Dairy Products Processing

Level-II

Based on October 2019, Version 2 Occupational Standards

Module Title: Operating a Waste Water Treatment System

LG Code: IND DPP2 M14 LO (1-5) LG (45-49)

TTLM Code: IND DPP2 TTLM 1020v1

October, 2020

United Nations
Educational, Scientific and
Cultural Organization

Contents

LG #45	LO 1:Prepare the Waste water Treatment Process for Operation

Instruction sheet

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

- Making available chemicals and test equipment
- Confirming services for treatment operation
- Conducting pre-operational checks
- Calibrating instrumentation and test equipment
- Identifying and reporting Health and safety hazards

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 chemicals and test equipment
- Confirm services for **treatment** operation
- Conduct pre-operational checks
- Calibrate instrumentation and test equipment
- Identify and reporting Health and safety hazards

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.
4. Accomplish the “Self-Checks” which are placed following all information sheets.
5. Ask from your trainer the key to correct your work.
6. If you earned a satisfactory evaluation proceed to “Operation Sheets.
7. Perform “the LAP 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, go back to “Operation Sheets”.

Information Sheet 1- Making available chemicals and test equipment

1.1 Introduction

A stable rise in the demand for milk and milk has caused enormous growth of dairy industries in most countries of the world. Consequently, the amount of wastewater generated and discharged from these industries has also increased. The dairy industry wastewaters are primarily generated from the cleaning and milk washing operations in the milk processing plants.

Wastewater is water whose physical, chemical or biological properties have been changed as a result of the introduction of certain substances which render it unsafe for some purposes such as drinking. Wastewater contains many substances that are considered impurities. Impurities are any substances that are not found in “pure” water.

Because the dairy product processing industry produces different products, such as milk, butter, yogurt, ice-cream and various types of desserts and cheese, the characteristics of these effluents also vary widely both in quantity and quality, depending on the type of system and the methods of operation used. Dairy product processing factory wastewaters commonly contain milk, byproducts of processing operations, cleaning products and various additives that may be used in the factory. Dairy wastewater contains milk solids, detergents, sanitizers, milk wastes and cleaning water. It is characterized by high concentrations of nutrients and organic and inorganic contents.

The wastewater created in a dairy product processing comes mainly from the cleaning of the company's means of transport and of production. High organic loads are created on a changeover of production more than 90% of the organic contents consist of milk and production residues. All steps in the dairy chain, including production, processing, packaging, transportation, storage, distribution, and marketing, impact the environment. Owing to the highly diversified nature of this industry, various product processing, handling, and packaging operations create wastes of different quality and quantity, which, if not treated, could lead to increased disposal and severe pollution problems.

In dairy product processing wastewaters, nitrogen originates mainly from milk proteins and is either present in organic nitrogen form such as proteins, urea and nucleic acids, or as ions. Phosphorus is found mainly in inorganic forms such as orthophosphate and polyphosphate as well as in organic forms. The detergents and their additives are also present in small quantities in dairy wastewater. They may be alkaline or acidic and very often contain additives like phosphates, sequestering agents, surfactants, etc.

Generally, wastes from the dairy processing industry contain high concentrations of organic material such as proteins, carbohydrates, and lipids, high concentrations of suspended solids, high biological oxygen demand (BOD) and chemical oxygen demand (COD), high nitrogen concentrations, high suspended oil and/or grease contents, and large variations in pH, which necessitates “specialty” treatment so as to prevent or minimize environmental problems.

1.2 Dairy Processes and Composition of wastewater

Before the methods of treatment of dairy processing wastewater can be appreciated, it is important to be familiarized with the various production processes.

Pasteurized Milk

The main steps include raw milk reception (the first step of any dairy manufacturing process), pasteurization, standardization, deaeration, homogenization and cooling, and filling of a variety of different containers.

Milk and Whey Powders

This is basically a two-step process whereby 87% of the water in pasteurized milk is removed by evaporation under vacuum and the remaining water is removed by spray drying. Whey powder can be produced in the same way.

Cheese

Because there are a large variety of different cheeses available, only the main processes common to all types will be discussed. The first process is curd

manufacturing, where pasteurized milk is mixed with rennet and a suitable starter culture.

Butter

Cream is the main raw material for manufacturing butter. During the churning process it separates into butter and buttermilk. The drained buttermilk can be powdered, cooled, and packed for distribution, or discharged as wastewater.

Evaporated Milk

The milk is first standardized in terms of fat and dry solids content after which it is pasteurized, concentrated in an evaporator, and homogenized, then packaged, sterilized, and cooled for storage.

Ice Cream

Raw materials such as water, cream, butter, milk, and whey powders are mixed, homogenized, pasteurized, and transferred to a vat for ageing, after which flavorings, colorings, and fruit are added prior to freezing.

1.3 Sources of dairy wastewater

The volume, concentration, and composition of the effluents arising in a dairy plant are dependent on the type of;

- Product being processed,
- The production program,
- Operating methods,
- Design of the processing plant,
- The degree of water management being applied, and,
- The amount of water being conserved

Dairy wastewater may be divided into three major categories:

a. **Processing water:** This includes water used in the cooling and heating processes. These effluents are normally free of pollutants and can with minimum treatment be reused or just discharged into the storm water system generally used for rain runoff water.
b. **Cleaning wastewater:** originate mainly from the cleaning of equipment that has been in contact with milk or milk products, spillage of milk and milk products, whey, pressings and brines, CIP cleaning options, and waters resulting from equipment malfunctions and even operational errors.
c. **Sanitary wastewater:** This is normally piped directly to sewage works. Sanitary wastewater is found in lavatories, shower rooms, etc**.** Sanitary wastewater is similar in composition to municipal wastewater and is generally piped directly to sewage works.

1.4 Chemicals and test equipment for wastewater treatment operation

Equipment is refers to a set of tools or machines commonly used to operate wastewater treatment system.

Test equipment used to wastewater treatment system includes;

- Screens /wire screen and grit chamber
- pH Correction
- Oil/Grease skimmers
- Setting and treatment ponds/Lagoons
- Aeration units
- First flush system and wet lands
- Pumps and valves

pH correction

The term “pH” refers to the measurement of hydrogen ion activity in the solution. Determination of pH plays an important role in the wastewater treatment process.

Extreme levels, presence of particulate matters, accumulation of toxic chemicals and increasing alkalinity levels are common problems in wastewater.

The pH of dairy product processing effluent varies between 2 and 12 as a result of the use of acid and alkaline detergents for plant cleaning. Both low and high pH values interfere with the activity of the microorganisms that break down organic pollutants in the biological treatment stage of the sewage treatment plant, transforming them into biological sludge (cell detritus).

The optimum pH range for biological treatment plants is between 6.5 and 8.5. Extreme pH values can be highly detrimental to any biological treatment facility, not only for the negative effect that it will have on the microbial community, but also due to the increased corrosion of pipes that will occur at pH values below 6.5 and above 10.

Common chemicals used to pH correction include:

- Calcium oxide or calcium hydroxide (as lime slurry)
- Sodium hydroxide (caustic soda/ NaOH)
- Sodium carbonate (soda ash) or sodium bicarbonate.
- Magnesium hydroxide or magnesium bicarbonate.

Physical Screening

The main purpose of screens in wastewater treatment is to remove large particles or debris that may cause damage to pumps and downstream clogging. It is also recommended that the physical screening of dairy wastewater should be carried out as quickly as possible to prevent a further increase in the COD concentration as a result of the solid solubilization.

Fats, Oil, and Grease Removal/ Skimmers

The presence of fats, oil, and grease (FOG) in dairy processing wastewater can cause all kinds of problems in biological wastewater treatment systems onsite and in public sewage treatment facilities. It is essential to reduce, if not remove FOG completely, prior to further treatment.

General FOG removal systems include the following;

- Gravity Traps,
- Air Flotation, and
- Dissolved Air Flotation

Chemicals used to wastewater treatment system may include;

- pH neutralizers like
  - ✓ Sulfuric acid/H2SO4,
  - ✓ Nitrate/HNO3,
  - ✓ Sodium Hydroxide/NaOH/
  - ✓ Carbon dioxide/ CO2/
  - ✓ Calcium hydroxide /lime
- Anti-foaming agents,
- Coagulants
- Flocculants

The most straightforward class of chemicals is pH neutralizers, although why and how they are used varies depending on the process producing the wastewater. Essentially, wastewater effluent flowing into the sewer system should be neither too acidic nor too basic (ideally completely neutral at pH 7), as this will help to prevent undesirable chemical reactions when the wastewater mixes with other effluent.

