SEAFOOD PROCESSING

HANDBOOK

for Materials Accounting Audits and

Best Management Practices Plans

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PREFACE

This document is the second draft of the Seafood Processing Handbook for Materials Accounting Audits and Best Management Practices Plans. The handbook is intended as advisory guidance to Alaska's seafood processing industry in developing approaches to pollution prevention, materials accounting audit, and BMP plans. Compliance with environmental and occupational safety and health laws is the responsibility of each individual business and is not the focus of this document.

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The U.S. Environmental Protection Agency invites your review of this handbook. In particular, the Agency seeks information which will improve the quality of the handbook and make it a more useful resource for the public. Please submit your comments and any supporting documentation to Burney Hill at the above address.

TABLE OF CONTENTS

INTRODUCTION

This handbook is designed to help seafood processors increase production and reduce waste. The goal is increasing product recovery and profits while reducing pollution and water discharge.

This handbook supports general National Pollutant Discharge Elimination System (NPDES) permit no. AK-G52-0000, which authorizes seafood processors to discharge pollutants to the surface waters of the United States in and continuous with the State of Alaska. The 1995 general NPDES permit for seafood processors in Alaska requires the management and accounting of waste generated in seafood processing plants.

The United States Environmental Protection Agency (EPA) offers this handbook as practical guidance in meeting the requirements for a best management practices (BMP) plan supported by an accurate materials accounting audit. An accounting audit of the inputs and outputs of seafood, seafood waste, water, and chemical contaminants that are generated in a seafood processor forms a quantitative basis for managing the materials of production. The BMP plan is an in-plant program that has the dual goals of maximizing production efficiency and minimizing waste.

The handbook addresses three areas of environmental concern. The first concern is the wasteful use of fresh water in processing seafood. This concern is addressed by managing and accounting the flow and use of water throughout a plant. The second concern is the excessive generation of suspended and solid wastes. This concern is addressed by managing and accounting seafood to maximize the recovery of raw products as marketable primary products, by-products, and secondary products. The third concern is the excessive generation of dissolved wastes. This concern is addressed by managing and accounting water and seafood to minimize contact time which converts solid wastes to dissolved wastes.

EPA expects that the time, energy, and expense of conducting a materials accounting audit and developing a BMP plan will vary in direct proportion to the size and complexity of a seafood processing facility. Relatively smaller operations may have a materials audit and BMP plan of as few as three pages. Relatively larger facilities may have a materials audit and BMP plan of as much as twenty-five pages. The size and complexity of the materials audit and BMP plan will reflect the size and complexity of the seafood processing facility.

Ultimately the plant manager is responsible for ensuring an accurate materials accounting audit and establishing an effective BMP plan. However, in medium and large facilities the plant manager will rely upon quality control, production, and engineering personnel to conduct the audit and assist in developing the plan. Ideally, trained lead people and processors will be included in the implementation phase. The understanding, participation, and support of these key members of the processing team is fundamental to achieving the dual goals of increased production and reduced pollution.

Since the whole of materials management is a measurement and accounting exercise, some algebra and math skills will be needed to calculate flow rates and concentrations and to convert measurement units. There will be examples included in the handbook. Through training programs, each plant manager can develop good support staff who understand both the objectives and the methods of the materials audit and BMP plan. In time personnel will become comfortable with taking measurements, making calculations, and using that information to make decisions which will increase product recovery and income which reducing pollution and water use.

Handbook sections include (1) materials accounting, (2) conducting a materials accounting audit, (3) materials management practices, (4) developing a best management practices (BMP) plan, and (5) end-of-pipe treatment options.

Materials Accounting - This section portrays seafood processing facilities as model systems with boundaries within which material inputs, flows and uses, and material outputs are governed by the law of conservation of mass. In fact, "materials accounting" is also known as "mass balance!" The handbook will consider which information is important in materials accounting and describe how to take good measurements to develop this information.

Conducting a Materials Accounting Audit - The goal of this section will be to show you how to measure the parts of the seafood that aren't making money. It will also address the water wastage which is costing money. Good materials accounting audits can guide a processor in getting an extra 1% to 3% increase in product recovery and a 10% to 30% reduction in water use. This means increased revenues and reduced expenses.

Materials Management Practices - This section will describe management practices which can increase production and decrease waste... wasted product and wasted water. Management practices considered may be a process step, a material stream, or an individual job and responsibility. The methods and technologies presented in this section have proven successful in reducing waste and water in other seafood processing plants.

Developing a BMP Plan - This section will describe how to make a BMP plan for a seafood processing facility. The different aspects of a BMP plan will be discussed and an example of a BMP plan will be laid out (Appendix D). Sample language will be provided which may be used as appropriate. The goal here is to help you develop the best BMP plan for your operation while meeting the requirements for authorization to discharge processing waste solids and wastewater.

End-of-Pipe Treatment Options - This final section is for facilities that can direct wastes to treatment processes above and beyond grind-and-discharge. The goal of such treatment is to reduce the organic and chemical load in the discharged wastewater. Much of the information in this section will cover equipment and technology that can clean up waste solids and wastewater. Descriptions of the different major pollutants will be included along with some simple tests to determine their amounts.

MATERIALS ACCOUNTING

Materials accounting is used to trace the inflow and outflow of components in a process stream and to establish the quantities of these components. This information can then be used to evaluate yields and efficiency of the processing operation as a whole and as parts. For high value or high volume seafood products the ability to efficiently inventory the processing operations using materials accounting principles has high payback potential.

The three things you, as a plant manager, should expect from a good materials accounting audit are:

1) a method to determine processing efficiency and materials use for any time period greater than two hours,

2) a method to identify areas that fall below expected performance standards, and

3) compliance with reporting requirements of the discharge permit.

Descriptions of the basic principles for doing materials accounting audits are presented below.

What Is the Law of Conservation of Mass

In a nutshell, the law of conservation of mass states that mass is neither created or destroyed. What goes in comes out... somewhere! Mass is conserved. This can be expressed in pretty simple arithmetic as a summation.

INFLOW = OUTFLOW + ACCUMULATION

Below are two examples of how the above equation may apply to a seafood processing plant. There are other ways to assign materials to the flows, but what goes in must always equal what comes out.

Example 1: Entire Plant

- INFLOW = Seafood catch, fresh water, salt water, cleaning chemicals, processing additives, boiler or cook water.
- ACCUMULATION = Product
- OUTFLOW = INFLOW minus PRODUCT

Example 2: Process Step of Head-and-Gut

- INFLOW = Whole seafood, cleaning water
- ACCUMULATION = Headed and gutted seafood (to next process step)
- OUTFLOW = Heads, guts, blood, slime, scales, trimmings, unusable seafood, water

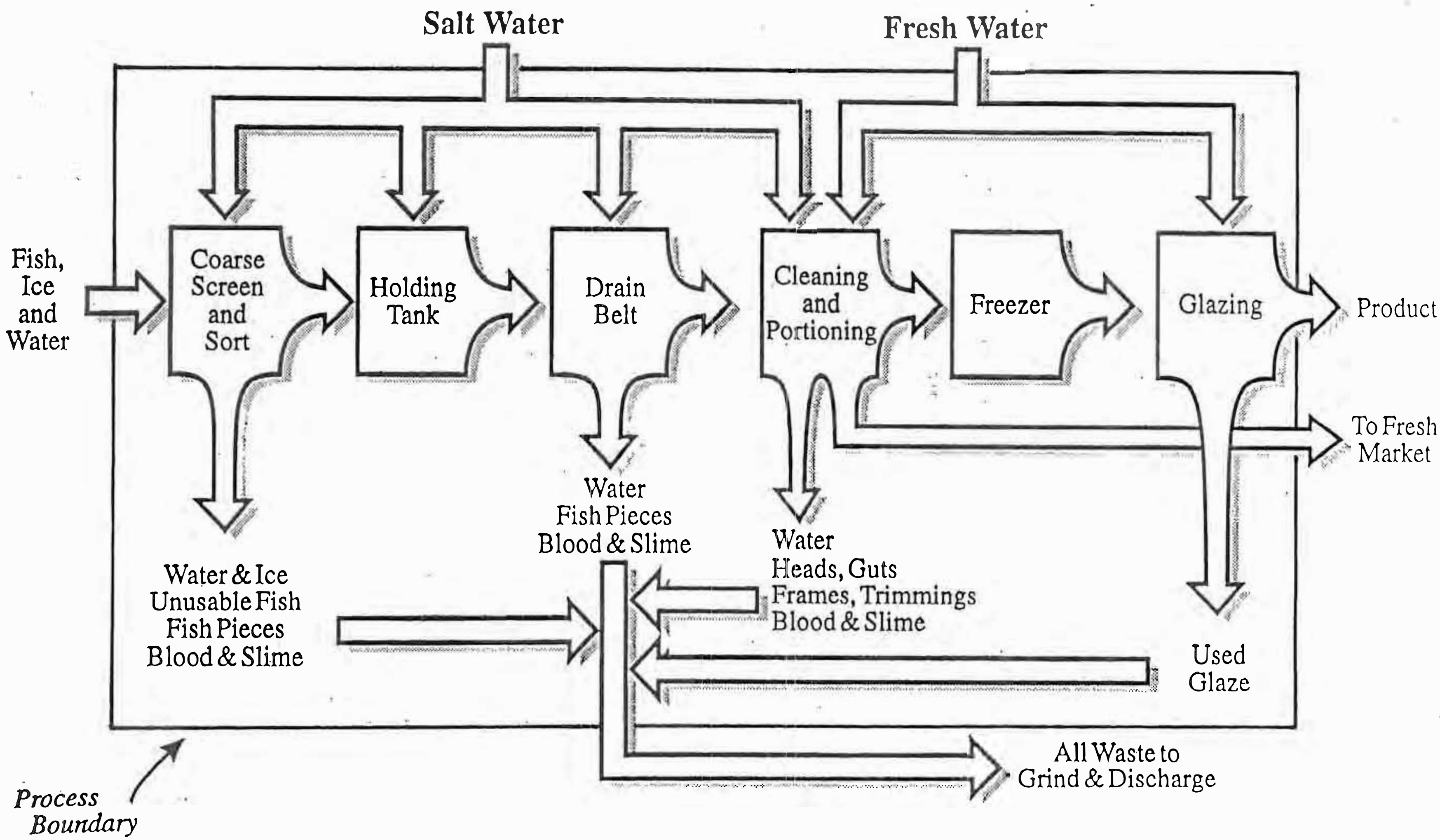
As can be seen from the above examples, the flows can be broken down into components. Identifying and measuring the key components for a process is the basis for doing materials accounting audits.

