safe edge, 40mm below the top of the tub to form the overflow. Standard 40mm diameter plastic waste pipe fittings were attached to the drain of each overflow and the tub drain.

The drainpipe from the overflow adjacent to the main tub drain joined with the tub drain before emptying into a punch plate basket. The pipe from the other overflow was directed into a second punch plate basket.

The baskets were made with 3mm diameter holes (40% open area) and were designed to be hung in position on 20 mm square cross members running between the bench legs (Figure 8).

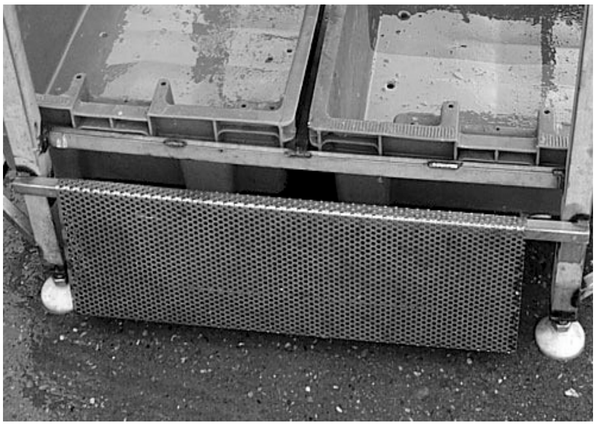

Figure 8 - Punch Plate Waste Basket

Figure 9 - Fish Box Mounting Frame

The cutting board supports were constructed from 25mm angle, each attached by 2 bolts to the bench frame. The angle was drilled to allow 20mm reductions in height starting with the cutting board level with the top of the tub. A simple piece of flat sheet was attached under each of the cutting boards to form a trimmings chute.

Adjustable feet were added to each of the bench legs to give a tub height adjustment of 100mm. A frame constructed from 20mm x 20mm square section was added to the lower portion of the bench to hold a standard Fishbox (Alibert 11075 / Driplast™ DB75 890mm x 560mm x 230mm) in position to catch the trimmings. (Figure 9) The modifications were made by a Grimsby fabricator at a total cost of about £1800.

5.3 Method

The trial was carried out in conjunction with a Humberside processor using medium size, gutted cod. The bench was set up by adjusting the feet to give a comfortable working height, with the cutting board positioned 40mm below the top of the tub and with a trimming gap of 40mm. The bench was operated on an empty and fill basis. Starting with a clean tub and empty punch plate waste collection baskets, the bench was filled with two boxes of gutted haddock (approximately 90kg) and then filled with water. Each time the bench was emptied, a 1 litre effluent sample was taken both before and after the punch plate basket which received effluent from the overflow and tub drain. This procedure was repeated three more times. The sampling was then repeated using an unmodified bench. To test the effectiveness of the bench overflow, several boxes of fish were added when the tub was full of water.

5.4 Results

The results of the effluent sampling are shown in Table 6. Modifying the bench reduced the sCOD of the effluent by 29%, (post baskets), resulting in a reduction in Mogden calculated trade effluent charges (Anglian Water Blue Tariff 2001-2002) of 18%. Very little waste (mainly scales) ended up in the punch plate basket of the modified bench. It was also effective at retaining very fine solids and reduced the strength and hence the trade effluent charge by a further 5% when compared to the standard bench.

Table 6 – Effluent Strengths and Costs (Anglian Water Blue Tariff 2001/2002) generated by the standard and the modified filleting bench

		sCOD (mg/l)	TSS (mg/l)	Average Cost (£m^3)
Modified Bench	Post Bench	1320	5580	1.72
		3920	3150	
		555	437	
		375	355	
	Average	**1542.5**	**2380**	
	Post collection basket	2490	2630	1.64
		3530	1190	
		2350	334	
		530	374	
	Average	**2225**	**1132**	
Standard Bench	Post Bench	1940	805	1.88
		1840	839	
		3830	1040	
		3870	1500	
	Average	**2870**	**1048.5**	
	Post collection basket	2070	819	2.00
		2420	961	
		4060	1400	
		3930	1340	
	Average	**3120**	**1105**	

Conversely with each emptying of the tub, waste (trimmings/lugs and scales) built up in the slotted basket of the traditional bench. Small pieces of waste were washed out, ending up on the floor and washing into nearby drains. The effluent passing through the catch basket of this bench increased in strength by an average of 6%.

The modified bench was very effective at collecting waste, however, the trimmings chutes failed to collect trimmings flicked to the extremities of the cutting board gap and required a slight modification. Negative comments regarding use of the bench were not made, with the only exception being when larger fish were being filleted and the filleting rate was slowed slightly, due to care being taken to avoid touching the knife tip on the edge of the tub. Widening the trimmings gap could counter this. The overflow worked effectively, containing the majority of displaced water when fish were tipped from either end of the bench. However, when tipped from the side of the bench some water may wash over onto the opposite cutting board and down the trimmings gap.

5.5 Conclusions

The modifications reduced the cost of the effluent by 18%. It is likely that the comparative savings would increase over time as solid waste built up in the basket of the traditional bench. The punch plate catch baskets worked effectively reducing the effluent strength of the modified bench directly from the tub by 5%.

To prevent trimmings ending up on the floor, the trimming chute design should be modified to include bent sides at either end to retain the trimmings and should be welded to either the tub or the cutting board support brackets to direct waste into the boxes below. The 'thin' frame design proved to be very effective at minimising filleter reach.

The payback period of the extensive modifications was estimated at between 2 to 4 ½ years (based on 8 hours use per day). After discussion with fabricators it was concluded that for some businesses the extent and cost of applying these extensive modifications would mean that it may be more cost effective to build a new bench from scratch.

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6. Trial IV – Technical Assistance for Building White Fish Filleting Benches from Scratch

6.1 Introduction

To assist with building a bench from scratch, Seafish has designed, built and tested two new bench designs, both of which incorporate all the principles developed from the previous trials. The first design is similar to the bench tested in the previous trial and the second was designed to keep fabrication costs to a minimum. (Figures 10 and 11 respectively). Both benches have their own advantages.

Details of these benches are given below and full technical drawings are available from the Seafish Library.

Figure 10 - Bench Design 1
Low positioned standard fishbox for trimming collection

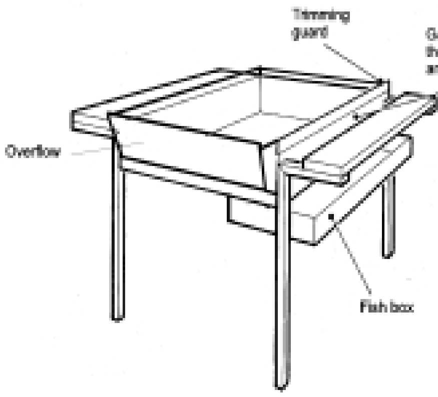

Figure 11 - Bench Design 2
Diagram showing high positioned smaller sized fishbox for trimming collection

Both benches were designed to have common thin section frame design at the tub top to minimise filleter reach and have fully adjustable cutting boards for both gap and height adjustment. Both have fine punch plate waste collection baskets and have high capacity overflows.