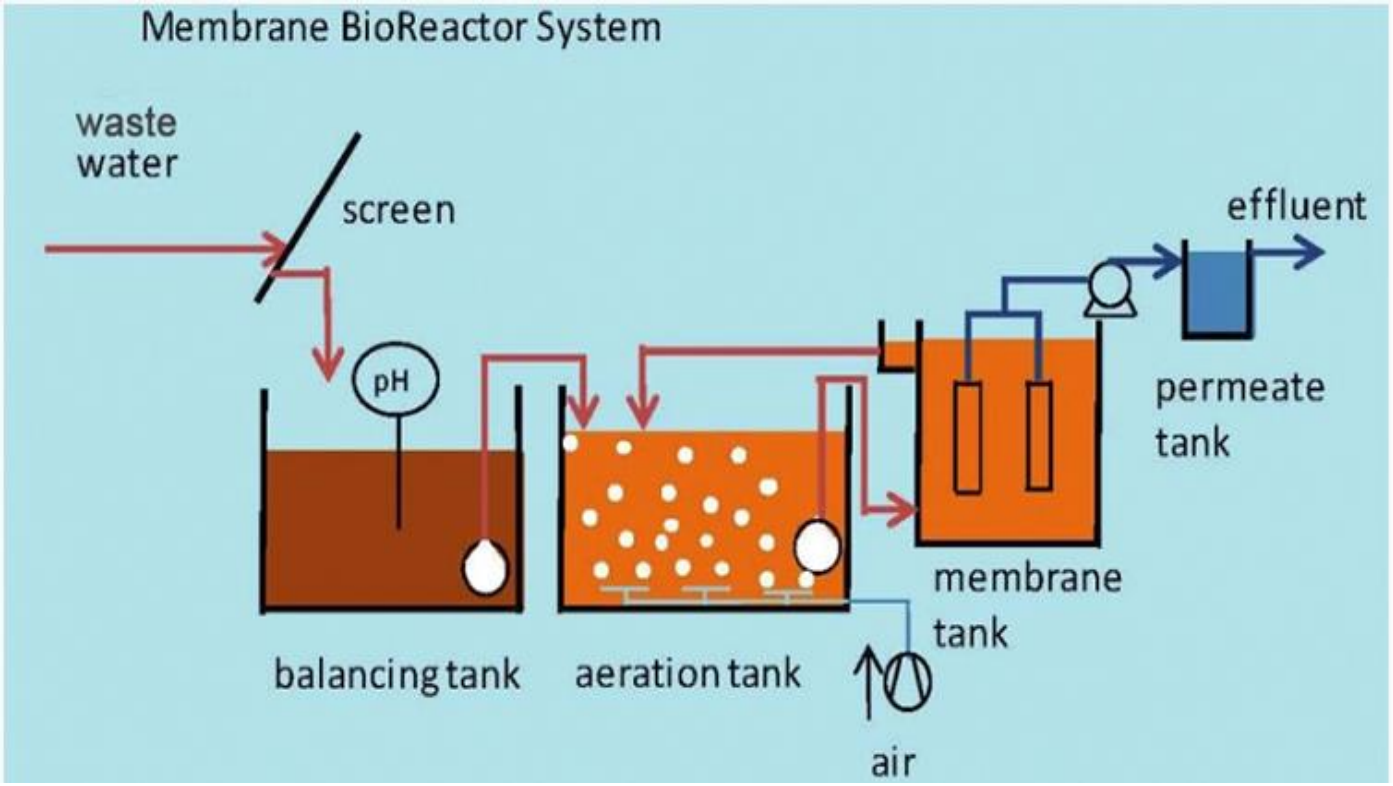

Figure 1: waste treatment system

Self- Check 1	Written test

Name…… ID…… Date…….

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

Part I: Choose the best answer (3 points each)

1. Which Chemicals can be used for wastewater treatment?

A. pH neutralizers B. Anti-foaming agents C. Coagulants D All

2. The volume, concentration, and composition of the effluents arising in a dairy plant can be depend on;

   A. Product being processed
   B. The production program
   C. Operating methods
   D. Design of the processing plant
   E. All

3. Common chemicals used to pH correction include:

   A. Calcium oxide or calcium hydroxide
   B. Sodium hydroxide
   C. Sodium carbonate.
   D. All

Part II: Short answer (6 point)

1. Define dairy wastewater.
2. Write dairy wastewater major categories:

Note: Satisfactory rating above- 8 points unsatisfactory rating below -8 points

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

Information Sheet 2- Confirming services for treatment operation

2.1 Confirming services for treatment operation

Confirming services for treatment operation covers basic equipment and inputs preparation for treatment system. Method used to treat wastewater depends on materials and specification requirements include;

- Confirming type of materials
- Visual inspection
- Sorting and grading
- Equipment preparation

Materials or chemicals should be preparing for treatment operation as required based on treatment requirements by measuring and weighing sample preparation.
The dairy product processing effluent treatment facility consists of the following units;

- Effluent collection sump
- Oil & grease removal chamber or skimmers
- Chemical solution dosing systems
- Aeration Tanks
- Secondary clarifier
- Sludge drying beds

There are wastewater treatment Operating Services Information institutions which provide a confirming a service. Wastewater treatment operating services are companies that operate and manage wastewater treatment facilities for public and private customers. They are staffed by certified plant operators who typically perform field sampling, laboratory analysis, routine maintenance, and pretreatment program monitoring.

Some wastewater treatment companies also offer services such as infrastructure evaluation, system optimization, and environmental compliance consulting. Others have secondary capabilities such as project management, systems integration, business consulting, and financial management.

There should be confirming activity of services for the purpose of reducing the Quantity of Pollutants in Wastewater. The confirming service done on;

- Equipment status involves
- Conducting relevant pre-start checks
- Confirming that housekeeping standards are met
- All safety guards are in place and equipment is operational.

Self- Check- 2	Written test

Name…… ID…… Date…….

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

Part I: Choose the best answer (6 point)

1. Which one of the following Method used to depends on materials and specification requirements?

A. Confirming type of materials B. Visual inspection C. Sorting and grading D. All

2. The dairy effluent treatment facility consists of the following units **except;**

A. Effluent collection sump
B. Oil & grease removal chamber or skimmers
C. Chemical solution dosing systems
D. None

Part II: Short answer (4 point)

1. Write the materials which are to be confirm in treatment operation..

Note: Satisfactory rating above- 5 points unsatisfactory rating below -5 points

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

Information Sheet 3- Conducting pre-operational checks

3.1 Conducting pre-operational checks

In dairy product processing wastewater treatment process, pre-operational check for treatment plant is important for the workers safety. It involves a daily check of the treatment plant normal function. Any warehouse machine that needs repairs, maintenance or is observed to be unsafe to operate has to be taken out until such repair or maintenance has been done.

Check to ensure there is a fire extinguisher, first aid kit, and any tools or supplies that you will need to perform your task. If using a cell phone, make sure to keep it on your person.

The purpose of a pre-operation check is to make sure that no hazards exist before you start your production for the day. Find out what you should be checking as part of these checks.

A pre-start inspection involves a routine examination of a piece of equipment by its operator that is standardized via a checklist. Whether it be a light vehicle, heavy vehicle, mobile plant or tools, pre-start inspections are an important task with financial, and more importantly, safety implications.

The purpose of an inspection is to identify whether work equipment can be operated, adjusted and maintained safely with any deterioration detected and remedied before it results in a health and safety risk. The need for inspection and inspection frequencies should be determined through risk assessment. Check that the outer cover of the equipment is not damaged in a way that will give rise to electrical or mechanical hazards. Check for burn marks or staining that suggests the equipment is overheating. Position any trailing wires so that they are not a trip hazard and are less likely to get damaged.

The pre-operation inspection helps to:

- Reduce the risk of injury to operator due to defective equipment.
- Verify that the equipment will operate is in safe working order
- Improves the condition of the lift truck.
- Increase productivity that is wastewater treatment quality.
- Reduces time and maintenance costs.

Before start using wastewater treatment plant and manipulate operations, consider the following guidelines;

- Parameter setting (pressure, temperature, flow...)
- Identify faulty conditions.
- Identify the possible hazards.
- Check the treatment processing plant is complete, with all safeguards fitted, and free from defects.
- Follow manufacturer specification.
- Establish a safe system of work for using and maintaining the plant.
- Maintenance as required to prevent risk.

Fig.1pre-operation check

Self-Check - 3	Written test

Name…… ID…… Date…….

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

Part I: Say True / False (2 point)

1. The purpose of a pre-operation check is to make sure that no hazards exist before you start your production for the day.

Part II: Choose the best (2 point)

1. Which one of the following is true about pre-operation inspection?

A. Reduce the risk of injury to you due to defective equipment.

B. Verify that the equipment you will operate is in safe working order

C. All

Part III: Short answer (6 point)

1. Define pre-operational check.

2. Write the importance of pre-operation inspection.

Note: Satisfactory rating above 5 points unsatisfactory rating below 5 points

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

Information Sheet 4- Calibrating instrumentation and test equipment

4.1 General Calibration and Maintenance

In dairy product processing wastewater treatment processing plant there are various equipment need to be calibrated like Pressure gauges, pressure and temperature transmitters, transducers, electronic sensors, valves, regulators, and pressure and temperature switches need to be checked and calibrated periodically.

Portable calibrators and test equipment requires periodic checks and calibration. Having local standards on site for calibration of these instruments offers a savings in cost and downtime of instruments calibrate the field instruments locally and then send only the standard in for regular calibration. There is no better pressure standard than a deadweight tester for calibrating pressure instruments and our deadweight testers are designed to be highly accurate but durable.

4.2 Calibrating instrumentation and test equipment to manufacturers

Calibrations are the documented comparison of the measurement device to be calibrated against a traceable reference device. The reference standard may be also referred as a "calibrator." Logically, the reference is more accurate than the device to be calibrated.

The goal of calibration is to minimize any measurement uncertainty by ensuring the accuracy of test equipment.

There are various reasons to calibrating our treatment plant equipment;

- Maintain industry compliance and consistency.
- Reduce costly errors.
- Eliminate safety risks.
- Minimize downtime.
- Keep your customers satisfied

Instrumentation is the basic process control in industry. In industrial control a wide number of variables temperature, flow, level, pressure, and distance can be sensed simultaneously.

Instruments are used to measure and control the condition of process streams as they pass through a Plant. They are used to measure and control process variables such as: temperature, flow rate; level of quality, pressure, pH, etc.

Principles of instrumentation

- Accessibility
- Selection of proper instrument.
- Condition of instruments (functionality).
- Selection and preparation of chemicals for treatment process.

Test equipment to be calibrated includes;

- Screens
- pH correction
- Oil/grease skimmers
- Aeration units
- Lagoons

Tests undertake in the treatment processing plant include:

pH of wastewater; the optimum pH range for biological treatment plants is between 6.5 and 8.5. Extreme pH values can be highly detrimental to any biological treatment facility, not only for the negative effect that it will have on the microbial community, but also due to the increased corrosion of pipes that will occur at pH values below 6.5 and above 10.

Solids; the treated wastewater should be free from solid materials.

BOD levels; BOD is a measure of the content of biologically degradable substances in sewage. The substances are broken down by micro-organisms in the presence of oxygen.

COD levels; COD indicates the quantity of the pollutants in wastewater that can be oxidized by a chemical oxidant. The normal reagents used for this purpose are strongly acid solutions of potassium dichromate or potassium permanganate at high temperature.

Fig.2 maintaining ready for operation

Fig. 3 Ready for operation

Self-Check - 4	Written test

Name…… ID…… Date…….

