DISSOLVED AIR FLOTATION FOR TREATMENT OF SHRIMP WASTE

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The speaker before me and I are here to share our observations made in regard to the DAF treatment of wastewater of a Shrimp canning plant.

I worked with Mr. Szabo very closely through the years; you heard his factual presentation about the technical findings of an EPA/industry sponsored, plant-scale demonstration project utilizing a DAF system.

The only reason I am here today is that I am connected with the plant that was selected by the shrimp industry to undertake the project and I was designated by our Association, the American Shrimp Canners and Processors, to act as the project manager during the three years it took to complete the project.

The livelihood of our industry depends on the environment and proper handling of our natural resources. Without it, the Shrimp industry could hardly survive. Through the years, we have been in the forefront to protect our marshlands and estuarine areas against all encroachments—which if preserved will stay for decades to come the nursing ground of the Shrimp—the most valuable seafood resource of the country.

It will only take me one minute to summarize what the Shrimp processing industry is.

On the average, the Gulf produces approximately 200,000,000 lbs. of heads-on Shrimp a year and this is handled by approximately 150 plants, located all the way from Brownsville, Texas to Key West, Florida.

Since the Shrimp is only caught during certain periods of the year, we can figure on the average appr. 120-150 operation days per plant.

If you divide the production, it comes down to an average of 1,300,000 lbs. per plant per year, divided by 150 days represents less than 9,000 lbs. per working day per plant.
I am only talking about averages--some plants process more, some less--but I would like to point out that basically the daily waste load that could be returned by the average plant to marine waters is a rather limited, non-toxic quantity.

During the past eight years, our industry has learned a great deal about its wastewater. Our Association has undertaken two EPA/industry sponsored research projects. The first one, completed six years ago, analyzed the characteristics of the wastewater of a Shrimp canning plant. The second one--a plant scale, demonstration project using dissolved air flotation system--was completed two years ago.

The goals of this second project were to find out whether the limits set for the Shrimp industry for 1983--the so-called BAT--could be achieved; we found it could not. In the meantime, due to the 1977 Clean Water Act, BAT for the industry was suspended and now we are awaiting the publication of ECT to be applied from 1984 on.

Actually, the demonstration project consisted of two phases:

First, better water management and screening of solids, which was very successful.

Second, operation of a DAF system, which is technically feasible, but we in the industry feel it is too costly to be considered for Shrimp plants.

Through the years it was the habit of all plant operators to use as much water as necessary to maintain a fast, clean, sanitary operation. The knowledge we gained through this project about water savings was an eye-opener.

When the project started, the plant was using over 700 gallons of water per minute and, after completion of the water management studies, through installation of all kinds of water saving devices and through educating people in water savings, the water usage decreased dramatically. Today, this same plant that used to run 700 gallons of water per minute is using approximately 450 gallons, representing a savings of well over 40% and there is still room for further improvement.

We experienced quite a bit of success by installing a more refined screening system which resulted in better removal of the solids.

In regard to the operation of the DAF system, you received a very precise technical presentation. Here I just would like to bring certain points to your attention.

Our operation is intermittent--we do not work every day. We work if and when the boats come in. There are many days when the average plant works only four, five or eight hours. By having this
intermittent operation, we found:

1. Start-up time is approximately two hours; it takes that long just to fill the tank.

2. Only then could the engineers start to activate the system.

We observed that their work involved making continuous adjustments and the readings—most of the time—were inconsistent, had tremendous variation. We know why—this is due to the nature of our product. There is no consistency in the Shrimp waste.

Some catches are two days old, some four days old or even older by the time it is processed by the plant, and depending on how old the Shrimp, different amounts of chemicals have to be added to achieve an effective treatment.

3. We observed that most of the time two graduate engineers, with tremendous interest in the project, had to work continuously to produce acceptable readings and even this way the readings fluctuated all the time.

On any given day, the Shrimp handled by the plant comes from different areas, which again can cause a variation in the waste-water.

When one day some consistency was reached, the frustration started all over again the next day.

4. When the day was over, the shut-down was a traumatic experience. For instance, on a day when the plant operated only four hours, cleanup needed at least three additional hours.

Actually, it took us considerably longer to clean the DAF system than to clean the entire plant.

5. At the end, time and again we let fresh water run through the system for three hours at a considerable labor and energy cost.

6. Last, but not least, there was the sludge, producing a watery substance that we didn't know what to do with. The project ran out of time; we didn't use a centrifuge, but even if we had, it was our understanding it would only have produced 30–35% solids and we still would have been left with the problem of what to do with it.

It is easier said to send this watery substance to a landfill than done. We are in urban areas and most of the time they do not want landfill and, if they do, they do not want the kind of landfill the sludge we were producing represented. Also, no matter how we would deliver it, it would drip all the way to the landfill.
We found the sludge was not welcome anywhere.

We are dehydrating our Shrimp hulls through a kiln. We have a hard time selling the dehydrated hulls, because the feed industry regards it to be rather low in protein.

We couldn't even think about mixing the chemically treated sludge with the Shrimp hulls because at the end it would have resulted in a completely unsaleable product. Even this way, we have to wait time and again for months before we have a taker and the value just about covers the labor and maintenance cost of the dryer.

I could go on and on, but I have limited time. I say in behalf of the industry that the sophisticated, highly complex operation of a DAF system is not suitable for a Shrimp plant. They may work in plants that day in-day out operate for long hours, particularly in plants that can operate around the clock and where the extremely costly clean-up operation only has to be performed maybe once a week—not on a day-to-day basis. This system is too sophisticated to be operated by Shrimp plants.

The results of this project indicated, as per the tables, that the greatest percentage reduction of the pollutants was achieved by good water management and screening. By using good water management and screening 67% of BOD, 58% of TSS, 57% of O&G was removed and, by using the costly DAF system, the additional removal was not substantial. The system—economically—is not feasible where our industry is concerned.

As you know, by congressional directive, in 1977 EPA was instructed to conduct a seafood study to review the effects of the discharge of processing wastewater into the ocean and render a report within a year. We understand that this long overdue report will be published shortly and we hope it will not restrict itself to the study in Alaska and Oregon, but will include all processing areas and will give us insight into EPA's thinking—whether it has been adjusted to today's realities, reflecting the congressional thinking of these days—to process more instead of less seafood.

Early this year, the report of the engineering firm of E. C. Jordan Co., who was commissioned by EPA, published a reassessment of the Limitations Guidelines for the different categories.

