# Ethiopian TVET-System

## Water supply and sanitation operation

## Level-III

## Based on Feb, 2017G.C. Occupational Standard

## Module Title: Monitoring, operating and controlling wastewater lagoon processes

## TTLM Code: EIS WSW3 TTLM 0620v1

**September,2020**

USAID FROM THE AMERICAN PEOPLE
jhpiego
Save the Children

# This module includes the following Learning Guides

## LG 47: Plan and prepare for work.

LG Code: EIS WSW3 M11LO1-LG_47

## LG 48: Monitor performance.

LG Code: EIS WSW3 M11 LO2-LG_48

## LG 49: Operate and control lagoon processes.

LG Code: EIS WSW3 M11 LO3-LG_49

## LG 50: Complete documentation

LG Code: EIS WSW3 M11 LO4-LG_50

| Instruction Sheet | Learning guide 47: Plan and prepare for work. |
|---|---|

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

- Determining work requirements
- Selecting and checking equipment required to meet safety requirements of task and site.
- Selecting, fitting and using personal protective equipment.

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

- Determine work requirements according to legislative and organizational requirements.
- Select and check equipment required to meet safety requirements of task and site.
- Select, fit and use personal protective equipment.

## 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 1- 3”. On pages 3, 7 and 17. Try to understand what are being discussed.
4. Accomplish the “Self-checks 1, 2 and 3” in each information sheets on pages 6, 15 and 21.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher 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 1, on pages 34.and do the LAP Test on page 23”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7. After you accomplish Operation sheets and LAP Tests, ensure you have a formative assessment and get a satisfactory result; then proceed to the next LG.

| Information Sheet-1 | Determining work requirements |
|---|---|

## 1.1. Introduction to work requirement

Before you start your work, it is important that you determine work requirements and work site boundary information's which are relevant for monitoring waste water log in process for installation and replacement. so that you can apply correct processes to the planning and preparation of a work activity.

Requirements of Good Distribution System Water quality should not get deteriorated in the distribution pipes. It should be capable of supplying water at all the intended places with sufficient pressure head. It should be capable of supplying the requisite amount of water during firefighting.

work requirement is a document indicating what has to be produced and by what date. The work requirement is created based on a process plan. The operations with the related details are populated in the work requirement. Once the operations are populated, the information can be overwritten if needed.

## 1.2. relevant federal and state or territory legislation and regulations requirement

The Guidelines are intended to support the development and implementation of risk management strategies that will ensure the safety of drinking-water and treated waste water supplies through the control of hazardous constituents of water. These strategies may include national or regional standards developed from the scientific basis provided in the Guidelines. The Guidelines describe reasonable minimum requirements of safe practice to protect the health of consumers and derive numerical "guideline values" for constituents of water or indicators of water quality. When defining mandatory limits, it is preferable to consider the Guidelines in the context of local or national environmental, social, economic and cultural conditions. The purpose of legislation is to control risks to injury or health that could occur in the workplace

## 1.3. codes of practice, associated standards and guidance material

Code of Practice is a practical guide to achieve the standards of health and safety required under the legislation. Codes of Practice provide duty holders with guidance on effective ways to manage work health and safety risks. An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the WHS Act and the Work Health and Safety Regulations (the WHS Regulations).

Code of practice deal with a duty or obligation under the work health and safety Act or Regulations include known information about particular hazards, risks and control measures

help in determining what is reasonably practicable in the circumstances, and can be supplemented with other types of guidance material.

### 1.3.1. Organizational Policies, Procedures, Standards and Guidelines.

Organizations use policies and procedures to outline rules outline courses of action to deal with problems. Policies are general statements of how an organization want to behave and procedures define exactly how to do a task or perform step by step.

All the employees must identify themselves with a two-factor identification process. Using identity card and with biometric finger print scan to enter inside the office area.

### 1.3.2. Regulatory agencies and water utility associations can issue codes and guideline documents

dealing with design and construction requirements for distribution systems (Water Services Association of Australia, 2002; Ontario Ministry of the Environment, 2008; Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2012). These codes and guidelines can provide direction and guidance on a broad range of issues, including:

- system planning,
- hydraulic design,
- structural design,
- water storages,
- pumping facilities,
- system construction,
- products and materials,
- separation distances from contamination sources and other pipework,
- backflow and cross-connection control, and
- pipe flushing and swabbing

### 1.3.3. Standards and Guidelines

A standard is used to specify the technologies which must be used for a specific task and guidelines are only suggestions and are not mandatory.

relevant community planning and development agreements, such as land care agreements

## 1.4. Water Supply Standards

- **Water supply standard 1: Access and water quantity**

  All people have safe and equitable access to a sufficient quantity of water for drinking, cooking and personal and domestic hygiene. Public water points are sufficiently close to households to enable use of the minimum water requirement.

- **Water supply standard 2: Water quality**

  Water is palatable and of sufficient quality to be drunk and used for cooking and personal and domestic hygiene without causing risk to health.

- **Water supply standard 3: Water facilities**

  People have adequate facilities to collect, store and use sufficient quantities of water for drinking, cooking and personal hygiene, and to ensure that drinking water remains safe until it is consuming

| Self-Check -1 | Written Test |
|---|---|

**Direction I:** Multiple choice item (2 points each)

**Instruction:** choose the best answer for the following questions and write your answer on the answer sheet provided in the next page:

1. Which one of the following is water supply standards?
   a. Access and water quantity
   b. Water quality
   c. Water facilities
   d. All
2. _____is a practical guide to achieve the standards of health and safety required under the legislation
   A. Code of Practice
   B. Standard
   C. Policy
   D. Regulation
3. _____is a document indicating what has to be produced and by what date
   A. work requirement
   B. work load
   C. work plan
   D. work schedule
4. which one of the following statements is true about work requirement?

a. Determine the nature of work
b. Determine the necessary resource
c. Determine the site of the project
d. All

***Note:*** **Satisfactory rating – 4 and above points** **Unsatisfactory - below 4 points**

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

**Answer Sheet**

Score = _____

Rating: _____

Name: _____ Date: _____

**Short Answer Questions**

1. _____
2. _____
3. ____
4. _____

| Information Sheet-2 | Select and check equipment required to meet safety requirements of task and site. |
|---|---|

## 2.1. Introduction Monitoring wastewater lagoon processes

Wastewater may be described as water that is used to carry waste products away from homes, schools, comm the wastewater comes from three general sources: domestic, industrial, and infiltration into the collection system. Domestic wastewater comes from homes, apartments, schools and the like. These flows, often called sanitary waste, contains materials from food preparation and clean-up, laundry operations, household cleaners, and of course human waste products.

## 2.2. types of equipment for Monitoring wastewater lagoon processes

### 2.2.1. electronic monitoring and metering systems

Because of the dynamic nature of many water treatment systems and the worldwide need for improved reliability and quality, a higher degree of precision is required in the monitoring and control of water treatment programs than that obtained through manual monitoring. To achieve the degree of precision needed, continuous on-line monitoring with automatic instrumentation is required.

Because of the many technological develop" meets in electronics and microprocessor technology over the last decade, there is a wide range of instrumentation available to monitor water treatment systems. The following sections address the systems available to monitor conductivity. pH, corrosion rate, turbidity, dissolved oxygen. sodium, fouling, biological activity, and halogens

### 2.2.2. recording systems

Common problems found in records systems include poor management (or no management at all), human problems dealing with attitudes toward work and lack of understanding of the needs of business, inefficient filing procedures, poor use of equipment, inefficient use of space, and excessive records costs.

### 2.2.3. basic hand and power tools

Employees should be trained in the proper use of all tools. Workers should be able to recognize the hazards associated with the different types of tools and the safety precautions necessary.

Five basic safety rules can help prevent hazards associated with the use of hand and power tools:

- Keep all tools in good condition with regular maintenance.
- Use the right tool for the job.
- Examine each tool for damage before use and do not use damaged tools.
- Operate tools according to the manufacturers' instructions.
- Provide and use properly the right personal protective equipment.

#### 2.2.3.1. Power Tools

Power tools present hazards such as noise, vibration, electrical, moving parts and projectiles. They have the power to cause severe and even fatal injury if used incorrectly

Appropriate personal protective equipment such as safety goggles and gloves must be worn to protect against hazards that may be encountered while using hand tools. To prevent hazards associated with the use of power tools, workers should observe the following general precautions:

- Never carry a tool by the cord or hose.
- Never yank the cord or the hose to disconnect it from the receptacle.
- Keep cords and hoses away from heat, oil, and sharp edges.
- Disconnect tools when not using them, before servicing and cleaning them, and when changing accessories such as blades, bits, and cutters.
- Keep all people not involved with the work at a safe distance from the work area.
- Secure work with clamps or a vise, freeing both hands to operate the tool.
- Avoid accidental starting. Do not hold fingers on the switch button while carrying a plugged-in tool.
- Maintain tools with care; keep them sharp and clean for best performance.
- Follow instructions in the user's manual for lubricating and changing accessories.
- Be sure to keep good footing and maintain good balance when operating power tools.
- Wear proper apparel for the task. Loose clothing, ties, or jewelry can become caught in moving parts.
- Remove all damaged portable electric tools from use and tag them: "Do Not Use."

### 2.2.3.2. Electric Tools

Employees using electric tools must be aware of several dangers. Among the most serious hazards are electrical burns and shocks.

Electrical shocks, which can lead to injuries such as heart failure and burns, are among the major hazards associated with electric-powered tools. Under certain conditions, even a small amount of electric current can result in fibrillation of the heart and death. An electric shock also can cause the user to fall off a ladder or other elevated work surface and be injured due to the fall.

The following general practices should be followed when using electric tools:

- Operate electric tools within their design limitations.
- Use gloves and appropriate safety footwear when using electric tools.
- Store electric tools in a dry place when not in use.
- Do not use electric tools in damp or wet locations unless they are approved for that purpose.
- Keep work areas well lighted when operating electric tools.
- Ensure that cords from electric tools do not present a tripping hazard.

### 2.2.2.4. Hand Tools

- All hand tools, whether furnished by the department or employee owned, must be maintained in safe condition.
- Hand tools must be inspected before each use. Unsafe hand tools must not be used on any campus worksite.
- Hand tools must be used for the designed purpose.
- Impact tools must be free of mushroomed heads.
- Wooden handles must be free of cracks or splinters and be tight to the tool.
- Wrenches must not be used when jaws are sprung to the point that slippage occurs.
- Electric power operated tools must be double-insulated or properly grounded.
- Appropriate personal protective equipment, such as safety glasses with side shields, face shields, leather work gloves, or leather work boots must be worn when using hand tools.

### 2.2.2.5. sampling and laboratory testing equipment

**Types of Sampling Devices**

There are many different types of sampling devices. The type of device that is used to collect a sample is determined by the type of sample to be collected and the analysis to be performed. Different types of sampling devices include:

**1. Bucket or Jar**

These can be used for grab or composite samples, but they only allow the surface of the basin to be sampled.

**2. Bottle**

This sampling device enables a sample to be collected slightly submerged below the surface of the basin. The bottle has a tube to allow sample to enter and a tube to allow the air to escape.

**3. Depth Sampler**

This device permits the collection of a sample from any desired level of a basin. The bottle sinks to the desired depths; the sampler is shut to trap the sample and is then withdrawn from the basin.

**4. Sludge Sampler**

A sludge sampler is used to sample a profile of sludge in a basin. The tube is inserted into the sludge blanket. The tube then fills with sludge. The top of the tube is sealed and withdrawn from the basin.

- **Sample Preparation**

Frequently, a sample is not suitable for direct analysis as collected and it must be prepared prior to analysis. This preparation can be physical or chemical in nature. There are some specific points you should be aware of during the collection, preservation, concentration, dilution, extraction and filtration of samples.

- **Collection**

Some analyses require that samples be collected in specialized containers. Some containers will add or absorb the analytes from the sample. For instance, residual chlorine can be absorbed by the plastic in plastic sample bottles and lead to erroneous analytical results. The acceptable sample containers by analyte will be presented in the Sampling Section.

- **Preservation**

If samples cannot be analyzed immediately after collection they may need to be preserved. The preserving chemicals are analyte specific and will be presented in the Sampling Section.

- **Concentrate**

At times there is too little of the analyte to be detected using the analytical instrumentation. This limitation can be overcome by concentrating the analyte, which means increasing the concentration to a point that the analyte is detectable. Concentration also can be used to remove interfering or extraneous material from the sample. There are a number of concentrating techniques which may be used. The technique utilized is usually dictated by the analyte for which analysis is desired.

- To Contain (TC) accurately measures how much liquid is in a container and To Deliver (TD) accurately measures how much liquid is delivered into another container

  - ✓ Burets are used in titrations
  - ✓ Volumetric glassware (flasks, pipettes, etc.) are extremely accurate (and costly) and are used when preparing standard solutions

- Common analytical equipment used in the laboratory analysis include:

  - ✓ pH meters
  - ✓ Spectrophotometers
  - ✓ Colorimeters

- Specific terminology is used in chemical, biological and analytical procedures. It is important to know what these terms mean in order to understand the procedures and the results.

- Beyond the direct analysis, sample preparation is extremely important in obtaining accurate test results. Sample preparation can include:

  - ✓ Collection
  - ✓ Preservation
  - ✓ Concentration
  - ✓ Dilution
  - ✓ Extraction
  - ✓ Filtration

- Analysis common in wastewater treatment include:

  - ✓ Ion Specific - ex: pH, Ammonia
  - ✓ Gravimetric – ex: Solids

- ✓ Spectrophotometric – ex: Chlorine Residual
- ✓ Titration – ex: Alkalinity

#### 2.2.2.6. Chemical Hygiene Plan Requirements

The goal of a Chemical Hygiene Plan is to limit the exposure to hazardous materials. All treatment plants that have a laboratory are required to have an acceptable Chemical Hygiene Plan in place.

A method for ensuring the proper operation of fume hoods and measures to be taken to ensure that all protective equipment will function properly.

- ✓ Employee training procedures including Hazard Communication procedures.
- ✓ Criteria for determining if specific laboratory procedures will require special approval prior to implementing. Criteria used to determine if medical consultation or examination is required.
- ✓ Designation of a Chemical Hygiene Officer.

- Lab safety is at least as much about common sense and orderliness as it is about hazardous chemicals and infectious wastes. A few common sense type rules and regulations are listed below.
  - ✓ Always keep work areas clean and avoid clutter.
  - ✓ Maintain access to safety showers and eyewashes and test them regularly.
  - ✓ Keep a properly stocked first aid kit available at all times.
  - ✓ Do not transfer chemicals from original containers to store in unmarked or poorly marked bottles.
- All chemical containers should be labeled with contents, date opened or prepared, and appropriate warning labels.
  - ✓ Store chemicals safely.
  - ✓ Store acids and bases separately.
  - ✓ Store flammables and volatile chemicals in storage locker intended for that purpose.
  - ✓ Keep oxidizing agents away from other chemicals.
  - ✓ Use care when transporting chemicals.
  - ✓ Use proper carrying equipment and personal protective equipment.
  - ✓ Keep emergency numbers posted next to the phone.
  - ✓ Always add acid to water.
  - ✓ Never add water to acid

### 2.2.3. computerized equipment

Identifying contaminants in your water is the first step to treating it. Having accurate measurements of your water's chemistry is crucial when planning a system and pretreatment design to ensure long-term reliable performance. Applied Membranes carries a large selection of water quality testers, ranging from pocket testers to analytical instrumentation for measuring SDI, TDS, pH, ORP, Conductivity, and other water quality characteristics.