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

Part I: Say True/ False (2 point)

1. Instruments are used to measure and control the condition of process.

Part II: Choose the best answer (6 point)

1. Which one of the following equipment used for testing purpose?

A. Screens B. PH correction C. Oil/grease skimmers D. All

2. Which one of the following **is not** a reason to calibrating our treatment plant equipment?

A. Maintain industry compliance and consistency.

B. Reduce costly errors.

C. Eliminate safety risks.

D. Maximize downtime.

Part III: Short answer (4 points)

1. What are the goals of calibration?
2. Write-down Principles of instrumentation.

Note: Satisfactory rating above 5 points unsatisfactory rating below 5 points

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

Information Sheet 5- Identifying and reporting health and safety hazards

5. Identifying and reporting health and safety hazards

5.1 Types of Pollutants

The food industry contributes to a great extent to pollution; these pollutants are of organic and inorganic matters.

a. Organic pollutants

The normal way to express the concentration of a pollutant is to specify the total quantity per unit volume of sewage. However, the quantity of organic substances is normally determined in the form of;

- Biological oxygen demand (BOD)
- Chemical oxygen demand (COD)
- Calcining loss
- Total organic carbon (TOC)

i. **Biological oxygen demand:** BOD is a measure of the content of biologically degradable substances in sewage. The substances are broken down by micro-organisms in the presence of oxygen. It is measured in mg oxygen/l or g oxygen/m3.

ii. **Chemical oxygen demand**: COD indicates the quantity of the pollutants in wastewater that can be oxidized by a chemical oxidant. The normal reagents used for this purpose are strongly acid solutions of potassium dichromate or potassium permanganate at high temperature. It is measured in mg oxygen/l or g oxygen/m3.

iii. **Calcining loss:** it is obtained by first determining the dry solids content in a sample, and then calcining it so that the organic substance is burnt. The difference in weight before and after calcining represents the quantity of organic substance. The value is expressed in %.

iv. **Total Organic Carbon**: it is another measure of the quantity of organic materials, determined by measuring the quantity of carbon dioxide produced from combustion of a sample. The unit is mg/l.

b. Inorganic pollutants

The inorganic components of sewage consist almost entirely of salts, and are determined largely by the ionic composition and salt concentration in the mains water. The presence of these salts in sewage is normally unimportant.

Present-day effluent treatment processes concentrate on the reduction of nitrogen, phosphorus, salts and heavy metals.

Nitrogen and phosphorus compounds are important, as they are nutrients for organisms, e.g. algae, in recipients. As a result of the growth of algae, secondary processes can proceed in the recipient, forming further organic substances which, when they decompose, can result in considerably higher oxygen demand than is caused by primary organic pollutants in the sewage effluent.

5.2 Identifying and reporting hazards

'Hazard' is defined as an agent or condition of an activity that has the potential to cause an adverse health effect in humans. Hazards in dairy wastewater treatment process include;

a. Biological Hazards which are Microorganisms or pathogens those can degrade the organic materials in the wastewater.

b. Chemical

Water can become contaminated with unwanted chemicals such as cleaning agents and processing additives. There should be proper handling of chemicals, and flammable gases in order to minimize chemical hazards.

c. Physical

Water can be contaminated with physical objects such as glass, metal, plastic, insects, and adhesive dressings and jewelers. If these things are found in water, they may introduce microbial hazards and may also result in physical harm to the worker.

Dairy processing plant is best ensured through the identification and control of hazards in the production, manufacturing and handling of processing inputs as described in the Hazard Analysis and Critical Control Point (HACCP) system. Hazard Analysis Critical Control point System is a way of ensuring that food is safe.

Safe work procedure including awareness of health and safety hazards related to waste water system operation and associated control measures can prevent or minimize hazards.

Report health and safety hazards to appropriate person which includes;

- Waste water treatment plant breakdown
- Waste water treatment storage area problem
- Useless/expired waste treatment chemicals
- Outcome of the operation
- Obstacles of the treatment operation

Self-Check - 5	Written test

Name…… ID…… Date…….

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

Part I: Choose the best answer (6 point)

1. Which one of the following are examples of Chemical hazard.

A. Cleaning agents B. Pesticides C. Fungicide D. All

2. Quantity of organic substances is normally determined in the form of;
   A. Biological oxygen demand
   B. Chemical oxygen demand
   C. Total organic carbon
   D. All

3. ---------- is a measure of the content of biologically degradable substances in sewage.

A. COD B. BOD C. TOC D. Calcining loss

Part II: Short answer (4 point)

1. Define hazard and list the at least three types of hazards.
2. Write down types of pollutants.

Note: Satisfactory rating above 5 points Unsatisfactory rating below 5 points

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

Operation Sheet -1	Conducting pre-operational checks

Conducting pre-operational checks Procedure;

Step 1: Wear appropriate personal protective equipment.

Step 2: Prepare chemicals and equipment.

Step 3: Properly calibrate materials and equipment.

Step 4: Check wastewater operating plant.

Step 5: Check Filtration parts of the equipment.

Step 6: Disinfection equipment.

Step 7: Start operating.

N.B

- Conduct the activity in accordance with workplace procedure.
- Properly check the plant before regular work.

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 **1:00 hour**. The project is expected from each student to do it.

Task- 1: Conduct Pre-operational checks

LG #46	LO2: Operate and Monitor the Waste Water Treatment Process

Instruction Sheet

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

- Starting up the waste water treatment system
- Operating plant
- Monitoring equipment
- Monitoring, testing and adjusting waste water quality
- Operating first flush systems during rainfall events
- Meeting the 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:**

- Start up the waste water treatment system
- Operate plant
- Monitor equipment
- Monitor, test and adjust waste water quality
- Operate first flush systems during rainfall events
- Meet the workplace housekeeping standards

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.
4. Accomplish the “Self-Checks” which are placed following all information sheets.
5. Ask from your trainer the key to correct your work.
6. If you earned a satisfactory evaluation proceed to “Operation Sheets.
7. Perform “the LAP 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, go back to “Operation Sheets”.

Information Sheet 1- Starting up wastewater treatment system

1.1 Wastewater treatment

Wastewater treatment is a process with a series of designed unit operations and processes that aims at reducing certain constituents of wastewater to acceptable levels.

Wastewater treatment is vital for the:

- Reduction of biodegradable organic substances in the environment
- Reduction of nutrient concentration in the environment.
- Elimination of pathogens /micro-organism
- Recycling and reuse of water.

1.2 Wastewater treatment systems

1.2.1 Unit operations

Due to the nature of contaminants in wastewater, unit operations can be;

a. Physical unit operations

- Screening
- Comminution
- Flow equalization
- Sedimentation
- Flotation
- Granular-medium filtration

b. Chemical unit operations

- Chemical precipitation
- Adsorption
- Disinfection
- Dechlorination

c. Biological unit operations

- Activated sludge process
- Aerated lagoon
- Trickling filters
- Rotating biological contactors
- Pond stabilization
- Anaerobic digestion

1.2.2 Levels of wastewater treatment

There are three broad levels of treatment:

a. Primary treatment / Mechanical
b. Secondary treatment / Biological
c. Tertiary treatment / Chemical sedimentation

a. Preliminary and primary treatment

Sometimes, preliminary treatment precedes primary treatment.

Preliminary treatment consists only in separating the floating materials (like dead animals, tree branches, papers, pieces of rags, wood, etc.), and also the heavy settleable inorganic solids. It also helps in removing the oils and greases, etc. from the sewage. This treatment reduces the BOD of the wastewater, by about 15 to 30%.

Primary treatment removes settleable organic and inorganic solids by sedimentation and floating materials (scum) by skimming. Up to 50% of BOD5, 70% of suspended solids and 65% of grease and oil can be removed at this stage. The effluent from primary sedimentation units is referred to as primary effluent.

The Preliminary and primary treatment processes used;

- Screening
- Grit chambers or Detritus tanks
- Skimming tanks for removing oils and greases

i. Screening

Screening is the very first operation carried out at a sewage treatment plant, and consists of passing the sewage through different types of screens, so as to trap and remove the floating matter, such as pieces of cloth, paper, wood, cork, hair, fiber, kitchen refuse, fecal solids, etc. present in sewage.

Depending upon the size of the openings, screens may be classified as;

Coarse screens are also known as Racks, and the spacing between the opening sizes is about 50 mm or more. These screens do help in removing large floating objects from sewage.

In medium screens, the spacing between bars is about 6 to 40 mm. These screens will ordinarily collect 30 to 90 liters of material per million liter of sewage.

