WHAT DO I NEED TO KNOW ABOUT GETTING A PERMIT TO DISCHARGE SEAFOOD PROCESSING WASTES IN ALASKA?

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ABSTRACT

It is common knowledge that the seafood industry is a major factor in the health of the Alaskan economy. Many seafood processing facilities have been in existence since the 1950s. However, aside from canning, the nature of processing has changed dramatically. This change results from the shift to bottomfish processing after the decline of the shrimp and crab harvest.

The emphasis on bottom fishing is changing the face of the seafood industry in Alaska. Bottomfish such as cod and pollock are in popular demand. The cod is frequently made into fillets, resulting in about 80% waste. The pollock is often made into surimi, also resulting in about 80% waste. The disposal of “billions of pounds of protein” in accordance with the federal and state regulations requires a well designed waste-handling system. This translates into a significant commitment of time and money by the seafood processor. It follows that if money can be made by further utilizing the resource, then that is the preferable course of action to simply dumping the unprocessed waste back into the water. Hence, there has been an increased interest in fish meal plants recently, especially since the white meat of the cod and pollock make a high-value meal.

Many of the companies that utilize the by-product are large processing vessels which operate at sea. These companies are able to obtain coverage under the “Authorization to Discharge Under the National Pollutant Discharge Elimination System for Alaskan Seafood Processors” general discharge permit (the Seafood GP) for disposal of their waste water. Shore-based facilities may also be able to obtain coverage under the general permit, but many require an individual permit. Both general permits and individual permits are good for a maximum period of five years.

INTRODUCTION

Currently, there are about 325 permits allowing seafood processors to discharge waste water in Alaska. Of those, five shore-based, meal-making facilities are covered by individual permits and at least a dozen meal plants on board processing vessels are covered by the General Permit for Alaskan Seafood Processors. The EPA’s Operations Office in Anchorage has seen an increased interest in new processing facilities, which include meal plants to be located in Dutch Harbor. I have also had one inquiry about requirements for obtaining a permit to discharge waste water from a new meal plant in Kodiak, a company not already doing business there. The purpose of the following paper is to provide prospective applicants with an understanding of the permitting program and its requirements.

ABBREVIATED HISTORY OF THE WATER POLLUTION CONTROL REGULATIONS

The Rivers and Harbors Act of 1899

The root of the water pollution control regulations is the 1899 Rivers and Harbors Act, which was passed for the protection and preservation of navigable waters of the United States. It states in Section 13, “That it shall not be lawful to throw, discharge, or deposit, or cause, suffer, or procure to be thrown, discharged, or deposited either from or out of any ship, barge, or other floating craft of any kind, or from the shore, wharf, manufacturing establishment, or mill of any kind, any refuse matter of any kind or description whatever other than that flowing from streets and sewers and passing therefrom in a liquid state, into any navigable water of the United States, or into any tributary of any navigable water from which the same shall float or be washed into such navigable water; and it shall not be lawful to deposit, or cause, suffer, or procure to be deposited material of any kind in any place on the bank on any tributary of any navigable water, where same shall be liable to be washed into such navigable water, either by
ordinary or high tides, or by storms or floods, or otherwise, whereby navigation shall or may be impeded or obstructed..." The sentence is finished with a description of lawful deposits in connection with public works and provision for authorization to grant discharge permits.

The Water Pollution Control Act of 1948

The Rivers and Harbors Act was a start at limiting pollution into the waters of the United States, but it did not go far enough. Furthermore, less than a dozen permits were issued under that act. The pressure mounted on Congress to help the states control the growing pollution. The first comprehensive statement of federal interest in, and financial commitment to, clean water programs came from the Water Pollution Control Act of 1948. The responsibility for carrying out its provisions fell to the surgeon general of the United States Public Health Service, and his power of enforcement was limited to problems involving "interstate waters... which endangers the health or welfare of persons in a state other than that in which the discharge originates, and is... declared to be a public nuisance."

The Water Quality Act of 1965

In 1965 the Water Quality Act initiated the development of water quality standards for interstate and coastal waters. While this enabled the determination of pollution, enforcement was a problem. It had to be shown the wastes discharged reduced the quality of the water below established standards (some of which were nonexistent and some were not specific), or that health and welfare was endangered.

The Federal Water Pollution Control Act Amendments of 1972

In order to establish legislation effective in reducing or eliminating the nation’s water pollution problems, the Federal Water Pollution Control Act Amendments of 1972 was passed. It was a turning point and laid the foundation for subsequent legislation via the following national policies:

1. No one has the right to pollute the navigable waters of the United States.
2. Permits shall limit the composition of a discharge and the concentrations of the pollutants in it.
3. Some permit conditions require the best controls technology can produce, regardless of the receiving water’s ability to purify itself naturally.
4. Any limits or control higher than the minimum federal requirements must be based on receiving water quality.