Electronic digital thermometers for use in most hot and cold fluids and semisolid materials. Provides reliable measurement of temperature in a wide range of temperatures (see details tab for individual models' ratings) and are sturdy enough for use in commercial/industrial environments.

- Benefit
  - ✓ Easy to Use
  - ✓ Fast and Accurate Results
  - ✓ Economical
  - ✓ Small, Compact Design for Convenient Storage and Portability
  - ✓ Digital Easy-to-Read LCD Screen
  - ✓ For use in Most Fluid

### 2.2.4. communication equipment

A communication device is a hardware device capable of transmitting an analog or digital signal over the telephone, other communication wire, or wirelessly. Other examples of communication devices include a NIC (network interface card), Wi-Fi devices, and access points.

A communication system is made up of devices that employ one of two communication methods (wireless or wired), different types of equipment (portable radios, mobile radios, base/fixed station radios, and repeaters), and various accessories (examples include speaker microphones, battery eliminators, and carrying cases) and/or enhancements (encryption, digital communications, security measures, and interoperability/networking) to meet the user needs

.

### 2.2.5. personal protective equipment

Working in a safe and healthful environment can stimulate innovation and creativity and result in increased performance and higher productivity. To assist employers and employees in developing effective safety and health management systems.

### 2.2.6. Basic Safety Rules for Hand Tools

- always wear eye protection.
- wear the right safety equipment for the job.
- use tools that are the right size & right type for your job.
- follow the correct procedure for using every tool.
- keep your cutting tools sharp and in good condition.
- don't work with oily or greasy hands.
- handle sharp-edged and pointed tools with care.
- always carry pointed tools by your side with the points and heavy ends down.
- secure all small work & short work with a vise or clamp.
- never carry tools in your pockets.
- don't use tools which are loose or cracked.
- keep your punches & chisels in good condition. mushroomed heads can chip & cause injuries.
- don't use a file without a handle.
- don't pry or hammer with a file. it may shatter.
- don't use screwdrivers as chisels or pry bars.
- don't try to increase your leverage by using a "cheater" with a wrench. wrenches are designed at the right strength for their size and length.
- after using a tool — clean it and return it to its proper storage place.
- if anything breaks or malfunctions — report it to your supervisor at once.
- use the right type of tool for the job.
- never place tools and materials where they hang on the edge of a bench.
- don't use tools for things they weren't meant for.
- store tools and materials vertically, with the points and heavy end down.
- cut away from yourself when you use chisels and other edged tools.
- don't force screws; make sure that the correct screw for the job is being used.

| Self-Check -2 | Written Test |
|---|---|

**Direction I: Multiple choice item (2 points each)**

**Instruction: choose the best answer for the following questions and write your answer on the answer sheet provided in the next page**:

1. which one of the following is Common analytical equipment used in the laboratory analysis?
   A. pH meters
   B. Spectrophotometers
   C. Colorimeters
   D. All
2. _____is a hardware device capable of transmitting an analog or digital signal different method.
   A. communication device
   B. Message
   C. Voice
   D. Channel
3. Sampling Devices except
   A. Bucket or Jar
   B. Depth Sampler
   C. Sludge Sampler
   D. All
   E. None
4. Basic Safety Rules for Hand Tools from the following except
   A. always did not wear eye protection.
   B. wear the right safety equipment for the job.
   C. follow the correct procedure for using every tool.
   D. All
5. Sample preparation can include the following
   A. Collection
   B. Preservation
   C. Filtration
   D. all

***Note:*** **Satisfactory rating – 5 and above points** **Unsatisfactory - below 5 points**

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

**Answer Sheet**

Score = _____

Rating: _____

Name: _____ Date: _____

**Short Answer Questions**

1. _____
2. _____
3. _____
4. _____
5. _____

| Information Sheet-3 | Selecting, fitting and using personal protective equipment |
|---|---|

## 3.1. Introduction to safety

All employees working around a wastewater treatment system should be aware of the hazards that exist there. These hazards may not be readily apparent, but without constant vigilance someone can be hurt or even lose their life.Practice good personal hygiene whenever working around wastewater. Use the right tool for the right job. Back injuries are one of the most frequent injuries suffered by wastewater plant personnel. Lift things properly and get help when needed. No smoking on the job except where permitted. Hold regular safety meetings with other plant staff and discuss hazards associated with the job and how best to avoid them. Keep notes of the meeting and distribute them to the staff.

## 3.2. Personal Protective Equipment

The use of personal protective equipment (PPE) is the single most important item in preventing injuries in the laboratory. Examples of PPE include eye protection, gloves, lab coats and respirators.

- Eye protection should be worn at all times in the lab. It can protect you from broken glass, flying objects and spilled chemicals. Gloves should be worn whenever handling hazardous material.
- Gloves will prevent hazardous chemicals from entering your body through your hands.
- Some chemicals can be transmitted directly through your skin even without a cut to travel through. Lab coats not only save your own clothing or uniform they may prevent a chemical spill from damaging your clothes or reaching your skin.

### 3.2.1. Personal Hygiene

There are typically three possible routes of infection in a laboratory:

- **Cutaneous**

Cutaneous infections occur through the skin. This is the typical route for bacterial infections. In order to avoid cutaneous infections, wash your hands thoroughly on a frequent basis. If necessary, wear gloves and/or cover breaks in the skin.

- **Oral ingestion**

Viruses and some bacterial infections can enter the body through this route. These typically cause gastroenteritis (diarrhea, nausea or vomiting). Thorough hand washing and immunizations against viral pathogens are the best defense against these agents. Consider

changing out of work clothes before returning home. Work and street clothes should be stored in separate lockers.

- **Inhalation**

There is very little defense against airborne disease transmission. However, there are no documented cases of a sanitary worker being infected with Tuberculosis of other types of airborne contaminants. The best defense against these diseases is immunization and conscientious personal hygiene

### 3.2.2. Accident Prevention

Most accidents occur due to carelessness; routine duties become mundane and a lapse in concentration leads to disastrous results. There are a number of accident possibilities in a laboratory. Common accidents are listed below.

- **Electric Shock**

Be mindful of electrical outlets and frayed wires. Use grounded outlets and GFCIs. Follow Lock Out/Tag Out procedures when working on electrical equipment.

- **Cuts**

Broken laboratory glassware is a common source of cuts. Promptly clean up any broken glass and place in a container designated for broken glass. Do not place broken glass into the waste paper basket as it will get covered and people may try to push the paper down further to make more room in the basket and then cut themselves on the hidden glass. Discard chipped or cracked glassware.

- **Burns**

There are two possible types of burns: burns caused by heat and burns caused by chemical action.

- ✓ Heat - You cannot tell by looking at an item if it is hot, so treat all items as if they were. This will minimize the possibility of heat burns. Use gloves or tongs to transport glassware that may be hot.
- ✓ Chemical - Both acids and bases can cause chemical burns. Use PPE to minimize the exposure of skin and eyes. If exposure does occur, immediately flush with water or eyewash solution.
- ✓ Fire All laboratories should be equipped with a fire blanket and fire extinguisher. Key Points

- Good Laboratory Hygiene protects the operator from infection and/or a laboratory accident.
- A chemical hygiene plan includes standard operating procedures (SOPs) and established control measures designed to protect operators by making good Laboratory Hygiene familiar and routine.
- Wastewater operators are exposed to infectious wastes and toxic chemicals. Exposure can be limited by use of protective equipment (gloves, goggles, lab coats, respirators) and by following standard laboratory safety rules.
- Standard laboratory safety rules include:
  - ✓ Access to first aid, safety showers and eyewash stations
  - ✓ Proper chemical storage areas
  - ✓ Clean work area o No food in the lab – EVER

- Routes of infection include:
  - ✓ Cutaneous – through the skin
  - ✓ Oral – by mouth, no mouth pipetting EVER
  - ✓ Inhalation
- Common lab accidents include:
  - ✓ Burns – glassware doesn't appear hot, check first
  - ✓ Cuts – glassware breaks easily
  - ✓ Electrical shock – replace or discard equipment with frayed wiring, take care when working around water
  - ✓ Falls – clean-up spills promptly

The selection of PPE takes account of risks to heal based on knowledge of the hazard and exposure assessment. Consideration is then required as the degree of protection needed and the job tasks must be analyzed to determine if there are any constraints on selection of equipment.

- Criteria for selection includes the following
  - ✓ Nature of hazards gases, vapor or liquid
  - ✓ Severity of exposure
  - ✓ Frequency and distribution of exposure how often and for how long
  - ✓ Parts of body exposed and manner of exposure
  - ✓ Nature of work engaged in when exposed to the hazard
  - ✓ Environmental condition
  - ✓ Degree of protection which a particular PPE can provide

**A. Selection**

Selection and purchase of PPE specific and appropriate to the job must involve a suitable trained person as well inputs by the end user (work who is going to use the PPE)

**B. Fitting**

PPE fitting must be done on first issuance of selected PPE particularly in the use of respiratory protective equipment. Various size of each type of equipment will need to be available to fit each and individual worker.

**C. Healthy aspect**

PPE use may have an impact on the worker health

**D. Compatibility**

PPE use must be compatible to the different task involved in the job. The use of different type of simultaneous in performing a task must be evaluated

**E. Provision**

It must be borne in the mind that each PPE comes in several types i.e specification. the provision of PPE must be suited to each and individual worker's needs.

**F.** Proper use

PPE is effective only when used correctly and appropriate for tasks. PPE that can provide complete protection but if not properly used may provide no protection at all. Use of PPE by supervisor staff, employee encouragement and enforcement of use are important

**G.** Maintenance

With the exception of single use PPE, procedure for the cleaning maintenance of PPE should be established accordingly to manufacture guideline.

**H.** Storage

As mentioned, PPE may be contaminated with toxic substance during its use. Suitable labeled container for cleaning

| Self-Check -3 | Written Test |
|---|---|

**Direction I: Multiple choice item (2 points each)**

**Instruction: choose the best answer for the following questions and write your answer on the answer sheet provided in the next page**:

1. Criteria for selection of PPE from the following except
   A. Nature of hazards gases, vapor or liquid
   B. Parts of body exposed and manner of exposure
   C. Environmental condition
   D. All
   E. None
2. typically, possible routes of infection in a laboratory from the following
   A. Cutaneous
   B. Oral ingestion
   C. Inhalation
   D. All
   E.
3. Cause of Burns in the laboratory according to safety from the following
   A. heat
   B. chemical
   C. physical load
   D. A and B
4. From the following which one is Common lab accidents
   A. Burns
   B. Cuts
   C. Electrical shock
   D. All
5. Examples of PPE
   A. eye protection
   B. gloves
   C. Respirators
   D. All

***Note:*** **Satisfactory rating – 5 and above points** **Unsatisfactory - below 5 points**

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

**Answer Sheet**

Name: _____ Date: _____

Score = _____

Rating: _____

**Answer Questions**

1. _____
2. _____
3. _____
4. _____

| Operation Sheet 1 | Techniques of problem-solving procedure |
|---|---|

**steps for an effective problem-solving process.**

**Step1. Identify the issues. Be clear about what the problem is.**

**Step2. Understand everyone's interests.**

**Step3. List the possible solutions (options)**

**Step4. Evaluate the options.**

**Step5. Select an option or options.**

**Step6. Document the agreement(s).**

**Step7. Agree on contingencies, monitoring, and evaluation.**

| LAP Test | Practical Demonstration |
|---|---|

Name: _____ Date: _____

Time started: _____ Time finished: _____

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within _____hours.

**Task 1. Write problem solving steps for waste water lagoon aeration**

| Instruction Sheet | Learning guide 48: Monitor performance |
|---|---|

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

- Carrying out routine inspections lagoon system
- Collecting process samples and conduct standard tests.
- Collecting and reporting process data according to organizational and lagoon system requirements.

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

- Carry out routine inspections according to particular lagoon system and organizational requirements.
- Collect process samples and conduct standard tests.
- Collect and report process data according to organizational and lagoon system 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 1- 3”. On pages 26, 33 and 39 . Try to understand what are being discussed.
4. Accomplish the “Self-checks 1, 2, and 3” in each information sheets on pages 31, 38 and 42.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher 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 1,2 and 3 on pages 44, 45 and 46.and do the LAP Test on page 47”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7. After you accomplish Operation sheets and LAP Tests, ensure you have a formative assessment and get a satisfactory result; then proceed to the ne

| Information Sheet-1 | Carrying out routine inspections according to particular lagoon system |
|---|---|

## 1.1. Introduction to monitoring waste water treatment

Most industrial water treatment systems are dynamic. They constantly undergo changes because of seasonal variations in water chemistry, varying plant operating conditions, new environmental laws, and other factors. Because of this, proper monitoring is essential to ensure that the water treatment program applied to a boiler, cooling, wastewater or other industrial water system is satisfactorily controlled so that the desired results are achieved.

Some of the value-added benefits obtained through proper monitoring of a water treatment program include:

- reduced risks associated, with chemical underfeed or overfeed
- continuing compliance with environmental regulations
- improved quality of plant operation
- increased water and energy savings
- improved plant productivity

Industrial water treatment systems may be monitored by manual methods or by continuous systems employing automatic instrumentation.

## 1.2. routine inspection waste water lagoon pross

Regularly walking around the workplace and observing how things are done can help you predict what could or might go wrong. Look at how people actually work, how plant and equipment is used, what chemicals are around and what they are used for, what safe or unsafe work practices exist as well as the general state of monitoring waste water lagoon process.

Things to look out for include the following:

- Does the work environment enable workers to carry out work without risks to health and safety (for example, space for unobstructed movement, adequate ventilation, lighting)?
- How suitable are the tools and equipment for the task and how well are they maintained?
- Have any changes occurred in the workplace which may affect health and safety?

Routine Operational Procedures for Monitoring and Analysis, which shall, at a minimum, include:

- operational and compliance tests to be performed;

- bacteriological quality monitoring plan;
- methods used for monitoring and analysis;
- locations of monitoring points; and
- laboratory data quality assurance information.

Lagoons are one of the most popular methods for wastewater treatment around the world they are also among the simplest and least expensive. Lagoon systems use natural and energy-efficient processes to provide low-cost wastewater treatment for many homes and rural communities.

Lagoons are especially well suited to small communities because they can cost less to construct, operate, and are simpler to maintain than other systems. They require more land than other wastewater treatment methods, but land is usually more available and less expensive in rural areas. Lagoons work well for many seasonal rental properties and recreational areas, because they are able to handle intermittent periods of light or heavy use

**Lagoons are pond-like bodies of water or basins designed** to receive, hold, and treat wastewater for a predetermined period of time. If necessary, they are lined with material, such as clay or an artificial liner, to prevent leaks to the groundwater below.