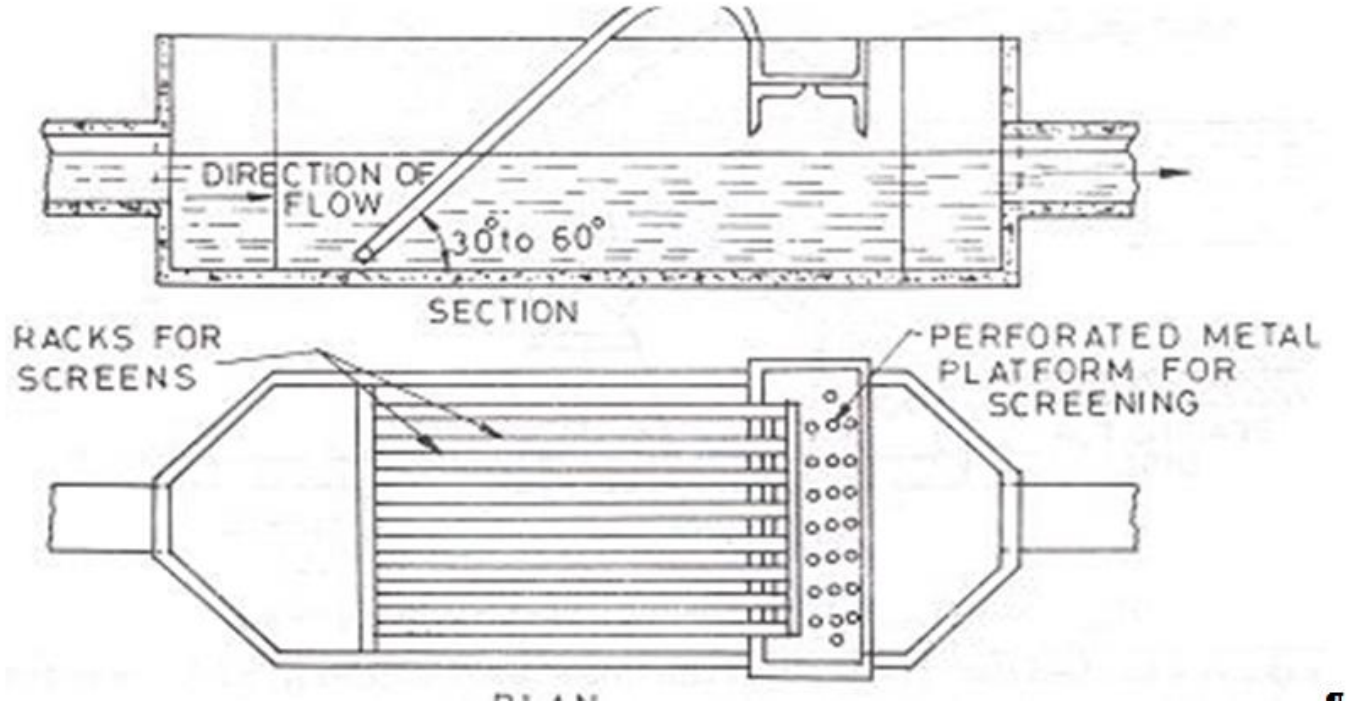

Figure 4 Fixed bar type coarse or medium screen

Fine Screens have holes of 1.5 mm to 3 mm in size. The installation of these screens proves very effective, and they remove as much as 20% of the suspended solids from sewage. These screens, however, get clogged very often, and need frequent cleaning. These screens will considerably reduce the load on further treatment units.

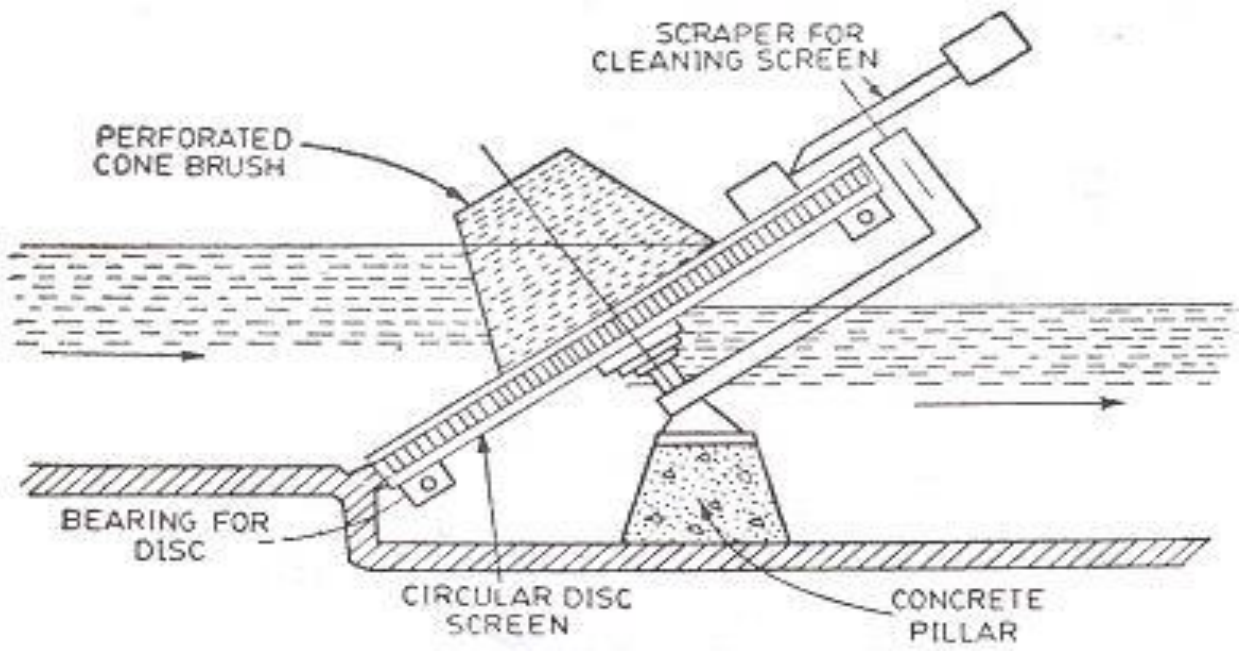

Figure 5 Reinsch-Wurl screen (disc type fine screen)

Comminutors

Comminutors or Shredders are the patented devices, which break the larger sewage solids to about 6mm in size, when the sewage is screened through them. Such a device consists of a revolving slotted drum, through which the sewage is screened

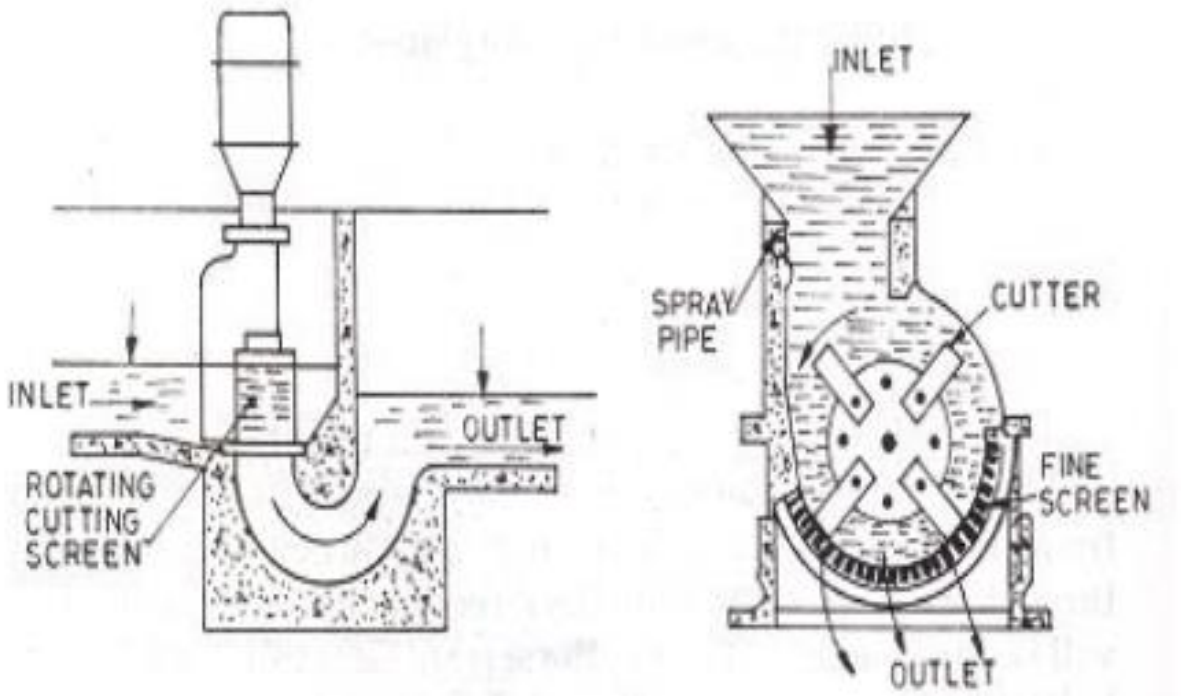

Figure 6 Comminutor or shredder

Disposal of Screenings

The material separated by screens is called the screenings. It contains 85 to 90% of moisture and other floating matter. To avoid such possibilities, the screenings are disposed of either by burning, or by burial, or by dumping.

ii. Grit Chambers or Detritus Tanks

Detritus tanks are nothing but rectangular grit chambers, designed to flow with a smaller flow velocity (of about 0.09m/sec) and longer detention periods (about 3 to 4 minutes) so as to separate out not only the larger grit, etc., but also to separate out the very fine sand particles, etc. for removing grit and sand.

iii. Skimming /Tanks for removing Oils and Grease/

Skimming tanks are employed for removing oils and grease from the sewage, and placed before the sedimentation tanks. They used where sewage contains too much of grease or oils which include fats, soaps, fatty acids, etc. The skimming tank consists of a long trough shaped structure divided into two or three lateral compartments by means of vertical baffle walls for a short distance below the sewage surface. The collected greasy materials are removed.

Disposal of Skimming

The oil and greasy material removed as slimmings from the skimming tanks can be disposed of either by burning or burial. It is generally too polluted to be of any economic use.

Generally, Primary treatment consists in removing large suspended organic solids. This is usually accomplished by sedimentation in settling basins. Sometimes, the preliminary as well as primary treatments are classified together, under primary treatment.

