Ethiopian TVET-System

Water Supply and Sanitation Supervision

Level-IV

Based on Feb, 2017G.C. Occupational Standard

Module Title: Assessing and optimizing Treatment process of Sedimentation and Granular Media Filtration

TTLM Code: EIS WSO4 TTLM 09 20v1

September,2020

This Module includes the following Learning Guides

LG 53: Plan and prepare for work

LG Code: EIS WSO4 M 13 LO1-LG-53

LG 54: Investigate, Operate and control process

LG Code: EIS WSO4 M 13 LO2-LG-54

LG 55: Investigate the operational options for process optimization

LG Code: EIS WSO4 M 13 LO3-LG-55

LG 56: Complete documentation

LG Code: EIS WSO4 M 13 LO4-LG-56

Instruction Sheet	LG 53: 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 relevant to organizational or legislative requirements.
- Selecting and checking equipment 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 relevant to organizational or legislative requirements.
- Select and check equipment 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". Try to understand what are being discussed.
4. Accomplish the "Self-checks 1,2, and 3" in each information sheets on pages 12, 17, and 20.
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. After You accomplish each self-check, ensure you have a formative assessment and get a satisfactory result; then proceed to the next LG.

1.1. Introduction to Preparing a Work Plan

Keep in mind that not all work requires extensive planning. For some routine tasks, it can be enough to just think for a moment before you start. For example, imagine your overall task is to clean your entire house. You may want to make a plan on how to approach that, when to take breaks and so on. But when it comes to a task like unloading the dishwasher, there's probably no benefit in planning out how to complete this job; it's straightforward enough that you'll waste more time making the plan than it will actually take to complete it. Some work tasks are like this: simple, straightforward and likely repetitive. Planning is most effective and most efficient when applied to larger, more complex and/or longer-term projects.

1.1.1. Project Planning Steps

Remember, plans are the first step in a cycle that helps successfully execute a strategy and meet goals:

1. Planning
2. Execution
3. Evaluation
4. Suggestion

In the planning stage, goals are identified and steps to meet those goals are constructed. The execution stage is where the work is completed according to the plan. In the evaluation stage, the results are examined to determine whether or not they met the goals while remaining within the constraints set up by the plan.

The suggestion stage is an iteration or a repeat, where suggestions for changes are made based on the evaluation; these suggestions then lead into the next planning session for the next year, problem or project. Thus, each iteration of planning can be improved by taking lessons learned from previous work and applying them to your current planning strategy.

1.1.2. Work Plan Basics

There are a couple of different types of planning used in the workplace, and they all take slightly different skill sets to develop. The names are somewhat interchangeable, but for the sake of explanation can be categorized as such:

- **Personal work plan:** This is a plan based on the employee's responsibilities over time and how they intend to meet said expectations; it's focused on the employee, usually over a longer period (six months to one year), and should involve activities that give them all the training they need to meet the set of tasks included in their plan.
- **Daily work plan:** This plan helps the employee manage their day-to-day work. These types of plans are most important for jobs that have long-term projects but are also required to respond to daily upsets; the plan should help the employee prioritize their work when changes occur.
- **Project plan:** This is a well-developed type of plan that outlines the tasks required to successfully execute and complete a specific project. The desired endpoint is defined, and the internal steps required to get to that point are broken down and scheduled as needed.
- **Action plan:** This is similar to a project plan, but is usually used to address an existing problem; project plans are usually proactive, whereas action plans tend to be reactive. These plans spell out the steps to take to resolve an issue that has occurred in the workplace.

1.1.3. Project Plan Document Ideas

The difference between these types of plans although, again, different organizations will use different nomenclature are mostly in the initiating event and in the endpoint; different types of paths will require different types of planning to be effective.

- **Personal Work Planning:** These work plans are used to manage the tasks and workflow on an individual's desk over a longer period of time. They are often integrated with the performance review process, setting out performance expectations over the next six months to one year with the company, and address specific tasks and projects to be completed as well as development goals and skill competencies to be developed. In order to successfully create a personal work plan:
  - ✓ Understand the daily tasks on an individual's plate and the percentage of their time they should spend on these daily tasks;

- ✓ Identify the long-term projects the individual is responsible for, the time period for delivery and what a successful execution looks like;
- ✓ Highlight any technical or interpersonal competencies the individual will need to complete this work, and describe how these relate to their specific position;
- ✓ Include trainings, development opportunities and expectations for "outside the box" work not included in the above categories;
- ✓ Estimate the priorities of all of this work, and/or the percentage of the employee's time that should be spent on each task/type.

These types of plans can be initiated by the employee, the manager or can be developed in a conversation between the two. Again, as these plans usually overlap with the development of performance expectations, they're often updated annually or bi-annually.

- **Daily Work Planning:** A daily work plan is a set of ongoing tasks and responsibilities an employee is expected to perform daily or weekly, and a tool this individual can use to manage this work and prioritize their tasks. Some teammates take time each morning to make their daily plan; others have an established routine they follow and only adjust plans when there are deviations. For example, an accountant might have to execute a set of transactions and reports daily, be able to respond to emergency inquiries immediately and also work on long-term projects to develop their accounting software. Having a general daily work plan helps the individual prioritize their work and ensures they're meeting expectations. Things to keep in mind when making a daily or weekly work plan:
  - ✓ Discuss priorities with management to make sure everyone is on the same page. In some roles, it's the daily tasks that are the most important; in others, emergency or unexpected requests have to take precedence.
  - ✓ Don't forget about the long-term projects; it's easy to get overwhelmed by day-to-day tasks and requests. Make sure to set time aside daily or weekly to make progress on less immediate assignments.
  - ✓ Daily tasks eventually become automatic; find a method that will ensure everything gets done, because it's easy to forget one or two things on a bad day. Consider task lists, checkboxes or automation to help.

- ✓ When in doubt, confirm with your manager that you're prioritizing the right types of work. It's also easy for these types of positions to become overloaded with work such that long-term assignments slip; be sure to bring that up with management as soon as possible.

1.1.4. **Project Planning**

Project planning is a thoroughly studied field in today's business landscape. The key to project planning is identification: identifying the endpoint (project goal), the starting point (current status) and the constraints (time, resources and scope). Project plans are different than the previously discussed types of plans, as they are specifically dedicated to one overarching task or goal, and have an endpoint that produces an output, rather than a collection of responsibilities for an individual. They're also proactive: the planning is done once an endpoint is defined, but before anything actually happens. While project planning methods vary, they all generally follow the same set of steps:

- ✓ First, define the scope of the project. This requires a good understanding of the project's endpoint; the scope is a description of the things that will define project success, as well as identification of anything not included inside this project's plan.
- ✓ Next, define the constraints. These are usually time (what's the project deadline?), money (what's the budget?), resources (how many people are on the project team?) and a capture of the scope (how many things need to be done)?
- ✓ Outline, on a high level, the steps that need to be taken to move from the starting point to the endpoint. Then, take time to further break down each step into a set of tasks to be completed.
- ✓ Estimate timing for these tasks, such that the project will be done by its deadline, and assign individuals who will be responsible for these tasks.
- ✓ Don't forget to include "post-live" steps like training, documentation updates and record-keeping to the overall timing and scope. These pieces will continue to require resources after the project "appears" finished.

- **Action Planning:** Action planning usually occurs as a response to something a mistake, a shutdown, an incident where the outcome is negative and needs correction. As such, these plans are usually *reactive,* as they're addressing an issue that has already happened, rather than meeting a goal yet to be reached.

The key to a reactive action plan is to ensure enough data is gathered that the suggestions will, in fact, correct the true cause of the problem, rather than addressing some surface issue.

To create a proper action response plan, be sure to keep these things in mind:

- ✓ Investigate the incident fully; keep records on the environment, what happened that day and who was involved. Talk to multiple employees to get different angles on the situation.
- ✓ Perform a *root cause analysis* on the situation: this type of analysis looks at something that has happened and continues to ask "why?" to drill down into the details of a problem. For example, if an employee made a mistake, a root cause analysis can reveal whether the training is inadequate, if the systems had an internal failure or if the employee couldn't distinguish between two options. All of these will have different solutions. Situations can also have multiple root causes that will require action.
- ✓ Create a list of corrective actions to take to adjust the behavior, incident or situation that initiated the planning. Assign individuals who will take responsibility for these tasks, and assign relative due dates, as well as someone who will check in to ensure this work is completed.
- ✓ Gather the team together after a time period (a few months) and evaluate whether the changes that were made have actually fixed the problem, or if additional actions need to be taken.

1.1.5. How to Write a Work Plan

A work plan is an outline of a set of goals and processes by which a team and/or person can accomplish those goals, and offering the reader a better understanding of the scope of the project. Work plans, whether used in professional or academic life, help you stay organized while working on projects. Through work plans, you break down a process into small, achievable tasks and identify the things you want to accomplish. Learn how to write a work plan so that you can be prepared for upcoming projects.

Method -1: Mapping out Your Work Plan

1. **Identify the purpose for your work plan**: Work plans are written for various reasons. Determine the purpose up front so you can prepare properly. Keep in mind that most work plans are for a certain period of time (i.e., 6 months or 1 year).
   In the workplace, work plans help your supervisor know what projects you will be working on over the next several months. These often come right after an annual performance review or as teams undertake large projects. Work plans can also be the result of strategic planning sessions your organization holds at the beginning of a new calendar or fiscal year.

In the academic world, work plans can help students create a schedule for a large project. They can also help teachers plan their course material for the semester. For a personal project, work plans will help you delineate what you intend to do, how you intend to do it, and by what date you intend to have it done. Personal work plans, while not strictly necessary, will help the individual keep track of his/her goals and progress.

2. **Write the introduction and background:** For professional work plans, you may have to write an introduction and background. These provide your supervisor or manager with the information they need to put your work plan into context. Writing an introduction and background is often unnecessary for an academic work plan.

The introduction should be short and engaging. Remind your superiors why you are creating this work plan. Introduce the specific project(s) you will be working on during this time period.

The background should highlight the reasons you are creating this work plan. For example, recite details or statistics from recent reports, identify problems that need to be addressed, or build off of recommendations or feedback you received during previous work projects.

3. **Determine your goal(s) and objectives:** Goals and objectives are related in that they both point to things you hope to accomplish through your work plan. However, remember the differences, too; goals are general and objectives are more specific.

Goals should focus on the big picture of your project. List the desired ultimate outcome of your work plan. Keep it broad; for example, make your goal be to complete a research paper or to learn more about writing.

Objectives should be specific and tangible. In other words, you should be able to check these off your list when you accomplish them. For example, finding people to interview for your research paper would make a good objective.

Many work plans break down objectives into short-, middle-, and long-term objectives if they vary significantly. For example, a company's short-term goal to increase viewership 30% in three months may vary significantly from its long-term goal to strengthen brand visibility in social media outlets over the next year.

Objectives are generally written in the active voice and use action verbs with specific meanings (e.g. "plan," "write," "increase," and "measure") instead of verbs with vaguer meanings (e.g. "examine," "understand," "know," etc.).

4. **Consider ordering your work plan by "SMART" objectives**: SMART is an acronym used by individuals searching for more tangible, actionable outcomes in work plans.

Specific.

- ✓ What exactly are we going to do for whom?
- ✓ Lay out what population you are going to serve and any specific actions you will use to help that population.
- ✓ Measurable. Is it quantifiable and can we measure it?
- ✓ Can you count the results?
- ✓ Did you structure the work plan so that "health in South Africa would increase in 2020?" or did you structure it so that "cases of HIV/AIDS in newborn South African babies would decrease 20% by 2020?"

Remember that a baseline number needs to be established to quantify change. If you don't know the incidence rate of HIV/AIDS among South African newborns, it's going to be impossible to reliably say that you decreased incidence rates by 20%.

Achievable. Can we get it done in the time allotted with the resources we have available? The objective needs to be realistic given the constraints. Increasing sales by 500% is reasonable only if you're a small company. Increasing sales by 500% if you dominate the market is near impossible.

In some cases, an expert or authority may need to be consulted to figure out if your work plan objectives are achievable.

Relevant. Will this objective have an effect on the desired goal or strategy? Although it's probably important for overall health, does measuring the height and weight of high-schoolers directly lead to change in mental health procedures? Make sure your objectives and methods have a clear, intuitive relationship.

Time bound. When will this objective be accomplished, and/or when will we know we are done? Specify a hard end date for the project. Stipulate which, if any, outcomes would cause your project to come to a premature end, with all outcomes having been achieved.

5. **List your resources.** Include anything that will be necessary for you to achieve your goals and objectives**:** Resources will vary, depending on the purpose of your work plan. At the workplace, resources can include things like financial budget, personnel, consultants, buildings or rooms, and books. A detailed budget may appear in an appendix if your work plan is more formal.

In the academic arena, resources may include access to different libraries; research materials like books, newspapers, and journals; computer and Internet access; and professors or other individuals who can help you if you have questions.

6. **Identify any constraints:** Constraints are obstacles that may get in the way of achieving your goals and objectives. For example, if you are working on a research paper for school, you may find that your schedule is too crowded to allow you to research and write properly. Therefore, a constraint would be your overwhelming schedule, and you would need to cut something out during the semester in order to complete your work plan effectively. (Planning is needed if you are taking more than one hard class per-semester).
7. **Who is accountable:**
   - ✓ Accountability is essential for a good plan?
   - ✓ Who is responsible for completing each task?

   There can be a team of people working on a task (see resources) but one person has to be answerable to a task being completed on time.
8. **Write your strategy:** Look over your work plan and decide how you will use your resources and overcome your constraints in order to reach your goals and objectives.

List specific action steps. Identify what needs to happen each day or week for you to complete your objectives. Also, list steps other people on your team will need to take.

Consider using project management software or a personal calendar to keep this information organized.

Create a schedule. Though you can create a tentative work schedule, realize that unexpected things happen and you need to build space into your schedule to prevent falling behind.

Self-Check -1	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. ____ are the third step in a cycle that helps successfully execute a strategy and meet goals.

A. Planning
B. Execution
C. Evaluation
D. Suggestion

2. Among different types of planning used in the workplace, _____helps the employee manage their day-to-day activity.

A. Personal work plan
B. Daily work plan
C. Project plan
D. Action plan

3. _______is an acronym used by individuals searching for more tangible, actionable outcomes in work plans.

A. Identify the purpose for your work plan
B. Write the introduction and background
C. Consider ordering your work plan by "SMART" objectives
D. Determine your goal(s) and objectives

4. In SMART _____is the relevant question that more tangible, actionable outcomes in work plans.

A. What exactly are we going to do for whom?
B. Measurable. Is it quantifiable and can we measure it?
C. Can you count the results?
D. Did you structure the work plan?
E. All are answers

5. To create a proper action response plan, be sure to keep these things in mind. One is not applicable from the list?

A. Investigate the incident fully;
B. Perform a *root cause analysis* on the situation
C. Create a list of corrective actions
D. Gather the team together before a time period

Note: **Satisfactory rating ≥5 points** **Unsatisfactory <5 points**

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

Answer Sheet-1

Name: ____________________ Date: _______________

Score: ___________
Rating: ____________

Choice Questions

1.________ 2. _______ 3. _______4. _______5. __________

Information Sheet-2	Selecting and checking equipment to meet safety requirements of task and site

2.1. Selecting and checking work equipments

In all types of workplaces, there are different types of equipment and machinery that we use to carry out everyday tasks. All work equipment has the potential to cause problems in the workplace, so you need to ensure that it remains safe to use and that you're not putting employees at risk.

2.1.1. work equipment

Work equipment is any equipment used at work, such as:

- **lifting equipment** – including fork-lift trucks, vehicle hoists and lifting slings;
- **hand tools** – including hammers, chisels, screwdrivers and saws;
- **transport equipment** – including vans and forklift trucks;
- **display screen equipment (DSE)** – including computer displays and work stations.

In addition, workplace equipment can include:

- **respiratory protective equipment (RPE)**: respirators and breathing apparatus;
- **personal protective equipment (PPE)**: safety footwear, hard hats, goggles and respirators.

2.1.2. Legal duties around work equipment

If you own, operate or have control over work equipment, you need to ensure it is fit for purpose, and is being used safely and effectively under the Provision and Use of Work Equipment Regulations 1998 (PUWER).PUWER requires that work equipment is safe for use, used in accordance with requirements and is only used by employees who have been trained to use it.

2.1.3. Safe work equipments

There are a number of measures you can take to ensure that risks created by work equipment are eliminated or controlled, including:

- selecting suitable equipment and maintaining it properly;
- carrying out a risk assessment to identify any risks presented by work equipment;
- following the manufacturers' instructions for use and maintenance;
- ensuring a robust system of defective fault reporting is in place, and that employees use this system.

2.1.4. Personal protective equipment (PPE)

Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to a variety of hazards. Examples of PPE include such items as gloves, foot and eye protection, protective hearing devices (earplugs, muffs) hard hats, respirators and full body suits.

Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. Personal protective equipment may include items such as gloves, safety glasses and shoes, earplugs or muffs, hard hats, respirators, or coveralls, vests and full body suits.

2.1.5. Ensure proper use of personal protective equipments

All personal protective equipment should be safely designed and constructed, and should be maintained in a clean and reliable fashion. It should fit comfortably, encouraging worker use. If the personal protective equipment does not fit properly, it can make the difference between being safely covered or dangerously exposed. When engineering, work practice, and administrative controls are not feasible or do not provide sufficient protection, employers must provide personal protective equipment to their workers and ensure its proper use. Employers are also required to train each worker required to use personal protective equipment to know:

- When it is necessary
- What kind is necessary
- How to properly put it on, adjust, wear and take it off
- The limitations of the equipment
- Proper care, maintenance, useful life, and disposal of the equipment

If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness.

Table 1: Equipment checklist

Equipment	✓
Single or multi-parameter water quality instrument	
Field data sheets, notebook or field computer	
Labelling equipment (e.g. stickers and/or permanent markers)	
Personal Protective Equipment (PPE): • Safety boots, high visibility vest, long pants, long-sleeved shirt, hardhat (industrial sites); • Waders, gumboots, broad-brimmed hat or similar PPE (shore-based sampling).	
Gloves - non-powdered latex free (e.g. nitrile) corresponding to the chemical risk	
Clean collection containers as provided by the analytical laboratory	
Clean sediment sampling equipment* for collection of surficial layers (<10cm depth): • stainless steel (organics or metals) or plastic (HDPE or PTFE for ultra-trace metals) trowel for dry sediments or for exposed littoral sediments (tidal flats); • stainless steel benthic grab sampling equipment (e.g. Ponar or Van Veen) grab sampler for deployment from a boat or jetty.	
Clean hand corer for sediment profiling	
Clean stainless steel sieve (10mm) for removal of stones, plant material or fauna	
Cool-box with ice bricks or portable refrigerator	

Self-Check -2	Written Test

Direction I: Matching Items of A with Items of B for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

A	B
1. lifting equipment	A. hammers
2. hand tools	B. lift trucks
3. display screen equipment	C. forklift trucks
4. transport equipment	D. work stations
5. respiratory protective equipment	E. goggles
6. personal protective equipment	F. breathing apparatus
	G. lungs

Note: **Satisfactory rating ≥3 points** **Unsatisfactory <3 points**

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

Answer Sheet-2

Name: ___________________________ Date: ________________

Matching Questions

1_______ 2. ______ 3______4. ______5. _______

6. ______ 7. __________8_______ 9. ______ 10______

Score = ____________

Rating: _____________

3.1. Introduction to Personal protective equipments

When the selection has been made, the “fitting” component should be put in place. The key is to fit each worker with PPE on an individual basis. At the time of fitting, show each worker how to wear and maintain PPE properly.

In some cases, individual fitting programs should be carried out by qualified personnel. For example, for eye protection this qualified person could be an optometrist, an optician, a manufacturers' representative or a specially trained staff member, such as a nurse.

Eye wear should cover from the eyebrow to the cheekbone, and across from the nose to the boney area on the outside of the face and eyes. When eye wear/glasses sit halfway down the nose, protection from the hazard of flying particles is reduced, sometimes to the point where no protection is given. The calculated degree of protection will not be achieved in practice unless the PPE is worn properly at all times when the worker is at risk.

3.1.1. Important PPE

Making the workplace safe includes providing instructions, procedures, training and supervision to encourage people to work safely and responsibly.

Even where engineering controls and safe systems of work have been applied, some hazards might remain. These include injuries to:

- ✓ The lungs, eg from breathing in contaminated air
- ✓ The head and feet, eg from falling materials
- ✓ The eyes, eg from flying particles or splashes of corrosive liquids
- ✓ The skin, eg from contact with corrosive materials
- ✓ The body, eg from extremes of heat or cold
- ✓ Ppe is needed in these cases to reduce the risk

3.1.2. Selection and use of PPE

You should ask yourself the following questions:

- ✓ Who is exposed and to what?
- ✓ How long are they exposed for?
- ✓ How much are they exposed to?