**In the lagoon, wastewater is treated through a combination of physical, biological, and chemical processes**. Much of the treatment occurs naturally, but some systems use aeration devices to add oxygen to the wastewater. Aeration makes treatment more efficient, so that less land area is necessary. Aerators can be used to allow existing systems to treat more wastewater.

### 1.3. Advantages and Disadvantages of Lagoon Systems

- Lagoon systems can be cost-effective to design and construct in areas where land is inexpensive.
- They use less energy than most wastewater treatment methods.
- They are simple to operate and maintain and generally require only part-time staff.
- They can handle intermittent use and shock loadings better than many systems, making them a good option for campgrounds, resorts, and other seasonal properties.
- They are very effective at removing disease-causing organisms (pathogens) from wastewater.

- The effluent from lagoon systems can be suitable for irrigation (where appropriate), because of its high-nutrient and low pathogen content.

- Lagoon systems require more land than other treatment methods.
- They are less efficient in cold climates and may require additional land or longer detention times in these areas.
- Odor can become a nuisance during algae blooms, spring thaw in cold climates, or with anaerobic lagoons and lagoons that are inadequately maintained.
- Unless they are property maintained, lagoons can provide a breeding area for mosquitoes and other insects.
- They are not very effective at removing heavy metals from wastewater.
- Effluent from some types of lagoons contains algae and often requires additional treatment or "polishing" to meet local discharge standard

## 1.4. Common Lagoon Problems

- **Weeds and long grass-**Banks need to be mowed and weeded regularly. Duckweed, water meal, and hyacinth that grow on the water surface should be physically removed, often from a boat with a tool, like a rake or skimmer.
- **Blue-green algae-**Unlike green algae, this alga is stringy and can clump, block sunlight, and cause short-circuiting. It can dominate lagoons when conditions are poor, when pH is low, or when protozoa eat all of the green algae. Blue-green algae can be physically removed like duckweed.
- **Algae blooms-**After periods of cloudy weather or abrupt temperature changes, algae can multiply quickly and then die-off. Matted algae on the surface can block sunlight and cause foul odors and should be broken up (with a boat or rake) and dispersed.
- **Odors**-Lagoons may have odors occasionally from alga blooms, anaerobic conditions, scum, and turnover of the lagoon contents after thawing. Proper operation and maintenance can help prevent odors.
- **Short-circuiting-"**Dead spots" in the flow pattern, due to obstructions in the lagoon or to wind on the surface, can cause wastewater to leave the lagoon too quickly, resulting in inadequate treatment.
- **Erosion**-Controlling burrowing animals around the lagoon can help prevent erosion of banks and dikes. Installing a stone or rock surface (called riprap) along banks and dikes can help in some cases.

- **Burrowing animals**- Muskrats and other burrowing animals can be discouraged by weeding and mowing lagoon banks. Alternately raising and lowering water levels can drive out muskrats who like their tunnels partially submerged. Otherwise, animals can be trapped and relocated.
- **Sludge accumulation-**Sludge in the bottom of lagoons should be measured at least once per year and removed as needed.

### 1.5. Collection and Conveyance

Factors that affect the operation of the collection system and ultimately impact treatment plant performance include:

• Seasonal flow and loading variations by industrial users.

- ✓ Short-term overloads
- ✓ Changes in process loadings

• Knowledge of location, amount, and types of wastes from major water-using industries enables operator to locate sources of problems in the influent.

• Long travel times can result in septicity and hydrogen sulfide generation.

- ✓ Rotten-egg odor
- ✓ Concrete degeneration

**Septicity** is a condition brought on by the action of anaerobic bacteria in a wastewater devoid of dissolved oxygen. Septic wastewater has a characteristic black color.

**Influent** is wastewater or other liquid that is raw (untreated) or partially treated that flows into a treatment process or treatment plant.

### 1.6. Waste water lagoon system inspection

A carefully designed structure constructed to contain and to facilitate the operation and control of a complex process of treating or stabilizing wastewater

A lagoon system consists of many parts. It will have one or more, usually earthen-diked containments, constructed to hold water. Each containment may be called a lagoon, pond, or cell. The containments (with a few exceptions) are lined so that the water cannot seep into the ground uncontrolled. A system of pipes is included with appropriate valves to conduct the collected wastewater into, though, and out of the system as controlled by the operator. The size and number of ponds in these systems vary greatly depending on the amount of

wastewater to be treated. Each cell may have a surface area as small as a few thousand square feet to as large as several acres.

The purpose of lagoon systems is to provide for the operation and control of a complex process of treating or stabilizing wastewater. This process is necessary because the components in the wastewater, if discharged will cause changes that will be harmful to the environment or to public health. The treatment process causes changes to occur in the wastewater under control in the lagoon system so that components in the wastewater are removed or broken down into less harmful compounds. The “treated” water is then “stabilized” and will cause no significant hazard when discharged.

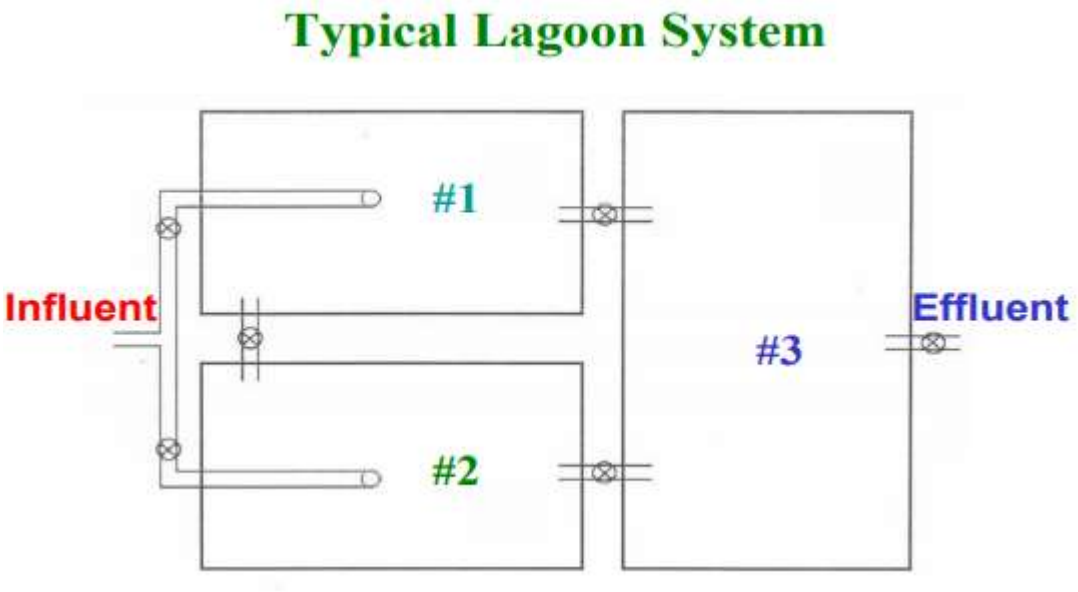



**Figure 1.1. lagoon system**

| Self-Check -1 | Written Test |
|---|---|

**Direction I: Multiple choice item (3 points each)**

**Instruction: choose the best answer for the following questions and write your answer on the answer sheet provided in the next page**:

1. Routine Operational Procedures for Monitoring and Analysis, wastewater lagoon processes minimum, include the following except
   A. operational and compliance tests to be performed
   B. quality monitoring plan
   C. methods used for monitoring and analysis
   D. locations of monitoring points
2. which one of the following systems is true about advantages and disadvantages of lagoon systems?
   A. Lagoon systems can be cost-effective to design and construct in areas where land is inexpensive.
   B. They use less energy than most wastewater treatment methods.
   C. They are simple to operate and maintain and generally require only part-time staff.
   D. Lagoon systems require more land than other treatment methods
   E. All
3. Common problem of lagoon process
   A. Weeds and long grass
   B. Blue-green algae
   C. Algae blooms
   D. Odors
   E. All
4. Factors that affect the operation of the collection system and ultimately impact treatment plant performance include the following except
   A. Seasonal flow and loading variations
   B. Knowledge of location, amount, and types of wastes from major water-using
   C. Long travel times can result in septicity and hydrogen sulfide generation
   D. All

***Note:*** **Satisfactory rating - 6 and above points** **Unsatisfactory - below 6 points**

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

## Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

**Short Answer Questions**

1. _____
2. _____
3. _____
4. _____

| Information Sheet-2 | Collecting process samples and conduct standard tests. |
|---|---|

## 2.1. Introduction to collection sampling

Water sampling, the process of taking a portion of water for analysis or other testing, e.g. drinking water to check that it complies with relevant water quality standards, or river water to check for pollutants, or bathing water to check that it is safe for bathing, or intrusive water in a building to identify its Qualitative and quantitative measurements are needed from time to time to constantly monitor the quality of water from the various sources of supply.

## 2.2. settling

Settling is an important process in several of the unit operations in wastewater treatment plants. The most commonly known of these unit processes are primary settling tanks (PSTs), which are a treatment unit before the biological reactor, and secondary settling tanks (SSTs), which are a clarification step prior to discharge into a receiving water. Moreover, settling also plays an important role in new technologies that are being developed such as granular sludge reactors.

**Equipment**

a. A graduated (minimum resolution 50 mL) cylindrical reservoir with a volume of 1 liter (for SVI and DSVI) or with dimensions specified by White (1975) for SSVI.
b. digital timer displaying accuracy in seconds.
c. sludge sample from either the recycle flow of the SST or the feed flow into the SST.The latter can be collected from the bioreactor or the splitter structure.
d. Effluent from the same WWTP (in case dilution is needed).
e. Equipment for the Total Suspended Solids (TSS) test (according to method 2540 D in

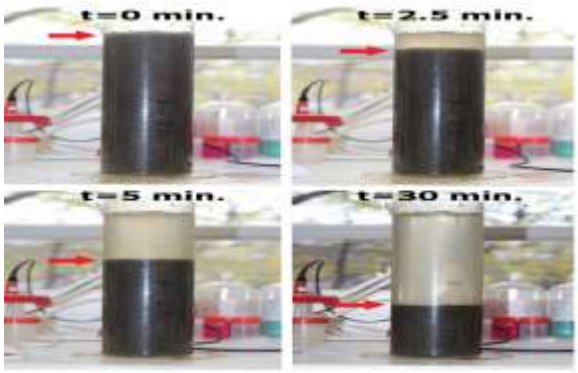



**Figure 2.1 Bach 5 Chronological process of a batch settling test**

## 2.3. microscopic observation

by magnification is usually enough to see some of the tiny life forms living in the water. Use the eyedropper to get some water from one of your samples. Place 1 drop of water on the microscope slide and place it under the microscope to examine it.

## 2.4. pH

pH is one of the most common water quality tests performed. pH indicates the sample's acidity but is actually a measurement of the potential activity of hydrogen ions (H+) in the sample. pH measurements run on a scale from 0 to 14, with 7.0 considered neutral. Solutions with a pH below 7.0 are considered acids. Solutions with a pH above 7.0, up to 14.0 are considered bases. All organisms are subject to the amount of acidity of stream water and function best within a given range.

The pH scale is logarithmic, so every one-unit change in pH actually represents a ten-fold change in acidity. In other words, pH 6.0 is ten times more acidic than pH 7.0; pH 5 is one hundred times mores acidic than pH 7.0.

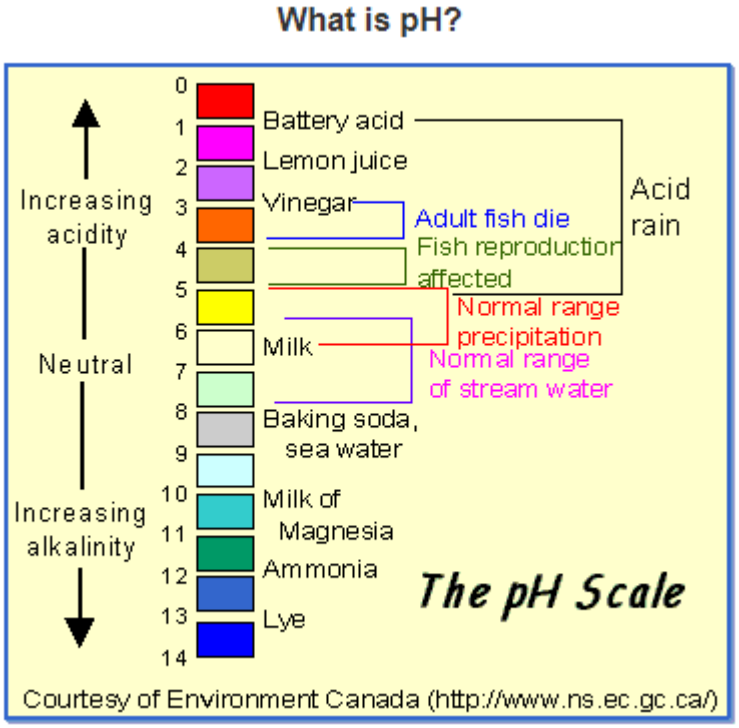



**Figure 2.2. pH scale**

## 2.5. dissolved oxygen

Dissolved oxygen analysis measures the amount of gaseous oxygen (O2) dissolved in an aqueous solution. Oxygen gets into water by diffusion from the surrounding air, by aeration (rapid movement), and as a waste product of photosynthesis

Dissolved oxygen is used as an indicator of the health of a water body, where higher dissolved oxygen concentrations are correlated with high productivity and little pollution. This test is performed on-site, as delays between sample collection and testing may result in an alteration in oxygen content.

## 2.6. electrical conductivity

Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol, and sugar do not conduct electrical current very well and therefore have a low conductivity when in water. Conductivity is also affected by temperature: the warmer the water, the higher the conductivity

Pure water is not a good conductor of electricity. Ordinary distilled water in equilibrium with carbon dioxide of the air has a conductivity of about 10 x $10^{-6}$ $W^{-1}*m^{-1}$ (20 dS/m). Because the electrical current is transported by the ions in solution, the conductivity increases as the concentration of ions increases.

## 2.7. Temperature

Temperature testing is the process of measuring temperature levels in water. Temperature is a key factor in water chemistry. Temperature affects the dissolved oxygen levels in water, the rate of photosynthesis, metabolic rates of organisms, etc. Aquatic organisms depend on particular temperature ranges for their health. Each species of organism thrives in a specific temperature range, and many animals use temperature as a signal for when to reproduce and when to migrate. If there is an abnormality in temperature this can disrupt the balance of aquatic ecosystems with devastating effect. Water temperature also impacts water density; differences in water temperature and density can cause stratification.