How to Define Process Boundaries and Develop Flow Diagrams

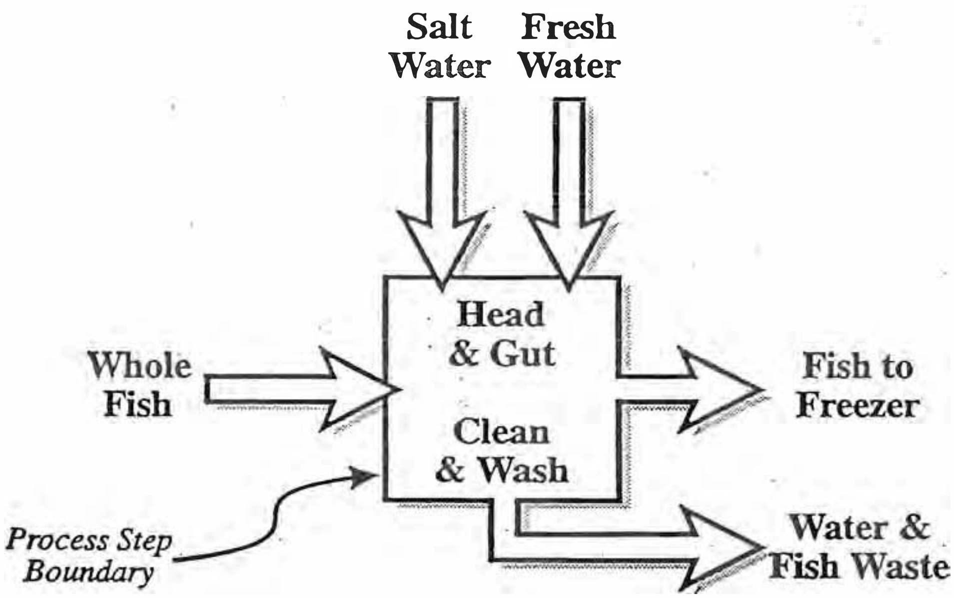
To begin, a process flow diagram is needed to define what process and components are to be measured. Below are diagrams based on the two examples in the previous section.

The defining plant boundary in Figure 1 encompasses all the processing steps in the butchering operation. The materials accounting audit for this flow diagram would only deal with the total inflow, outflow, and accumulation that enter and exit this defining box. Measuring these major streams would give information on overall product recovery and water use, but would not give any information on the contribution from the individual steps. Identifying and

Flow Diagram for Rocky Cove Processors



Process Flow Diagram for a Unit Step Operation in a Fish Butchering Plant



measuring the individual processing steps would define and rank their contribution of product and waste to the total processing operation.

The process step boundary in Figure 2 defines a box around just the butchering step. The measured flows in and out of this box can be compared with the overall flows from Figure 1 to determine their contribution to the total outflow. From a production point of view the efficiency of this step translates directly to product and money.

Thus, the first step in an audit is to draw a flow diagram of the process or process step that is to be measured. Next, a boundary box needs to be drawn around each process or process step that you want to measure. Having done this, you are prepared to identify the flows and components that you want to measure entering and leaving the boundary box. You have a non-quantitative "model" of your processing operations which can be evaluated and quantified.

Except for very simple processes, materials accounting audits should be planned in steps. Start with the big picture of the entire plant and build good solid information of the overall process flow. The initial overall measurement will be the foundation for all of the following steps. A materials accounting audit step is complete when you can measure the inflow, outflow, and accumulation for a defined box and get them all to add up. Inflow should equal outflow plus accumulation.

The goal of a materials accounting audit is to have a basis for reducing waste and wastewater. For a producer the components of interest are seafood in, accumulation of product, and water use. For authorization to discharge the components of interest are all waste and wastewater streams.

Once the flows to be measured have been selected a units system and tie material can be decided. The units system is probably best decided by whatever the product is weighed as. The major units used will then be either pounds, feet, and gallons, or kilograms, meters, and liters. A conversion table for these units and other useful measurement units is provided in Appendix A.

A tie material is a component used to relate the quantity of one process stream to the quantity of another. A good tie material is the amount of product produced in a given time period. The relation of any other component or flow to product is a direct measure of efficiency.

Which Information Is Needed

The goal of a materials accounting audit is to develop a good set of these relationships and then to control them in order to increase efficiency. Measurements taken during steady production and steady flow can be directly linked to product output. The information needed is the relation of a measured flow stream or component to product recovery for a unit of time. In some situations these relations will help identify and recover significant losses. In other situations measuring and minimizing waste in one process step may produce a very small improvement, but when added to other steps the total savings can be significant. Once a measurement program has been set up and initial relationships have been established, goals to improve product recovery and reduce water use can be set and production efficiency can be improved.

A key trait of a good measurement system is that it must consist of simple, repeatable procedures. A good example is a "grab" sample of a materials stream, one literally grabbed with a hand, a bucket or a shovel. Being able to grab a measurement easily and accurately has the following advantages.

1) The procedure can be taught to other workers so production line efficiency can be checked regularly.

2) There is less chance of error and confusion. If the data measured differs from the typical or standard data then it's much easier to check the collection procedure. There's always the chance that the data which differs significantly is actually showing an inefficient process step.

3) You can take more measurements easily and quickly.

It is important to take measurements under steady flow conditions to establish relationships between different processing steps. If you can get five or six different measurements quickly then you have information to support five or six solid processing relationships. It is also possible to take some measurements simultaneously. Good steady flow is not the rule in most operations so taking lots of measurements throughout your line or system when the steady flow opportunity arises is important. Once relations between processing steps and flow streams have been established at a steady flow, measurements can be taken at any time for comparison.

How to Take Good Measurements

Even people who are experienced with conducting materials accounting audits may come up with unbelievable or unusable data when they add up flow stream measurements. The end result is confusion and wasted time. The solution is to know what information to collect and when to measure and to use simple procedures to collect this information.

A good way to start is to measure any easily accessible stream or component and calculate the flow rate.

When to Measure? The best information is taken when processing is at a smooth consistent rate or flow. These situations can usually be recognized by experienced plant personnel. Most often steady plant flow occurs when operations are running at 100% and steady feed-in is keeping the plant humming. It is also important to look for opportunities to take measurements if there is a steady pace at 50% to 75% capacity. This is how to build good relations between different flow streams.

Here is an example of how steady state information could be used.

> On Monday a full load of seafood comes in and after two hours of processing the first product is going in the box and the crew and machinery have a good pace set up. Foreman Bob goes down to the packing table and sees that they're getting a twenty pound case out every 60-70 seconds over the course of about ten minutes. Bob grabs a five gallon bucket and walks up to where the fresh water spray is rinsing the cleaned seafood on the conveyor. He fills the bucket three times in an average time of 28 seconds per bucket. From this he calculates that he uses about 0.6 gallons of fresh water spray for every pound of product. This information can now be used to control water use. First, water flow can be checked during slower production periods so the ratio of 0.6 gallons per pound of product is not exceeded. Second, a flow ratio of 0.3 or 0.4 gallons per pound of product could be tried to determine what the minimum water requirement is.

The example above is fairly simple, but is typical of many measurements that can be made in different processing plants. The result of 0.6 gallons of fresh water spray per pound of product is now a solid number and a reference standard for this one step. Over the course of time more relationships can be established.

The above example has some elements which you may not have noticed but which ensure the quality and validity of the measurements. First, a single individual took the measurements... thus avoiding differences which might exist between how different people would take a measurement. Second, the person taking the samples was Bob, a knowledgeable and trained foreman... thus avoiding the problems of sloppy sampling techniques and bad data. Thirdly, Bob collected (at least) three samples... thus achieving a level of replication which should ensure precise data.

<u>A Summary of Materials Accounting Principles</u>

Here is a summary of materials accounting (a.k.a. mass balance).

1) Law of conservation of mass - This refers to the imaginary boundary boxes that are drawn around a processing plant or a processing step. The amount of material that crosses over the boundary (water and seafood especially) must equal the amount that comes out. In a nutshell: "What goes in must come out." You can actually model your plant and process steps and account for the input, utilization, and discharge of both water and seafood.

2) Boundary boxes - Draw a boundary box around the process or process steps that are to be measured.

3) Flows to be measured - Identify the flows in and out of each boundary box that are to be measured. Start big, with good solid data for overall process and recovery for the entire facility.

4) Flow diagrams - This refers to flow measurements of volume or weight within a processing plant or a processing step. Draw a flow diagram showing all processing steps and all material flow streams in and out of the each process step.

5) Measurement system - Choose between metric and English units based upon what you customarily use in measuring product weight. Choose a tie material such as production rate or product recovery to compare all other measurements to.