- **When selecting and using PPE**
  - ✓ Choose products which are CE marked in accordance with the Personal Protective Equipment (Enforcement) Regulations 2018 – suppliers can advise you
  - ✓ Choose equipment that suits the user – consider the size, fit and weight of the PPE. If the users help choose it, they will be more likely to use it
  - ✓ If more than one item of PPE is worn at the same time, make sure they can be used together, eg wearing safety glasses may disturb the seal of a respirator, causing air leaks
  - ✓ Instruct and train people how to use it, eg train people to remove gloves without contaminating their skin. Tell them why it is needed, when to use it and what its limitations are

3.1.3. Emergency equipment

Careful selection, maintenance and regular and realistic operator training is needed for equipment for use in emergencies, like compressed-air escape breathing apparatus, respirators and safety ropes or harnesses.

- ❖ https://www.youtube.com/watch?v=ZDbNLbhld8M
- ❖ https://www.youtube.com/watch?v=qayTdbC7av0

Self-Check -3	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. When the selection has been made, the "fitting" component should be put in place. A. True B. False
2. In some cases, individual fitting programs should not be carried out by qualified personnel. A. True B. False
3. where engineering controls and safe systems of work have been applied, some hazards might remain. A. True B. False
4. Careful selection, maintenance and regular and realistic operator training is not needed for equipment for use in emergencies.
   A. True B. False
5. Making the workplace safe includes providing instructions, procedures, training and supervision to encourage people to work safely and responsibly.
   A. True B. False

***Note:* Satisfactory rating ≥2.5 points** **Unsatisfactory <2.5 points**

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

Answer Sheet-3

Name: ___________________________ Date: ________________

Choose Questions

Score = ____________

Rating: _____________

1.______2. ______3_____4. ______5_____

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

- Carrying out routine inspection and Existing fault reports on assets and reviewing other relevant plant asset information.
- Collecting process samples from sedimentation, clarification and final filtrate.
- Carrying out routine tests from sedimentation, clarification and final filtrate.
- Preparing samples for laboratory testing from sedimentation, clarification and final filtrate.
- Identifying and reporting process faults and operational condition of assets.
- Carrying out basic **processes** adjustments to enhance process performance.
- Monitoring processes to maintain parameters of operation.
- reviewing existing fault reports and other relevant plant asset information.
- investigating the operational status of ***plant components*** with reference to manufacturers' and plant designers' specifications.

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 inspection and Existing fault reports on assets and reviewing other relevant plant asset information.
- Collect process samples from sedimentation, clarification and final filtrate.
- Carry out routine tests from sedimentation, clarification and final filtrate.
- Prepare samples for laboratory testing from sedimentation, clarification and final filtrate.
- Identify and reporting process faults and operational condition of assets.
- Carry out basic **processes** adjustments to enhance process performance.
- Monitor processes to maintain parameters of operation.
- Review existing fault reports and other relevant plant asset information.
- Investigate the operational status of ***plant components*** with reference to manufacturers' and plant designers' specifications.

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- 9". Try to understand what are being discussed.
4. Accomplish the "Self-checks 1,2,3, 4, 5, 6, 7, 8, and 9" in each information sheets on pages 27, 32, 41, 44, 49, 59, 73, 76, and 83.
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- 3" on page 84, 85, and 86.and do the LAP Test-1 on page 887". 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 Test-1, ensure you have a formative assessment and get a satisfactory result; then proceed to the next LG.

Information sheet-1	Carrying out routine inspection and Existing fault reports on assets and reviewing other relevant plant asset information

1.1. Asset inspections

For assets to operate effectively they need to be maintained to a point such that the risk of a fault or failure is eliminated or minimized to their lowest level. This proactive risk-based approach, as opposed to a reactive response or a routine maintenance cycle, can be targeted to specific needs, in turn prioritized by the scale of risk, asset value, refurbishment cost, consequential costs (which may be the highest cost by a significant factor) and current condition.

To understand all of those factors the asset owner would need to include a formal asset appraisal or inspection. It's a process we are very familiar with; right now, we're helping to manage this very process in respect of the Environment Agency's active flood risk assets in flood plain areas like Fogera.

We have the technical experience to know when a routine visual inspection will suffice, and when to move to a more thorough engineering inspection or a specialist investigation perhaps requiring computer modelling to help understand the asset's integrity and predict any potential for failure. These reviews, carried out in conjunction with risk and performance assessments, will help to ensure an efficient management of assets (which we can also undertake) and, thereby, a financial and, at worse, traumatic cost saving for the asset owner.

Straying with flood protection assets as an example, our experience has always been to go beyond the primary asset itself and extend our inspection to the transition elements; for example, the 'join' between a more recently built defense structure and an established flood embankment.

Asset degradation can be brought about by any number of causes (and combination of causes); from extreme weather to vandalism; from animal burrowing to scouring. KGAL's engineers can undertake investigations, at various levels of intensity, to provide asset owners with reliable survey reports.

At a basic level these reports will provide an overview, give constructive feedback to the owner's own maintenance regime and indicate whether the degree of inspection level needs elevating; at the highest level our comprehensive inspection report will identify any repairs to mitigate risk and, if required, the cost of those repairs along with our own submissions in terms of future project management.

1.2. Site supervision

A typical construction site might host workers from up to a dozen different trades, often employed by several different companies, operating to slightly different standards. Add to that the cultural differences of international work and, despite individual best efforts, the group's ability to achieve the over-arching objectives safely, to schedule and within budget, may never be efficiently realized without professional supervision.

With our help your project objectives are more likely to be accomplished. We coordinate resources by managing teams, communications, timing plans and assets (plant and equipment). We use our expert knowledge of projects, practices and procedures to help control work against agreed parameters, legal requirements, building regulations and quality standards, to control costs and site security, to prevent accidents and to protect the environment.

From our experience we know that of all the impacting influences on a project's successful development, three most frequently dominate: the weather, the materials used, and the people.

We can do nothing about the weather. But we can give materials advice and it's why we use our leadership and social skills in managing relationships at all levels: working with people to keep them informed, to monitor welfare and performance, to align them with applicable regulations, to improve motivation and productivity, to help resolve conflicts and enforce best practice for safe working.

Last but not least we put systems in place for regular client reporting (site visits, written reports and formal meetings). We work to a doctrine of 'no surprises' and ensure clients are kept fully informed of potential problems, current progress and the latest forecasts.

1.2.1. Existing fault reports on assets

Asset management is critical to meeting local government strategic goals within an Integrated Planning and Reporting approach. Asset Management Policies, Asset Management Strategies and Asset Management Plans are informed by, and in turn inform, the community aspirations and service requirements in the Strategic Community Plan. They are also integral to developing and delivering the local government's strategic direction and the priority projects and services outlined in the Corporate Business Plan. Asset management ensures that robust Long-Term Financial Plans and Annual Budgets are developed and that local governments have the financial capacity to deliver their strategic priorities into the future.

1.2.2. Report a fault

It is critical that you quickly report any fault that may occur when working on the water or sewerage network, including damaging pipes, hydrants, manholes or meters.

Although incidents are preventable, we understand accidents can happen. The important part is that you talk as soon as possible to report the following details:

- Your exact location
- Sequence of events including date and time
- Potential health and safety risks to public
- Any other useful information

Failing to report faults can cause wide spread water discoloration, outages, bursts, contamination, sewerage blockages or overflows, which significantly impact our community and Icon Water as a business.

1.2.3. How to report a fault

Our customer service team is here to help you. The more information you provide us about the issue, the easier it is for us to help you.

Remember, we're not responsible for plumbing on your private property - for that, you need to call a plumber.

A. **Identify your problem**

To best assist us in helping you, try and identify your service fault from the list below:

- ✓ Is your inspection point clear?
- ✓ Do you know if this has happened before at this property?

We'll take care of any blockages, odours or sewer overflows from the sewer main and connection point. If your inspection point is clear, generally this means the block is coming from your private plumbing and you'll need to contact your plumber.

Your stop tap is located on your water meter and controls the flow of water to your property. If you have a water pressure problem at your property, check your stop tap. If your stop tap will not turn off, is broken or leaking, we will repair it for you.

- ✓ What's the water pressure like in the tap closest to your meter?
- ✓ Is your stop tap turned on?
- ✓ Are you getting any water at all?

If your stop taps or water meter is vandalized or damaged, please get in touch with us and we'll let you know about next steps.

Drinkable water

- ✓ Is the issue with the smell or taste?
- ✓ What colour is your water?

If it's milky white, it's just air from the pipes making it that colour. Let it stand for a few minutes and it will go back to normal.

Untreated water

- ✓ If your water has a strange odour give us a call as we might need to arrange an inspection.
- ✓ How long has the issue existed for?
- ✓ Is the leak large (bubbling or gushing) or small?

B. Provide as much detail as possible

- ✓ Where is the fault? What's the address?
- ✓ Is the fault on the road, nature strip or pipeline?
- ✓ If you're in a rural area, what's the closest town?
- ✓ Can you provide any other details to help us identify the location, such as nearest crossroad or visible landmark?

Timing and duration

- ✓ How long has the problem existed for?
- ✓ When did you first notice it?
- ✓ Does it happen at certain times?

Surrounding area

Have your neighbors been experiencing similar issues?

Self-Check -1	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. During fault reports, some important questions must be arising **except____**.
   A. Your exact location
   B. Sequence of events including date and time
   C. Potential health and safety risks to public
   D. None of the above
2. Reporting untreated water provides some possible details due questioning.
   A. Where is the fault?
   B. What's the address?
   C. Is the fault on the road?
   D. Nature strip or pipeline?
   E. All
3. If your stop tap will not turn off during water meter supervision, we will repair it for you using some questions **except____**.
   A. What's the water pressure like in the tap closest to your meter?
   B. Is your stop tap turned on?
   C. Are you getting any water at all?
   D. Do you have screwdriver?

***Note:* Satisfactory rating ≥1.5 points** **Unsatisfactory <1.5 points**

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

Answer Sheet-1

Name: ___________________________ Date: ________________

Score = ___________

Rating: ____________

Choice Questions

1________ 2. _______ 3_______

2.1. Collecting process samples from sedimentation

In some cases, sediment can be collected directly from the substrate by a diver using SCUBA gear or supplied air. The sediment can be collected directly into the sample container or placed into the container by the diver with a scoop and sealed and composited at the surface.

Sediments can be used to help locate nonpoint, historical, or intermittent discharges that may not be readily apparent using samples collected from the water column. Sediments are used to identify the location of these sources by upstream incremental collection of samples from a contaminated site.

Sediment analysis is primarily based on the recognition of the main sedimentary components, including the identification of heavy minerals and clay minerals for provenance studies. Textural and structural analyses are based on standard routines and techniques used in sedimentology.

Sedimentary processes, namely weathering, erosion, crystallization, deposition, and lithification, create the sedimentary family of rocks.

2.2. Sediment Sampling Methodology

Where possible, sediment should be collected from a depth of 60 cm below the water surface. The sampler should wade into the pond until the desired depth is reached, and then scoop sediments directly into sampling jars, or by using a stainless-steel pan. Three individual samples should be collected at each site. Each sample should then transfer to the mixing pan, stirred into a homogenous mixture, and then placed into three separate, pre-labeled glass jars.

Figure 2.2: sample sediment data collection

2.2.1. Pre-sample Preparations for sediment

In analytical chemistry, sample preparation refers to the ways in which a sample is treated prior to its analyses. Preparation is a very important step in most analytical techniques, because the techniques are often not responsive to the analyte in its in-situ form, or the results are distorted by interfering species.

Sample preparation could involve: crushing and dissolution, chemical digestion with acid or alkali, sample extraction. Treatment is done to prepare the sample into a form ready for analysis by specified analytical equipment. Sample preparation could involve: crushing and dissolution, chemical digestion with acid or alkali, sample extraction, sample clean up and sample pre-concentration.

General Comments. Sample preparation is performed for the specific purpose of modification of the sample to make it amenable for a particular chemical analysis or to improve that analysis.

Treatment is done to prepare the sample into a form ready for analysis by specified analytical equipment. Sample preparation could involve: crushing and dissolution, chemical digestion with acid or alkali, sample extraction, sample clean up and sample pre-concentration.

2.2.1.1. Sediment Sampling Steps

Fill in the "Location Information" box on the Field Data Form (see example field data sheets)Always wear new, clean latex gloves while sampling.

Thoroughly clean all sampling equipment (mixing tray, spoon, etc.) with metals-free soap and de-ionized water prior to sampling at each site. Where analyses require, use chemical solvents such as hexane and acetone to ensure all residues are dissolved from equipment surfaces.

Where possible, pond sediments should be collected from a depth of at least 30 cm below the water surface. The sampler should wade into the pond until the desired depth is reached, and then scoop sediments directly into sampling jars, or by using a stainless-steel pan.

Repeat collection protocol until sufficient sediment volume has been collected to fill the sample jars.

Be sure to record the number of grabs needed at each sample station in the notes section of the field data collection form.

Using the stainless-steel spoon, mix the sediment sample until it is thoroughly combined into a single homogeneous sample in a mixing tray.

Transfer representative subsamples of the homogeneous mixture to the clean sample jars, using the mixing spoon. Fill the jar as full as possible with the sample mixture.

If the samples will be frozen, be sure to leave enough space in the jar to allow for water expansion (otherwise, the jars may break).

Ensure the label on the container includes the sampling site number, date of sampling, type of sample (sediment), name of project, and is securely fastened to the jar. Place clear plastic tape around label to make it water-resistant. Complete a final check to ensure that the data sheet has been completed and that all required samples have been collected and are properly labeled. Immediately place collected sediment samples in a cold, dark cooler.

https://www.youtube.com/watch?v=So17DAsYak8

2.2.2. Collecting process of sediment samples from clarification

Sedimentation and Clarification Sedimentation is the next step in conventional filtration plants. (Direct filtration plants omit this step.) The purpose of sedimentation is to enhance the filtration process by removing particulates. Sedimentation is the process by which suspended particles are removed from the water by means of gravity or separation. In the sedimentation process, the water passes through a relatively quiet and still basin. In these conditions, the floc particles settle to the bottom of the basin, while "clear" water passes out of the basin over an effluent baffle or weir.

A typical rectangular sedimentation basin. The solids collect on the basin bottom and are removed by a mechanical "sludge collection" device. sludge collection device scrapes the solids (sludge) to a collection point within the basin from which it is pumped to disposal or to a sludge treatment process. Sedimentation involves one or more basins, called "clarifiers." Clarifiers are relatively large open tanks that are either circular or rectangular in shape. In properly designed clarifiers, the velocity of the water is reduced so that gravity is the predominant force acting on the water/solid's suspension.

The rate at which a floc particle drops out of the water has to be faster than the rate at which the water flows from the tank's inlet or slow mix end to its outlet or filtration end. The difference in specific gravity between the water and the particles causes the particles to settle to the bottom of the basin. Some plants have added baffles or weirs in their sedimentation basins to limit short-circuiting through the basins, promoting better settling.

Other forms of sedimentation used in the water industry are:

1. Tube and plate settlers;
2. Solids contact clarifiers, sludge blanket clarifiers, and contact clarifiers;
3. Dissolved air flotation.

- ✓ https://www.youtube.com/watch?v=ecZC85ADirs

Self-Check -2	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth two points.

1. In Pre-sampling Preparation procedures for jar test, one is not included.
   A. Identify Sediment Sampling Sites
   B. Prepare sampling jars
   C. Clean Sediment Sampling Equipment
   D. None
2. The difference in specific gravity between the water and the particles causes ____.
   A. the particles to settle to the top of the basin
   B. the particles to settle to the side of the basin
   C. the particles to settle to the bottom of the basin
   D. the particles to settle to the boundary of the basin
3. The reasons adding weirs to plants in their sedimentation basins _____**except.**
   A. to limit short-circuiting through the basins
   B. to promoting better settling
   C. to promoting better settling
   D. to form sedimentation

Note: **Satisfactory rating ≥1.5 points** **Unsatisfactory <1.5 points**

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

Answer Sheet-2

Name: ___________________________ Date: ________________

Choice Questions

1________ 2. ________ 3________

Score = ____________

Rating: _____________

Information-3	Carrying out routine tests from sedimentation, clarification and final filtrate

3.1. Carrying out routine tests of a water

Conducting tests from sedimentation, clarification and final filtrate Testing include:

3.1.1. Turbidity

Turbidity is a measurement of the clarity of water. It is predominantly used for potable water monitoring, although it is occasionally used to assess wastewater treatment processes. Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates.

Clouded water is caused by suspended particles scattering or absorbing the light. Thus, turbidity is an indirect measurement of the amount of suspended matter in the water. However, since solids of different sizes, shapes, and surfaces reflect light differently, turbidity and suspended solids do not correlate well. Turbidity is important in potable water because microorganisms attach to suspended particles.

The more total suspended solids in the water, the darker it seems and the higher the turbidity. Turbidity is considered as a good measure of the quality of water.

The higher the intensity of scattered light, the higher the turbidity. Turbidity is the amount of cloudiness in the water. This can vary from a river full of mud and silt where it would be impossible to see through the water (high).

Figure 3.1.1: Turbidity

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

https://www.youtube.com/watch?v=fOY2qHfBW0w.

3.1.2. True color

Colour and turbidity are two water quality parameters that detract from the appearance of water, making it unpleasing to drink for aesthetic reasons. Colour is organic material that has dissolved into solution, while turbidity consists of tiny particles suspended in the water column. To perform turbidity and colour tests on a given set of water samples and to pH and alkalinity are key water quality parameters in environmental engineering. Chemical water quality parameters.

Fluoride: At least one-color disk test kit is available for fluoride. See the You tube links below:

https://www.youtube.com/watch?v=WpWjGf65V3A

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

3.1.3. Filter run profile

Treated through iron and manganese oxidation, requires filtration to remove floc created by coagulation. Since surface water is subject to run-off and does not undergo if some means of controlling the media carryover is installed.

Conventional treatment processes commonly utilize granular media filters as the filtration system. Various combinations of filter media can be combined to develop the media filtration system. Dual-media filters consist of anthracite and sand; however, monomania (sand), multimedia (garnet, anthracite, and sand), and other media configurations, including the use of granular activated carbon (GAC), are also used in drinking water treatment.

During filtration, the majority of suspended particles are removed in the top portion of the filter media. The filter loading rate, a measure of the filter production per unit area typically expressed in gallons per minute per square foot, typically ranges from 2 to 4 gpm ft^{-2}. The filter loading rate determines the water velocity through the filter bed and can impact the depth to which particles pass through the media.

Filter backwashes dislodge and remove particles trapped within the filter bed to clean the filter media. Filter performance, particularly with regard to particulate contaminants, is often poorest immediately following a backwash while the filter is ripening or reconditioning. After ripening, the filter reaches steady-state operation, and as the concentration of solids in the media increases, the filtration process generally performs better with regard to particulate contaminant removal. Eventually, sufficient solids accumulate on the filter causing filter breakthrough or the filter reaches a point of maximum head loss. In either case, the filter will be taken out of service and backwashed again constituting the end of the filter run.

The filter run time describes the length of time between filter backwashes and is often described by unit filter run volume, measured in gallons per square foot. Unit filter run volume not only gives an indication of filter performance but can also provide insight regarding the effectiveness of the pretreatment process.

The water leaving the sedimentation tank still contains floc particles. The settled water turbidity is generally in the range from 1 to 10 TU with a typical value being 3 TU. In order to reduce this turbidity to 0.3 TU a filtration process is normally used. Water filtration is a process for separating suspended or colloidal impurities from water by passage through a porous medium, usually a bed of sand or other medium. Water fills the pores (open pores) between the sand particles, and the impurities are left behind, either clogged in the open spaces or attached to the sand itself.

There are several methods of classifying filters. One way is to classify them according to the type of medium used such as sand, coal, dual media (coal plus sand) or mixed media (coal, sand and garnet). Another common way to classify the filters is by allowable loading rate. Loading rate is the flow rate of water applied per unit area of the filter. It is the velocity of the water approaching the face of the filter:

$$v_a = \frac{Q}{A_s}$$

v_a = loading rate, $m^3/d.m^2$
Q=flow rate onto filter surface, m^3/d
A_s=surface area of filter, m^2

Based on loading rate, the filters are described as being slow sand filters, rapid sand filters, or high-rate sand filters.

Rapid Filters

These filters have graded (layered) sand within the bed. The sand grain size distribution is selected to optimize the passage of water while minimizing the passage of particulate matter. Rapid sand filters are cleaned in place by forcing water backwards through the sand. This operation is called backwashing. The wash waterflow rate is such that the sand is expanded and the filtered particles are removed from the bed. After back washing, the sand settles back into place. There are different valves which are operated for different operations as described below:

(a) Working of filter

(b) Washing the filter

(c) Running the filtered water to waste

(d) Resuming filtration

Rapid sand filters are the most common type of filter used in water treatment today. Traditionally, rapid sand filters have been designed to operate at a loading rate of 120 m^3 / day. m^2.

In general, the rapid filter characteristics are:

1. Adaptability: It is adopted in case of municipal water supply for colour and turbidity removal and for softening pre-treatment with lime and soda ash.
2. Bacterial removal efficiency: It is 90-99% if properly operated.
3. Turbidity limitation: The rapid sand filter is very efficient in handling a highly turbid water.
4. Colour limitation: It is quite efficient in colour removal
5. Flexibility: The rate of filtration can be varied. But skilled operators are required for these filters to operate the mechanical equipment.

