SPICE AND HERBS PROCESSING Level-II

Based on May 2019, Version 2 Occupational standards

Module Title: - Implementing waste management system

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LG #82	LO #1- Prepare for implementation of waste management system

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following content coverage and topics: • Making available and ready equipment • Confirming services and equipment availability • Conducting checks pre-waste management • Calibrating instrument and test equipment • Identifying and reporting health and safety hazards/maintenance This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to: • Make available and ready equipment • Confirm services and equipment availability • Conduct checks pre-waste management • Calibrate instrument and test equipment • Identify and report health and safety hazards/maintenance
Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them. 4. Accomplish the "Self-checks" which are placed following all information sheets. 5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks). 6. If you earned a satisfactory evaluation proceed to "Operation sheets 7. Perform "the Learning activity performance test" which is placed following "Operation sheets" ,

8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Making available and ready equipment

1.1 Introduction

The word “waste” derived from an old French word “vastum” , which means empty or desolate, it was first used to depict a desolate, ruined or neglected region. Later, the term was used to describe a wasteful expenditure. It finally acquired its current meaning in the 15th century. Waste management is the “generation, prevention, characterization, monitoring, treatment, handling, reuse and residual deposition of solid and liquid wastes”. There is a wide array of issues relating to waste management and these areas include: generation of waste, waste minimization, recycling and reuse, storage, collection, transport and transfer, treatment, landfill disposal, environmental considerations, financial and marketing aspects, policy and regulations, education and training, planning and implementation. Food industry waste recycling and management is a critical issue today. The continuously increasing human population has resulted in a huge demand for processed and packed food.

Food processing industry around the world is making serious efforts to minimize by-products, compost organic waste, recycle processing and packaging materials, and save energy and water. The three R’s of waste management-Reduce, Reuse and Recycle-can help food manufacturers in reducing the amount of waste sent to landfill and reusing waste. This Learning guide aims to provide the trainees with the knowledge, skills and attitudes required to implement waste management system to comply with workplace requirements, trade waste agreements and site environmental authority.

1.2. Making available and ready equipment

Major considerations of equipment selection and use must meet local conditions. These considerations include climate, management, waste characteristics, available equipment sales and service, and the experience and desires of the decision maker. Safety must be considered in addition to the cost, correct type, size, and practicality of the selected equipment. The equipments used in waste management include:

Screens-food production plant waste streams contain large chunks which require separation. The simplest and most economic process for removing these solids is screening. A number of screen designs exist and facility layout should be a basis for the selection. Models include rotary drum screens, climber screens and channel screens with shaft less conveyors.

Figure 1.1: Waste water screening equipment

pH correction- the pH is a measure of an aqueous solution's acidity or alkalinity. This is dependent on the comparative number of hydrogen ions (H^+) or hydroxyl ions (OH^-) in the solution. An acidic solution contains a higher relative number of hydrogen ions; conversely, alkaline solutions have a higher relative number of OH^- ions. The Ph is an important equipment to check the pH of water in spice/food processing industries.

Figure 1.2: Water pH tester

Incineration unit- incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials.

Settling and treatment ponds/ lagoons-wastewater treatment ponds (lagoons) are one of the most common types of technologies used for wastewater management worldwide, especially in small cities and towns.

Figure 1.3: Treatment plant waste water with settling ponds

Aeration units- industrial wastewater treatment, aeration is part of the stage known as the secondary treatment process. Aeration provides oxygen to bacteria for treating and stabilizing the wastewater. Aeration is the most critical component of a treatment system using the activated sludge process. **First flush systems and wetlands**- is an artificial wetland to treat industrial wastewater, grey water or storm water runoff. **Pumps and valves**- Plumbing uses pipes, valves, plumbing fixtures, tanks, and other apparatuses to convey fluids. A valve is a device that regulates, directs or controls the flow of a fluid by opening and closing.

SELF-CHECK-1	Written test

Name………………………………………… ID……………………… Date……

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions (4 point)

1. List and describe the equipments used in waste management system.

Test II: Choose the best answer (2 point)

1. Which is used to testing the pH of water in processing industries?
   a. Valve
   b. pH meter
   c. screener
   d. pump

Note: Satisfactory rating ≥ 3 points Unsatisfactory <3 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Confirming available services and ready for waste management

The facilities are essential services that play a vital role to industry. Quality facilities and utilities provided like water, light, power, hygiene facilities, containers, tanks, drip pads, containment buildings, incinerators, boilers and industrial furnaces, landfills, surface impoundments, waste piles, land treatment units, injection wells, road, well designed lagoons, well equipped laboratory etc. Services/facilities are also receiving hazardous wastes for treatment, storage or disposal. Before starting implementation of waste management system these services should be available and ready for waste management. If pre start checks required the services should also repair or replace properly and timely.

SELF-CHECK-2	Written test

Name…………………………………………… ID………………………… Date……

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions (10 points)

1. What are the services confirmed before starting implementation of waste management?
2. Why confirming and available services?

Note: Satisfactory rating ≥5 points Unsatisfactory <5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Conducting pre-waste management checks

The idea behind a pre start is that the best way to avoid issues is to be proactive, to take the time to inspect equipment or situations prior to them beginning. A few basic checks on known risks and problematic areas can drastically reduce risk and potential consequence. Pre starts often involve routine inspections conducted by the machine or equipment operator. The most obvious reason for why pre start checks are important is for human safety. Heavy machinery or equipment which malfunctions is not just a project or financial risk, it can result in serious injury or death to people. Pre starts are one of the most relied upon and basic safety steps for almost any company who engages with dangerous equipment or activities. Pre starts protect the operator as well as other people on site, on the factory floor etc.

The less known and less focused on benefit of pre start checks are the financial gains which companies and projects get from doing good pre starts regularly. Pre starts enable companies to catch small/minor issues before they snowball into bigger issues. Catching minor issues which take minutes or hours to repair also minimizes the chance of large scale repairs and downtime which has a very real cost in terms of production and productivity. Pre starts are crucial for safety and an important part of good asset and equipment management. The facilities and equipments require pre start check before implementing waste management may include testing equipment, waste collecting equipment, waste recycling facilities, inclinators, lagoons, pipes etc.

A first step in every wastewater management program should be the cataloguing of wastewater sources. Sources need to be first catalogued by general categories such as process, cooling, runoff, and sanitary. These general source classifications need to be further catalogued by their individual component sources such as, for process flows, peeling, blanching, etc of spice and herbs. Design of wastewater treatment and/or disposal systems is based upon:

- The volume of wastewater requiring treatment,
- The physical and chemical characteristics of the wastewater, and
- The degree to which the wastewater must be treated as established by a comparison of discharge requirements with raw wastewater characteristics.

It is necessary that the foregoing information be developed before considering treatment and discharge alternatives appropriate to the situation at hand. Methods for determining the volume of wastewater, both as total plant effluent and as flow from individual unit operations should be describe. Procedures for developing data to characterize wastewater are also set. Treatment and disposal costs are directly related to these measurements, it is important to develop these data for individual in plant sources of wastewater as well as for the combined plant effluent. Prior to consideration of new treatment systems or expansion of existing treatment works, an effort to reduce the volume and strength of the plant effluent should be made. Measures which can be taken are:

- Wherever possible, clean wastewaters (such as evaporator condensate and can-cooling water) should be segregated and separately discharged or reused.
- Avoid indiscriminate use of water-e.g., unattended hoses, excessive overflows from flumes, washers, tanks, etc.
- Conserve water through recirculation and extensive reuse, thereby concentrating pollutants in minimum volumes of water.
- Implement process modifications and procedural changes to minimize wastewater generation and product-water contact, such as by use of dry cleaning techniques together with dry product and dry waste conveyance systems.

SELF-CHECK-3	Written test

Name…………………………………………… ID……………………….. Date……

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (15 points)

1. What are the equipments require pre check before implementing waste management?
2. What is/ are the benefits of pre start check?
3. Mention the factors that determine the design of wastewater treatment and disposal systems.

Note: Satisfactory rating ≥7.5 points Unsatisfactory <7.5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 4- Calibrating instrument and test equipment

Calibration is the comparison of measurement values delivered by a device under test with those of a calibration standard of known accuracy. Measurement uncertainties are managed through timely and traceable calibration and maintenance of measuring equipment and instruments. A complex field governed by national, international and industry-specific standards, expert help is required to ensure the quality and validity of calibration services. Calibration of your measuring instruments has two objectives: it checks the accuracy of the instrument and it determines the traceability of the measurement. In practice, calibration also includes repair of the device if it is out of calibration.

The accuracy of all measuring devices degrade over time. Depending on the type of instrument and the environment in which it is being used, it may degrade very quickly or over a long period of time. The bottom line is that calibration improves the accuracy of the measuring device. Accurate measuring devices improve product quality. Consider these calibration frequencies:

- **Manufacturer-recommended calibration interval.** Manufacturers' specifications will indicate how often to calibrate their tools, but critical measurements may require different intervals.
- **Before a major critical measuring project.** Suppose you are taking a plant down for testing that requires highly accurate measurements. Decide which instruments you will use for that testing. Send them out for calibration, then "lock them down" in storage so they are unused before that test.
- **After a major critical measuring project.** If you reserved calibrated test instruments for a particular testing operation, send that same equipment for calibration after the testing. When the calibration results come back, you will know whether you can consider that testing complete and reliable.
- **After an event.** If your instrument took a hit-something knocked out the internal overload or the unit absorbed a particularly sharp impact-send it out for calibration and have the safety integrity checked, as well.

- **Per requirements.** Some measurement jobs require calibrated, certified test equipment-regardless of the project size. Note that this requirement may not be explicitly stated but simply expected-review the specs before the test.
- **Monthly, quarterly, or semiannually.** If you do mostly critical measurements and do them often, a shorter time span between calibrations means less chance of questionable test results.
- **Annually.** If you do a mix of critical and non-critical measurements, annual calibration tends to strike the right balance between prudence and cost.
- **Biannually.** If you seldom do critical measurements and don't expose your meter to an event, calibration at long frequencies can be cost-effective.
- **Never.** If your work requires just gross voltage checks, calibration seems like overkill. But what if your instrument is exposed to an event? Calibration allows you to use the instrument with confidence.

SELF-CHECK-4	Written test

Name…………………………………………… ID……………………….. Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (15 points)

1. What is calibration?
2. What is/ are the benefits of calibration?
3. Mention the factors that determine the frequency of calibration.

Note: Satisfactory rating ≥7.5 points Unsatisfactory <7.5 points

You can ask you teacher for the copy of the correct answers.

OPERATION SHEET 1- CALIBRATION OF pH METER

Steps/procedure to calibrate the pH meter with pH 7 Buffer

Step 1. Select the pH Mode and set the temperature control knob to 25°C. Adjust the cal 2 knob to read 100%.

Step 2. Rinse the electrode with de-ionized water and blot dry using a piece of tissue (Shurwipes or Kimwipes are available in the labs).

Step 3. Place the electrode in the solution of pH 7 buffer, allow the display to stabilize and, then, set the display to read 7 by adjusting cal 1. Remove the electrode from the buffer.

Step 4. Rinse the electrode with deionized water and blot dry using a piece of tissue (Shurwipes or Kimwipes are available in the labs).

LAP TEST	Performance Test

Name………………………………ID………………Date……………………………

Time started: ________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 30 minutes. The project is expected from each student to do it.

Task: Calibrate pH meter

Information Sheet 5- Identifying and reporting health and safety hazards/maintenance

Health and safety hazards can be identify through risk assessment. Management of waste encompasses a complex set of potential impacts on human health and safety, and the environment. Although the type of hazards may be similar, the impacts are distinguished between three types of operation.