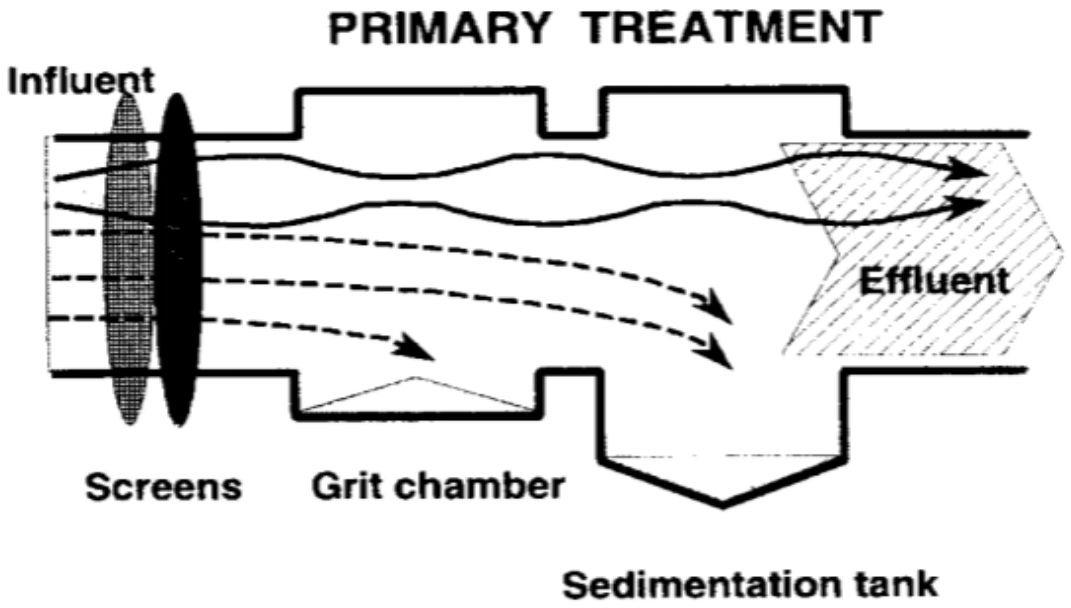

Figure 8 Primary Treatment

b. Secondary wastewater treatment

The secondary stage of treatment is the further treatment of primary effluent to remove residual organics and suspended solids and it removes about 85% of the organic matter in sewage by making use of the bacteria in it.

The principal secondary treatment techniques used in secondary treatment are the trickling filter and the activated sludge process. After effluent leaves the sedimentation tank in the primary stage it flows or is pumped to a facility using one or the other of these processes. A trickling filter is simply a bed of stones from three to six feet deep through which sewage passes.

Waste treatment Ponds

These ponds used to achieve secondary (biological) treatment without all of the mechanical equipment and treatment units associated with the activated sludge process.

There are different types of treatment Ponds.

i. **Aerobic ponds:** shallow pond designed to treat wastewater under aerobic conditions.
ii. **Anaerobic ponds:** shallow pond designed to operate in the absence of dissolved oxygen.
iii. **Facultative ponds:** Combines aerobic and anaerobic treatment. Aerobic treatment occurs in the upper portion of the pond where oxygen is available from photosynthesis and absorption at the water/air interface
iv. **Aerated Ponds**: Similar to Facultative pond, except deeper, ranging in depth to 20 feet. Aerobic treatment occurs in upper portions of pond. Extended depth provided to allow for long-term storage of settled solids.

Pond Location

Ponds should be located at least 200m (preferably 500m) downwind from the community they serve and away from any Likely area of future expansion. Odour release, even from anaerobic ponds, is most unlikely to be a problem in a well-designed and properly maintained system, but the public May need assurance about this at the planning stage, and a minimum distance of 200 m normally allays any fears.

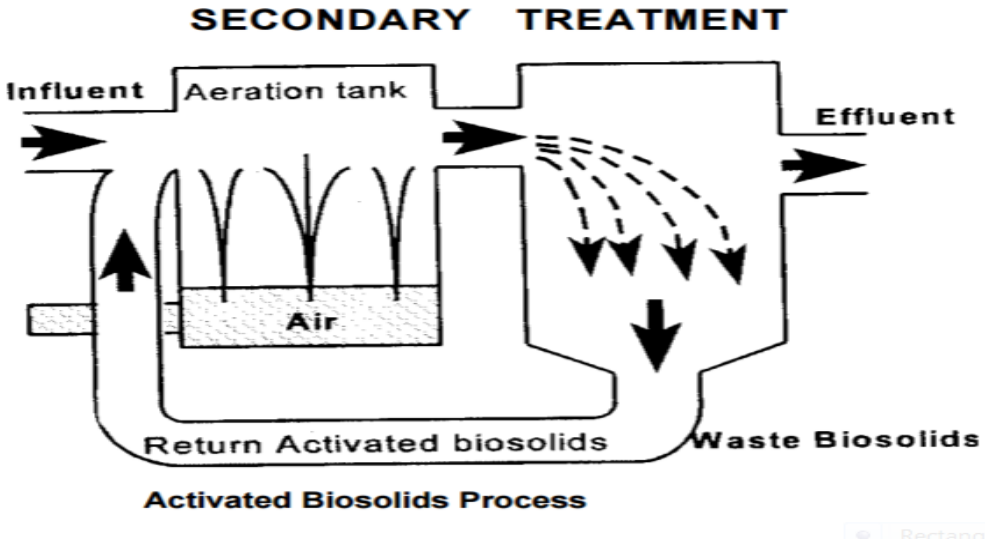

Figure 9 Secondary wastewater treatments

c. Tertiary wastewater treatment processes

This is an advance treatment employed when specific wastewater constituents which cannot be removed by secondary treatment must be removed. Advance treatment removes significant amounts of nitrogen, phosphorus, heavy metals, biodegradable organics, bacteria and viruses.

The purpose of tertiary treatment is to provide a final treatment stage to raise the effluent quality before it is discharged to the receiving environment. More than one tertiary treatment process may be used at any treatment plant. If disinfection is practiced, it is always the final process. It is also called effluent polishing.

Tertiary wastewater treatment processes can be done and realized through;

- Filtration
- Lagooning/ further biological ponds
- Nutrient removal
- Nitrogen removal
- Phosphorus removal
- Disinfection
- Odour Control

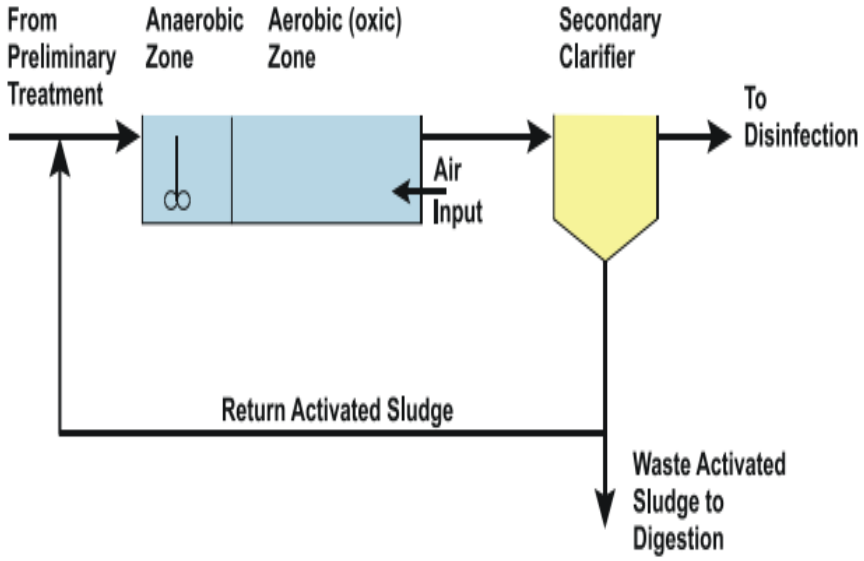

Figure 9 Biological phosphorus removal process schematic

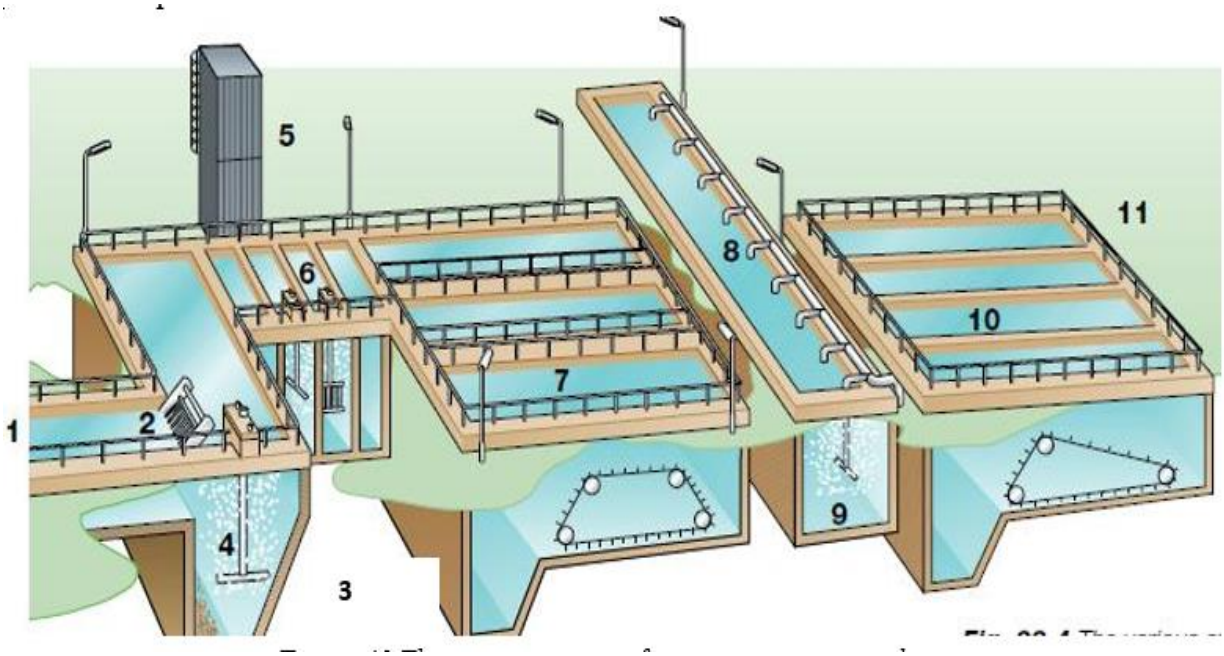

Figure 10 The various stages of a sewage treatment plant

1 Inlet channel
2 Grid
3 Sand trap
4 Aeration
5 Silo for flocculants
6 Pre-precipitation
7 Pre-sedimentation
8 Biological treatment
9 Aeration
10 Post-sedimentation
11 Clarified effluents to recipient

Self-Check -1	Written test

Name…… ID…… Date…….