The passage of the Federal Water Pollution Control Act Amendments essentially established the National Pollutant Discharge Elimination System (NPDES) program. It allowed the federal government, through EPA, to assume the dominant role in directing water pollution control programs across the country. Its well-known goals, listed in Section 101 (a), were to:

1. Eliminate the discharge of pollutants into navigable waters by 1985, and
2. Achieve an interim water quality level that would protect fish, shellfish, and wildlife while providing for recreation in and on the water wherever attainable.

In addition, Section 101 (b) made it a policy to preserve the states’ primary responsibility to meet these goals. Further sections describe how this will be done, including the state’s certification requirement, Section 401; and the mechanisms by which the state can obtain full administration of the permit program, 402 (b).

The act required EPA to issue permits to every point source discharger in the country by December 31, 1974. Thus, the “first round” of permits was issued in 1973 and expired in 1978. We are currently in the “fourth round” of permit issuances. Since the turning point, additional amendments have been passed to further reduce the effects of pollution. The result of adjustments to the regulations is a permitting approach which utilizes a combination of technology-based and water quality-based tools to control the pollution, and permits that are often 30 pages long.

THE LEGISLATION BEHIND THE PERMITS

Sections 301 and 402 of the Federal Water Pollution Control Act as amended by the Clean Water Act of 1977.

The requirement, authorization, and general guidance for discharge permits is referred to in the title of a discharge permit. The permit is titled:

“Authorization To Discharge Under the National Pollutant Discharge Elimination System”

In compliance with the provisions of the Federal Water Pollution Control Act, as amended. (33 U.S.C. 1251 et seq.; the “Act”),

[Your Company]

is authorized to discharge from a facility located in [Somewhere,] Alaska

to receiving waters named [Beautiful Bay]
in accordance with discharge point(s), effluent limitations, monitoring requirements and other conditions set forth herein.

Section 301 of the act says, "Except as in compliance with this section and sections 302, 306, 307, 318, 402, and 404 of this Act, the discharge of any pollutant by any person shall be unlawful."

We will focus on Section 402 of the act which is the NPDES program. The other sections referenced are Water Quality Related Effluent Limitations, National Standards of Performance (for various industry categories), Toxic and Pretreatment Standards, Aquaculture, and Permits for Dredged or Fill Material.

NPDES

Section 402 of the Clean Water Act states all "point sources" "discharging pollutants" into "waters of the states" must obtain an NPDES permit from EPA or an approved state. Waters of the state basically means anything that is wet or may get wet! An approved state is one which has been granted the authority by EPA to administer the NPDES program in that state. A permit can be either an individual permit or a general permit.

The General Permit

"Authorization to Discharge Under the National Pollutant Discharge Elimination System for Alaskan Seafood Processors." EPA has authority to issue a general permit under certain parameters.

The Seafood GP is a grind and discharge permit and is applicable throughout the state except in Dutch Harbor-Unalaska, Akutan, Kodiak, and the Kenai, Kasilof, and Alsek rivers (previously excluded also Cordova, Petersburg, Finger Bay in Adak, and Anchorage area). In some cases, a processor may receive a waiver to operate in Unalaska Bay or Akutan Harbor.

Other exceptions from the Seafood GP are:

1. Discharges into area of concern, such as areas where the water depth is less than 42 feet, that are likely to have poor flushing.
2. Discharges within one-half mile of area of special concern.
3. Discharges to fresh water in the vicinity of drinking water sources.
4. Discharges to lakes.
5. Minor (less than 1,000 pounds) discharges at sea.

The following are the Seafood GP criteria:

1. Same geographic area warranting similar pollution control measures.
2. Involve substantially similar operations.
3. Discharge same types of wastes.
4. Require similar monitoring.
5. Director feels they are more appropriately controlled this way.

The Individual Permit

An individual permit is issued to a "person," rather than a category of discharges, and authorizes the discharge into water. In cases where a general permit is not applicable an individual permit will be written. "Person" means an individual, association, partnership, corporation, municipality, state or federal agency, or agent or employee thereof.

There are two types of facilities requiring an individual permit:

1. Existing source, i.e., expansion of an existing meal plant such as Ayleska Seafoods, Inc. in Unalaska.
2. New source, i.e., "its processes are substantially independent of an existing source at the same site" (40 CFR 122.29) such as Westward Seafoods, Inc. in Captains Bay or Trident Seafoods in Akutan Harbor.

THE APPLICATION PROCESS

Before proceeding, make sure your facility cannot be covered by the Seafood GP. It is the easiest permit to acquire. However, if you are a shore-based meal plant located in a processing center such as Dutch Harbor, you will need an individual permit.