Bench 1 has the advantage of being able to take most sizes of fish box, held in position and off the floor by a frame incorporated into the bottom of the bench. The prototype bench was built by Gallagher Engineering (Hull) at a cost of £2000.

Bench 2 was designed to reduce the manufacturing costs by simplifying the design. It uses a smaller Alibert fish box, which is suspended under the cutting board gap. This reduces the need for the box support metal work. and reduces fabrication costs by approximately two hundred pounds.

This design makes it easier to clean the surrounding floor. However, disadvantages include the necessity for more frequent emptying of the smaller trimming collection boxes into a standard fish box. Being close to the cutting board means removal has to be carried out with care. The prototype of this bench was built by A & M Engineering.

The typical fabrication costs of these new benches will vary between about £1500-£2000 plus VAT (including cutting boards and a tub-bung with sliding pipe overflow), which is about £500 more than a standard bench. When used on an empty and fill basis (8 hours per day), the payback period of the additional £500 per bench is estimated at between 200 days and 460 days.

Keeping the basic design principles, these standard designs can be modified to accommodate different sized boxes or trimming collection systems to suit the needs of each individual processor.

Both benches have been on long term use in processing companies with positive feedback from the filleters. Their water and effluent costs are similar to those described in the earlier trials.

7. Trial V – Modifications to reduce the Water and Effluent Costs associated with the Baader 417/208 Mechanised Heading/Filleting Machine

7.1 Introduction

Many mechanised filleting machines were originally designed when water supply and effluent disposal were not a problem. When used on fishing vessels there is a plentiful supply of seawater for cleaning, lubrication and washing away the waste, which falls into a flume under the machine. When used on land however, the waste is commonly collected in boxes placed adjacent to, or under the equipment. These boxes rarely catch all the waste, resulting in waste ending up on the floor and in the drain, and require constant emptying. In addition the design of machines allows water to wash through the collected waste. Previous unreported work has shown that this washing through can increase effluent strength by 138%. As a result, these machines can use large volumes of water and produce large volumes of high strength effluent which inevitably attracts high charges when used ashore.

This trial details the modifications made to a Baader 417 heading machine and 208 filleting machine to reduce these costs. Flow meters were used to measure water usage in order to identify opportunities for water reductions. To reduce effluent strength, the standard waste chute of the 417 heading machine was modified to incorporate a water/solids separator section to prevent the effluent washing through the waste boxes. An SF Engineering Clean Tech water separating waste conveyor was installed beneath the Baader 208 to collect and transfer waste into a 660L bin. Effluent samples were taken to determine any reduction in effluent strength.

7.2 Equipment

The original waste collection systems of the unmodified Baader 208 and 417 are shown in figures 12 and 13 respectively.

Figure 12 - Waste Collection System of the Unmodified Baader 417 heading machine

Figure 13 - Waste Collection System of the Unmodified Baader 208 filleting machine

Figure 14 – Top view of the modified Baader 417 Waste Chute

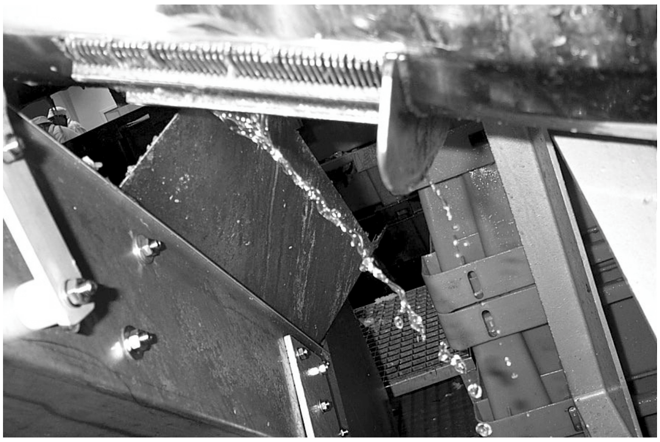

Figure 15 – Underside of the modified Baader 417 Waste Chute

A 160mm x 180mm section of 1mm aperture (28SWB – Bar Spacing) wedge wire and a water diversion plate were inserted into the original 417 waste chute (Figures 14 and 15) at a cost of about £100 plus VAT. A dimensioned sketch of the insert is shown in Figure 16

In use, the water falls through the wedge wire screen whilst the solid materials pass over it and on into the waste bin.

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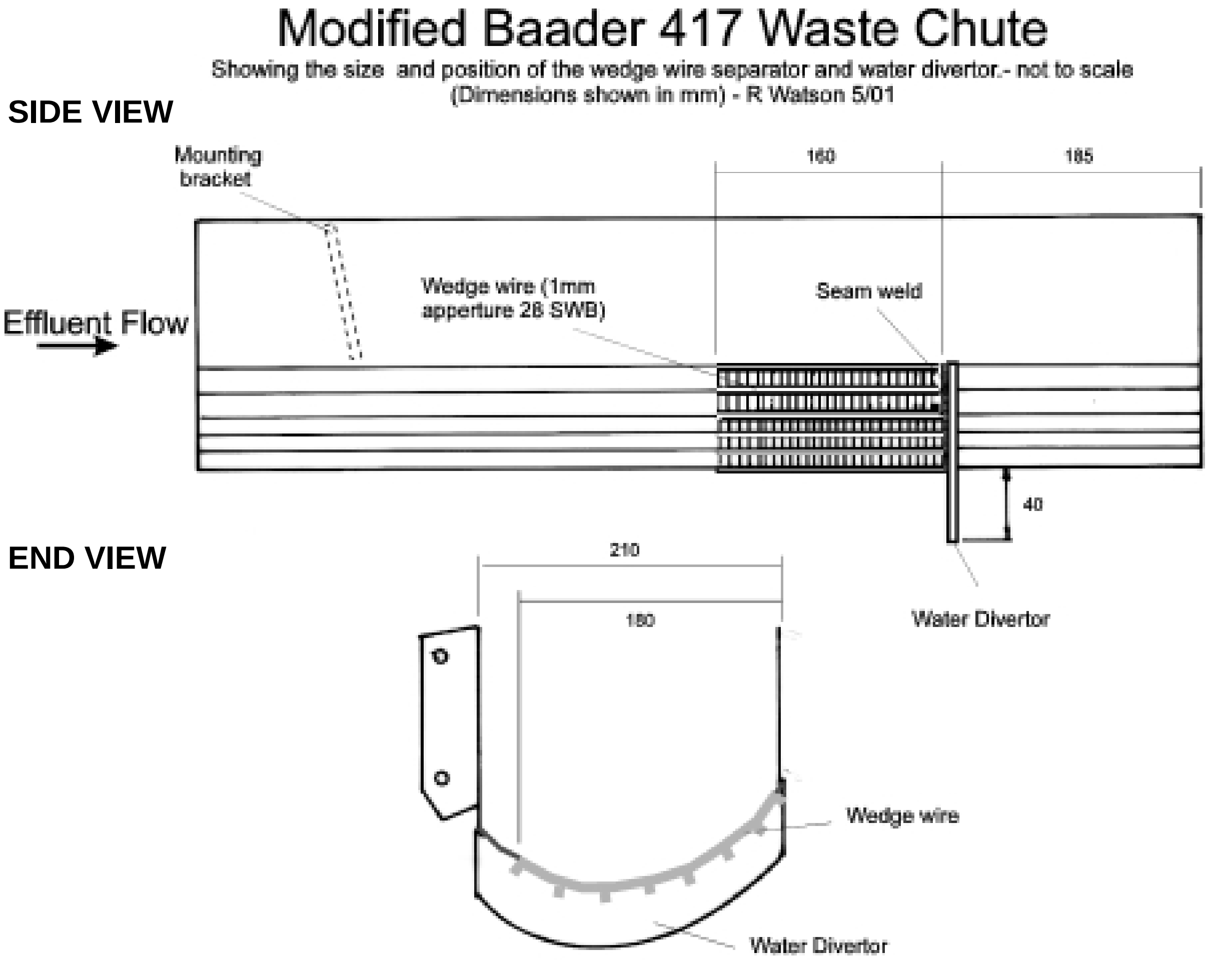