Problem: 1

For a flow of 0.8 m^3/s, how many rapid sand filter boxes of dimensions 10 m x 20 m are needed for a hydraulic loading rate of 110 $m^3/d{\cdot}m^2$? If a dual-media filter with a hydraulic loading rate of 300 $m^3/d{\cdot}m^2$ were built instead of the standard filter mentioned above, how many filter boxes would be required?

Solution

a. For $q = 110\ m^3/d{\cdot}m^2$ and $N = Q/(q\ A)$

$Q = (0.8\ m^3/s)\ (86,400\ s/d) = 69,120\ m^3/d$

$A = (10\ m)\ (20\ m) = 200\ m^2$

Thus, $N = (69,120\ m^3/d)/[(110\ m^3/d{\cdot}m^2)(200\ m^2) = 3.14 \rightarrow$ **4** filters

b. For $q = 300\ m^3/d{\cdot}m^2$ for the same Q and A: $N_1q_1 = N_2q_2$ Or

$N_2 = (N_1q_1)/q_2 = [(3.14)\ (110\ m^3/d{\cdot}m^2)]/300\ m^3/d{\cdot}m^2 = 1.15 \rightarrow$ **2** filters

Problem:2

As part of Urbana new treatment plant, they are going to install rapid sand filters after their sedimentation tank. The design loading rate to the filter is 200 m^3 / day. m^2. How much filter surface area should be provided for their design flow rate of 0.5 m^3 / sec? If the surface area per filter box is to be limited to 50 m^2, how many filter boxes are required.

4. Particle counting

Many particles in water are too small to remove by sedimentation alone. Filtration removes microorganisms and suspended matter from water not receiving sedimentation treatment, or it eliminates precipitated particles and flocs remaining after sedimentation. Filtration was actually developed prior to the discovery of the germ theory by Louis Pasteur in France. The first sand filter beds were constructed in the early 1800s in Great Britain.

Particle removal is accomplished only when the particles make physical contact with the surface of the filter medium. This may be the result of several mechanisms, as shown in Figure 1. Larger particles may be removed by straining. That is, the particle is larger than the pore, so it is trapped. Particles may also be removed by sedimentation as they progress through the filter. Others may be intercepted by and adhere to the surface of the medium due to inertia. Filtration efficiency is greatly increased by destabilization or coagulation of the particles prior to filtration. This reduction in the particle charge increases particle agglomeration and reduces the forces necessary to trap particles within the filter.

5. Head loss

As deposits are formed, the pores become occupied by solids and so the effective porosity decreases, leading to an increase in head loss, if the flow rate is maintained constant. It is not easy to estimate the local change in porosity, since the volume occupied by deposits is uncertain. If particles are deposited singly, fairly compact deposits may form, giving only a slow increase in head loss. However, if deposits have a less dense structure, as expected for fractal flocs then there will be a greater effect on head loss.

Since deposits form preferentially in the upper part of the bed, the clogging can be quite pronounced there and lead to a rapid build-up of head loss. At some point the head loss may become so large that the filter operation has to be terminated and the bed has to be cleaned. Often, particle breakthrough occurs before the head loss limit is reached, but cleaning is necessary in any case. In practice, filters are usually backwashed on a time basis but, should a limiting head loss or filtrate quality be reached, a backwash is initiated automatically.

6. Media expansion rates

Broadly speaking, filter media should possess the following qualities:

1. Coarse enough to retain large quantities of floc,
2. Sufficiently fine particles to prevent passage of suspended solids,
3. Deep enough to allow relatively long filter runs, and
4. Graded to permit backwash cleaning.

These attributes are not a compatible. For example, a very fine sand retains floc, which also tends to shorten the filter run, while for a coarse sand the opposite would be true. Recent trends are toward coarse sands and dual-media beds of anthracite overlying sand so that high rates of filtration can be obtained.

A filter medium is defined by effective size and uniformity coefficient. The effective size is the 10-percentile diameter; that is, 10% by weight of the filter material is less than this diameter. The uniformity coefficient is the ratio of the 60-percentile size to the 10-percentile size. In water treatment, the conventional sand medium has an effective size of 0.45-0.55 mm, a uniformity coefficient less than 1.65, and a bed depth of 24-30 in. For dual-media filters, the top anthracite layer has an effective size of 0.8-1.2 mm, a uniformity coefficient of less than 1.85, thickness of a few inches to two thirds of the total filter thickness of 24-30 in., and is underlain by a sand filter layer as described above. The supporting coarse sand layer between the filter sand and the underlying gravel has an effective size of 0.8-2.0 mm and a uniformity coefficient less than 1.7. The coarsest layer of gravel required is determined by the kind of underdrain and size of openings for passage of filtered and backwash water.

A sand filter bed with a relatively uniform grain size can provide effective filtration throughout its depth. If the grain-size gradation is too great, effective filtering is confined to the upper few inches of sand. This result because the finest sand grains accumulate on the top of the bed during stratification after backwashing. The problem of surface plugging of sand filters led to development of dual-media filters.

A dual-media filter consists of a sand [specific gravity (sg), 2.65] layer topped with a bed of anthracite coal medium (1.4 - 1.6 sg). The coarser anthracite top media layer pores about 20% larger than the sand medium. These openings are capable of adsorbing and trapping particles so that floc carried over in clarified water does not accumulate prematurely on the filter surface and plug the sand filter.

Unconventional filters, are dual-media with coarse anthracite having an effective size of about 1.5 mm and a low uniformity coefficient to provide a greater volume of voids to collect impurities and extend filter runs of highly turbid surface waters and wastewaters. To avoid problems in backwashing, the recommended effective size of the underlying sand medium is 0.75 to 0.90 mm for anthracite densities of 1.45 to 1.65. The use of a single-medium coarse-sand filter is practiced in Europe. For example, sand with a size range of 0.9-1.5 mm and about 1.0 m depth has been used in surface-water treatment plants. These filters are scoured with concurrent air and water at no-fluidizing velocity followed by a brief wash at high velocity with water alone. Triple-media filters comprising anthracite, sand, and garnet layers have been used for many years in the United States. Both dual- and triple-media filters are substantially better than the conventional sand filter in providing longer filter runs with a corresponding reduction in required backwash water. In comparing these two filters, however, the benefit fit of adding a third layer has not been well demonstrated.

7. Solids retention profile

Filter backwashes dislodge and remove particles trapped within the filter bed to clean the filter media. Filter performance, particularly with regard to particulate contaminants, is often poorest immediately following a backwash while the filter is ripening or reconditioning. After ripening, the filter reaches steady-state operation, and as the concentration of solids in the media increases, the filtration process generally performs better with regard to particulate contaminant removal.

Eventually, sufficient solids accumulate on the filter causing filter breakthrough or the filter reaches a point of maximum head loss. In either case, the filter will be taken out of service and backwashed again constituting the end of the filter run.

The filter run time describes the length of time between filter backwashes and is often described by unit filter run volume, measured in gallons per square foot. Unit filter run volume not only gives an indication of filter performance but can also provide insight regarding the effectiveness of the pretreatment process.

Residuals generated by the conventional treatment process include coagulation solids (sludge) and spent backwash. Spent backwash can be recovered and returned to the treatment process to minimize water loss. Process solids (i.e., coagulation sludge and filtered solids) will contain elevated concentrations of contaminants removed during the treatment process. Depending on the source water concentration of a particular contaminant and any disposal limitations, the disposal of process solids may need to be evaluated with respect to state and local waste disposal regulations.

Self-Check -3	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. ______is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates.
   A. Odder
   B. Dissolved oxygen
   C. Turbidity
   D. Filter run profile
2. During filtration, the majority of suspended particles are removed in______.
   7.1. the bottom portion of the filter media
   7.2. the left side of the filter media
   7.3. the medium portion of the filter media
   7.4. the top portion of the filter media
3. There are different valves which are operated for different operations except____.
   A. Working of filter
   B. Washing of the filter
   C. Running the filtered water to waste
   D. Resuming filtration
   E. None of them
4. One of the following is the rapid filter characteristics:
   A. Adaptability
   B. Turbidity limitation
   C. Colour limitation
   D. Flexibility
   E. All are answers

5. As part of Urbana new treatment plant, they are going to install rapid sand filters after their sedimentation tank. The design loading rate to the filter is 300 m^3 / day. m^2. How much filter surface area should be provided for their design flow rate of 1.5 m^3 / sec? If the surface area per filter box is to be limited to 80 m^2, how many filter boxes are required.
   A. 2
   B. 31
   C. 6
   D. 9

Note: **Satisfactory rating ≥2.5 points** **Unsatisfactory <2.5 points**

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

Answer Sheet-3

Name: ___________________________ Date: ________________

Choice Questions

1.________ 2. _______ 3. _______4. _______ 5. ________

Score = ___________

Rating: ____________

Information-4	Preparing samples for laboratory testing from sedimentation, clarification and final filtrate

4.1. Procedure for Preparation of sediment sampling

4.1.1. Preparation for sampling

In some cases, sediment can be collected directly from the substrate by a diver using SCUBA gear or supplied air. The sediment can be collected directly into the sample container or placed into the container by the diver with a scoop and sealed and composited at the surface. Sedimentation is the process of allowing particles in suspension in water to settle out of the suspension under the effect of gravity. Sedimentation is one of several methods for application prior to filtration: other options include dissolved air flotation and some methods of filtration.

A sediment core is a type of sample that captures the stratigraphic layers with depth while preserving the depositional sequence (younger sediments are at the top and older sediments are at the bottom). There are different tools and techniques "Procedure for Handling and Chemical Analysis of Sediment and Water Samples," Technical Report EPA/CE-81-1, prepared by Great Lakes Laboratory, State Procedures for Sediment Samples 3-23 Method 1: Agitation, Filtration 3-23 Method 2: survey of the project area to better define the final sampling program. and types of cores.

There are two main processes operating: compaction: by overlying sediments, involving the close-packing of the individual grains by eliminating the pore space and expulsion of entrapped water. cementation: development of secondary material in the former pore spaces which then binds the sedimentary particles together.

https://www.youtube.com/watch?v=ecZC85ADirs

4.1.2. Post sampling

Sediment samples must be delivered to the laboratory to allow for analyses or tests to be conducted within the prescribed holding and testing times. Holding times will vary depending on the analyses to be performed. Sediment toxicity tests should be commenced as soon as practical after sample collection and two weeks is recommended as a maximum holding time. See Direct toxicity assessments for further information.

Self-Check -4	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth ten points.

1. Write the procedures for preparation of sampling for laboratory (jar) test (10 points).

Note: **Satisfactory rating ≥5 points** **Unsatisfactory <5 points**

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

Answer Sheet-4

Name: ___________________________ Date: ________________

Score = ___________

Rating: ____________

Short answer Question

1. ____
____
____
____
____
____
____
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____
____
____
____
_________________________.

5.1. sedimentation and clarification

5.1.1. Sedimentation

Particles that will settle within a reasonable period of time can be removed in a sedimentation basin (also called clarifier). Sedimentation basins are usually rectangular or circular with either a radial or upward water flow pattern. Regardless of the type of basin, the design can be divided into four zones; inlet, settling, outlet, and sludge storage.

The purpose of the inlet zone is to evenly distribute the flow and suspended particles across the cross section of the settling zone. The inlet zone consists of a series of inlet pipes and baffles placed about 1 m into the tank and extending the full depth of the tank. The outlet zone is designed so as to remove the settled water from the basin without carrying away any of the floc particles.

The first is the particle (floc) settling velocity, v_s. The second is the velocity at which the tank is designed to operate, called the overflow rate, v_0. The easiest way to understand these two concepts is to view a upward-flow sedimentation tank. In this design, the particles fall downward and the water rises vertically. The rate at which the particle is settling downward is the particle-settling velocity, and the velocity of the liquid rising is the overflow rate.

Obviously, if a particle is to be removed from the bottom of the clarifier and not go out in the settled water, then the particle-settling velocity must be greater that the liquid-rise velocity ($v_{s,nu}$ v_0). If v_s, is greater than v_0, one would expect 100 percent particle removal, and if v_s is less than v_0, one would expect 0 percent removal. In design, the procedure would be to determine the particle-settling velocity and set the overflow rate at some lower value. Often v_0 is set at 50 to 70 percent of v_s for an up-flow clarifier.

Let us now consider why the liquid-rise velocity is called an overflow rate and what its units are. The term overflow rate is used since the water is flowing over the top of the tank into the weir system. It is sometimes referred to all the surface-loading rate because it has units of m^3 / day. m^2. The units are flow of water (m^3 / day) being applied to a m2 of tank surface area per day, which is similar to loading rate. Recall from:

$$v = \frac{Q}{A_c}$$

v = water velocity, m/s
Q= water flow, m^3/s
A_c= cross-sectional area m^2

that the velocity of flow is equal to the flow rate divided by the area through which itflows, hence an overflow rate is the same as a liquid velocity:

$$v_0 = \frac{Volume/Time}{Surface\ Area} = \frac{(Depth)(Surface\ area)}{(Time)(Surface\ area)} = \frac{Depth}{Time} = liquid\ velocity$$

$$v_0 = \frac{\forall / t_0}{A_s} = \frac{(h)(A_s)}{(t_0)(A_s)} = \frac{h}{t_0}$$

As long as v_s is greater than v_0, the particles will settle downward and be removed from the bottom of the tank regardless of the depth. The percentage of particles removed, P, with a settling velocity of v_s in a sedimentation tank designed with an overflow rate of v_0 is:

$$P = 100 \frac{v_s}{v_0}$$

Problem 1

The town of San Jose has an existing horizontal-flow sedimentation tank with an overflow rate of 17 m^3 / day. m^2, and it wishes to remove particles that have settling velocities of 0.1 mm / sec, 0.2 mm / sec and 1 mm / sec. What percentage of removal should be expected for each particle in an ideal sedimentation tank?

Problem 2

Determine the surface area of a settling tank for the city of Urbana's 0.5 m^3 / sec design flow with design overflow rate of 32.5 m^3 / day. m^2. Compare this surface area with that which results from assuming a typical overflow rate of 20 m^3 / day. m^2. Find the depth of the clarifier using detention time of 95 minutes.

5.1.2. Clarification

Clarification of wastewater through the process of sedimentation is the separation of suspended solids by gravitational settling. The sedimentation process is used in primary settling basins, removal of chemically treated solids, and solids concentration. Sedimentation basins perform the two-fold function of producing both a clarified water product, and a concentrated slurry (sludge) product.

Two distinct forms of sedimentation vessels are in common use. The clarifier is used, as the name suggests, for the clarification of a dilute suspension to obtain water containing minimal suspended solids, while producing a concentrated sludge. A thickener is used to thicken a suspension to produce an underflow with a high solids' concentration, while also producing a clarified overflow.

Primary clarification is the most economical unit process for pollutant removal from a cost per unit weight of biochemical oxygen demand (BOD) or solids removed. For this reason, it is the most widely used process for wastewater treatment.

- **Slow granular media filters**

Slow sand filters were first introduced in the 1800's. The water is applied to the sand at a loading rate of 2.9 to 7.6 m^3 / day. m^2. As the suspended or colloidal material is applied to the sand, the particles begin to collect in the top 75 mm and to clog the pore spaces. As the pores become clogged, water will no longer pass through the sand. At this point the top layer of sand is scraped off, cleaned and replaced. Slow sand filters require large areas of land and are operator intensive. Basically, all the filters have the graded layers of gravel or other porous material (sand) through which water filters. An underdrain system is provided for collecting the filtered water.

- **Conventional granular media filters**

Granular media filtration (GMF) is a process for removing suspended or colloidal particles that passed through media filtration in conventional pretreatment. Filtration is commonly the final polishing step in the conventional water treatment process, designed to meet final treated water turbidity limits.

A method of treating water that consists of the addition of coagulant chemicals, flash mixing, coagulation-flocculation, sedimentation, and filtration. Also called complete treatment. Also see direct filtration and inline filtration.

- **Pressure and gravity granular media filters**

Gravity filtration through beds of granular media is the most common method removing colloidal impurities in water processing and tertiary treatment of wastewater.

The mechanisms involved in removing suspended solids in a granular-media filter are complex, consisting of interception, straining, flocculation, and sedimentation. Initially, surface straining and interstitial removal results in accumulation of deposits in the upper portion of the filter media. Because of the reduction in pore area, the velocity of water through the remaining voids increases, shearing off pieces of capture floc and carrying impurities deeper into the filter bed.

The effective zone of removal passes deeper and deeper into the filter. Turbulence and the resulting increased particle contact within the pores promote flocculation, resulting in trapping of the larger floc particles. Eventually, clean bed depth is no longer available and breakthrough occurs, carrying solids out in the underflow and causing termination of the filter run.

Microscopic particulate matter in raw water that has not been chemically treated will pass through the relatively larger pores of a filter bed. On the other hand, suspended solids fed to a filter with excess coagulant carryover from chemical treatment produces clogging of the bed pores at the surface. Optimum filtration occurs when impurities in the water and coagulant concentration cause "in-depth" filtration. The impurities neither pass through the bed nor are all strained out on the surface, but a significant number of flocculated solids is removed throughout the entire depth of the filter.

Self-Check -5	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. Sedimentation basins are not usually rectangular or circular with either a radial or upward water flow pattern.
   A. true B. false
2. If a particle is to be removed from the bottom of the clarifier and not go out in the settled water, then the particle-settling velocity must be greater that the liquid-rise velocity ($v_{s,nu}$ v_0).
   A. true B. false
3. Clarification of wastewater through the process of sedimentation is the separation of suspended solids by gravitational settling.
   A. true B. false
4. Rapid sand filters require large areas of land and are operator intensive.
   A. true B. false
5. Granular media filtration (GMF) is a process for removing suspended or colloidal particles that passed through media filtration in conventional pretreatment.
   A. true B. false
6. Gravity filtration through beds of granular media is the most common method removing colloidal impurities in water processing and tertiary treatment of wastewater.
   A. true B. false
7. The town of San Jose has an existing horizontal-flow sedimentation tank with an overflow rate of 27 m^3 / day. m^2, and it wishes to remove particles that have settling velocities of 0.3 mm / sec, 0.4 mm / sec and 3 mm / sec. What percentage of removal should be expected for each particle in an ideal sedimentation tank?
8. Determine the surface area of a settling tank for the city of Urbana's 0.8 m^3 / sec design flow with design overflow rate of 36 m^3 / day. m^2. Compare this surface area with that which results from assuming a typical overflow rate of 30 m^3 / day. m^2. Find the depth of the clarifier using detention time of 95 minutes.

Note: **Satisfactory rating ≥4 points** **Unsatisfactory <4 points**

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

Answer Sheet-5

Name: ___________________________ Date: ________________

Score = ___________

Rating: ____________

Choice Questions

1.________ 2. _______ 3. _______4. _______ 5. ________ 6. ________

7._______

6.1. Introduction to Basic processes and adjustments in the organization

When someone mentions performance management or reviews at your organization, and have the typical responses as follows:

- ✓ Do employees and managers cringe?
- ✓ Do they avoid completing performance-related tasks?
- ✓ Do visions of tracking down incomplete appraisal forms come to mind?

Forward-thinking companies are taking steps to address this negative view of performance management. They are implementing innovative solutions that ensure the process delivers real results and actually improves employee performance and the business' bottom line.

In this TTLM, you'll find 10 practical steps that can be used to improve the performance management processes at your organization.

I. Set goals effectively

Goals are the basis of an effective performance management process. There are two key elements to consider when developing goals.

- ✓ First, are goals written clearly and objectively?
- ✓ Second, are they directly contributing to the achievement of business strategy?

Typically, the process begins with departmental managers setting goals for their departments, based upon organization-wide goals, which support the general business strategy. Making departmental goals accessible to all managers ensures there is no overlap, reduces conflict, and allows members of different departments to see where they support each other and ensure they are not working at cross purposes.

Some organizations choose to include competencies within performance expectations, to reinforce the link to business strategy, vision and mission. An accepted framework to use to help write effective goals is **SMART:**

- **S**–Specific
- **M**–Measurable
- **A**–Achievable/Attainable
- **R**–Results Oriented/Realistic/Relevant
- **T**–Time-Bound

The inclusion of the above criteria results in a goal that is understandable and easily visualized and evaluated. Making a goal specific, measurable, and time bound contributes to the ability to make progress on the goal and track that progress. Some managers choose to further define goals with a start and finish date with milestones in between. As we have mentioned, goals must be achievable and realistic. Goals must reflect conditions that are under the employee's control and the R's (results oriented, realistic and relevant) should definitely consider these conditions. Sometimes the focus on the outcome of the goals can overshadow the necessary steps to achieve them. Action plans to support each goal can include documentation of the steps necessary to achieve a goal. By keeping goals relevant, a manager reinforces the importance of linking to strategic objectives and communicating why the goal is important. Some organizations have suggested the use of SMARTA, or SMARTR with the additional A standing for aligned and the R standing for reward.

Using the SMART framework provides clarity up front to employees who will be evaluated against these goals.

II. Begin with performance planning

Using established goals as a basis, performance planning sets the stage for the year by communicating objectives, and setting an actionable plan to guide the employee to successfully achieve goals.