The initial application is in three parts and must be submitted 6–12 months in advance, though 12–18 months in advance is preferable. The three parts are:

1. The State Coastal Project Questionnaire;
2. The EPA Application Form 1, General Information to the Seattle EPA Region 10 Office (EPA Form 3510-1) and;
3. Existing source, the EPA Application Form 2C, Wastewater Discharge Information (EPA Form 3510-2C); or new source, the EPA Application Form 2D, New Sources and New Discharges: Application for Permit to Discharge Process Wastewater (EPA Form 3510-2D).

The following actions result from the application package:
1. Whether you are an existing source or a new source, the following actions will result upon receipt of the application package. Your submittal of the Coastal Project Questionnaire to the State of Alaska’s Division of Governmental Coordination (DGC) sets the wheels in motion to:

A. Identify permits required by the state resources agencies as well as the federal agencies, and

B. Determine the project’s consistency with the Alaska Coastal Management Program.

The DGC reviews your project for consistency with the state’s Coastal Zone Management Program. If you are an existing facility this questionnaire will probably be a mere formality.

2. After EPA has received the application package you will receive a form letter stating whether or not your application package was complete: your status as a major or minor discharger; the permit action, i.e., issuance, re-issuance, or modification; and the permit processing decision which will give you a general idea of the processing schedule. Shortly thereafter, a priority status will be assigned to your permit as well as a writer in EPA’s Region 10 office to draft the permit.

At the time of public notice of the final draft permit, EPA initiates the state certification actions. If the Alaska Department of Environmental Conservation (DEC) concurs with the permit as written, then the state issues a Certificate of Reasonable Assurance that the permitted discharge(s) will comply with the appropriate sections of the Clean Water Act, as required by Section 401. Thus, the certification is referred to as the “State’s 401 Cert.”

If the state concurs with permitting the discharge, but feels additional requirements are necessary in order to certify the permit, stipulations will be added to the certification that become part of the permit. It should be noted that if your company plans to discharge in an area of marginal flushing capabilities or the nature of your discharge is such that you may require a mixing zone in order to comply with the foreseeable permit limitations, then it would behoove you to contact the regional DEC office as soon as possible—before a lot of money is spent on consulting fees for plant design and application preparation.

3. If you are a new source, there are additional considerations. First, the Coastal Project Questionnaire may indicate the need to coordinate with the Alaska Department of Natural Resources (DNR) if state tideland leasing is required, or the U.S. Army Corps of Engineers (COE) if dredge and fill is necessary. The questionnaire may also trigger strict local-area requirements if the project is located in an Area Meriting Special Attention (AMSA), e.g., Kenai.

A new source necessitates that an environmental assessment (EA) be done to determine the potential impacts of the project’s alternatives on the environment. When the regional administrator has determined the facility is a new source, a public notice shall be issued to that effect, which includes a statement that the applicant must comply with the environmental review requirements of the National Environmental Policy Act (NEPA) as set out in 40 CFR 6.600 et seq. [40 CFR 122.21(e)]. The EA will require a lot of information before either a Finding of No Significant Impact (FONSI) or determination of the need for an Environmental Impact Statement (EIS) can be made.

**TECHNICAL REQUIREMENTS **
**AND TIPS TO MINIMIZE THE PAIN OF **
**THE PERMITTING PROCESS**

**Tips**

To obtain a discharge permit for either an existing source or a new source, it is important to submit a complete application. Include all the information you have to clearly identify and quantify the various waste streams. Include the attachments such as water use diagram and the topographic and bathymetric map. Also, include the State Coastal Zone Questionnaire in your packet to EPA.

Remember, if you are likely to be considered a new source, an environmental assessment will be required in order to comply with the NEPA regulations. At this point, you may need to hire a consultant, unless you’ve already retained one to help locate a suitable site. The more information and the better the information you provide to EPA, the sooner your EA will be completed.

**Effluent Limitations Guidelines**

The effluent limitations are arrived at by referring to the effluent limitations guidelines for your particular category, which for seafood processors is found in 40 CFR 408. The new source performance standards apply to all facilities for which national standards of performance have been established, the canned and preserved seafood category being one of many. However, there are no effluent guidelines for the subcategories of
meal plants or surimi processing in Alaska. Since the effluent limitations guidelines cannot be applied directly to a meal plant operating in Alaska, best professional judgement (BPJ) is used to apply limitations the regional administrator feels are appropriate. Meal plants in Alaska are usually assigned the East Coast limits for Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), and Oil and Grease (O&G): 6.7, 3.7, 1.4 lb per 1,000 lb for all the meal plant waste water except stickwater. Since EPA has had trouble determining the best conventional pollutant control technology (BCT) for stickwater, the approach taken to limit the associated pollutants is to limit the flow and to require a stickwater recovery plan. The goal of the stickwater recovery plan is to achieve complete recovery of stickwater through the use of in-plant modifications.