Figure 16: Dimensioned Sketch of the Modified Baader 417 Waste Chute

The water diverter plate is located 10mm past the wedge wire and is seam welded to the chute. It prevents water running down the underside of the chute and into the waste.

The Clean Tech™ conveyor manufactured by SF Engineering (Co, Sligo) consisted of a 3630mm long x 250mm wide main conveyor with a 900 series belt which was designed to run under the full length of the filleting section of the Baader 208. The belt is constructed of small plastic links which allow the water to pass through it whilst the solid waste is carried away. The design of this conveyor includes effluent return plates, which direct the effluent to a single effluent outlet point. A smaller 2230mm long elevator conveyor, positioned at 90^o to the end of the main conveyor, transferred the waste onto a 660 litre bin. This is shown in figure 17. The cost of the conveyors was £5000 plus VAT and installation.

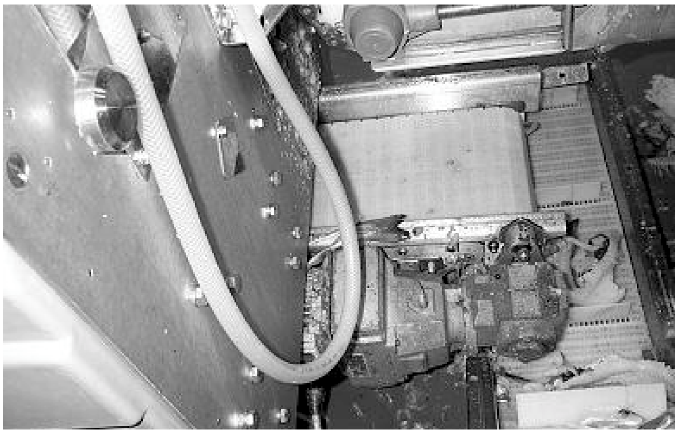

Figure 17 – The Waste Conveyors

7.3 Method

An inline flow meter was put into the water supply of both the Baader 417 and 208. The water flow rate to the 417 header was then reduced to the lowest level at which the equipment worked effectively and a *Cottham and Preedy* flow regulator was then fitted to maintain the reduced flow. The water use of the Baader 208 filleting machine was already set to half the manufacturer's recommended flow rate, using its own built in flow regulator. It was deemed by the company that this was the lowest practical setting and hence the flow rate was not reduced further.

To determine the effectiveness of the modified Baader 417 header chute, four 1litre samples were taken from the effluent draining from the 660 litre waste tub, with the standard chute in place. This was repeated with the separator chute in place, but with the samples taken from the effluent running through the wedge wire (as no effluent enters the tub).

Unfortunately the fitment of the waste conveyor to the Baader 208 filleting machine corresponded with a change of fish species, which meant that direct comparison with the original box waste collection and the conveyor was not possible. However, to determine the effectiveness of the waste conveyor, effluent samples were taken from a tray placed over the conveyor to simulate a waste collection box and then from the conveyor drain.

7.4 Results

The water consumption of the modified Baader 417 varied between 5 ltr/min to 15 ltr/min depending on the operator (average 13 ltr/min). Fitting the flow regulator reduced the water consumption to 5 ltr/min, representing a 66% reduction on average. The water usage of the Baader 208 was set to 10.5 ltr/min using its own internal flow meter. The Baader recommended flow rate for this machine is 25 ltr/min, which represents a 58% reduction.

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The results of effluent sampling of the standard and modified header chute are shown in table 7

Table 7 - Comparison of Effluent Sampling – Heading Machine Results using Unmodified and Modified chutes

		sCOD (mg/l)	SS (mg/l)	Average Trade Effluent Charge £/m³
Standard Chute		6440	1100	£2.57
		7850	1950	
		7920	1450	
	Average	**7403.33**	**1500**	
Modified Chute		2300	1380	£1.20
		3240	524	
		869	860	
	Average	**2136.33**	**921.33**	

The modified chute considerably reduced the effluent strength and the Mogden calculated trade effluent charge was reduced by 53% (Yorkshire Water 2000-2001)

The results of the effluent samples taken before and after the filleter conveyor was installed are given in table 8.

Table 8 – Results of Effluent Sampling for Filleting Machine using a Catch Tray and the Conveyor.

		sCOD (mg/l)	SS (mg/l)	Average Trade Effluent Charge £/m³
Pre-Conveyor		5450	6950	4.21
		5540	4970	
		6980	9540	
	Average	**5590**	**7153**	
Post conveyor		3000	3470	2.30
		5280	3440	
		3150	1870	
	Average	**3810**	**2926**	

The conveyor considerably reduced the effluent strength and the Mogden calculated trade effluent charge by 45%

7.5 Conclusion

The modifications to the Baader 417 header were very effective. The flow regulator prevented the operator using more water than necessary and the modified chute prevented the water washing through the collected waste and so significantly reduced the effluent strength and cost.

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It is estimated that the modifications made to the Baader 417 would reduce the water supply and effluent disposal costs from about £23.68 per day to £4.60 per day (based on 8 hours' use). It is likely that this would give a payback period of less than 7 days.

The Clean Tech™ conveyor was very effective at collecting and removing the waste from beneath the filleting machine. It prevented the effluent from washing through waste and increasing in strength. It also significantly reduced the amount of solid waste entering the drain, whilst dramatically reducing the staff time required for the emptying of waste boxes.

It is estimated that these modifications made to a standard Baader 208 would reduce the water supply and effluent disposal costs from around £60 to £15.21 per day (based on 8 hours use). This represents an estimated payback period of about 4 ½ months.

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8. Trial VI – Modifications to A Baader 51 Skinning Machine to Reduce Water and Effluent Costs

8.1 Introduction

In many companies it was found that skinning machines used excessive amounts of water. This resulted from very high flow rates and the water commonly being left running when not in use. High effluent strength was also common as a result of the water washing through the skins in waste boxes and picking up additional organic material. All these factors result in higher than necessary water and effluent costs.