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

Part I: Say True/ False (3 point)

2. Objectives of wastewater treatment is elimination of pathogens

Part II: Choose the best answer (3 point)

1. Which one of the following objectives of starting waste water treatment system?

A. Reduction of biodegradable organic substances

B. Reduction of nutrient concentration

C. Elimination of pathogens

D. All

Part III: Short answer (4 point)

1. Write the objectives of wastewater treatment.

Note: Satisfactory rating above 5 points Unsatisfactory rating below 5 points

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

Information Sheet 2- Operating plant

2.1 Operating plant within limits of manufacturer's specification

Wastewater Treatment Plant is a plant with a series of designed unit operations and processes that aims at reducing certain constituents of wastewater to acceptable levels.

Figure 11 Wastewater treatment plant

Operations of the treatment plant

During plant operation activity, there will be normal or abnormal operation.

- Normal operations are when processes are functioning properly.
- Abnormal operations are when a process is not working properly, or when equipment is not available and this required corrective action.

Guidelines for plant operations should be included in the plant Operations and Maintenance manual or Standard Operating Procedures (SOP) manual.

Wastewater treatment processing activities such as plant cleaning, material conveying, bottling, and product washing create wastewater. Many food processing facilities require on-site treatment before operational wastewater can be land applied or discharged to a waterway or a sewer system. High suspended solids levels of organic particles increase BOD and can result in significant sewer surcharge fees. Sedimentation, wedge wire screening, or rotating belt filtration (micro screening) is commonly used methods to reduce suspended organic solids loading prior to discharge.

Industrial wastewater treatment describes the processes used for treating wastewater that is produced by industries as an undesirable by-product. After treatment, the treated industrial wastewater (or effluent) may be reused or released to a sanitary sewer or to surface water in the environment. Most industries produce some wastewater. Recent trends have been to minimize such production or to recycle treated wastewater within the production process.

Self-Check -2	Written test

Name……ID…… Date……

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

Part I. Give short Answer (10 points)

1. Write does it mean operation.
2. Write down types of plant operations which will be occurred in treatment plant.

Note: Satisfactory rating above 5 points Unsatisfactory rating below 5 points

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

Information Sheet 3- Monitoring equipment

3.1 Monitoring waste water treatment equipment

Monitoring is the systematic process collecting, analyzing and using information to track a process progress toward reaching its objectives and to guide waste water treatment equipment management decision**.**

Operation and monitoring of equipment and processes typically requires the use of control panels and systems.

The treatment system should be designed so that sampling of the inflow and- outflow is practicable. The design should also permit easy access to most parts of the treatment system. The equipment necessary to any out a sampling programmer includes: a fixed or portable sampling device, a data logger, a flow measuring device and a power supply.

Flows and wastewater characteristics should be monitored. Operational monitoring generally includes Mixed Liquor Suspended Solids (MLSS).solids contact aeration basin DO, pH sludge settle ability, inflow, percolating filter recirculation flow, return sludge glow sludge wasting rate.

Monitoring requirements include stem in flow and final wastewater flows, suspended solids concentrations and substrate concentrations.

Operational monitoring generally includes Rotating Biological Chambers/RBC basin dissolved oxygen (DO) levels, pH, sludge settle ability, sludge flow from secondary to primary settlement tank and sludge wasting rate. If the RBC is overloaded, there will be odor problems at the inlet end of the biological zone. Monitoring requirements may include' stem inflow and wastewater flows, suspended solids Concentrations and substrate concentrations.

Self-Check -3	Written test

Name…… ID…… Date…….

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

Part I: Choose the best answer (4 point)

1. Which one of the following includes operational monitoring of treatment equipment?

A. pH sludge settles ability B. Sludge flow from secondary to primary settlement tank C. Dissolved Oxygen D. All

Part II: Short answer (6 point)

1. Define monitoring.

Note: Satisfactory rating above 5 points Unsatisfactory rating below 5 points

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

Information Sheet 4- Monitoring, testing and adjusting wastewater quality

4.1 Monitoring, testing and adjusting wastewater quality

Wastewater quality monitoring is commonly is a process of taking a sample and analysis of water in wastewater treatment operation. Waste water quality monitoring can evaluate the physical, chemical, and biological characteristics of water. Monitoring requirements may include system inflow and final wastewater flows, suspended solids Concentrations and substrate concentrations.

Operational monitoring should include Mixed Liquor Suspended Solids (MLSS), Reactor DO, pH sludge settle ability, alkalinity, and return Sludge flow, and sludge wastage rate. The treatment system should be designed so that sampling of the inflow and- outflow is practicable. The design should also permit easy access to most parts of the treatment system without dismantling any fixed components.

The equipment necessary to any out a sampling program includes: a fixed or portable sampling device, a data logger, a flow measuring device and a power supply. Flows and wastewater should be monitored.

4.2 Wastewater quality

Water quality sampling and test procedures including the purpose of test and safe use care and storage of relevant test equipment, interpretation and recording of results.

The objective of wastewater quality monitoring is to obtain quantitative information on the physical, chemical, and biological characteristics of water via statistical sampling.

Wastewater quality indicators include;

- Temperature and dissolved oxygen.
- Conventional variables (pH, TDS, conductivity, and suspended sediment)
- Organic Nutrients.
- Presence of metals.
- Hydrocarbons.
- Chemicals and minerals

Ways to testing and monitoring the wastewater quality, encouraging a clean and healthy aquatic ecosystem include;

- Chlorophyll Fluorescence Analysis.
- Conductivity, Salinity, and TDS Monitoring.
- Recording the water temperature.
- Measuring the DO levels.
- PH testing.

Self-Check -4	Written test

Name…… ID…… Date…….

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

Part I: Choose the best answer (6 point)

1. Which one of the following is water quality indicator?

A. Temperature and dissolved oxygen. B. Conventional variables Organic Nutrients.

C. Presence of metals. D. All

2. Which one of the following used to encouraging a clean and healthy aquatic ecosystem?

A. Chlorophyll Fluorescence Analysis. B. Conductivity monitoring

C. Salinity monitoring D. TDS Monitoring. E. All

Part III: Short Answer (4 point)

1. What is the Objective of water quality monitoring?

Note: Satisfactory rating above 5 points Unsatisfactory rating below 5 points

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

Information Sheet 5 - Operating first flush systems during rainfall events

5.1 Operating first flush systems during rainfall events

First flush is the initial surface of runoff the rainstorm. During this phase, water pollution entering storm drains in areas with high proportions of impervious surface is typically more concentrated compared to the reminder of the storm. Consequently, these high concentrations of urban runoff result in high levels of pollutants discharged from storm sewers to surface waters.

First flush device is one that takes the first water from the roof and diverts it to the tank. If it important to flush the roof and divert water from your tank, because over time your roof gets dust and dirt and debris from the environment. The rainwater effectively washes your roof.

The term "first flush effect" refers to rapid changes in water quality (pollutant concentration or load) that occur after early season rains. Soil and vegetation particles wash into streams; sediments and other accumulated organic particles on the river bed are re-suspended, and dissolved substances from soil and shallow groundwater can be flushed into streams.

The term is often also used to address the first flood after a dry period, which is supposed to contain higher concentrations than a subsequent one. This is referred to as "first flush flood." There are various definitions of the first flush phenomenon.

Primary treatment consists of temporarily holding the sewage in a quiescent basin where heavy solids can settle to the bottom while oil, grease and lighter solids float to the surface. The settled and floating materials are removed and the remaining liquid may be discharged or subjected to secondary treatment.

The major aim of waste water before releasing wastewater treatment is to remove as much of the suspended solids as possible before the remaining water, called effluent, is discharged back to the environment. As solid material decays, it uses up oxygen, which is needed by the plants and animals living in the water.

Primary treatment removes material that will either float or readily settle out by gravity. It includes the physical processes of screening, commination, grit removal, and sedimentation. Screens are made of long, closely spaced, narrow metal bars.

First flush systems during rainfall events

Self-Check -5	Written test

Name…… ID…… Date…….

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

Instruction: Short answer (10 points)

D. Define first flush systems?
E. Define the term "first flush effect?

Note: Satisfactory rating above 5 points Unsatisfactory rating below 5 points

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

Information Sheet 6 - Meeting workplace housekeeping standards

6.1 Meeting workplace housekeeping standards

Effective housekeeping can help to prevent or minimize workplace hazards. It includes keeping work areas neat and orderly, maintaining halls and floors free of slip and trip hazards, and removing of waste materials and other fire hazards from work areas.

Good housekeeping practices help ensure neat, organized, and safe workspaces, which can reduce stress and improve morale. An increase in productivity and lower operating costs may also result when workers spend less time tracking down a needed tool or other item. Reducing workplace injuries will also help lower costs.

Good housekeeping Practice in the workplace includes;

- Properly drain wastewater to the store tank.
- Ensure all spills are immediately cleaned up.
- Keep walkways and stairways clear.
- Regularly inspect, clean and repair all tools.
- Apply Kaizen to the processing plant, etc.

Dairy wastewater which is originated from the processing plant has significant impact on the environment if there is no proper management.

Treated wastewater with high levels of pollutants caused by poor design, operation or treatment systems creates major environmental problems when discharged to surface water or land. Such problems include;

- Contamination and deoxygenation of streams and waterways by direct discharge or run-off of inadequately treated wastewater.
- Excessive concentration of nutrients such as nitrogen and phosphorus in surface and subsurface waters (this contributes to excessive growth of plants and algae blooms which makes downstream water unsuitable for domestic, agricultural and industrial uses).

- Land degradation and damage to pastures and crops. Long-term damage to soil productivity may arise from;
    - ✓ Excessive nutrient loading
    - ✓ High salinity
    - ✓ Low/high pH
    - ✓ Over-application of wastewater to land, resulting in contaminated groundwater
    - ✓ Soil structure decline due to wastewater with high sodium adsorption ratio
    - ✓ Poor irrigation design

Most site losses come from activities associated with liquid handling and to a lesser extent, with the discharge of air and solid waste. Examples of avoidable losses are;

- Leaking valves, pumps, pipelines or other fittings
- Spills usually happen over a short period but the amount & high concentration of milk or product lost may be a significant increase in the pollution load
- Losses from processing and cleaning during the normal operation of plant and equipment.

Each dairy processing plant should therefore assess opportunities for reducing waste arising from its operations.