Sometimes the permit limits may need modifying to protect the state’s water quality standards, or a zone of deposit or mixing zone must be established. These additional requirements are stipulated in the “State’s 401 Cert.” It should be noted that the State favors a policy of “no new, persistent (year-round) waste piles.”

CONCLUSION

It is often heard that EPA is too strict in regulating the seafood waste water discharges in Alaska. The seafood waste makes a good meal for sea life just as it is produced, without grinding. One look at the thousands (millions?) of sea gulls around the Kodiak and Dutch Harbor processors verifies that statement. In addition, there are sea lions, flatfish, crab, etc. to utilize the by-product. Therefore, if the pressure of the federal regulations seems too great, then remember these two important points:

First, it is well known that in addition to being a major factor in the Alaska economy, the seafood industry is a major discharger of seafood wastes into Alaska waters. When “billions of pounds of protein” are discarded in relatively few locations there will be a significant impact, primarily because the waste will smother portions of the sea floor, and foul fishermen’s nets.

Second, the EPA strives to apply the effluent limitations guidelines as equitably and as reasonably as possible, while still protecting the receiving water. As the industry changes this makes the permit limits in some areas seem too lenient and in others, too strict.

It is a fact of life in today’s world that you will be regulated. The best way to ensure receiving a reasonable discharge permit is to cooperate fully in sharing information with the EPA. There is room for negotiation in the early stages of the process.

Be alert to when the guidelines are published for your industry category. If you feel they are inappropriate, take the time to argue your case then, so you will not have to spend time fighting them later.

REFERENCES


EXPORT AND FOREIGN INVESTMENT OPPORTUNITIES FOR ALASKAN PROCESSORS

Ron Miller
Governor’s Office of International Trade
Anchorage, Alaska

In 1986 a key part of Governor Cowper’s platform was a commitment to diversify Alaska’s economy. After he was elected, he gave a direct charge to our office to increase export opportunities for Alaskan products, and also search for foreign sources of capital for investment in Alaska.

We do this through a main office in Anchorage, and we have foreign offices in Tokyo, Seoul, and Taipei. We lead trade missions, we sponsor trade fairs, we host foreign trade delegations in Alaska, and we provide international trade information to the Alaska business community through a quarterly newsletter, a biweekly fishery mailing, and co-sponsorship of trade seminars with the University of Alaska. My current trade mission consists of polling the Alaska fishing industry to see if there is interest in a tour of Japanese and Korean fish markets this fall. That may provide an opportunity.

I’ve taken some trade statistics from the Bureau of the Census, export statistics. Alaska has doubled its exports between 1985 and 1989, with a substantial increase in fishery products. Fish exports in 1985 accounted for approximately 34% of the total exports. In 1989 that had increased to over 42%. Our major fish markets are the Pacific Rim, Western Europe, and the Americas. The Americas include Canada and Latin America, but most of the fish products go to Canada. Very little now goes to Central or South America.

In fish by-products export, we’ve gone from approximately $121,000 in exports of inedible fish meal in 1985 to total fish meal exports of over $33 million last year. Basically there are four markets for those fish by-products: Japan, Taiwan, Korea, and Indonesia.

We see some opportunities to significantly increase fishery exports, particularly in Korea and Taiwan. The standard of living in those two countries is increasing, and the people are looking for sources of protein other than rice, such as fish and meat. Last year Korea initiated a three-year trade liberalization program on food products. On the schedule for tariff decreases are 95 fish products. In 1991 edible fish meal is included on that schedule. So we hope that will provide some opportunity for this emerging by-product industry in Alaska.

We are currently hosting large parties of foreign buyers for fishery products. They have contacted our office here through our overseas offices. Some have not bought products from Alaska before, and some have worked through brokers based in Seattle. They’re interested in buying products directly from Alaska. We have scheduled appointments around the state in our major fishing ports to discuss opportunities with fish processors.

We also initiated discussions between a foreign investor and an Alaskan fishing company recently. This involves the formation of a joint venture for seafood processing and marketing. It will combine Alaskan expertise and foreign capital.

So if you develop wonderful new products from fish by-products, how can we help you sell them? All you have to do is contact our office by telephone or telefax, or stop by the Anchorage office, tell us what you have to sell, and give us a simple proposal. We will shop that proposal through our foreign offices to potential buyers.

We’re very easy to deal with. We’re not a regulatory agency; we’re there to assist businesses.