One of the most common types of skinning machine currently in use is the Baader 51. In audited companies *(Seafish Report Number SR514)* the measured water usage of this model of skinning machine varied from 8 ltr/min to 73 ltr/min. Although Baader recommend a flow rate of 25 l/min, some companies use the machine at around 10 l/min and have reported no problems with either fillet yield or the machine itself. This type of machine also has a simple stainless steel waste chute, which allows the effluent to wash through the collected waste.

This trial was concerned with the development and testing of a prototype wedge wire water separator chute for a Baader 51. The chute was designed to replace the existing waste chute and prevent the water washing through the waste to reduce the Mogden calculated trade effluent costs. Effluent sampling was carried out to determine the effectiveness of the modified chute. The modifications were made to a machine which had already had the water regulated to 10 l/min using a flow regulator.

8.2 Equipment

A schematic diagram showing the principles of the separator chute is shown in figure 18. The skins slide down the chute and into the waste collection box, whilst the water passes through the wedge wire. The water, which runs down the back of the wedge wire is collected by the water diverter and is channelled away to the side of the box, away from the skins.

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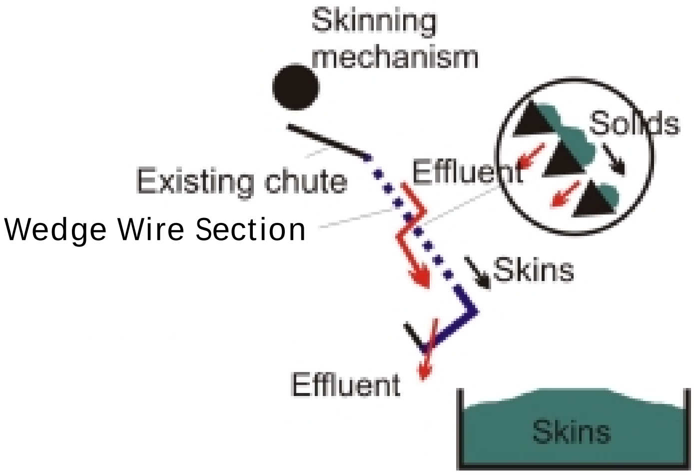

Figure 18 - Schematic Diagram of the Separator Waste Chute

The standard and modified Baader 51 waste chutes are shown in figures 19 and 20 respectively. Initial tests to develop a separator chute were carried out by experimenting with different apertures and angles of wedge wire sections to determine the optimum arrangement for the separation for skins and effluent.

A dimensioned drawing of the chute is shown in figure 21. The chute comprised a 415mm x 178mm section of 28 SWB wedge wire with 50mm plates welded on to form the sides of the chute. The existing chute was cut down, leaving 20mm protruding. The original prototype chute was mounted by bolting it onto tabs welded to this protrusion. However, it is considered that bolting it directly to the conveyor arms would be more secure. The water diverter consisted of two plates seam welded together at a 90^o angle to form a chute. This was then welded to the back of the wedge wire across the chute. A smooth weld fillet is essential as it smoothes the flow of effluent onto the water diverter, and prevents effluent running under the plate and bouncing back through the wedge wire.