We were amazed to see in this report that Jordan recommended treatment of Shrimp processing waste by a DAF system with chemical optimization.

Before publishing this report, all data and findings of our plant-scale demonstration project were available to them.

They accepted from this report the fact that the use of a DAF system, in principle, is technically feasible, but ignored the rest of the findings. No consideration was given to the basic problems that a DAF system represents for the shrimp industry.
1. We have a fragmented industry consisting of approximately 150 plants located along the Gulf.

2. We only have intermittent operations which is deadly for a DAF system—the plants operate 120-150 days a year.

3. Due to the nature of the raw product, there is a tremendous variation in performance of the system.

4. The range of the readings are unbelievably wide and could hardly be stabilized by continuously adjusting the dosage of the chemicals.

5. The system was operated by highly trained, research-minded engineers and they couldn't come close to the numbers that were required by the suspended BOD.

6. Not to mention the problem of the sludge.

We thought that all the problems the demonstration project pointed out would have been considered.

We feel prescribing a DAF system for the Shrimp industry does not even consider the congressional intent that there should be some kind of reasonable relationship between the cost of obtaining reduction and the effluent benefits derived.

Last week I received a copy of the Draft Document prepared for EPA by Planning & Research Associates, which analyzes the economic impact of Proposed Limitations Guidelines for the seafood categories.

Since we only had the report for a few days, we could not fully digest their findings, but we feel this is the first document coming from the Agency that states that a DAF system for the Shrimp industry may be technically feasible but economically impossible. The report states that the overall impact is greater on the Shrimp industry than on any other subcategory.

According to one of their tables, the Gulf Shrimp industry consists of 138 plants. They differentiate according to sales volume between small, medium, and large plants. Small is under one million, large is over six million, and medium is in-between.

It is their analysis, if compelled to use a DAF system, it will lead to closure of the 42 smaller plants, 37 of the medium-sized plants, a mortality of 57%.

The rest of the plants, whether at the present they have a viable operation as in the case of thirty-eight, will become marginal—some not earning any money—some may earn a little over 1% on sales.
We should not forget that half of U. S. consumption is imported, coming from countries with hardly any environmental restrictions. Our industry so far has survived; no EPA regulations should be imposed on this industry that may close the door on a number of family operated plants, and make the rest of the industry look to government handouts for survival.

I tried to be as factual as I could on this issue. I hope I was able to present the case that DAF should not be imposed on the Gulf Shrimp industry.
SEAFOOD PROCESSING WASTELOAD REDUCTION BY MECHANICAL FILTRATION

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INTRODUCTION

Under the Federal Water Pollution Control Act Amendments of 1972, effluent limitation guidelines for the Canned and Preserved Seafood Processing Industry Point Source Category were promulgated. The achievement of effluent limitations based on Best Practicable Control Technology Currently Available (BPCTCA) was required by July 1, 1977. The Act also required the achievement of effluent limitations based on Best Available Technology Economically Achievable (BATEA) by July 1, 1983.

With adoption of the Clean Water Act of 1977, discharge of conventional pollutants will no longer be controlled by the BATEA guidelines. Conventional pollutants include Biological Oxygen Demand (BOD₅), Total Suspended Solids (TSS), Oil and Grease (O&G), fecal coliform and pH. Control of these pollutants by seafood processors with point source discharges (those requiring NPDES permits) will be based on the implementation of Best Conventional Pollution Control Technology (BCT) no later than July 1, 1984. The EPA has indicated that final BCT limitations for the seafood processing industry can be no more stringent than BATEA guidelines, nor less stringent than BPCTCA regulations.
WASTEWATER CONSERVATION

As a result of the Water Pollution Control Act Amendments of 1972 and the Clean Water Act of 1977, the seafood industry has become more aware of in-plant water and waste management and its relationship to plant effluent characteristics. There are a number of benefits which can be derived from implementing in-plant waste controls and through optimizing water use. These include decreased end-of-pipe treatment cost, decreased waste loads, improved raw material utilization, saleable secondary products and byproducts, and cost savings from reduced process water use.

A general survey of the seafood processing plants in Maryland indicates a good possibility of reducing wastewater volume by conserving water use in certain operations. Some obvious steps to reduce water usage are: turn off hoses and faucets after use, use high-pressure low volume wash-down systems, use spring loaded hose nozzles, and encourage plant personnel to minimize water consumption by eliminating other wasteful practices.

To achieve a higher degree of water management, individual unit processes require evaluation. Significant flows are usually generated during raw material unloading. Wastewater which is highly contaminated should be isolated for separate treatment and/or disposal. Cleaning tables should have provisions for controlling water flow at individual stations. Flows associated with processing equipment should be adjusted, where possible, to accommodate variable raw material quality and production levels. Raw and final product handling through fluming should be eliminated, where possible, in favor of belt or pneumatic conveying.

Based on observations, a reduction in water flow by as much as 20% can be achieved in the average processing plant without jeopardizing sanitation or product quality. Such reductions would save the processor pumping cost as well as wastewater treatment cost, particularly in those plants where treatment facilities other than screening would be required to meet future permit conditions.

EFFECTIVENESS OF CURRENT TREATMENT PRACTICES

Present wastewater treatment practices for the seafood industry are set forth in the NPDES permit which is issued to each processor as a joint federal-state permit. The permit requirements for the Maryland seafood industry include the following: solids removal by 20-mesh screens, prohibition of floating solids or foam in the effluent other than trace amounts, effluent pH in the range of 6.0 to 8.5, and disinfection of effluent with bacterial quality not to exceed a total coliform count of 70 MPN per 100 ml.

For Maryland 20-mesh static screens are considered to be fairly successful in meeting future treatment requirements. As Table 1 indicates, the hand shucked clam processors are now meeting all the 1977 and 1984 effluent guidelines. Since six of the 10 oyster processing plants are now meeting the 1977 and 1984 guidelines, it is believed
<table>
<thead>
<tr>
<th></th>
<th>No. of Plants Sampled</th>
<th>No. of Samples</th>
<th>BPCTA (1977)</th>
<th>BCT (1984)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>TSS</td>
<td>O&amp;G</td>
</tr>
<tr>
<td>Blue Crabs (conventional process)</td>
<td>6</td>
<td>74</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Non-Alaska Bottom Fish (conventional process)</td>
<td>2</td>
<td>10</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Atlantic Oysters (hand shucked)</td>
<td>6</td>
<td>76</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Soft Shell Clams (hand shucked)</td>
<td>4</td>
<td>40</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 1. Maryland seafood current ability to meet EPA BPCTA (1977) and BCT (1984) effluent guidelines.

that the other plants could meet the same guidelines simply by improved housekeeping and relatively minor modifications to the present screening system. Although the fish processors cannot meet the guidelines, both are scheduled to be served by municipal wastewater treatment systems in the near future. This leaves only the Maryland blue crab processors with the problem of meeting the 1984 guidelines. If the limitations are not raised, improved screening methods in conjunction with alternative treatment systems must be considered.