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ECONOMICS OF FISH BY-PRODUCT UTILIZATION FOR SMALL PROCESSORS IN ALASKA

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We have seen that there are economic benefits in worldwide by-product processing of fish waste. Producers are putting forth effort and money to get hold of by-products to be processed. What are the possibilities here in Alaska, where processors already have the by-products in their hands and do not know what to do with them?

We have been looking at this problem with regard to:
- Product compositions
- Seasonal variations in amounts of by-products
- Shore- or ship-based installation
- Factory and storage space requirements
- Shipment costs
- Established markets and new markets

The traditional solution to the utilization of a smaller amount of fish by-product in the past was installation of a small fish meal plant, often a so-called compact plant, because these plants are built skid-mounted ready to hook up to utility supplies on site.

We are looking into the feasibility of a plant with a capacity to process one metric ton of offal per hour. Plants with larger capacities of two or even up to four or five tons per hour are available, but the one ton per hour plant can be built fairly easily into many of the existing factory trawlers and is small enough for many shore-based plants. If we can find economy in installing this small-capacity plant, we certainly can do so if installing a plant with a bigger capacity, if the raw material exists.

Small plants have the same components as bigger plants. The main components are shown in Figure 1. We can either produce presscake (Figure 2), or we can install an oil recovery system and a stickwater recovery system and produce whole meal (Figure 3). The latter is

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Figure 2. Flow diagram for fish plant producing presscake.
Figure 3. Flow diagram for fish plant with oil and stickwater recovery system, producing whole meal. (ato = atmospheric overpressure.)
Table 1. Budget price sheet for one ton per hour plant.

<table>
<thead>
<tr>
<th>Budget Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact fish meal plant, ACP 25 capacity 1.0 MT/h</td>
<td>290,000</td>
</tr>
<tr>
<td>Raw material conveyor, with hopper</td>
<td>20,000</td>
</tr>
<tr>
<td>Meal conveyor, bagging station, scale, etc.</td>
<td>15,000</td>
</tr>
<tr>
<td>Mechanical and electrical installation</td>
<td>20,000</td>
</tr>
<tr>
<td>Freight, customs duty</td>
<td>40,000</td>
</tr>
<tr>
<td>Steam generator 25 BHP (estimate)</td>
<td>45,000</td>
</tr>
<tr>
<td>Buildings &amp; foundations (estimate)</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$450,000</strong></td>
</tr>
<tr>
<td>Fish oil unit</td>
<td>120,000</td>
</tr>
<tr>
<td>Freight, duty, etc.</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$140,000</strong></td>
</tr>
<tr>
<td>Evaporator</td>
<td>185,000</td>
</tr>
<tr>
<td>Freight, duty, etc.</td>
<td>25,000</td>
</tr>
<tr>
<td>Bigger steam supply (estimate)</td>
<td>10,000</td>
</tr>
<tr>
<td>Installation (estimate)</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$240,000</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$830,000</strong></td>
</tr>
</tbody>
</table>

The solution to choose if we are not allowed to discharge the press or stickwater, or if the amount of oil recovered in the raw material or amount of solids in the stickwater justifies installation of the recovery system. The components for the fish meal plant with the oil and stickwater recovery system is shown in Figure 4.

Table 1, a budget price sheet for the one ton per hour plant, gives our estimate for the presscake meal plant and the oil recovery-stickwater recovery plant. No raw material storage or product storage facilities are included in the prices.

Table 2 shows two different production cost calculations:

1) A 5,000 hour per year operation equally spread over the whole year, and (2) A 90 day (2,160 hour) operation concentrated over a three month period. Calculations are made for a plant producing presscake meal as well as whole meal.

We also made a calculation showing return on investment and operation (Table 3). This calculation is done for the one metric ton per hour plant producing presscake meal, and the same size plant producing whole meal. The latter at the same time recovers a certain amount of oil from the raw material.

With respect to oil recovery it should be mentioned that all the oil in the raw material will be recovered. The oil yield, generally at 5.0%, is dependent on the amount of oil in the raw material. About 7%–9% of the produced meal will be oil, but the remainder of the oil will be recovered.

With 15% meal recovery of presscake meal and a meal price of $500 per metric ton, we will earn about 35% return on invested capital in the 5,000 hour per year plant, even based on a five-year depreciation. We are just about at the break-even point after 90 days of operation, however, with a 10-year depreciation of the investment.

A plant producing whole meal can reach the break-even point in about five years on non-oily waste, at 5,000 hours operation per year, but the plant cannot meet expenses in a short 90 day season.

If the raw material is waste from a salmon operation, the situation is quite different: A higher solid content in the salmon waste results in a higher meal production.

Any saving in cost of discharging the waste, if no fish meal plant is available, is to be added to the above calculation as a further improvement.