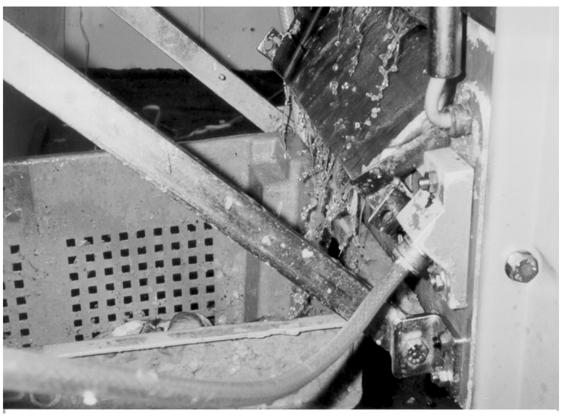

Figure 19 - Standard Baader 51 Chute Side View

Figure 20 - Standard Baader 51 Chute Front View

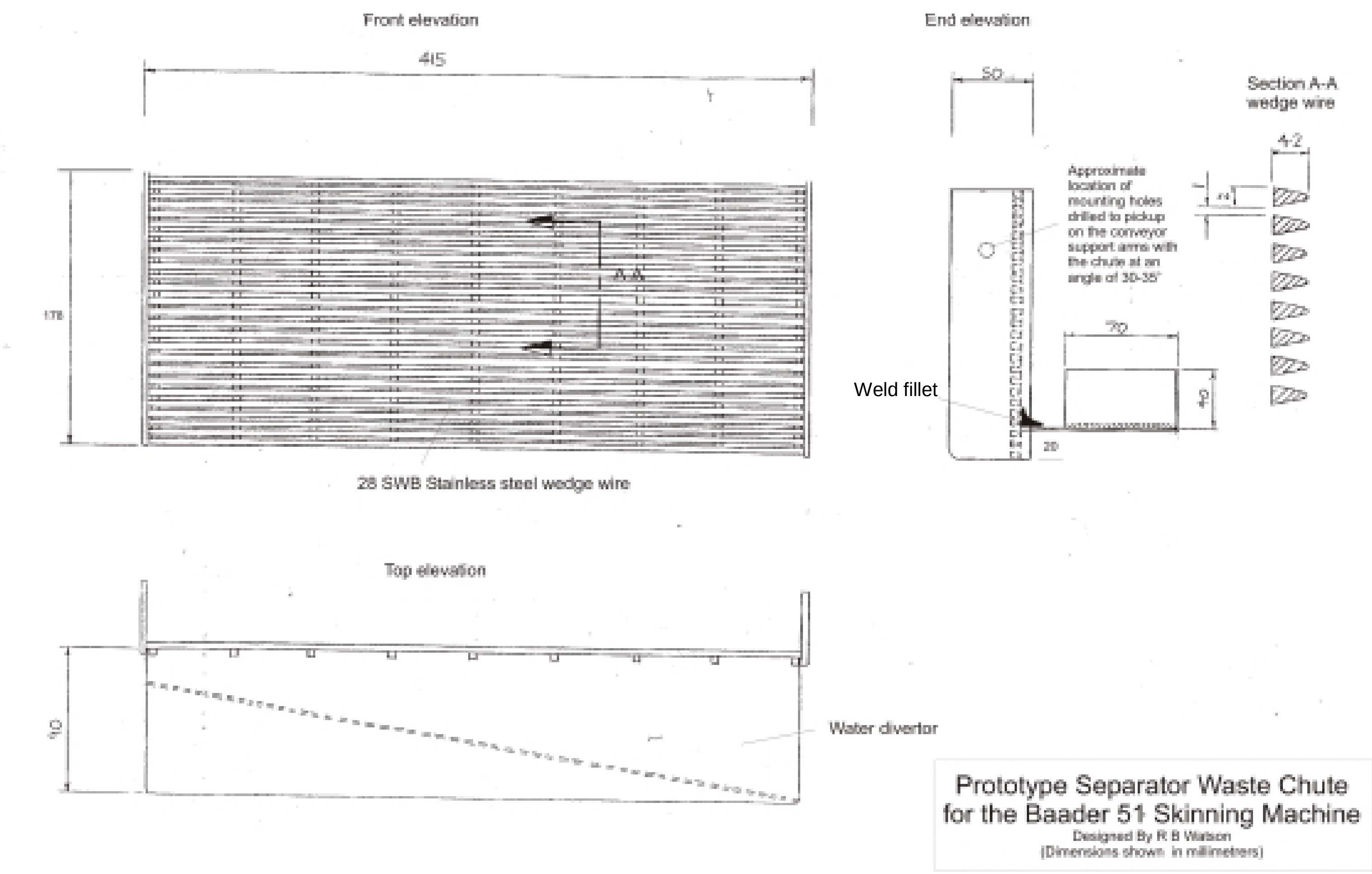

Figure 21 - Dimensioned Drawing of The Prototype Separator Waste Chute

8.3 Method

The trial was carried out in conjunction with a Humberside processor with the machine skinning headed and gutted, frozen at sea haddock fillets. The angle of the separator screen to the vertical was adjusted to give the best separation. With the original chute fitted, a shallow watertight tray was placed under the box of skins to collect effluent. The effluent in the tray was agitated to re-suspend any settled solids and a 1 litre sample taken and sent for analysis. With the separator chute fitted, a 1 litre effluent sample was taken from the water diverter. Sampling was repeated 3 times for each chute.

8.4 Results

The most effective angle for the chute was 30^o to 35^o to the vertical. The chute worked effectively with all of the water passing through the wedge wire section. The results of the effluent analysis are shown in Table 9.

Table 9: Effluent strengths and costs before and after fitting the Separator Chute to a Baader 51 skinning machine

	Effluent Strength (mg/l)		Mogden Calculated Trade Effluent Charge (Yorkshire Water 2000/01) (£)
	sCOD	SS	
Standard Chute	3300	628	1.36
	4130	744	1.58
	3030	960	1.42
Average	**3486**	**777**	**1.45**
Modified Chute	1420	434	0.87
	760	212	0.65
	1410	480	0.89
Average	**1196**	**375**	**0.80**

The average sCOD and SS were reduced by 66% and 52% respectively, by fitting the separator chute. The Mogden calculated trade effluent charge was reduced by 45%

A visual comparison of the effluent samples taken both with and without the separator chute can be seen in Figure 22

Figure 22 - Effluent Samples Taken With (1,2 & 3)and Without (4,5 &6) the Separator Chute

The action of the skins appeared to assist the cleaning of the wedge wire preventing small pieces of fish from blocking the gaps, thus allowing the skinner to run continuously without the screen becoming blocked.

8.5 Conclusion

The modified chute worked very effectively and gave a significant reduction in the strength and cost of the effluent. Many businesses could make significant savings by fitting a flow regulator and separator chute. As an example, fitting a flow regulator (10 l/min) and a separator chute to a standard Baader 51 would reduce the estimated water and trade effluent disposal costs associated with this machine from £26.04 per 8-hour day to £7.29 per 8-hour day, representing a reduction of 72%.

Gallagher Engineering (Hull) currently manufacture these chutes for £120 plus VAT. This would represent a payback period of less that 2 weeks. It is likely that the simple principle of separation can be applied to other types of skinning machine and other equipment to reduce costs where effluent washes through waste. Through trial and error the aperture and angle of the wedge wire can be adjusted to suit different flow rates, effluent types and applications.

8.6 Further Development of the Chute Design

Following the trial of the initial prototype a second chute with an alternative design of water diverter to simplify manufacture was tested. The water diverter was bent from one piece of sheet steel and welded to the end of the wedge wire section (Figure 23). This design worked equally as efficiently as the initial prototype. Drawings for both chutes can be obtained from the Seafish Library, Hull.

Figure 23 - Alternate Water diverter Design

9. Trial VII - Determining an Effective Drain Cover Design

9.1 Introduction

Drain covers play a significant part in reducing effluent strength by keeping solid material out of the drain. Many businesses use cast iron covers with large aperture slots. Unfortunately, this design allows large pieces of fish, even whole frames, to enter the drain.

This trial was carried out to investigate the effectiveness of both wedge wire and simple drilled plate drainage channel covers. Wedge wire covers with an aperture of 0.5mm, 1mm and 5mm and drilled covers with 5mm, 10mm and 15mm holes were tested to determine which were the most effective at keeping waste out of the drain, resistance to blocking, safety and ease of cleaning.

9.2 Equipment

Six drain covers (1000mm x 190mm x 20mm deep) were manufactured in 304 stainless steel to fit an existing drainage channel. Three covers were constructed from 0.5mm, 1mm and 5mm aperture wedge wire respectively. Four drilled covers were constructed from 3mm thick stainless plate with support spars welded onto the underside at 300mm intervals. The first cover was drilled with 5mm diameter holes 20mm between centres. The second, third and fourth covers had 5mm, 10mm and 15mm holes respectively, drilled at 40mm between centres .

The original drain cover is shown in figure 24. Figures 25, 26, 27, 28 and 29 show the 0.5mm, 1mm, 5mm, wedge wire and 5mm and 15mm diameter (40mm between centres) drilled covers respectively.

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Figure 24 - Original Slotted Drain Cover (40% open area)

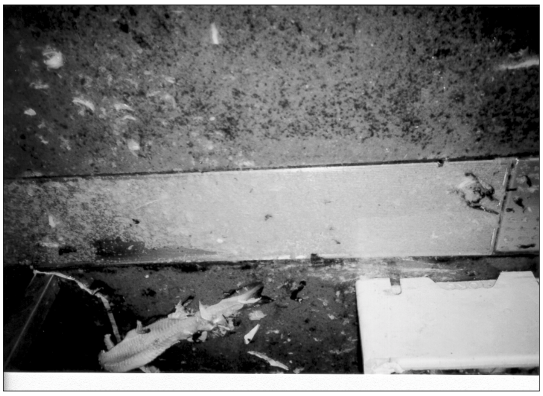

Figure 25 - 0.5mm Aperture Wedge Wire Drain Cover (16% open area)

Figure 26 - 1mm Aperture Wedge Wire Drain Cover (27% open area)

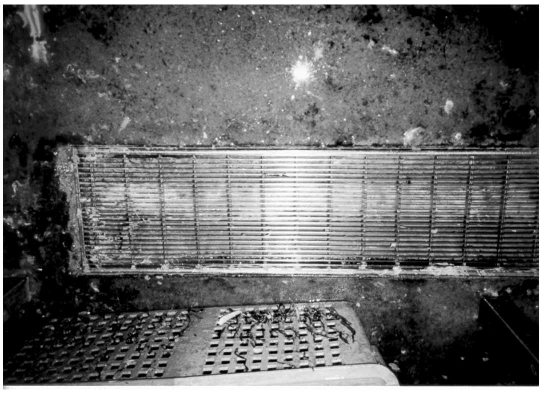

Figure 27 - 5mm Aperture Wedge Wire Drain Cover (44% open area)