## 2.8. Odour

At times, water can have an unpleasant odor, taste, or appearance. These aesthetic characteristics usually don't pose a public health threat and, in most cases, they don't last long. However, a sudden change in the color, taste or odor of your tap water could indicate a public health concern. We don't recommend that anyone drink water that looks, smells or tastes objectionable Colored water If your water suddenly changes color no matter what color it becomes it could indicate a public health concern. Contact your water utility or, if you have your own well, your local health agency. It's likely that something disturbed the water flow in the water main, such as a line break or firefighting, or a plumbing problem allowed unsafe water to enter the line.

## 2.9. visual observation

- **color**

✓ **Green or blue water**: Usually caused by corrosion of copper plumbing. If corrosion is occurring, dripping water will leave a bluish-green stain on porcelain fixtures. Certain metals that can get into drinking water from corrosion, such as copper or lead, may pose a health concern. Overly corrosive water may cause a problem with the home's piping. If you suspect corrosion, contact your water utility or a licensed plumber.

✓ **Black or dark brown water**:

Often caused by manganese in the water or pipe sediment. If the water doesn't clear after a few minutes of flushing all your cold-water faucets and toilets, wait about an hour and try again. If it still isn't clear, contact your water utility. If you have your own well, you may need a licensed plumber to evaluate and correct the problem. Check with your local health agency for advice.

✓ **Brown, red, orange or yellow water**: Usually caused by iron rust. Galvanized iron, steel, or cast-iron pipes in a home or business, or the water main can cause rusty water. While unpleasant and potentially damaging to clothes and fixtures, iron in drinking water is not a human health concern.

✓ **Milky white or cloudy water**: Usually caused by tiny air bubbles. If your water is white, fill a clear glass with water and set it on the counter. If the water starts to clear at the bottom of the glass first, the cloudy or white appearance is trapped air. It is not a health threat and should clear in a few minutes. If you have your own well, the pumping system may be causing this issue. You may need a qualified contractor to determine how it to correct it.

Factor consider during visual observation for to check water color

- Scum

Scum is a floatable material skimmed from the surface of primary and secondary settling tanks, especially from the surface of grit chamber in wastewater treatment plants. It can clog wastewater treatment systems and result in the flotation of sludge in thickening units.

- Insects
- Birdlife
- weed growth

### 2.10. Redox potential

Redox potential (also known as reduction / oxidation potential, is a measure of the tendency of a chemical species to acquire electrons from or lose electrons to an electrode and thereby be reduced or oxidized respectively. Redox potential is measured in volts (V), or millivolts (mV)

| Self-Check -2 | Written Test |
|---|---|

**Direction I: Multiple choice item (3 points each)**

**Instruction: choose the best answer for the following questions and write your answer on the answer sheet provided in the next page**:

1. Factor consider during visual observation for to check water color
   A. insects
   B. birdlife
   C. weed growth
   D. All
2. During visual observation of waste water lagoon process the color of water becomes
   A. Green or blue water
   B. Black or dark brown water:
   C. Milky white or cloudy water:
   D. All
3. Which one of the following is system of collection sampling?
   A. microscopic observation
   B. dissolved oxygen
   C. electrical conductivity
   D. all
4. _____is an important process in several of the unit operations in wastewater treatment plants.
   A. Settling
   B. Observing
   C. Screening
   D. Locking

**Answer Sheet**

Score = _____

Rating: _____

Name: _____ Date: _____

**Short Answer Questions**

1. _____
2. _____
3. _____
4. _____

| Information Sheet-3 | Collecting and reporting process data |
|---|---|

### 3.1. Introduction water quality data collection and processing

Data must be processed and archived in an electronic format that is readily available for future statistical analysis. Meta data and other field notes should be archived in databases. Some information for analysis may need to be estimated rather than measured.

### 3.2. Existing Water Quality Data Sources and Monitoring

Although wetland studies focus on wastewater data, other types of model development and data sources should be considered when collecting data. Existing wetland databases at other nearby sites may often be the only available historical data for a wetland study. Continuous monitoring at a nearby wetland site can provide clues to explaining study site conditions.

### 3.3. Water Quality Data Gaps and Data Development Considerations

Existing historical data may be adequate for initial cursory analysis. Analysis of other data sources, including new continuous thermistor data, could help in confirming data sets and in providing a reference in applying data sets to previous years. Additional considerations include:

- Accommodating special hydraulic situations.
- Evaluating potential action alternatives associated with ongoing basin water use planning and evaluating wetland modeling priorities, water quality parameters, and other requirements.
- Cooperation between participants who have technical expertise in water quality modeling, ecology, and fisheries.

### 3.4. Data Collection Priorities and Practical Considerations

Data collection and initial assessment development activities for supporting future water quality studies and ongoing planning studies of water distribution system.

### 3.5. Prioritizing Critical and Secondary Data Sets

Existing data sources should be reviewed to determine common collection sites and problems with proposed sites. Critical and secondary data sets can then be collected and assessed. Increasing levels of data are usually required to increase the certainty of results.

### 3.6. Existing Data Sources and Data Compilation

Initial time spent searching for data and talking to those familiar with historical data collection is time well spent. Most projects have data that go undiscovered. A program should be put in place to convert data into a modern electronic format. Multiple backups on different types of electronic media are recommended for long-term storage and archival.

### 3.7. Data Review, Analysis, and Processing Concerns

Data collected on the first field trip should be processed, analyzed, and plotted to spot problems or to ensure a complete modeling data set. Adjustments to the SAP may be necessary. Data should also be analyzed and processed in a format that optimizes future usability. Developing a method to minimize data processing and time spent on data formatting and analysis is helpful. Ideally, data should be processed immediately after collection. Analysis of data includes eliminating incorrect data and providing corresponding metadata. Not developing a protocol introduces error, often results in more wasted efforts as more similar data become available, and results in inconsistencies which make replication of data analysis difficult if the process needs to be repeated.

### 3.8. Method of data collection

The most commonly used methods are: published literature sources, surveys (email and mail), interviews (telephone, face-to-face or focus group), **observations**, documents and records, and experiments

### 3.9. Data collection tools

- Case Studies. A case study is usually an in-depth description of a process, experience, or structure at a single institution
- Checklists
- Interviews
- Observation Sometimes, the best way to collect data through observation.
- Surveys or Questionnaires.

### 3.10. Method of reporting

Reporting: The process of organizing data into informational summaries in order to monitor how different areas of a business are performing. Analysis

The process of exploring data and reports in order to extract meaningful insights, which can be used to better understand and improve business performance

- three **methods** of **reporting**, i.e ,
  - ✓ Written **Reporting**,
  - ✓ Graphic **Reporting**, and
  - ✓ Oral **Reporting**

the five **key** elements of report writing?

- Title page
- Table of contents
- Executive summary
- Introduction
- Discussion
- Conclusion
- Recommendations
- References

| Self-Check -3 | Written Test |
|---|---|

**Direction I: Multiple choice item (3 points each)**

**Instruction: choose the best answer for the following questions and write your answer on the answer sheet provided in the next page**:

1. Which one of the following is **key** elements of report writing?
   A. Title page
   B. Table of contents
   C. Introduction
   D. All
2. Method of **reporting**
   A. Written
   B. Graphic
   C. Oral
   D. All
3. Data collection tools except
   A. Checklists
   B. Interviews
   C. Observation
   D. All
4. _____is the process of organizing data into informational summaries in order to monitor how different areas of a business are performing.
   A. Writing
   B. Reporting
   C. Collecting
   D. Observing

***Note:*** **Satisfactory rating - 6and above points** **Unsatisfactory - below 6 points**

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

**Answer Sheet**

Score = _____

Rating: _____

Name: _____ Date: _____

**Short Answer Questions**

1. _____
2. _____
3. _____
4. _____

| Operation Sheet _1 | Procedures for collecting dissolved oxygen sampling |
|---|---|

**steps for collection sampling dissolved oxygen sampling**

**Step1**. Carefully fill a 300-mL glass Biological Oxygen Demand (BOD) stoppered bottle brim-full with sample water.

**Step2**. Immediately add 2mL of manganese sulfate to the collection bottle by inserting the calibrated pipette just below the surface of the liquid. (If the reagent is added above the sample surface, you will introduce oxygen into the sample.) Squeeze the pipette slowly so no bubbles are introduced via the pipette.

**Step3**. Add 2 mL of alkali-iodide-azide reagent in the same manner.

**Step4.** Stopper the bottle with care to be sure no air is introduced. Mix the sample by inverting several times. Check for air bubbles; discard the sample and start over if any are seen. If oxygen is present, a brownish-orange cloud of precipitate or floc will appear. When this floc has settle to the bottom, mix the sample by turning it upside down several times and let it settle again.

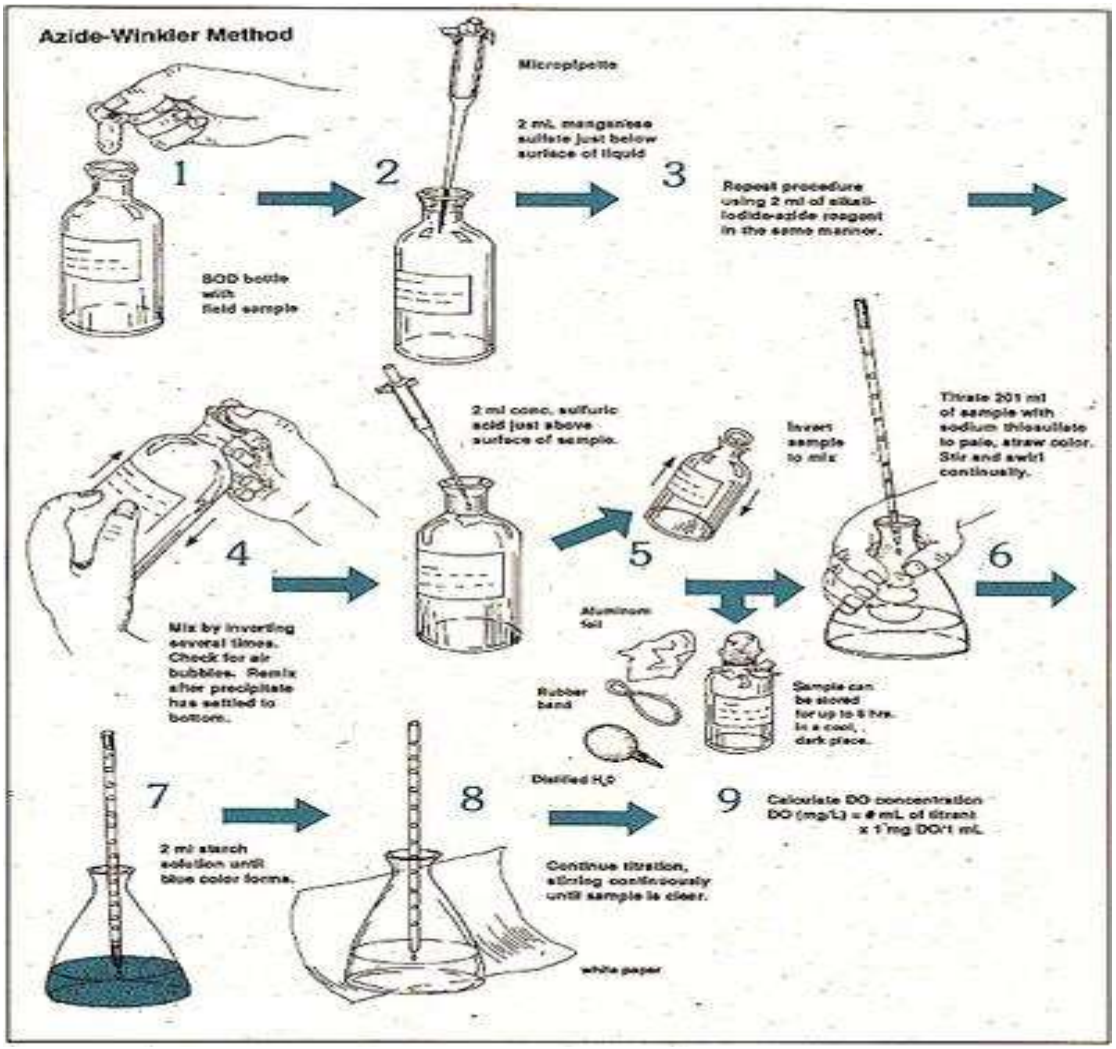
**Step5**. Add 2 mL of concentrated sulfuric acid via a pipette held just above the surface of the sample. Carefully stopper and invert several times to dissolve the floc. At this point, the sample is "fixed" and can be stored for up to 8 hours if kept in a cool, dark place. As an added precaution, squirt distilled water along the stopper, and cap the bottle with aluminum foil and a rubber band during the storage period.

**Step6.** In a glass flask, titrate 201 mL of the sample with sodium thiosulfate to a pale straw color. Titrate by slowly dropping titrant solution from a calibrated pipette into the flask and continually stirring or swirling the sample water.

**Step7**. Add 2 mL of starch solution so a blue color form.

**Step8**. Continue slowly titrating until the sample turns clear. As this experiment reaches the endpoint, it will take only one drop of the titrant to eliminate the blue color. Be especially careful that each drop is fully mixed into the sample before adding the next. It is sometimes helpful to hold the flask up to a white sheet of paper to check for absence of the blue color.

**Step9.** The concentration of dissolved oxygen in the sample is equivalent to the number of milliliters of titrant used. Each mL of sodium thiosulfate added in steps 6 and 8 equals 1 mg/L dissolved oxygen.




| Operation Sheet _2 | procedures for collecting samples and analyzing conductivity test |
|---|---|

**. steps for collecting and analyzing electrical conductivity sampling**

step 1 Prepare the sample containers

step 2 Prepare before leaving for the sampling site

step 3 Collect the sample (if samples will be tested in the lab)

step 4 Analyze the sample (field or lab)

step 5 Return the samples and the field data sheets to the lab/drop-off point.

| Operation Sheet _3 | Procedure for collecting success full data – six steps to success |
|---|---|

steps for success full data collection

Step 1: Identify issues and/or opportunities for collecting data.

Step 2: Select issue(s) and/or opportunity(ies) and set goals
Step 3: Plan an approach and methods
Step 4: Collect data
Step 5: Analyze and interpret data
Step 6: Act on results.

| LAP Test | Practical Demonstration |
|---|---|

Name: _____ Date: _____

Time started: _____ Time finished: _____

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within _____hours.

**Task 1.** collect dissolved oxygen sampling

Task2. collect electrical conductivity sampling

Task3. write the steps to collect success full data collection method

| Instruction Sheet | Learning guide #: Operate and control lagoon processes. |
|---|---|

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

- Monitoring processes to maintain parameters of operation.
- Identifying and reporting process faults and operational condition of plant
- Carrying out basic **system adjustments** within defined parameters to enhance system performance.
- Handling, using and storing chemicals.