SOLIDS SEPARATION BY SCREENING

Physical Screening

Physical screening processes are defined as those processes containing elements which remove solids by virtue of physical restrictions at their surface and which have no appreciable thickness in the direction of the liquid flow. These restrictions may be due to the screening device itself or may be imparted by a thin layer of solids previously removed and deposited upon a relatively coarse substrate or fabric. Processes which fit this category are rotary screens, vibrating screens, ultrafiltration and diatomaceous earth filters, among others (3).

Microscreening

Microscreening has been a viable solids removal process for over twenty years in the area of municipal sanitation. Its use as a tertiary unit process for filtering secondary effluent dates back to the early 1950's when it was installed at the Luton Sewage Works in England. A microscreener consists of a rotating drum with a fine screen constituting its periphery. Feedwater enters the drum through the open end and passes radially through the screen with the deposition of solids on the inner surface of the screen. At the top of the drum, pressure jets of effluent water are directed onto the screen to remove the mat of deposited solids. The portion of the backwash stream which penetrates the screen and the dislodged solids are captured in a waste hopper and removed.

The weave and shape of individual fabric wires are such that they allow the water from the backwashing jets to penetrate and detach the solids mat which forms on the inside of the screen during its passage through the feed stream. Approximately 50% of the applied washwater actually penetrate the screen. The rest flows down the outer perimeter into the effluent compartment of the structure.

The removal efficiency of the unit is not entirely due to the small openings of the microscreens. The mat of trapped solids provides the fine filtration which is characteristic of the unit. Rotary screens which are similar in principle and appearance to microscreens, are available and generally more applicable for the removal of gross solids (Figure 1).
Figure 1. Typical rotary screen for wastewater processing.

Vibrating Screens

The vibrating screen (Figure 2) is a device which produces a rapid screen motion with one or more perforated or meshed surfaces for separating material according to size. Since the effectiveness of a vibrating screen depends on a rapid motion, they normally operate at speeds of 1,000 to 2,000 rpm with a horizontal motion of 0.03 to 0.13 inches.

The major functions of vibrating screens are:

- Agitation of materials retained on the screen such that the liquid and undersize particles can pass through.
- Movement of particles to prevent screen clogging.
- Distribution of the materials over the surface area of the screen to insure efficient screening.

Some of the advantages of the vibrating screen over the rotary in handling seafood waste are:

- The vibrating screen requires less floor space and less energy for operation.
- Spray water is not needed to wash particles from the screen cloth.
- The resurfacing cloth for a vibrating screen is less expensive than for a rotary screen and easier to install.
- Generally the capital investment is less for vibrating screens than for other powered screening systems.

Tangential Screens (Static) Hydrasieve

The more acceptable type of static fine screens for the seafood industry are tangential (Figure 3). Tangential screens have achieved wide acceptance in the industry due to their simplicity. Flow can be delivered to these devices by gravity or through pumping. As the water moves down the face of the screen, solids are retained on the screen while the wastewater passes through. Removed solids progress down the surface of the screen by gravity and are collected. Therefore, no moving parts or drive mechanisms are involved with the actual screening operation.

Tangential devices, generally, have flow capacities based on the upper third of the screen surface with the remaining two thirds provided for dewatering of the accumulated solids. On the first (top) slope of the screen most of the fluid is extracted from the bottom of the stream traveling at 25° from vertical. When the angle of the screen changes to 35°, some additional fluid is withdrawn and the mass of solids begins to roll down the screen surface. On the final slope of the screen, the solids will hesitate for drainage but are moved off the flat surface by displacement with oncoming material. Arrangement of the wires provides a flow pattern which results in a relatively non-clogging surface.

Some advantages of tangential screening over vibrating or rotary screens are:

- Minimum capital investment.
- Simple installation.
Figure 2. Vibrating screen.

Figure 3. Diagram showing path of wastewater screened by Hydrasieve.
No moving parts, noise, or safety problems.
No screens to puncture or warp.
Can accept wide variations in flow rate.

The delivery of wastewater to the screen headbox can be accomplished by pumps or gravity flow. The preferred approach is by gravity feed, but the use of centrifugal non-clog pumps is more common. Screen performance can be impaired as a result of the pulverizing action of the pumps on larger solids, thereby creating smaller particles that will clog the finer screens. These smaller particles can increase the waste loadings in terms of BOD$_5$, TSS, and oil and grease. Replacement of centrifugal pumps with positive displacement pumps may have a beneficial impact on effluent discharged to receiving waters or subsequent treatment processes (4).

The reduction of TSS will indicate the effectiveness of screening devices. Samples are taken at the screen headbox to determine influent characteristics and compare with effluent samples that have passed through the screening mesh surface. Removal efficiency is calculated by determining the difference between the two suspended solids levels. A comparison of tangential and rotating drum screens has shown that the removal of TSS to be comparable (4).

The National Marine Fisheries Service (NMFS) has investigated the relative screen performance for shrimp, salmon, tuna and bottom fish processing by comparing rotary and tangential devices with various size openings. The use of screens was shown to be applicable to several subcategories which are characteristic of the industry as shown in Table 2.

Bough and Perkins (1) have shown that screening and dry clean-up procedures have been quite successful in reducing the total waste load from shrimp processing plants. Table 3 indicates that dry clean-up procedures in conjunction with tangential screens reduced the BOD loading by 69%.

A system utilizing tangential screens will require less management than powered systems but more management than simple vertical screening systems. The following list of suggestions should result in an effective tangential screening system:

- Keep a replacement set of screens on hand to make cleaning easier.
- A schedule for cleaning screens should be established. The frequency of cleaning will be determined by observing the system.
- Assign a specific person to clean and maintain the screening system. Some type of rough screening (20 mesh) prior to the tangential screens will reduce problems with clogging.
- Use dry clean-up procedures prior to washdown.

