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POLLUTION PREVENTION
for
CANNING INDUSTRIES

Training Manual

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CHAPTER 1
INTRODUCTION

1 1 Purpose of Manual

This manual provides an introduction to the application of pollution prevention techniques in the canning industry Other helpful information is provided in the appendix

This is the seventh manual in a series on the topic of pollution prevention The first manual, "Pollution Prevention Concepts/Applications," discusses the theory and practice of pollution prevention techniques in general terms The reader should refer to this manual for general pollution prevention methodologies and definitions The second manual, "Pollution Prevention in Metal Finishing Industries," provides a survey of the application of pollution prevention techniques within the range of metal finishing processes The third manual, "Pollution Prevention in the Textile Industry," provides an introduction to the application of pollution prevention techniques in various textile preparation and finishing processes The fourth and fifth manuals, "Pollution Prevention for Dairy Industries," and "Pollution Prevention in the Fish and Shellfish Industries," outline pollution prevention strategies that are applicable to the food processing industries The sixth manual, "Pollution Prevention in the Chemical and Petroleum Processing Industries," provides information on the pollution prevention opportunities that exist in these industries In addition, there are plans to prepare pollution prevention manuals for the pulp and paper, tanning, mining, and printing industries

The user of this canning manual should view it as a first source in pursuing process and equipment changes in the industry The manual is intended to assist professionals in determining 1) where there might be potential for improving process efficiency and profitability in canning facilities, and 2) which alternatives are worthy of consideration for implementation Users of this manual should not rely on its contents alone to carry out specific measures, but rather seek assistance from experienced professionals in the field However, as a general rule of thumb, those process improvement measures which can be implemented at no cost or low cost, or with minimal effort should be considered first, while the more capital and labor intensive options will require more extensive review

1 2 Background

The canning industry uses billions of liters of water and produces tons of food and process waste each day A long-term environmental management program is required to ensure environmental progress in water conservation and pollution control

The canning industry encompasses a wide variety of food products and procedures This course will focus on four main canned food industries fruit and vegetable processing, meat and poultry processing, fish and shellfish processing, and dairy processing

The implementation of practical pollution prevention measures is one way to generate revenue and profits by reducing product loss In the cannery, a majority of the contaminants in the wastewater is lost product Many countries require that before plant wastewater can be discharged, these contaminants be removed, a condition that can lead to increased treatment costs By making process changes that prevent these materials from getting into the wastewater, product losses can be reduced substantially, further increasing profitability Product that previously was lost to the environment can be saved and sold for additional revenue

1 3 Waste Characteristics

The major pollutants and wastes associated with any food processing operation are organic material (e g , fats, proteins, carbohydrates) and although the types of wastes are limited, the amount of waste that is generated is significant Although organic material is not considered toxic, its effects on the environment can be severe High levels of organic waste in a plant's wastewater contribute to high levels of biological oxygen demand (BOD) in the body of water to which the water is released When dumped untreated into a body of water, this organic material is decomposed by microorganisms in the water When breaking down the organic pollution, the microorganisms consume oxygen in the water Depleted oxygen levels can have a catastrophic effect on the ecology of the natural water body and its surrounding environment and populations BOD is discussed in more detail in Chapter 2

CHAPTER 2
ORGANIC (FOOD) WASTE

2 1 What is Organic Waste?

Organic waste refers to any waste material of plant or animal origin When discharged into a water body, organic waste impacts the receiving water body in two ways First, it serves as sustenance for microorganisms, inducing growth of particular species which otherwise would not occur at all or would occur at only very low concentrations One example would be the proliferation of algae, which frequently increases turbidity and alters the aquatic chemistry, often with dramatic negative impact on affected aquatic life Pathogenic (disease causing) microorganisms also thrive on dead organic matter, placing populations using the polluted water at risk of illness

Depending on the type of food being processed, waters polluted with food waste can contain any combination of bacteria, protozoa, fungi, algae, or viruses The second way in which organic waste impacts the receiving body of water is by consuming dissolved oxygen, leading to reduced dissolved oxygen concentrations Depleted oxygen levels cause water conditions to become septic (unable to sustain species that require oxygen), resulting in water quality problems which can seriously impact public health Oxygen levels in receiving waters can be replenished after discharged organic waste has been consumed by microorganisms, but this process requires time The result is a zone of lower dissolved oxygen levels downstream of or around the point of discharge With several points of discharge, entire water bodies can become septic if there is no longer enough time for oxygen levels to recuperate

2 2 What is Biological Oxygen Demand (BOD)?

Biological oxygen demand (BOD) is an indirect measure of the amount of organic material present in water which can be biologically degraded (by microorganisms) Since dissolved oxygen is consumed in the process of degrading organic material, the amount of organic material in the water can be expressed in terms of the amount of oxygen required to degrade it BOD is typically expressed as BOD_5 which refers to the amount of dissolved oxygen in a sample which is consumed over a period of five days under a standard temperature and pressure Calculations can then be performed to determine the total BOD (and thus the total amount of organic matter) in the sample Milligrams of oxygen per liter are the units conventionally used to express BOD

2 3 Estimating BOD

Since BOD is an indirect measure of the amount of organic matter present in a sample, BOD can also be estimated in food plant wastewater by determining the fat, protein, and carbohydrate content of the sample Conversions are accomplished relatively easily since fat,

protein and carbohydrates each require a specific amount of oxygen to be degraded

CHAPTER 3
WATER

3 1 Introduction

Water is important to all aspects of the food industry It is an ingredient in many food products, and it is used for washing products, blanching, making syrups and brines, cooking, cooling, cleaning, and sanitation

The amount of water used in food processing operations is significant For example, some large canning operations may use up to 40 million liters of water per day, vegetable processors use about four liters of water for every can of green beans produced