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

- Monitor processes to maintain parameters of operation.
- Identify and report process faults and operational condition of plant according to organizational requirements.
- Carry out basic system adjustments within defined parameters to enhance system performance according to organizational requirements.
- Handle, use and store chemicals according to organizational 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 1- 4”. On pages 49, 63, 66 and 69. Try to understand what are being discussed.
4. Accomplish the “Self-checks 1, 2, 3, and 4” in each information sheets on pages 61, 65, 68and 75.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher 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 1, and 2 on pages 76 and 77and do the LAP Test on page 78”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7. After you accomplish Operation sheets and LAP Tests, ensure you have a formative assessment and get a satisfactory result; then proceed to the next LG

| Information Sheet-1 | Monitoring processes to maintain parameters of operation |
|---|---|

## 1.1. Introduction to lagoon process

When wastewater enters a lagoon system, natural decomposition begins to take place. The insoluble settleable solids drop to the bottom. The soluble portions and the suspended solids remain in the water phase. Microorganisms, which are plant and animal life too small to be seen without a microscope, perform the decomposition processes and often do it in a cooperative way. Similarly, pollutants discharged to a receiving stream are decomposed through natural processes. Too many pollutants in a stream causing a large amount of biological decomposition in the water body can result in poor water quality and undesirable conditions.

## 1.2. basic types of lagoons

- **Facultative lagoons**

The most common and simplest type of wastewater system to construct and operate. Facultative cells are usually 4 to 8 feet deep with about 5 to 6 feet generally accepted as an optimum depth. Facultative lagoons are characterized by having an aerobic surface and an anaerobic lower layer. A type of bacteria called facultative are prominent in these lagoons. Facultative bacteria have the ability to exist in both aerobic and anaerobic environments. Facultative cells receive raw domestic sewage and the settleable solids drop to the bottom where anaerobic fermentation and decomposition occurs

- **Aerated lagoons**

depend upon mechanical methods of adding supplemental air (oxygen) to the water. The process of aeration generally mixes the water while dispersing or dissolving oxygen in the upper layer of the lagoon water column. Aerated lagoons are usually designed deeper than non-aerated systems, with depths of 12 to 15 feet not uncommon. Aerated lagoons are less dependent upon climate and weather. Aerated lagoons are frequently used for industrial wastewater treatment and in situations where limited land area is available.

- **Anaerobic lagoons**

used to treat high strength industrial wastes such as dairy or meat processing waters, or other high BOD waste. They are efficient in treatment of high strength wastewater, but odor control can be a problem. The anaerobic biological processes, which occur in anaerobic lagoons, produce hydrogen sulfide and other gases which cause odors Other terms that are used in reference to sewage lagoons are stabilization ponds or oxidation ponds. The term oxidation pond is usually applied to a cell that follows some other type of wastewater treatment

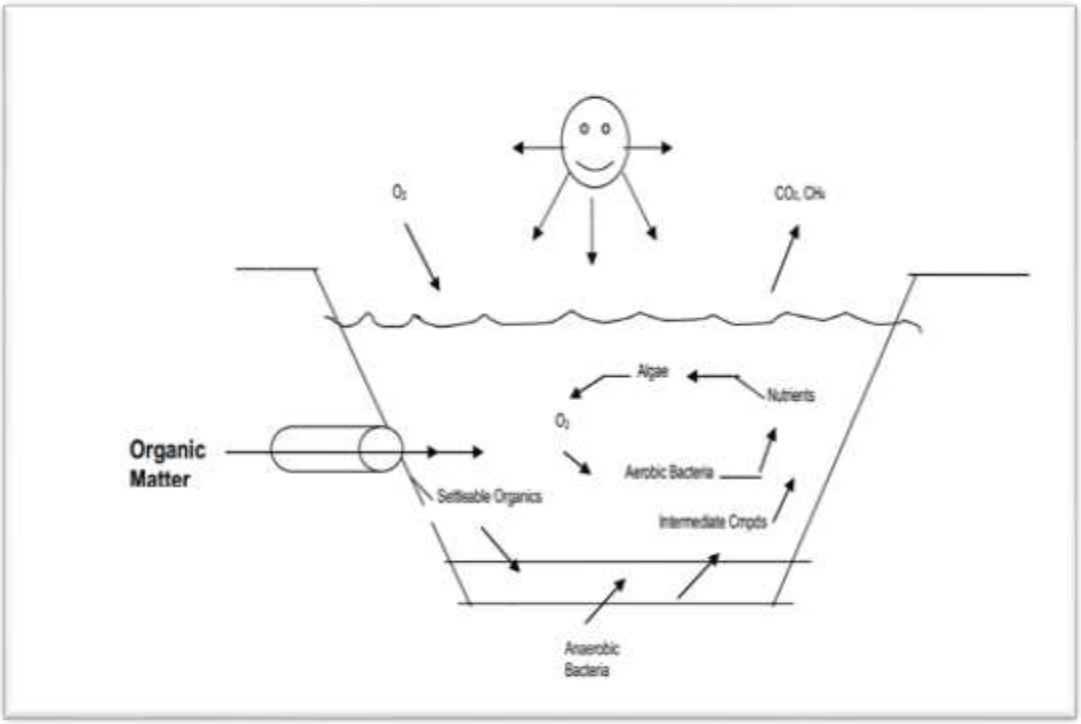



**Figure 1.1. Biological Activity in a Facultative Lagoon**

## 1.3. primary, secondary and maturation lagoons maintenance process

Screens are fixed in the intake works or at the entrance of treatment plant so as to remove the floating matters as leaves, dead animals etc. As a Waste Water treatment work is designed to treat a specific volume of wastewater per day, it is important to know how much wastewater is entering so as not to overload the plant. Flow metering Changes in the volumes entering the plant will alert the Process Controller to possible problems upstream of the works, e.g. at a pump station. It is also important to know when the peak flow arrives at the waste water treatment work

Flow is typically measured just after the screens and grit removal processes and it is important to note that one of the conditions of an authorization will be that the flow is measured. In other words, flow measurement is a legal requirement. Changes in the volumes entering the plant will alert the Process Controller to possible problems

**Lagoons** often are equipped with a weir or flume type of flow measurement device. There are several different open channel flow measurement weirs and flumes. Devices such as a weir which measure flow directly are called primary measuring devices. A flume is a specially shaped open channel flow section usually including a converging section, throat and diverging section. The flume creates a known hydraulic condition where the area of the flow stream can

be measured to determine flow. Flumes work well for measuring the flow of raw sewage because they tend to be self-cleaning, without an accumulation of solids.

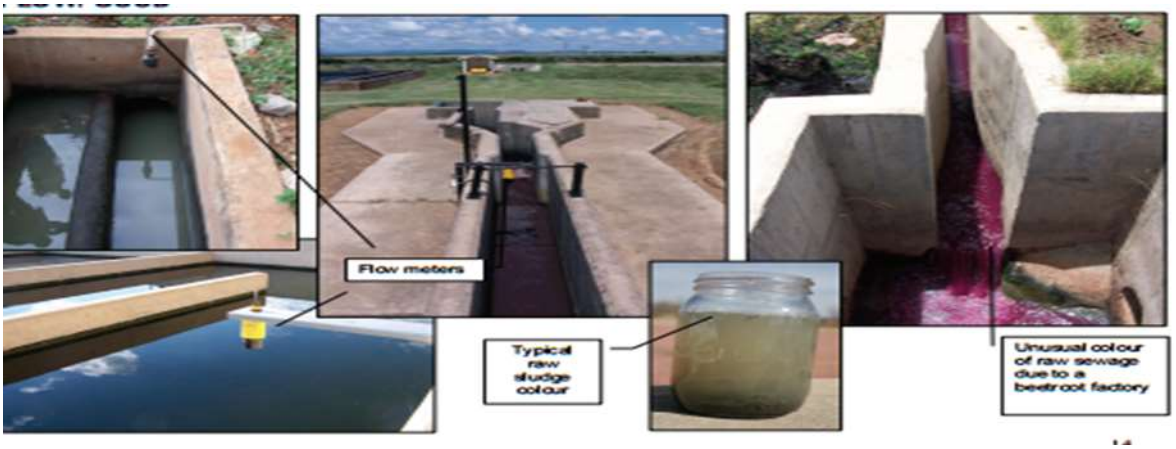



**Figure 1.1. flow measuring**

the main purpose of primary sedimentation is to allow separation of the solid and liquid phase fractions in the wastewater. It removes the

readily settleable solids which are mainly organics as well as the floating material such as fats, oils and grease. The settled solids are known as primary sludge. The process therefore reduces the suspended solids content of the influent wastewater. Even though the volume of primary sludge is only about 2% of the total influent wastewater volume, it makes up approximately 30 to 40% of the organic load received (expressed as COD) and some 40 to 60% of the suspended solids loading.

### 1.4. Primary sedimentation tanks (PST)

Look and listen to all moving parts to determine if the equipment is functioning properly. Odd vibrations or noises could be an indication that a piece of equipment needs maintenance or replacement. If there is more than one. it is good practice to ensure that the flow to the primary sedimentation tanks is equally distributed. This can easily be checked by observing the overflow at the weirs – it should be similar. Weirs should be level to ensure uniform overflow of settled wastewater along the primary sedimentation tanks weirs. Check that the surface scum layer is being properly skimmed off and that there is no sign of belching. If the scum is not being skimmed off adequately, it could mean that:

- Scrapers are worn or damaged
- Sludge may be decomposing in the PST

- There is return of well-nitrified waste activated sludge. inflow that should be light grey in colour
- **Primary sedimentation tank is present**
  - ✓ weirs in good condition
  - ✓ scum or floating sludge layer
  - ✓ layer of fats/grease/oil
  - ✓ a schedule for desludging and check that it is implemented
- records of process sampling are important to adhere to the schedule of desludging
- **Process sampling** should be undertaken on samples from the PSTs - daily if the capacity of the works is >20 Ml/day or twice a week if smaller.
  - ✓ Suspended Solids (SS)
  - ✓ Total and Volatile Solids (TS and VS)
  - ✓ Chemical Oxygen Demand (COD)
  - ✓ Imhoff cone tests on settleable solids in influent and effluent
  - ✓ Records should be kept of preventative maintenance procedures including:
  - ✓ Lubrication schedules
  - ✓ Spare parts (required and available)
  - ✓ Stoppages and malfunction ry solids in sludge underflow


**Figure 1.2. Primary sedimentation**

## 1.5. Aerated lagoons

Aeration is the treatment process whereby water is brought into intimate contact with air for the purpose of

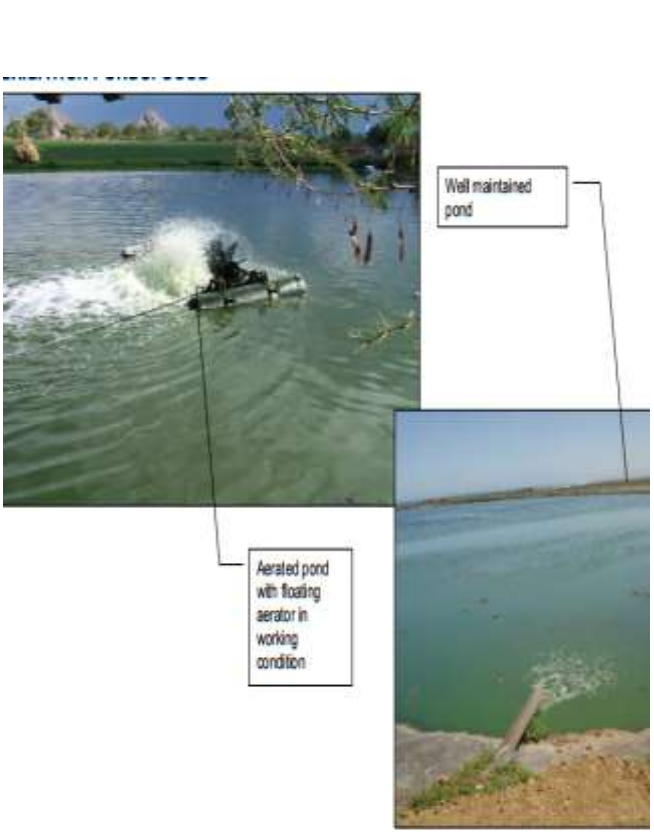
- ✓ increasing the oxygen content,
- ✓ reducing the carbon dioxide content, and
- ✓ removing hydrogen supplied, methane and various volatile organic compounds responsible for bad taste and odor

Pond systems may be aerobic and anaerobic and at least four ponds should be linked in series. Short-circuiting means that the wastewater is following a course through the ponds that would mean that the detention time of the wastewater in the pond is inadequate to allow any biological

purification to occur, so that the final effluent will be of very poor quality. Often, floating mechanical aerators are used to add air (oxygen) to one or more ponds to assist with the biological processes. The advantage of a floating aerator is that it is portable and can be easily removed or moved from place to place.

pond to which the influent can be diverted while desludging occurs. All sludge must be disposed of responsibly in accordance with the relevant authorisation in place.

The area around the ponds must be kept clean and tidy. Any solids that have passed through the inlet must be removed from the surface of the ponds and disposed of with the grit and screenings if these are removed prior to the ponds. No solids should be allowed to accumulate on the side of the ponds