Performance planning, as with all other steps, is a collaborative process between the manager and employee, although there will always be some elements that are non-negotiable. Begin with the job description and identify major job expectations; expectations then can be clarified for each major area.

Under each key contribution area, it is important to identify long-term and short-term goals, along with an action plan around how they will be achieved. Goals can be weighted to identify priorities. Discuss specific details related to how progress against goals will be evaluated. Next steps include determining any obstacles that would stand in the way of these goals being achieved. If an obstacle is knowledge, skills or behavior- a plan should be developed to overcome, i.e. training, mentoring, etc.

Performance planning and ongoing performance feedback are critical because they facilitate continuous improvement and aid open communication.

III. Create an ongoing process

Performance management including goal setting, performance planning, performance monitoring, feedback and coaching should be an ongoing and continuous process, not an once or twice-yearly event. Feedback that is delivered when it is most relevant enhances learning and provides the opportunity to make any adjustments needed to meet objectives. The attitude towards ongoing feedback is also crucial. If there is organizational support for building constructive feedback into the fabric of day-to-day interactions, then the environment will encourage development and drive goal-directed performance improvement.

IV. Improve productivity through better goal management

Regular goal tracking allows for the opportunity to provide feedback as needed, make adjustments to performance plans, tackle obstacles and prepare contingencies for missed deadlines. Without a mechanism to regularly track progress against goals, the ongoing, cyclical nature of the process falls apart and productivity dips.

Goal progress discussions, along with all performance feedback, should be delivered with respect and should be objective and supportive. Specific examples provide clarity and help the employee focus on future improvements. It is crucial that the manager listens to the employee's perspective and incorporates the employee's observations into future plans the employee often experiences roadblocks the manager may not see.

V. Gather information from multiple sources

Gathering performance information from a variety of sources increases objectivity and ensures all factors impacting performance are considered. This information should include objective data like sales reports, call records or deadline reports. Other valuable information includes:

- ✓ feedback from others, results of personal observation,
- ✓ documentation of ongoing dialogue,
- ✓ records of any external or environmental factors impacting performance.

Many reviews also include an employee self-evaluation. Other documents that help define performance objectives include: past performance appraisals, current departmental and organizational objectives and documented standards related to career goals.

Objectivity is essential when evaluating performance and it begins with clarity about job expectations and evaluation methods. Certain checks and balances can be built in to ensure objectivity.

Reporting is very valuable to assess the fairness and consistency of the process. For example, it can be used to compare ratings from one division to the next or from one manager to the next. People analytics and technologies like machine learning are also helpful in removing bias from performance appraisals and evaluation.

VI. Documenting documents

Note-taking must be consistent and include all significant occurrences, positive or negative. Documentation is important to support performance decisions, and notes should be written with the intent to share. In addition to documenting the details of an occurrence, any subsequent follow up should be detailed.

The performance log is a record that the manager keeps for each employee and is a record of performance "events." The maintenance of a performance log serves a number of purposes. The manager can record successes or performance that requires improvement. When it comes time to complete the appraisal, the manager has a historical record of events and will not have to rely on recent memory.

The performance log can also act as a reminder for coaching, i.e. record of upcoming tasks, manager can make note to discuss with the employee to ensure he/she is prepared for the individual for a task ahead, and then follow up discussion can promote learning and continuous improvement.

This log should be objective and based on observable, job-related behaviors including successes, achievements and, if applicable, any documentation related to disciplinary actions taken.

VII. Prepare and train your managers

Managing the performance of another individual is not an easy task and requires many skills. Training may be required to ensure managers feel adequately prepared to effectively complete all the tasks related to performance management. This is especially the case for newly promoted supervisors. Managers need to understand human behavior, how to motivate, how to develop, provide coaching and deal with conflict. To a great extent, managers must be observers and able to assess a situation, provide motivation and identify problems that interfere with performance.

A manager who feels adequately prepared to provide and receive feedback, deliver a performance evaluation and conduct a performance evaluation meeting will be a major contributor to a successfully functioning process.

VIII. Perfect the performance review

The employee performance appraisal or review should be a summary of all that has been discussed. Based upon job expectations and key areas of contribution, and previously discussed goals and evaluation methods, the appraisal should be a written confirmation of what has already been discussed with the employee.

The form should include key job responsibilities, current project work, relevant competencies, goals and achievements. Previously completed performance appraisals should be used as reference documents. It should also contain an area to allow employees to record their comments and input.

All comments included on the appraisal form need to be job-related and based upon observable behaviors. For the appraisal meeting, it is imperative to prepare ahead of time. Schedule an appropriate place and time with no interruptions.

The focus, as pointed out previously, should be forward looking. The way the manager approaches this meeting conveys a message related to its importance and should be approached with the appropriate level of seriousness and an open mind. The manager must be prepared in regard to what he/she wants to discuss, but just as importantly must be prepared to listen.

Many suggest that it is important to first define the purpose of the meeting and provide an agenda. A factual discussion with a focus on job-related behaviors will keep the discussion objective. At the end of the meeting, key points should be summarized. It is important to note that the employee will be asked to sign the appraisal, whether or not there is agreement.

IX. Link performance with rewards and recognition

More and more, organizations are linking performance to compensation. This link, however, cannot effectively be established without the existence of sound performance management processes that are seen as fair and equitable.

Clear documentation of progress against performance expectations also allows proper recognition for a job well done. This can be provided a number of ways, i.e. formal recognition events, informal public recognition or privately delivered feedback.

A consistent process creates a sense of fairness and significantly increases job satisfaction. Employees need to know that if an individual in one department is identified as a top performer and compensated accordingly, then an employee performing at the same level in another department will receive similar rewards.

X. Encourage full participation and success

The performance management process must add value, otherwise problems with resistance and non-participation will surface. In addition, the process itself must be as efficient and simple as possible. Automated reminders and scheduling tools can help keep the process on track.

Another element that contributes to success is upper-level management support. This support needs to take not only the form of verbal support, but also through participation in the same performance management process for evaluations. In addition, consider the current culture of your organization when it comes to performance appraisals and performance management.

- ✓ Is the atmosphere supportive of an effective process?
- ✓ Is there a culture of open, honest communication or are employees fearful when they make a mistake?

Employees must be able to honestly discuss performance and consider how to make improvements in order to move forward.

Another thing to consider is a mechanism to evaluate the process itself, whether it consists of an annual survey, focus groups, manager feedback, reporting, or a combination of these and other methods.

- **Choosing the right performance management system**

Organizations are increasingly using innovative technology solutions to implement performance management best practices and automate tedious manual processes. Cloud-based performance management systems are making advanced capabilities and technologies like machine learning, predictive analytics, and chatbot coaching affordable to companies of all sizes. These systems also offer quick implementation schedules, no IT support requirements, and automatic upgrades.

When selecting an automated performance management solution, make sure to do your research. Some solutions offer nothing more than an electronic appraisal form, while others offer complete best-of-breed performance and goal management. The best solutions include:

- ✓ Instant form routing and paperless processes

- ✓ Goal tracking and cascading functionality for complete visibility and alignment
- ✓ Automated goal management and performance review reminders
- ✓ Legal scan wizards to ensure appropriate/legal use of language
- ✓ Writing assistants to help managers prepare appraisal forms
- ✓ Support tools providing coaching support to managers when they need it most
- ✓ Dashboards to deliver company-wide, aggregated or individual reporting.

It is especially important that technology provides us with access to performance data and the ability to evaluate progress against goals, compare average manager ratings, easily access performance levels of individuals and use this data to support decision making. Aggregating and analyzing data in traditional paper-based forms is often too time-consuming and costly.

- **Sedimentation and clarification**

Sedimentation, or clarification, is the processes of letting suspended material settle by gravity. Suspended material may be particles, such as clay or silts, originally present in the source water.

Sedimentation is the tendency for particles in suspension to settle out of the fluid in which they are entrained and come to rest against a barrier. ... Settling is the falling of suspended particles through the liquid, whereas sedimentation is the termination of the settling process.

A clarification step is the first part of conventional treatment for waste and surface water treatment. The act of clarifying; the act or process of making clear or transparent by freeing visible impurities; particularly, the clearing or fining of liquid substances from feculent matter by the separation of the insoluble particles which prevent the liquid from being transparent.

- **Slow granular media filters**

here are several types of granular media filters: Slow sand filters: These were the first filters used for treatment of public water supplies. They have a low loading rate (2 to 5 L/min /m^2). The clean water is pumped back through the bed to dislodge trapped solids.

- **Conventional granular media filters**

A method of treating water that consists of the addition of coagulant chemicals, flash mixing, coagulation-flocculation, sedimentation, and filtration. Also called complete treatment. Also see direct filtration and inline filtration.

- **Pressure and gravity granular media filters**

Granular Media Filtration is the process for removal of suspended solids by passage of water through a porous medium. Both open gravity filter and pressure filter designs are used for this application and are supplied by Aquatec Maxcon to suit the specific water treatment requirements.

Self-Check -6	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. When someone mentions performance management or reviews at your organization, and have the typical responses as follows:
   A. Do employees and managers cringe?
   B. Do they avoid completing performance-related tasks?
   C. Do visions of tracking down incomplete appraisal forms come to mind?
   D. All
2. During creation of ongoing process, Performance management **except**____included.
   A. goal setting
   B. performance planning
   C. performance monitoring
   D. three times-yearly events
3. Gathering performance information from a variety of sources increases objectivity and ensures all factors impacting performance must be considered. This information should include____.
   A. feedback from others, results of personal observation
   B. documentation of ongoing dialogue
   C. records of any external or environmental factors impacting performance
   D. All
4. Some solutions offer nothing more than an electronic appraisal form, while others offer complete best-of-breed performance and goal management. The best solutions include ____:
   A. Goal tracking and cascading functionality for complete visibility
   B. Automated goal management and performance review reminders
   C. Legal scan wizards to ensure appropriate/legal use of language
   D. Writing assistants to help managers prepare appraisal forms
   E. All are answers

Note: **Satisfactory rating ≥2 points** **Unsatisfactory <2 points**

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

Answer Sheet-6

Name: ___________________________ Date: ________________

Choice Questions

1.________ 2. _______ 3. _______4. _______

Score = ___________

Rating: ____________

6.1. Water quality monitoring

Qualitative and quantitative measurements are needed from time to time to constantly monitor the quality of water from the various sources of supply. The harbor-master should then ensure appropriate water treatment within the fishery harbor complex as well as initiate remedial measures with the suppliers when water supply from outside is polluted.

Water sampling and analysis should be done by ISO-certified laboratories. Wherever laboratories available locally are not ISO-certified, it is advisable to get their quality assessed by an ISO-certified laboratory by carrying out collaborative tests to ensure that variation in the accuracy of results is sufficiently small. Unreliable results exacerbate problems of pollution when corrective action cannot be taken in time. Sampling and monitoring tests should be carried out by qualified technicians.

Depending on the actual state of the fishing harbor infrastructure and environmental conditions in and around the harbor, monitoring should be carried out according to a specific programme for each source of water supply.

- ✓ Borewells
- ✓ Water tanks and reservoirs
- ✓ Harbor basin water

7.1.2. Testing procedures

While the details of sampling, testing and analysis are beyond the scope of this handbook, what follows is a general description of the significance of water quality tests usually made.

Testing procedures and parameters may be grouped into physical, chemical, bacteriological and microscopic categories.

- ✓ ***Physical tests*** indicate properties detectable by the senses.
- ✓ ***Chemical tests*** determine the amounts of mineral and organic substances that affect water quality.
- ✓ ***Bacteriological tests*** show the presence of bacteria, characteristic of faecal pollution.

A. Physical tests

Colour, turbidity, total solids, dissolved solids, suspended solids, odour and taste are recorded.

- ✓ **Colour** in water may be caused by the presence of minerals such as iron and manganese or by substances of vegetable origin such as algae and weeds. Colour tests indicate the efficacy of the water treatment system.
- ✓ **Turbidity** in water is because of suspended solids and colloidal matter. High turbidity makes filtration expensive. If sewage solids are present, pathogens may be encased in the particles and escape the action of chlorine during disinfection.
- ✓ **Odour and taste** are associated with the presence of living microscopic organisms; or decaying organic matter including weeds, algae; or industrial wastes containing ammonia, phenols, halogens, hydrocarbons. This taste is imparted to fish, rendering them unpalatable. While chlorination dilutes odour and taste caused by some contaminants, it generates a foul odour itself when added to waters polluted with detergents, algae and some other wastes.

A. Chemical tests

pH, hardness, presence of a selected group of chemical parameters, biocides, highly toxic chemicals, and B.O.D are estimated.

pH: is a measure of hydrogen ion concentration. It is an indicator of relative acidity or alkalinity of water. Values of 9.5 and above indicate high alkalinity while values of 3 and below indicates acidity. Low pH values help in effective chlorination but cause problems with corrosion. Values below 4 generally do not support living organisms in the marine environment. Drinking water should have a pH between 6.5 and 8.5. Harbor basin water can vary between 6 and 9.

B.O.D.: It denotes the amount of oxygen needed by micro-organisms for stabilization of decomposable organic matter under aerobic conditions. High B.O.D. means that there is less of oxygen to support life and indicates organic pollution.

B. Bacteriological tests

For technical and economic reasons, analytical procedures for the detection of harmful organisms are impractical for routine water quality surveillance. It must be appreciated that all that bacteriological analysis can prove is that, at the time of examination, contamination or bacteria indicative of faecal pollution, could or could not be demonstrated in a given sample of water using specified culture methods. In addition, the results of routine bacteriological examination must always be interpreted in the light of a thorough knowledge of the water supplies, including their source, treatment, and distribution.

Whenever changes in conditions lead to deterioration in the quality of the water supplied, or even if they should suggest an increased possibility of contamination, the frequency of bacteriological examination should be increased, so that a series of samples from well-chosen locations may identify the hazard and allow remedial action to be taken.

Whenever a sanitary survey, including visual inspection, indicates that a water supply is obviously subject to pollution, remedial action must be taken, irrespective of the results of bacteriological examination. For uniped rural supplies, sanitary surveys may often be the only form of examination that can be undertaken regularly.

The recognition that microbial infections can be waterborne has led to the development of methods for routine examination to ensure that water intended for human consumption is free from excremental pollution.

A more logical approach is the detection of organisms normally present in the faeces of man and other warm-blooded animals as indicators of excremental pollution, as well as of the efficacy of water treatment and disinfection. The presence of such organisms indicates the presence of faecal material and thus of intestinal pathogens.

The intestinal tract of man contains countless rod-shaped bacteria known as coliform organisms and each person discharges from 100 to 400 billion coliform organisms per day in addition to other kinds of bacteria.

Conversely, the absence of faecal commensal organisms indicates that pathogens are probably also absent. Search for such indicators of faecal pollution thus provides a means of quality control. The use of normal intestinal organisms as indicators of faecal pollution rather than the pathogens themselves is a universally accepted principle for monitoring and assessing the microbial safety of water supplies. Ideally, the finding of such indicator bacteria should denote the possible presence of all relevant pathogens.

Indicator organisms should be abundant in excrement but absent, or present only in small numbers, in other sources; they should be easily isolated, identified and enumerated and should be unable to grow in water. They should also survive longer than pathogens in water and be more resistant to disinfectants, such as chlorine. In practice, these criteria cannot all be met by any one organism, although many of them are fulfilled by coliform organisms, especially *Escherichia coli* as the essential indicator of pollution by faecal material of human or animal origin.

7.2. Water treatment methods

Treatment of raw water to produce water of potable quality can be expensive. Sizing of the equipment is crucial to produce acceptable water at reasonable cost. The main point to remember is that separate systems and pipelines are required for potable and non-potable water to avoid cross contamination.

Water used for drinking, cleaning fish and ice-making must be free from pathogenic bacteria and may require secondary treatment or even complete treatment depending on chemical elements that need to be removed. Water for other needs like general cleaning may perhaps need only primary treatment.

- **Primary treatment**

There are four methods of primary treatment: chlorination; ozone treatment; ultraviolet treatment; and membrane filtration.

Chlorination: Fresh or sea water can be chlorinated using either chlorine gas or hypochlorites. Chlorinated water minimizes slime development on working surfaces and helps control odour.

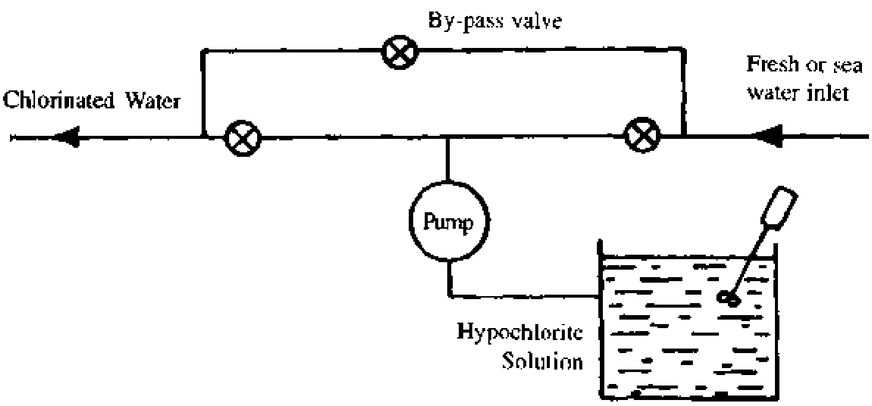


Figure 9: Chlorination

The main advantages of using chlorine gas are:

- ✓ It is the most efficient method of making free chlorine available to raw water.
- ✓ It lowers the pH of the water slightly.
- ✓ Control is simple; testing simple; and it is not an expensive method.

The main disadvantages are:

- ✓ Chlorine gas is toxic and can combine with other chemicals to form combustible and explosive materials.
- ✓ Automatic control systems are expensive.
- ✓ Chlorine cylinders may not be readily available at small centers.
- ✓ Chlorine expands rapidly on heating and hence the cylinders must have fusible plugs set at 70°C. It also reacts with water, releasing heat. Water should not therefore be sprayed on a leaking cylinder.

The main disadvantages of using hypochlorites are:

- ✓ Calcium hypochlorite is not stable and must be stored in air-tight drums.
- ✓ Sodium hypochlorite is quite corrosive and cannot be stored in metal containers
- ✓ Sodium hypochlorite must be stored in light proof containers.
- ✓ It is difficult to control the rate of addition of hypochlorites in proportion to water flow.
- ✓ Hypochlorites raise the pH in water.
- ✓ They are more expensive than chlorine gas.

Ozone treatment: Though the principle is relatively simple, this method needs special equipment, supply of pure oxygen and trained operators. Ozone is generated by passing pure oxygen through an ozone generator. It is then bubbled through a gas diffuser at the bottom of an absorption column, in a direction opposite to the flow of raw water. Retention or contact time is critical and the size of the absorption column depends on the water flow.

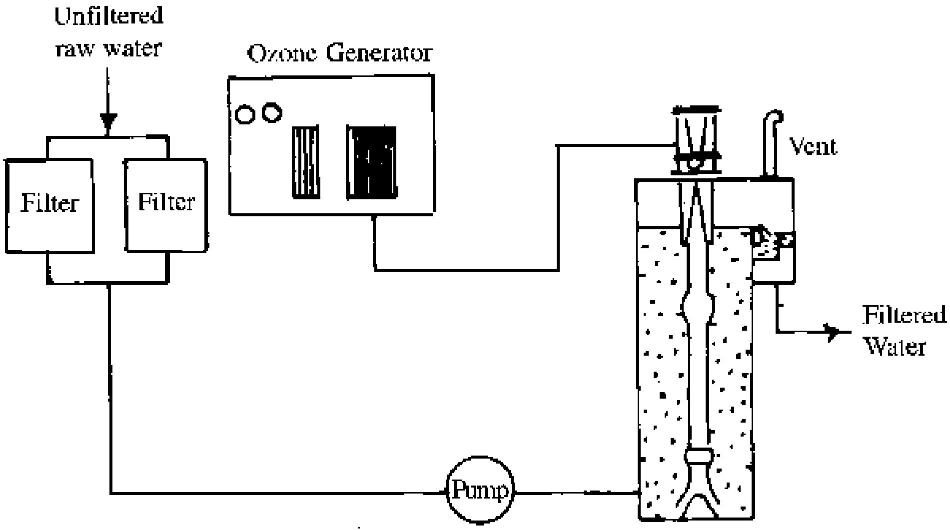


Figure 10: ozone treatment

The main advantages of ozone treatment are:

- Ozone is a much more powerful germicide than chlorine especially for faecal bacteria.
- It reduces turbidity of water by breaking down organic constituents.
- The process is easily controlled.

The disadvantages are:

- Pure oxygen may not be readily available locally.
- Ozonized water is corrosive to metal piping.
- Ozone decomposes rapidly into oxygen.
- Water has to be aerated prior to use to remove the ozone.

Ultraviolet irradiation treatment: This method is often used to treat drinking water. Successful commercial installations have been made to purify sea water in large fish processing plants.