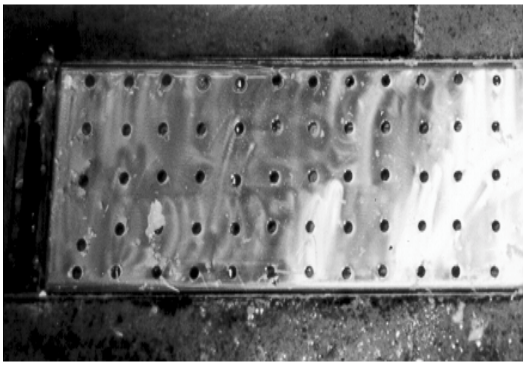

Figure 28 -5mm Diameter Drilled Cover (5% open area)

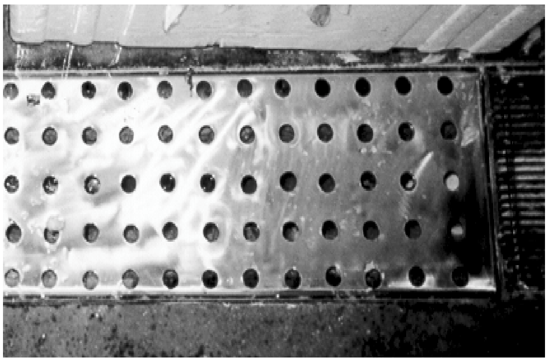

Figure 29 -15mm diameter Drilled Cover (12% open area)

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9.3 Method

The trial was carried out in conjunction with a Humberside processor, filleting defrosted headed and gutted haddock. A 1m section of the factory drainage channel cover, receiving effluent from three traditional white fish filleting benches was replaced by each of the wedge wire and drilled covers in turn. A visual observation was made on the way the effluent and solid waste interacted with the covers, the time taken to block, the potential for slipping and other factors such as ease of cleaning.

9.4 Results

The 0.5mm and 1mm wedge wire and 5mm diameter (20mm between centres) drilled covers blocked within ten minutes of use. However, these covers unblocked very easily if brushed, squeegeed or cleaned with a flow of water such as a hose pipe.

The 10mm diameter (40mm between centres) drilled cover resisted blocking for approximately twenty minutes. However, the 5mm wedge wire and 15mm drilled covers worked effectively, keeping relatively small solids out of the drains whilst resisting blockage. Both of these covers were easily cleaned with a squeegee or power washer as part of the cleaning schedule.

All covers were found to be more of a slip hazard than the original cast iron covers.

9.5 Conclusions

The smaller 0.5mm wedge wire and the 5mm and 10mm drilled covers were not considered to be practical for commercial use. Although very effective at keeping waste out of the drain, the frequent blocking would require constant attention from staff to prevent flooding. Although both the 5mm and wedge wire and the 15mm drilled covers were effective, it is thought that for the majority of businesses, the simple drilled plate covers would be preferable due to their inherent strength (fork lift traffic), the cost of fabrication and ease of cleaning.

As each commercial application is different in terms of the volume and nature of the effluent, the design of the drain covers should be tailored to each application in order to achieve the maximum efficiency. A cover should have the minimum amount of 15mm holes necessary to achieve effective drainage whilst ensuring that as little solid waste as possible enters the drain. The upper surface of commercial covers should be designed with a non slip surface to prevent the covers becoming a slip hazard. This may be achieved in manufacture by pressing out the holes from the underside to create a small collar or flange around each hole.

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10. Trial VIII – Development of a Separator Catch Basket

10.1 Introduction

Traditionally, most companies use catch baskets to prevent large pieces of fish from entering and blocking the drainage system. In terms of reducing trade effluent charges, the design of the traditional catch basket can itself contribute to increased effluent strength and hence higher costs as the effluent flows through the collected waste.

This trial was concerned with the development and trial of a new type of catch basket using the waste separator principle, proven in the skinning machine chute, to eliminate the washing through effect and reduce trade effluent charges. A separator catch basket was designed to fit an existing catch basket housing in the processing area of a white fish filleting business. Composite effluent sampling was carried out to directly compare the new basket with the original traditional basket. The trial was also repeated under supervision by a postgraduate student from the University of Lincoln (*formerly The University of Lincolnshire and Humberside)* as part of a PHd. These results are also included.

10.2 Design Theory

Schematic diagrams showing a traditional catch basket and the separator catch basket are shown in Figures 30 and 31 respectively.

It was found that many baskets were a poor fit in their housing due to bad design or damage to the basket or its housing. Often baskets have large aperture holes (up to 25mm have been observed) which allows a lot of solid waste to enter the drain. Conversely the hole sizes may be too small, resulting in the holes quickly becoming blocked and the basket being permanently removed by the staff.

In all current traditional catch basket designs, the effluent washes through the waste trapped in the basket. This washes out soluble material such as blood, some proteins and small pieces of fish, which increases both the strength and disposal costs of the effluent. In a simple test, running clean tap water through a catch basket containing waste, resulted in an increased disposal charge from £0.41/m^3 to £1.16/m^3 (Yorkshire Water 1999-2000).