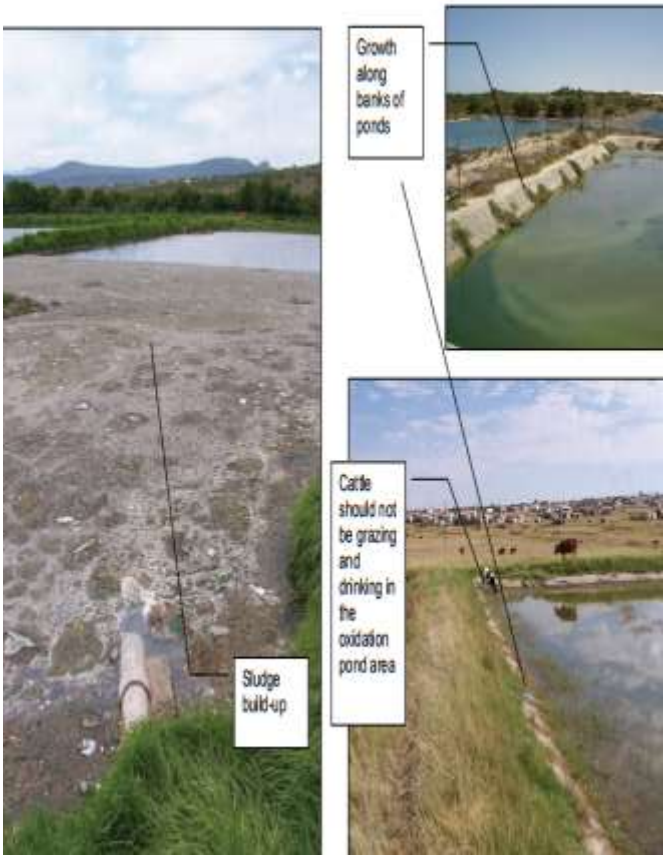




**FIGURE 1.3. aerated pond with floating aerator in working condition**


Figure 1.4. different type of aerator

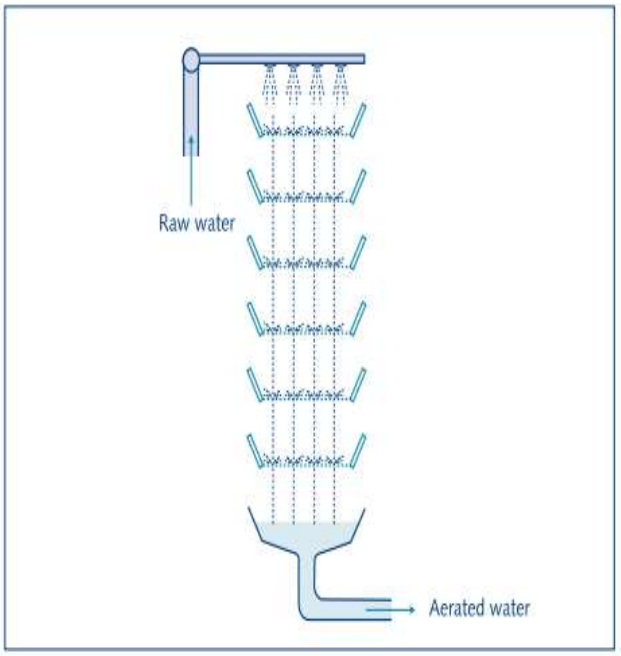



Figure 1.5. Multi tray aerator for ground water

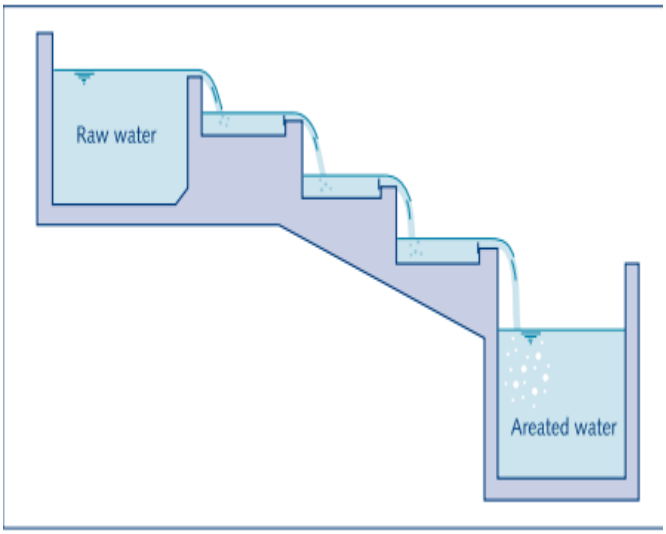



Figure 1.6. Cascade aerator

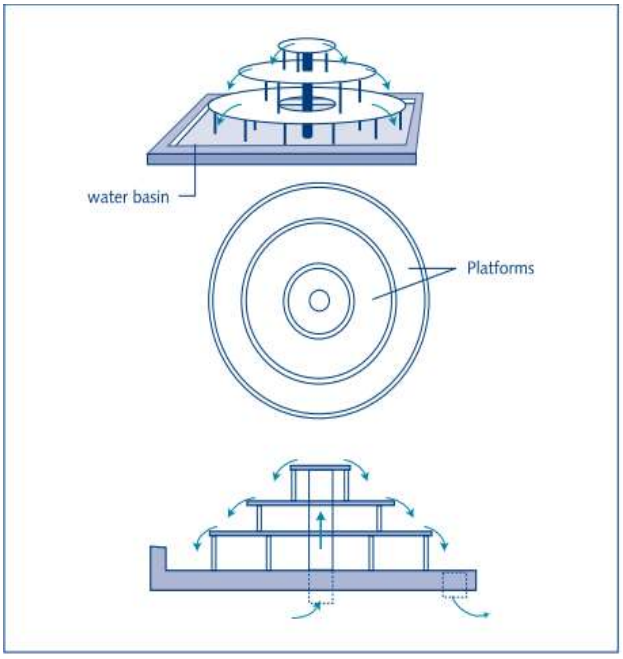



Figure 1.7. Multiple platform aerator

## 1.6. Clarification/ secondary settling

Clarification, also known as secondary sedimentation/settling, is required after the aerobic oxidation processes encountered with trickling filters and activated sludge plants. In both cases the purpose is to clarify the effluent and prevent solids carry-over to the water resource (e.g. river)

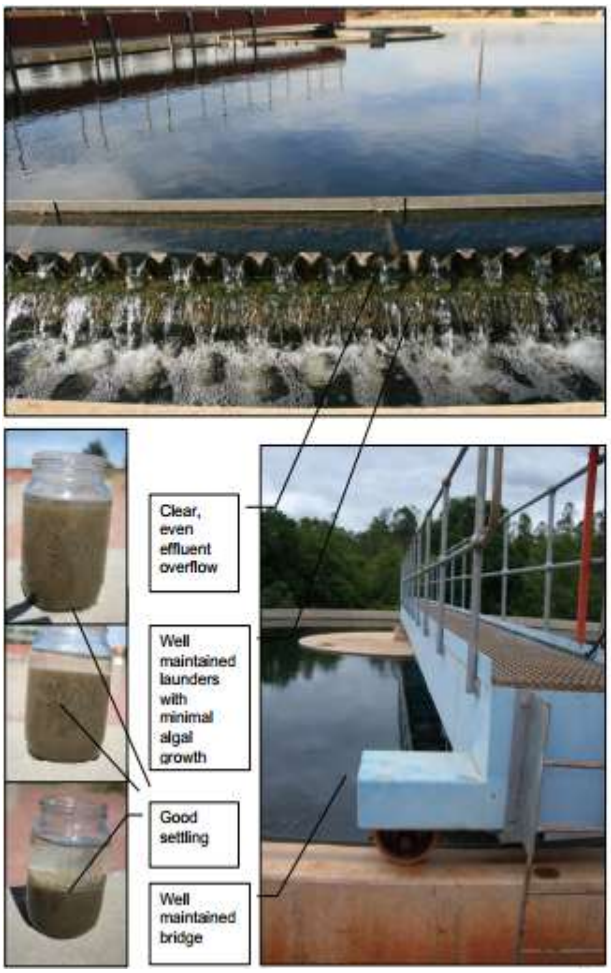




**Figure 1.8. secondary sedimentation**

## 1.7. Maturation ponds

Maturation ponds give a final 'polish' to effluents before discharge. They are used to improve the bacteriological quality of the final effluent and can also act as a buffer in the event of a breakdown at the works. If used after a process such as the activated sludge process, a series of maturation ponds can reduce the bacteriological count considerably.

The water use authorization will give specific conditions with respect to the quality of the final effluent and the frequency at which sampling must take place. The ponds and surrounds should be kept neat and tidy to minimize nuisance conditions which include rats, snakes and insect infestations. Due to the fact that the ponds are shallow, plant growth is common and needs to be controlled


Figure 1.9 Maturation ponds

The first cell in a series of cells is called the primary cell. The following cells are secondary cells and the last cell in the series may also be called the polishing cell. Cells are usually created through an engineered construction of earthen dikes although fabric baffles are being used occasionally to divide cells into smaller treatment units.

## 1.8. winter storages

**Winter** - Cold weather slows down all biological activity. When temperatures drop, the anaerobic digestion of bottom sludge slows down and sludge may begin to accumulate. The colder temperatures also slow the aerobic activity. With lower biological rate, the demand for oxygen is lower. With shorter days and lower sunlight intensity, algae reduce in numbers and activity. Ice cover and snow on top of ice reduces sunlight intensity as well. As a result of the slow treatment process, winter may not be a good time to discharge water. There is often a time in late fall or early winter when BOD tests on the treated water are acceptable and the algae concentration is lower. This is a good time to discharge and to draw down the levels enough to allow storage volume in the pond to contain water through the winter months. Lagoons constructed to current design

standards should have 180 days detention time at design flows. This amount of volume is needed in cold climates to hold the wastewater in the lagoon during the winter to allow for adequate treatment levels.

**Spring** - As spring temperatures begin to melt the snow and ice cover, the pond will warm and reach a turnover condition. The surface will warm before the bottom and, strangely, water at 39°F is slightly heavier than water at lower, say 34°F. The heavier surface water will roll to the bottom, and the anaerobic bottom water with some suspended sludge will rise. This condition may continue to exist for one to three weeks.

**Summer** - Warm summer temperatures increase the rate of bacterial action. An increase of 10°C in the water can double the rate of biological activity. The sludge layer decreases, releasing high organic loads to the water and the oxygen demand increases dramatically. The longer daylight hours and the increase in sunlight generate high algal growth and bacterial activity.

**Fall** - Many operators find a period in the fall when effluent tests are good for discharge. This also allows them to lower the water level sufficiently to discontinue discharge during winter months when effluent tests may not be good. The ponds may turnover again in late fall or early winter.

### 1.9. General Operation and Maintenance

**Daily Log** - The data required is not very extensive, but should include the flow rate and any sampling or testing that is done. Many operators have developed their own record keeping and find it very useful as it allows them to anticipate conditions and make provision for actions as needed

**A list of daily notations in the log could include these items:**

- Note if any scum, floating debris, or algae mats are present. Rake off large accumulations, if possible.
- Look for signs of burrowing animals and eradicate if found. Fill all holes.
- Note the smell and appearance of each cell. Is there any odor of anaerobic or septic condition?
- Check for cattails, reeds or willow growth. Remove plants, taking care not to damage the liner.
- Note condition of dikes. Any erosion?

- Look for exposure of liners. Some synthetic liners are degraded by exposure to sunlight. Recover with earth. Check exposed liners for damage, tears, split seams and other conditions which would require repairs.
  - ✓ Note fencing condition and repair as needed.
  - ✓ Keep gates and locks in good condition.
  - ✓ Unauthorized persons should not be allowed access.
  - ✓ Make sure that warning signs are in place and in good condition.
- Owners of lagoons near inhabited areas should take all necessary measures to prevent unauthorized access.
  - ✓ Children have drowned in lagoons in Montana through entry by illegal access!
- Check the inlet structure. Clean trash from bar screens and dispose of it.
- Check the draw off structure. Which level is being used? Is it the optimum level? It is important to maintain water 2 feet above the solids layer to provide treatment of the wastewater and reduce odors from the lagoon, even following draw down. Make gradual changes in lagoon level rather than allowing drastic differences in water surface elevation.
- Exercise all valves on a periodic schedule to make certain they will operate.
- Look for evidence of short-circuiting and correct the problem, if the capability is available to the operator such as changing flow paths.
- Check around the perimeter of cells for evidence of leakage or seepage.

**Waste water lagoon sludge removal process**

https://www.youtube.com/watch?v=YwsPrtQP-4Y

https://www.youtube.com/watch?v=BJg0skm4xW8

https://www.youtube.com/watch?v=CjwmjiFSW8Q

**waste water lagoon aeration process**

**https://www.youtube.com/watch?v=Tt0wAmTDVgA**

**https://www.youtube.com/watch?v=YctXi9jDK8U**

**https://www.youtube.com/watch?v=P2R4v3AjAnk**

**https://www.youtube.com/watch?v=Z8Oq-pRdfmU**

| Self-Check -1 | Written Test |
|---|---|

**Direction I: Multiple choice item (2 points each)**

**Instruction: choose the best answer for the following questions and write your answer on the answer sheet provided in the next page**:

1. A lagoon which is aerobic near the surface but is anaerobic at lower levels is called:
   A. A facultative lagoon
   B. An anaerobic lagoon
   C. A complete-mix aerated lagoon
   D. None of the above
2. A total containment lagoon cell is one that:
   A. Is covered to keep out sun and rain.
   B. The entire contents are discharged at one time
   C. Evaporation from the surface is equal to, or greater than total inflow and rainfall.
   D. The contents are entirely of industrial origin.
3. The oxygen in an aerated lagoon cell is:
   A. Derived completely from the air by wind and wave action.
   B. Obtained primarily by mechanical means
   C. Formed by aerobic bacteria
   D. Generated at the benthic layer by anaerobes.
4. An advantage of an aerated lagoon over a facultative lagoon is:
   A. It does not require as much land area
   B. It is not as dependent upon climate and weather.
   C. It is mixed by the aerators
   D. All of the above.
5. Bacteria that require oxygen to live and grow are:
   A. Aerobic bacteria
   B. Anaerobic bacteria
   C. Facultative bacteria
   D. All of the above
6. You would expect to find anaerobic bacteria:
   A. In the upper levels of a facultative lagoon
   B. In the bottom sludge layer of a facultative lagoon
   C. Distributed uniformly throughout a facultative lagoon.
   D. All of the above

8. Aerobic bacteria require which of the following to survive:
   A. Hydrogen oxide
   B. Sulfur dioxide
   C. Carbon dioxide
   D. Free oxygen
   E. All of the above
9. Algae are useful in a facultative lagoon because:
   A. They consume the bacteria
   B. They convert oxygen to carbon disulfide
   C. They convert carbon dioxide to oxygen
   D. They react with the BOD
10. One thing that makes algae multiply in a lagoon is:
   A. Plenty of mixing
   B. Plenty of pathogenies
   C. Plenty of darkness
   D. Plenty of sunshine
11. When algae are flourishing, the pH of the water will:
   A. Increase
   B. Decrease
   C. Stay about the same
   D. All

***Note:*** **Satisfactory rating - 3 and 5 points  Unsatisfactory - below 3 and 5 points**

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

**Answer Sheet**

Name: _____ Date: _____

Score = _____

Rating: _____

**Short Answer Questions**

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____

| Information Sheet-2 | Identifying and reporting process faults and operational condition of plant |
|---|---|

## 2.1. Introduction to Importance of Inspection and Examination waste water

sewer systems are intended to be a reliable method of conveying sewage from individual discharge to sewage treatment plants. Inspection and examination are the techniques used to gather information to develop operation and maintenance programs to ensure that new and existing collection systems serve their intended purposes on a continuing basis. Inspection and testing are necessary to do the following:

- ✓ Identify existing or potential problem areas in the collection system,
- ✓ Evaluate the seriousness of detected problems,
- ✓ Locate the position of problems, and
- ✓ Provide clear, concise, and meaningful reports to supervisors regarding problems

The detailed method for each process of inspection is to identify the waste water faults based on the following

- ✓ Preliminary inspection
- ✓ Inspection & Examination
- ✓ Judge from inspection results
- ✓ Decide the necessary measure (Repair, replacement, and modification

- **Common problem waste water Treatment Plants**
  - ✓ Downstream equipment is failing due to a build of large solids, hairs and fibers.
  - ✓ treated effluent is not meeting Total Nitrogen (TN) targets.
  - ✓ High Ammonia.
  - ✓ High Nitrate.
  - ✓ treated effluent is not meeting Total Phosphorus (TP) targets.
  - ✓ Energy consumption. Energy consumptions is one of the biggest issues confronting wastewater plants.
  - ✓ Staffing shortages. Like many other industries, wastewater treatment plants also face the problem of a staffing shortage.
  - ✓ Environmental footprint.
  - ✓ Looking for new water treatment systems?

## 2.2. reporting faults

Fault reporting is an optional feature that can be forwarded to remote displays using simple configuration setting in all modern computing equipment. The system level of reporting that is appropriate for Condition Based Maintenance are critical, alert, and emergency, which indicate software termination due to failure. Specific failure reporting, like interface failure, can be integrated into applications linked with these reporting systems.