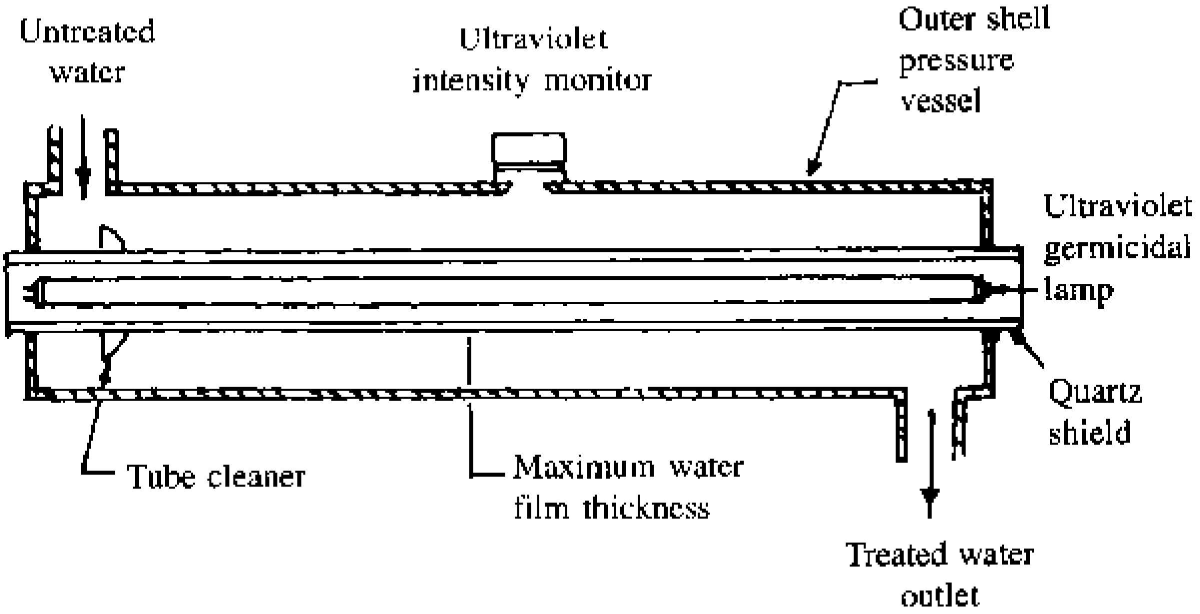


Figure 11: ultraviolet irradiation treatment

The main advantages of U-V treatment are:

- ✓ U-V rays in the range of 2500-2600 Angstrom units are lethal to all types of bacteria.
- ✓ There is no organoleptic, chemical or physical change to the water quality.
- ✓ Overexposure does not have any ill effects.

The main disadvantages are:

- ✓ Electricity supply should be reliable.
- ✓ Turbidity reduces efficiency.
- ✓ Water may require prior treatment like filtration.
- ✓ The unit requires regular inspection and maintenance.
- ✓ Thickness of the water film should not exceed 7.5 cm.

Membrane filtration: Osmotic membrane treatment methods are generally expensive for commercial scale installations. Combinations of membrane treatment with U-V treatment units are available for domestic use.

- **Secondary treatment**

Secondary treatment of water consists of sedimentation and filtration followed by chlorination. Sedimentation can be carried out by holding the raw water in ponds or tanks. The four basic types of filtration are cartridge filtration, rapid sand filtration, multimedia sand filtration, and up-flow filtration.

Cartridge filtration: This system is designed to handle waters of low turbidity and will remove solids in the 5 to 100-micron range.

The main advantages are:

- ✓ Low cost and 'in-line' installation.
- ✓ Change of cartridge is simple.
- ✓ Operation is fool-proof. Once the cartridge is clogged, flow simply stops.

The main disadvantages are:

- ✓ Sudden increase in turbidity overloads the system.
- ✓ Cartridges may not be readily available and large stocks may be required.

Rapid sand filtration: This system consists of a layer of gravel with layers of sand of decreasing coarseness above the gravel. As solids build up on top, flow decreases until it stops. This is corrected by back-flushing the system to remove the solid build up on top, Figure 12.

The main advantages are:

- ✓ Cost of filtration media is negligible.
- ✓ Operation is simple.

The main disadvantages are:

- ✓ A holding tank for filtered water is required to provide clear water back flushing.
- ✓ Pumping loads increase as sediments build up.

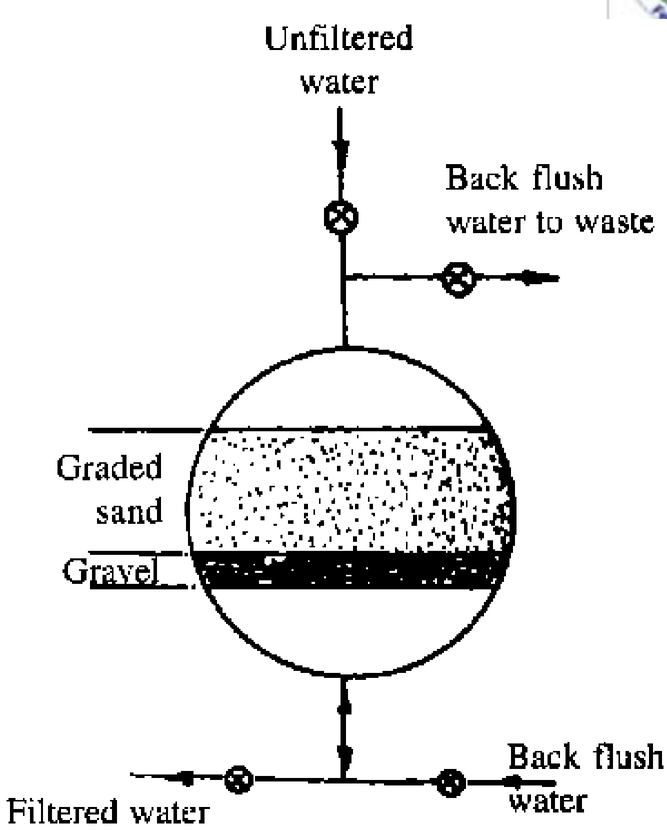


Figure 12: rapid sand filtration

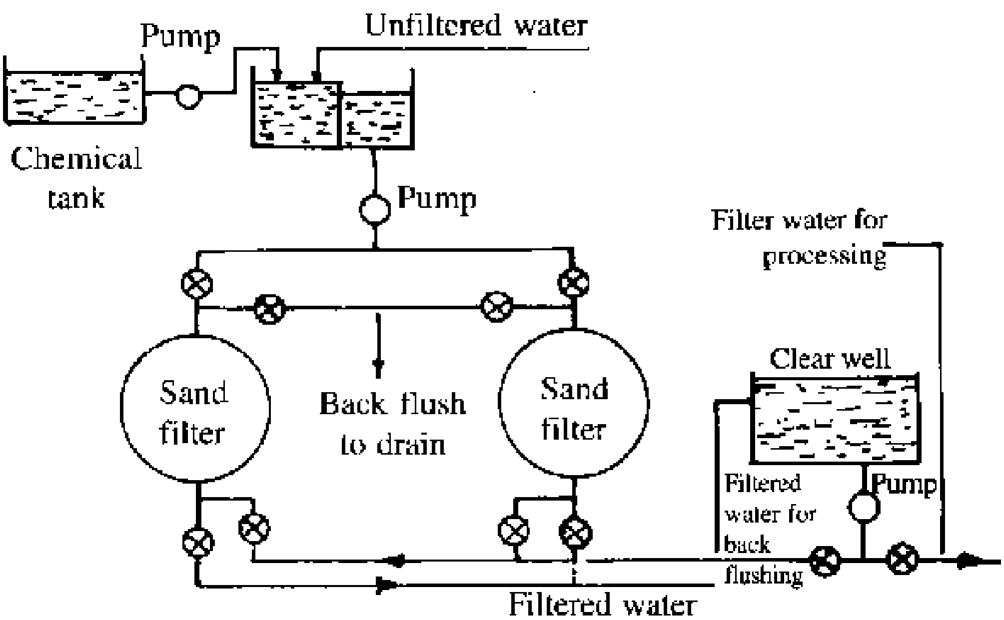


Figure 13: conventional sand filtration

Multimedia sand filtration: This system is similar to the rapid sand filtration method.

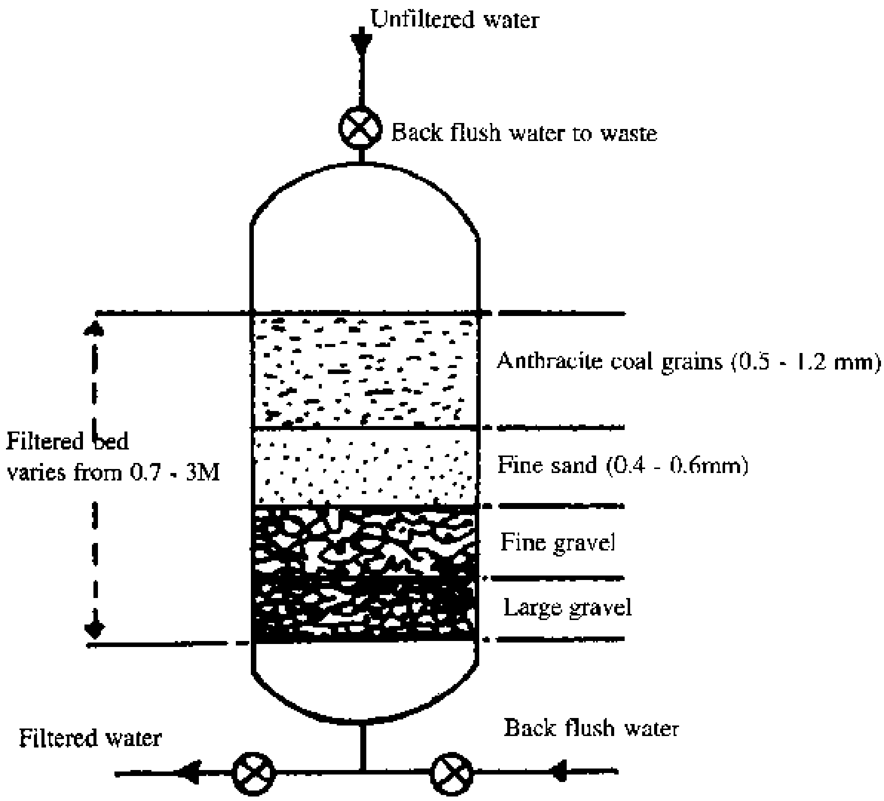


Figure 14: multi-media sand filtration

Up-flow filtration: Filtration can be at atmospheric pressure or by using a pressurized system, Figures 15a and 15b.

The main advantages are:

- ✓ High flow rates are easily attained.
- ✓ Water with turbidity up to 1500 ppm can be handled.
- ✓ Degree of filtration can be easily adjusted.
- ✓ The filter bed can be easily cleaned using the filtered water.

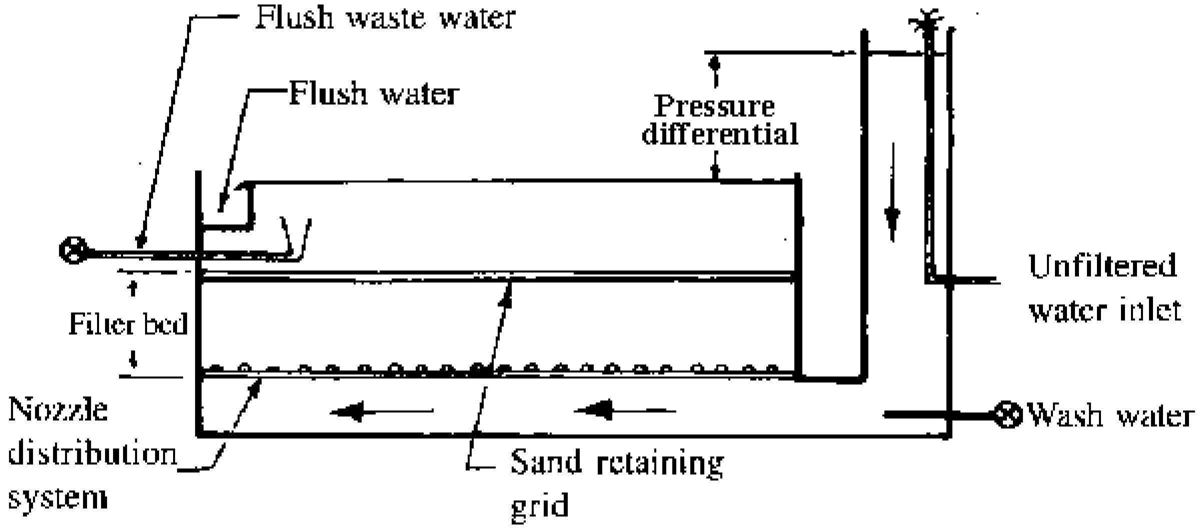


Figure 15a: atmospheric pressure up-flow filter

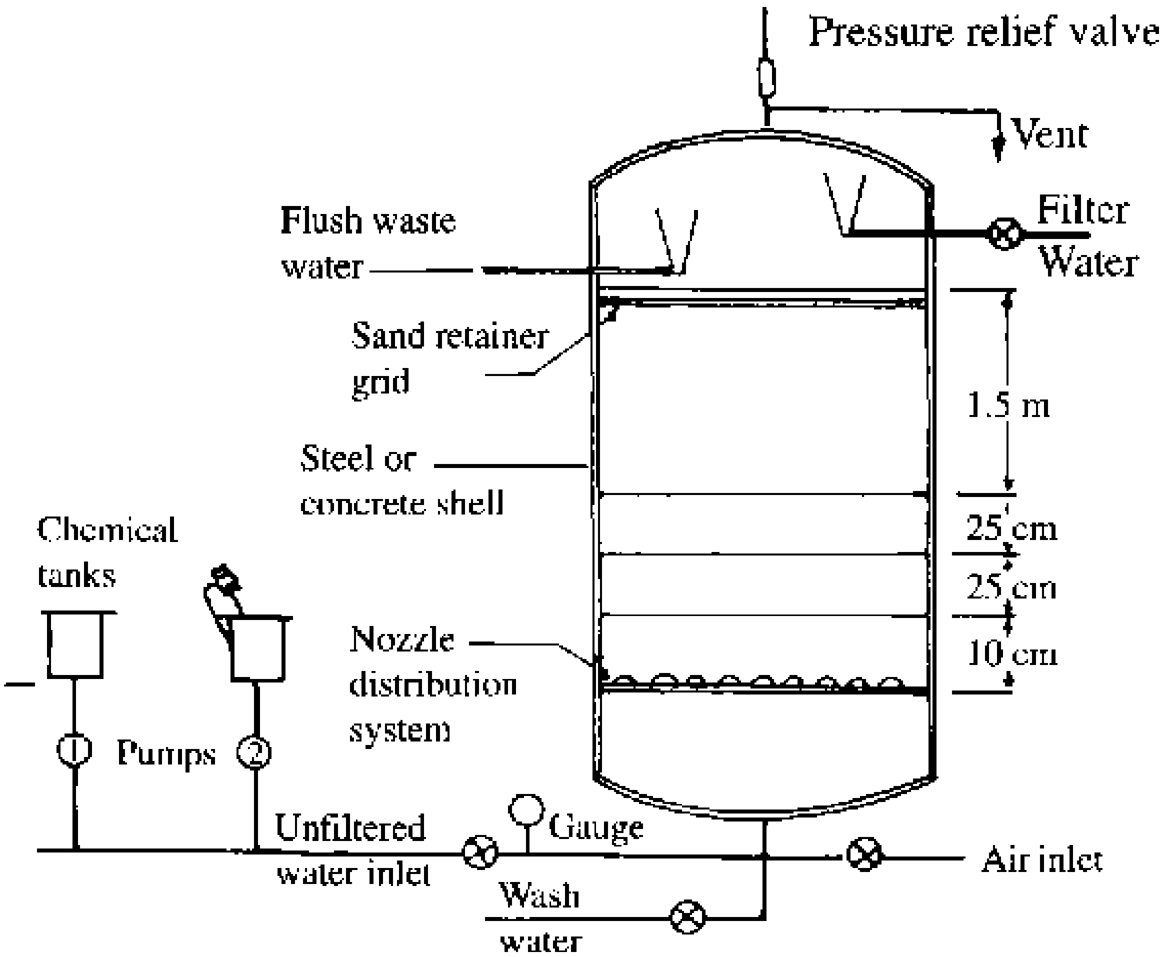


Figure 15b: pressure type up-flow filter

The main disadvantage is:

- Close supervision is necessary to ensure that the filter bed does not rupture.
- **Complete treatment**

Complete treatment consists of flocculation, coagulation, sedimentation and filtration followed by disinfection. Flocculation and coagulation will assist in removing contaminants in the water, causing turbidity, colour odour and taste which cannot be removed by sedimentation alone. This can be achieved by the addition of lime to make the water slightly alkaline, followed by the addition of coagulants like Alum (aluminum sulphate), ferric sulphate or ferric chloride. The resultant precipitate can be removed by sedimentation and filtration.

Chemical treatment may be required to reduce excessive levels of iron, manganese, chalk, and organic matter. Such treatment is usually followed by clarification. Iron may be removed by aeration or chlorination to produce a flocculant which can be removed by filtration. Manganese may be removed by aeration followed by adjustment of pH and up-flow filtration. Most colours can be removed by treatment with ferric sulphate to precipitate the colours.

Self-Check -7	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. Depending on the actual state of the water infrastructure and environmental conditions, monitoring should be carried out according to a specific programme for each source of water supply of ____.
   A. Borewells
   B. Water tanks and reservoirs
   C. Harbor basin water
   D. All
2. One of the following parameters is not grouped into physical.
   A. Colour,
   B. turbidity,
   C. total solids,
   D. dissolved solids,
   E. PH
3. One of the following parameters is **not** grouped into Chemical
   A. pH,
   B. hardness,
   C. Dissolved solids
   D. B.O.D
4. The main advantages of using chlorine gas is___.
   A. It is the most efficient method of making free chlorine available to raw water
   B. It lowers the pH of the water slightly
   C. Control is simple; testing simple; and it is not an expensive method
   D. All
5. One of the following parameters is **not** t*he main disadvantages* using chlorine gas.
   A. Chlorine gas is toxic and can combine with other chemicals
   B. Automatic control systems are expensive.
   C. Chlorine cylinders may not be readily available at small centers
   D. It lowers the pH of the water slightly

6. One of the following is not the main advantages of ozone treatment are:
   A. Ozone is more powerful germicide than chlorine especially for faecal bacteria.
   B. It reduces turbidity of water by breaking down organic constituents
   C. The process is easily controlled
   D. Ozone decomposes rapidly into oxygen
7. The main disadvantages of ozone are:
   A. Electricity supply should be reliable
   B. Turbidity reduces efficiency
   C. Thickness of the water film should not exceed 7.5 cm
   D. All

Note: **Satisfactory rating ≥3.5 points** **Unsatisfactory <3.5 points**

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

Answer Sheet-7

Name: ___________________________ Date: ________________

Choice Questions

Score = ___________
Rating: ____________

1. _______
2. ______
3. ______
4. ______
5. _______
6. _______
7. _______

Information-8	Reviewing existing fault reports and other relevant plant asset information

8.1. Introduction to Existing fault reports Related to Treatment plant

An appropriate body, usually the regulator or their designated agents, should review and approve water safety plans prepared by suppliers or Government agencies. This process is designed to ensure that the water safety plans developed are consistent with the water safety requirements articulated within the health-based targets. The review process is essential in the overall implementation and links to ongoing audit by providing the basis from which future assessments can be based.

Undertaking a systematic technical review of the water safety plan is based on the assessor using a range of materials. In particular the review team will be expected to review the documents provided by the supplier, to undertake field investigations, to interview and question the water safety plan team and to review material from similar supplies and best-practice guidance.

The review process should come to one of the following conclusions:

- Water safety plan is approved in full and is ready for implementation. This approval would be time-bound and a date for the next review would be set at this time (usually 2-5 years from the initial review);
- Water safety plan receives provisional approval and can be implemented subject to ensuring identified information gaps are filled. In this situation the water safety plan would be likely to adequately cover most areas of concern in delivery of safe drinking-water, but may have some gaps in knowledge, for instance because there remains a lack of research. Provisional approval allows implementation, but should set time limits for the resolution of identified problems.
- Water safety plan is rejected as inadequate and the supplier is required to go back and develop a new water safety plan.

This situation would only occur when the supplier had failed to cover the major issues for which knowledge is adequate to establish a water safety plan or has failed to employ sufficient staff to implement the water safety plan. Failure should be linked to a requirement for a re-submission or, if there is repeated failure, for the imposition of a water safety plan by the review team.