Still a certain amount of raw material is needed to secure an economical operation of a small fish meal plant.

Several alternatives exist: but because of the established market for fish meal, we made our calculation for the traditional utilization of fish wastes into production of fish meal. Nearly any of the alternative utilizations of fish wastes will produce a semi-produced product or an end-product for which an established market, like the one for fish meal, does not exist.
An obvious solution would be hydrolysis to produce fish silage. The problem with using this method in Alaska is that the weight of the product will not be decreased; rather it will be increased unless a rather expensive evaporator plant is installed with a corresponding boiler plant.

Two advantages of producing fish silage are the low investment in equipment and the fact that the product is liquid and storable in tanks and can be moved by pumps.

The volume and weight will make it difficult and expensive to move the product from place of production to consumer. Fish silage can be five times as heavy as fish meal from the same amount of raw material, and the volume is 2.5–3 times larger.

Further, fish silage cannot be stored forever. According to Norwegian feed experiments, growth of mink and salmon fed silage hydrolyzed with formic acid will start decreasing if the silage is more than five to six months old. Fish silage has for several years been produced in Northern Europe and used for mink and other animal feeds.

A concentrate of fish silage can also be produced without the above-mentioned evaporator by using a combination of acid and salt for hydrolysis of the fish. Tests on this method have been carried out by the Research Laboratorium under the Danish Ministry of Fisheries, and the product has been used for mink fodder with good results.

The acid-salt hydrolysate will drain quite freely and can further be pressed to a fish silage concentrate with approximately 42%–45% solid content. The raw material has to be minced, mixed with salt (NaCl), acid, and an anti-oxidant. The processing equipment needed for this process is simple as shown in Figure 5.

The comparison of the analysis for the raw material (herring offal) shows that the protein content is increased twofold and the oil content is reduced by half (Table 4). The salt content is of course increased, but not to the extent expected. Analysis has shown that the salt content is proportionate to the water content and is thus drained off in the press.

About 10%–20% of the raw protein will go out with the liquid phase, as will approximately 50% of the oil in the raw material. This oil can be recovered easily by separation, and the quality will be excellent because the material has not been exposed to temperature treatment.

From the above you will notice that we are reluctant to recommend systems other than those producing fish meal of one or another quality. It is not because we are manufacturers of fish meal equipment; we are ready to start manufacturing any type of equipment for this industry needed to produce the right marketable product. The reason we reluctantly recommend other products is that:

- Markets for such products are limited or uncertain,
- We will experience difficulties with costly transportation of voluminous and heavy goods, but
- We know there is a market for fish meal.

Requests for small and cheaper, more simple fish meal plants and the fact that the Alaska Fisheries Development Foundation has tempted us with a presentation during this symposium has also got our research and development people to consider other principles and cheaper plant combinations for small fish meal.
Table 2. Production cost calculation.

<table>
<thead>
<tr>
<th></th>
<th>Presscake meal 5,000 h/year</th>
<th>Whole meal 5,000 h/year</th>
<th>90 Days operation presscake meal day-night 2,160 h</th>
<th>90 Days operation whole meal day-night 2,160 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>One operator/shift, three shifts/day, 210 days/year, $10.00/h + 20%</td>
<td>60,000</td>
<td>60,000</td>
<td>26,000</td>
<td>26,000</td>
</tr>
<tr>
<td>Maintenance/cleaning person, one shift $10.00/h + 20%</td>
<td>20,000</td>
<td>20,000</td>
<td>8,650</td>
<td>8,650</td>
</tr>
<tr>
<td>Steam cost $8.00/1000 lbs x 750 lbs/h 1250 lbs/h</td>
<td>30,000</td>
<td>50,000</td>
<td>13,000</td>
<td>21,600</td>
</tr>
<tr>
<td>Electricity 50 KWH x $0.13/KWH (75 KWH)</td>
<td>32,500</td>
<td>48,000</td>
<td>14,000</td>
<td>20,750</td>
</tr>
<tr>
<td>Lubrication</td>
<td>2,000</td>
<td>3,000</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Maintenance 3.0% of investment</td>
<td>12,500</td>
<td>25,000</td>
<td>2.0% 8,000</td>
<td>2.0% 16,000</td>
</tr>
<tr>
<td>Meal bags</td>
<td>25,000</td>
<td>31,000</td>
<td>11,000</td>
<td>13,400</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>$152,000</td>
<td>$237,000</td>
<td>$81,650</td>
<td>$107,400</td>
</tr>
<tr>
<td>Depreciation over 10 years</td>
<td>45,000</td>
<td>83,000</td>
<td>45,000</td>
<td>83,000</td>
</tr>
<tr>
<td>Interest on investment 14.0% p.a. on an average of 50% of investment</td>
<td>31,500</td>
<td>58,100</td>
<td>31,500</td>
<td>58,100</td>
</tr>
<tr>
<td><strong>Total cost per year</strong></td>
<td><strong>$228,500</strong></td>
<td><strong>$378,100</strong></td>
<td><strong>$158,150</strong></td>
<td><strong>$248,500</strong></td>
</tr>
<tr>
<td>Alternatively:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation over 5 years</td>
<td>90,000</td>
<td>166,000</td>
<td>90,000</td>
<td>166,000</td>
</tr>
<tr>
<td>Interest on investment 14.0% p.a. on an average of 50% of investment</td>
<td>31,500</td>
<td>58,100</td>
<td>31,500</td>
<td>58,100</td>
</tr>
<tr>
<td><strong>Total cost per year</strong></td>
<td><strong>$273,500</strong></td>
<td><strong>$461,100</strong></td>
<td><strong>$203,150</strong></td>
<td><strong>$331,500</strong></td>
</tr>
</tbody>
</table>
Table 3. Return on investment and operation. Raw material is waste from dressed head-off catch.