3 2 Water Quality

Water quality is an especially important consideration for canneries because clean water is essential for the production of canned products Processing water use includes washing products, scalding, making brines, cooking, cooling, cleaning and sanitation

Although recirculated or reconditioned water may be used for a variety of processes, canneries must pay attention to both the organic and inorganic impurities, and bacterial content of the water that they use The U S requires food processing industries to use only potable water during the final preparation and canning of foods intended for human consumption

3 3 Wastewater Characteristics

As water is used in the canning plant, parts of the food product being processed are deposited in the water, and this wastewater must be properly handled

During production, some industrial wastewater is generated from spillage and activities such as cleaning operations The type and quantity of food that is canned will determine the characteristics of any particular canning wastewater stream

CHAPTER 4
CANNING PROCESSES

4 1 Introduction

Canning operations, despite the different end products, share several common steps These steps, along with pre-canning preparation techniques for specific products, are outlined in this chapter

Canning procedures vary with product type The general rule for all products, however, is that they should be canned as soon as possible after harvesting or initial processing

The canning process involves several steps

- Packing the prepared product into cans,
- Adding ingredients to enhance flavor, improve quality, or aid preservation,
- Removing air from the cans (usually performed by vacuum methods),
- Closing and sealing the cans, and
- Heating the cans to sterilize the product [1]

4 1 2 Fruits and Vegetables

Fruit and vegetable products intended for canning are harvested before processing In general, all subcategories of fruit and vegetable processing have similar process operations

4 1 2 1 Preparation

Harvesting The crop or commodity is harvested, separated from "trash" (stems, leaves, etc), sorted, transported, and received at the processing plant No wastewater is generated

Washing and Rinsing Prior to processing, the fruits and vegetables are washed and rinsed by means of flumes, soak tanks, water sprays, flotation chambers, or any combination of these methods Great quantities of water are used

Sorting and Grading The commodity is sorted and graded by mechanical, optical, manual or

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Processing Aquatic Food Products John Wiley & Sons, 1985

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hydraulic means Density graders employing brine of controlled density are used to separate ripe from overripe produce Weed seeds, chaff, and stones may be separated from the valuable food product by density and in froth separators

Stemming, Snipping, Trimming Stemming, snipping, and trimming are accomplished by a variety of mechanical means No wastewater is generated

Peeling Many fruits and vegetables are peeled prior to canning This serves the multiple purpose of removing residual soil, pesticide residues, coarse, fuzzy, or tough peeling with unpleasant appearance, mouth feel, or digestive properties

Peeling is accomplished mechanically by cutting or abrasion, thermally by puffing and loosening the peel by application of steam, hot water, hot oil flame, or blasts of heated air, or chemically, principally using caustic soda (with optional surfactants) to soften the cortex so it may be removed by mechanical scrubbers or high-pressure water sprays

Pitting, Coring, Slicing, and Dicing Pitting, coring, slicing, and dicing are accomplished by a variety of mechanical techniques depending upon the commodity used and end product desired No wastewater is generated

Pureeing and Juicing Widely varied techniques are used for pressing and separating fluid from fruits and vegetables The equipment used for this process includes reamers and a wide variety of crusher-presses, either batch or continuous in operation

Oxygen and other gases (nitrogen, carbon dioxide) present in freshly pressed or extracted fruit and vegetable juices may be effectively removed using deaerating vacuums The liquids to be deaerated are pumped into an empty chamber either as a spray or as a thin film Products that have been properly deareated exhibit improved color and flavor retention, and have the added benefit of producing reduced amounts of foam during container filling and reduced separation of suspended solids

Some solutions will require evaporation to create concentrate In this process, the liquid to be concentrated flows continuously across a heat exchange surface which separates it from the heating medium After being heated, the resulting vapors are separated from the residual liquid There are various types of evaporators, including open kettles, shell-and-tube heat exchangers, flash evaporators, rising and falling film evaporators, plate type evaporators, thin-film centrifugal evaporators, vapor separators, vacuum evaporators and heat pump evaporators

Size Reduction A wide range of size reduction equipment is required to produce different types of particulated solids It is important to select a machine which can most economically produce the desired result The physical characteristics of the material and by the required particle size and shape are considerations

Blanching Blanching (scalding or parboiling) of the commodity for canning is done to achieve any of the following results removal of air from tissues, removal of solubles which may affect clarity of brine or liquor, fixation of pigments, inactivation of enzymes, protection of flavor, leaching of undesirable flavors or components such as sugars, shrinking of tissues, raising of temperature, and destruction of microorganisms

Blanching is accomplished by putting the products in contact with water or steam Commodities intended for canning are usually not cooled after blanching

The pollution loads from blanching are a significant portion of the total pollution load in the effluent stream during the processing of certain fruits and vegetables

4 1 2 2 Canning Prior to filling, cans should be thoroughly washed There are usually three steps in the can cleaning operation First, the cans travel a short distance in the inverted position, second, they are flushed with a relatively large volume of water under high pressure, and third, they travel another short distance in the inverted position for the purpose of draining excess water This is usually accomplished mechanically

The commodity is then filled into the can by hand, semi-automatic machines, or fully automatic machines, depending on the product involved In some products, there is a mixture of product and brine or syrup In other cases, brine or syrup is added hot or cold as top-off liquid When the top-off is cold, it is necessary to exhaust the headspace gases to achieve a vacuum and maintain product quality

Exhausting in order to create a vacuum is usually accomplished by one of the following three methods

- Thermal exhaust or hot filling The contents of the container are heated to a temperature of between 65 to 81 degrees Centigrade, prior to closing the container Contraction of the contents of the container after sealing produces a vacuum

- Mechanical A portion of the air in the container headspace is pumped out by a gas pump

- Steam displacement Steam is injected into the headspace to replace the air, and sealed A vacuum is produced when the steam condenses