CHEMICAL COAGULATION

Wastewaters contain many varieties of organic and inorganic suspended solids that must be removed in order to produce a high quality effluent.
<table>
<thead>
<tr>
<th>Species</th>
<th>Screen Type</th>
<th>Opening Size</th>
<th>Total Suspended Solids Removal (%)</th>
<th>No. of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmon</td>
<td>Tangential</td>
<td>0.010</td>
<td>9.0</td>
<td>1</td>
</tr>
<tr>
<td>Salmon</td>
<td>Tangential</td>
<td>0.014</td>
<td>18.6</td>
<td>1</td>
</tr>
<tr>
<td>Salmon²</td>
<td>Tangential</td>
<td>0.014</td>
<td>25.0</td>
<td>2</td>
</tr>
<tr>
<td>Salmon</td>
<td>Tangential</td>
<td>0.020</td>
<td>18.6</td>
<td>5</td>
</tr>
<tr>
<td>Salmon²</td>
<td>Tangential</td>
<td>0.030</td>
<td>25.6</td>
<td>3</td>
</tr>
<tr>
<td>Salmon</td>
<td>Rotary</td>
<td>0.010</td>
<td>15.4</td>
<td>2</td>
</tr>
<tr>
<td>Tuna</td>
<td>Tangential</td>
<td>0.010</td>
<td>1.2</td>
<td>1</td>
</tr>
<tr>
<td>Tuna</td>
<td>Tangential</td>
<td>0.020</td>
<td>25.8</td>
<td>6</td>
</tr>
<tr>
<td>Tuna</td>
<td>Rotary</td>
<td>0.020</td>
<td>12.6</td>
<td>2</td>
</tr>
<tr>
<td>Shrimp</td>
<td>Tangential</td>
<td>0.014</td>
<td>60.1</td>
<td>1</td>
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<td>Shrimp</td>
<td>Tangential</td>
<td>0.020</td>
<td>36.0</td>
<td>2</td>
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<tr>
<td>Shrimp</td>
<td>Tangential</td>
<td>0.040</td>
<td>37.9</td>
<td>1</td>
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<tr>
<td>Bottom</td>
<td>Tangential</td>
<td>0.020</td>
<td>8.8</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 2. Fine Screen performance relative to various process wastewaters.

2. Data collected over the entire processing day using composite samples. Note: Remaining data provided by NMFS-Seattle.
<table>
<thead>
<tr>
<th>Operation</th>
<th>Before Screen</th>
<th>After Screen</th>
<th>With Dry Clean-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processing</td>
<td>117&lt;sup&gt;3&lt;/sup&gt;</td>
<td>72</td>
<td>71</td>
</tr>
<tr>
<td>Clean-up</td>
<td>104</td>
<td>49</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
<td>121</td>
<td>92</td>
</tr>
</tbody>
</table>

Table 3. Effects of screening and dry clean-up practices on the BOD loading ratios from a breaded shrimp processing plant.

2. Effluent passed through hydrasieve screening which removed particles larger than 0.02 inches in diameter.
3. BOD loads in lbs/1000 shrimp processed.
Many factors affect the rates at which particles settle out of suspension. Particularly important is particle size. Small particles in the colloidal range will not settle out in a practical detention time. The chemical coagulants cause small particles to form larger particles and hasten sedimentation by electrical charge reduction, physical or chemical bridging or coagulant molecular chains between particles and by physical enmeshment of the particle. Coagulants used in wastewater treatment are alum, ferric chloride, ferric sulfate, and lime, to name a few. For each combination of coagulant and wastewater there is an optimum dosage of coagulant and optimum pH range for the reactions to occur. The addition of chemical coagulants prior to screening can significantly increase solids removal (Table 4).

INCLINED STATIC SCREENS

To determine the effectiveness of a simple inclined static screening system in conjunction with limited aeration, a research wastewater treatment system was installed and tested for one season (5). A description of the system and a preliminary evaluation of its effectiveness are presented below. The water flow pattern in the crab plant shown in Figure 4 indicates how the wastewater was generated. Water use records taken before and after the system was installed are summarized by the annual cycle graph, Figure 5. Water measurements in combination with raw product volume records were used to determine allowable pollutant concentrations for the plant.

In the direction of flow, the wastewater treatment components are a collection pit (including 40 and 60-mesh screens), sump, sump pump, aeration tank, effluent pump, and chlorination system. The collection pit was a concrete tank approximately 3 feet by 1.5 feet by 1.0 feet deep (Figure 6). The sump was a septic tank (1000 gallons) installed below grade and attached to existing discharge pipes. The aeration tank was an above-ground plastic lined swimming pool, 18.0 feet diameter, 4.0 feet deep. Air was supplied to agitate and aerate the wastewater with a simple holes-in-pipe distribution system placed on the bottom of the sump and pool. The source of air was a positive displacement rotary blower. The pumps were controlled automatically with float sensing devices.

Wastewater samples were collected before screening, after screening, sump, and aeration tank. The samples were transported on ice to the water quality laboratory and analyzed for BOD₅, TSS, and % organic residue. Observations of wastewater color, clarity and color were recorded. With an events recorder, the interval between sampling and last pumping was determined to indicate minimum residence time between sampling.

The water quality results for the system were averaged as shown in Tables 5, 6, and 7 and Figures 7, 8, 9, and 10. These values do not reflect any variations in minimum residence time or variations in temperature. There was a significant reduction in both BOD₅ and TSS across the inclined screens and after aeration. Despite the
<table>
<thead>
<tr>
<th>Operating Condition</th>
<th>BOD&lt;sub&gt;5&lt;/sub&gt;</th>
<th>TSS</th>
<th>OSG</th>
<th>COD</th>
<th>No. of Samples</th>
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</thead>
<tbody>
<tr>
<td>With Chemical Addition</td>
<td>49.8</td>
<td>62.1</td>
<td>60.3</td>
<td>42.2</td>
<td>5</td>
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<tr>
<td>Without Chemical Addition</td>
<td>16.1&lt;sup&gt;1&lt;/sup&gt;</td>
<td>34.6</td>
<td>14.9&lt;sup&gt;1&lt;/sup&gt;</td>
<td>23.4</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 4. Performance comparison for 165-mesh screen for treating salmon cannery waste with and without chemicals.<sup>2</sup>

Note: Data provided by NMFS-Seattle.
1. Determination based on two samples.
Figure 4. Water uses and flow pattern at blue crab processing plant in Maryland.
Figure 5. Daily water use for a blue crab processing plant.
Figure 6. Diagram showing inclined static screens installed at blue crab processing plant.
Table 5. Average TSS and percent reduction as a function of sampling station within the crab plant.