<table>
<thead>
<tr>
<th></th>
<th>Presscake meal 5,000 h/year</th>
<th>Whole meal 5,000 h/year</th>
<th>90 Days operation presscake meal day-night 2,160 h</th>
<th>90 Days operation whole meal day-night 2,160 h</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Cod-pollock:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17% Fat-free solids</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expected yield %</td>
<td>15.0</td>
<td>19.0</td>
<td>15.0</td>
<td>19.0</td>
</tr>
<tr>
<td>Meal production MT/y</td>
<td>750</td>
<td>950</td>
<td>324</td>
<td>410</td>
</tr>
<tr>
<td>Sales price per year</td>
<td>$375,000</td>
<td>$475,000</td>
<td>$162,000</td>
<td>$205,000</td>
</tr>
<tr>
<td>at $500/MT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Salmon and other oily fish:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expected yield:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meal %</td>
<td>17.0</td>
<td>21.0</td>
<td>17.0</td>
<td>21.0</td>
</tr>
<tr>
<td>Oil %</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Meal production MT/year</td>
<td>850</td>
<td>1,050</td>
<td>365</td>
<td>450</td>
</tr>
<tr>
<td>Oil production MT/year</td>
<td>250</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Sales price per year</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meal at $500/MT</td>
<td>425,000</td>
<td>525,000</td>
<td>182,500</td>
<td>225,000</td>
</tr>
<tr>
<td>Oil at $240/MT</td>
<td>60,000</td>
<td>60,000</td>
<td>60,000</td>
<td>60,000</td>
</tr>
<tr>
<td>Total return per year</td>
<td>$485,000</td>
<td>$585,000</td>
<td>$242,500</td>
<td>$285,400</td>
</tr>
</tbody>
</table>

Figure 5. Processing equipment needed to produce fish silage concentrate.
Figure 6. Plant for processing fish offal, with stickwater discharge.

Figure 7. Plant for processing of fish offal, with bone and stickwater discharge.
Table 4. Composition of raw material and presscake (fish silage concentrate).

<table>
<thead>
<tr>
<th></th>
<th>Raw material</th>
<th>FSC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids %</td>
<td>32.6</td>
<td>43.5</td>
</tr>
<tr>
<td>Protein %</td>
<td>13.5</td>
<td>27.1</td>
</tr>
<tr>
<td>Oil %</td>
<td>17.0</td>
<td>8.7</td>
</tr>
<tr>
<td>FFA %</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>Peroxide/kg oil</td>
<td>0.4</td>
<td>3.3</td>
</tr>
<tr>
<td>Salt %</td>
<td>0.4</td>
<td>3.3</td>
</tr>
<tr>
<td>TVN mgN/100 g</td>
<td>21</td>
<td>22</td>
</tr>
<tr>
<td>pH</td>
<td>6.7</td>
<td>3.6</td>
</tr>
</tbody>
</table>

FFA = free fatty acids; TVN = total volatile nitrogen.

plants. The result is shown on Figure 6.

Besides aiming for a simple plant, our people have also concentrated on making a plant that can be installed in small and often separated areas on board a ship. The product is moved by steam pressure and pumps, and different equipment can therefore be installed in separate rooms.

The waste is fed to a pressure cooker equipped with a special in-feed screw, and cooked by direct steam injection for three to eight minutes depending on the degree of hydrolysis wanted.

From the cooker, the product is moved by steam pressure to a flash chamber and discharged into a pump taking the fish hydrolysate to a decanter. The decanter separates the liquid and the solid phases, the latter of which can be taken to a drier for meal production.