As a waste reducing hierarchy, the wastewater from dairy processing plant operation can be reducing through;

i. Reduce
ii. Reuse
iii. Recycle
iv. Treatment
v. Dispose safely

Self-Check -6	Written test

Name…… ID…… Date…….

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

Part I: Say True/ False (3 points)

1. Effective housekeeping can help to control or eliminate workplace hazards.
2. Reducing workplace injuries will help increase costs.
3. Dairy wastewater from the processing plant has significant impact on the environment if there is no proper management.

Part II: Choose the best answer (2 points)

1. Which one of the following is true about good housekeeping?

A. Ensure all spills are immediately cleaned up.
B. Keep walkways and stairways clear
C. Properly drain wastewater to the store tank
D. All

2. Land degradation and damage to pastures and crops may arise from **except;**
A. **Good irrigation design**
B. High salinity
C. Low/high pH
D. Excessive nutrient loading

Part III: Short Answer (10 points)

1. Write at least four workplace good housekeeping measurements.
2. Mention waste reducing hierarchies in dairy processing plant.

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

Note: Satisfactory rating above 8 points unsatisfactory rating below 8 points

Operation Sheet -1	Starting up wastewater treatment system

Starting up wastewater treatment system Procedure:

Step 1 Wear appropriate personal protective equipment

Step 2: Prepare chemicals and equipment.

Step 3: Calibrate required chemicals and equipment.

Step 4: Check the equipment or treatment machine

Step 5: Start the waste water treatment system

Step 6: Monitor the equipment

Step 7: Test waste water quality

Step 8: Meet Workplace housekeeping standards

N.B:

- Conduct the activity in accordance with workplace procedure.
- Properly operate the machine without any damage and hazard on the operator.
- Maintain workplace safety.

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 **2: 00 hour**. The project is expected from each student to do it.

Task-1: Operate waste water treatment

LG #47	LO3: 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
- 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
- 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.
4. Accomplish the “Self-Checks” which are placed following all information sheets.
5. Ask from your trainer the key to correct your work.
6. If you earned a satisfactory evaluation proceed to “Operation Sheets.
7. Perform “the LAP 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, go back to “Operation Sheets”.

Information Sheet 1- Analyzing water condition and plant operating conditions

1.1 Analyzing water condition and plant operating conditions

During treatment, the pH is reduced because of the reaction between the coagulant and the alkalinity of the raw water. To avoid corrosion in the distribution system, the pH must be adjusted upwards (usually with lime) before treated water is discharged from the plant - but this can conflict with disinfection.

Measurements of pH should be made routinely and recorded for raw water, settled water, filtered water and water discharged to the distribution system

Most treatment plants do not routinely adjust the pH for coagulation except if additional alkalinity is essential for the reaction to proceed. The coagulant dose to produce a good settle able flock is usually determined in the laboratory and through experience. The main reason for this practice is convenience - the pH may not be optimum but in the opinion of the operators it may be satisfactory.

Water departments should maintain at least a basic set of equipment and reagents which can be used by appropriately-trained personnel to measure accurately the physical, chemical and biological characteristics of raw and treated water. Complete and accurate information is an essential element of water quality monitoring and of the design of treatment plant improvements.

The main objective of analyzing water condition and plant operating conditions is to determine the pH and other constituents of the waste water in order to determine the wastewater quality.

Self-Check 1	Written Test

Name…… ID…… Date…….

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

Part I: Choose the best answer (4 point)

1 Which one of the following water measurements of pH should be made routinely and recorded?

A. raw water B. Settled water C. Filtered water D. All

Part III: Short answer (6 point)

1. Write at least 3 workplace good housekeeping.
2. What is the main objective of analyzing water condition and plant operating conditions?

Note: Satisfactory rating above 5 points Unsatisfactory rating below 5 points

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

Information Sheet 2- Taking corrective action

2.1 Taking corrective action to hazards

Hazard is a potential that cause harm to the worker and also leads to environmental pollution Foods can become unsafe and have the potential to cause harm through hazards in the milk processing plant. They cause harm by spoiling of food, or causing sickness, disease, or death in people consuming the food.

There are different types of hazards which can rise from wastewater treatment plant includes

- Biological
- Chemical
- Physical

Microorganisms or pathogens leads to product out of specification and risk on peoples. These are harmful micro-organisms such as bacteria, viruses, helminthes, protozoa, algae, and certain toxic products they may produce.

Chemical hazards can be emanates from handling and using of chemicals for treatment operation and in the dairy processing as additive of the product.

To prevent and correct such problems Safe work procedures including awareness of health and safety hazards related to waste water system operation and associated control measures. Hazard analysis each hazard is then analyzed along the source, what can go wrong, how, when etc. and understanding the conditions that may cause the hazard to be present or to increase.

Hazard characterization should consider the qualitative and/or quantitative evaluation of the nature of the adverse health effects. Hazard identification is the identification of biological, chemical, and physical agents capable of causing adverse health effects and which may be present in a particular food or group of foods.

Self-Check 2	Written Test

Name…… ID…… Date…….

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

Instruction: Short Answer (10 point)

1. Mention potential hazards which require correction and prevention
2. .How can minimize occurrence of potential hazards in treatment plant?

Note: Satisfactory rating above 5 points Unsatisfactory rating below 5 points

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

Information Sheet 3- Implementing emergency procedures

3.1 Implementing emergency procedures

Emergency procedure is identifying 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 program set out for testing, training and periodic review. Calling the emergency services and continuing to communicate with them.

Implementing Emergency plan promotes safety awareness and shows the organization's commitment to the safety of workers. The lack of an emergency plan could lead to severe losses such as multiple casualties and possible financial collapse of the organization. Since emergencies will occur, preplanning is necessary.

The fundamental principles of emergency management have four phases;

- Preparedness
- Mitigation
- Response
- Recovery

Emergency Response

Emergency response plans are required because of regulations, natural disasters, and unforeseen events. To deal with natural disasters, emergency response plans should cover power generation, staffing, and continued operation of the plant.

Emergency response plans should also be prepared to deal with events such as spills, accidents, and injuries. Safety Program Contents An emergency response plan is closely tied to a plant’s safety program.

A safety program in order to provide effective emergency response, it should cover:

- Operator participation
- Process and equipment safety information
- Pre-start-up safety review
- Process technology
- Incident investigation
- Operating procedures and Process hazard analysis
- Emergency planning and response
- Training and Compliance audits

Self-Check 3	Written Test

Name……ID…… Date…….

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

Part I: Choose the best answer (3 points)

1. Which fundamental principle phase of emergency management is used as a preventive mechanism?

A. Mitigation B. Preparedness C. Response

Part II: Short Answer (4 points)

1. Write down the fundamental principle phases of emergency management.
2. Define Emergency procedure?
3. Mention at least three elements that safety program cover.

Note: Satisfactory rating above 5 points Unsatisfactory rating below 5 points

You can ask you teacher for the copy of the correct answer

LG #48	LO4: Handover Waste Water Treatment 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 workplace procedures
- Capacitating for waste water treatment operators

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 workplace procedures
- Capacitate for waste water treatment operators

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.
4. Accomplish the “Self-Checks” which are placed following all information sheets.
5. Ask from your trainer the key to correct your work.
6. If you earned a satisfactory evaluation proceed to “Operation Sheets.
7. Perform “the LAP 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, go back to “Operation Sheets”.

Information Sheet 1- Maintaining Workplace records

1.1 Maintaining Workplace records

Record keeping is an activity simply to collect relevant information that can help to take good decisions and to keep track of activities in packaging operation.

Workplace records are an important parts of wastewater treatment processing operation and should be accurately maintained within the required timeframes and they can be can be overall records and individual staff records

Records can be done about;

- Any performance of wastewater treatment,
- Economic development, or
- Activity of the operator;
- Outcome of the process,
- Inputs of the treatment process.

1.2 Importance of Record keeping

Workplace records have the following importance in dairy wastewater treatment plant. It used to;

- Continuous monitoring of quality system
- Identify failures in equipment and take correction.
- Assess workplace neatness and healthiness,
- Set solutions for drawbacks.
- Determining profitability of the processing plant.
- Decision making, especially on a strategic level
- Compare the efficiency of use of inputs,
- Rationalize labour
- Planning and management
- Assess profitability/losses (financial records)

Self-Check -1	Written test

Name…… ID…… Date…….

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

Instruction: Short Answer Questions (10 points)

1. What is record keeping?
2. Write the importance of record keeping?

Note: Satisfactory rating - 5 points Unsatisfactory - below 5 points

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

Information Sheet 2- Carrying out handover workplace procedure

2.1 Carrying out handover according to workplace procedure.

Handover wastewater according to the required legal or regulatory requirements, organizational health, safety, environmental and hygiene standards or instructions

A handover responsibility procedure includes;

- Take precautions to ensure that production is not interrupted during handover
- Maintain quality standards during task handover
- Provide information in accordance with organizational procedures
- Exchange information in accordance with organizational procedures

Shift handover should be:

- conducted face-to-face;
- two-way, with both participants taking joint responsibility;
- done using both verbal and written communication;
- based on an analysis of the information needs of incoming staff;
- Given as much time and resource as necessary.

Good handover workplace procedure can be realized by;

- Right person,
- Right place, and
- Right time

Key components of a handover report

- The Precise Status of Ongoing Tasks. Specifically, this section entails a brief but detailed description of all the unfinished projects and tasks.
- Upcoming Deadlines.
- Forthcoming Events.
- Distinctive Roles

Checklist of what could be included in the project handover plan: Identifying and managing key stakeholders including the group who will receive the handover. A clear date for handover of the part is required. A communication plan that starts early in the life of the project and includes the target group.

Self-Check 2	Written Test

Name…… ID…… Date…….