The descriptions below outline the various processes that are used to prepare several of the most popular forms of canned fruits and vegetables [2]

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[2] *A Complete Course in Canning and Related Processes 12th Edition, Volume III -- Processing Procedures for Canned Food Products* The Canning Trade, Inc , 1987

4 1 2 2 1 Pineapple Ripe pineapple must be canned on the same day as it is picked From the field, the fruit is manually graded and sorted by size It is then loaded into a machine that removes the outer casing and the core, and cuts off the ends Any imperfections are then removed manually The prepared fruit is then washed and cut into the desired shapes (e g , slices, chunks, crush) Cans are typically hand filled and, if desired, are filled with syrup The filled cans are then vacuum sealed, heated to approximately 88 degrees Centigrade, and then cooled in cold water

4.1.2.2.2 Beans Varieties of beans are harvested and washed, and then sent through grading and sorting systems (manual and automatic) The beans are blanched, and then sent to the canning area The cans are manually filled and then a boiling hot mild brine is added as a preservative The cans are vacuum sealed and then cooled in water immediately after sealing

4 1 2 2 3 Tomatoes After harvesting, tomatoes are thoroughly washed and manually inspected for quality and suitability for canning Canning quality tomatoes are either scalded to remove their skin and then cooled immediately to prevent heat damage or peeled by hand The canning process requires several steps Typically, small amounts of preservatives such as sugar and salt are added to the cans Pure tomato juice and then the tomatoes are added next This process is mechanized

4 1 3 Meat and Poultry

4 1 3 1 Preparation

Cattle, hogs, and poultry intended for canning are usually slaughtered and prepared (e g , headed, skinned, eviscerated) before they reach the canning facility A complete guide to slaughtering and meat processing operations and the pollution prevention opportunities associated with them are provided in another Environmental Pollution Prevention Project (EP3) training manual, *"Pollution Prevention for the Food Processing Industries "* Although processing techniques vary with animal type, procedures that apply to cattle, hogs, and poultry are briefly described here

Slaughtering and Processing Animals are killed and their carcasses are allowed to bleed thoroughly They are then decapitated, skinned, and eviscerated Carcasses are thoroughly cleaned and cut to desired specifications

Rendering Cattle and hog meats are sent to a rendering area The process of rendering separates fats and water from tissues and solids, resulting in a marketable product suitable for canning from otherwise unmarketable wastes Both wet and dry rendering processes are used, and either may produce edible or inedible products It is imperative that all inedible products be separated from the edible products

Dry rendering, also known as low temperature or batch rendering, is used more often for

edible products Edible trimmings and cuttings are collected from cutting operations and sent to be rendered into edible fats and tallow This process is performed without the addition of water or steam

Chilling After thorough washing, the processed products are chilled and prepared for shipment to the cannery

4 1 3 2 Canning As described above, cans should be thoroughly washed and sanitized prior to filling The description below outlines the basic process used to prepare canned meat and poultry products Because the basic processes are so similar, they have been combined into one description Canners interested in processes for specific products should refer to, "*A Complete Course in Canning and Related Processes*," Volumes I-III (ordering information is available from the EP3 Washington Clearinghouse)

4 1 3 2 1 Beef, Pork, and Poultry The meats are cooked according to the intended recipe The meats are cut into the desired size and then packed into cans Flavorings and preservatives are added as needed To prevent any bacterial growth or product spoilage, the cans are sealed immediately, heated, and then cooled in water

4 1 4 Fish and Shellfish

A complete guide to fish and shellfish processing operations and the pollution prevention opportunities associated with them are provided in another EP3 training manual, *"Pollution Prevention for the Fish and Shellfish Industries "*

Harvesting Fish and shellfish are harvested by shipping vessels of various sizes and capacities After emptying the catch from their fishing nets, large commercial fishing vessels are capable of performing some processing activities on board (such as live-catch storage or refrigeration) before returning to port Smaller vessels, with inadequate space for preserving the harvest, must usually return to port immediately to empty their catch Undesirable fish (e g , wrong species, unhealthy, or undersized) are returned to the sea from the boats

Sorting The catch is usually sorted into categories of like species, market-sized animals, and debris while still on board the fishing vessel Manual sorting procedures often continue throughout processing Tumblers have been developed to assist in sorting operations and are particularly effective in separating debris from shellfish

Washing Washing the harvest is performed to remove undesirable elements such as slime, external bacteria, dirt, and additional contaminants As a cleaning operation, washing processes must utilize a high grade of non-polluted fresh or salt water A variety of techniques exist for washing fish and shellfish Tumbler, rotary, brush, and pressurized spray washers provide thorough cleaning and can be set to minimize product damage Product can also be effectively cleaned by being placed in tanks of water with jets of air or targeted air

currents to circulate around the product Using a hose to "clean" a pile of fish or shellfish is not considered an adequate procedure

Grading The catch is sent to an area where its quality is evaluated manually The quality of the animal is assessed depending on factors such as size, weight, color, damage, and odor Bruised or darkened fish, not generally considered acceptable for human consumption, is separated and may be used for animal feed

Scaling Removing the scales from the exterior of a fish can be performed manually (by rubbing an abrasive substance over the surface of the fish) Most commercial fish processing plants, however, use manual electric scalers or automated measures which save a great deal of time and allow a larger number of fish to be treated In automated systems, the fish are placed on a conveyor belt and sent through a series of scraping mechanisms which remove the scales

Shucking A process exclusive to shellfish, shucking involves removing the shells of animals such as oysters, mussels, and clams from their bodies Automated shucking machines are preferred because manual shucking is labor and time intensive The automated machines partially cook the animal in order to weaken the bond between the meat and the shell and then send the heated animals to a tumbler which separates them from their shells