Fault reporting is a maintenance concept that increases operational availability and that reduces operating cost through three mechanisms.

- ✓ Reduce labor-intensive diagnostic evaluation
- ✓ Eliminate diagnostic testing down-time
- ✓ Provide notification to management for degraded operation

- Maintenance requires three actions.
  - ✓ Fault discovery
  - ✓ Fault isolation
  - ✓ Fault recovery

## 2.3. Operational problems at wastewater treatment plants

frequently lead to violations of discharge water quality requirements. Such violations can result in impairment of the receiving water body and expose the owner to fines and liability. When operational problems occur that threaten water quality it is imperative to inform and involve all pertinent parties to help reduce or mitigate any threat to public safety. Such parties may include the operation superintend, utility managers, regulatory authorities, and first responders according to the established emergency responds plan. operational problems are described as temporary identifiable events, which will or may affect wastewater treatment performance and effluent quality

## 2.4. Identify hazards and hazardous events and assess the risks

Hazardous agents, including microbial pathogens and chemical contaminants, that get access to drinking-water and distribution systems could affect the quality of the water and have an adverse impact on human health. This section describes the different microbial, chemical and physical hazards that can affect the safety of drinking-water in distribution systems. It also identifies the various hazardous events that could affect the water quality and the physical and hydraulic integrity of the distribution system, leading to water in distribution systems becoming contaminated or to supply being interrupted.

| Self-Check -2 | Written Test |
|---|---|

**Direction I: Multiple choice item (2 points each)**

**Instruction: choose the best answer for the following questions and write your answer on the answer sheet provided in the next page**:

1. Inspection and testing are necessary to do the following except
   A. Identify existing or potential problem areas in the collection system
   B. Evaluate the seriousness of detected problems
   C. Locate the position of problems
   D. Downstream equipment is failing due to a build of large solids, hairs and fibers.
2. The detailed method for each process of inspection is to identify the waste water faults based on the following except
   A. Preliminary inspection
   B. Inspection & Examination
   C. Decide the necessary measure (Repair, replacement, and modification
   D. High Ammonia.
3. Common problem waste water Treatment Plants from the following except
   A. treated effluent is not meeting Total Nitrogen (TN) targets.
   B. High Nitrate.
   C. treated effluent is not meeting Total Phosphorus (TP) targets.
   D. Inspection & Examination
4. Maintenance requires three actions from the following **except**
   A. Fault discovery
   B. Fault isolation
   C. Fault recovery
   D. Fault expansion

***Note:*** **Satisfactory rating – 4 and above points** **Unsatisfactory - below 4 points**

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

**Answer Sheet**

Name: _____ Date: _____

Score = _____

Rating: _____

**Short Answer Questions**

1. _____
2. _____
3. _____
4. _____

| Information Sheet-3 | Carrying out basic system adjustments within defined parameters to enhance system performance. |
|---|---|

## 3.1. Introduction to pH correction

Pure or distilled water has a pH level of 7, which means it is neutral. If you want to increase the pH of water, you must add an alkaline substance, such as baking powder, to it. If you want to decrease the pH of water, you add an acidic substance, such as lemon juice, to it. As an example, it's important to keep pH levels steady in the water in an aquarium because even minor changes to pH can have severe health effects on fish. A high (alkaline) pH can affect a fish's gills and can be fatal. A low (acidic) pH can increase toxic elements in the aquarium, lead to eye damage and hyperplasia (thickening of skin and gills) and can also be fatal.

## 3.2. Mixing

While mixing in a lagoon is important the only effective energy for mixing in a facultative lagoon comes from wind. Wind will stir the surface and move the aerobic layer to deeper levels. This will moderate overloading conditions and lead to more complete treatment. Without any wind or waves, a thin layer of high algae concentration tends to accumulate at the surface. Stratification can occur and result in anaerobic conditions in the lagoon cell. Stratification is the condition where the surface becomes much warmer than lower levels. The warm surface is not easily mixed into the main body of water. A poor weather condition for a facultative lagoon is a hot, sunny and quiet week

## 3.3. dissolved oxygen levels

The aeration tank is regarded as the key treatment facilities in the conventional activated sludge process. The running condition of the aeration tank has a great influence on the quality of outlet water. The phenomenon that the speed of oxygen consuming is higher than that of oxygen supplying at the head of aeration tank, the concentration of dissolved oxygen is excessive in the back of aeration tank is common in the aeration tank.

## 3.4. recirculation rates

The biological wastewater treatment technologies in anoxic and aerobic bioreactors with recycle of sludge mixture are used for the effective removal of organic compounds from wastewater. The change rate of sludge mixture recirculation between bioreactors leads to a change and redistribution of concentrations of organic compounds in sludge mixture in bioreactors and change hydrodynamic regimes in bioreactors. Determination of the coefficient of internal recirculation of sludge mixture between bioreactors is important for the choice of

technological parameters of biological treatment (wastewater treatment duration in anoxic and aerobic bioreactors, flow capacity of recirculation pumps).

### 1.5. **chemical additives**

Chemical additives and agents include a wide range of materials added to polymer resins, paints and coatings, adhesives, and other substances to modify specific processing or end-use properties. They include catalysts, wetting agents, levelers, clarifiers, coupling agents, deflocculants, thinners, thickeners, anti-caking agents and other chemicals.

| Self-Check -3 | Written Test |
|---|---|

Direction I: Multiple choice item (5 points each)

Instruction: choose the best answer for the following questions and write your answer on the answer sheet provided in the next page:

1. include a wide range of materials added to polymer resins, paints and coatings, to modify specific processing or end-use properties.
   A. Chemical additives and agents
   B. Chemical reaction
   C. Chemical extraction
   D. Chemical isolation
2. Which one of the following statements is true?
   A. dissolved oxygen is excessive in the back of aeration tank is common in the aeration tank.
   B. Pure or distilled water has a pH level of 7, which means it is neutral
   C. A poor weather condition for a facultative lagoon is a hot, sunny and quiet week
   D. All

***Note:*** **Satisfactory rating – 5 and above points Unsatisfactory - below 5 points**

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

**Answer Sheet**

Score = _____

Rating: _____

Name: _____ Date: _____

**Short Answer Questions**

1. _____
2. _____

| Information Sheet-4 | Handling, using and storing chemicals. |
|---|---|

## 4.1. Introduction to chemical handling

safe handling instructions and identify personal protective equipment to be used while handling chemicals. Beware of instructions regarding the mixing of chemicals. Always wash yourself thoroughly after handling chemicals. If a chemical spill on you, wash it off at once.


**Figure 4.1. chemical handling**

## 4.2. Category of chemicals

- Corrosive
- Flammable
- Toxic
- Reactive
- Biological (infectious)
- Carcinogen (cancer-causing)
- Radioactive

## 4.3. Physical state of chemicals

- Liquid
- Solid
- Gas
- Vapor

4.4. How to use chemicals

- Follow these safety precautions:

✓ Carefully read the ingredient list of any product or chemical you use.

✓ Purchase the proper personal protective equipment like gloves or goggles.

- ✓ Be aware of the hazardous materials you come in contact with.
- ✓ Follow safe procedures when you handle hazardous material.

### 4.5. Chemical storing

Chemical storage is the storage of controlled chemicals or hazardous materials in chemical stores, chemical storage cabinets, or similar devices.

Improper chemical storage can result in the creation of workplace safety hazards including the presence of heat, fire, explosion and leakage of toxic gas

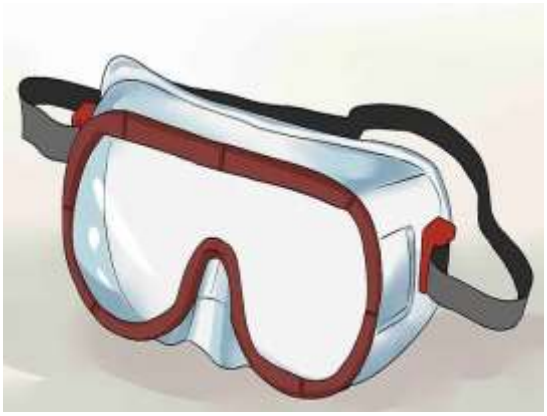
Chemical storage cabinets are typically used to safely store small amounts of chemical substances within a workplace or laboratory for regular use

Proper labeling is important to ensure that chemicals are not misidentified, which is key to protecting health and safety. For example, organizing chemicals alphabetically is not generally recommended, because it may lead to incompatible chemicals placed near each other, risking a dangerous reaction.


**Figure 4.2. safe chemical storage**

### 4.6. How to Work Safely with Chemicals

**1. Wear splash goggles.**



2. **Wear tight protective clothing**

3. **Wear an apron**

4. **Wear close-toed shoes**

5. **Wear gloves**

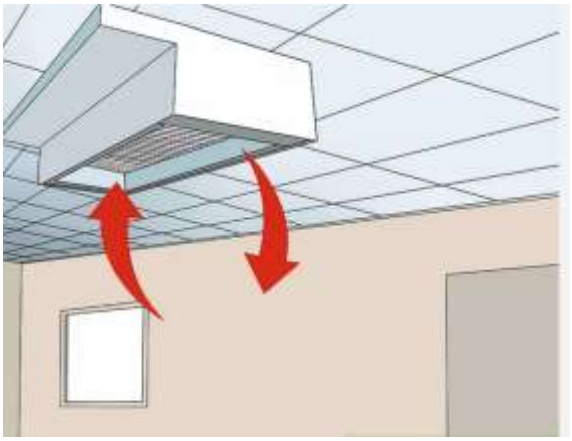
6. **Keep your hair out of your face**

**a. Preparing Your Work Site**

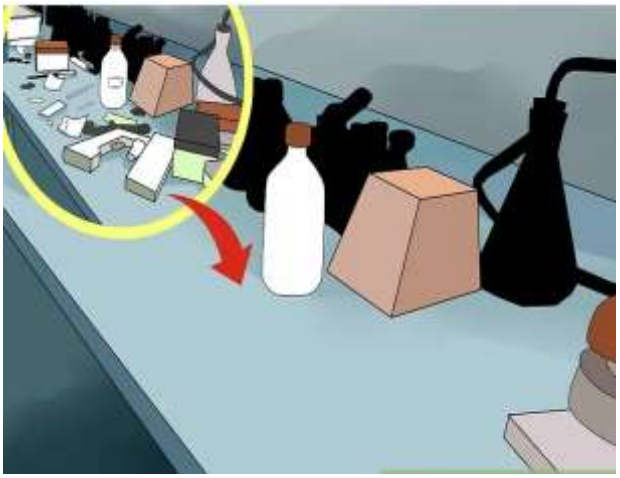
1. **keep emergency equipment on hand**

2. **Have an exit plan**


3. **Use a room with ventilation.**



4. **Remove clutter**



5. **Keep chemicals in a safe, segregated location**


1. **Do not substitute chemicals**

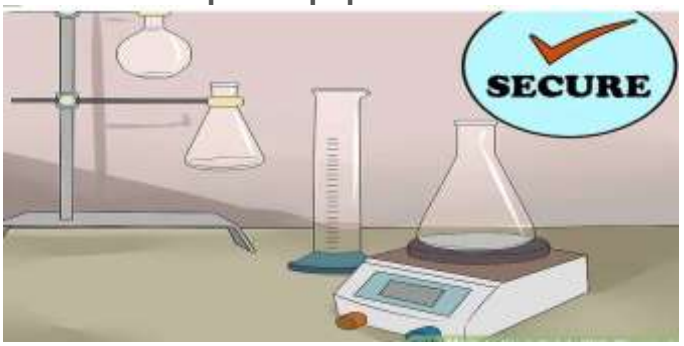
**b. Chemical handling**

2. **Use properly stored materials**

3. **Carefully read the MSDS.**


4. **Heat chemicals carefully**

5. **Keep all equipment secured**




6. **Wash after handling chemicals**

| Self-Check -4 | Written Test |
|---|---|

Direction I: Multiple choice item (2 points each)

Instruction: choose the best answer for the following questions and write your answer on the answer sheet provided in the next page:

1. Which one of the following is **not** Category of chemicals?
   A. Corrosive
   B. Flammable
   C. Toxic
   D. Liquid
2. Physical state of chemicals from the following **except**
   A. Liquid
   B. Solid
   C. Gas
   D. Toxic
3. Which one of the following statements is true about chemicals use safety precautions?
   A. Carefully read the ingredient list of any product or chemical you use.
   B. Purchase the proper personal protective equipment like gloves or goggles.
   C. Follow safe procedures when you handle hazardous material.
   D. All
4. Which one of the following activities should be apply during chemical handling?
   A. Wear tight protective clothing
   B. Wear close-toed shoes
   C. Wear gloves
   D. All

***Note:*** **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 5 points**

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

**Answer Sheet**

Name: _____ Date: _____

Score = _____

Rating: _____

**Answer Questions**

**1.** _____ **3.** _____

**2.** _____ **4.** _____

| Operation sheet -1 | Procedure to solve operational problem in waste water lagoon process |
|---|---|

**steps to solve operational problems of waste water treatment process**

**step1**. Select appropriate tools and equipment

**step2**. Select specific location of treatment plant

**step3**. Identify problems

**step4**. Record the problem

**step5**. Describe the current situation

**step6**. Take temporary countermeasures on the spot

**step7**. Find the root cause

**step8**. Propose solutions

**step9**. Establish an action plan

**step10.** Check results

**step11**. Record result

| Operation sheet -2 | Procedure to identify hazard and risk to the organization |
|---|---|

**Steps to Identify Hazards & Risks to the Organization Aviation risk management process**

**Step1**. Establish the context.

**Step2**. Identify the hazards.

**Step3**. Record the hazard

**Step4**. Prioritize hazard

**Step5**. Analyze the risk.

**Step6**. Evaluate the risk.

**Step7**. Apply the solution

**Step8**. Monitor and review solution

**Step9**. record the solution

| Operation sheet _3 | Techniques for the treatment waste water lagoon system |
|---|---|

**Steps to treat waste water lagoon process**

**Step 1:** select appropriate working site

**Step2.** Select appropriate safety equipment

**Step4.** Select appropriate tools and equipment

**Step5.** Screening and Pumping

**Step6.** Grit Removal.

**Step7.** Primary Settling.

**Step8.** Aeration / Activated Sludge

**Step9.** Secondary Settling.

**Step10.** Filtration.

**Step11.** Disinfection.

**Step12.** Oxygen Uptake.

| LAP Test | Practical Demonstration |
|---|---|

Name: _____ Date: _____

Time started: _____ Time finished: _____

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within _____hours.

**Task1.** solve operational problem in waste water lagoon process from your surrounding

**Task2**. Identify Hazards & Risks to your surrounding waste water treatments plant

**Task 3**. Treat waste water lagoon process which is present in your surrounding with the collaboration of town water utility office

| Instruction Sheet | Learning guide #: Complete documentation. |
|---|---|

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

- Maintaining records of plant and system data.
- Reporting observations outside defined parameters for further action.