6) Taking good measurements - Identify and build a set of measurements and relations that can be used to monitor and change inefficiency and waste. Develop simple measurement techniques to get more information and more dependable information. Build

reliable information through procedures which assure quality. Trained personnel using described sampling procedures with adequate replication will produce information which is accurate and precise and capable of saving you money.

CONDUCTING A MATERIALS ACCOUNTING AUDIT

How to Organize and Maintain Good Records

Developing a materials accounting audit program involves two stages. The first stage is learning and experimentation. The second stage is defining a set measurement routine that is eventually determined to work the best for your facility and your personnel.

High value should be placed on any and all measurements and information. Often a random measurement may not seem important at the time, but a month or a year later it may show you how far you have progressed. It is important to set aside space in your office for all work associated with doing a materials accounting audit so that all records can be kept organized and usable. Do this right away.

Generally you will collect four types of information.

1) Learning and experimentation - When starting out the value and accuracy of measurements will not be obvious. The measured streams and components will also change as part of your development of the best daily approach for your plant. Save all of this information. It will be very useful in the future.

2) Set measurement routine - These are the measurements that can be taken on a regular basis to check the efficiency of the processing operation. A manager may want this information collected four to six times a day in order to run a tight operation. You will need to set up a good records system to stop these records from becoming a useless paper pile.

3) Random measurements - There could be a relationship between two different steps that are not in a flow diagram. An example would be a machine speed versus a water flow rate. Sometimes the opportunity arises to measure a difficult stream at a rare steady flow. Many times these measurements are not planned and end up written on matchbooks or scraps of cardboard. The information is still valuable and should be kept and organized.

4) Calculations and records - These could include a large flow diagram with measured ratios entered for different streams and the current target goals for those streams. Also included could be the calculation methods for determining different flows and concentrations, and up to date graphs, totals, or averages of key streams that would give a measure of efficiency.

Communication is much easier with a well-organized system. In larger operations measurement responsibilities will be part of the foreman's and leads' jobs. They will need to understand the goals and results of the input they are providing. If a manager sets up a system that only he can understand then he cannot use his hands-on production staff to full advantage. A well-organized system with plant floor involvement helps set measurable goals for the crew to aim for. There's nothing better for production than two good foreman trying to outdo each other!

What Are Good Records and Forms

In order to stay organized a standard measurement form should be developed and used. If information is from the experimental period before a form has been developed or is a random measurement then the information should be transferred to a regular 8.5" by 11.0" sheet of paper. The goal is to be able to arrange the records in order so that you can easily flip through them. It is assumed that a regular form would be copied on a standard sheet size.

Don't limit the space for information on a form by drawing too many boxes or lines. Keep it as simple as possible. Leave space for making notes on what the process or seafood condition is like at the time. Design your form so you can locate the numbers and information you want instantly. If possible use "write in the rain" waterproof paper and a pencil.

Most importantly, always have a time and date associated with every measurement or note. Placing the date in the upper right hand corner is easiest for flipping back to check past data. Time should be recorded in 24-hour military format (e.g., 1:30 P.M. = 1330). Most information can be recorded as a shift total so that the time would be consistent with shift change. Some information, such as a water side-stream measurement, may be checked periodically so the time of the measurement would need to be recorded.

An example of how this works refers back to foreman Bob who wonders two days after making his initial measurement what the relation of fresh water spray to whole seafood is. His notes say that he made his measurements at 02:37 and

02:45 (pretty early in the morning!), so he checks the sorted seafood feed tally and finds that two 1,000 pound totes were run that hour. From this he can figure a recovery and also predict how to adjust his fresh water spray based on seafood coming in.

If a good materials accounting audit program can be developed for a larger facility it may have up to ten points that can be easily measured in order to routinely check efficiency. A computer running a spreadsheet program is the best way to handle more than five or six data points. With a good program set up the computer can make all calculations of interest, graph the data for comparison to previous production periods, and even give a relative performance rating. This is a little sophisticated for most facilities, but a good computer setup can help squeeze the most out of an operation. Another advantage is that all of the information can be saved on a floppy disk. The information can then be easily copied, stored, or distributed to other company officers.

Which Materials and Methods Support Good Measurements

A good start for a recording kit is the aluminum bi-fold clipboard that snaps closed and is about one inch thick. In addition to waterproof paper, pencils, and a watch, some other useful items to include would be a plastic English/metric ruler, English/metric tape measure, small flashlight, four function calculator, and waterproof marker.

Nearly all measurements of interest will be either a volume or weight per unit time. Most of the time you will be measuring how long it takes to fill a bucket with something. Even though this is pretty basic the first step is to assure that good weights and measures can be made and the people taking them understand exactly what the procedure is. The ability to use the tools at hand and innovate with them will simplify things and increase the chance for success.

For weighing, the first step is to find the location and condition of all scales in the plant. The quality control department may have a good scale that is accurate for one pound and below. There may be a spare product scale that can be used for weights in the 10-50 pound range. A 300 pound platform scale may be handy for putting a large box on and diverting a whole stream to. Checking the weight gain every few minutes would give a very accurate flow measurement. The number and type of scales available will determine what measurements can be done and if they can be done simultaneously. The next step is to check the accuracy of the scales and recalibrate them if necessary. If weight standards are not available then set volumes of water can be used. (The density of water is included in Appendix A.) Finally, the buckets or containers to be used can be weighed and the net weight written on the side.

For volume measurements the tool of choice is a five gallon plastic oil or chemical bucket. To calibrate a bucket pour in a set amount of water and draw a line with a waterproof marker at each fill line. The bucket can be marked off in increments of gallons, quarts, or liters. Measuring pitchers will be needed for this. If none are available some options are to weigh out the water, borrow a measuring pitcher from the cook, or buy some calibrated juice pitchers from the local dry goods store. The volume can also be calculated by measuring the bucket dimensions and using the formula for a cylinder volume in Appendix B. Other volume measurements may be a holding tank, bin, or forklift tote and timing how long it may take to fill or empty them to a certain depth. Formulas for different tank geometries are also in Appendix B. The dimensions for tanks and equipment can be gotten from blueprint drawings. These are usually in the plant office or with the plant engineer.

Some streams of interest can't be easily measured so a best guess or estimate is the only approach. With a little planning and practice this technique can be very easy and helpful. Two examples are provided below.

Example 1: Troughs or flumes

An example would be a floor drain carrying waste and process water to a sump. There are two ways to estimate the flow rate. The first would involve measuring the depth of the flow, the cross section of the trough, and the speed of material in the trough. The second method would be to measure the volume of the flume, block it off, and time how long it takes to fill.

Example 2: Seafood washing

Another example is from a seafood washing step where all wastewater was collected in catch-pans and piped to a sump. The sump had high and low level float switches that turned the sump pump on and off. The sump was square and the depth between the high and low marks was consistent. The fill volume could then be calculated and the time to fill the sump between pumpings could be easily timed. The flow rate could then be calculated and the time between pumpings was a very easy relation to check water use at this process stage.

As shown above there are other ways to get useful information than by direct volume or weight measurement. It may be the time required to fill a tank, bin, or sump. It may also be an equipment speed setting such as a whole seafood pump or a meat pump. The advantage to finding these types of measurements is that they are easy, quick, dry, and can be performed by anyone with a watch.

Developing a good materials accounting audit and the measurement techniques to increase efficiency and income takes time. Experimentation and innovation are both keys to your success. It takes practice to identify what measurements and calculations will work the best. Start by measuring the simplest streams possible even if they do not seem important. This will give a way to evaluate the skill level of the people involved. The goal is to build confidence and familiarity with the process and avoid confusion.

A Recap of "How To"

After a flow diagram has been made and the different flow streams identified, check the following elements of your materials accounting before any measurements are taken.

1) Long term goals - Start out simple and build confidence and skill. Developing solid techniques and procedures will ensure progress and results over the long term.

2) Personnel - Identify the people who will be involved and make sure that everyone understands the goals, measurements, and procedures.

3) Available measurement tools and calibration - Hold a scavenger hunt to find all volume and weight measuring items that may be used. Calibrate these items and formulate a plan to regularly check their calibration.

4) Organization - Think through a system of how to keep measurements and records in order.

What about Instruments and Computer Data Collection Systems

The easiest way to do a job is have a reliable instrument do it! Instruments or meters installed at key measurement points often pay for themselves in a very short time by providing information for better control and efficiency. Flow meters in major water lines will help define and control water use very quickly. Other meters can indicate equipment use and speed, or product flow.

There are three main benefits of having a key instrument or meter in a visible location. First is the ability to check a key measurement and maintain the desired setting. Second is assuring that those in charge are making use of the information and maintaining the desired setting or rate. Third is a method to set new goals and incentives to achieve the optimum operating rate for that measured quantity.

Instruments and meters can also be set up to electronically communicate the measured values to a computer. These systems are very useful in large seafood processing facilities (e.g., surimi plants) where there are many streams and a very high volume of processed seafood. The computer can quickly graph all measurements and make it easy to pinpoint operations which are out-of-line. A good real-time instrumentation and data acquisition system can outperform any human and increase plant operations to a maximum. (Experience in the surimi industry has shown these instrument and computer systems to pay for themselves in less than ten days!)

MATERIALS MANAGEMENT PRACTICES

Management and style are often linked together because of the personal style and experience brought to the job. The different and difficult nature of seafood processing in Alaska makes a manager's job pretty hard to define. However, the one thing that good managers share in any business is that they make it look easy while being successful. This is due in part to minimizing effort through good organization and preparation.