Picking and Peeling Another process particular to shellfish is that of picking and peeling Crab meat is typically hand-picked from its shell Mechanized pickers have been developed but are not in wide use because of their complexity and a certain degree of inefficiency Shrimp are usually peeled mechanically and their intestines are removed with a deveining machine The machine cuts the shell the length of the intestine, separates the shell from the body, and then washes away the intestine

Heading Removing the head of fish or shrimp, or "heading," is most often accomplished by manually cutting off the head or by sending the animal through a machine that automatically aligns it in the right direction and then severs the head using a saw or guillotine method Severed heads are collected and typically sent to a viscera holding area Oils and fish meal are valuable by-products that can be extracted and manufactured from fish heads

Eviscerating The internal organs are removed from the animal either manually or with the assistance of machinery Evisceration should be performed soon after the fish is harvested to prevent the enzymes that exist in the animal's digestive tract from attacking the product meat Although specific eviscerating techniques vary depending on species type, the basic principle behind any eviscerating process is that the animal's body cavities must be opened and the entrails removed Main arteries should also be removed at this time to improve the bleeding of the carcass (the better the bleeding process, the better the quality of the meat)

Filleting During this process, entire pieces of meat are removed from either side of the skeletal bones Since it is an exact process (which varies depending on the species) requiring

considerable skill, typically only medium to large-sized fish undergo the filleting process In the manual process, cuts are made along the spine and the head and the meat is removed intact Automated filleting machines, which vary based on factors such as species and size, generally orient the fish in the direction of the filleting blades which then cut the meat from the bone For all their speed, filleting machines do not remove as much meat as manual methods, and in fact, create a great many meat pieces These pieces can be reclaimed and sold as minced meat product

Skinning Removing the skin from all or part of a fish is not performed on scaled fish Instead, it is a process reserved for fish such as catfish Skinning can be performed manually on a whole fish by removing the fins, making an incision in the skin, and peeling the skin off Fillets are skinned by inserting a knife between the skin and the meat Skinning machines utilize a variety of knife and abrasive processes to remove the skin The main difference between manual and automated operations is that peeling the skin off leaves a protective membrane below the skin's surface intact, while cutting the skin off removes that membrane Leaving the membrane intact creates an additional protective layer against decay around the meat, removing the membrane and a dark layer of meat that often lies directly beneath it can often improve the appearance of the meat but will also minimize the product yield

Candling Filleted meats are passed over a glass-topped surface with a bright, diffused light underneath it The light exposes product defects such as parasites, bruises, or other undesirable qualities These imperfections are removed manually and the unwanted meat is discarded or sent for processing as animal feed

4 1 4 1 Canning As previously described, cans should be thoroughly washed prior to filling The descriptions below outline the various processes that are used to prepare several of the most popular forms of canned fish and shellfish

4 1 4 1 1 Salmon After being prepared (e g , headed, scaled, eviscerated, filleted), salmon is cooked or smoked and sent through cutting machines that cut it into pieces appropriate to the size of can being used The cans are filled by product weight, salt is added, and the cans are sealed by vacuum closing machines

4 1 4 1 2 Tuna Eviscerated, raw tuna are placed in layers in cooking baskets The filled baskets are placed in large capacity steam cookers Cooking times vary by the size of the fish After cooking, the fish are cooled overnight The fish are then taken to a cleaning room where undesirable material such as skin, bones, and fins are removed from the edible meat Inedible meat is typically sent for animal food processing The good, chunked meat is packed into cans, ingredients (such as salt, vegetable oil, or water) are added for flavoring, the cans are sealed by steam-vacuum machines, and then heated

4 1 4 1 3 Sardines Sardine canning is performed differently in different countries In the United States, sardines are harvested, cleaned mechanically, headed, scaled, eviscerated, and

then sent to brining tanks The brine solution improves the overall canning quality of the meat After brining, the fish are dried with warm air to toughen the sardine skin for further processing and to lower the moisture content of the meat The sardines can then be prepared a variety of ways (including frying, baking, or smoking) before being packed into cans Ingredients such as oil or tomato sauce are added to the cans, the cans are sealed and then heated

4 1 4 1 4 Crabs and Shrimp Healthy crabs are steamed or cooked in brine or fresh water prior to canning The meat is then picked from the shells, packed into lined cans, the air is removed, and then the cans are sealed Shrimp destined for canning are headed, peeled, and deveined before being cooked in a hot brine Cooked shrimp are organized by size, packed into appropriate sized cans, weighed, salt is added, the cans are sealed and then heated

4 1 4 1 5 Oysters and Clams Oysters and clams are washed thoroughly before being steamed to loosen shells from the meat The shells are removed, the animals are placed in cans, flavorings and preservatives are added, the cans are sealed and then heated

4 1 5 Dairy

A complete guide to dairy processing operations and the pollution prevention opportunities associated with them are provided in another EP3 training manual, *"Pollution Prevention for the Dairy Industries "*

4 1 5 1 Preparation Many dairy products undergo similar processing techniques In general, the main techniques used for dairy products intended for canning include pasteurization, homogenization, and clarification All finished products must be refrigerated at temperatures between one and four degrees Centigrade

Pasteurization Milk is heated at a sufficient temperature to destroy most disease-producing microorganisms

Homogenization A uniform product consistency is achieved by emulsifying the fat content of the milk product Because the fat globules are permanently reduced in size and distributed throughout the milk, cream does not rise

Clarification The desired fat content of the milk (whole, lowfat, nonfat, or skim) is achieved through a clarification process

4 1 5 2 Canning Cans should be thoroughly washed and sterilized prior to filling The description below outlines the processes used to prepare the most popular form of canned milk

4 1 5 2 1 Evaporated and Condensed Milk Milk is heated to remove approximately 60

percent of its original water content The product is then homogenized and canned The canned milk is sealed and then heat treated for sterilization