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

- Maintain records of plant and system data according to organizational requirements.
- Report observations outside defined parameters for further action.

## 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 1and 2”. On pages 80 and 87. Try to understand what are being discussed.
4. Accomplish the “Self-checks 1 and 2” in each information sheets on pages 85 and 89.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher 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 1, on pages 90and do the LAP Test on page 91”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7. After you accomplish Operation sheets and LAP Tests, ensure you have a formative assessment and get a satisfactory result; then proceed to the next LG.

| Information Sheet-1 | Maintaining records of plant and system data. |
|---|---|

## 1.1. Introduction to maintenance plant performance data record

A facultative lagoon should be visited regularly, daily if possible, during the workweek. Each visit should be recorded in a logbook, or data sheet. The maintenance should ensure that the materials, equipment and facilities, necessary safety equipment are in standby state at all times with the plant performance**.**

Records of all cleaning operations should be entered and filed for future reference. These records should include the data, street name or number, line size, distance and manhole numbers or identification. Also, the kind and amount of materials removed, wastewater flow, and auxiliary water used should be noted. If particular problems were encountered, these too should be noted, especially the exact location of obstructions

- To avoid damages of the system, the maintenance should do the following:
  - ✓ Collect all related information about the construction actives which are planned around the plant location,
  - ✓ Advise appropriate construction methods to minimize impact for plant, and
  - ✓ If necessary, request the concerned agencies to adopt the protective measures for plant prior to the work commencement

### 1.1.1. Routine Maintenance

Once the ponds have started functioning in steady state, routine maintenance is minimal but essential for good operation. The main routine maintenance actives are

- 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. This is done to maximize the light energy reaching the pond algae, increase surface re-aeration, and prevent fly and mosquito breeding
- If flies are breeding in large numbers on the scum on anaerobic ponds, the scum should be broken up and sunk with a water jet
- Removal of any material blocking the pond inlets and outlets
- Repair of any damage to the embankments caused by rodents or rabbits (or any other burrowing animals)
- Repair of any damage to fences and gates.

## 1.2. Maintenance checklist and Record Keeping

### 1.2.1. Maintenance checklist for water treatment plant

routine maintenance such as grass mowing, weeding, trash removal, mulch raking and maintenance, erosion repair, reinforcement plantings, tree and shrub pruning, and sediment removal shall be performed as necessary. The checklists shall be signed, dated, and maintained at an accessible location with an official representative of the homeowner's association, the individual or company contracted for maintenance, or the owner

### 1.2.2. Records necessary for Anaerobic Pond

Daily tests and records will be the flow and SS. Monthly tests shall be the BOD after filtering through Whatman 42 filter paper, and pH.

### 1.2.3. Records necessary for Facultative Pond

- ✓ Daily tests and records will be the flow and SS.
- ✓ Weekly tests will be identification of organisms as per Standard Methods" drawings.
- ✓ Monthly tests shall be the BOD after filtering through Whatman 42 filter paper, and pH.

### 1.2.4. Record necessary for Maturation Pond

- ✓ Daily tests and records will be the flow and SS.
- ✓ Monthly tests shall be the BOD after filtering through Whatman 42 filter paper, and pH.
- ✓ Yearly test of faecal and total coliforms at peak rainy season shall be conducted.

## 1.3. Maintain chemical usage

1.3.1. Maintain an organized orderly facility

**a. Work area:**

- Keep the work area clean and uncluttered.
- Never play practical jokes or engage in horseplay.
- Always use adequate safety measures and never leave the following unattended:
  - ✓ Ongoing chemical reactions in laboratories
  - ✓ Exposed sharps (needles, razor blades, etc.)
  - ✓ Energized electrical, mechanical, or heating equipment

**b. Chemical storage and inventory:**

- Follow chemical storage and compatibility guidelines.
- Maintain lean, well managed chemical inventories to avoid fire code violations and subsequent inventory reduction measures.

**c. Follow basic safety**

- Evaluate the hazards:

- ✓ Read the Safety Data Sheet (formerly called *Material* Safety Data Sheets) before beginning work with a chemical.
- ✓ Follow hazard control plans for extremely hazardous materials.
  - Pay particular attention to control measures for chemicals that are known to be particularly high hazard or chemical carcinogens.

- Never underestimate risk.
  - ✓ Do not pipette by mouth.
  - ✓ Never smell chemicals to identify them.
- Be aware of electrical hazards.
  - ✓ Keep electrical panels clearly visible and unobstructed.
  - ✓ Know how your circuits are labeled so equipment can be de-energized quickly in an emergency.
  - ✓ Never use extension cords as permanent wiring. Unplug them at the end of the workday.
  - ✓ Mount multi-plug adaptors a few inches off the floor to avoid possible water damage.
  - ✓ Never use multi-plug adaptors in series.
  - ✓ Replace any damaged or frayed electrical cords immediately.
- Do not eat, drink, store food, smoke, or apply cosmetics in areas where chemicals are in use except in clearly marked Clean Areas. Wash your hands frequently and before eating.

**d. Prepare for accident and emergencies**

**Follow basic emergency preparedness best practices:**

- Never work alone when hazardous chemicals are involved.
- Prepare for spills.
  - ✓ Clean up only very small quantities and only if you have been properly trained. All other spills should be cleaned up by specially trained personnel.
  - ✓ Read How to Handle Chemical Spills in Laboratories.
  - ✓ Keep a fully stocked chemical spill kit easily accessible.
  - ✓ Train personnel on how to use the spill kit, and when it is safe to do so.
- Know the locations of emergency equipment and how to use it:

- ✓ Telephones
- ✓ Emergency Guide
- ✓ First-aid kit
- ✓ Fire extinguishers and fire alarm pull stations
    - Read Fire Extinguisher Types and Maintenance to learn about different types of extinguishers and how to have them serviced or replaced.
    - Get training: see Fire Extinguisher Training for options.
    - Read How to Use a Fire Extinguisher.
    - Check your fire extinguisher monthly to ensure it is charged and accessible.

- Eye wash and emergency showers

**Recording format**

**Table 1.1 maintenance recording format**

| LOG/RECORD SHEET | | | | | |
|---|---|---|---|---|---|
| Date | Equipment Name | Operation and Maintenance Performed | Materials Used; Cost of Materials | Operator Time Required | Operator Initials |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| MONTHLY LOG – SUPERIOR SEWAGE LAGOON | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Flow | | | | | | | | | | |
| Date | Avg | Peak | Effluent Data | | | Dissolved Oxygen | | | Parrell or | Comments | Initials |
| | Flow | Flow | BOD | TSS | FECAL # | Cell 1 | Cell 2 | Cell 3 | Series Flow? | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Note: Record flow as an average daily or peak daily flow in terms of gallons per day | | | | | | | | | | | |

| Self-Check -1 | Written Test |
|---|---|

Direction I: Multiple choice item (2 points each)

Instruction: choose the best answer for the following questions and write your answer on the answer sheet provided in the next page:

1. Know the locations of emergency equipment and how to use
   A. Telephones
   B. Emergency Guide
   C. First-aid kit
   D. All
2. Be aware of electrical hazards from the following except
   A. Keep electrical panels clearly visible and unobstructed.
   B. Mount multi-plug adaptors a few inches off the floor to avoid possible water damage.
   C. use multi-plug adaptors in series.
   D. Replace any damaged or frayed electrical cords immediately
3. Maintain chemical usage based on the following activities except
   A. Keep the work area clean and uncluttered
   B. Never play practical jokes or engage in horseplay
   C. Always use adequate safety measures and never leave the following unattended
   D. Keep electrical panels clearly visible and unobstructed.
4. The main routine maintenance actives are
   A. Removal of screenings and grit from the preliminary treatment units
   B. Periodically cutting the grass on the pond embankments
   C. Removal of any material blocking the pond inlets and outlets
   D. Repair of any damage to fences and gates.
   E. all

***Note:*** **Satisfactory rating – 4 and above points** **Unsatisfactory - below 4 points**

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

## Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

**Answer Questions**

1. _____
2. _____
3. _____
4. _____

| Information Sheet-2 | Reporting observations outside defined parameters for further action. |
|---|---|

## 2.1. Introduction to report writing for observations

First, you record your observations of a particular setting or situation that is, take field notes. Next, you interpret those notes according to relevant criteria. Finally, you write a well-organized paper that presents your observations and interpretations, usually with the aim of answering a problem.

Reporting accurate findings in a timely manner is one of the key indicators of a successful observation effort. Without effective reporting, an observer group does not meet its commitment to provide an impartial assessment of the election process to the public. Only by providing this critical information does a group meet its responsibility to citizens. When planning your observation effort, it is important to consider your public information strategy. In particular, how will your group communicate its findings to the outside world? Designing a public information strategy from the beginning will help to ensure that your group has a consistent approach for reporting throughout its project activities. Here are some key issues to consider:

The quality and accuracy of your reporting relies on the data that is collected by observers around the country. While data collection is often associated with Election Day observation, it is just as necessary for pre-election observation and reporting. It is important to have a clear system in place for the collection of data that quickly and accurately transmits information to the central office. The design of your system will have to take many factors into account including the size of the country, quality of infrastructure and number of observers, etc. Building and maintaining a system will be one of the main challenges of your observation effort and an indicator of the efficiency of your organization. What are the necessary components of an effective data collection system?

## 2.2. Good Statement Writing

- **Do's:**

✓ Statements should be brief, but should contain necessary facts to support conclusions.

✓ Pay attention to language.

✓ Quantify your observations. Be specific about how many cases or in how many districts a violation

✓ was observed. Was this an anomaly or a general pattern? Was it isolated to a particular region, or observed across the country?

✓ Highlight positive aspects and best practices from the election process.

- ✓ Reference to international and regional standards make statements stronger.
- ✓ Recommendations can initially be made in a preliminary statement, and elaborated in the final report.
- ✓ Next steps of the observer group should be announced in the report.

- **Don't**:

- ✓ Do not exaggerate -
- ✓ Avoid inflammatory language, it may undercut your credibility and could incite tensions.
- ✓ Do not include any hearsay – all findings must be observed and verified by the observer group.
- ✓ Avoid presenting observations and conclusions in a manner that could be understood as biased or unbalanced. Your credibility rests on objective reporting.
- ✓ Do not jump to conclusions – ensure that all your assessments and conclusions are based on observed findings and give detailed examples when relevant.
- ✓ Do not distort statistics. When using statistics in reports, make sure that you are presenting them in a straightforward manner that does not mislead the reader.

| Self-Check 2 | Written Test |
|---|---|

Direction I: Multiple choice item (3 points each)

Instruction: choose the best answer for the following questions and write your answer on the answer sheet provided in the next page:

1. Reporting accurate findings in a timely manner is one of the key indicators of a successful observation effort
   A. True B. False
2. Good Statement Writing do
   A. Statements should be brief, but should contain necessary facts to support conclusions.
   B. Pay attention to language
   C. Highlight positive aspects and best practices from the election process
   D. All
3. When writing good reporting you should be avoid
   A. Do not exaggerate
   B. Avoid inflammatory language, it may undercut your credibility and could incite tensions.
   C. Do include any hearsay
   D. Avoid presenting observations and conclusions in a manner that could be understood as biased or unbalanced.

***Note:*** **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 5 points**

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

**Answer Sheet**

Score = _____

Rating: _____

Name: _____ Date: _____

**Answer Questions**

1. _____
2. _____
3. _____

| Operation sheet_1 | Procedure for essential report writing stages |
|---|---|

**Steps for Writing the report**

Step 1. Decide on the 'Terms of reference'

Step 2. Decide on the procedure

Step 3. Find the information

Step 4. Decide on the structure

Step 5. Draft the first part of your report

Step 6. Analyse your findings and draw conclusions

Step 7. Make recommendations

Step 8. Draft the executive summary and table of contents.

| LAP Test | Practical Demonstration |
|---|---|

Name: _____ Date: _____

Time started: _____ Time finished: _____

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within _____hours.

**Task1.** Write maintains activity result report to your department

## List of Reference Materials


1. "Guidance on Safe Storage of Chemicals in Laboratories" (PDF).
2. "Safe Storage of Hazardous Chemicals in Stockrooms, Workshops and Laboratories" (PDF).
3. ^ "STORING CHEMICALS IN THE LABORATORY". chemistry.umeche.maine.edu. Retrieved 2018-02-23.
4. ^ Jump up to:[a] [b] Chemical Inspection & Regulation Service. "The UN Globally Harmonized System of Classification and Labeling of Chemicals (GHS)". Retrieved 22 February 2018.^ "Chemical storage"
5. American Water Works Association Committee on Aeration (1975). 'Aeration of water'. 1n: Journal American Water Works Association, vol.47, no 5, p. 873-893.
6. APHA. 1992. Standard methods for the examination of water and wastewater. 18th ed. American Public Health Association, Washington, DC.
7. COMPREHENSIVE MANUAL OF PORT RECEPTION FACILITIES, International Maritime Organization, London, 1995
8. Guideline for the Inspection of Wastewater Treatment Works (2009)
9. GUIDELINES FOR DRINKING WATER QUALITY, Volume 1, Recommendations, World Health Organization, Geneva, 1984.
10. GUIDELINES FOR DRINKING WATER QUALITY, Volume 2, Health Criteria and Other Supporting Information, World Health Organization, Geneva, 1984.
11. GUIDELINES FOR DRINKING WATER QUALITY, Volume 3, Water Quality Control in Small-Community Supplies, World Health Organization, Geneva, 1984.
12. MARPOL-HOW TO DO IT, Manual on the practical implications of ratifying and implementing Marpol 73/78, International Maritime Organization, London, 1993.
13. Occupational Health and Safety Service. "Safe storage of hazardous chemicals in stockrooms, workshops and laboratories"
14. TRAINING MANUAL for OPERATORS of WASTEWATER STABILIZATION LAGOONS(2010)
15. WASTE WATER ENGINEERING, TREATMENT, DISPOSAL AND REUSE, Metcalf and Eddy, McGraw-Hill 1991.
16. Wastewater System Operation and Maintenance Guideline(2018)
17. Waste water lagoon sludge removal process video and other related video

    https://www.youtube.com/watch?v=YwsPrtQP-4Y

https://www.youtube.com/watch?v=BJg0skm4xW8

https://www.youtube.com/watch?v=CjwmjiFSW8Q

https://www.youtube.com/watch?v=Tt0wAmTDVgA

https://www.youtube.com/watch?v=YctXi9jDK8U

https://www.youtube.com/watch?v=P2R4v3AjAnk

https://www.youtube.com/watch?v=Z8Oq-pRdfmU

http://www.ccohs.ca/oshanswers/prevention/toxic_safe.html

http://www.ccohs.ca/oshanswers/prevention/toxic_safe.html

http://chemical-safety.com/documents/pdf/GENERALRULES.pdf

http://www.ccohs.ca/oshanswers/prevention/toxic_safe.html

http://ehsdailyadvisor.blr.com/2012/04/11-rules-for-safe-handling-of-hazardous-materials/