The most important benefit of organization is having a program that can be explained readily to all supervisors and personnel. Having a clear description of what is wanted and expected makes it easier to involve more people and distribute effort. The goal is to increase efficiency by measuring and controlling more process points. This requires good communication so that all production personnel know what is going on and what their responsibilities are.

Using materials accounting principles, key process steps can be defined in terms of the flow of waste, water, and product. Once these have been defined the job responsibility of the people in these areas should include meeting the goals set by management. This requires a clear description and communication of the goals. Trained workers can recognize what is right and act to correct it if needed.

In addition to demanding more responsibility, incentives can also be used effectively. If special treatment or rewards bring higher efficiency, then new performance benchmarks are established that can be used as goals. Once established these new levels should be maintained. This is where a simple measurement procedure is helpful in checking performance both by supervisors and workers.

The best way to create an efficient processing operation is to establish a steady rate of operations so that all streams and processing steps can be adjusted to that rate. This must be done for long enough so that the seafood catch entering the process has determined the output at the packing table. Once this pace is set up all the steps in between can be adjusted. If there is an up or down production change then all new adjustments can be in proportion to the change. Maintaining steady flow allows production personnel to know where things are at and control where they are going.

How to Achieve Water Conservation

Water conservation is achieved by people, mechanical modifications, and instruments or meters.

Ultimately it is the people who will control the water use. Manual water adjustments should be the responsibility of individuals who are familiar with water-use goals and proper settings for plant operation. Unauthorized people need to know that they are not allowed to adjust water use.

However, mechanical modifications are generally needed to achieve water conservation. Below are some simple mechanical modifications that will help minimize water used in a process.

1) Tanks - Float valves will prevent overflows in holding or washing tanks.

2) Hose Nozzles - Any style of nozzle that requires hand pressure will prevent waste at unattended hoses. This can be pistol grip style or the more rugged rubber types found in the dairy industry.

3) Spray Tips - Spray tip performance is determined by pressure, volume, and area. Spray tips provide impact for cleaning with either pressure or volume. The effective distance and area of spray on a target also determines the efficiency. Technical sales people can greatly help in providing the correct application.

4) Brushes - Good design and adjustment of rotary brushes are very effective in reducing spray cleaning water.

5) Hoses - Smaller hoses will require lower flows.

6) Pressure Regulation - Lower pressure produces lower flow.

7) Instruments and Meters (a two-sided application) - The primary function here is to provide a tool to give personnel the information to make good adjustments of key flows or equipment in the plant. The other function is to check and ensure that responsible personnel are meeting the goals set.

How to Control and Reduce Waste

This section discusses handling methods for waste that is being discharged or collected for treatment. The primary goal is to eliminate leaks and assure that all waste is disposed in the manner consistent with your permit. The secondary goal is to reduce water use in conveying waste material.

Where possible, consolidating waste streams reduces the chances for spills and overflows. For flume conveyance the ratio of waste to water can be increased with the higher flow volume of combined streams. Having a higher waste to water ratio also decreases separation of waste in holding areas. Less separation helps to control oil and fat dispersion at discharge points and also limits the possibility of creating hard-to-break foams.

How to Convey Waste

The following methods of moving waste are directed at reducing the use of high volume hoses and flumes.

1) Solid Belt Conveyors - This is applicable to hand cleaning lines where waste and offal can be put on the belt.

2) Pumps - Progressing cavity or piston type pumps do not need added water and can move waste with very little damage. Undamaged waste is easier to handle and has less chance for separation and foaming problems.

3) Vacuum - This is the same as a vacuum cleaner except the material of interest is seafood processing waste.

4) Elbow Grease - Scoop it up and put it in the conveying system or tote boxes for waste. Don't use a hose to wash it away when a little elbow grease will do as well!

How to Cleanup Your Facility

The difficult part of cleanups is motivating and training people to do a good job quickly. There is much information available from state and federal agencies on how to conduct a good cleaning program. The basic steps of a cleanup are below.

1) Remove all heavy solids or deposits. Doing this by hand, using brushes or scrapers, reduces water use. High pressure spray may be needed for some deposits.

2) Apply cleaners where necessary and scrub with scrub brushes and other cleaning tools.

3) Rinse and spray off all cleaned equipment and surfaces.

4) Apply sanitizer.

The keys to any good cleanup are elbow grease, a bucket of cleaning solution, a scrub brush, and specific cleaning tasks outlined for individuals. Water sprays should only be used at the beginning of cleanups to remove heavy deposits and to rinse cleaning chemicals from equipment.

A way to decrease water used for cleaning and increase production time is to clean as much as possible during production. Identify areas and procedures for cleaning during a slowdown or when other opportunities arise. This can extend periods between total stoppage of the plant for a major cleanup.

Cleanups are the most difficult part of an operation to make efficient. To reduce water use and cleanup downtime the first step is to define what needs to be cleaned, how it will be cleaned, and who will do it.

What:

1) The processing and contact surfaces that determine the health, quality, and nutritional value of the finished product,

2) Areas and machinery that are important to safety,

3) Buildup that affects machinery operation and service, and

4) Walls and other surfaces.

Depending upon the operation, items #3 and #4 may not need to be cleaned every cleanup. They do not contribute to the income of the plant and are usually a distraction, water waster, and labor waster. Thousands of dollars in potential revenue have been lost during good harvest periods from downtime used during poorly planned cleanups.

How:

1) Determine the best procedure for a specific job,

2) Determine the time needed,

3) Assign and communicate steps 1 & 2 to an individual, and

4) Inspect and check-off.

Who: Specific people need to be responsible for the areas or equipment associated with their production work. Exceptions would be ability to finish quickly and assist in other areas, unskilled with equipment or procedures, ad physical limitations for the defined job.

DEVELOPING A BEST MANAGEMENT PRACTICES PLAN

This section will cover information and topics that will form the basis for Best Management Practices (BMP) plans. The goal here is to describe what specific information will be needed and how to present it. This will help you to save time and effort in developing a BMP plan and to develop a BMP plan that will lead to better waste and water handling practices. Since this is a plant-wide effort a committee of key plant personnel should be involved in the development of the BMP plan.

The key words are management, planning, and organization. The NPDES permit will require that each facility document the how, what, and why of any process streams that are being put back in the environment. In addition, there will also be the need to identify potential reductions in pollution and propose possible solutions.

How to Identify and Evaluate Pollutant Discharges

The first step is to identify what is being discharged and to recognize the effect it may have on the environment. Below is a list of process streams that contribute to discharges and their potential environmental impacts.

Ground Seafood Waste:

Particles and pieces - Deposition and burial of marine life. Reduction of dissolved oxygen in receiving waters and sediments. Increase in turbidity and color of the water column. Nutrient enrichment of receiving water and sediments.

Solubles - Reduction of dissolved oxygen in receiving waters. Increase in turbidity and color of the water column. Nutrient enrichment of receiving water and sediments.

Oil and grease - Effects on the aesthetic quality of sea surface, shoreline, water column and sea floor. Reduction of dissolved oxygen in receiving water and sediment. Increase in turbidity and color of the water column. Nutrient enrichment of receiving water and sediments. Oiling of seabirds.

Bone and shell - Deposition and burial of marine life. Reduction of dissolved oxygen in receiving waters and sediments. Increase in turbidity and color of the water column. Nutrient enrichment of receiving water and sediments.

Heated Process Water:

Cook water - Wide range of solid particles and soluble protein depending on species and process. Deposition and burial of marine life. Reduction of dissolved oxygen in receiving waters and sediments. Increase in turbidity and color of the water column. Nutrient enrichment of receiving water and sediments. Increase in temperature.

Retort condensate and water - Moderate protein from canning process. Reduction of dissolved oxygen in receiving waters and sediments. Increase in turbidity and color of the water column. Nutrient enrichment of receiving water and sediments.

Fishmeal stickwater - Very high in protein and oil. Reduction of dissolved oxygen in receiving waters and sediments. Increase in turbidity and color of the water column. Nutrient enrichment of receiving water and sediments.

Other Process water

Refrigerated seawater - Moderate seafood pieces and solubles. Deposition and burial of marine life.

Reduction of dissolved oxygen in receiving waters and sediments.

Brine freezer - Some seafood pieces and solubles. Saturated salt solution. Reduction of dissolved oxygen in receiving waters and sediments.

Glaze water - Moderate seafood pieces. Glaze additive. Reduction of dissolved oxygen in receiving waters and sediments.

Cleanup water - Moderate to high seafood pieces and solubles. Cleaning chemicals. Deposition and burial of marine life. Reduction of dissolved oxygen in receiving waters and sediments. Increase in turbidity and color of the water column. Nutrient enrichment of receiving water and sediments. Chemical hazard.

Seafood Handling Water

Seafood hold and pump water - Moderate to high seafood pieces and solubles. Deposition and burial of marine life. Reduction of dissolved oxygen in receiving waters and sediments. Increase in turbidity and color of the water column. Nutrient enrichment of receiving water and sediments.

Ice and slush - Low to moderate seafood pieces and solubles. Reduction of dissolved oxygen in receiving waters and sediments.

Seafood washer - Low to moderate seafood pieces and solubles. Reduction of dissolved oxygen in receiving waters and sediments.

The streams above are general operations that can be a part of most seafood processing facilities and contribute effluent. The remaining process streams for almost all plants should only involve fresh water, salt water, and seafood waste that are unique for each process and contribute to the ground seafood waste that is discharged.

What Is a Materials Accounting Audit

The initial materials accounting audit should include a product recovery rate on which to base waste discharge estimates and an overall water use rate estimate. If other chemicals and waste components can be estimated then they should be included. For materials accounting audits that are not accurate or require more information on major process streams, a plan and timetable should be included on how this information will be gotten.