CHAPTER 5
POLLUTION PREVENTION OPPORTUNITIES

5 1 Introduction

Due to the potentially high BOD content of all canned food products, canners should give serious consideration to taking every possible measure to prevent pollution This tactic has both economic and environmental benefits Controlling product loss can save money in two ways by reducing raw materials costs and cutting waste treatment costs It is important to remember that recovered product translates into recovered revenues

Water is used extensively during canning operations Not only is it used to prepare foods for canning, but it is often an essential ingredient in the end-product itself For this reason, it is imperative that high quality water be conserved

5 2 Pollution Prevention Program

The overall objective of any pollution prevention program is the minimization of losses of product, materials, water and energy to the greatest extent possible

Developing a detailed pollution prevention program will depend to a considerable degree upon the size of the organization, the complexity of the operation, and the type of product(s) being produced In any prevention program, the preventable wastes can be traced, in a large percentage of cases, to maintenance or maintenance/operator interrelated problems Therefore, a strong pollution prevention program should focus on preventive maintenance

Employee education is another important element of a successful and comprehensive pollution prevention program Educational efforts should generally follow three phases 1) an indoctrination program to acquaint management and operators with the background of dairy food plant wastes, their significance and sources, 2) a how-to, short-term educational program to indicate the general principles of pollution prevention applicable to the particular plant involved, and 3) a long-term continuing in-plant educational plan

There are many measures that canners can use to effectively, efficiently, and economically reduce water use, product losses, and waste loads This section identifies where waste is produced during canning operations and suggests pollution prevention measures that can be taken in specific plant areas

5 3 Pollution Prevention Opportunities

Without regard to the type of food product that is being canned, there are several areas that canners can evaluate to potentially achieve their pollution prevention goals These include

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- Reducing packaging waste,
- Monitoring the use of cleaning chemicals, and
- Monitoring water use

One of the largest sources of preventable product waste is the clean-up operation Spillage, leakage, and overflow are often quickly flushed to the drain by employees Product remaining in storage tanks, vats, processing lines and equipment are "rinsed" to the discharge system Losses can be minimized by proper maintenance and care of equipment, employee education, installation of air purge systems to remove product, product recovery systems at filler and other equipment, and by recovering initial rinses with high solid concentrations Overuse of cleaning compounds and lubricants contribute to the pollution load Spilled dry ingredients (seasonings, preservatives, etc) can be disposed of as solid waste and not flushed to the drain as these have high BOD values

5 3 1 General Opportunities

- Utilize a product-saving pre-rinse at the end of the can washer and allow adequate time for complete drainage
- Make sure that the weigh tank is properly assembled and free from all leaks from fittings and pumps
- Handle all sanitary fittings valves, rotary seals, pump parts and filler parts with extreme care during every phase of operation to prevent damage to the surface which may cause leaks Small parts should be properly washed in small parts washers and placed on rubber mats for draining to minimize any damage
- Do not use a constant running waterhose in any area
- Encourage employees to eliminate the cause of spillage rather than washing away spilled product Valves, pipelines, and pumps should be properly installed, and gaskets installed and carefully sealed to prevent leakage
- Thoroughly drain all lines, tanks, and processing vats before rinsing The process equipment surfaces should be rinsed as soon as possible after use so that the product does not dry on the equipment and increase cleaning requirements
- Ensure that all lines on the suction side of the pumps are properly sealed to avoid air leaks and resultant foaming which can cause excessive waste
- Ensure that all worn and obsolete equipment is observed during plant operations and

reported to the maintenance department for repair

- Correct all drips and leaks occurring during processing runs if possible If this is not possible, the drips should be collected in containers and not allowed to go down the drains

- Where drip shields are supplied, they should be in place and provided with adequate containers for each day's operation

- For processing vats that are not supplied with high level shut-off controls, the employee must be responsible for filling the processing vat and should pay careful attention to the filling operations so that overflows do not occur

- Make sure automated air-blow systems are operating properly For manual air-blow systems, do not actuate for more than three seconds, since this will empty the line into the tank and allow product to reenter the pipe

- Handle all return products or products that have to be repacked in a sanitary manner Collect them to use as animal feed -- don't discard them down the drain Animal feed represents revenue while waste represents lost revenue

- Drain and collect all product remaining in the filler bowls of the milk operation at the end of the processing day

5 3 2 Cleaning and Sanitizing Wastewater Opportunities

- Care should be taken to avoid the possibility that cleaning compounds and/or sanitizing solutions will seep into milk products, thus eliminating the need for disposal of large quantities of milk solids

- Control the concentration of cleaning and sanitizing compounds carefully Where cleaning compounds are added by hand, only sufficient cleaning compounds necessary to ensure adequate cleaning and sanitizing should be used to minimize discharge of potentially toxic materials or wastes at excessively high or low pH levels

5 3 3 Opportunities for Fruit and Vegetable Canners

Fruit and vegetable canners generate significant quantities of waste material (e g , rinds, stems, cores, seeds) and use large quantities of water As with almost all waste prevention situations, unique solutions may exist for each processing operation

One of the first and best approaches to devising a fruit and vegetable pollution prevention program is to investigate the opportunities and techniques for in-plant modifications The

following is a list of specific suggestions and good housekeeping practices which may help fruit and vegetable canners reduce waste and product loss

- Use air blowers and wash-filled floatation tanks to remove debris from the crop
- Modify the peeling and pitting operations to use less water and waste less of the raw product
- Recover and reuse process water throughout the plant
- Monitor process water use and sources to ensure that equipment is not leaking or operating unnecessarily
- Separate waste process water throughout the plant
- Separate waste with differing characteristics
- Sweep fruit and vegetable scraps found around machinery on a regular schedule
- Ensure proper disposal of the fruit and vegetable scraps For an additional source of revenue, consider whether they can be used in agricultural processes as a type of mulch or fertilizer