<table>
<thead>
<tr>
<th>Sampling Station</th>
<th>TSS (lbs/1,000 lbs)</th>
<th>% Reduction</th>
<th>No. of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Screen</td>
<td>5.20</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>After Screen</td>
<td>3.15</td>
<td>39</td>
<td>8</td>
</tr>
<tr>
<td>Sump</td>
<td>2.43</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Aeration Tank</td>
<td>1.94</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>Guidelines</td>
<td>0.75</td>
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</tbody>
</table>

Table 6. Average BOD₅ and percent reduction as a function of sampling station within the crab plant.

<table>
<thead>
<tr>
<th>Sampling Station</th>
<th>BOD₅ (lbs/1,000 lbs)</th>
<th>% Reduction</th>
<th>No. of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Screen</td>
<td>1.34</td>
<td>45</td>
<td>8</td>
</tr>
<tr>
<td>After Screen</td>
<td>0.74</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Sump</td>
<td>2.79</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Aeration Pool</td>
<td>0.85</td>
<td>70</td>
<td>4</td>
</tr>
<tr>
<td>Guidelines</td>
<td>0.25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7. Percent organic residue in the sample as a function of sampling station within the crab plant.

<table>
<thead>
<tr>
<th>Sampling Station</th>
<th>Organic Residue (%)</th>
<th>No. Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before Screen</td>
<td>70</td>
<td>1</td>
</tr>
<tr>
<td>After Screen</td>
<td>68</td>
<td>1</td>
</tr>
<tr>
<td>Sump</td>
<td>59</td>
<td>1</td>
</tr>
<tr>
<td>Aeration Tank</td>
<td>73</td>
<td>1</td>
</tr>
</tbody>
</table>
Figure 7. Average lbs. BOD/1000 lbs. crabs as a function of sampling within plant.
Figure 8. Average lbs. TSS/1000 lbs. and lbs. organic residue/1000 lbs. crabs as a function of sampling location within plant.
Figure 9. Average percent reduction in BOD and TSS for screening and aeration.
Figure 10. Average lbs. TSS/1000 lbs. crabs as a function of sampling location within plant.
significant reductions, both parameters significantly exceed the proposed EPA guidelines. The significant increase in BOD\textsubscript{5} in the sump as compared to the screened values results from the addition of retort wastewater to the system. Tests were also conducted to determine the percentage of organic versus inorganic residue in the TSS (Table 7, Figure 10).

Evaluation of the treatment system for factors other than water quality included odor, appearance, and management. The appearance of both the sump and aeration tank was described as cloudy gray but not unpleasant. Observations of the system suggest that excellent management practices are required to optimize system performance.

CONCLUSIONS

Although screening can result in a significant reduction in waste loading, considerable thought must be given to the selection of the device for a specific effluent characterization. Installation and proper design is paramount in order to achieve the proper screening performance with the least operational and maintenance problems. Sizing and selection of the equipment must be based on the specific wastewater characteristics. In view of the size of capital investment, simplicity, and general industry acceptance, screening has been shown to be instrumental in the reduction of waste loading and reduction of treatment cost.

Results of the experimental wastewater treatment system indicate a significant reduction in both BOD\textsubscript{5} and TSS utilizing inclined static screens. In addition, significant additional amounts of BOD\textsubscript{5} and TSS were removed by the aeration system. However, neither BOD\textsubscript{5} nor TSS reduction are sufficient to meet the original 1984 guidelines. Results also indicate that a significant amount of the TSS in the wastewater is inorganic residue, therefore does not contribute to the BOD\textsubscript{5} loading in the estuary.

REFERENCES


CLOSED LOOP PROCESS FLUID SYSTEM *

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Blue Channel Corporation  
P. O. Box 128  
Port Royal, SC 29938

The Blue Channel Corporation with assistance from the Food Science Department at Clemson University is conducting preliminary investigations of a new close-loop fluid system for treating process water used in the extraction of blue crab meat. The closed-loop system is simply a series of screens and progressively finer filters which cleanse the process water before recycling for further processing. The process water is the brine solution used in the Harris Machine for separating crab meat from the shell. In the proper brine, the crushed shell sinks and the meat is floated onto a conveyor belt for further inspection. During the brine separation process, crab meat proteins are extracted and saturate the brine at approximately two percent protein. Preliminary results indicate the closed-loop system can remove most particulates, clarifies the brine, and reduces microbial counts by $10^2$-$10^3$. The protein concentration in the brine remains near saturation and appears to prevent continued protein extraction from subsequent batches of crab meat. After processing, the brine tanks are emptied and cleaned, and the recycled brine is stored in refrigeration until further processing. Additional brine is added when needed. These initial results indicate the closed-loop system has potential as an in-plant modification to reduce waste loads in the effluent and to conserve brine solutions.

* This abstract was prepared from the authors recorded presentation by the editor to serve in the absence of a submitted paper.
RECOVERY OF BY PRODUCTS FROM SEAFOOD PROCESSING WASTES

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Government regulation of effluents from food processing plants has provided incentive to recover and utilize waste materials as one way of reducing effluents at the source. The recovered material may justify the removal process itself. Foam fractionation was used to remove potential products from effluents and implant streams. Products include enzymes, surfactants, and proteins. The surf clam and quahog processing industry will be used as an example.

INTRODUCTION

The seafood processing industry as well as the developing aquaculture systems have been confronted with the need for establishing waste water discharge control procedures in compliance with planned environmental protection regulations. There is also the need for a practical method for reusing water whenever possible.

Foaming is a common sight in the seafood industry as a result of the presence of natural surfactant materials. Foam separation is a very effective method of solid-liquid separation that has been used in non-food and water treatment areas for more than a century. Foam separation has only recently become important in waste treatment of industrial effluents. Dissolved air flotation (DAF) is related but not identical to traditional flotation processes. DAF and chemical coagulation were used by the EPA as a base for the development of the 1983 effluent limitations for shrimp processing wastes (8).