- handling and storage at the waste producer;
- collection and transportation;
- sorting, processing and disposal

Health and safety hazards will arise where the waste is originally produced at the factory. This influences the occupational health and safety risks associated with the waste separation, storage, collection, transportation, processing and disposal. The basis of good health and safety management is a thorough and detailed risk assessment, and the same principles apply to assessing risks in waste management as to any other workplace activity. Most managers will be familiar with the risk assessment process, which simply stated is:

- Identify the hazards
- Decide who might be harmed and how
- Evaluate the risks
- Decide on control measures
- Record significant findings and implement controls
- Review the assessment and update if necessary.

Where chemical wastes are involved, a Control of Substances Hazardous to Health (COSHH) assessment will be required. Under COSHH, the employer must identify the hazards and eliminate or minimize the risks, using personal protective equipment (PPE) only as a last resort. Workers must receive suitable training in safe working, and specifically in the use of PPE.

Hazards: the hazards of waste collection and handling are well known. The different types of hazards that can be related to waste management are chemical (including dust), biological, physical (noise, vibration, manual handling, repetitive movements, slips, trips and falls.), sharps, work organization, and psychosocial problems. For the industry in general, the majority of accidents involve vehicles. Reversing a vehicle is a hazardous activity, particularly if it is being backed into a confined space where workers or pedestrians could be crushed. Serious injuries are also incurred when heavy bins or equipment fall onto employees. Where waste contains chemicals, they are at risk from contact dermatitis or even poisoning. Those handling waste chemicals must take into account the specific hazards associated with the substances. The storage of flammable liquid wastes near to combustible items, such as plastic containers, is another obvious hazard. Accidents have also occurred where liquid chemical wastes have reacted with sludge of unknown composition at the bottom of storage or mixing tanks. Aerosols can be particularly hazardous as they may explode and fly through the air if heated or shredded.

Table 5.1: Hazards in the waste management related to work processes

Processes	Hazards	Remarks
Production steps that determine the later waste character	Dangerous substances (chemicals) Heavy loads Repetitive movements for dismantling	Technical and quality issues may limit the replacement of problematic agents and processes
Street cleaning	Dangerous substances (diesel motor emissions (DME), carbon monoxide (CO), etc.) Sharps (broken glass, tins, etc.) Cold, heat UV radiation	
Separation at source into specific waste elements depending on material characteristics	Dangerous substances (including dust and biological agents such as microorganisms) Fire and explosions Untidy and unclear conditions may cause slips, trips and falls Heavy loads Repetitive movements	
Temporary storage at the waste producer in bins, sacks, containers or in bulk Compacting	Dangerous substances Forklift trucks Contusions, trapping, crushing by heavy compacting machines	
Collection and transportation by vehicle	Dangerous substances (microorganisms, dust) Natural ultra violet radiation Traffic accidents (falling off, run over, being wedged, etc.) Hydraulic presses Heavy loads Repetitive movements Physical exertion Heat, cold	
Transfer station: compaction and reloading to larger transport units	Dangerous substances Fire and explosions Untidy and unclear conditions may cause slips, trips and falls Heavy load Awkward positions	

	Repetitive movements Physical exertion	
Recycling Can be at any stage of the waste system, and at each stage of the waste system	Dangerous substances including biological agents and dust Fire and explosions Untidy and unclear conditions may cause slips, trips and falls Heavy load Awkward positions Repetitive movements Flying objects	Problematic items (e.g. end of life vehicles, ships)
Waste processing: - manual or mechanical sorting out into different material fractions for recycling - processing of pre-sorted waste elements to secondary raw materials - processing for new (raw) materials - incineration for volume reduction - incineration for energy recovery - anaerobic digestion of organics for production of soil conditioner, fertilizer and energy (biogas) -composting of organics for production of soil conditioner and fertilizer	Dangerous substances including dust, micro-organism and toxins Machines Fire and explosions Untidy and unclear conditions may cause slips, trips and falls Confined spaces (e.g. during maintenance) Insufficient work organization Heavy loads Awkward positions Prolonged standing Repetitive movements	Includes a high degree of manual work often by migrant workers.
Waste disposal (e.g. ashes), in e.g. landfills	Dangerous substances including micro-organism and dust Fire and explosions Untidy and unclear conditions may cause slips, trips and falls Heavy loads Awkward positions Repetitive movements	

Managing the risks-anyone that handles waste containers whether employed by the waste producer or contractor will need adequate PPE. This is likely to include:

- hard hats
- high-visibility clothing
- safety boots with ankle support (to avoid slipping on muddy or wet surfaces)
- heavy-duty gloves
- cut-resistant trousers

Those handling chemical wastes may also need goggles and respiratory protection. Hygiene is vital, particularly with chemical wastes. Staff should be provided with hand washing and changing facilities. Employers must ensure that anyone handling waste receives appropriate training, whether in manual handling techniques, good hygiene to prevent dermatitis, the use of PPE or the specific hazards of waste chemicals. Staff should be able to recognize hazardous substances and know what to do in the case of a spillage, including an awareness of reporting requirements.

Each type of waste can be characterized by its origin. Its health and safety hazards can be influenced by the waste producer, i.e. the amount of dangerous substances in the product, whether the product can be easily transported, dismantled or decomposed, without creating dust, etc. The product should be designed in such a way as to create minimum waste and health and safety problems at the later waste stage. The generator of the waste has an important responsibility, however, collection, sorting, treatment and disposal entail their own significant hazards and risks- linked to work processes and work organization

SELF-CHECK-5	Written test

Name………………………………………… ID……………………… Date……

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (20 points)

1. How risks can be eliminate or minimize?
2. Mention some of PPE that helps to minimize an occurrence of risk.
3. Mention types of hazard that appear in implementing waste management system
4. List some of the risks that happen in waste disposal.

Note: Satisfactory rating ≥10 points Unsatisfactory <10 points

You can ask you teacher for the copy of the correct answers.

LG #83	LO #2- Monitor implementation of waste management

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Waste collection and management system operation
- Operating plant
- Monitoring equipment to confirm operating condition
- Monitoring, testing and adjusting waste treatment and management
- meeting workplace housekeeping standards

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Waste collection and management system operation
- Operate the plant
- Monitor equipment to confirm operating condition
- Monitor, test and adjust waste treatment and management
- Meet workplace housekeeping standards

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Information Sheet 1- Waste collection and management system operation

Waste collection is a part of the process of waste management. It is the transfer of solid waste from the point of use and disposal to the point of treatment or landfill. Proper waste collection is important for the protection of public health, safety, and environmental quality. Proper management and operation of a solids disposal system is as important as it is for a wastewater treatment and disposal system. A major factor for successful operation is the timing of land application. Waste collection can be facilitate by using waste collecting equipments such as; hand scrapers, shovels, brooms, washers, tractor scraper blades, lawn and garden size tractor scraping, tractor front-end loaders, skid steer and articulated loaders, all-wheel drive front-end loader, motor grader, elevating type box scrapers, mechanical scrapers for gutters and alleys, conveyors and stackers, flushed gutters and alleys, air-pressure and vacuum waste pumping, piston-plunger pumps etc.

- Influencing factors of waste collection:
  - ✓ Type of equipment: Vehicle Pushcart
  - ✓ Maintenance services for equipment Garage Workshop
  - ✓ Number and capacity of equipments
  - ✓ Site and accessibility of collection situations
  - ✓ Cost and routing of collection
  - ✓ Number of crewmen
  - ✓ Intermediate treatment and final disposal site distance

1.1. Methods of waste management

Waste management includes the generation, collection, processing, transport and disposal of waste. The major methods of waste management are:

- Recycling-the recovery of materials from products after they have been used by consumers.
- Composting-an aerobic, biological process of degradation of biodegradable organic matter.

- Sewage treatment-a process of treating raw sewage to produce a non-toxic liquid effluent which is discharged to rivers or sea and a semi-solid sludge, which is used as a soil amendment on land, incinerated or disposed of in land fill.
- Incineration-a process of combustion designed to recover energy and reduce the volume of waste going to disposal.
- Landfill-the deposition of waste in a specially designated area, which in modern sites consists of a pre-constructed 'cell' lined with an impermeable layer (man-made or natural) and with controls to minimize emissions.

Table 1.1: waste management options-key advantages and disadvantages

Option	**Advantages**	**Disadvantages**
Recycling	Conservation of resources Supply of raw materials to industry Reduction of waste disposed to landfill and incineration	Diverse range of processes Emissions from recycling process May be more energy use for processes Currently low demand for products Requires co-operation from individuals
Composting	Reduction of waste to dispose to landfill and incineration Recovery of useful organic matter for use as soil amendment Employment opportunities	Odors, noise, vermin nuisance Bio-aerosols-organic dust containing bacteria or fungal spores Emits volatile organic compound Potential pathway from use on land for contaminants enter food chain
Sewage treatment	Safe disposal of human waste	Discharges may contain organic compounds, endocrine disrupting compounds, heavy metals,

		pathogenic microorganisms
Incineration	Protects sources of potable water supply Reduces weight and volume of waste, about 30% is left as ash which can be used for materials recovery Reduces potential infectivity of waste Produces energy for electricity generation	Odors nuisance Produces hazardous solid waste Discharges contaminated waste water Emits toxic pollutants, heavy metals and combustion products
Landfill	Cheap disposal method Waste used to backfill quarries before reclamation Landfill gas contributes to renewable energy supply	Water pollution from leach ate and runoff Air pollution from anaerobic decomposition of organic matter to produce methane, carbon dioxide, nitrogen, sulphur and volatile organic compounds Emissions of known or suspended carcinogens or teratogens (e.g. Arsenic, nikel, chromium, benzene, vinyl chloride, dioxins,polycyclic aromatic hydrocarbons) Animal vectors Odor, dust, road traffic problems

The internationally accepted approach of waste management hierarchy helps to prioritize waste management practices in order to handle waste in a sustainable manner. It sets out the preferred order of waste management options, from the most preferred to the least one. Prevention of waste is the most preferred and often the least costly option.

Figure 1.1: Waste management hierarchy

SELF-CHECK -1	Written test

Name…………………………………………… ID………………………… Date……

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short Answer Questions (12 points)

1. Mention some of the equipment that helps to collect waste.
2. What are the factors that influence waste collection?
3. Sketch and explain the waste management hierarchy.

Note: Satisfactory rating ≥6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Operating the plant

2.1. Waste treatment and disposal alternatives

Disposal of processing residuals with the creation of little or no environmental problems requires a great deal of care and good management practices. Procedures for keeping plants clean and sanitary include removal of spilled produce and other solid refuse from equipment, floors, and other processing facilities. The management program which is followed for handling these residual materials will have a substantial effect on the hydraulic and organic loadings of the wastewater effluent.

2.1.1. Management of solid residuals

Whether solid food processing residuals are to be utilized or disposed of, good management practices must be observed to preclude the development of nuisance conditions. Considerations must be given to:

- Procedures used to handle residual materials from the point of generation within the plant,
- On-site facilities provided to temporarily accumulate and hold the materials,
- Equipment used to transport the residuals to the utilization or disposal site, and
- Procedures for properly disposing of solid wastes. The following discussions pertain primarily to the management of spice processing industry residuals from these sources.

2.1.1.1. Stockpiling

Accumulating and holding residual materials in stockpiles is the method least employed by the industry, due largely to environmental problems associated with this practice. Whenever possible, this method should be avoided. However, if stockpiling is deemed necessary, even on a temporary basis, certain measures should be provided to minimize possible problems.

- Areas in which materials are to be piled should be paved, preferably with conceit
- Curbs and/or gutters should be provided around the periphery of the slab.

- The slab, as well as any gutters, should be graded to enable the collection of seeped liquid at a central location. A sump equipped with a level-controlled pump should be provided to pipe accumulated liquids to the plant wastewater disposal system.
- Stockpiled materials must be removed as quickly as possible.