How to Rank and Prioritize Process Streams

Assign each and every process stream a rank based on contribution to overall discharge. If a stream is too difficult to measure or has not been finished for the materials accounting audit then make your best estimate and assign it a rank.

Why Establish Preliminary Improvement Goals

This is the initial plan that expresses goals and improvement of discharge effluent based on rank of the stream and practical modification of equipment or procedures.

What Is Meant by Methods of Operation

This part of the BMP plan will include operations policies that cover daily or periodic practices and documentation to support control of effluent discharges.

Good Housekeeping - This is directed at maintaining an orderly work environment in regard to chemicals and waste that may enter the discharge stream. Use and storage of chemical cleaners and process additives should be described. A policy describing the amounts of chemicals used and the steps taken to assure the proper use of chemicals should be included. The other part of good housekeeping is eliminating spills and assuring that waste and process streams follow the flow paths outlined in the plant flow diagram. Examples would be a system that assures that a proper number of waste totes and removal time are available, or periodic checking of areas where waste flow may back up.

Equipment Maintenance and Repair - This part of the plan would demonstrate that responsible production and engineering personnel are aware of the proper operation and maintenance of key equipment used for conveying processing wastes. Procedures for repair of equipment and preparedness would also be included.

Inspections and Records - These records will be of the specific measurements or estimates that track the performance of discharge goals. They will cover set production periods and demonstrate the effectiveness of the BMP plan for the facility. They will also describe any improvements or problems associated with that production period and any action taken.

Employee Training - Much of this information would be included in the job descriptions and safety training for the majority of the processing crew. The specific information wanted here is related to those responsible personnel that are trained to recognize and control generation of waste and water. This information would describe the key streams of interest, the people familiar with the control of those streams, the methods to control those streams, and the communication of methods and procedures to responsible personnel. This program should also assure that these selected people are familiar with both hands on and written procedures.

Completion of BMP Plan

Upon completion of the BMP plan it will be reviewed by the facility manager and members of the committee. The facility manager will sign off to acknowledge that the committee of key experienced plant personnel and/or technical people approve of the BMP. This step is important to assure that the BMP plan is realistic and within the capabilities of the people and physical layout of the plant.

Refer to the example in Appendix D to help form an approach to making a materials accounting audit and BMP plan. Much of the information in this handbook will be new to some operators. Hopefully, it will help make the permitting process easier. Much of the information and presentation used in a materials accounting audit and BMP plan will be useful for other government programs. Finally, approaching this job with the goal of higher recovery, better quality, lower overhead, and increased income in the next one to two years will make the effort more worthwhile.

END-OF-PIPE TREATMENT OPTIONS

This section addresses the treatment options which are available to reduce the pollutant loading of your effluent. It is simply an overview of the pollutants found in seafood processor discharges and some of methods of treating these wastes

Which Pollutants Occur in Seafood Processor Wastes

BOD - Biochemical Oxidation Demand. It is the amount of dissolved oxygen required in the decomposition of the discharged effluents. In discharge areas where waste is not well dispersed, the oxygen in the water may be used up in the decomposition of the wastestream and thus be unavailable to aquatic life. This will lead to accumulation of waste and also eliminate many of the plants and animals that rely on oxygen. The BOD is the main indicator of pollution levels from seafood processing effluents.

TSS - Total Suspended Solids. These are the particles, such as muscle fibers and bone fragments, that are suspended as solids in the liquid effluents. These suspended solids are the product of mechanical grinding or shear forces breaking tissue into fine pieces.

Oil and Grease - Although this is usually a minor constituent, its chemical nature make it more troublesome. Oil and grease will emulsify with protein (making separation very difficult), catalyze reactions that cause odor and formation of unwanted byproducts, and form visible scum and foams.

Solubles - These are the water-soluble proteins that are contained in the cells and bloodstream of the seafood. These proteins greatly affect the BOD since they are the first metabolized by micro-organisms and cause the greatest depletion of oxygen.

TRC - Total Residual Chlorine. This is the amount of free chlorine in the water. Sources are from chlorinators for potable water and salt water, and from cleaning chemicals. Chlorine is a very "reactive" chemical, breaking down molecules, which is why it is such an effective sanitizer. It is also why TRC is highly toxic to aquatic life.

<u>How to Measure Effluents</u>

This section outlines some methods to measure some of the above discharge components. The information from these measurements can be compared to any laboratory analysis to compare their accuracy. These measurements can also be used to gain information that can used by engineers or technical support people to make preliminary estimates for any separation equipment that may be considered. With practice and good scientific technique these simple tests can approach the accuracy of laboratory tests. The practical use of these tests is to establish a measured point and then compare future tests to see if the different components are higher or lower than the previous test. This section may be of the most use to surimi producers, but may also be applicable to other processes and seafood species.

Particle Size and Suspended Solids - This is simply taking a set volume of waste and water, running it through a screen, and seeing how much doesn't go through. Starting with a large mesh and running the filtrate through successively smaller mesh size will give you an idea of the particle size distribution. Ideally, having a set of different mesh sizes of stainless steel screens is the best approach. Realistically, this type of measurement will probably be done with whatever is at hand. Some common sources of mesh are expanded metal and wire mesh from the maintenance department, anything the cook is willing to loan, and anything that is available from local supply houses or dry goods stores. (For example, women's nylons or cotton gauze work well for removing much of the finest solids.) The mesh size will need to be measured or estimated for the filtering steps to aid in any preliminary designs of equipment. Other information that can be gotten from filtering trials are observations on drain times, clogging of the different screens, and cleaning requirements.

Total Residual Chlorine - Inexpensive and simple test kits are available from chemical and scientific supply houses to check TRC.

Soluble Protein Measurement - Both of the two methods described below will work for mixtures of solubles and fine suspended solids if the means to remove all the particles are not available. These measurements are based on two different treatments for making soluble protein lose its affinity for water and become insoluble particles that can be separated and measured.

Heat Denaturation and Freeze/Thaw Settling is most applicable to surimi wastewater since stickwater has already been cooked and the stickwater solubles may not all separate out. The items needed are some containers and tubing. Five gallon buckets and the large clear two liter plastic beverage bottles work well. Cut the tops off the pop bottles and save the lids for the buckets. Below is the separation and measurement procedure.

1) Take a sample of wastewater in the five gallon bucket or some of the pop bottles. Two to four gallons is a good sample size.

2) The next step is to heat the wastewater to cook out the protein. This is very similar to poaching an egg. The goal is to heat the water 70 C. to 80 C. as quick as possible to prevent enzyme breakdown of the protein.

3) After cooking put the container(s) of cooked wastewater in the cold storage freezer.

4) The next day put the sample containers in a warm place to thaw where they will not be moved or disturbed. When the cooked wastewater thaws all of the protein will be settled out on the bottom. Be careful not to stir it up.

5) Make a mark showing the depth of the protein in the container. This can be used to compare with future measurements. Now the clear top liquid can be siphoned off with the tubing.

6) The watery protein slurry that is left can be put in a smaller container(s) and the freezing, thawing, and siphon steps can be done again to remove more water. The final volume here can be measured and compared with the beginning volume. It may be possible to do a moisture content on this material and then calculate the actual protein content of the beginning wastewater.

7) If the protein is still too wet for moisture measurement it should be thick enough to filter out water using nylons or even an old tee shirt. Getting a final wet weight and moisture content will provide the information for calculating a wastewater protein concentration.

The information from the above procedure can be absolute or relative. If a good final measurement can be made through to step (7) then it should be relative to the mark made in step (5). This will give a good estimation technique in the future by doing just the first cook/freeze/thaw cycle. The other alternative is to just go to step (5) and use the mark established there to determine if the amount of protein is increasing or decreasing.

If heating is done quickly to limit enzyme breakdown of protein in the cooking step then this technique will extract 90% to 95% of all protein in the wastewater.

Acid/Base Separations change the pH of a wastewater solution and cause soluble protein to separate out. The procedure described here covers only an acid method that uses low pH. If strong acid is used then proper safety gear and trained people should only conduct this test. This test can be done with approximately a one gallon sample size. The containers to use would be the pop bottles or something similar.

1) Distribute the wastewater sample to the containers to be used. Only fill the containers 1/2 to 2/3 full. Clear containers are the best to use.

2) Adjust the pH to 3.0 - 3.5. Vinegar containing 5% acetic acid can be used. It is safer, easier to get, but takes more to lower the pH. As the pH drops the soluble protein will turn white and the mixture will look milky. Let the mixture sit for five or ten minutes.

3) Get a stick that is long enough to reach the bottom of the container. Wet the stick with water and coat it with a thin layer of baking soda.

4) Put the stick with baking soda in the container all the way to the bottom, give it a few swirls, and pull it out. The gas generated from the reaction will float all the protein to the surface. Don't breath the gas. It may contain irritating substances.

5) After a few minutes the foam can be scraped off or the liquid can be siphoned off. Prime the siphon tube by filling with water, not by mouth suction.

6) The separated protein can be measured at this point for a relative measurement or can be concentrated further by freeze/thaw and filtering. Determining the weight and moisture content of the separated protein can then be used to calculate the concentration in the original wastewater. This method should cause about 95% of the protein to separate out.

What Are Some of the End-of-Pipe Treatment Technologies

This section covers equipment and treatment technologies that have potential use for removing protein, oil, and grease from seafood processing wastewater. The descriptions will be brief. More detailed information has been published from other studies that can better describe the procedures and equipment. The references for these studies are contained in Appendix C.