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

Part I: Choose the best answer (6 point)

1. Which one of the following is key Component of a handover report?

A. Upcoming Deadlines. B. Forthcoming Events. C. Distinctive Roles D. All

2. Which one of the following is handover responsibility procedure?

A. Take precautions to ensure that production is not interrupted during handover
B. Maintain quality standards during task handover
C. Provide information in accordance with organizational procedures
D. All

Part III: Short Answer (4 point)

1. How good handover workplace procedure can be realized? .

Note: Satisfactory rating above- 5 points Unsatisfactory below -5 points

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

Information Sheet 3- Capacitating for waste water treatment operators

3.1 Capacitating for waste water treatment operators

Treatment plant operators have many responsibilities ranging from:

- Planning and Design
- Operations and Maintenance
- Public relations
- Supervision
- Laboratory procedures

Roles of the treatment plant Operator

- Duties and Responsibilities of the Treatment Plant Operator
- Planning, Design, and Construction of New Facilities
- Administration
- Wastewater Treatment Plant Operations and Maintenance
- Public Relations
- Safety
- Continuing Education

Self-Check 3	Written Test

Name…… ID…… Date…….

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

Part I: Choose the best answer (3 point)

1. Which one of the following is treatment plant operators' responsibility?

    A. Planning and Design
    B. Operations and Maintenance
    C. Public relations
    D. Supervision
    E. All

2. Roles of the treatment plant Operator includes;
    A. Administration
    B. Public Relations
    C. Safety
    D. All

Note: Satisfactory rating above-5 points Unsatisfactory below- 5 points

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

LG #49	LO5: 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 water treatment system
- Preparing waste water treatment 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 water treatment system
- Prepare waste water treatment system for storage
- Identify and reporting 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.
4. Accomplish the “Self-Checks” which are placed following all information sheets.
5. Ask from your trainer the key to correct your work.
6. If you earned a satisfactory evaluation proceed to “Operation Sheets.
7. Perform “the LAP 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, go back to “Operation Sheets”.

Information Sheet 1- Shutting down waste water treatment system

1.1 Shutting down waste water treatment system

The point and objective of a shutdown is to create a plan for a complete cessation of all treatment plant activities in order to perform necessary maintenance, repairs, equipment replacements, and to perform internal maintenance.

At process plants, most alteration, inspection, repair, replacement, and minor maintenance work can be done while the plant is in operation. In spite of these activities, however, without scheduled maintenance outages equipment will eventually fail.

An unscheduled outage is in most cases substantially more expensive than a scheduled one, and the cost is substantially higher again if the outage is due to a catastrophic failure.

Therefore, in order to minimise costs, a plant needs to undergo scheduled process outages for major maintenance work and for possible modifications of the facility. Such an outage is referred to as a plant shutdown. Most major scheduled plant shutdowns are of high intensity involving sometimes hundreds of people.

Normal shutdown includes steps to provide the systems safe, such as removal of hazardous process materials and inert gases. The systems might be cleaned as part of the shutdown; cleaning is often a process unto itself requiring its own set of startup, operation, and shutdown procedures.

To perform proper shutdown of treatment processing line, consider the following;

- End of treatment sequence
- Air purge and cleaning of the equipment
- Environmental Protection
- Get support if necessary
- Preventive maintenance for treatment plant

Self-Check 1	Written Test

Name…… ID…… Date…….

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

Instruction: Short Answer (10 points)

1. What is the aim of shut down procedure for treatment plant?
2. Write down possible procedures to perform proper shutdown of treatment processing line.
3. Write at least three shutdown procedures.

Note: Satisfactory rating above-5 points Unsatisfactory below -5 points

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

Information sheet 2- Preparing waste water treatment system for storage

2.1 Preparing waste water treatment system for storage

Wastewater storage should be in a secure area, away from an excessive heat source, and free from combustible materials that could react in the presence of chlorine.

The storage site should be located above ground level, and have adequate ventilation. The area should be protected from direct sunlight since temperature control is essential.

Plant turnarounds are the management process of a plant shutdown. Only the accomplishment phase of a plant turnaround procedure is called a plant shutdown, which in turn is defined as a scheduled event wherein an entire process unit of an industrial plant is shut down for an extended period for revamp and/or maintenance.

The storage tank of wastewater system should be in good shape and need fewer repairs and maintenance work before re-open it like;

- Evaluate the water system
- Drain and repair the storage tank
- Pressure tanks
- Shut down treatment
- Turn off the power to all treatment systems.
- Discard unused chlorine solutions and stock.

Fig. 1West water treatment process

Fig 2 Disposed water

Fig. 1 storage area for treated wastewater

Fig .2 Stored wastewater

Fig. 1 treated water tank

Self-Check 2	Written Test

Name…… ID…… Date…….

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

Instruction: Short Answer (5 points)

1. Write down the storage tank of wastewater system should be considered before re-open.

Note: Satisfactory rating above-5 points Unsatisfactory below -5 points

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

Information Sheet 3- Identifying and reporting maintenance requirements

3.1 Identifying maintenance requirements

Maintenance helps to protect the treatment plant and ensures an effective and economical expenditure in operating and maintaining the wastewater treatment facilities.

There are two types of maintenance activities.

a. Preventative maintenance

It helps to maintain the continued operation of the plant without disruptions. Good preventative maintenance also helps to preserve emergency funds. Preventive maintenance is more economical and provides for reliability in operations of the sewage facilities.

b. Emergency maintenance

It should be avoided because it often costs more and is more time consuming than preventative maintenance.

To operate and maintain a sewer collection system to function as intended, the maintenance engineer should try to strive towards the following objectives:

- Minimize the number of blockages per unit length of sewer, and
- Minimize the number of odor complaints.

Maintenance of production equipment in industrial enterprises plays an increasingly important role. It is quite obvious that it can eliminate a number of risks associated with the business and ensure effective use of financial resources necessary to ensure the working order of the machinery and equipment of the businesses.

3.2 Reporting maintenance requirements

The main routine maintenance activities include in report;

- Partial or full dis functionality of treatment plant
- Removal of screenings and grit from the preliminary treatment units
- Periodically cutting the grass on the pond embankments
- Removal of scum and floating macrophytes from the surface of facultative ponds and maturation ponds.
- Removal of any material blocking the pond inlets

In order to report faults and problems, there should be maintenance schedule. Every work shop has a different maintenance schedule and it is important that be familiar with the schedule implemented on the work shop.

Table 4 Documenting and report maintenance

S.No.	Date	Equipment	Maintenance Check points	Maintenance Required	Signature
1					
2					
3					

Generally, reporting of maintenance requirements is essential for the operator to get a solution for defects and also for the processing plant to evaluate its factory standard.

Self-Check 3	Written Test

Name…… ID…… Date…….

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

Instruction: Short Answer (10 points)

1. Define maintenance?
2. Write down types of maintenance.

Note: Satisfactory rating below -5 points Unsatisfactory below -5 points

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

Operation sheet-1 Shutting down waste water treatment system

Shut down procedure:

Step 1: Wear appropriate personal protective equipment.

Step 2: Follow steps for proper shutdown of manufacturing guide line

Step 3: Discard unused chlorine solutions and stock.

Step 4: Clean treatment plant.

Step 5: Complete and turn off the power of all treatment systems.

N.B:

- Check the treatment plant machine is off.
- Properly operate the operation with workplace procedure.

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 **1 hour**. The project is expected from each student to do it.

Task1. Implement shutting down procedure

Reference Materials

Adu-Ahyiah, M. and Anku, R. E. “Small Scale Wastewater Treatment in Ghana (a Scenerio)” Retrieved, 03-10-2010:1-6

Awuah, E. and Amankwaa-Kuffuor, R., (2002) “Characterisation of Wastewater, its sources and its Environmental Effects” I-Learning Seminar on Urban Wastewater

Dreschsel, P (2006) “Sanitation and Urban Wastewater Management” Book Chapter in Irrigated Urban Vegetable Farming in Ghana: Characteristics, Benefits and Risks

Hendy, S. M. H. (2006) “Wastewater Management and Reuse in Egypt” Regional Workshop on Health Aspects of Wastewater Reuse in Agriculture Amman, Jordan 30 October –3 November 2006

http://water.me.vccs.edu/courses/env110/Lesson17_print.htm accessed 03-10-2010.

http://www.cityfarmer.org/GhanaIrrigateVegis.html

Keraita B. N. and Dreschsel, P (2004) “Agricultural Use of Untreated Wastewater in GhanaInternational Research Development Center Publication 11-19

Management Economic and Social Commission for Western Asia (2003) “Waste-Water Treatment

Metcalf and Eddy, Inc. (2003) “Wastewater Engineering: Treatment and Reuse,” Fourth edition.: McGraw-Hill, New York.

Mountain Emire Community College (2010) “Activated Sludge” Lecture Notes

National Academy (2005) “Water Conservation, Reuse, and Recycling”: Proceedings of an Iranian-American Workshop National Academies Press, Washington

Niyonzima, S. Awuah, E. and Anakwa, A. O. (2008) Grey Water Treatment using Constructed Wetland in Ghana. Abstract—Switch Urban Water 2008
Obuobie, E., Keraita B. N., Danso, G., Amoah, P., Cofie, O. O. Raschid-Sally, L. and

Schultz, T. E. (2005) “Biotreating Process Wastewater: Airing the Options, Chemical Engineering.

Acknowledgement

We wish to extend thanks and appreciation to the many representatives of TVET instructors and respective industry experts who donated their time and expertise to the development of this curriculum.

We would like also to express our appreciation to the TVET instructors and respective industry experts of Regional TVET Bureaus, TVET College/ Institutes, BEAR II Project, Bishoftu Management Institute Center, UNESCO and Federal Technical and Vocational Education and Training Agency (FTVET) who made the development of this curriculum with required standards and quality possible.

This TTLM was developed on October 2020 at Bishoftu Management Institute Center.

The trainers who developed this TTLM

No.	Name	Qual.	Educational Background	Region	E-mail
1	Abera Shiferaw	B	Animal production and health	Oromia	aberashiferaw2014@gmail.com
2	Hirpha Ketema	A	Animal Production	Oromia	hirphaketema2@gmail.com
3	Tarekegn cheo	B	Agricultural and process Engineering	Sidama	tarekegncheo155@gmail.com
4	Tesfaye Asrat	B	Animal Science	Amhara	tesfaye99love@gmail.com
5	-------	---	FTA	-------	----------