2.1.1.2. Portable containers

Portable containers are used most widely to accumulate and hold residuals for hauling. These include barrels, boxes, wheelbarrows, bins, portable hoppers, and portable trash compactors. Generally, several types of containers are used. Barrels and boxes, or similar small containers, are used to collect solid residuals from various operations. These are emptied into larger containers, such as bins or portable hoppers located in different operational areas of the plant. The larger containers are then transported to a central location to await hauling vehicles, or are in turn emptied into even larger containers, such as a drop box, for holding and hauling. Alternatively, mechanical or hydraulic conveying systems are used to transport residuals to a central location where the solids are deposited directly into the large containers.

The major advantage of containers is the flexibility afforded by their portability and their relatively low costs. Containers can be readily moved from place to place as demands dictate, eliminating the need for expensive, fixed mechanical conveying systems. They are “modular” in that more or fewer units can be used to meet fluctuating needs. The major disadvantage is increased labor required to handle the containers, especially the smaller sizes. Observing a few precautions will assure that environmental problems are minimized when using containers.

- Small containers used to handle residuals in the processing areas must not be used to handle raw products intended for packaging. The chances for food products to be placed into waste containers can be minimized by painting such containers a distinctive color.
- Residuals accumulated in containers must not be allowed to set for prolonged periods. Containers used for this purpose should be leak proof. These containers should be emptied and the materials hauled from the plant at least

once per day. Whenever possible, containers awaiting hauling vehicles should be covered.

- All waste containers should be washed regularly, preferably at least once per day. Both the interior and exterior surfaces must be cleaned.
- Containers should be held on a paved area. The area must be kept free of spilled materials and hosed regularly.
- Each container should be used for handling only one type of material, such as food residuals, non-food wastes, or metals, to facilitate recycling and disposal.

Color-coding and labeling all containers will help. For larger quantities of food wastes, drop boxes are very convenient. They can be quickly loaded onto suitably designed trucks. Raised platforms should be provided for these boxes to minimize spillage that may otherwise occur during pick up by the trucks. By eliminating the need to compensate for tilting, a larger percentage of the box capacity can be utilized. For convenience of emptying, drop boxes should be constructed for end discharge. The door or end-gate must be tightly sealed to prevent leakage of product juices that will inevitably be released from food residuals.

2.1.1.3. Permanent Hoppers

Elevated hoppers are used by plants of all sizes. Solid residuals are deposited into the hoppers by bucket elevators, drag or screw conveyors, or pneumatic systems. Where residuals are hydraulically handled, screens are often installed above the hopper to separate solids from the water and the residuals are discharged directly from the screens. A sliding gate, either mechanically or manually operated, is opened to discharge accumulated solids directly into hauling vehicles. Permanent hoppers are especially suitable for handling large quantities of food residuals. However, they can be designed and readily constructed to any size. Permanent hoppers minimize labor required for on-site handling of food residual materials but are not suitable for bulky non-food items. Although they are relatively costly, their convenience often more than justifies the expense. The pavement, as well as the exterior of the hopper, should be hosed regularly to prevent odor development and insect attraction. The hopper should be emptied frequently, with special attention given to assuring that pieces of debris do not collect on support braces and other appurtenances.

2.1.1.4. Trucks

Trucks are used to accumulate, as well as to haul, product residuals. Dump trucks are normally used for solid residuals, while tank trucks are used for fluid materials. Solids are usually collected in containers which are emptied directly into the truck; liquids, such as juice settlings, are pumped directly to the tanker. Although this is a convenient method for handling small volumes of wastes, it may not be practical for managing large quantities of steadily-generated residuals unless a fleet of vehicles can be provided. The use of permanent hoppers or drop boxes, or storage tanks in the case of liquids, will reduce the number of vehicles required by providing holding capacities between trips. Dump trucks, or other rear discharge vehicles (such as manure trucks), can be conveniently put to dual use. However, the rear gate must be water-tight since leaking fluids can cause roadways to become dangerously slick. Watertight seals are mandated for such vehicles in many states.

2.1.2. Waste water treatment

There are basically only two reasons to treat wastewater-to reduce sewer service charges or to comply with an effluent standard, the state or the local agency providing sewerage service. Once the need to treat is established, three options can be used:

a. Install pretreatment, discharging the partially treated effluent to the public sewer.
b. Install full treatment, discharging the treated effluent to a water course.
c. Discharge to land.

Pretreatment differs from full treatment in that pretreatment provides partial treatment of the wastewater with subsequent “final” treatment being provided by the public sewage treatment plant. Full treatment, on the other hand, implies that the processor provides all necessary treatment to and has full control of the treatment of the wastewater from its points of generation to its point of discharge back into the environment. Wastewater treatment processes are grouped into three categories - primary, secondary and tertiary. Each step removes a greater quantity of pollutants than the preceding step. Additionally, each step, by virtue of its pollutant removal, renders the wastewater sufficiently “clean” for introduction into the ensuing step.

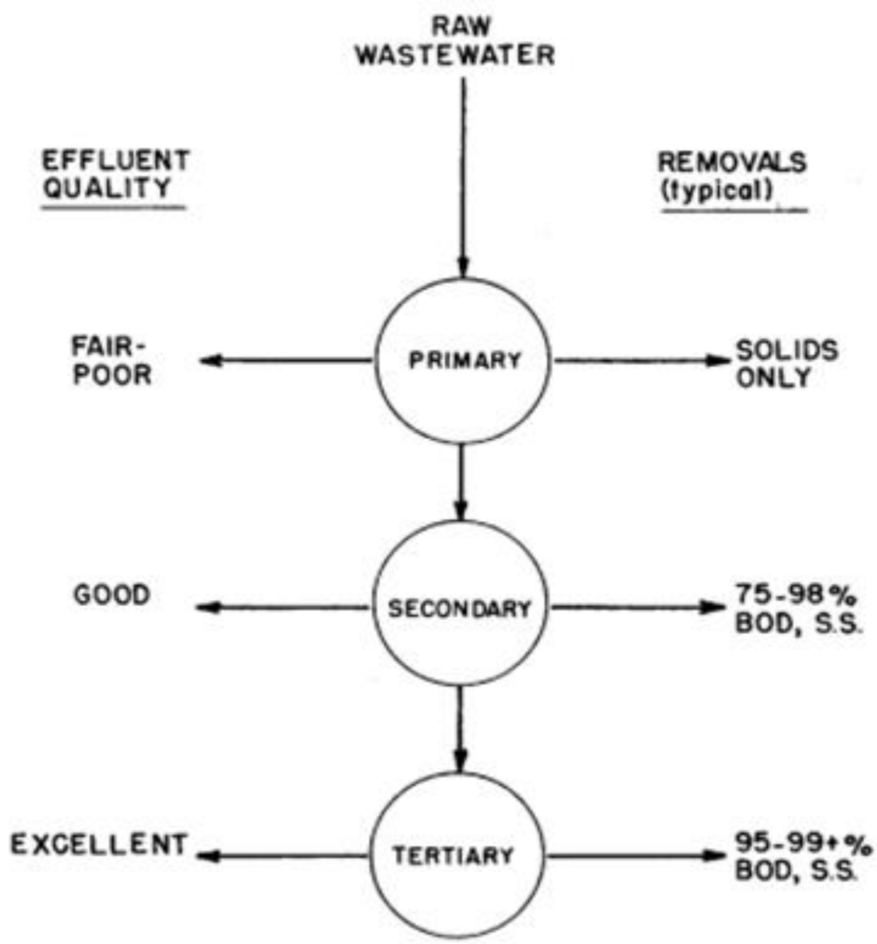


Figure 2.1: Degrees of treatment by progressively higher technologies

2.1.2.1. Primary treatment

Primary treatment systems are designed to effect solids-liquid separation. Biochemical oxygen demand (BOD) associated with the removed solids is, of course, also removed, while BOD in the soluble phase, the bulk of the BOD load from fruit and vegetable processing, is not reduced. Equipment used for primary treatment includes screens, clarifiers, and air flotation devices.

2.1.2.2. Secondary treatment

Most biochemical oxygen demand (BOD) associated with food processing wastewater is removed in secondary treatment. Secondary treatment systems appropriate for use by food processors are generally restricted to those employing biological processes. The alternative physical-chemical treatment processes are not generally applicable to secondary treatment of food processing wastewaters, except where the BOD is associated principally with suspended solids and very little is in a truly dissolved state. The biological processes most commonly used include activated sludge, aerated ponds, and trickling filters. The most commonly used physical-chemical process is coagulation-flocculation in conjunction with sedimentation or air flotation.

2.1.2.3. Tertiary treatment

Tertiary treatment systems are considered only where an extremely high quality effluent is desired. Wastewaters reclaimed by tertiary treatment may be suitable for reuse in many food processing plant unit operations, particularly ancillary operations such as cooling. While tertiary systems are used principally to remove nutrients, refractory organics and heavy metals from secondary effluents, these systems also reduce effluent BOD and suspended solids concentrations to extremely low levels. The most commonly used tertiary processes include:

- Chemical (lime or ferric) coagulation and sedimentation;
- Fine or mixed media filtration; and
- Disinfection employing chlorine. Special tertiary processes occasionally applicable include carbon adsorption, ultra-filtration, and reverse osmosis.

2.1.3. Pre treatment

Most food processing plants discharging to a public sewer system use some method of pretreatment. In the broadest sense, pretreatment is simply treatment before discharge to a public treatment system. However, pretreatment usually refers to gross solids removal, soil removal or neutralization. Common pretreatment steps are screening, neutralization, or flow equalization, but sometimes more extensive treatment, such as gravity sedimentation or dissolved air flotation, is used. The following are reasons to pre treat:

- Meet ordinance requirements
- Reduce costs
- Accommodate production increases

Pretreatment is also needed when discharging wastewater to land. Screening prevents the spray nozzles and soil surface from plugging. Removal of grease or neutralization may be required to prevent soil or crop damage. Certain ions may have to be removed or others added to prevent soil or crop damage or ground water contamination. Many processes can be used for pretreatment. The processes that are most frequently used are screens, neutralization systems, flow equalization, and soil removal. Added pretreatment could include sedimentation units, dissolved air flotation units, or even biological treatment units (roughing trickling fillers, ponds, etc.).

2.1.3.1. Solids removal

Removal of solids from wastewater will reduce the organic and/or physical loads imposed on subsequent treatment systems. Removal of these solids will also minimize problems in public sewers and treatment plants. Public treatment plants are seldom designed to accommodate significant quantities of large and/or heavy solids such as pits, tops and vines. Heavy discharges of these solids plug piping and equipment associated with preliminary treatment units in public facilities. Organic solids contained in food processing wastewater tend to be reduced in size and solubilise rapidly with time, resulting in an ever smaller portion of the wastewater BOD being associated with the wastewater suspended solids. BOD removals as well as suspended solids removals are maximized by placing solids removal steps as close in time and distance to the wastewater source as possible. The solids removal techniques discussed below are appropriate to pretreatment for solids removal.

2.1.3.1.1. Screening

Screening is the most common form of pretreatment. Screens remove large particles that might clog sewers or cause problems at the treatment plant. Although fine screens (200 to 400 meshes) can remove large amounts of suspended solids, they also produce wet screenings. Common practical screen sizes are coarser-20 to 40 meshes. Screens should be as close as possible to the process producing the waste. Contact time and agitation of solids with water should be kept at a minimum to gain maximum benefits from screening. The following are often considerations in purchasing screens:

- Initial cost,
- Hydraulic capacity,
- Solids captured,
- Blinding potential,
- Moisture of screenings,
- Operating and maintenance costs,
- Space required and
- Hydraulic head required

Vibratory screens are very common. Two variations are the circular units in which solids may be discharged in a spiral toward the center or periphery; and the rectangular, end-feed variation, in which solids are discharged at the lower end. The rotary drum screen is also common. These screens may be designed so the flow is from the inside of the drum toward the outside, or the reverse. If the flow is from the inside, then the solids are collected inside the screen and removed by augers, or a trough. In units where the flow is from the outside to the center, the solids are retained on the outer surface of the drum and are removed by scraper blade.