Screening - This is a simple and very effective way to remove insoluble meat and protein particles. The equipment and concept is simple, but good design is difficult. Very good flow and particle size data are needed to determine an effective design.

Sedimentation - This is collecting the waste stream in a tank or pond and letting material settle out.

Centrifugation - Decanter type centrifuges are very effective at removing particles. Models are available that can separate fine suspended particles. Centrifugation is also used to separate oil and water mixtures.

Heating and Centrifugation - This uses heat to coagulate protein and centrifugation to separate the mixture. The protein is very high quality and the water can be recycled and used in the plant. Viscosity and flow characteristics of the waste streams often require some equipment modification.

Dissolved Air Floatation - This is a common technique that is used in some seafood processing plants and other food processing facilities. The basic mode of operation is similar to the acid separation described earlier. There are a number of variations that use different chemicals and ways to introduce gas bubbles.

Ultrafiltration - This uses very fine filters that can be sized down to remove many of the soluble proteins.

Electrocoagulation - This uses an electro-chemical reaction to start the coagulation of protein.

Ozonation - This process generates ozone which acts as the protein coagulating agent. The clarified water may be recycled for plant use depending on its chemical content.

APPENDIX A

UNITS AND CONVERSIONS

COMMON UNITS OF MEASUREMENT AND EQUIVALENTS

1.0 kilogram = 1000 grams = 2.2046 pounds

1.0 pound = 454 grams = 0.454 kilogram = 16 ounces

1.0 ounce = 28.3 grams

1.0 metric ton = 1000 kilograms = 2204.6 lbs. = 1.0 long ton

1.0 short ton = 2000 lbs. = 907.2 kilograms

1.0 meter = 100 centimeters = 1000 millimeters = 3.28 feet

1.0 foot = 0.3048 meters = 30.48 centimeters

1.0 inch = 2.54 centimeters

1.0 liter = 1000 millilters = 1000 cubic centimeters

1.0 liter = 1.0567 quarts

1.0 quart = 0.946 liter = 57.75 cubic inches

VOLUME AND WEIGHT OF FRESH WATER

1.0 cubic centimeter H2O = 1.0 gram

1.0 liter H2O = 1000 grams = 1.0 kilogram

1.0 gallon H2O = 8.34 pounds

1.0 quart H2O = 2.08 pounds

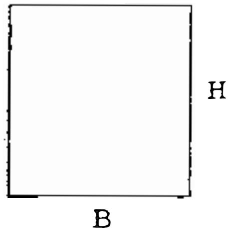
1.0 cubic foot H2O = 62.43 pounds

1.0 short ton H2O = 240 gallons

1.0 long ton H2O = 264 gallons

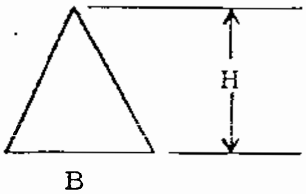
APPENDIX B

MENSURATION FORMULAS FOR AREA AND VOLUME



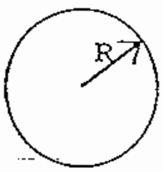
AREA = BASE x HEIGHT

RECTANGLE



AREA = 1/2 x H x B

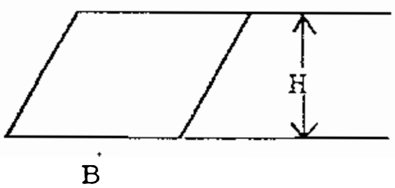
TRIANGLE



π = 3.14159

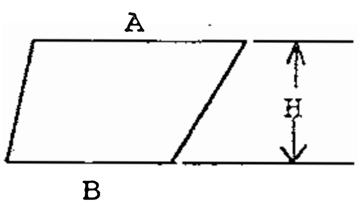
AREA = 3.14159 x R x R

CIRCLE



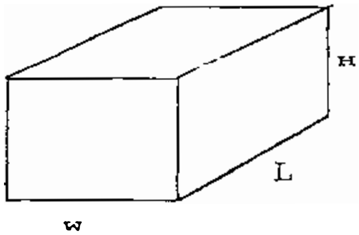
AREA = B x H

PARALLELOGRAM



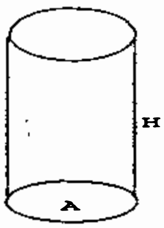
AREA = 1/2 x H x (A + B)

TRAPEZOID



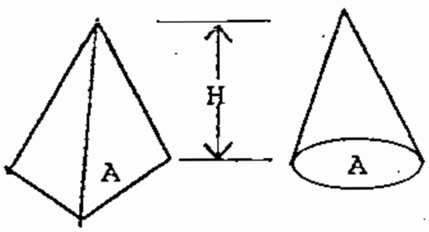
VOLUME = L x W x H

RECTANGULAR SOLID



VOLUME = H x (Area of Base)

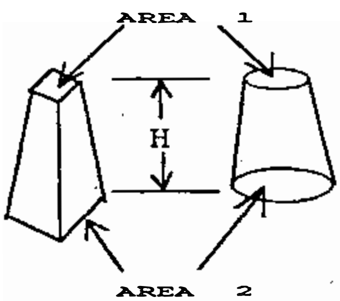
CYLINDER



VOLUME = 1/3 H x (Area of Base)

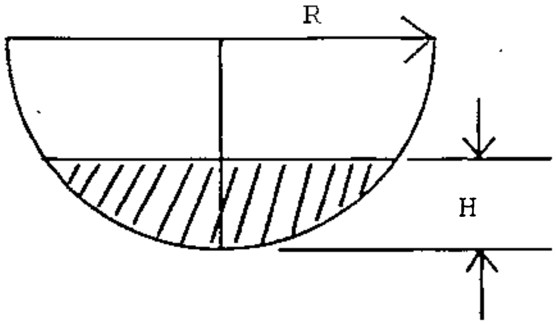
PYRAMID OR CONE

PYRAMID CAN HAVE ANY NUMBER OF SIDES.
THE LENGTHS OF THE BOTTOM EDGE OF
EACH SIDE MUST BE EQUAL.



VOLUME = $1/3 \times H \times (A1 + A2 + \sqrt{A1 \times A2})$

SECTION OF PYRAMID OR CONE



CIRCLE SECTION

TABLE OF RATIOS FOR CALCULATING CIRCLE SECTION AREA

RATIO OF H/R	RATIO OF AREA/RADIUS SQUARED
0.008555	0.0014901
0.015192	0.0035229
0.023704	0.0068570
0.034074	0.0117993
0.046283	0.0186444
0.060307	0.0276720
0.076121	0.0391456
0.093692	0.0533100
0.112989	0.0703895
0.133975	0.0905860
0.156609	0.1140780
0.180848	0.1410188
0.206647	0.1715355
0.233956	0.2057277
0.262723	0.2436676
0.292893	0.2853982
0.324410	0.3309339
0.357212	0.3802606
0.391239	0.4333348
0.426424	0.4900846
0.462700	0.5504103
0.500000	0.6141847
0.538251	0.6812546
0.577382	0.7514417
0.617317	0.8245437
0.657980	0.9003667
0.699294	0.9785754
0.741181	1.0589969
0.783560	1.1413210
0.826352	1.2252533
0.869474	1.3104871
0.912844	1.3967057
0.956381	1.4835852
1.000000	1.5707963

APPENDIX C

TECHNICAL REFERENCES

1971 Utilization and Disposal of Crab and Shrimp Wastes. University of Alaska Marine Advisory Bulletin No. 2, Fairbanks, Alaska.

1979 Reassessment of Effluent Limitations Guidelines and New Source Performance Standards for the Canned and Preserved Seafood Processing Point Source Category. Prepared for the U.S. Environmental Protection Agency by Edward C. Jordan Co., Inc. of Portland, Maine.

1992 Ways to Reduce, Reuse, and Recycle Solid Waste Generated by Southwest Alaska's Fish Processing Industry. Southwest Alaska Municipal Conference, 3300 Arctic Blvd., Suite 203, Anchorage, Alaska, 99503. Telephone (907) 562-7380.

1993 Recoveries and Yields from Pacific Fish and Shellfish. Chuck Crapo, Brian Paust, and Jerry Babbitt, Alaska Sea Grant College Program, University of Alaska, Fairbanks, Alaska, 99775-5040. Telephone (907) 474-6707; FAX (907) 474-6285.

1993 Pollution Prevention Opportunities in the Fish Processing Industry. Pacific Northwest Pollution Prevention Research Center, 1326 Fifth Avenue, Suite 650, Seattle, Washington, 98101. Telephone (206) 223-1151; FAX (206) 223-1165.

1993 Wastewater Handling Practices in Selected Fish Processing Plants in Northern Europe. Report to the Fisheries Council of British Columbia. Prepared by NovaTec Consultants, Inc., 224 West Eighth Avenue, Vancouver, British Columbia, V5Y1N5.

1994 Proceedings of the Wastewater Technology Conference and Exhibition. Fisheries Council of British Columbia, 1188 West Georgia Street, Suite 1400, Vancouver, British Columbia, V6E4A2. Telephone (604) 686-6454; FAX (604) 684-5109.

1994 How to Do a Seafood Processing Plant Water, Waste, and Wastewater Audit. Prepared by Alan Ismond, Aqua-Terra Consultants, Vancouver, British Columbia for the Province of British Columbia, Ministry of Agriculture, Fisheries and Food (Attn: John Willow, Industry Development Officer), 808 Douglas Street, Victoria, British Columbia, V6A2Z7. Telephone (604) 356-2167; FAX (604) 953-5162.

APPENDIX D

EXAMPLE

OF

BEST MANAGEMENT PRACTICES PLAN

BEST MANAGEMENT PRACTICES PLAN

FOR

ROCKY COVE FISH PROCESSORS, INC.