5 3 4 Opportunities for Meat and Poultry Canners

The waste load from a meat or poultry cannery is a result of blood, flesh particles, soluble protein and fat from the meat and its byproducts Raw discharge of wastes pollutes the receiving water and causes odor, insect, and rodent problems To minimize the impacts of either of these factors, the goal at any meat cannery is to identify pollution prevention options that reduce the quantity of raw materials, products, and byproducts or potential byproducts lost to the discharge systems during meat processes and to minimize the water and energy used in the manufacturing process

- Ensure proper disposal of the meat and poultry scraps -- consider whether they can be used in other food processing operations or sold as animal feed If reuse options do not exist, dispose of the meat as solid waste Do not dump it down the drain!
- Recover and reuse process water through the plant
- Monitor process water use and sources to ensure that equipment is not leaking or operating unnecessarily
- Separate waste process water through the plant

- Separate waste with differing characteristics

5 3 5 Opportunities for Fish and Shellfish Canners

There are many measures that fish and shellfish canners can use to effectively, efficiently, and economically reduce water use, product losses, and waste loads To a large degree, the technology to deal with many of the industry's waste problems already exists, however, many canners may find their options constrained by non-technology based aspects of the industry such as the timing of the fishing seasons, the location of the cannery, or high storage and transportation costs When considering the feasibility of any particular pollution prevention option, the canner should thoroughly assess all of the factors that will contribute to the option's success or failure

- Recover and reuse process water through the plant

- Monitor process water use and sources to ensure that equipment is not leaking or operating unnecessarily

- Separate waste process water through the plant

- Separate waste treatment and disposal of wastes with differing characteristics

- Use just enough water to thoroughly clean the harvest Centrifuges can be used to recover fish from process rinse water Hose stations, which can contribute to a high level of water use if employees do not turn off hoses when they are not being used, should be regularly monitored to ensure that the connections are secure and that they are not leaking

- Substances such as seasonings, salt, and oils are significant contributors to high levels of BOD Dry materials should not be swept down drains which lead to the wastewater drainage system, they should be swept up and placed in suitable containers Employees should be careful to avoid spills when adding flavoring ingredients to product

5 3 6 Opportunities for Dairy Canners

A certain degree of waste generation is unavoidable Spills and leaks from pipe line joints, valves, and pumps contribute to a dairy plant's waste stream Although these sources are significant to varying degrees in different dairy food plants, they are inherently controllable through the application of good management practices Generally, the nature of the wastes generated by the various processes is similar and consists of milk solids in some form, other ingredients such as sugar, detergents and sanitizers, and lubricants used in packaging and distribution operations

- The high product viscosity and high BOD of condensed milk contributes greatly to the wastewater load Spray drying plants have the potential for losses of dried product, which is often washed to the environment and contributes greatly to increased BOD levels

- When using hot wells, avoid overfilling to prevent the product from boiling over

- Operate evaporators at sufficiently low liquid level to prevent the product from boiling over

- Where dry ingredients are utilized, or where milk powder is spilled on the floor, contents should be swept up and not washed into the environment

- Handle materials carefully to avoid breakage of containers and product spillage

- Monitor lactose crystallization and the storage of condensed products to minimize precipitation of lactose crystals and loss of product that cannot be pumped

5 4 Conclusion

Regardless of the commodity being canned, significant reductions in waste can be achieved with a minimum of effort The canner who seriously implements the pollution prevention measures outlined in this manual can expect increased product yield, increased revenues, and reduced operating costs