The wastewater is introduced behind the slotted drum, which rotates forward at the top. Solids are retained on the surface of the drum and scraped off by a blade. The screened wastewater falls through the drum and backwashes the underside before being discharged. Rotating centrifugal or collar screens can be used when high-solids capture is required. The screens can be very fine, up to 400 meshes. The waste is sprayed under pressure onto the inside of the rotating drum. The water passes through the screen and the solids are collected on the inside of the collar. The solids typically have a high moisture content. Successful application of screens depends on many variables. The literature is often confusing and contradictory. Screens ordinarily achieve a high removal of settleable and floatable solids, but variable amounts (up to 70 percent) of suspended solids. Proportional but much lesser amounts of BOD are ordinarily removed with the solids. Location of the waste screen is very important. One option is to collect wastewater in a sump below the floor level of the plant, and then pump the wastewater to the screen.

Many screens are located above the solids hopper. These require pumping but usually avoid the need for a solids conveyor. Pumping may reduce screening efficiency by reducing the particle size of suspended solids. Pumps, valves, and piping should be designed to minimize agitation. Another option is to place the screens below the level of the plant drains (if the elevations permit). After screening, the solid waste can be conveyed up to the waste hopper. Screening is an inexpensive method for removing large solids (greater than about 60 meshes) from wastewater. Compared to other pretreatment methods, screens require only a small space and can usually be easily installed in an existing plant.

2.1.3.1.2. Sedimentation-Clarification

Sedimentation in gravity clarifiers is not generally used in pretreatment practice, being more commonly associated with full treatment systems. Clarifiers may be used to remove, by gravity sedimentation, most (50 to 80 percent) of the small but discrete spice and herbs fragments which have passed through a typical 20- to 40-mesh screen. Sedimentation should, where necessary, supplement screening in pretreatment systems but should seldom, if ever, substitute for screening. Chemical aids, such as polymers, may be added to enhance suspended solids removal in sedimentation. Sedimentation would be far more attractive as a pre treatment unit process were it not for the problems and costs associated with processing and disposing of the solids removed. Unless the solids removed are soil they will be accompanied by large amounts of water; water generally represents 95 to 99 percent of the wet solids weight.

Solids dewatering, sufficient to make subsequent transportation and disposal or reuse practical, is costly and operations intensive. Circumstances which individually or collectively may point to sedimentation use include:

- The screened wastewater contains substantial concentrations of settleable organic solids having a significantly high associated BOD.
- The settleable organic solids have a commercial value (such as for cattle feed) sufficient to at least partially defray costs -a condition not uncommon today.
- Pretreatment efficiency of solids and/or BOD removal must be increased to conform to limits established for discharge to the public sewer.
- The pretreated wastewater is to be discharged to land where the solids would lead to soil surface plugging and/or development of nuisance conditions.

Most food processing residuals are disposed of on land, either in landfills or by spreading. Small quantities of non-food residuals are burned and an even smaller quantity discharged to receiving waters. A number of processors manage the disposal of their own wastes, utilizing either company owned or private land. The distances between plants and disposal sites vary widely and will be dictated primarily by the availability of suitable land. No specific type of land is required for landfill operations and the size of the site will be determined by the quantity of materials that must be disposed of. However, certain practices must be followed to obviate the development of environmental problems.

SELF-CHECK – 2	Written test

Name………………………………………… ID………………………… Date……

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short Answer Questions (16 points)

1. What are the considerations when purchasing screens?
2. What are the reasons/objectives of pre treatment?
3. Mention some of the common pre treatment steps.
4. Differentiate pre and full waste water treatment.

Note: Satisfactory rating ≥8 points Unsatisfactory <8 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Monitoring equipment to confirm operating condition

Equipment conditions should be monitor for continuous operation flows by using condition monitoring equipment. Condition monitoring comprises actions collecting regularly information about machinery/equipment condition to detect failures or deterioration of machinery condition. Condition monitoring equipment is any equipment used to carry out condition monitoring measurements. Condition monitoring system is a system used to detect the condition of a component. It consists of condition monitoring equipment, procedures, schedules as well as methods for data collection and analysis procedures including trend estimation. The condition Monitoring Method describes the technique for the collection and evaluation of information about the condition of components or parts of it. Examples are vibration monitoring, oil analysis, performance monitoring, thermography or motor current signature analysis.

Measurements or observations shall be carried out during operation under defined Reference Conditions. Condition based maintenance is a form of preventive maintenance which uses the information from a condition monitoring system as additional input to adjust the planned activities according to the actual wear and tear condition of a machinery and equipment component.

Several ways of monitoring can be implemented depending on the hazard posed by the service. Monitoring of flow is essential to understand the actual operating conditions of the pump and/or to detect wear of internal pump components. Capacity monitoring of flow may be accomplished by fixed in-line devices such as flow meters. Pump pressures can be monitored for several reasons, such as obtaining indications on the operating point of the pump with reference to the performance curve; avoiding over-pressurization of the casing that may cause joint seal leakage. Pressure values can be acquired automatically with pressure transmitters or visually with analogy pressure gauges.

SELF-CHECK -3	Written test

Name………………………………………… ID……………………… Date……

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: True or false question (6 points)

1. Condition monitoring comprises actions collecting regularly information about machinery/equipment condition to detect failures or deterioration of machinery condition.
2. Monitoring of flow is not essential to understand the actual operating conditions of the pump and/or to detect wear of internal pump components.
3. Condition monitoring system consists of condition monitoring equipment, procedures, schedules as well as methods for data collection and analysis procedures including trend estimation.

Note: Satisfactory rating ≥3 points Unsatisfactory <3 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 4- Monitoring, testing and adjusting waste treatment and management

Laboratories routinely engaged in analytical work will find standard methods for the examination of water and wastewater in waste treatment management.

4.1. Water quality parameters

The impact which discharged pollutants have on receiving waters is evaluated by measuring certain water quality parameters. These measurements are made by analyzing samples collected from the wastewater or from the receiving stream after mixing has occurred. The parameters are listed below.

4.1.1. Dissolved oxygen

A stream normally possesses the ability to purify itself. Water flowing in a stream becomes aerated (oxygen enriched) as it tumbles over rocks and other natural obstacles. The dissolved oxygen in turn enables the water to sustain a variety of oxygen-dependent microorganisms, as well as other aquatic life. These microorganisms are primarily responsible for the stream's self-purifying capability. When plant debris and other waste materials are deposited into water, the microorganisms quickly utilize these materials, ultimately converting the organic matter to cell mass and carbon dioxide. Dissolved oxygen in the water is consumed during the biological process.

The rate at which dissolved oxygen is consumed is directly related to the concentration of pollutants present in water. That is, the higher the concentration, the more active are the bacteria, and hence the higher the rate at which oxygen is used; the lower the concentration, the lower the consumptive or de oxygenation rate. When the consumptive rate exceeds the oxygenation rate of a stream, the level of dissolved oxygen in the water begins to decrease. Since minimum levels of dissolved oxygen are required by fish and other aquatic life, excessive oxygen depletion will result in biological stress and, ultimately, fatality. The quantity of pollutants which may be added to a stream without deleterious effects on aquatic organisms is called the assimilative capacity of the stream.

Waste discharges, whether domestic sewage or industrial wastewaters, impose demands upon the assimilative capacity of the receiving water. When a heavy load exceeding the assimilative capacity is discharged, the dissolved oxygen content of the stream will be greatly depressed. However, provided no further waste discharges occur downstream, the dissolved oxygen content of the stream will eventually be reestablished. Excessive waste loads can result in the complete depletion of dissolved oxygen. In such an event the water will no longer support most aquatic life. Instead, microorganisms capable of existing without oxygen will begin to predominate and eventually exist exclusively. These so-called anaerobic organisms can only partially stabilize organic matter, giving rise while so doing to the odorous gases which are commonly associated with stagnant ponds and septic tanks.

4.1.2. Temperature

The solubility of oxygen in water is inversely proportional to temperature. The temperature of water also affects aquatic organisms-some species can only survive in relatively cool waters while others require a warmer environment. The level of microbiological activity is also affected by temperature. Thus, temperature is considered to be an important parameter. However, the temperature of wastewater discharged to receiving streams is of concern only from the standpoint of its effect on the temperature of the receiving water (thermal pollution). Therefore, temperature requirements are usually based upon the receiving water temperature. Generally, the normal water temperature must not be raised more than 5^{o}F.

4.1.3. Oxygen demand

Oxygen demand is defined as that quantity of oxygen required to degrade, and thereby stabilize, the organic constituents of wastewaters. Under natural conditions in receiving streams the oxygen source is the dissolved oxygen contained in the water. To measure the pollution strength of wastewater in terms of effects upon the dissolved oxygen content in receiving waters, several laboratory tests are routinely used.

4.1.4. Biochemical oxygen demand (BOD)

The biochemical oxygen demand test has been devised to simulate under laboratory conditions the biochemical reactions which occur in receiving streams. Factors, such as time, temperature, pH, and dissolved oxygen content, are standardized, thereby enabling direct comparisons of relative pollution strengths of various wastewater samples. The normally used BOD test procedure requires a five-day sample incubation period; the results are reported as five-day BOD. It is assumed that during this period most carbonaceous and other readily oxidizable materials have been biochemically degraded. Other waste constituents, especially nitrogenous compounds, are degraded more slowly; only a portion of these materials are measured during the five-day test. For this reason, BOD determinations are sometimes made after a twenty-day incubation period and are reported as *20*-day BOD (BODzo). Ultimate BOD determinations require prolonged incubation periods and are generally only of academic interest.