If working on oily waste, the decanter can for a small additional cost be replaced with a three-phase machine separating the hydrolysate into grax, oil-free stickwater, and fish oil.

If there is no space on board to install a drier, the grax from the hydrolysate can either be stabilized by acid and anti-oxidant or can be frozen, assuming a market for this product can be created.

The system can further be expanded to produce a high-quality meal with reduced ash content by installing a vibration strainer between the flash chamber and the decanter as shown in Figure 7.

If the waste is hydrolyzed properly, the main part of the fish bones can be separated by the strainer before the rest of the hydrolysate is taken by a pump to the decanter for separation into liquid and solid phases.

In test operations, the difference in ash content between the two different plants (Figures 6 and 7) has shown 19% and 13% ash content, respectively, in the final meal, against a reduction in meal yield from 13.8% to 10.9%.

The stickwater from the hydrolysate can in this case, as well as in a traditional plant, be recovered in a stickwater evaporator and the concentrate mixed into the grax for drying or storage.

No specific plant size has been decided upon nor has a budget price been calculated, but it is expected that the total price for a 1.0 metric ton per hour plant will be about the same as the price for a similar size fish meal plant. A slightly bigger plant could be relatively cheaper in investment cost. Electricity consumption will be slightly less than for a traditional fish meal plant. The only drawback will be that for this plant, direct live steam would be consumed, and consequently fresh boiler feed water would have to be provided to replace the steam consumption.

The product quality of fish meal and fish oil produced with the on-board, steam-driven process will be very much like traditional fish meal. Because of the much shorter time the product is exposed to high temperature, the quality should be better than standard. The smaller space requirement and the possibility of a split installation should be an important advantage.

QUESTIONS AND ANSWERS

Q. I have a question on the price of meal for salmon and other oil fish. I've been told that you can't sell meal made from salmon and other oily fish for the same price as white fish meal.

A. I think that for white fish meal you should be able to get a little bit better price than the $500. Salmon is lower for some reason.

Q. If this were done in stainless steel, what would the increased price be?

A. It needs to be in stainless steel so there will not be rusting.

Q. This is stainless?

A. No. The small units are not made of stainless steel. The oil separator and the evaporator plant are stainless steel, but not the unit itself.

Q. How much space do you need to operate this plant? Where I come from it's very expensive to make extra square meters. So it would be crucial that the plant is compact.

A. It is difficult to say exactly how small a space one can squeeze it into. We have several plants of this size on board ships. The space is no more than for the machinery plus a little bit so you can squeeze around it. It's not ideal to have it like that in land installations. But generally I would say that an 8 x
4 meter floor space will be sufficient for a one ton per hour presscake meal plant. An additional 8 x 4 meter space will be needed for additional equipment for a whole meal plant. The height is 5–6 meters.

Q. Could you define the makeup of the waste better than you have on the drawing?

A. No, I have had to generalize. If we knew the specific composition of the waste material, we would have to change the 15%, 17% yields that I had on the former schemes as well as the oils. This is a fair, but in American eyes probably not a very good business to plan, a small fish meal plant with this capacity. I assure that if we made the calculations for a two tons per hour plant, it would be an excellent business under all circumstances, counting depreciation over five years.

Q. (Susan Goldhor) I want to make one clarification which is that there really is a difference between silage and hydrolysate, or at least one of the ways you can make hydrolysate. In making silage, the product is acidified and it’s left to continue digesting. And therefore as you correctly pointed out, it is not infinitely storable, and as time goes on it does lose nutritional quality. But one can make a hydrolysate which can be stored for quite a long time and remain stable nutritionally.

I was also very impressed by your ingenious processes, but I want to give one warning: In our experience with hydrolysis, one has to be careful about reducing the water content of the product prior to the enzyme liquefaction. The enzyme processes need a certain water level, so one must be aware of that.

A. Thank you.

Q. How much moisture do you take off in the flash chamber?

A. The ambient temperature is 10° centigrade, and we cook it up to about 150° centigrade. What will flash off will be the water which we in surplus for cooling the product down to 100° again. Some water will be added to the product—that is, the condensate resulting from the direct added steam for heating the product from ambient temperature to boiling point.

Q. What would you have as a percentage of solids coming out of this?

A. You will have to add about 16%, 17% water to it. If you have a product with 15% solids at the intake, you will reduce that to about 12% or 13%.

Q. I’d like to ask a question about the concentration of the solids. If sulfuric acid is in there, and you concentrate, drive off moisture, the sulfuric acid will become concentrated. I got caught once that way by trying to dry some material that had about 0.5% acid. When I dried it, it all turned black because it was concentrated acid. I suppose you would have to neutralize the acid before you tried to concentrate it? Would that put an additional cost on the process?

A. Yes. And it will increase your ash content.