Microgas dispersions are collections of small bubbles (1-50 micrometers in diameter) linked together in an aqueous medium. Microgas dispersions (MCD) were first produced by Sebba (6) utilizing a modified venturi device. Cyclones were also used by Shaler and McLean and Shea and Barnett (7). Both the modified venturi and the cyclone provide a point for introduction of a gas into a stream of high velocity and low pressure. If the stream contains a small quantity of an appropriate surface active agent, a dispersion is formed which includes characteristic MCD bubbles. These micron sized bubbles retain their integrity, despite repeated circulation to remove undesirable bubbles, thus providing a high ratio of area per volume of bubbles charged to a flotation column. The matrix of MCD bubbles removes contaminants from a solution during its
rise to the surface of a column. Unlike traditional foams, MGD bubbles can be pumped from a generator to a column or tank for use in flotation operations (2, 5).

MATERIALS AND METHODS

The generator used for the production of MGD dispersions is shown in Figure 1. It is based on the device first used by Sebba (6). The recirculation of the surfactant solution and dispersion mixture is critical to the formation of a stable MGD. Referring to Figure 1, the liquid (A) enters the constricting region (B). Air under slight positive pressure for control enters the gap (C) and becomes entrained to form the MGD dispersion. The air pressure at (D) is used to maintain the proper level of the liquid phase in the generator.

Support apparatus, shown in Figure 2, was incorporated to maintain and monitor steady state conditions. The operation of this system was as follows: surfactant solution in reservoir (A) was fed to the pump (B) and then to the generator at (F) to form the MGD foam. The dispersion was withdrawn on demand by opening valve (D). Batch flotations were carried out in a cylindrical glass column 60 inches in height and 7 inches in inner diameter.

The column was filled with a liter of the solution to be treated and pH adjusted if necessary. An initial sample taken of both the liquid remaining and the foam after the dispersion had risen to the surface of the column. Dilution factor was used as an indication of the amount of dispersion added to the untreated solution to affect separation. Percent removal was used as an indication of the extent of removal. Foam quality, a measure of the air entrained in the dispersion, was determined by allowing the foam to settle and measuring the remaining liquid. Foam quality was the ratio of original volume-liquid volume to the original volume.

The dispersions were bubbled into the system for 12-30 seconds. Rise time was about 4-5 minutes.

Effluents and process streams were collected from local commercial clam processing plants. The composition of clam waste is shown in Table 1. The pH was 6.5 for fresh waste water. Other streams studied included the retort liquor and the debellying wash water.

Sodium dodecylbenzenesulfonate or ethylhexadecyl dimethylammonium bromide were used to prepare MGD foams using synthetic surfactants. Foam floated clam waste water provided a surfactant material suitable for producing MGD foams with a natural surfactant.
Fig. 1. MGD Generator
### TABLE 1. COMPOSITION OF CLAM WASTE WATER AND FOAM

<table>
<thead>
<tr>
<th></th>
<th>Whole Waste Water*</th>
<th>Foam</th>
<th>Freeze Dried</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>1.1-1.6 mg/ml</td>
<td>1.8-4.9 mg/ml</td>
<td>52%</td>
</tr>
<tr>
<td>Lipids</td>
<td>0.65 mg/ml</td>
<td>1.7</td>
<td>7%</td>
</tr>
<tr>
<td>Sugar</td>
<td>5.6 μg/ml</td>
<td>10</td>
<td>--</td>
</tr>
</tbody>
</table>

*0.5/0.7% Solids
RESULTS AND DISCUSSION

Viscera from the seafood processing has proven useful for broiler rations (7). Waste water was also dehydrated to prepare a clam flavor concentrate by boiling and then freeze-drying, ultrafiltering, spray drying or drum drying (3). Although not yet tested for feed or clam flavoring agent, a clam waste water treated by the MGD process did yield potentially valuable products. The clam waste water had the composition shown in Table 1. The composition of a wet, but drained foam and a freeze-dried foam are also shown.

By running clam processing waste water through a foaming unit such as the MGD generator, without the addition of a synthetic surfactant, a foam was produced which after freeze-drying could be used to reform an MGD dispersion. As shown in Figure 3, both the original clam waste water and the freeze-dried material produced similar foams, based on foam quality.

The freeze-dried foam, which must be considered a surfactant, was used to remove fish waste solids from an aquaculture system. Complete removal of solids, originally present at levels of 0.2-5 ml/l were achieved, as shown in Figure 4. The full range of foam quality shown could be obtained by varying the pH or by the foam formation time.

Of particular interest, is the composition of the protein obtained from clam waste waters by the flotation method. Bang et al. (4) using an acid precipitation technique, obtained a rather poor protein according to FAO standards. An equivalent or better distribution was obtained for protein from clam processing waste waters separated by MGD flotation. Comparisons are not reported because they must be confirmed, but isolation of protein from individual waste streams before merging with other process line effluents appears to provide different amino acid patterns.

Chitosan, a by-product of seafood waste processing was used as a chelating agent for the MGD flotation process in order to remove metals from metal plating waste waters. It was planned to use chitosan as a complexing agent for the seafood protein as well, assuming the recovered protein would be used as a feed. However, due to the ease of removal of the protein from seafood waste stream, and its potential as a surfactant, a study of complexing and cross-linking agents was not carried out.

CONCLUSIONS

A process has been presented which can be used to remove proteins from seafood processing waste. Besides possible use of the protein for a feed, other products were recovered, including surfactants. Further work in this area is underway, with particular emphasis on isolation of specialty products and separate treatment of key implant streams.
FIGURE 3. Effect of pH of Clam Waste on the Quality of MGD Dispersion.
REFERENCES


MUNICIPAL DISCHARGE - REGULATIONS AND SURCHARGES

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INTRODUCTION

Beck (5) has explained how the Environmental Protection Agency (EPA) plans to assure that industrial users of publically owned treatment works (POTWs) pay the costs for treating their discharges. Beck concluded that EPA has evidence that municipal dischargers enjoy a degree of subsidy when compared with direct dischargers. This evidence includes the following kinds of relief: (i) financial burden of bearing the full market cost of money for treatment plant expenditures, (ii) financial burden of raising capital for treatment facilities, and (iii) substantial management, administrative and legal costs of operation and maintenance. Beck assumes that municipal systems can be built cheaper than private systems because of grants and subsidies. However, the management of many larger food plants are now finding that they can build and finance waste treatment systems cheaper than governmental units. Massey and Dunlap (10) have examined the effects on industries of federal construction grants.

PL 92-500 and PL 95-217 have given EPA the authority to develop regulations that will increase costs for seafood plants discharging to municipal systems. The requirements for industrial cost recovery, user charges and sewer use ordinances will surely affect seafood plants. Probably less than 20% of the seafood plants now discharge to municipal systems. However, with developing regulations and technologies, the future may find 90% of the seafood plants discharging to municipal systems.