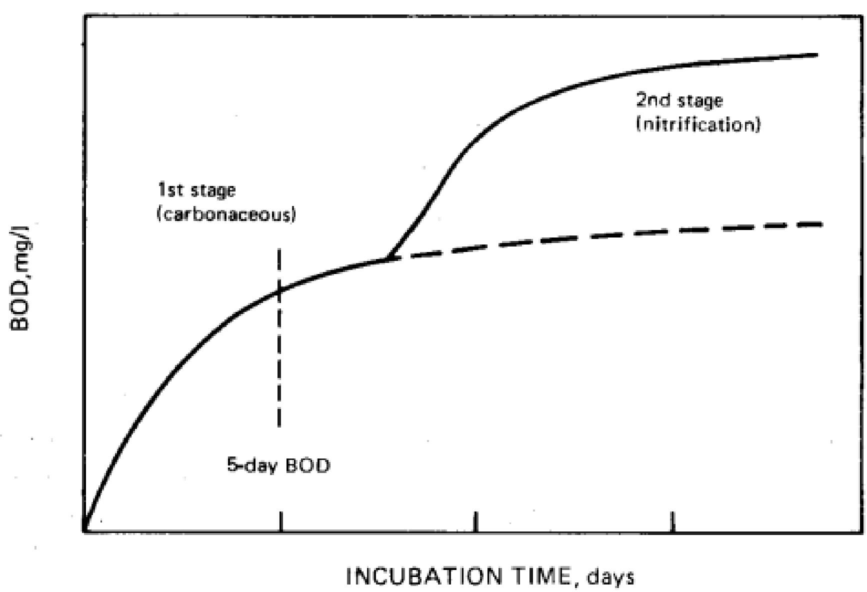


Figure 4.1: a typical BOD reaction curve for untreated waste water

Analytical results from the BOD test are expressed as milligrams per liter (mg/l)-i.e., the milligrams of dissolved oxygen consumed under test conditions per liter of wastewater. Organic loads contained in industrial effluents are frequently expressed as pounds of BOD. Laboratory data (mg/l) may be converted to organic loads (lbs) by the following equation

The BOD of most wastewaters are attributable to organic matter present in the water in two forms, solid and dissolved. Therefore, it is possible to obtain two distinct BOD values for most wastes. Total BOD, obtained by analyzing a blended or homogenized sample, is of primary interest when determining the oxygen demand of wastewaters which are discharged directly into a receiving stream or to a treatment system. The soluble BOD obtained by removing solid matter by settling or filtering the sample, is of primary interest when contemplating pretreatment of wastewaters prior to discharge. For most spice and herbs processing wastewaters which have been screened, the soluble BOD will be greater than 85% of the total BOD.

$$Pounds\ BOD = \frac{\mathrm{C\ x\ V\ x\ 8.34}}{1{,}000{,}000}$$

Where

C=concentration (mg/l or ppm BOD)

V=volume of waste water (gallons)

8.34=weight, in pounds, of one gallon of water

4.1.5. Chemical oxygen demand (COD)

The relative pollution strength of wastewaters is often measured by the chemical oxygen demand (COD) test. The oxygen demand as measured by this test is based upon chemical reactions between the constituents in the wastewater and the test reagents, as compared to biochemical reactions which are measured by BOD analysis. Because some wastewater constituents are not biologically degradable but can be chemically oxidized, COD values are higher than BOD values. However, the relative rapidity-two hours vs. five days-of the COD test makes it useful for routinely monitoring wastewater discharges. Correlation factors between COD and BOD can generally be established for each individual waste stream. COD test results are expressed as milligrams per liter (mg/l); the preceding equation may be used to convert concentrations to pounds of COD.

Table 4.1: Typical concentration of organics in untreated domestic wastewater

Constituents	**Unit**	**Typical concentration**		
		Low	Medium	High
BOD (biochemical oxygen chemical	mg/l	110	190	350
COD (chemical oxygen demand)	mg/l	250	430	800
TOC (total organic carbon)	mg/l	80	140	260
O & G (oil and grease)	mg/l	50	90	100

4.2. Testing and adjusting waste water

4.2.1. Water flow

Selection of an appropriate method for the measurement of water used by unit operations or of flows in specific in-plant waste streams and in composite plant effluents is limited by the physical arrangement of each system. Determination of flows in various waste streams can be accomplished by several methods. The commonly employed systems, and hence, the choices of measuring techniques are classified under three general categories:

- Open channels (gutters, flumes, ditches)
- Partially-filled pipes (gravity-flow conduits)
- Pipes under pressure (pumping systems)

For successful conduct of waste treatment and disposal operations, permanent flow metering and recording installations are recommended. The quantity of water used in food processing plants, and hence the volume of wastewater discharged from each facility, varies widely; the sources and quantities, as well as factors that influence waste generation, are discussed later in this section. The highly-variable nature of food processing plants makes each facility somewhat unique from others within the industry relative to wastewater discharges. Accurate flow measurements are essential for determining the hydraulic load and for calculating the organic load of wastewater discharges. Each processing plant must provide suitable means for measuring and recording the volume of its effluent. This information is required to properly design wastewater treatment facilities and to evaluate the effectiveness of in-plant pollution abatement measures. Plants discharging wastewaters into publiclyowned treatment works will be assessed sewer service charges based on both hydraulic and organic loads.

4.2.1.1. Container and stop watch

The simplest and least expensive method for measuring flows is by the container and stopwatch technique. Although this method is rather crude when compared to the equipment and devices discussed in the ensuing sections, reasonable estimates are obtainable. Flows are determined by recording the time required to fill a container of known volume.

4.2.1.2. Water meters

For convenience and greatest accuracy, the installation of meters on influent water lines is recommended. In-line water meters are available in a wide variety of sizes and flow ranges.

4.2.1.3. Flows in Open Channels

Open channels are commonly used in food processing plants. These include flumes and gutters used for the hydraulic transport of product within the plant, as well as flumes, gutters and ditches used for the collection and transport of liquid waste streams within and away from the plant. The flow of water in these systems can be:

a. Estimated by measuring the depth and velocity of flow in the channel, or
b. Measured with the use of a suitable device, such as a weir or Parshall flume

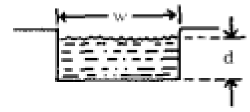
a. Depth and velocity of flow method

A reasonable estimate of the flow in an open channel can be derived from observation' of the velocity, or rate of flow, within the channel and measurement of the cross-sectional area of the water along the stretch of the channel in which the rate of flow is observed. The rate of flow is estimated by recording the time required for a floating object *to* travel between two points of the channel. The accuracy of results obtained by this method proved when:

a. The flow in the channel is constant, and

b. The bottom and walls of the channel are smooth and of even dimensions along the section where the measurements are taken.

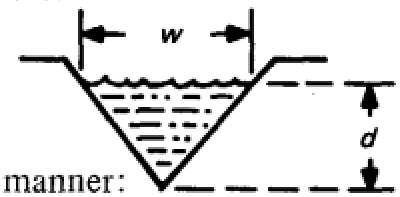
1. For rectangular channels:
   A = width x depth



2. For trapezoidal channels:
   $A = \frac{(w + b)}{2} \text{ x depth}$

where
w = width of channel at water surface
b = width of channel at the bottom

3. For triangular channels:
   $A = \frac{\text{width x depth}}{2}$



Determine the flow in the following manner:

- Select a straight portion of the channel, if possible of sufficient length to require at least 10 seconds for a float to traverse the distance.
- Place a marker at each end of this stretch. Measure the distance between the two points.
- Calculate the cross-sectional area of the channel as outlined above. If the dimensions of the channel are irregular, make several measurements along the selected length and use the average for calculation.
- Place a float (a piece of wood or cork or an empty, sealed can) on the water at a distance slightly upstream from the first marker.
- Using a stopwatch, time the interval required by the float to traverse the distance between the markers. Repeat several times and use the average for calculation.

$$\text{Q, flow gallons per minute (gpm)} = \frac{\text{area (ft squre)x length (ft)}}{\text{t(seconds)}}\text{x449}$$

or

$$Q, \text{flow gallons per minute (gpm)} = \frac{\text{area (i squre)x length (in)}}{\text{t(seconds)}} x0.26$$

b. Weirs

A weir is an inexpensive device for measuring flows in open channels. A weir is simply a barrier or dam containing a recess or notch, through which water flows to fall freely to a level below the bottom of the recess or notch. The height of the water passing over the weir varies with the volume of water flowing in the stream. Thus, flows are determined by measuring the head (i.e, the depth of the stream between the bottom of the recess and the water surface) at an appropriate distance behind the weir. Various shapes are used in the construction of these devices. The more common forms are V-notch, rectangular, and trapezoidal. Selection of a weir shape is determined by the flow rate and the dimensions of the channel. By referring to these tables a properly designed weir can be constructed in the following manner:

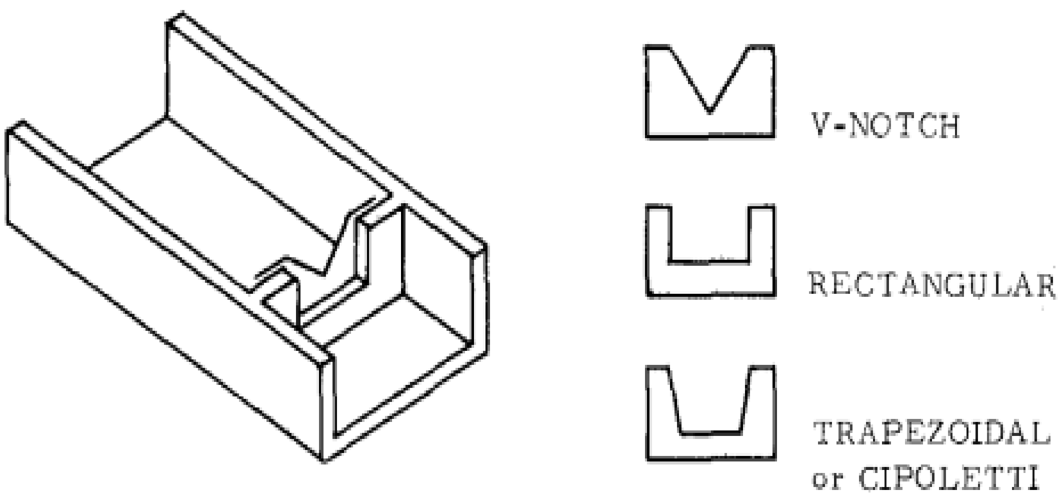
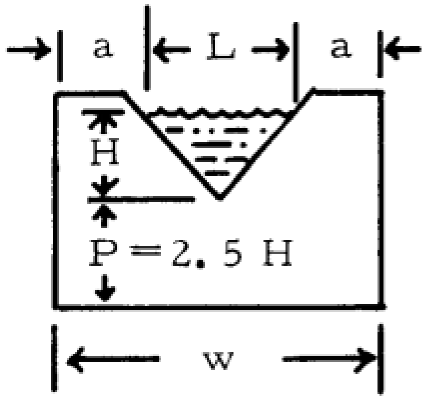


Figure 4.2: Common forms of weir plates

- Estimate the maximum waste flow that can be expected. The depth-velocity or container and stopwatch methods are useful for this purpose.
- Select one of the weir types and find the head over the weir corresponding to the estimated maximum flow by referring to the appropriate table.
- The total depth for maximum flow should be at least 3.5 times H, the head as found in Step 2.

- Compare this to the actual depth of the channel in which the flows are to be measured. Allow at least two inches to insure against flooding.
- Check the lateral dimensions to see if the channel width fulfills the specifications for the type of weir selected:



a. For a 90^o V-notch weir the width of each end contraction, a, must be at least 1.5 times H. Thus, the width of the channel should be at least 4 times H.
b. For a standard rectangular weir, the width of each end contraction, a, should be greater than 2.5 times H. Thus, W>5H+L.
c. For rectangular weirs with modified end (trapezoidal) contractions, the width of each end contraction need only be large enough to permit the free passage of air between the walls of the channel and the flow of passing over the weir.

The rectangular weir with modified end contractions appears to be the best design for general use since most gutters and flumes in food processing plants are too narrow to permit the use of a V-notch weir with the listed tables. However, this latter type is excellent for measurement of small flows. Observation of the following points will increase the accuracy of the weir measurements.

- The weir plate must be vertical and the top must be level.
- The sides and bottom of the plate should be sealed to prevent leakage.

4.2.2. pH

The pH measurement determine the relative acidity or basicity of a substance, pH values alone will not indicate its buffering capacity, i.e., its capacity to accept acid or alkali without corresponding changes in the hydrogen ion concentration. The pH of food processing wastewaters may vary from 3.5 to 11.5, depending upon the product being processed and the types of operations conducted within the plant. Natural-occurring waters have pH values between 5.5 and 8.5; effluent limits frequently state that wastewater discharges must be between pH 6.5 and 8.5. Aquatic organisms are extremely sensitive to pH values outside of this range. Therefore, accurate pH measurements and control of plant effluents are often essential for successful treatment and disposal.

pH determination: pH is a measure of the hydrogen ion concentration and, thus, the degree of acidity or alkalinity of the solution. The pH values are expressed by a numerical scale from 0 to 14, the mid-point, 7.0, being neutrality. The 0 to 7 range is the acid scale; 7 to 14, the alkaline scale. The pH of spice, fruit and vegetable processing wastes may be expected to vary from 3.5 to 11.5, depending upon the product being packed and the type of operations conducted within the plant. Accurate pH measurement of the plant effluent may be essential for successful treatment and disposal operations. Certain chemicals or chemical combinations are effective as flocculent only within a limited pH range. Biological treatment systems are also subject to optimum pH levels for efficient operation. Thus, liquid wastes being discharged to lagoons, to spray irrigation fields, to trickling filters, or to activate sludge systems may require pH adjustment.