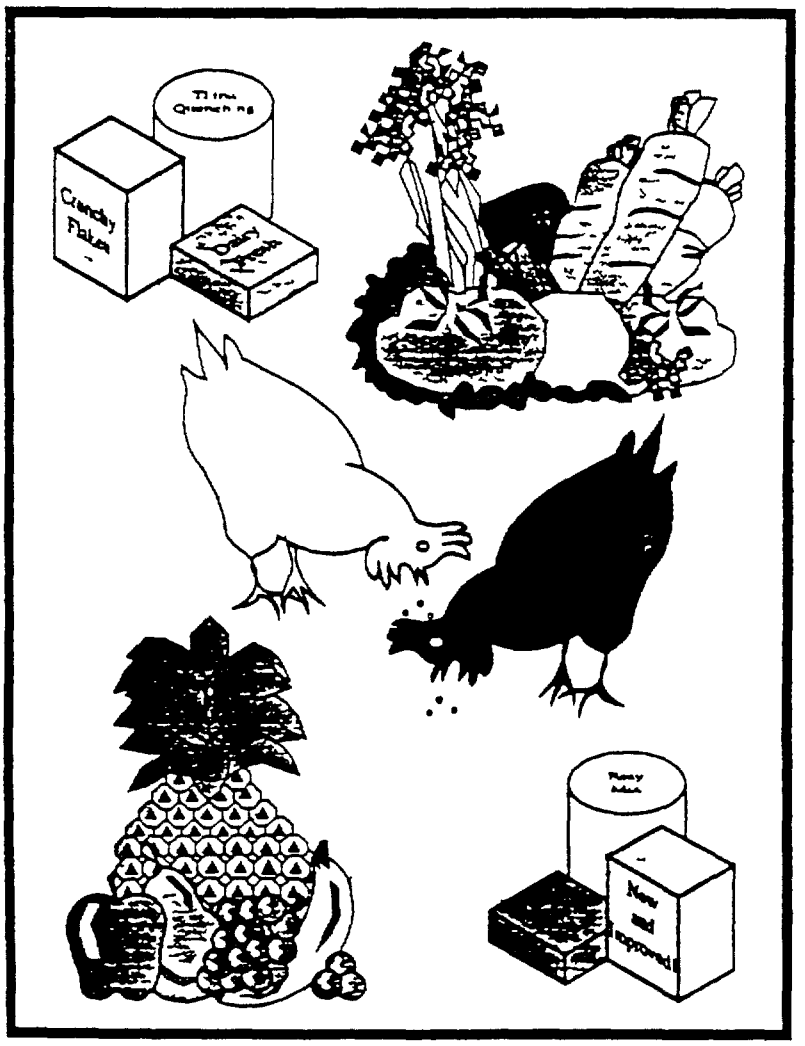
APPENDIX 1

A POLLUTION PREVENTION GUIDE FOR FOOD PROCESSORS

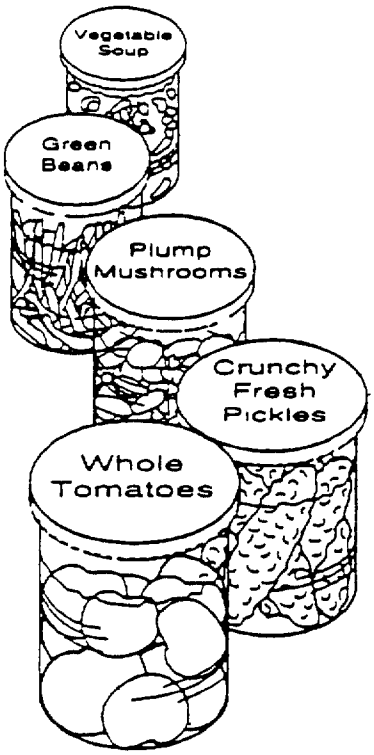
DELAWARE

PREVENTS
POLLUTION

A Pollution Prevention Guide for Food Processors



A Publication of the Delaware Department of Natural Resources and Environmental Control



FOOD PROCESSORS

Companies in the business of processing food may produce a variety of wastes Much of the waste is in the form of waste water but there may also be solid wastes as well as emissions to the air Some examples of food processing wastes are given by the following

- process wastewater
- sludge
- off-spec product
- waste oils
- spent and dirty filters
- empty raw material containers
- outdated inventory
- damaged pallets

All of these wastes have one thing in common they all represent a **loss of resources** and a **loss of money**

Businesses throughout the country have implemented waste reduction programs and found that there are many benefits to be gained from such an approach to the management of resources Reducing the amount of waste your business generates can help you

- reduce operating costs
- reduce waste disposal costs
- reduce long-term liability
- help sustain environmental quality
- improve workplace safety and health
- project a positive public image

The most effective way to minimize the losses associated with waste is to avoid producing the waste in the first place This is the concept behind DNREC's Pollution Prevention Program, which has produced this Guide to assist you and others in the food processing business to **reduce your losses** while at the same time **improve the environment**

Getting Started

A comprehensive waste audit is the essential first step in developing a waste reduction strategy The waste audit should evaluate opportunities in the areas of improved operating procedures, process and equipment modifications, and reuse/recycling

Here are the steps to follow in conducting a waste audit

1 List all wastes being generated

2 Identify the composition and source of each waste

3 Identify options to reduce the generation of these substances, focusing on those wastes that are most hazardous and those techniques that are most easily implemented

4 Compare the technical and economic feasibility of the options identified

5 Evaluate the results and schedule periodic review of the waste reduction program

Improved Operating Procedures

Improving the facility's operating procedures is often the easiest and least expensive way to reduce waste No expensive equipment or materials are involved -- only small changes in the way things are done This includes improvements in housekeeping, inventory control, material handling, and actions taken to prevent spills, leaks, or equipment breakdowns Here are a few examples of good operating procedures that can reduce waste

- Keep storage and work areas clean and well organized and keep all containers properly labeled

- Inspect materials upon delivery, and immediately return unacceptable materials to the supplier

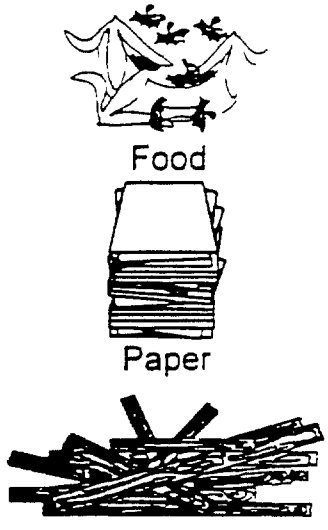
- Keep accurate records of raw material usage so that you can measure reductions in use Mark the purchase date on each container and adopt a "first in, first out" policy so that older materials are used up before new ones are opened, assign someone to distribute and keep track of raw materials

- Practice preventative maintenance to avoid future losses Periodically inspect containers and equipment for leaks

- Keep all containers covered to prevent evaporation contamination, spillage, or drying out of contents

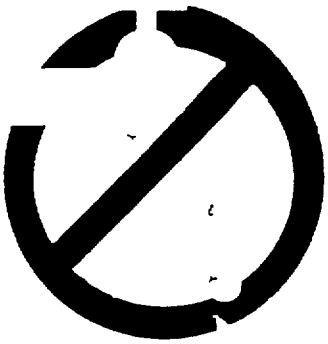
- Keep waste streams separate for reuse recycling or treatment Keep nonhazardous materials from becoming contaminated

Keep Waste Streams Separate



Production Process and Equipment Modifications

Often a process can be modified, or the equipment used can be improved or upgraded, so that the process will run more efficiently and produce less waste Some examples of production process and equipment changes that may help you reduce waste are



- Improved scheduling Sequential scheduling the products that use the same production line or equipment can reduce cleaning requirements For example, scheduling the use of light dyes before dark dyes through the same machine or production line eliminates the need for cleaning between batches

- Maximizing dedication of process equipment This can reduce equipment cleaning frequency and waste generated