Self-Check -8	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. An appropriate body, usually the regulator or their designated agents, should review and approve water safety plans.
   A. True B. False
2. The review process is essential in the overall implementation and links to ongoing audit by providing the basis from which future assessments cannot be based.
   A. True B. False
3. In particular the review team will be expected to review the documents provided by the supplier to _____.
   A. undertake field investigations
   B. interview and question the water safety plan team
   C. review material from similar supplies and best-practice guidance
   D. All are answers.
4. The review process should come to one of the following conclusions:
   A. Water safety plan is approved in full and is ready for implementation.
   B. Water safety plan receives provisional approval and can be implemented subject to ensuring identified information gaps are filled.
   C. Water safety plan is rejected as inadequate and the supplier is required to go back and develop a new water safety plan.
   D. A and B
   E. All

Note: **Satisfactory rating ≥2 points** **Unsatisfactory <2 points**

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

Answer Sheet-8

Name: ___________________________ Date: ________________

Choice Questions

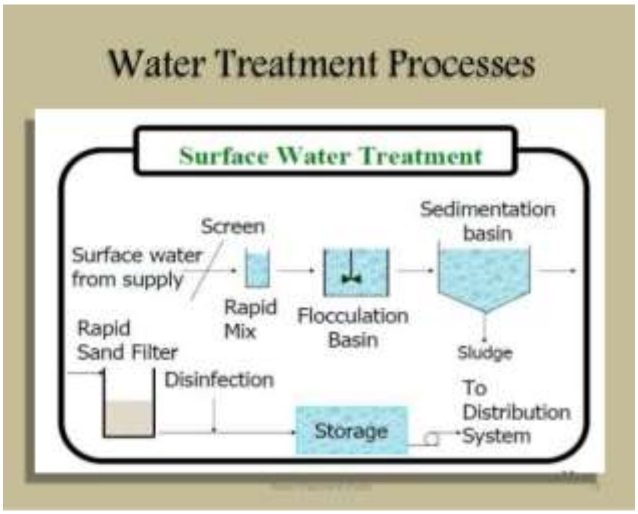
Score = ___________

Rating: ____________

1.________ 2. _______ 3. _______4. _______

9.1. Water treatment plant components

Clarifier/Multi Media Filtration skids consisting of either a clarifier vessel or a train of multimedia vessels to treat water containing high suspended solids for use as a prefeed to: Chemical dosing skids consisting of dosing pumps, controllers, process analytical instrumentation, chemical storage tank and bund.



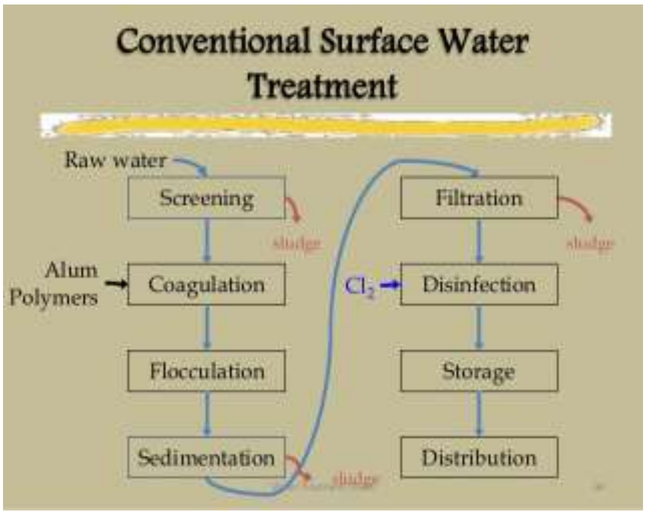


Figure 16: Water treatment plant processing in each component

- **Main Components of Water treatment plant**
  1. Screening
  2. Coagulation
  3. Aeration
  4. Flocculation
  5. Sedimentation
  6. Filtration
  7. Disinfection or chlorination
  8. Lime dosing

Additional Water Treatment Plant components:

- **Valves**

A **valve** is a device or natural object that regulates, directs or controls the flow of a fluid (gases, liquids, fluidized solids, or slurries) by opening, closing, or partially obstructing various passageways. **Valves** are technically fittings, but are usually discussed as a separate category.

Figure 17: Valve

- **Blower**

Blower is a plumbing equipment that rotates the fan with the force it receives from the engine, which transfers the air in the emitted environment at high flow or low pressure. The fan in the **blowers** rotates and vacuum the air in the suction section. The trapped air is then pushed into the outlet side.

Figure 18: Blower

- **Wash water troughs**

Leopold fiberglass **wash-water troughs** are employed in **water** and wastewater filters to provide uniform removal of **wash water** during backwashing.

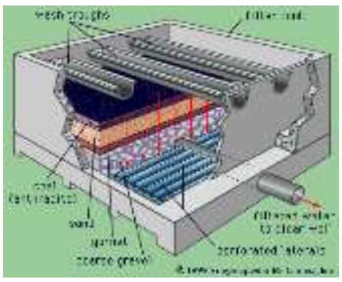


Figure 19: Wash water troughs

- **Under drain system**

An agricultural **drainage system** is a **system** by which water is drained on or in the soil to enhance agricultural production of crops. It may involve any combination of stormwater control, erosion control, and water table control.

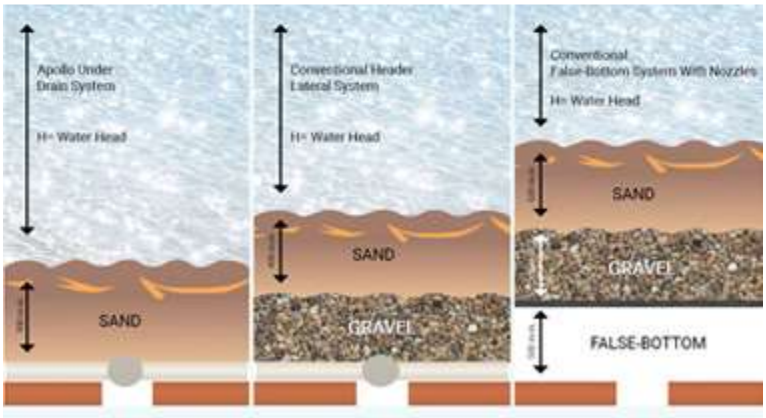


Figure 20: Under drain system

- **Nozzles and air scour components**

Air scour must be distributed evenly across the base of a filter if it is to work is used to introduce air into the plenum underneath a nozzle floor, and whatever the membrane elements by air scouring and air-assisted backwash every 30–60.

Filter nozzles are designed to be used in all filter & drainage system & can be are set at an exactly uniform level & therefore evenly distributes air while air scour of manufacturer and supplier of plastic components for Water treatment plant.

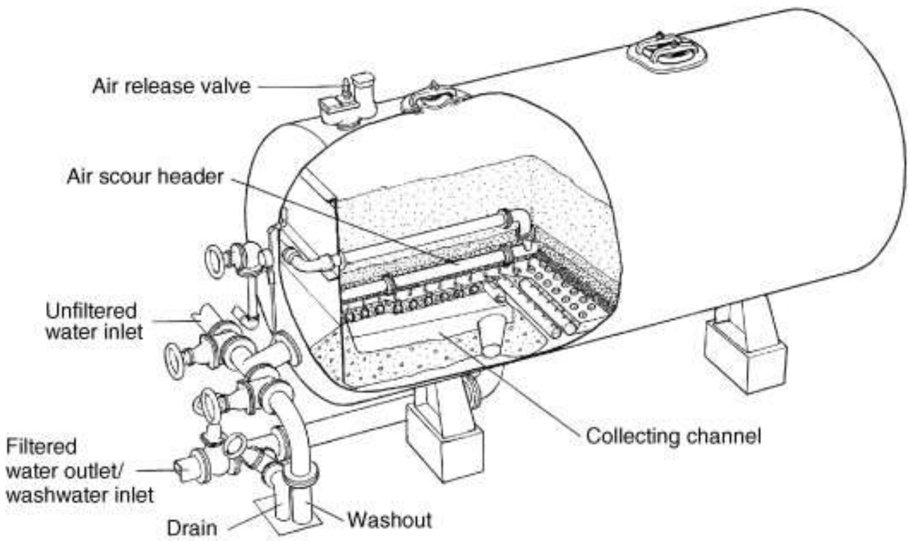


Figure 21: Nozzles and air scour components

- **Control systems**

control system manages, commands, directs, or regulates the behavior of other devices or systems using control loops. It can range from a single home heating controller using a thermostat controlling a domestic boiler to large Industrial control systems which are used for controlling processes or machines.

A structure for water control is a structure in

a water management system that conveys water, controls the direction or rate of flow, or maintains a desired water surface elevation. These structures are normally installed in a well-planned irrigation or drainage system.

- **Filter cell**

The standard tertiary filter system provides filter cell flow division, filtration, air scouring, backwashing, and backwash return of the wastewater. The filtrate percolates through each of the multi-media filter cells and then into the area below the filter nozzle plates.

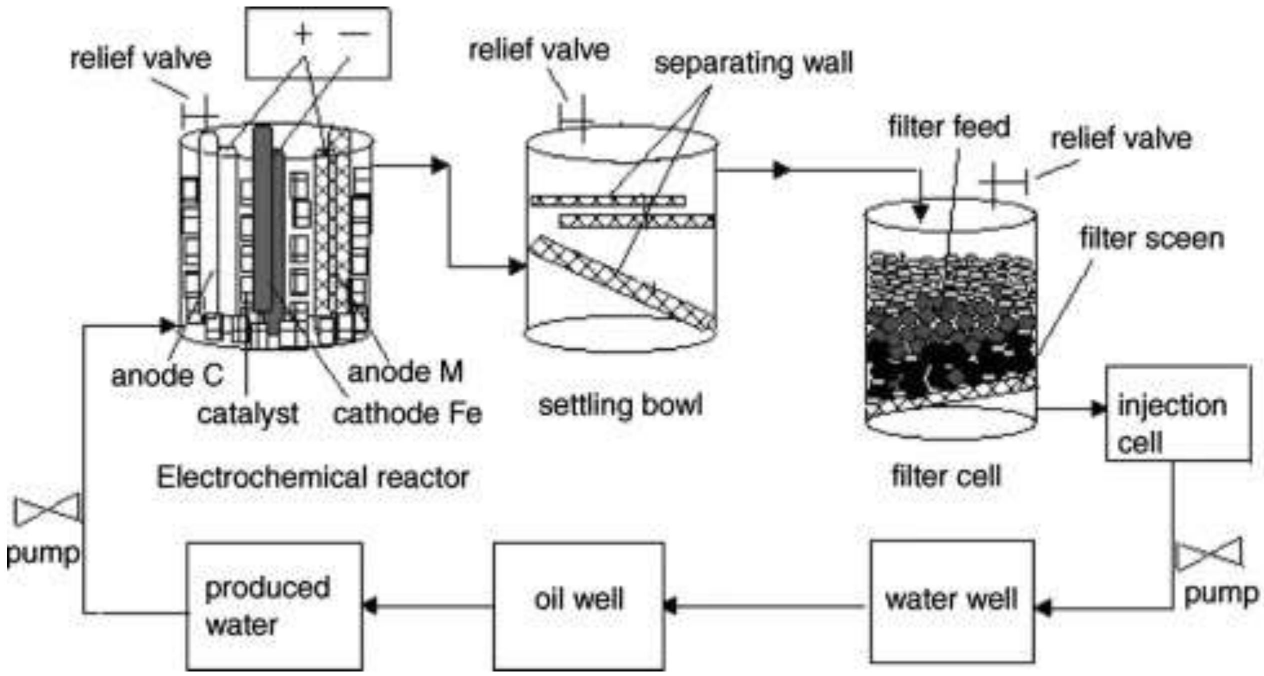


Figure 23: Filter cells

- **Surface washers**

Surface Washing Pre-cleaning can allow you to use less water and cleaning chemicals (such as wastewater in the sanitary sewer system or at the wastewater treatment plant. The following are examples of other equipment you may.

Figure 24: Surface washer

- **Turbidity meter**

Turbidity meters are used to quickly measure the turbidity (or cloudiness) of water, caused by suspended solid particles. Understanding how turbidity meters work can help in achieving more accurate results and ensuring the samples and meter are handled correctly.

Figure 25: Turbidity meter

- **Particle counter**

A particle counter is an instrument that detects and counts physical particles. Cleanrooms have defined particle count limits. Aerosol particle counters are used.

Figure 26: Particle Counter

Self-Check -9	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth four points.

2. Clarifier/Multi Media Filtration slides consisting of either a clarifier vessel or a train of multimedia vessels to treat water containing high suspended solids for use as a pre feed to: Chemical dosing skids consisting of_______.
   - A. dosing pumps
   - B. controllers
   - C. process analytical instrumentation
   - D. chemical storage tank and bund
   - E. All
3. Write all the main components of water treatment plant and their functions
4. Write at list seven components of water treatment plant and their functions

Note: **Satisfactory rating ≥6 points** **Unsatisfactory <6 points**

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

Answer Sheet-9

Name: ___________________________ Date: ________________

Choice Questions

Score = ___________

Rating: ____________

1. _______
2. ______
3. ______
4. ______
5. _______

Operation Sheet: 1	conducting operational problems of water treatment plant

Steps to conduct operational problem of water treatment plant

Step 1: Use relevant PPE

Step 2: Identify problems

Step 3: Describe the current situation

Step 4: Take temporary counter measures on the spot

Step 45: Find the rout cause

Step 6: Propose solution

Step 7: Establish an action plan

Step 8: Check results

Step 9: Decide on results

Operation Sheet: 2	Techniques for Conduct pre-sampling of jar test

Steps for sample Preparations of sediment test by jar test

Step 1: Use relevant PPE

Step 2: Use Appropriate tools and equipment

Step 3: Identify/Locate Sediment Sampling Sites

Step 4: Fill out field data sheet

Step 5: Prepare sampling jars

Step 6: Clean Sediment Sampling Equipment

Step 7: Put on gloves, rinse gloves with clean water

Step 8: First scrub equipment with sparkline

Step 9: Rinse with clean water (3×)

Step 10: Rinse with acetone

Step 11: Rinse with hexane

Operation Sheet: 3	Techniques for Preparing post samples for jar test

Steps for Post Sampling jar test

Step 1: Use relevant PPE

Step 2: Use Appropriate tools and equipment

Step 3: Label sampling containers (e.g. jars, bags) to be used.

Step 4: Clean all sampling equipments prior to sampling.

Step 5: Put on clean gloves, ensuring the type corresponds to the chemical risk.

Step 6: Either wade or navigate the boat (depending on type of sampling) to the sampling location to collect sediments, taking care not to disturb sampling area.

Step 7: Find a suitable sampling location, aiming to collect sediments from locations where finer sediments tend to be deposited.

Step 8: Collect sediments using a suitable sampling device (such as a clean trowel, Van Veen Grab Sampler or corer).

Step 9: Siphon off any overlying water with care to minimize loss of fine surface sediments that may be resuspended.

Step 10: Take a photo of the sample.

Step 11: If sub-sampling from a core sample, specific depth horizons can be selected by extruding the core and cutting the exposed sediment with a stainless steel or plastic cutter.

Step 12: If collecting a composite sample, place sediment from different individual samples into a stainless steel or plastic bowl. If possible, avoid using sediment that has been in direct contact with the metal sampling device.

Step 13: If the sample is **not** to be frozen.

Step 12: If the sample is to be frozen e.g. for measurement of acid volatile sulfide (AVS).

Step 14: If possible, measure in situ water quality data 5 to 20cm above the sampling site (i.e. pH, electrical conductivity, temperature, redox potential, turbidity and dissolved oxygen).

Step 15: Collect sediment quality characteristics if required (e.g. pH, redox potential).

Step 16: Record all relevant information relating to the sample collected in the field notebook/field data sheets.

Learner's Activity Performance (LAP) Test 1-3	Practical Demonstration

Project Title: Analyzing incidents and applying incident management procedures. Name: ____________________

Date ____________

Starting time___________

Finishing time_________________

Instructions: Go to the nearby water sources which have quality problems and do the following activities. (Use at least two sources).

Task 1: Identify and investigation of water quality problems.

Task 2: Conduct Pre-Sampling of sediments for water quality problems in a treatment plant.

Task 3: Conduct Post Sampling of sediments forwater quality problems in a treatment plant.

Instruction Sheet-3	LG 55: Investigate the operational options for process optimization

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

- Reviewing and taking Relevant fault and incident reports actions
- Investigating Current media status with reference to manufacturers' or plant designers' specifications
- Investigating Potential changes to operational processes to identify possible optimization strategies

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**:

- Review and taking Relevant fault and incident reports actions
- Investigate Current media status with reference to manufacturers' or plant designers' specifications
- Investigate Potential changes to operational processes to identify possible optimization strategies

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". Try to understand what are being discussed.
4. Accomplish the "Self-checks "1, 2, and 3"in each information sheets on pages 91, 97, and 104.
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 "self-check 1, and 2 on pages 91 and 116. 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.

1.1. Fault and Incident reports actions

Effective feedback from incident reporting systems in healthcare is essential.

Why do we need to investigate Incidents? The main reasons for investigating incidents is to try and identify the root cause/s that contributed to the incident or near miss occurring, so you have a greater opportunity to prevent the same type of incident from potentially occurring again.

- ✓ workers on the investigation team are trained in investigation techniques
- ✓ workers are trained in the importance of reporting accidents/incidents
- ✓ accidents/incidents are promptly reported
- ✓ employers demonstrate their commitment to health and safety to their workers and the public

1.1.2. When an incident occurs

1. Provide first aid and make sure the worker gets the right care.
2. Take care not to disturb the incident site until an inspector arrives.
3. Record it in the register of injuries.
4. Notify your insurer within 48 hours.

1.1.3. Importance of Incident Reporting and Investigations

In our busy working world, there can be times where things don't quite go the way we hoped they would, and employees may end up being injured while carrying out the work that we have engaged them to do.

It is important and necessary to report incidents as they occur. Reporting is not about attributing blame, but more about identifying possible workplace issues so they don't happen again.

- **Why do we need to report Incidents?**

The provision of timely and efficient first aid and medical response is crucial in caring for workers, sub-contractors and visitors in the event of an injury. Incidents can be Minor, Serious or Major but they are all "incidents" and need to be investigated to identify what happened with a view to preventing them happening again.

Employees are asked to report incidents and injuries so employers can make certain that their staff receive the correct medical treatment as soon as practicable. Fatalities have occurred from minor scratches that have gone untreated.

Additionally, timely and efficient reporting on hazards, incidents and other occurrences with actual or potential adverse risk to health and safety or damage to the environment are required to be in place so that risk assessment identifies appropriate corrective actions that can be taken.

Depending on the risk of the hazard or incident involved, immediate action must be taken to prevent further persons from being injured. This may involve the activation of emergency procedures or other actions to control the immediate risk to persons in the area, e.g. barricading the area, alerting Workers in Charge etc. If an injury has been sustained, first aid treatment should be given from a suitably qualified first aider promptly.

- **Why do we need to investigate Incidents?**

The main reasons for investigating incidents is to try and identify the root cause/s that contributed to the incident or near miss occurring, so you have a greater opportunity to prevent the same type of incident from potentially occurring again.

Determining the facts of the incident will also assist in identifying control measures that can be put in place to prevent further re-occurrences. It is equally important to communicate the outcome of any incident investigation to the rest of your employees, as that way they are all made aware of the potential risks and of changes the business has made to a process or procedure, including the reasons behind those changes.

Any witnesses to an incident should also be identified and their details documented in case required later. Photos can be taken of the scene as soon a possible following an incident as these may assist an investigation.

Corrective actions need to be finalized, the investigation closed, and documentation kept for including reopening of long-term injury claims or legal action, which could arise a long time after the event.

Each state and territory have mandatory requirements when it comes to reporting “notifiable incidents” please see the links below for your respective legislations and the requirement.

Self-Check -1	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. Effective feedback from *incident reporting* systems in healthcare is essential.

   A. true B. false

2. Reporting is not about attributing blame, but more about identifying possible workplace issues so they don't happen again.

   A. true B. false

3. When an incident occurs,

   A. Provide first aid and make sure the worker gets the right care.
   B. Take care not to disturb the incident site until an inspector arrives.
   C. Record it in the register of injuries.
   D. Notify your insurer within 48 hours.
   E. All

4. Depending on the risk of the hazard or incident involved, immediate action must be taken to prevent further persons from being injured.

   A. true B. false

5. If an injury has been sustained, first aid treatment should not be given from a suitably qualified first aider promptly.

   A. true B. false

Note: **Satisfactory rating ≥2.5 points** **Unsatisfactory <2.5 points**

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

Answer Sheet-1

Name: ___________________________ Date: ________________

Choice Questions

1._______ 2. ______ 3. ______4. ______ 5. _______

Score = ___________

Rating: ____________

Information-2	Investigating Current *media status* with reference to manufacturers' or plant designers' specifications

2.1. Investigating Current media status of Treatment plant

Filtration is used to separate no settleable solids from water and wastewater by passing it through a porous medium. The most common system is filtration through a layered bed of granular media, usually a coarse anthracite coal underlain by a finer sand. Filters may be classified according to the types of media used as follows:

A. **Single-media filters:** These have one type of media, usually sand or crushed anthracite coal.
B. **Dual-media filters:** These have two types of media, usually crushed anthracite coal and sand.
C. **Multi-media filters:** These have three types of media, usually crushed anthracite coal, sand, and garnet.

In water treatment all three types are used; however, the dual- and multimedia filters are becoming increasingly popular. In advanced tertiary wastewater treatment, nearly all the filters are dual- or multimedia types.