The sewer use ordinance is an instrument setting forth rules and regulations governing the use of the public sewer system. In most cases, the industrial cost recovery and surcharges (user charges) may be a part of this instrument.

Seafood processors must ask themselves what is happening now and what will happen in the near future (6). Although charges for industrial wastes began as early as 1907 (7), as late as 1969 only about 10% of United States municipalities collected these charges (1). Most municipalities do not have a stringent sewer
use ordinance that is strictly enforced. Federal pressure and encouragement will surely force most municipalities to draft such an ordinance. Industrial dischargers must ask how they can get a reasonable ordinance that is mutually beneficial to the discharger and the municipality. The city system must recover its cost and be protected from toxic discharges. Unless the seafood processor has an outlet for its effluent at a fair cost, the plant cannot continue to be a productive economic influence in the community.

PL 92-500 and EPA require that municipalities institute industrial cost recovery, a system of user charges, and have a sewer use ordinance if they obtain federal funds for water or wastewater facilities (4). However, one must look carefully at exactly what is required. The initial requirements were modified substantially by PL 95-217.

DISCUSSION

The seafood industry must assist in the development of a "practical and sound regulatory ordinance fitted to local conditions" (3). The minimum number of restrictions that will protect the municipal system with minimal costs will benefit both. Any restrictions should be technically sound and rigidly enforced. Lenvin (9) related how an ordinance helped one system with enforcement.

The seafood industry is perhaps unique in that many of the seafood processing plants, especially the smaller ones, are located on docks over the water without the benefit of city sewage. However, many of the these areas will receive municipal sewage facilities in the next several years.

Sewer use ordinances are largely a matter of local and state jurisdiction. However, EPA regulations contain specific requirements for a sewer use ordinance if federal monies are received for that system. Specific requirements include:

(i) Prohibit new connections from inflow sources into sanitary sewers.

(ii) Insure that new sewers and connections are properly designed and constructed.

(iii) User charge system must be incorporated providing an equitable system of cost recovery, and

(iv) Users shall be required to immediately notify waste treatment plant of any unusual discharge (flow or waste parameters).

(v) Pretreatment of wastewaters required if they would be detrimental to treatment systems or personnel.
A number of specific requirements such as: (i) temperature less than 100°F, (ii) FOG less than 100 mg/l, (iii) BOD₅ less than 2000 mg/l, and (iv) pH less than 9.0 often appear in sewer use ordinances. These and others can present specific problems for any food plants. Most ordinances are a composite of several "model ordinances" including the following:

(i) WPCF MOP No. 3 - Regulation of Sewer Use - 1975 (3)
(ii) APWA - Special Report No. 23 - Guidelines for Drafting a Municipal Ordinance on Industrial Waste Regulations and Surcharges - 1971 (7)
(iii) CWPA Model Wastewater Discharge Ordinance (2).

The key to industrial input appears to be contact with the body which passes the ordinance. Most ordinances are passed relying on the advice of technical and legal consultants for the municipality. Leaders often have little understanding of the serious consequences of their actions. Industry must help these leaders realize the impact of overly stringent requirements.

Review of Proposed Sewer Use Ordinance

The best and perhaps the only time that industry can get input into a sewer use ordinance is during its development by the city council or the sewer district board, i.e., the governing body. Normally public hearings are held but everyone must be most observant for the hearing notice.

The study of a proposed sewer use ordinance requires time and expertise. However, anyone can read and understand such an ordinance with a little extra effort. The key parts of a sewer use ordinance include the following:

. Preamble - Whereas
. Definitions
. Use of sewers - Required
  - Prohibitions
  - Limitations
. Power and authority of inspectors
. Surchage - Sampling, analysis and formula
. Enforcement and penalties
. Review process
. Effective date

A description of some of these and other key parts can be found in Table 1. Each word and sentence can have a real meaning. One should not only ask the engineer or utilities director to explain
<table>
<thead>
<tr>
<th>Definitions</th>
<th>All key words should be included in the definitions. For instance: Does representative sample mean a grab sample, an average of 4 grab samples at 15 minute intervals or a 24 hour, proportional composit sample?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resampling</td>
<td>Does the ordinance contain the specifics of resampling if industry objects to a particular sample? What are the costs of the resampling?</td>
</tr>
<tr>
<td>Mock Bill</td>
<td>A clause in a new ordinance can require the city to sample for a period of 6-12 months to perfect their techniques while billing you on a &quot;mock bill&quot; which does not have to be paid. If there are high charges, you have time to institute in-plant changes or pretreatment.</td>
</tr>
<tr>
<td>Appeal Procedure</td>
<td>State law probably requires an appeal if an action is considered unreasonable or unjust. However, if a procedure and time schedule for appeal is not specified, an industry may find themselves without water and sewer for an extended period while court action is followed.</td>
</tr>
<tr>
<td>Responsible Person</td>
<td>The individual(s) responsible for interpretation and enforcement should be specified. Everyone should be aware of any interpretable decisions that might be made.</td>
</tr>
<tr>
<td>Representative Samples</td>
<td>What method(s) is specified for sampling? Is the sample proportional to flow? What is the frequency of the samples? Does each sample period give a set of characteristics or are sample periods averaged to determine wastewater characteristics?</td>
</tr>
<tr>
<td>Waiver (Special Agreement)</td>
<td>Does the ordinance have a special clause allowing a contract or agreement between industry and the municipality to allow otherwise prohibited flows or concentrations? Who okays such a pact? Will you be able to get one approved?</td>
</tr>
<tr>
<td>Effluent Volume</td>
<td>There should be a clause allowing plant records or metering or engineering studies to establish a percentage of metered water which actually leaves in the sanitary sewer which is sampled. Thus a &quot;fair&quot; wastewater load can be established.</td>
</tr>
<tr>
<td>Pretreatment</td>
<td>When, by whom and how is pretreatment or flow equilization required?</td>
</tr>
</tbody>
</table>

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what they meant to say but insist that the ordinance have language that clearly states the same. For example, does "sample manhole" refer to the manhole in the street or does it refer to a specially constructed box with a weir, flow recorder, sampler and sample refrigerator that might cost more than $25,000? Specific problems seen in ordinances for seafood plants have included:

- Holding tanks or flow equilization being required - where are you going to put the tank?
- Control manhole or sampling facility required.
- Limitations or prohibitions on BOD, FOG, etc.
- Surcharge for industrial users only with other contributing commercial customers not charged equally.