- Minimizing the amount of cleaning solution used If water is the cleaning agent, use sprays or jets of water to clean tanks or equipment Where possible, small amounts of concentrated was collected should be recycled or used as a raw material Rinse machinery and tanks less often

- Avoiding use of the wastewater stream as a 'conveyor" Transfer solids and particulate matter by mechanical means (eg augers or conveyors) or manually This helps minimize loadings to the wastewater treatment system

- Substituting less toxic or non-toxic substances as cleaning agents

- Conserving water Use automatic shutoffs on hoses and at wash stations Use high pressure, low volume washing systems Incorporate water conserving equipment into process lines

- Minimizing the loss of product Prevent product from becoming waste when it hits the floor Provide catch pans under problem areas of production lines

- Utilizing "dry cleanup" methods Scrape up and scoop up particulate matter before wash down This technique prevents the unnecessary addition of waste to the wastewater stream

Reusing and Recycling Other Wastes

Good waste reduction plans address all of the waste streams being generated by a particular business or industry Try to find ways to apply the three R's to all of your plant's waste, including such things as waste paper empty containers, lubricating fluids, etc Here are some tips for these types of materials

- Reuse or recycle excess, off-specification materials and samples taken for quality control testing For example, off-spec material can be added to an often already existing waste stream that is used for animal feed Some organic waste products that are not suitable for use as animal feed may be suitable for composting operations

- Find as many ways to reuse paper as you can (as note pads, poster paper, etc) When paper has been reused as much as possible recycle white paper and computer paper Recycle other office wastes, such as aluminum cans

- Recycle lubrication oils

- Find ways to recycle water Recycling water can consist of simply screening the water and reusing, or recycling may consist of a complex cleaning and filtration process The specific process must be evaluated before a decision can be made

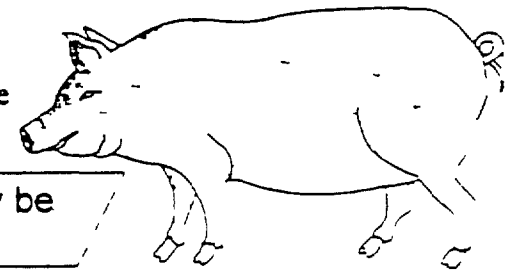
Getting the Job Done

Accomplishing the goals of a waste reduction program requires the cooperation of every employee of the company Top management must make a commitment to pollution prevention, but it will be the workers themselves who will make the program succeed

Management can demonstrate its commitment to waste reduction by

- Providing employees with training in waste reduction techniques and practices -- including periodic "refresher courses" to increase employees' awareness of the importance of waste reduction

- Involving the employees in designing and implementing waste reduction measures



Organic waste products may be suitable for animal feed

- Establishing incentives to encourage workers to use waste reduction techniques and to suggest changes in design or operating procedures that would further reduce waste generation

Following Up

As long as wastes are being produced, there is the potential for waste reduction Less-polluting materials, equipment, and procedures are constantly being developed, so that wastes that are difficult or costly to control today may be easily eliminated tomorrow Stay alert for such developments

When buying new equipment, **look for equipment that will minimize both the amount of toxic materials used and the amount of waste produced**

Publicize
Your Firm's Commitment to Waste Reduction

Reassess the company's operations and waste handling practices periodically with an eye to avoiding the temptation of slipping back into old more wasteful ways of doing things and to identifying additional waste reduction possibilities

Publicize the firm's commitment to waste reduction Customers will feel good about doing business with a company that is environmentally responsible

Sources of Additional Help

This Guide is not intended to be comprehensive list of all the techniques that could be used to reduce waste in a food processing company Each facility is unique, with its own challenges and opportunities for minimizing waste, therefore, each waste reduction program will be unique There are a number of resources available to help Delaware businesses develop and implement programs that meet their individual needs

- A **Waste Reduction Self-Evaluation Manual** has been developed by the Department of Natural Resources and Environmental Control to assist small and medium-sized business in implementing waste reduction programs The manual includes information specifically targeted for food processors Copies of the manual can be obtained by calling the Department at (302) 739-3822

- **The Pollution Prevention Program** in the Department of Natural Resources and Environmental Control (302) 739-3822 provides technical assistance, information resources as well as assistance with other services that are available to your business

The Mid-Atlantic **Food Processors Association** has many members from the food processing industry that includes but is not limited to regulatory agencies, food processors, and engineering firms The association holds yearly meetings and publishes a monthly newsletter The association's offices can be reached at (410) 546-5854

- **The Delmarva Poultry Industry** can provide information to companies directly in the poultry industry and related businesses This organization holds its annual meeting in October and publishes a bimonthly newsletter For more information, their offices can be reached at (302) 856-9037

- The **Waste Minimization/Pollution Prevention Information Clearinghouse**, housed in the Delaware Development Office, contains a bibliography of waste reduction reference materials and a case study database of actual waste reduction experiences worldwide, sorted according to Standard Industrial Classification (SIC) Codes Information relating to the food processing industry is filed in the database under SIC code 20 Use a modem to connect to the computerized database by calling (302) 739-3757, or call the System Operators at (302) 739-4271

- **The Delaware Waste Reduction Assistance Program (DELWRAP)** at the University of Delaware offers on-site evaluations of waste reduction opportunities for Delaware businesses For information about the program, call the University (302) 831-8522 or the State Chamber of Commerce (302) 655-7221 in New Castle County, 1-800-292-9507 in Kent and Sussex Counties

- **The Northeast Industrial Waste Exchange** may be able to help you find companies that can use your wastes You can call the Exchange directly at (315) 422-6572

This publication is one of a series of pollution prevention guides for various types of businesses For more information on this and other pollution prevention or waste minimization programs, contact the Department of Natural Resources and Environmental Control at 739-3822 or 739-5071

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