Many particles in water are too small to remove by sedimentation alone. Filtration removes microorganisms and suspended matter from water not receiving sedimentation treatment, or it eliminates precipitated particles and flocs remaining after sedimentation. Filtration was actually developed prior to the discovery of the germ theory by Louis Pasteur in France. The first sand filter beds were constructed in the early 1800s in Great Britain.

Particle removal is accomplished only when the particles make physical contact with the surface of the filter medium. Larger particles may be removed by straining. That is, the particle is larger than the pore, so it is trapped. Particles may also be removed by sedimentation as they progress through the filter. Others may be intercepted by and adhere to the surface of the medium due to inertia.

Filtration efficiency is greatly increased by destabilization or coagulation of the particles prior to filtration. This reduction in the particle charge increases particle agglomeration and reduces the forces necessary to trap particles within the filter. Media status may include but not limited to:

- **Regularity of surface:**

Regularity of Minimal Surfaces begins with a survey of minimal surfaces with free boundaries. Following this, the basic results concerning the boundary.

- **Media depth and Media profile**

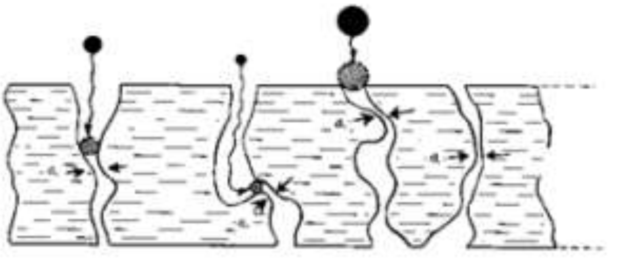
A depth media uses multiple layers of fiber or foam so that particles can be trapped within the depth of **t** Depth filters are the variety of filters that use a porous filtration medium to retain particles throughout the medium, rather than just on the surface of the medium. These filters are commonly used when the fluid to be filtered contains a high load of particles because, relative to other types of filters, they can retain a large mass of particles before becoming clogged. he filters, rather than just on the surface.

Depth filtration utilizes the thickness (depth) of a cellulose based filter media. This "depth" matrix is used to trap suspended particles; separating them from their carrying fluid. Depth filtration is most commonly applied in polishing filtration applications including, but not limited to:

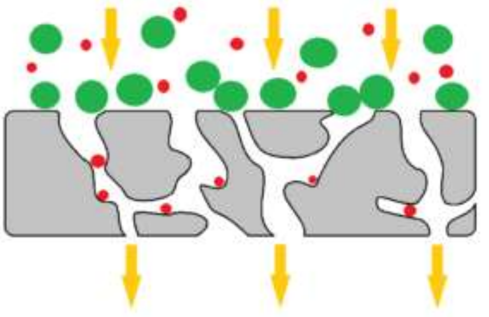
- ✓ Essential oil and extract clarification
- ✓ Haze removal in distilled spirits
- ✓ Blood fractionation operations recovering plasma
- ✓ Transformer oil filtration and water removal
- ✓ Bulk chemical production
- ✓ Large Volume Parenteral Solutions

The characteristic of depth filter media allow for fine filtrate removal with the flexibility to develop large filter cakes if needed. Depth filtration clarifies through several means of retention including sieving, interception, adsorption, and absorption.

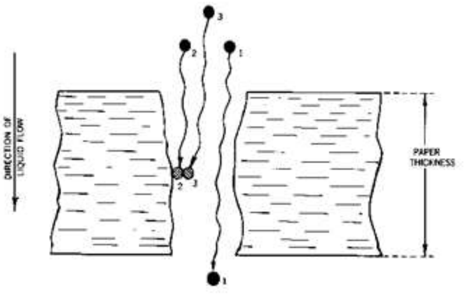
Sieving occurs when the particulate is larger than the pore spaces in the media, and therefore cannot pass through.



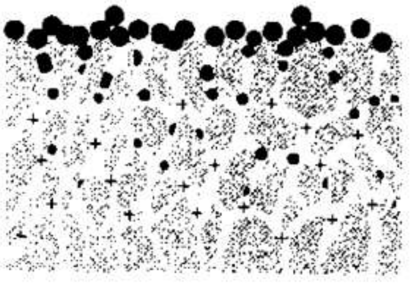
Interception of solids occurs in depth media due to loss of energy. Solids must pass through a tortuous path while crossing the depth of the filter media. The loss of energy experienced traps solids within the matrix.



Adsorption is the adhesion of molecules to the solid structure that they are in contact with. Adsorption usually occurs as a result of physical attraction between molecules (van der Waals force), chemical attraction at the surface/molecule interface, or more commonly in-depth media through electro-static attraction.



Ertel Alsop depth media is manufactured with varying amounts of wet strength resin mixed with cellulose fibers, the presence of these resins creates an inherent positive charge in our depth media filters. This positive charge (referred to as Zeta potential) generates an electro-static attraction (adsorption!) to negatively charged contaminants in the slurry stream.



Absorption characteristics within Depth Media helps to assist in the separation of water from oil-based slurries. ErtelAlsop's depth media is manufactured from cellulose fibers which naturally absorbs water through a blotter effect. For the most efficient water removal try ErtelAlsop's patented AquaKV Paks which utilize a laminate and depth media combination and boasts a minimum water capture of 8oz per square foot

One major advantage of Depth Media is the ability to impregnate the medium with filter aids to assist in filtration and resist blinding. Commonly Depth Media is impregnated with Diatomaceous Earth (DE), Volcanic Ash (Perlite), and Activated Carbon. The addition of filter aids offers the following additional advantages

- ✓ Advantages of DE vs. Perlite
    - Haze Filtration
    - Retention Levels
    - High Purity Grades
    - Void Volume
- ✓ Advantages of Perlite vs. DE
    - Low Crystalline Silica Content
    - Wet Strength

- **Media uniformity**

Uniformity Coefficient: This is defined as a ratio and is calculated as the size opening that will just pass 60% of the sand (d60 value) divided by the size opening that will just pass 10% of the sand sample (d10 value). ES is basically a value describing the average size of sand grains in a sand sample.

measure of the degree of uniformity in a granular material such as filter media. The measure is the ratio of the diameter of a grain (particle) of a size that is barely too large to pass through a sieve that allows 60 percent of the material (by weight) to pass through to the diameter of a grain (particle) of a size that is barely too large to pass through a sieve that allows 10 percent of the material (by weight) to pass through.

- **Solids retention profile**

The relationship between retention and particles size is not a step function. Larger particles are easily retained by the filter media; however, particulates that are within the intermediate range between the nominal particle and waste components are harder to preserve and as a result are often lost as a waste component.

To maximize the retention passage for a range of particle sizes, filter media is layered in a manner such that sections with a higher pore size are closer to the inlet stream, capturing particles of a larger size. Pore sizes decrease as it approaches the outlet stream. By adopting this method, the filter media caters for a wider range of particle sizes, resulting in greater control of retention and extending the life of the filter.

- **Presence of contaminants**

The Safe Drinking Water Act (SDWA) defines "contaminant" as any physical, chemical, biological or radiological substance or matter in water. The presence of contaminants does not necessarily indicate that the water poses a health risk.

Contamination is the presence of a constituent, impurity, or some other undesirable element that spoils, corrupts, infects, makes unfit, or makes inferior a material, physical body, natural environment, workplace, etc.

Self-Check -2	Written Test

Direction I: Choose the best answer for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. Filtration is used to separate a settleable solids from water and wastewater by passing it through a porous medium.
   A. true B. false
2. The most common system is filtration through a layered bed of granular media. A. true B. false
3. Many particles in water are too small to remove by sedimentation alone.
   A. true B. false
4. Particle removal is accomplished only when the particles make physical contact with the surface of the filter medium.
   A. true B. false
5. Filtration efficiency is greatly increased by destabilization or coagulation of the particles prior to filtration.
   A. true B. false
6. Reduction of the particle charge that increases particle agglomeration and reduces the forces necessary to trap particles within the filter using media status including_____.
   A. Regularity of surface
   B. Solids retention profile
   C. Presence of contaminants
   D. All are answers
7. How may Filter media types mainly used:

A. **2**
B. **3**
C. **4**
D. **5**

Note: **Satisfactory rating ≥3.5 points** **Unsatisfactory <3.5 points**

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

Answer Sheet-2

Name: ___________________________ Date: ________________

Choice Questions

Score = ___________
Rating: ____________

1.________ 2. _______ 3. _______4. _______ 5. ________ 6. ________ 7. ________

Information-3	Investigating Potential changes to operational processes to identify possible optimization strategies

3.1. Conventional Water Treatment Processes

3.1.1. Coagulation

Surface waters must be treated to remove turbidity, color and bacteria. The object of coagulation (and subsequently flocculation) is to turn the small particles of color, turbidity and bacteria into larger flocs, either as precipitates or suspended particles. These flocs are then conditioned so that they will be readily removed in subsequent processes. Technically, coagulation applies to the removal of colloidal particles. We define coagulation as a method to alter the colloids so that they will be able to approach and adhere to each other to form larger floc particles.

3.1.2. Colloid Stability

Before discussing colloid removal, we should understand why the colloids are suspended in solution and cannot be removed by sedimentation or filtration. Very simply, the particles in the colloid range are too small to settle in a reasonable time period and too small to be trapped in the pores of a filter. For colloids to remain stable they must remain small. Most colloids are stable because they possess a negative charge that repels other colloids particles before they collide with one another.

3.1.3. Colloid Destabilization

Since colloids are stable because of their surface charge, in order to destabilize the particles, we must neutralize this charge. Such neutralization can take place by addition of an ion of opposite charge to the colloid. Since most colloids found in water are negatively charged, the addition of sodium ions (Na^+) should reduce the charge. As we would have predicted, then higher the concentration of sodium we add, the lower the charge, and therefore the lower the repelling forces around the colloid. If, instead of adding a monovalent ion such as sodium, we add a divalent or trivalent ion, the charge is reduced even faster. In fact, it was found by Hardy that one mole of a trivalent ion can reduce the charge as much as 30 to 50 moles of a divalent ion and as much as 1,500 to 2,500 moles of a monovalent ion.

3.1.4. Coagulants

The purpose of coagulation is to alter the colloids so that they can adhere to each other. During coagulation a positive ion is added to water to reduce the surface charge to the point where the colloids are not repelled from each other. A coagulant is the substance (chemical) that is added to the water to accomplish coagulation. There are three key properties of a coagulant:

A. **Trivalent cation**: As indicated in the last section, the colloids most commonly found in natural waters are negatively charged, hence a cation is required to neutralize the charge. A trivalent cation is the most efficient cation.
B. **Nontoxic:** This requirement is obvious for the production of a safe water.
C. **Insoluble in the neutral pH range:** The coagulant that is added must precipitate out of solution so that high concentrations of the ion are not left in the water. Such precipitation greatly assists the colloid removal process. The two most commonly used coagulants are aluminum (Al^{+3}) and ferric iron (Fe^{+3}). Both meet the above three requirements and their reactions are outlined here.

3.2. Water Treatment System

The raw (untreated) surface water enters the plant via pumps. Usually screening has taken place prior to pumping. During mixing, chemicals called coagulants are added and rapidly dispersed through the water. The chemical reacts with the desired impurities and forms precipitants (flocs) that are slowly brought into contact with one another during flocculation. The objective of flocculation is to allow the flocs to collide and grow to a settleable size. The particles are removed by gravity (sedimentation). This is done to minimize the number of solids that are applied to the filters. For treatment works with a high-quality raw water, it may be possible to omit sedimentation and perhaps flocculation. This modification is called direct filtration. Filtration is the final polishing (removal) of particles. During filtration the water is passed through sand or similar media to screen out the fine particles that will not settle. Disinfection is the addition of chemicals (usually chlorine) to kill or reduce the number of pathogenic organisms. Disinfection of the raw water is neither economical nor efficient. The color and turbidity consume the disinfectant thus requiring the use if excessive amounts of chemical. In addition, the presence of turbidity may shield the pathogens from the action of the disinfectant and thereby prevent efficient destruction. Storage may be provided at the plant or located within the community to meet peak demands and to allow the plant to operate on a uniform schedule. The high – lift pumps provide sufficient pressure to convey the water to its ultimate destination. The precipitated chemicals, original turbidity, and suspended materials are removed from the sedimentation basins and form the filters. This sludge must be disposed of properly.

3.3. Identifying Problem Assets

Problem assets can be defined as pieces of equipment that have had significant negative impacts on the manufacturing process. This definition includes:

- Equipment that has a low MTBF (mean time between failure). This means the equipment fails more regularly than expected.
- Equipment that has a very high annual maintenance cost.
- Equipment that has caused production downtime.
- Equipment that has failed shortly after its last repair.

In order to identify the problem asset list and resolve issues, it is necessary to rank each piece of equipment based on the total cost of failure. This is done by adding the maintenance repair cost to the loss of production value to calculate a total cost of the impact of failure. The “worst” asset is the one which has the highest total cost of impact. Normally, the loss associated with lower production far outweighs the individual cost of a repair.

It is critical to go through this process of quantifying the impact of the problem assets and rank them in order of priority. This will facilitate the right level of attention being paid to the biggest problems so that overall manufacturing production improves. These problems can be resolved once the biggest impact issues have been addressed.

A comprehensive strategy is needed to resolve problematic assets, involving every department. Once the focus is clear, each specialist group can play their part to remove the threat that problem assets pose to the business.

- Operators are concerned with the operating conditions of the equipment and work hard to ensure that these conditions are kept as close to ideal as possible at all times. Regular checks are carried out to monitor that the equipment is still functioning well. Alarm points are set to trigger corrective action when ideal operating limits are violated.
- Condition monitoring technicians develop routines that specifically focus on the problem assets. For example, a system is designed to watch the trends in vibration, temperature and other indicators so that an early warning is received when signs of deterioration start to show.
- Maintenance staff document accurate work procedures and ensure they are performed as scheduled by properly trained technicians. This includes defining step by step instructions, including parts and special tools needed for the repair.

- Design engineers review the design criteria for the equipment concerned. Evaluations are done in terms of how the design can be improved to prevent failures that occur because of operating outside of ideal design conditions.

3.4. Identify Problem Assets to Improve Operations

Creating a list of problem assets focuses the organization on either taking proactive steps to prevent issues or justifying replacement of the asset. No longer are they pieces of equipment with a poor reputation; now an action plan can be created that will genuinely improve the performance of the manufacturing facility.

Generally, Potential changes to operational processes may include but not limited to:

- **Backwash rates**

Backwash and flow rate statistics are given below for many of the media most commonly used in backwashing filters. This is information you should have if you're considering a backwashing filter.

All filters clean in backwash. In order to achieve a proper bed expansion for cleaning, choosing your media is, in many cases, dependent on the well pump flow rate. There is no cheating here.

If the chosen filter requires a backwash flow rate of 10 gpm and the pump only produces 7 gpm, the bed will not clean completely and though it may take a few months to a year, the bed will foul prematurely.

Water temperature also plays a role in selecting the right equipment. Colder water will expand the mineral bed more than warmer water at the same flow rate.

- **Filtration rates**

Glomerular filtration rate (GFR) is a test used to check how well the kidneys are working. Specifically, it estimates how much blood passes through the glomeruli each minute. Glomeruli are the tiny filters in the kidneys that filter waste from the blood.

The rates of filtration, or the glomerular filtration rate (GFR), is determined by the equation $GFR = K_f \times$ net filtration pressure, where K_f is the filtration coefficient. The glomerular capillary hydrostatic pressure is affected by the afferent and efferent arteriolar resistance and the renal artery pressure.

- **Air scour rate and time**

Air scour must be distributed evenly across the base of a filter if it is to work air and water the required rate of application of water is about four times as great.

Eliminating sediment and debris from municipal water mains that deliver potable water to residences and businesses can help preserve water quality.

- **Filter aid addition**

Addition of filter aid. Filter aids can improve the permeability and sometimes porosity of a filter cake, improve filtrate clarity and help to prevent filter medium. an agent consisting of solid particles (as of diatomite) that improves filtering efficiency (as by increasing the permeability of the filter cake) and that is either added to the suspension to be filtered or placed on the filter as a layer through which the liquid must pass.

Liter-aid filtration is widely used to remove impurities which tend to clog the filter medium. In many processes, filter aid is continuously dosed to the suspension to be purified. In these cases, a suitable filter-aid concentration is important to assure good separation with a minimal energy consumption.

- **Storage of offline filters**

Offline Filter Benefits. Very efficient Removal of Particles and Water. Very efficient Removal of Bacterial Sludge. High Dirt Holding Capacity. Reduced Build Up of Bacterial Sludge. Extend Life of Fuel in Storage. Reduced Risk of Inline Filter Blockage. Units Easy to Operate and Maintain.

Self-Check -3	Written Test

Direction I: Match the section A with section B properly for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

A	**B**
1. Coagulation	A. Altering the colloids
2. Purpose of coagulation	B. Nontoxic
3. Nontoxic	C. Allow the flocs to collide and grow to a settleable size
4. Trivalent cation	D. The change from liquid to insoluble state
5. Coagulant	E. Required to neutralize the charge
6. Commonly used coagulants	F. Required to neutralize the charge
7. properties of a coagulant	G. Aluminum (al^{+3}) and ferric iron (fe^{+3})
8. Raw surface water	H. The substance added to the water to do coagulation
9. Objective of flocculation	I. Untreated surface water
10. Disinfection	J. Treated water
	K. Addition of chemicals (usually chlorine) to kill or reduce the number of pathogenic organisms.

Note: **Satisfactory rating ≥5 points** **Unsatisfactory <5 points**

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

Score = ___________

Rating: ____________

Answer Sheet-3

Name: ____________________________ Date: ________________

Choice Questions

1._______ 2. ______ 3. ______4. ______ 5. _______

6._______ 7. _______ 8. ______ 9. ______10. ______

Instruction Sheet-4	LG 56: Complete documentation

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

- Collecting, recording, and completing process data.
- Identifying data that falls outside normal parameters and report 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**:

- Collect and record and complete process data.
- Identify data that falls outside normal parameters and report 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 "1- 2". Try to understand what are being discussed.
4. Accomplish the "Self-checks "1 and 2"in each information sheets on pages 115, and 119.
5. If you earned a satisfactory evaluation proceed to "Operation sheets "1" on page 120, And do the LAP Test-1 on page 121". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
6. After You accomplish Operation sheets and LAP Test-1, ensure you have a formative assessment and get a satisfactory result; then proceed to the next LG.

Information Sheet-1	Collecting, recording, and completing process data

1.1. Introduction about data processing

In contrast with laboratory investigations which commonly give rise to relatively few observations, large-scale nutrition intervention programmes require the collection, orderly handling and management of large quantities of data.

Since the data ultimately constitute the link between the design of the intervention and the evaluation of results, its management and handling clearly merit careful consideration. In this context, the procedures required for the collection of data and its subsequent treatment, which include the definition of the plan for analysis and expected outputs, should be an integral part of the study design.

Some basic procedures relating to various aspects of data recording and processing are described in this chapter, Although the coverage is neither complete nor exhaustive, it is hoped that the topics considered provide some general guidelines which may be useful as a frame of reference for identifying appropriate data management procedure under the specific set of circumstances of a particular study.

The processes to be described can best be summarized in terms of a gross flow chart diagram, as illustrated in figure 4.1A. Stages of Data Recording and Processing). Obviously, the different stages depicted here on a macro basis can, and must be, expanded in detail in accord with conditions pertaining to any specific investigation. Two examples of such expansion are presented later in the text in connection with the preparation of forms and questionnaires and the description of the sequence of events that relate to the process of data analysis.