Specific review points when considering a sewer use ordinance should include the following: (i) What's it going to cost?, (ii) Are there defacto or real limitations prohibiting discharge?, (iii) Who handles complaints and reviews decisions?, and (iv) Can you object to unreasonable bills?

Seafood plant managers must carefully consider all limitations and restrictions in a sewer use ordinance. In many cases, some sections of the ordinance may not be initially enforced. Assume that each limitation and restriction will be enforced at some time in the future. Remember that the current city engineer might leave tomorrow. Where is his promise that he does not plan to enforce the maximum FOG restriction? If it is not written, it is not the law!

If the ordinance requires a permit to connect to the municipal system, review carefully the costs and procedures. Williams (14) has described a permit system that was developed by a municipal-industry committee.

Municipal Charges

Municipal charges for industrial plants include water, sewer, surcharge (user charge) and industrial cost recovery. Most municipalities compute water and sewage charges as follows:

**Water ...**

Based on water consumption metered into the plant. Often on a declining block scale so that the cost/unit decreases as you use more water. Note that the bill is usually in hundreds of cubic feet (1 cu. ft. = 7.48 gal.). Cost usually ranges from $0.10 to $1.00 per 100 gallons.

**Sewer Charge ...**

Based on computed water charge and usually represents 10 to 200% of the water bill. The most common figure in the Southeast is 100%.
Surcharge ... Based most often on metered water consumption and a parameter(s) measured in the wastewater. The most common factor is $\text{BOD}_5$ and usually charged at a rate of $\$0.10$ to $\$2.00$ per pound for those pounds in excess of domestic sewage. Similarly, the suspended solids (TSS) load is also used. A hydraulic load charge is sometimes included and is often used as a "demand charge" especially for seasonal operations.

Industrial Cost Recovery ... Recovery by the grantee from the industrial users of a treatment works of the grant amount allocable to the treatment of wastes from such users pursuant to section 204 (b) of the Act and this subpart. (Note that ICR is under review and there may be some changes)

Surcharges are often included in a sewer use ordinance. However, they may be included in a separate ordinance. Surcharges are usually passed because of local government's problems such as: (i) Waste treatment costs are rising, (ii) More treatment is being required, (iii) Loads are often increasing, (iv) Property tax is already overburdened, or (v) Because the municipality has received federal funds and is required to institute user charges. Washburn (13) critiqued user charges. Any food plant should keep careful records about their surcharge bill. A plant should keep up with the following information in respect to their surcharge bills:

- For which characteristics (BOD, flow, TSS) are you paying?
- How much do your monthly charges fluctuate?
- Does your flow and effluent concentration vary widely?
- How does your bill compare with similar plants?

Careful attention should be paid to the methods the city uses for calculating the surcharge, sampling and sample analysis, flow measurement and the accuracy of the results. A surcharge calculation involves flow measurement, sampling, sample preservation, sample analysis, laboratory calculation, and surcharge calculation. An error in any of these will cause an error in the surcharge bill.

A sample bill for a shrimp plant is shown in Table 2. Sewer surcharges can be reduced by modifying the charging system (11), pretreatment and/or management action (8). A poorly managed shrimp plant with little control of water use, without dry clean-up procedures and without final effluent screening may pay 500% more than a well managed plant.
Table 2. Monthly Costs for Municipal Water and Wastewater Service for Shrimp Plant

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good Management of Water Use and Wastes</td>
<td></td>
</tr>
<tr>
<td><strong>Flow = 4311 gal. BOD$_5$ = 6.7 lb. and SS = 3.2 lb. per 1000 lb. shrimp processed</strong></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>$ 379</td>
</tr>
<tr>
<td>Sewer</td>
<td>379</td>
</tr>
<tr>
<td>Surcharge</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$ 758</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor Management of Water Use and Wastes</td>
<td></td>
</tr>
<tr>
<td><strong>Flow = 9111 gal., BOD$_5$ = 100.4 lb. and SS = 39.8 lb. per 1000 lb. shrimp processed</strong></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>$ 802</td>
</tr>
<tr>
<td>Sewer</td>
<td>802</td>
</tr>
<tr>
<td>Surcharge</td>
<td>2024</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$3628</td>
</tr>
</tbody>
</table>

Calculated Using:

(a) 22 day month
(b) Water cost $0.40/1000 gal.
(c) Sewer cost = 100% water
(d) Surcharge $90/1000 lb. BOD$_5$*  
              90/1000 lb. SS*
(e) Processing 10,000 lb./day of shrimp

* (In excess of 250 mg/l)

**Note - Industrial Cost Recovery Not Included**
The seafood industry is affected by surcharges and sewer use ordinances because for health and sanitation, much cleaning and washing results in large amounts of organic wastes which equate to BOD₅. Also, many seafood wastewaters contain fat which is forbidden above certain levels in most ordinances. Further, much of the raw material is wasted in seafood processing. If this wasted raw material is not recovered for by-products, problems will develop.

The legal field of sewer use ordinance making is complex and ill reported. Challenges are usually settled out of court and legal records and precedents have not been established. The best defense to a badly drafted sewer use ordinance is a good lawyer and an open-minded body responsible for voting on the same. Industries faced with bad ordinances must rally their forces and present a united front.

CONCLUSIONS

A serious and detailed legal study should be made of sewer use ordinances for the seafood industry. Technical input is required if this study is to be a success. The 1975 revision of WDP No. 3, (WPCF) appears to have much technical input, but legal questions may remain unanswered. Also, recommendations concerning industrial input and assistance are largely ignored.

A pact with the city fathers allowing specific exemption for a seafood plant's wastes is a realistic alternative if an ordinance is in existence with a clause for such a pact (12). But, a seafood processor should get the best technical and legal advice before doing this. For example, exemptions could be granted for wastewaters with BOD₅ or FOG levels exceeding sewer use limitations.

In conclusion, almost all seafood plants will probably face the issues discussed herein within the next several years. The seafood industry must plan for these most serious negotiations. Managers must be alert to any indication that a sewer use ordinance is being developed or revised by their municipal system. This will take place whenever systems are modified, enlarged or replaced. EPA regulations for toxics, safe drinking water and pretreatment should also be reviewed for possible affects of municipal discharge regulations.
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3. ANON. 1975a. Regulation of Sewer Use. WPCF Manual of Practice No. 3, Water Pollution Control Federation, Washington, D. C.