THE electrometric method: it is based on the assumption that hydrogen ions carry a positive electrical charge. By the introduction of suitable electrodes, the difference in charge (potential) between that of the solution and that of a standard cell can be determined by means of a potentiometer. The amount of this difference is a measure of the hydrogen ion concentration of the solution. Various types of electrodes and meters are available commercially for measuring pH and other ions (specific ion electrodes).

Acidity: It is sometimes desirable to know the acidity of wastewater and whether the acidity is caused by mineral acids or weakly ionized acids. Titrating a sample to the methyl orange endpoint of pH 4.5 will determine “free acidity” which is caused by mineral acids. Titration to the phenolphthalein endpoint of pH 8.3 gives total acidity which will include both mineral and weak acids. More often it is required to know the amount of alkali needed to neutralize the acid in a given volume of wastewater.

Alkalinity: The alkalinity of natural water represents its content of carbonates, bicarbonates, and hydroxides. When products are being packed which require lye peeling, the dumping of the lye bath or the alkali carry-over from the bath may increase the hydroxide content of the waste to such an extent that a municipal sewage sewage disposal system might refuse to handle it. In such cases, the necessary amount of acid should be added to neutralize the alkali. Phenolphthalein alkalinity will indicate the presence of strong alkali, such as sodium hydroxide. Methyl orange or total alkalinity measures all forms of alkaline substances, including carbonates and bicarbonates.

Calcium: is the fifth most abundant element found on earth. Its presence, with magnesium, contributes to the hardness of water. Calcium salts, in appreciable quantities, result in the formation of harmful scale in boilers, hot water lines, and cooking utensils. Reduction of calcium compounds in water supplies necessitates chemical softening treatment or ion exchange techniques.

Chloride: the presence of chlorides, with sodium, is often responsible for salty tastes detected in water supplies. For this reason many regional water quality control agencies place limits on the permissible levels of chloride discharged in industrial effluents. This is of concern especially to olive, pickle and sauerkraut packers who use large quantities of salt as integral part of their operation. Chlorides in fresh water supplies are also of concern to others, since a high concentration exerts corrosive effects on pipes, tin-plated containers and other metallic objects and is detrimental to agricultural plants. Selection of the appropriate method for analysis will be determined by the nature of the sample. The titrimetric method is most suitable for relatively low concentrations of chloride, such as found in potable water samples. The potentio-metric method is recommended for wastewater samples from brining operations, for brackish and saline waters, and for wastewater samples where color interferes with detection of the indicator endpoint.

4.2.3. Solids-total

The total solids determination measures all matter which is contained in a water or wastewater sample. Included in the determination are suspended materials, which contribute to the turbidity of water, and dissolved components, such as sugars and salts, which contribute to tastes (objectionable or otherwise) detected in water supplies. Despite the fact that some volatile organic compounds may be excluded in the analysis, which is conducted at the boiling point of water, the total solids is a useful tool for the qualitative determination of the pollutants contained in wastewater samples. Total solids, which is the residue remaining after evaporation of water from a sample, can be subdivided into fixed and volatile fractions. The fixed solid, determined by combustion of the total solids sample, represents the inorganic contaminants contained in the waste sample; the volatile solids represent the organic matter.

Solids-**suspended** content of an activated sludge system is used as an index for determining the operating efficiency of the treatment system. The test is also important to pollution abatement officials since suspended solids are responsible for creating turbid or cloudy conditions in receiving waters, as well as in the wastewater itself. The suspended solids determination measures all insoluble (filtrable) material contained in a wastewater sample. This includes insoluble inorganic salts and organic material, such as raw product fragments and microorganisms whch may be present in biological treatment systems. The suspended solids content of an activated sludge system is used as an index for determining the operating efficiency of the treatment system. The test is also important to pollution abatement officials since suspended solids are responsible for creating turbid or cloudy conditions in receiving waters, as well as in the wastewater itself.

To determine total suspended so lids the follow the following procedures Place a glass fiber disc in the filter funnel. Rinse the filter, under vacuum, with 10-15ml distilled water. Shut off vacuum, remove the filter disc from the funnel (using forceps), and dry at 103^{O}C for 1 hour (30 min in a mechanical convection oven). Cool to room temperature in a desiccator (about 30 min) and weigh to the nearest 0.1 mg. carefully measure out a well-mixed sample with a wide tip pipette or a cut-down volumetric flask. Vacuum filter the sample through the tarred filter disc. While the vacuum is still on, rinse the filter with 10 ml distilled water to remove soluble salts. The sides of the filter funnel should be washed free of all material. Shut off vacuum, remove the filter disc, dry and weigh as prescribed above.

$$\text{Total suspended solids (mg/l)} = \frac{\text{Gross weight (mg)} - \text{Tare weight}}{\text{Sample (ml)}} \text{x}100$$

To determine fixed and volatile suspended solids you can follow these procedures. Place the filter disc containing the total suspended solids into a tared crucible (platinum or silica). Ignite the crucible for 15-20 minutes in a pre-heated muffle furnace at 600OC. Allow the crucible to cool partially and place in a dessicator. Cool to room temperature (45-60 min) and weigh the crucible and ash to the nearest 0.1 mg.

$$\text{Fixed suspended solids (mg/l)} = \frac{\text{Gross weight after ignition(mg)} - \text{Tare weight}}{\text{Sample (ml)}} \text{x}100$$

Volatile suspended solids =total suspended solids (mg/l)-fixed suspended

Solids-dissolved: the dissolved solids determination is a measure of the solids contained in the fluid which passes through a filter paper. If both total and suspended solids determinations are conducted, the dissolved solids content may be found by the difference between the two results. When a suspended solids determination is conducted alone, the filtrate (the liquid which passes through the filter) may be used to obtain the dissolved solids content by following the procedure for total solids.

Surfactants (Anionic): the use of synthetic detergents containing surface-active agents, or “surfactants”, has gained wide-spread popularity for general cleaning purpose. These compounds are largely responsible for froth or foam which has become a common sight in polluted streams. A concentration of 1 mg/l surfactant can produce a light froth. For this reason water pollution control agencies are placing increasingly stringent requirements on the discharge of wastewaters containing surfactants. The most widely used surfactant has been alkyl benzene sulfonate (ABS), a non biodegradable compound. Due to the increasingly serious problem of water pollution, the soap and detergent industry has replaced much of the ABS with linear alkylate sulfonate (LAS) surfactant. The latter compound is biodegradable and is, hence, reduced to non-frothing components in biological waste treatment systems.

SELF-CHECK-4	Written test

Name………………………………………… ID……………………Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short answer questions (12 point)

1. Mention some water quality parameters.
2. How water flow can measure in open channel and in pipe.
3. Why pH test is required?
4. What are the constituents in total solid?

Note: Satisfactory rating ≥6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

OPERATION SHEET -1	Determining pH waste water

Steps / Procedures to determine pH of wastewater

Step 1. Select pH meters and the manufacturer's instructions must be followed for each instrument.

Step 2. Electrodes must be thoroughly wetted before use. Follow the manufacturer's instructions for preparation.

Step 3. The pH meter must be standardized against a buffer solution, preferably one which has a pH close to that of the solution to be measured. The linearity of the instrument may be checked with the use of two buffer solutions of different pH.

Step 4. The electrodes should be rinsed with distilled water and blotted with an absorbent tissue before and after immersion into a solution.

Step 5. When the instrument is not in use, glass electrodes should be left immersed in distilled water and the meter placed in the "stand-by" or "off" position.

OPERATION SHEET-2	Determining total solids

Steps / Procedures to determine total solids in wastewater

Step 1. Obtain the tare weight of a clean evaporating dish by placing it in a drying oven for 1 hour at 103℃, cooling for 45 minutes in a dessicator and weighing.

Step 2. Place 50-100 ml well mixed wastewater sample into the evaporating dish. Evaporate the sample to dryness by leaving the dish on a steam table. Drying time is dependent on the amount of solids present in the sample.

Step 3. Place the evaporating dish in a drying oven for one hour at 103℃.

Step 4. Transfer the dish to a dessicator and cool for 45 to 60 minutes.

Step 5. Obtain the weight, in mg, of the dried sample.

Step 6. Calculate total solids

$$\text{Total solids (mg/l)} = \frac{(G - T) \times 1000}{V}$$

Where

G=mg (g x 1000), dish +sample after drying

T= mg (g x 1000), dish only (tare weight)

V= ml sample

Figure 4.3: Wastewater analysis

OPERATION SHEET-3	Determining water flow

Steps / Procedures to determine water flow by using container and stop watch

Step 1: A stopwatch, rather than an ordinary clock, should be used

Step 2: Containers which require more than 10 seconds to fill should be used to minimize observational errors.

Step 3: Calculate the capacity of rectangular or cylindrical containers by the following formula:

a. Volume of rectangular box (gallons) = length (ft) x width (ft) x depth (ft) x 7.48

Or

$$\text{Volume of rectangular box (gallons)} = \frac{\text{length (in)x width (in)x depth (in)}}{231}$$

b. Volume (gallons) of cylinder = (diameter, ft)^2 x depth (ft) x 5.87

Or

$$\text{Volume of cylinder (gallons)} = \frac{\text{(diameter, in)2x depth (in)}}{294}$$

Step 4: If an irregular-shaped contained, such a bucket, is used, its capacity may be determined as follows:

i. Weigh the empty container
ii. Fill the container with water and weigh again
iii. Calculate the capacity by:

$$\text{Volume (gallons)} = \frac{\text{filled weight lbs)} - \text{empty weight(lbs)}}{8.34}$$

Step 4: If water to an operation is from a single pipe, a container can readily be placed to collect the influent stream. If, however, the influent water is difficult to collect in a single container, as in the case of a bank of sprays, a suitable catch basin can be used to initially collect the water flow. The collected flow can then be diverted to the measuring container. Then, the flow determine in the following manner.

Step 4a: If a catch basin is required, place it in a suitable position, taking care that water will not be lost over its sides.

Step 4b: Turn on the water supply to the operation. Be certain that flow rates are as close to operating conditions as possible.

Step 4c: Place the container in position to collect all the water from the catch basin. Simultaneously start the timer (stopwatch).

Step 4d: When the measuring container has filled to capacity (or a predetermined level), immediately stop the timer.

Step 4e: For greatest accuracy, repeat the procedure several times and use the average interval to calculate the flow.

Step 4b: Calculate the flow:

$$\text{Q, flow gallons per minute (gpm)} = \frac{\text{volume of container(gallons)}}{\text{Time required to fill (seconds)}} \text{x60}$$

LAP TEST	Performance Test

Name………………………………ID………………Date……………………………

Time started: ________________________ Time finished: ________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 5 hours. The project is expected from each student to do it.

Task-1: Determine pH of waste water

Task-2: Determine total solid of waste water

Task-3: Determine water flow

Information Sheet 5- Meeting workplace housekeeping standards

Although difficult or impossible to quantify, many operations in food processing which are incidental to the principal steps in preparing the product affect the quantity and the strength of wastewater. Water running in unused equipment is a source of waste that is readily controlled. Examples are cleanup hoses which are left on between periods of use, and flumes, washers, and graders which are empty of product. All contribute unnecessarily to the hydraulic load. Sweeping (instead of hosing) and dry conveying solid residuals save water and reduce pollutant generation. High pressure-low volume systems permit plant cleaning with efficient use of water. The continuous or intermittent but frequent application of chlorinated water to belts and other food contact surfaces makes subsequent cleanup easier and more efficient. Clean-in-place systems can be designed to clean pipes, tanks, and other equipment automatically and without wasting water. Prompt removal of residues and preventing a buildup of food deposits where water is running avoid excessive leaching. If spills are unavoidable, the product should at least be kept out of the wastewater stream.