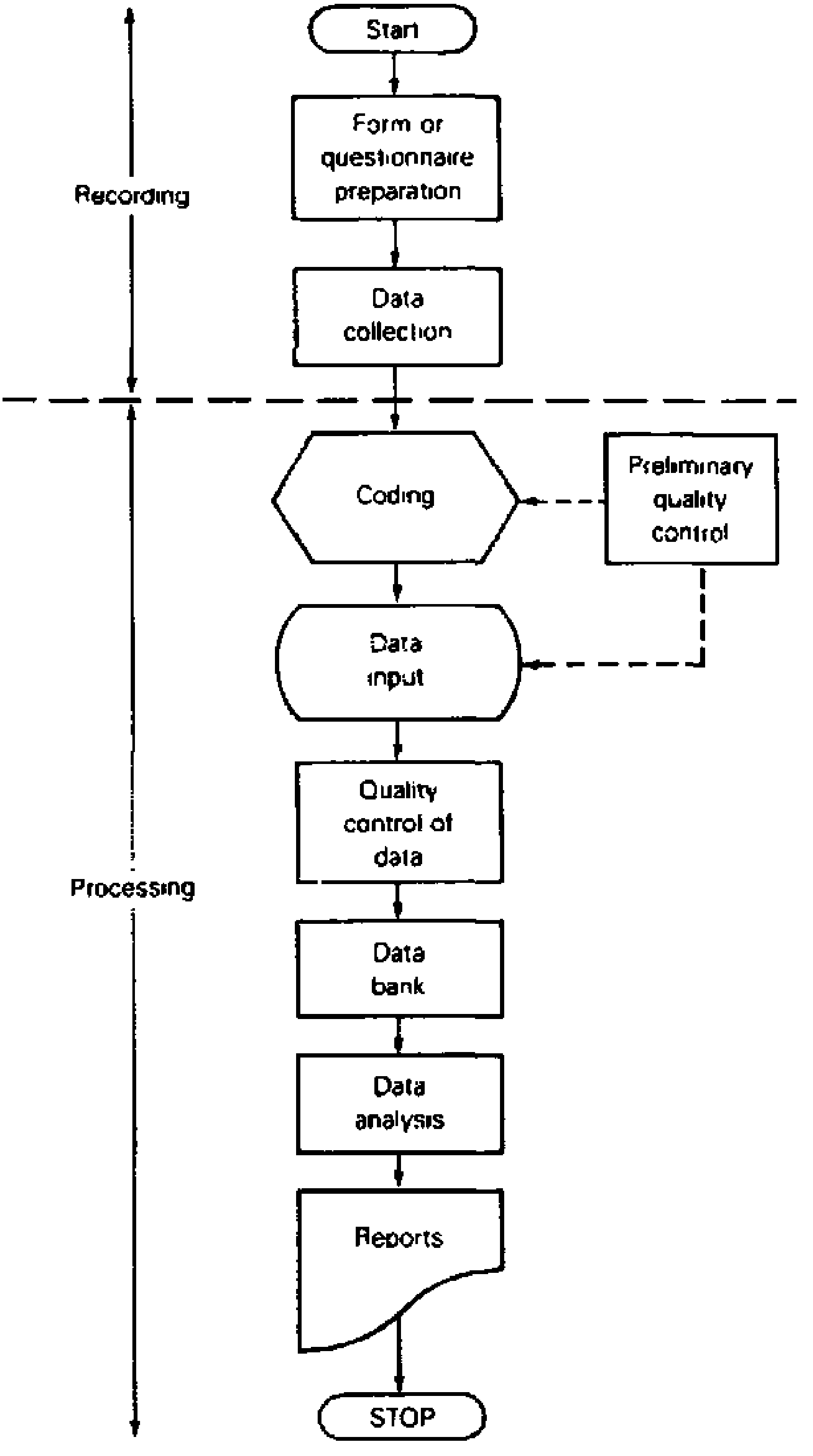


figure 4.1A: gross flow chart diagram

1.2. Data recording

The general purpose of data recording is to set in writing and assure the preservation of the data collected in the course of field or laboratory studies.

The experimental design of each study determines the types of data to be collected in terms of the objectives and resources available for the study. The types of data commonly used in field studies, among others, often relate to morbidity, anthropometry diet. immunology and anthropology. Whatever the nature of the types of data, however, there is need for suitable forms or questionnaires to record the information to be gathered. It is often convenient to prepare these forms or questionnaires by discipline or type of data. The use of pre-coded forms or questionnaires that permit the direct registry of data is to be preferred, since with proper training, their use often results in fewer errors. Additionally, only one protocol or set of forms will be used to collect and code the information to be recorded in the field or in the laboratory for each unit of study (e.g., family or individual).

1.2.1. **Form or Questionnaire Preparation**

The objective of this stage is to produce all the needed forms and/or questionnaires in their final versions, as they will be used in the field or laboratory. These forms and questionnaires must be accompanied by a set of detailed instructions explicitly set out in a coding manual. In general, three steps are involved in the preparation of forms or questionnaires which comprise a series of coordinated actions as shown schematically in figure 4.1B. (see figure 4.1B: Coordinated Actions in the Preparation of Forms and Questionnaires for Data Recording)

The forms and questionnaires contain the information needed by both the investigator and the data processing personnel, and generally consist of two parts: a heading and a body.

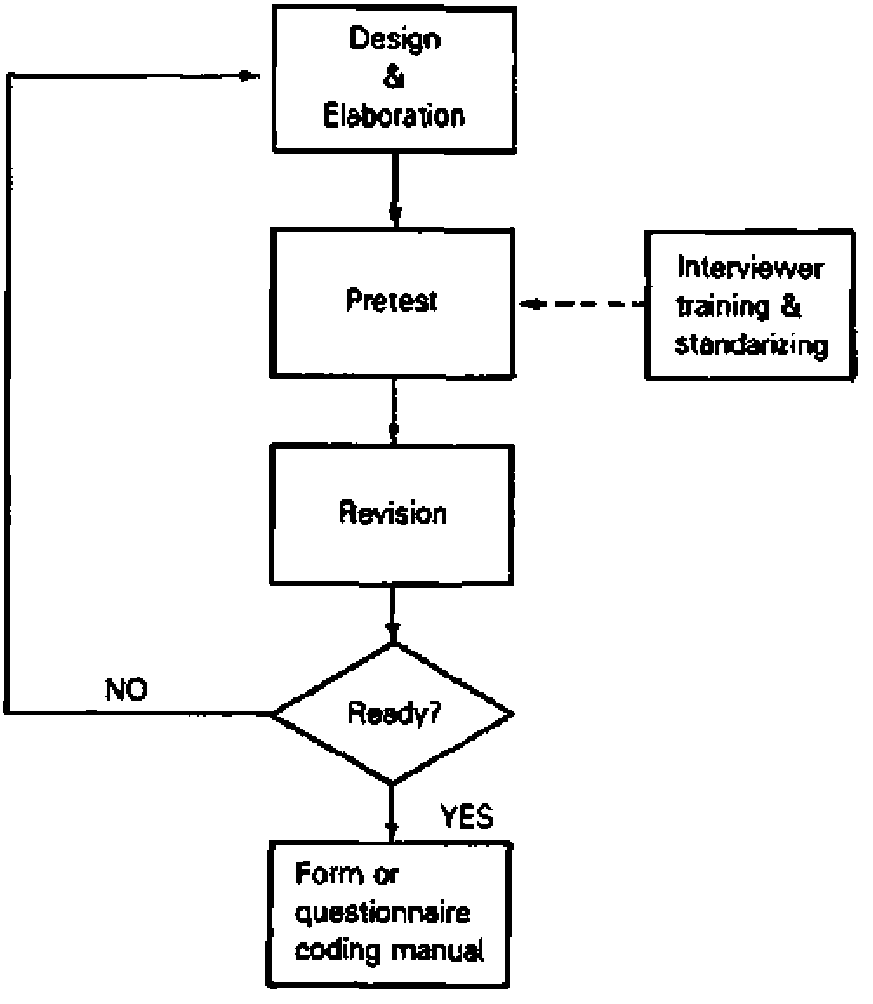


figure 4.1B: Preparation of Forms and Questionnaires for Data Recording

The heading of the forms or questionnaires includes information needed mainly to prepare appropriate data files in accord with the objectives of the study as defined by the responsible investigator. The heading, however, may also include information to allow subject recall by the investigator, either for further interviewing or for checking the original recordings.

Each study and type of data or area should be assigned a code. For each type of data there may be as many forms as needed for complete recording, and therefore, each form also requires the assignment of a proper code identification. Since the study sample generally relates to country, region, community or similar geographic location classes, these items also must be identified a priori with specific codes.

The field tests will permit proper adjustments and improvement of the recording forms and accessory materials, prior to preparing them for production in sufficient volume to satisfy the needs of the study. The investigator must also consult with the personnel responsible for processing data prior to producing the definitive versions of the forms and questionnaires to be used in the evaluation.

The testing required for developing the forms and questionnaires offers the opportunity to include activities related to the training and coordinating of examiners and interviewers. Otherwise, the training and standardization procedures must take place later, but always prior to the initiation of actual data collection.

1.2.2. **Data Collection**

Data collection can be initiated when the personnel responsible for data collection have been properly trained and have reached a satisfactory level of standardization. In addition, forms, questionnaires and coding manuals must be considered operational. The description of recording forms, and the techniques and procedures to be employed should be integrated into a standard operating protocol (SOP) for the evaluation. In the course of long-term studies, changes in procedure may be mandatory.

Accordingly, it is advisable to produce the SOP in a loose-leaf form for ease of insertions as may be required. In this connection. however, it is essential that all changes introduced in the course of the evaluation be fully documented in terms of justification, nature of the change and date of implementation.

Several types of errors may arise during the data collection stages which may produce biases affecting the interpretation of results. These errors are generally associated with failure to complete interviews, missing data, interviewer mistakes, and conceptual misunderstandings, lack of knowledge, and intentional misrepresentations of truth by the respondents. To minimize the effects of these factors or conditions, special attention must be given to proper supervision throughout the data collection stages.

In any case, full documentation of the execution of all aspects and levels of activity is essential. This includes field procedures, and data collection, editing, input and analysis. In particular, causes of missing data must be fully documented, since such information is essential for identifying possible biases arising from sample attrition.

1.2.3. **Coding**

This stage can be initiated even before the actual collection of data. For example, some items in the heading of the form can be pre-coded using computer facilities. Computers may also be used to produce the self-printed forms which contain information on the types of data to be collected, the geographic classification (country, community) and the observation unit (family, individual). More generally, however, forms and questionnaires are coded after data collection. In such a procedure, it is advisable that the coding be completed as soon as possible, preferably on the same day that the data were collected.

1.2.4. Data processing

In general, data processing can be understood as the treatment given to the data after collection. In small evaluations, this treatment is usually manual. In the case of large-scale efforts, the bulk of the data handling requires access to computer facilities although some parts of the data processing may be performed manually. In this context, a description of manual and computerized techniques will be reviewed, with special reference to large-scale studies.

1.2.5. Data Input

Recent advances in computer sciences provide a choice of alternatives for data input. These range from the use of the traditional punched card to direct access with automated systems using mark sense devices or direct on-line input from a measuring apparatus.

When the survey or research comprises a small number of cases and each case is evaluated in terms of many characteristics, an interactive data input procedure might be recommended, especially when the original data is generated in a place where facilities for data input (terminals) are available or can be easily installed. The interactive data input procedures provide the opportunity to test for completeness, inconsistencies and errors at the data sources. This often permits the implementation of proper procedures of data recovery. Unfortunately, this type of data input will undoubtedly have limited application in field evaluations.

When interactive data input procedures are not applicable, some type of key-to-tape data input systems must be implemented. In such systems, the speed of data recording can be high. However, immediate checks for completeness or inconsistency controls are not possible. since the processing of data unavoidably must take place with a delay. Under these conditions, delayed checks for errors and completeness or inconsistency controls are possible. although the recovery of data in most instances is practically impossible.

1.2.6. Data Quality Control

The control of data quality is a most important aspect of any research process. Once the data have been collected and coded. the control of its quality generally proceeds in two stages: the first relates to completeness and the second to the internal consistency among the various items that comprise the data set.

The preliminary controls for completeness of the data are usually, but not necessarily, performed after the coding of the data is complete. The purpose of this exercise is to control for the inclusion of every required item in each observation vector, both in terms of identification and actual data items (variables).

As indicated earlier, the identification portion of the observation vector generally includes several items or information bits that describe different individual characteristics. These descriptive items, considered in parallel with the evaluation or survey design, provide the reference criteria for the preliminary control of the completeness of the set of observation units.

The preliminary quality control procedures also relate to the checking of completeness for the remaining portion of the observation vector, which constitutes the actual data portion (variables) of each vector. In this case, special care is required to identify logical omissions of data which may be the valid result of logical associations among variables. For example, when one observation data item identifies a male subject, the observation vector for this subject cannot, and must not, include data items that refer to the number of pregnancies of the subject.

In the preliminary procedures for the quality control of observation of data items, it is often possible to include obvious control items that do not require much effort in the checking process. For example, if the questionnaire is applicable only to adults for example those 18 years of age or older, it is possible, while checking for completeness of the age information bits, to identify subjects under 18 years of age.

After satisfactorily completing this preliminary stage of data quality control checks, the first stage edited information vectors are ready for entry into appropriate devices for further processing. This is done prior to implementing computing procedures as required under the plan of analyses defined in the SOP.

The processing required in the control of consistency generally relates to two types of variables: continuous variables (interval scaled) such as age, weight, height, temperature and blood values; and discrete variables (nominally or ordinally scaled) such as sex, race, marital status and birth order.

The actions to be taken when an error is detected through any checking procedure are as follows:

1. Rechecking of the original data records to decide on recovery, acceptance or rejection;
2. Automatic deletion of a specific datum;

3. Automatic deletion of a specific datum with additional checking for decisions concerning data related to the questionable datum;
4. Deletion of the complete observation vector (all variables in the observation).

Although there are many possibilities for consistency controls, the procedures to be applied generally relate to the check of admissible ranges, and the examination of arithmetic, logical or special relations among variables.

1.2.7. Data Bank

The quality control of data will produce clean files for each type of data collected. A properly identified and cross-related set of such files is called a Data Bank.

The master data file will be created from the data bank by merging individual files using proper identification keys: study, data type, form identification, family, individual, date and examiner, for example. It is important to stress the need of complete and full documentation of the structure of the master data file, since this provides the keys and needed criteria for manipulating the information it contains When a properly and exhaustively documented master file is ready, the stage of data analysis can begin.

With computer system facilities having capability for Data Base Management, the Data Bank constitutes the original source of data for structuring a useful Data Base for subsequent processing. This feature is particularly useful for executing the statistical analyses required in the testing of specific hypotheses.

It is also important to point out that the data bank stage is not fixed. It is a very dynamic situation requiring continuous action and attention for as long as the interactive processes of data analyses and interpretation continue.

1.2.8. Data Analysis

The analysis of data relates both to the type of data and the hypotheses posed by the investigator. Most of the time, the first stage in the analysis of continuous variables consists of a scan of the data set. By scanning, one can define a set of basic descriptive statistics that will permit a first approximation to the pattern of behavior of each variable included in the evaluation. This type of analysis, however, also provides information that can be used in assessing the relative effectiveness and success of the data cleaning and consistency controls already executed. Different levels of scans can be used to secure adequate preliminary descriptions of the study variables. In particular, in the case of discrete variables, frequency tables with single or multiple cross-classification criteria may provide a good description of these variables.

Once the quality of the data collected has been documented and the general descriptions for the study variables have been obtained, the investigator may proceed with the statistical testing of the specific hypotheses. Simple comparison between two classes may be performed using student-t tests.

Analysis of variance techniques may be used when testing hypotheses that involve more than two classes, provided proper attention is given to satisfying the basic assumptions underlaying the use of these procedures. Trends and associations among variables may be examined by multiple regression and correlation analyses.

The classification and identification of groups of observations may be performed using clustering techniques and discriminate analysis, while confounded inter-relationships among large sets of variables may be examined using factor analysis. Overall relations in sets of variables, regardless of the nature of the variables within the set (continuous or discrete or mixtures), may be tested using canonical correlation analysis.

Frequently, it is not possible to satisfy the requirements and conditions inherent in the use of the parametric techniques listed above. Under such conditions, there is the option of using distribution free (non-parametric) techniques. The ability of rejecting a null hypothesis, when in fact the alternative hypothesis is true (power of the test), is generally smaller for non-parametric than for parametric procedures. However, under a given set of circumstances, they may be the only choice.

The level of generalization possible through non-parametric testing often compensates for the apparent, usually small, reduction in the power of the test. A partial listing of some useful analytical procedures.

Self-Check -1	Written Test

Direction I: Say true if the statement is correct or False if the statement is wrong for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. The general purpose of data recording is to set in writing and assure the preservation of the data collected in the course of field or laboratory studies.
2. The objective of form or questionnaire preparation is to produce all the needed forms used in the field or laboratory.
3. The description of recording forms, and procedures to be employed should not be integrated into a standard operating protocol (SOP) for the evaluation.
4. Data processing can be understood as the treatment given to the data after collection.
5. The control of data quality is not the most important aspect of any research process.
6. The analysis of data relates both to the type of data and the hypotheses posed by the investigator.

Note: **Satisfactory rating ≥3 points** **Unsatisfactory <3 points**

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

Answer Sheet-1

Name: ___________________________ Date: _______________

Score = ____________

Rating: _____________

True or False Questions

1________2. _______ 3_______4. _______ 5. ________ 6. ________

2.1. Risk reporting practices

Accurate, complete and timely data is a foundation for effective risk management. However, data alone does not guarantee that the board and senior management will receive appropriate information to make effective decisions about risk. To manage risk effectively, the right information needs to be presented to the right people at the right time. Risk reports based on risk data should be accurate, clear and complete. They should contain the correct content and be presented to the appropriate decision-makers in a time that allows for an appropriate response.

To effectively achieve their objectives, risk reports should comply with the following principles.

2.1.2. Accuracy-Risk management reports

Risk management reports should be accurate and precise to ensure a bank's board and senior management can rely with confidence on the aggregated information to make critical decisions about risk. To ensure the accuracy of the reports, a bank should maintain, at a minimum, the following:

a) Defined requirements and processes to reconcile reports to risk data;

b) Automated and manual edit and reasonableness checks, including an inventory of the validation rules that are applied to quantitative information. The inventory should include explanations of the conventions used to describe any mathematical or logical relationships that should be verified through these validations or checks;

c) Integrated procedures for identifying, reporting and explaining data errors or weaknesses in data integrity via exceptions reports.

Approximations are an integral part of risk reporting and risk management. Results from models, scenario analyses, and stress testing are examples of approximations that provide critical information for managing risk. While the expectations for approximations may be different than for other types of risk reporting, banks should follow the reporting principles in this document and establish expectations for the reliability of approximations (accuracy, timeliness, etc) to ensure that management can rely with confidence on the information to make critical decisions about risk. This includes principles regarding data used to drive these approximations.

Supervisors expect that a bank's senior management should establish accuracy and precision requirements for both regular and stress/crisis reporting, including critical position and exposure information. These requirements should reflect the criticality of decisions that will be based on this information.

Supervisors expect banks to consider accuracy requirements analogous to accounting materiality. For example, if omission or misstatement could influence the risk decisions of users, this may be considered material. A bank should be able to support the rationale for accuracy requirements. Supervisors expect a bank to consider precision requirements based on validation, testing or reconciliation processes and results.

2.1.3. Comprehensiveness

Risk management reports should cover all material risk areas within the organization. The depth and scope of these reports should be consistent with the size and complexity of the bank's operations and risk profile, as well as the requirements of the recipients.

Risk management reports should include exposure and position information for all significant risk areas (eg credit risk, market risk, liquidity risk, operational risk) and all significant components of those risk areas (eg single name, country and industry sector for credit risk).

Risk management reports should also cover risk-related measures (eg regulatory and economic capital). Reports should identify emerging risk concentrations, provide information in the context of limits and risk appetite/tolerance and propose recommendations for action where appropriate. Risk reports should include the current status of measures agreed by the board or senior management to reduce risk or deal with specific risk situations. This includes providing the ability to monitor emerging trends through forward-looking forecasts and stress tests.

Supervisors expect banks to determine risk reporting requirements that best suit their own business models and risk profiles. Supervisors will need to be satisfied with the choices a bank makes in terms of risk coverage, analysis and interpretation, scalability and comparability across group institutions. For example, an aggregated risk report should include, but not be limited to, the following information:

- ✓ capital adequacy,
- ✓ regulatory capital,
- ✓ capital and liquidity ratio projections,
- ✓ credit risk,
- ✓ market risk,

- ✓ operational risk,
- ✓ liquidity risk,
- ✓ stress testing results,
- ✓ inter- and intra-risk concentrations,
- ✓ funding positions and plans.

Supervisors expect that risk management reports to the board and senior management provide a forward-looking assessment of risk and should not just rely on current and past data.

The reports should contain forecasts or scenarios for key market variables and the effects on the bank so as to inform the board and senior management of the likely trajectory of the bank's capital and risk profile in the future.

Self-Check -2	Written Test

Direction I: Say true if the statement is correct or False if the statement is wrong for the following questions. Use the Answer sheet provided in the next page: Each question worth one point.

1. Accurate, complete and timely data is a foundation for effective risk management.
2. To manage risk effectively, the right information not needed to be presented to the right people at the right time.
3. Risk reports based on risk data should be accurate, clear and complete.
4. Risk management reports should be accurate and precise to ensure a bank's board and senior management can rely with confidence on the aggregated information to make critical decisions about risk.
5. Risk management reports should cover all material risk areas within the organization.
6. The reports should contain forecasts or scenarios for key market variables and the effects on the data bank.

Note: **Satisfactory rating ≥3 points** **Unsatisfactory <3 points**

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

Answer Sheet-2

Name: ___________________________ Date: ________________

True or False Questions

Score = ___________
Rating: ____________

1________2. _______ 3_______4. _______ 5. ________ 6. ________

Operation sheet: 1	Testing environmental performance on water quality

Steps for environmental performance testing to investigate water quality problems

Step 1: Identify the Testing Environment

Step 2: Identify Performance Metrics

Step 3: Plan and Design Performance Tests

Step 4: Configure the Test Environment

Step 5: Implement Your Test Design

Step 6: Execute Tests

Step 7: Analyze the problems

Step 8: Report the problems

Step 9: Retest the problems (if you are not satisfied)

Learner's Activity Performance (LAP) Test-1	Practical Demonstration

Project Title: Analyzing incidents and applying incident management problems.

Name: ____________________

Date ____________

Starting time___________

Finishing time_________________

Instructions: Go to the nearby water treatment plants which have quality problems and do the following activity. (Use at least two sources)

Task 1: Identify and investigate water quality problems due to treatment plant.

- **References**

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