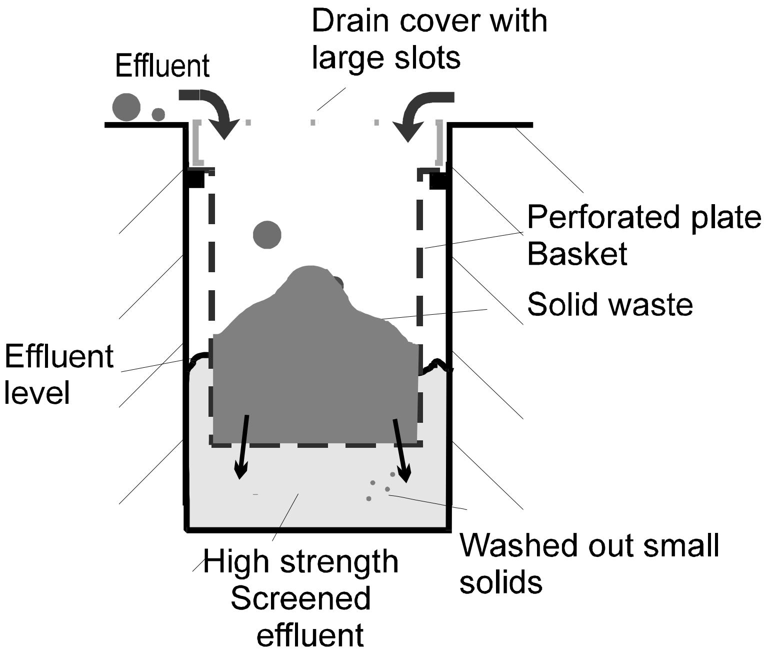

Figure 30 - A Traditional Catch Basket

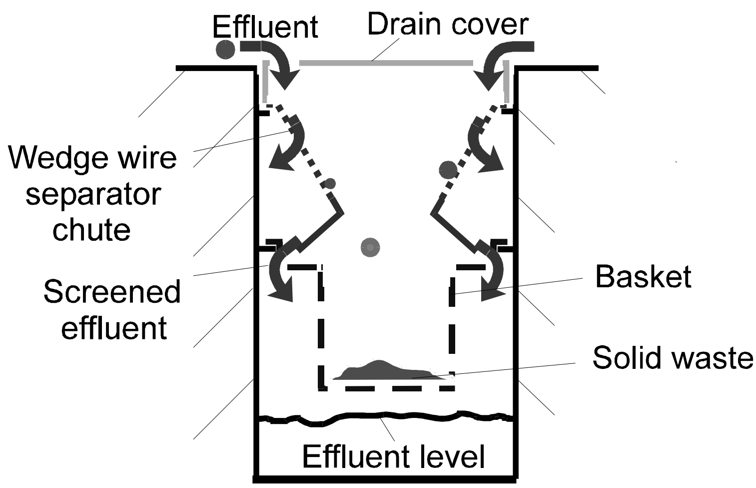

Figure 31 - The Separator Catch Basket

The separator catch basket consists of three sections. The drain cover is designed to keep large solids out of the drain whilst directing effluent onto the wedge wire section below. The effluent passes through the wedge wire separator section, whilst the solid waste slides down the wedge wire and falls into the waste collection basket.

The water diverter deflects the effluent which runs down the back of the wedge wire away from the solid waste, preventing wash through. The whole assembly is positioned above the water level in the drain to prevent soaking.

10.3 Equipment

Figure 32 - The Traditional Catch Basket and Cover

The original catch basket, which is shown in figure32, consisted of a large 230mm x 230mm x 6000mm deep perforated plate basket with 6mm diameter holes and used a 300mm x 300mm cover with 300mm x 25mm wide slots.

The large aperture slots in the drain cover allowed large solids to enter the basket. The bottom 200mm of the basket remained soaking in effluent. The drain cover and catch basket itself fitted well, allowing no solids to bypass the basket. The solids were typically emptied at the end of every week.

10.4 The Separator Catch Basket

The prototype separator catch basket (figures 33, 34 and 35) was designed to fit the existing catch basket housing which had two internal ledges. It was fabricated by Gallagher Engineering from 3mm thick 304 stainless steel and 1mm aperture 28 SWB wedge wire, at an approximate cost of £250. The 308mm x 308mm x 33mm deep cover used 30mm diameter holes to direct the effluent onto the face of the wedge wire. Holes were omitted from the corners as initial development trials showed that flow down the corners of the wedge wire screen below was not effectively separated. Ribs were welded onto the underside of the cover to give additional strength.

The separator section consisted of four wedge wire sections welded together at 40^o to the vertical . Flat sheet was attached to the bottom of the wedge wire to form the water diverter. A 5mm wide by 2mm thick soft rubber seal was glued to the top surface of the screen flange to form a seal with the cover. The total area of wedge wire was 1080cm^2

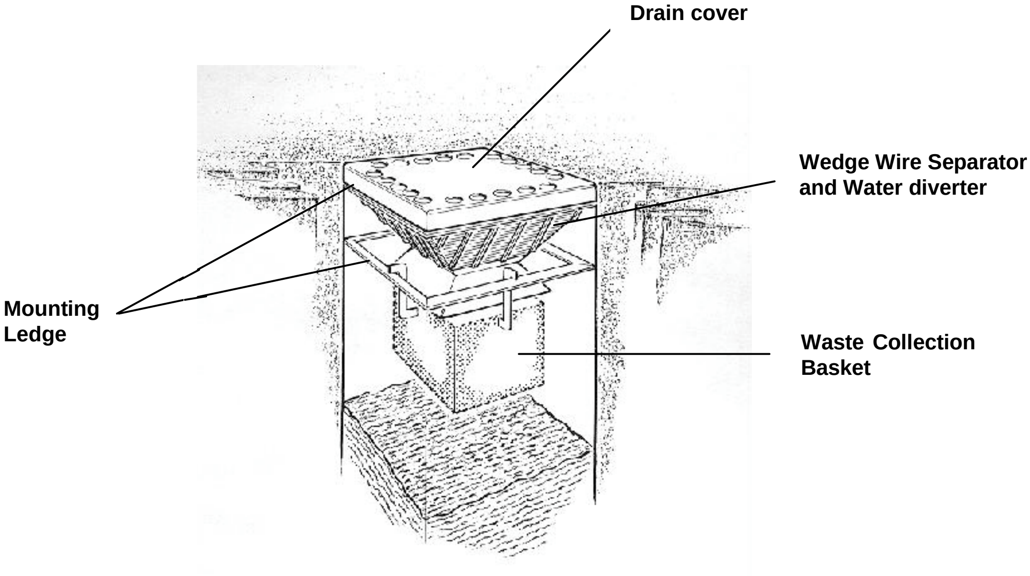

Figure 33 - Drawing of the Separator Catch Basket

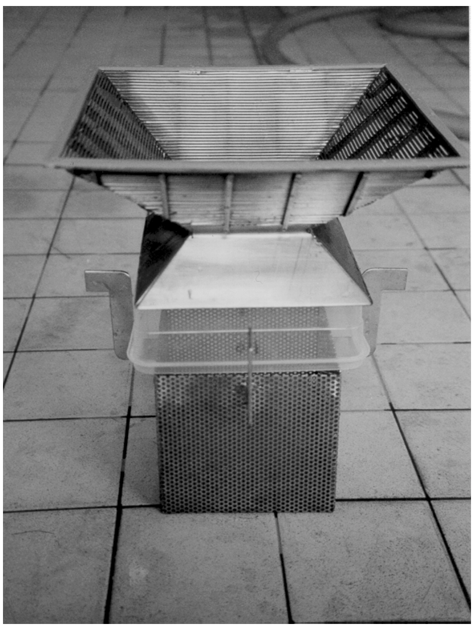

Figure 34 - Catch Basket Separator and Catch Tray Without the Cover

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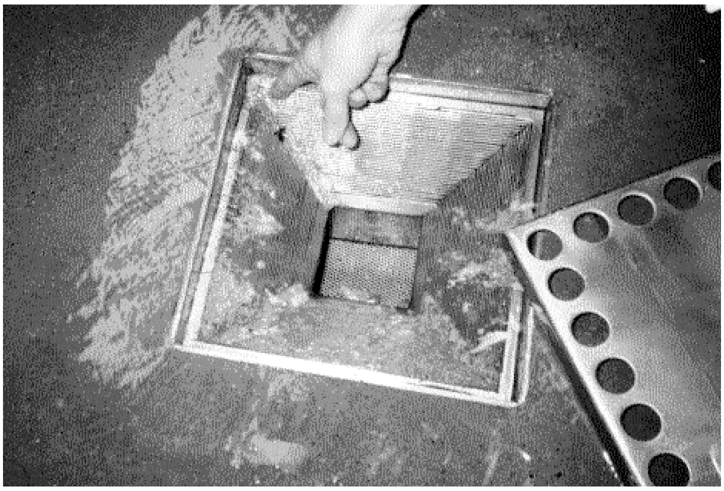

Figure 35 - Separator Catch Basket in the Drain with the Cover Removed

The catch tray was constructed from punch plate stainless steel with 3mm diameter holes and an open area of 38%. Four legs were attached to allow the basket to locate on the second ledge in the drain housing.