These and other practices can be controlled through a program of careful attention to reducing their impacts. Although each by itself may constitute a minor source of waste, the cumulative effect may comprise a high percentage of the total raw waste load. However, food processing demands a high level of sanitation. Whatever is done to conserve water and abate pollution must in no way compromise the sanitary conditions in a food plant and its equipment.

Good housekeeping is the foundation of a safe, healthy and pleasant workplace.
It is essential that all areas be kept clean, orderly, and with all necessary things in the proper places. Good housekeeping is a day to day activity and should not be viewed as a separate task or something to do after the shift. Clean up time is all the time! So in the work place any should follow the general housekeeping guidelines:

- Keep work areas neat and clean.
- Place tools, equipment and supplies in their correct places.

- Keep stairways and other walkways free of debris, hoses and other obstructions. Put trash in approved containers.
- Remove protruding objects such as nails, spikes, wire or other sharp points.
- Keep workbenches and stations free from items that are not being used or worked on at present.
- Place oily rags in the metal containers provided.
- Paper cups, plates, and lunch debris, including trash must be thrown in the appropriate trashcans.
- To avoid skin irritations, wash frequently, using soap and water. Wear gloves when handling substances that may cause irritation.
- Cigarette butts belong in containers provided.

Good housekeeping is a team effort and a team is made up of individuals. The individual employee's responsibility is as follows: To keep work areas clean, neat, tidy and free from excessive material at all times.

- To work areas clean during the shift.
- To constantly put trash in the proper trash bins, scrap in the scrap bins and recyclable materials in the designated bins with lids.
- To keep the floors free from excessive material.
- To ensure that aisles and walkways are clear, unobstructed and in good order.
- To ensure that materials are stacked correctly and safely in the correct places.
- To do an informal housekeeping inspection of the area on a daily basis and to rectify housekeeping hazards.
- To monitor that no items are stacked in no stacking areas such as under fire equipment and electrical switchgear.
- Report faded housekeeping notices and signs.
- Always return tools to their correct place after use.
- Ensure that spill and other tripping \ slipping hazards are cleaned up or fixed.

SELF-CHECK-5	Written test

Name…………………………………………… ID……………………Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short answer question (8 point)

1. Mention the general housekeeping guidelines.
2. Write the responsibility of employees in spice processing industry.

Note: Satisfactory rating ≥4 points Unsatisfactory <4 points

You can ask you teacher for the copy of the correct answers.

LG #84	LO #3- Analyze and respond to abnormal performance

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics: • Analyzing water condition and plant operating conditions • Taking corrective action in response to hazards • Implementing emergency procedures This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**: • Analyze water condition and plant operating conditions • Take corrective action in response to hazards • Implement emergency procedures
Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them. 4. Accomplish the “Self-checks” which are placed following all information sheets. 5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks). 6. If you earned a satisfactory evaluation proceed to “Operation sheets 7. Perform “the Learning activity performance test” which is placed following “Operation sheets” , 8. If your performance is satisfactory proceed to the next learning guide, 9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Analyzing water condition and plant operating conditions to identify causes of abnormal performance

After all practical initial-step measures have been taken; the plant effluent should be re measured and reanalyzed. These data can then be used for: design purposes if new treatment facilities are contemplated, revising wastewater load and associated treatment efficiency expectations, if an existing treatment system is being utilized, or reaching an agreement on or estimating service charges associated with discharge to a public sewerage system. Numerous potential problems exist which will compromise treatment system operation, performance and community acceptance, if not properly addressed in wastewater treatment system design and operation. Among these potential problems are the following: Odor, freezing, wind drift and fogging, coloration, floating solids, bulking sludge, vector propagation and changing wastewater quantity and character.

Odors in wastewater treatment are associated almost exclusively with wastewater or sludge septicity. Freezing or cold weather conditions have two potential adverse impacts on wastewater treatment. These are: The slowing of microbial metabolism, the essence of secondary treatment, and icing and its associated interference with operation of the physical treatment components. Wind drift of mist is not generally a problem in wastewater treatment. Exceptions include wind drift from spray application to land treatment and mechanically aerated activated sludge aeration basins. Fogging is a potentially greater problem than wind drift. Fogging becomes a critical problem when wind movement carries it to public areas, particularly roadways. There have been numerous fatal accidents caused by industrial fogging of public highways. The only good solution to the potential fogging problem is proper facilities location, giving consideration to adjacent property uses and limits.

Some food processing effluents will be colored even after a high degree of secondary treatment. The highly non-biodegradable color persists even after BOD satisfaction and suspended solids are removed. Floating solids discharged from pond systems and clarifiers add to effluent suspended solids and BOD levels. Sludge bulking is perhaps the greatest threat to successful operation of most activated sludge treatment plants in the food processing industry. Wastewater treatment, waste solids conditioning and disposal offer opportunities for propagation of various vectors. Vectors of principal concern are flies, mosquitos, and rodents. Any stored sludges or residual solids which emit odor will likely create a fly problem. Land treatment systems must be constructed without “low spots” or “pockets” as these are especially suited to mosquito propagation. Catch basins and out-of service tanks, channels, pipes, etc., serve as mosquito breeding places in treatment plants.

SELF-CHECK-1	Written test

Name…………………………………………… ID……………………Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short answer questions (10 point)

1. What are potential problems associated to waste water treatment that require regular analysis?
2. How can flies, mosquito and rodents are control from spice processing waste?

Note: Satisfactory rating ≥5 points Unsatisfactory <5 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Taking corrective action in response to hazards

Waste can possess many problems that cause for different risks such as, odor, ice formation in pipe vectors etc. Prevention or control of odor is by no means a simple matter; however, it is best to follow these simple rules where possible:

- Maintain minimum dissolved oxygen levels in aerobic system at 2.0 mg/l.
- Enclose all anaerobic systems, collecting and burning off gas.
- Minimize storage time of solid residuals and undigested sludge, limiting on-site storage to one shift or less prior to disposal or by-product utilization.

Odor release from wastewater can be controlled by addition of chlorine (up to 20 mg/l), ozone or, where detention time and mixing is sufficient, air or oxygen. Chlorine and ozone can be effective in disinfecting wastewaters as well as oxidizing the odor sources. Improper operation of clarifiers can produce odor problems easily solved by operating changes.

Controlling odors from sludge lagoons or drying beds receiving poorly digested or undigested sludge can be a real problem. Liming the sludge to pH 10 or greater can be effective. Fogging of aerosols has occasionally been successful. Where odor release from wastewater treatment or sludge disposal operations is anticipated, facilities location becomes of paramount importance. There will be few complaints if odor releases are sufficiently isolated from people. Where there are neighbors (true in most cases), try to locate in the prevailing downwind direction.

Ice formation in exposed pipes can be avoided by applying heat tracing tape and insulation. This same approach can be used to avoid ice buildup on the liquid side of steel clarifier and thickener tanks. Ice buildup on the liquid side of concrete tank walls is best avoided by tank burial. Ice buildup on the liquid side of clarifiers and thickeners not only lowers the wastewater temperature (an undesirable effect if secondary treatment is involved), the ice may stop mechanism rotation. Thawing a clarifier or thickener to loosen the mechanism is no small task. Generally, a buffer zone of 200 to 300 feet width is adequate to avoid wind drift of aerator and spray generated mist to adjacent property.

Dissolved color substances can be removed by activated carbon adsorption, generally oxidized by ozone, and occasionally diminished or removed by chemical treatment. Care in operating clarifiers to avoid heavy solids buildup and septicity will greatly decrease the incidence of floating sludge problems. Odor emissions invariably accompany floating solids problems. The conventional and probably most cost effective remedy is chlorination of either the aeration basin effluent (secondary clarifier influent) or the pumped sludge recycles.

Controlling flies around a wastewater treatment plant is a matter of good housekeeping and avoiding on-site storage of undigested residual solids or sludges. Insecticides should be used around solids bins and around sumps and other facility components through which wastewater is not continuously flowing. Where solids are buried or landfilled, at least 2 feet of cover should be provided. Eliminate standing water and you eliminate the mosquito. This is difficult where ponds are concerned. Where standing water cannot be eliminated, spraying breeding areas with insecticides and cutting and removing weeds and grasses growing in and adjacent to standing water are necessary. Rats and mice are controlled in much the same way as are flies-good housekeeping and rapid removal of undigested organic matter to off-site disposal or by-product utilization.

SELF-CHECK-2	Written test

Name…………………………………………… ID……………………Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short answer questions (6 point)

1. What are the corrective action to be taken to reduce the risks arise from off odor, ice formation in pipe and vectors (flies, mosquito and rodent)?

Note: Satisfactory rating ≥3 points Unsatisfactory <3 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Implementing emergency procedures

An emergency is an abnormal and dangerous situation needing prompt action to control, correct and return to a safe condition. An emergency procedure is a plan of actions to be conducted in a certain order or manner, in response to a specific class of reasonably foreseeable emergency, a situation that poses an immediate risk to health, life, property or the environment Where a range of emergencies are reasonably foreseeable, an emergency plan may be drawn up to manage each threat. Most emergencies require urgent intervention to prevent a worsening of the situation, although in some situations, mitigation may not be possible and agencies may only be able to offer palliative care for the aftermath. An emergency procedure identifies the responsibilities, actions and resources necessary to deal with an emergency. Once drafted, a procedure may require a consultative period with those who could be involved or affected by the emergency, and a programme set out for testing, training and periodic review.

Potential emergencies in the spice and herb processing industry include fire, explosion, structural damage, power or equipment failure, refrigerant or gas leakage and confined space mishaps. Implementation of emergency procedures require emergency response plan. Before creating an emergency response plan, there should be a full risk assessment conducted on-site. There are three stages of risk assessment:

- **Hazard identification:** Consider which types of hazards could affect your company, from natural disasters to human-caused dangers.
- **Vulnerability assessment:** In this stage, consider which assets are at risk from each potential hazard. The most important “asset” is always your employees, but you’ll also have to worry about things like supply chain interruptions and even your company’s long-term reputation.
- **Impact analysis:** This is where you get clear about the actual, measurable damage that could be done by the disaster.

The goal of the emergency plan is to ensure the safety of all occupants of the affected area and minimize damage to assets. The emergency plan usually describes:

a. Emergency procedures, including:
    - An effective response to an emergency
    - evacuation procedures
    - Identifying those that hold responsibility i.e. Wardens, first aid officers
    - Notification of emergency services at the earliest opportunity
    - Medical treatment and assistance; and
    - Effective communication between the person authorized by the person conducting the business or undertaking to coordinate the emergency response and all persons at the workplace.
b. Testing of the emergency procedures, including frequency
c. Information, training and instruction to relevant workers in relation to implementing the emergency procedures.

Role supervisor's in an emergency situation

The supervisor should:

- Have knowledge of the emergency procedures for the site, and the application to his or her area of responsibility
- Ensure all workers under their supervision are aware of the procedures, including early warning and evacuation
- Ensure all workers are aware of who the wardens and first aid officers are
- Ensure all workers have been trained and have practiced emergency procedures ensure maintenance of all equipment including fire extinguishers, warning systems, emergency lighting and exits
- Be trained in the use of emergency equipment such as a fire extinguisher.