SUBMITTED TO:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION X

TABLE OF CONTENTS

PAGE

The enclosed Best Management Practices Plan has been reviewed and accepted as reasonable by committee members of Rocky Cove Fish Processors.

Date_______________

____
Plant Manager

BMP COMMITTEE MEMBERS

The following people have provided input to the BMP plan for Rocky Cove Fish Processors and agree that the goals and content are reasonable for operation at this time.

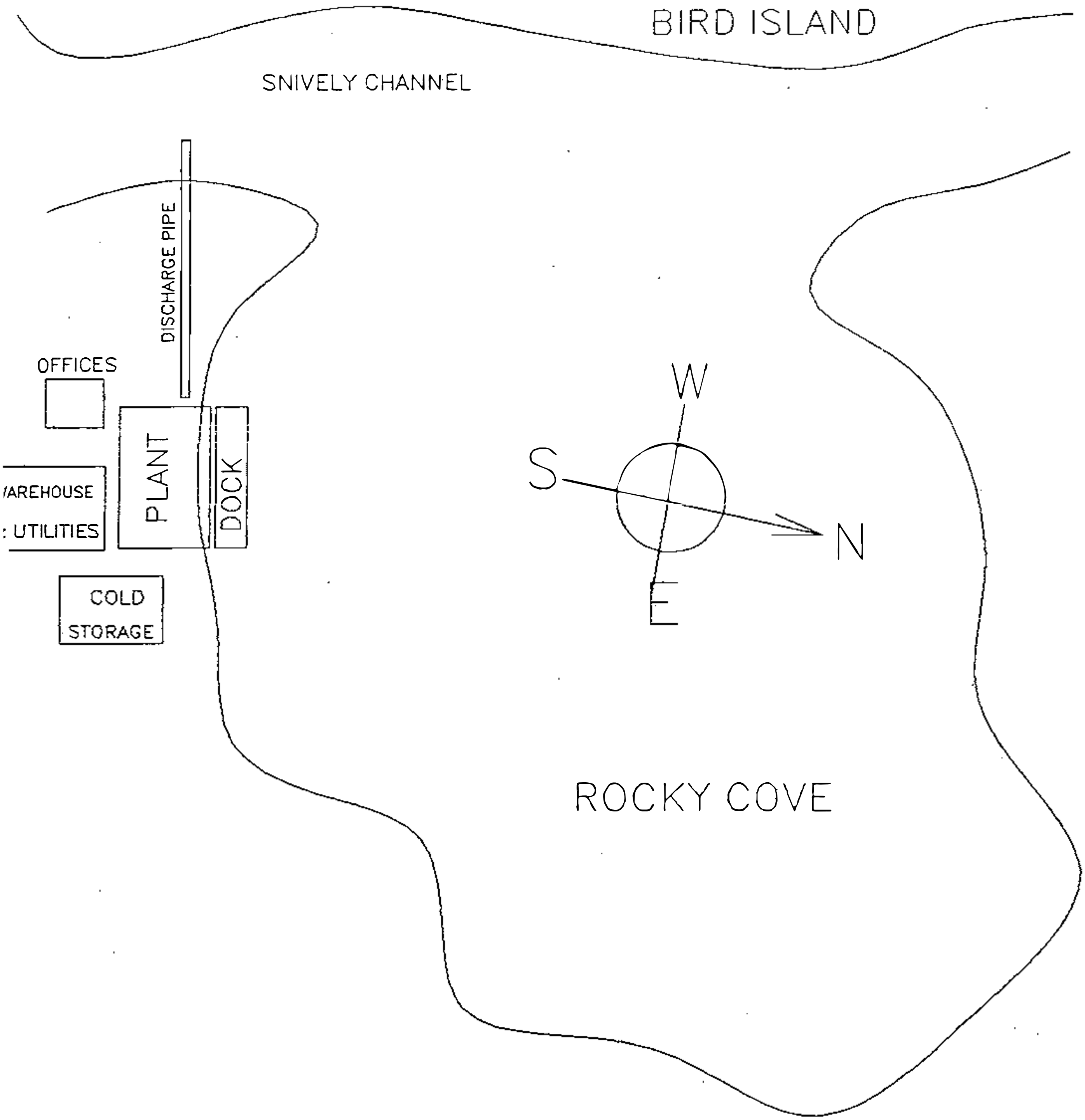
NAME	POSITION	EXPERIENCE
	Factory Manager	7 yrs.
	Chief Mechanic	3.5 yrs.
	Foreman	3.0 yrs.
	Foreman	2.5 yrs.
	Master Fisherman	21.0 yrs.

DESCRIPTION OF THE FACILITY

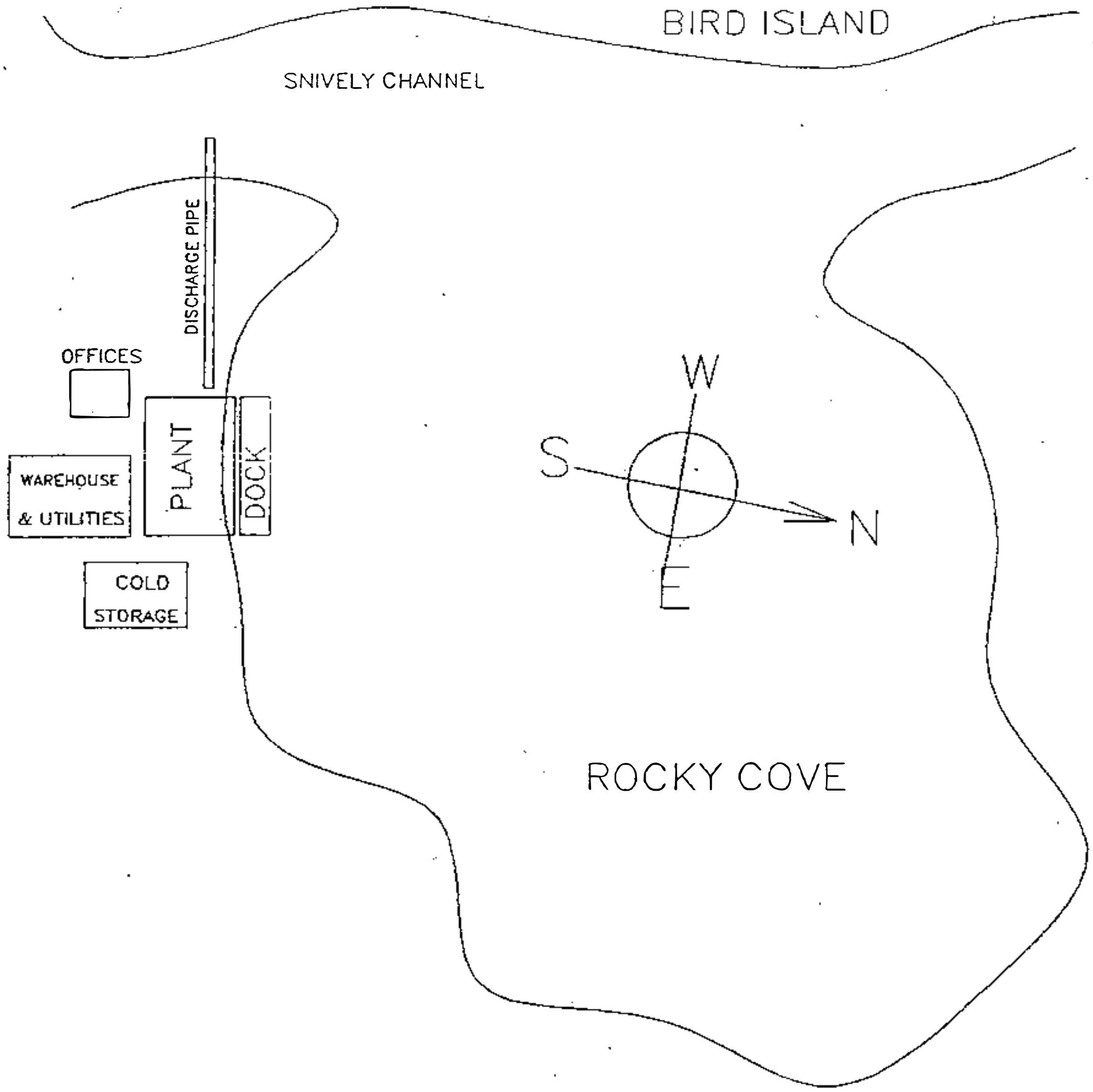
Rocky Cove Fish Processors is located on the Southeast shore of Rocky Cove. Rocky Cove is a small inlet that empties directly into Snively Channel one mile from the town of Redbank. The processing plant was built in 1948 and has operated every year on a seasonal basis. The facility consists of the main processing plant, a refrigeration plant and ice room, cold storage, storage warehouse, physical plant and engineering, offices, and a large dock that can accomodate three fishing vessels.

For the past eight years the main products have been fresh and frozen fish and fish fillets. Depending on availability of fish and market demand products range from cuts of individual servings to whole frozen fish. Over 60% of all fish processed is usually salmon. This takes place over a two and a half month period with one month being the peak of the season. During the rest of the year there is some steady and periodic processing of other finfish and flatfish depending on fishing and weather. This work is done by employees that live in the town of Redbank.

The fish waste from the Rocky Cove plant consists of heads, guts, frames, trimmings, and unusable fish. All this waste is flumed or conveyed to a grinder and pump. The ground fish waste is pumped through a 400 foot pipe out to Snively Channel where the discharge is located at the ten fathom mark.