Full technical drawings for the separator catch basket are available from the Seafish Library, Hull.

10.5 Method

The drain received effluent on all sides from three traditional white fish filleting benches. The benches used continually flowing water, resulting in a total flow of approximately 40 l/min. They were emptied periodically, resulting in the flow rate from any one bench increasing to approximately 100 l/min.

For the purposes of the trial the species of fish were controlled. One bench filleted plaice whilst the other two filleted cod/haddock during the testing of both baskets.

With the original catch basket in place, an Epic 80/10 effluent sampler was used to obtain a 1 litre composite sample of effluent (100ml every 10 minutes over an 8 hour period). This sampling, from the point at which the effluent left the drain housing, was repeated during a second day of production. The catch basket was not cleaned overnight as per normal practice.

The sampling procedure was repeated with the separator catch basket in place. The catch basket was cleaned nightly to keep the wedge wire working effectively. Effluent samples were sent off daily for analysis.

A similar supervised procedure was carried out by the University of Lincoln, although sampling was carried out over a period of 10 days. Prior to this trial both the catch baskets and the housing were cleaned. Chemical analysis of the effluent samples was carried out by the University.

10.6 Results

The results of both trials are shown in Table 10. Overall the average sCOD and SS of the effluent with the traditional catch basket fitted was 3122mg/l and 1972mg/l respectively. This corresponded to a Mogden calculated trade effluent charge (Anglian Water 2001-2002) of £2.26.

Table 10: Effluent Strength and Trade Effluent Disposal charge - comparison between the traditional and separator catch baskets

			Effluent Strength		Mogden Calculated Trade Effluent charge (Yorkshire Water 2000/01) £/m^3	
			COD mg/l	SS mg/l		
Seafish Trial	Traditional basket		2750	935		1.80
			4630	2110		2.93
		Average	**3690**	**1565**	Average	**2.38**
	Seafish Separator Catch Basket		1721	910		1.36
			1323	800		1.16
		Average	**1522**	**855**	Average	**1.26**
University Trial	Traditional Basket		2503	2219		2.07
			2734	2346		2.21
			2619	2369		2.17
			2658	2491		2.22
			2259	2473		2.05
		Average	**2554**	**2379**	Average	**2.14**
	Seafish Separator Basket		1081	1377		1.23
			1329	1313		1.31
			1407	1342		1.35
			1306	1457		1.35
			1491	1539		1.45
		Average	**1322**	**1405**	Average	**1.34**

The overall average effluent strength after fitting the separator catch basket was reduced to 1422mg/l and 1130mg/l respectively. This corresponds to a Mogden calculated trade effluent charge of £1.30/m^3 , and a reduction in costs of 42%.

The separator catch basket worked effectively in normal conditions but when two benches were drained simultaneously, a small amount of effluent, ended up in the waste collection basket as a result of the high effluent flow rate.

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Having the drain cover in place was essential to the correct functioning of the basket. With the drain cover removed, the smoother flow blinded the wedge wire within a few minutes. The 30mm diameter holes had the effect of randomising the flow onto the screen which gave a self cleaning action. These relatively small holes also kept the majority of waste out of the drain. After two days use, the amount of fish waste emptied daily from the waste tray, was approximately 3kg. The slotted cover of the traditional basket let significantly more waste into the drain.

10.7 Conclusions

The separator catch basket worked very effectively at keeping waste out of the drain and reducing trade effluent disposal costs by preventing soaking and effluent washing through the waste. In this situation (estimated flow 30l/min - 8 hours per day) it is estimated that the payback period for the separator catch basket could be less than 1 month. It is thought that these basic principles could be applied to most types of 'single point' drainage system. However, the aperture and surface area of wedge wire must be scaled up (or down) in line with the volume and nature of the effluent.

11. Overall Discussion and Conclusions

This series of trials has shown that significant reductions in water supply and trade effluent disposal costs can be achieved with relatively simple equipment modifications, most of which can be achieved for a modest financial outlay, with a short payback period.

Businesses that use traditional filleting benches and whose filleters predominantly use the continuously running water method should fit flow regulators or consider changing to, or enforcing water use on an empty and fill basis. The trial results indicate that significant savings in water supply and effluent disposal costs of between 30% and 60% could be made. This would equate to a maximum of about £5.05 for every tonne of fish processed. In addition, it was found that the trade effluent disposal costs can be reduced by a further 20% to 30% by simple and inexpensive modifications to prevent the trimmings being flicked back into the tub. This would prevent the waste soaking in the tub and building up in the bench catch basket where further washing out occurs, both of which increase effluent strength and cost. The typical payback period for these simple modifications is estimated at about 100 days. These modifications also allow much smaller aperture punch plate baskets to be used. These retain more solid waste and can reduce the effluent leaving the bench by a further 5%. If not using an empty and fill method of operation, further modifications, such as high capacity overflows can be used to help control displaced water and prevent it washing through the surrounding boxes of waste. However, these extensive modifications can prove expensive with a much longer payback period of well over a year.

If a company is building new benches it is thought that these simple modifications could be incorporated into the design of a standard bench for little extra cost. If a company wishes to apply all these modifications, it may be more cost effective to build a new bench from scratch. The payback on the estimated additional £500 needed to incorporate the full features in a new bench would be about a year. Full technical drawings are available for two such benches. The two designs differ only in the position of trimming collection boxes and slight differences in cost and ergonomics. These basic plans can be used as a starting point and can be fine tuned by individual companies to suit their operating requirements.

Similarly, modifications to mechanised filleting equipment were also effective. Fitting a flow regulator, waste separator chute and waste separator conveyor to the Baader 417/208 reduced the water supply and effluent costs by 76% when compared to standard machines. Despite the relatively high cost of the conveyor this gave an estimated payback period of less than 5 months.

The modifications to the Baader 51 skinning machine also worked well. Using a flow regulator and a wedge wire separator chute reduced the water and effluent costs by 72% compared to a standard machine. This gave an estimated payback period of less than 2 weeks.

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Both 5mm aperture wedge wire and 15mm drilled plate drain covers worked effectively at keeping waste out of the drain. However, the simple drilled covers have the advantage of being stronger, cheaper and slightly easier to keep clean. The surface of the covers tested would require modifying to prevent slipping.

The separator catch basket reduced the cost of the effluent leaving the catch basket housing by 42% compared to the traditional basket. This gave an estimated pay back period of less than 1 month.

It is thought that the principles demonstrated in this series of trials could be adapted to many types of business wishing to reduce the costs of trade effluent disposal and water usage.

As a starting point, a business wishing to reduce costs should tackle the main causes of the problem, such as filleting and skinning equipment. Once these have been addressed, other areas such as catch baskets/covers etc. can be investigated.

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