Training and Instruction

Every person permanently working on the site will be given training and instruction on emergency procedures and the evacuation plan on the day of engagement. The site will conduct annual evacuation drills as well as some training scenarios. Instruction must be given on the following subjects:

- Procedures to be followed in the event of an emergency.
- Means of escape from the building in the event of an emergency.
- Location and method of operation of:
  - ✓ Fire Fighting equipment
  - ✓ Emergency warning systems

Table 3.1: Emergency services and contact telephone numbers

Contact body	**Name**	**Phone**
Fire		
Police		
Ambulance		
Hospital		
Poison information line		
Site security		
Media/tv, radio		
Immediate neighbors		

SELF-CHECK-3	Written test

Name…………………………………………… ID……………………Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short answer questions (16 point)

1. Define the term emergency and emergency procedures.
2. Mention all the potential emergencies in the spice and herb industry.
3. Explain the three stages of risk assessment.
4. Write the emergency procedures you follow in spice processing industry.

Note: Satisfactory rating ≥8 points Unsatisfactory <8 points

You can ask you teacher for the copy of the correct answers.

LG #85	LO #4- Handover waste management system

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics: • Maintaining workplace records • Carrying out handover • Aware waste management systems This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**: • Maintain workplace records • Carry out handover • Aware waste management systems

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Maintaining workplace records

Records are the memory or proof of activities being carried out regarding your industry/organization. Records keep track of business transactions. They keep track of your agreements with suppliers and clients as in contracts. New records of all types are created by industry all the time. These records follow their own life cycle as they are created, distributed, used, stored and eventually disposed of at some point in the future. Records can vary in importance and often contain sensitive information. The handling and eventual destruction of many records are regulated by legislation.

When implementing waste management system the following records should include:

- Water volume used by process activity.
- Total land area waste volumes.
- Process down-times and their causes (equipment failure, personnel negligence).
- BOD and/or COD of effluent.
- Data needed for a national waste inventory;
- Data needed for waste characterization; (c) Records from the control process for treatment, packaging and conditioning;
- Documentation on the procurement of containers required to provide confinement for a specified period (e.g. in a repository);
- Specifications for waste packages and audit records of individual containers and packages;
- Operating performance trends;
- Incidents of non-compliance with the specifications for waste packages and the actions taken to rectify them;
- Monitoring records;
- Records of safety assessments;
- Written operating procedures;
- Any additional data required by the regulatory body.
- Other waste data essential to meet disposal requirements

SELF-CHECK-1	Written test

Name…………………………………………… ID……………………Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short answer questions (8 point)

1. What is the importance of maintaining workplace records?
2. Mention the data that record after completion of waste management system implementation.

Note: Satisfactory rating ≥4 points Unsatisfactory <4 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Carrying out handover

Waste management used to be a serious environmental concern in processing industry due to limited sorting at source and improper storage, collection, and treatment. The improper disposal of solid waste caused environmental impacts such as soil degradation, water quality impairment and air pollution, all with direct or indirect consequences for public health.

Implementation of waste management system can be performed either the industry itself or with contractors. After the completion of waste management system or construction of waste treatment lagoons and similar structures that used to treatment of both solid and liquid wastes there should be handover of the project to the owner of the industry or concerned body.

Information Sheet 3- Aware waste management systems

Raising awareness about waste management is a critical component of effective waste management. It is important for key stakeholders to be aware of a industry's waste management activities and have a strong understanding of the benefits of proper waste management. Although many challenges arise when raising awareness about waste management, a variety of communication techniques can be used to address them.

Raising awareness about solid waste management activities and the benefits of proper solid waste management can result in increases in:

- Use of waste collection services by the public and private sectors
- Funding for waste management from local elected officials
- Adoption and enforcement of local waste management policies by local elected officials
- Support for local-level activities from national governments
- Public participation in organic diversion and recycling programs. Each of these outcomes can contribute to industries' efforts to reduce the impacts of waste management on health, the economy, the environment, and society.

There are many barriers to raising awareness about waste management activities and the benefits of proper waste management.

- Lack of funds and capacity
- Embedded cultural practices, behavioral norms, and beliefs (e.g., the belief that waste has no value, which is a challenge for effective source separation and recycling programs)
- Lack of familiarity with the economic opportunities associated with waste management
- Capacity limitations of waste management agencies (e.g., lack of technical and financial resources for outreach)
- Unsupportive legal and regulatory frameworks
- Lack of time or interest from key stakeholders.

Benefits to society and environment from segregation of waste

- Enables easier, cleaner, safer and optimal resources recovery

- Reduces waste that is taken for landfill
- Reduces time, energy, labor and expense on resource recovery
- Larger quantity and better quality resources can be extracted from waste
- Leads to growth and modernization of recycling industry
- Facilities conversion of waste into resource
- Reduces dependency on extraction of depleting natural resources
- Promotes 3Rs and environmentally safe disposal
- Reduces costs, improves earning and promotes sustainability
- Helps in keeping our locality clean and green

SELF-CHECK-3	Written test

Name………………………………………… ID……………………Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short answer questions (12 point)

1. Mention the benefits from segregation of waste to the society and environment.
2. What are the communication techniques that can be used to address waste management awareness?
3. What the challenges to raising awareness about waste management activities and the benefits of proper waste management?

Note: Satisfactory rating ≥6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

LG #86	LO #5- Shutdown the waste water treatment system

Instruction sheet
This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics: • Shutting down waste management system • Preparing waste management system for storage • Identifying and reporting maintenance requirements This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**: • Shut down waste management system • Prepare waste management system for storage • Identify and report maintenance requirements
Learning Instructions:
1. Read the specific objectives of this Learning Guide. 2. Follow the instructions described below. 3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them. 4. Accomplish the "Self-checks" which are placed following all information sheets. 5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks). 6. If you earned a satisfactory evaluation proceed to "Operation sheets 7. Perform "the Learning activity performance test" which is placed following "Operation sheets" , 8. If your performance is satisfactory proceed to the next learning guide, 9. If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information Sheet 1- Shutting down waste management system

Waste management system should be shutdown based on the principles and procedures of the processing industries. During normal running of the plant, experienced people usually carry out familiar tasks using well-defined procedures, but during plant shutdown, one could come across hazardous procedures and unfamiliar events. A shutdown is temporary in nature, which means that it has a specific start and finish. There will be a preferred sequence of implementation for the shutdown tasks. Shutdowns have two objectives:

- To repair problems identified during previous major shutdowns, and
- To inspect parts of the plant not accessible during operation in order to identify problems that will be repaired during future planned shutdowns

Virtually all machines require maintenance and many of those machines may not be safe to service unless they are powered down. Shutting down your machines presents a great opportunity to make sure all of your machinery is clean in addition to collecting waste that may have accrued. You can perform all the cleanup tasks on your facility shutdown checklist, including:

- Power vacuuming
- Liquid waste removal
- Bulk solid waste removal
- Foundry Sand removal
- General industrial cleaning waste removal

A well-planned and well-executed shutdown can be an exciting and satisfying experience. A strong operations/maintenance partnership will be a key. Be sure to include all operations and maintenance activities in an integrated shutdown schedule, which should be under constant review and revision during the shutdown period.

SELF-CHECK-1	Written test

Name…………………………………………… ID……………………Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short answer questions (8 point)

1. What are the objectives of shutdown?
2. Which facilities are requiring cleaning while shutting down the waste management?

Note: Satisfactory rating ≥4 points Unsatisfactory <4 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 2- Preparing waste management system for storage in shut down mode

Storage may be required at any stage of the waste management process. There are four tiers to waste management to reduce its environmental impact: pollution prevention and source reduction; reuse or redistribution of unwanted, surplus materials; treatment, reclamation, and recycling of materials within the waste; and disposal through incineration, treatment, or land burial.

The function of the storage facility is to provide safe housing of the waste packages such that the operators and the general public are adequately protected from radiological hazards which could arise during normal storage and accident scenarios. Containment of the waste is required to be maintained over the storage period. Therefore it is important to ensure that deterioration of the waste package which is providing primary containment of the 66 waste, does not occur. Package deterioration also needs to be prevented to avoid problems when the waste is ultimately retrieved from the store and dispatched to the disposal facility. Degradation of the inner surface of the package is dependent on the waste and the containers themselves, whilst that of the outer surface will depend on the environmental conditions in which the package is held.

The ability to visually inspect the outer surface of the container will be a requirement for arranging containers that will be stored over a period in which, or in conditions in which, deterioration of the waste container might be expected. Since storage is temporary by definition it should be as easy to remove the waste containers as it was to put them into the store. This should preferably be done by the equipment used for loading and without the need for repackaging. Adoption of this approach negates those designs which utilize a backfill or permanent closure for storage purposes.

All solid waste must be stored in fly tight, watertight, rodent-proof containers or in other suitable containers with secured lids. Containers must be provided in sufficient number and capacity to properly store all solid waste between collections. The storage of hazardous materials must be in compliance with federal and state regulations. Your methods of handling waste are subject to unannounced inspections by state regulatory inspectors.

- All containers need to have a label at all time indicating contents.
- Put the label on the container before adding waste.
- All containers need a lid at all times when not actively adding or removing waste.
- Secondary containment is advised for liquid containers.
- Storage limits and locations are the same for waste as for new materials.

SELF-CHECK-2	Written test

Name…………………………………………… ID……………………Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short answer questions (6 point)

1. What are the four tiers to waste management to reduce its environmental impact?
2. What is the importance of storing waste?

Note: Satisfactory rating ≥3 points Unsatisfactory <3 points

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Identifying and reporting maintenance requirements

The term 'maintenance' covers many activities, including inspection, testing, measurement, replacement and adjustment, and is carried out in workplaces. It has a vital role to play in reducing the risk associated with some workplace hazards and providing safer and healthier working conditions. Insufficient/inadequate maintenance can cause serious accidents or health problems. Maintenance procedures and other work-related documents should identify preconditions and precautions, provide clear instructions for work to be done, and be used to ensure that maintenance is performed in accordance with the maintenance strategy, policies and programmes.

A risk assessment should be carried out before any maintenance work begins and work should be planned. It is best practice to keep a maintenance log which is regularly updated. Workers should be involved in the risk assessment process as those carrying out a maintenance task are often in the best position to identify hazards and the most efficient ways of dealing with them. The work area should be made safe and the people performing the maintenance work should be equipped with the proper tools and equipment to do the work safely (including personal protective equipment). The work should be monitored and safe working procedures need to be followed at all times. The process needs to end with checks to ensure that the job has been completed satisfactorily.

The frequency and nature of maintenance should be determined through risk assessment, taking full account of:

- the manufacturer's recommendations
- the intensity of use
- operating environment)
- user knowledge and experience
- the risk to health and safety from any foreseeable failure or malfunction

General requirements for equipment maintenance include:

- Obtaining a copy of the maintenance schedule recommended by the manufacturer.
- Ensuring that maintenance is performed as required.
- Ensuring that the person(s) performing the maintenance are competent (e.g. licensed mechanic).
- Retaining records of maintenance/service conducted.
- Specifying who is responsible for overseeing equipment maintenance and where the records are kept.
- Setting up a system for removal and tagging of damaged or defective tools and equipment.

Equipment failure can result in the following consequences:

- Loss in production and resources
- Possibility of project subcontracting
- Rescheduling of entire projects
- Material wastage from unused resources
- Overtime labor due to unexpected downtime
- Early disposal of machinery and equipment

SELF-CHECK-3	Written test

Name…………………………………………… ID……………………Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test: Short answer questions (12 point)

1. What are the problems that arise from Insufficient/inadequate maintenance in accordance with waste management?
2. Mention the general requirements for equipment maintenance.
3. How the frequency and nature of maintenance should be determined.

Note: Satisfactory rating ≥6 points Unsatisfactory <6 points

You can ask you teacher for the copy of the correct answers.

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