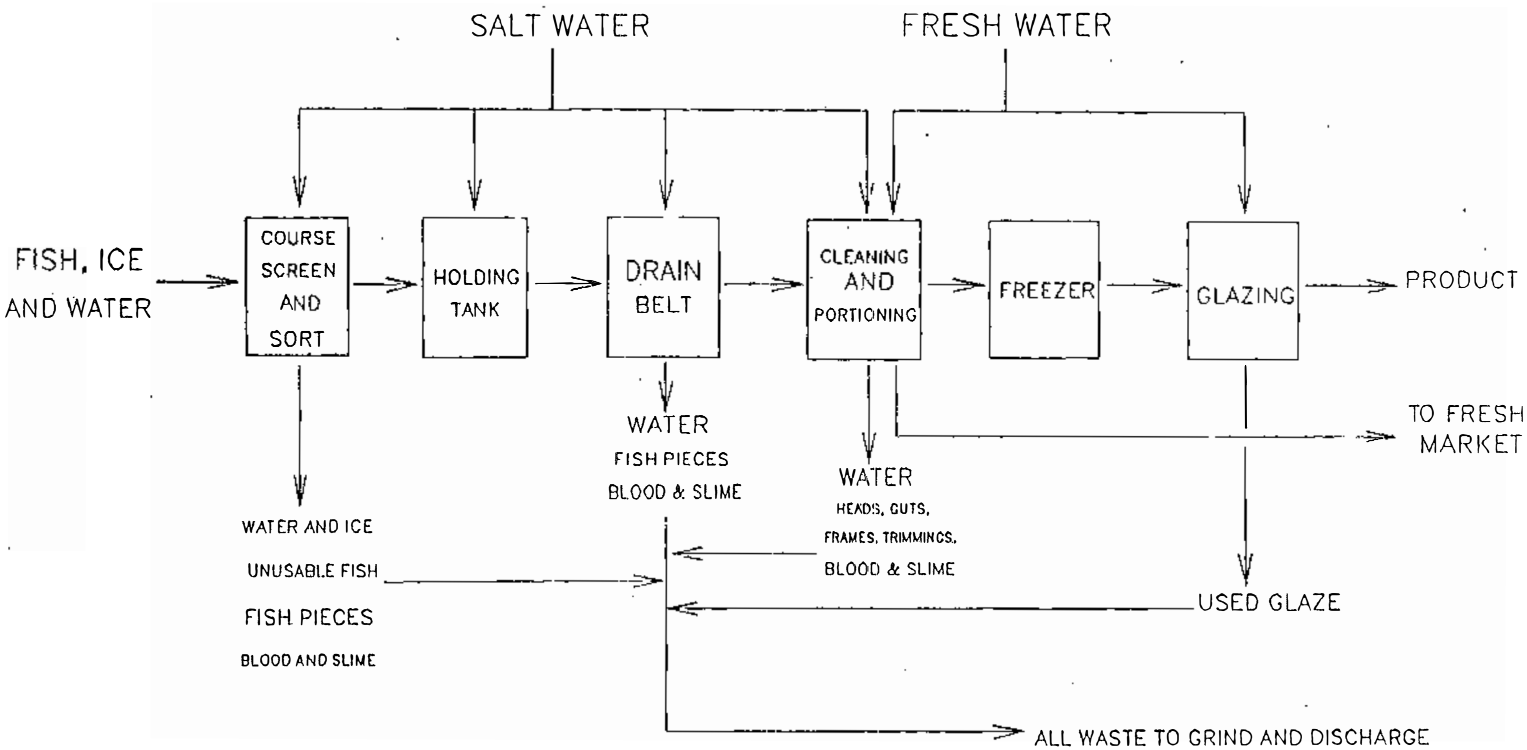


UNOFFICIAL LOCATION MAP FOR ROCKY COVE PROCESSORS



UNOFFICIAL LOCATION MAP FOR ROCKY COVE PROCESSORS

FLOW DIAGRAM FOR ROCKY COVE PROCESSORS



streams. All the streams are accessible. If this does not give good results the installation of a flow meter on the salt water line will be investigated.

RISK OF PROCESS STREAMS

Almost all of the fish waste is from the area where the fish are cut and cleaned. Most of the remaining waste is from the course screening step. Anything else would be in the drain water from the holding tank. It is estimated that these streams account for 96%, 3%, and 1% of the fish waste.

IMPROVEMENT GOALS

In order to increase recovery and reduce waste the number of sample weighings on fish being processed will be increased. The goal is to try to achieve and maintain a higher recovery rate.

GOOD HOUSE KEEPING POLICY

Chemicals and tools used for cleaning are kept in a separate storage area away from the processing floor. Foremen and selected people are trained in handling, use, and proper dilution of chemicals during cleaning. They are the only ones authorized to do this.

To keep buildup of waste on the floors and grating to a minimum there is one person from each processing area that is assigned to regularly clean and assure that waste streams are flowing.

All used ice is run through the screening step so it is part of the overall waste stream. If this is not possible it is set aside in tote boxes until it can be disposed of.

EQUIPMENT MAINTENANCE AND REPAIR

All fish and waste are moved by conveyor belts, water troughs and flumes, or by hand. Worn or jammed conveyor belts are usually repaired by the shift mechanic in ten to twenty minutes. Replacement may take up to one hour depending on the amount of damage. These are the only mechanical devices in the process line that can fail and cause a backup. This is a common enough occurance that the parts and procedures for repair are well known.

In the event that the main grinder and discharge pump needs repair or service the following provisions have been made.

- Spare parts and a motor are located nearby in a storage locker.
- Lift points and hoists are set up to remove the entire motor, grinder, and pump.

- To unclog the pump requires approximately one hour.
- To replace the grinder and pump impeller requires two to three hours.
- Replacing the entire unit would require four to five hours.

INSPECTIONS AND RECORDS

A new daily production report is being drawn up that will include the following information.

- Weight of fish processed, weight of product, amount of fish waste, and recovery rate.
- Water use based on measurements or best estimate.
- Any cleanups and amount of chemicals used.
- Mechanical failures, repairs, and modifications. The estimated effect on plant efficiency and waste streams.

EMPLOYEE TRAINING

The shift foremen are responsible for overseeing and training selected processing personnel in the proper operation and goals set for different process flow streams. The control points and procedures are covered below.

SCREEN AND SORT - Salt water spray should be set to a level to clean the fish being run. Reduce the flow rate if there is over spray or waste that is not entering the catch pan. The water should be shut off when no fish are being washed and sorted. If used ice is being discarded enough water flow must be provided to prevent blockage of the waste flume. Large unusable fish may need to be cut up before entering the waste flume to prevent blockage.

HOLDING TANK - The ratio of water or slush to fish should be about one to one. A high level mark one foot below the top of the tank is not to be exceeded. This high level mark would indicate a volume of about twenty tons of fish and water.

DRAIN BELT - The spray here should be adjusted to rinse the fish clean and also keep the belt clean. If the belt becomes clogged and dirty the spray may need to be turned up or the belt stopped and hand cleaned. A clean belt is needed to keep waste from being carried to other processing steps or outside the drain system at this step.

FISH CLEANING AND PORTIONING - There are a number of different stations and individuals that handle cutting, cleaning, and trimming tasks. All employees have been shown the water shutoffs for the hoses supplying their station and have been instructed to shut off any water that is not being used in the processing steps or when there is a break or stoppage. As outlined in the good housekeeping section a person has been assigned the duty of regularly policing this area to cleanup small spills and buildup, and make sure waste is flowing in proper channels. This person also monitors the use of water.

SPILL PREPAREDNESS

During very heavy fishing periods there is too much ice to dispose of. This ice will be disposed of by dumping off the West end of the dock on outgoing tides. The amount of dumped ice will be recorded. In the event that the main grinder and discharge pump is down, waste will be dumped down the old flume that empties directly into Rocky Cove. Past experience has shown that this can be done for up to twelve hours with no visible material deposited or left onshore after one daily cycle of tides. The amount of waste diverted will be recorded along with notes on any effect on beaches and wild life.

SECURITY

The entire waste system including collection in the plant, grinder, pump, and disharge pipe are all very visible. Any operation or tampering by unauthorized people could be seen by foremen and other workers. The pipeline is above the ground and parallels a well traveled path to the beach. Any leaks or damage to the pipe can be easily detected.

APPENDIX E

AGENCIES AND ORGANIZATIONS

Pacific Northwest Pollution Prevention Research Center
1326 Fifth Ave. Suite 650
Seattle, WA 98101

United States Environmental Protection Agency
1200 Sixth Ave.
Seattle, WA 98101

National Marine Fisheries Service
Northwest Fisheries Science Center
2725 Montlake Blvd. E.
Seattle, WA 98112

Ministry of Agriculture, Fisheries, and Food
Aquaculture and Commercial Fisheries Branch
808 Douglas Street
Victoria, B.C. V8W2Z7

Fisheries Council of B.C.
1188 West Georgia Street Suite 1400
Vancover, B.C. V6E4A2

Washington Dept. of Ecology
POB 47696
Lacey, WA 98504-7696

Industry Canada
900-650 West Georgia Street
Vancover, B.C. V6B5H8

B.C. Environment
1106-1175 Douglas Street
Victoria, B.C. V8V1X4

Environment Canada
224 West Espalnade
North Vancover, B.C. V7M3H7

University of Alaska
Fishery Industrial Technology Center
Kodiak, Alaska 99615

Institute for Food Science and Technology
College of Ocean and Fishery Sciences
University of Washington HF-10
Seattle, WA 98195

Oregon State University
Seafood Laboratory
250 36th Street
Astoria, OR 97103