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OBJECTIVE

The Major Aim of water treatment plants is to remove as much of the suspended solids from raw water to make it safe and portable drinking water.

 "Primary treatment" removes about 60 percent of suspended solids from raw water. This treatment also involves aerating (stirring up) the raw water, to put oxygen back in   “Secondary treatment” removes more than 90 percent of suspended solids. Then disinfectant is added in water to make it clean and reusable.

INTRODUCTION

The water treatment plant is a facility that cleans raw water from various sources, such as rivers, lakes, wells, or rainwater, and makes it suitable for human consumption or industrial use. A raw water treatment typically consists of several stages, such as screening, aeration, coagulation, sedimentation, filtration, disinfection, and storage. Each stage removes different types of contaminants, such as solids, gases, metals, organic matter, microorganisms, and chemicals. The treated water is then distributed through pipes or stored in tanks for later use. A raw water treatment plant is essential for ensuring the quality and safety of water supply for people and the environment.

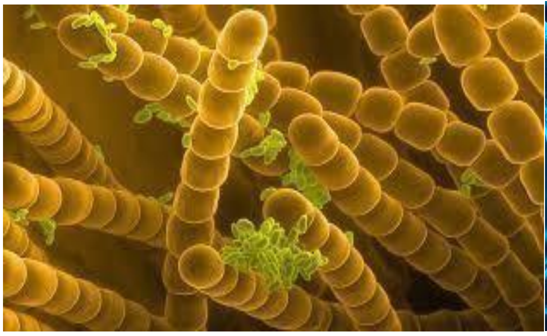
RAW WATER SOURCES

The raw water is taken from Ravishankar Dam, Dhamatari and Bhatagaon Anicut through intake wells. The raw water then treated in water treatment plant and then clean. usable water is delivered to Over-head tanks (OHT’s) for public use.

MICROBES IN RAW WATER

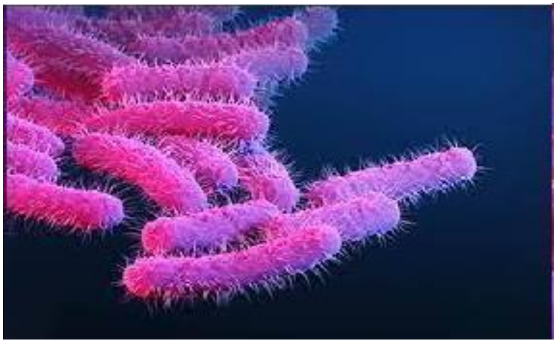
Raw water is water that has not been treated and may contain various microorganisms, such as bacteria, viruses, protozoa, and algae. Some of these microorganisms can be beneficial for the environment and the food chain, but some can also cause diseases in humans and animals. Therefore, raw water should not be consumed without proper treatment and disinfection.

Some examples of microorganisms that can be found in raw water are: Bacteria, Shigella, Escherichia coli, Vibrio, and Salmonella are found water bodies.



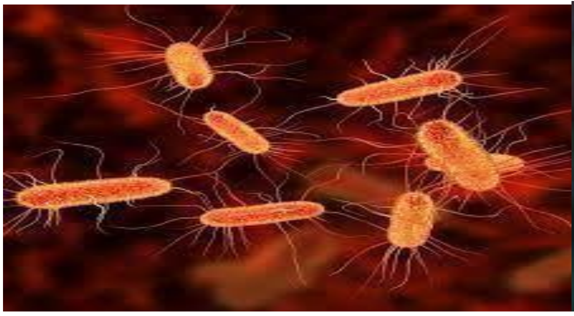
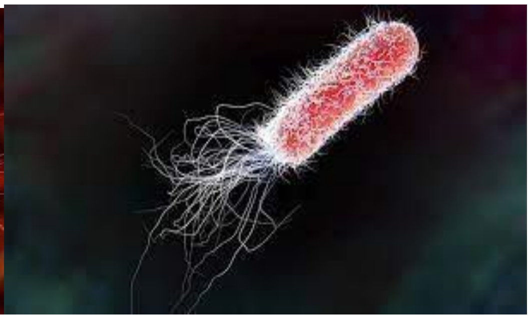

- **Shigella bacteria**

It causes an infection called shigellosis. *Shigella* can spread easily from one person to another and it only takes a small amount of *Shigella* to cause illness.



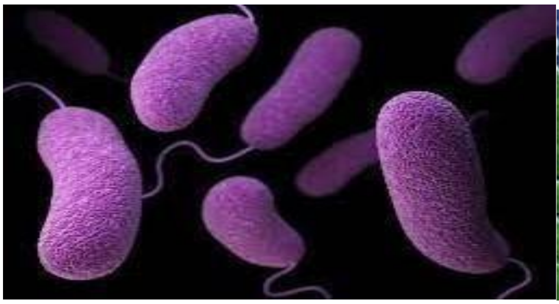

- **Escherichia coli (E. coli) bacteria**

It normally lives in the intestines of healthy people and animals. Most types of E. coli are harmless or cause relatively brief diarrhea. But a few strains, which may be found in water bodies, can cause stomach cramps, bloody diarrhea, and vomiting.

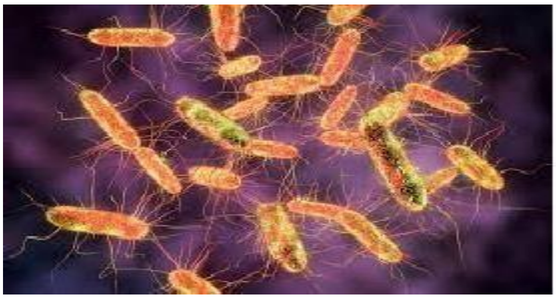
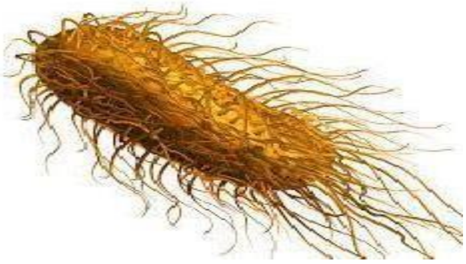
§ **Vibrio**

It is a genus of Gram-negative bacteria, possessing a curved-rod shape, several species of which can cause foodborne infection, usually associated with eating undercooked seafood.



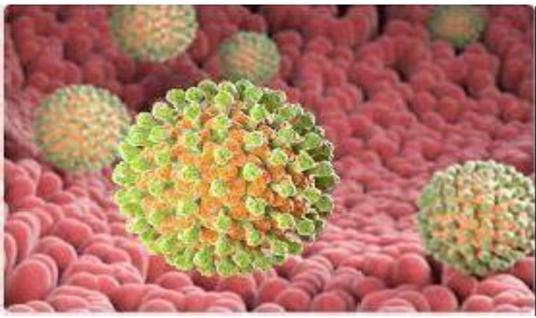

§ **Salmonella infection**

Salmonellosis is a common bacterial disease that affects the intestinal tract. Salmonella bacteria typically live in animal and human intestines and are shed through stool (feces). Humans become infected most frequently through contaminated water.

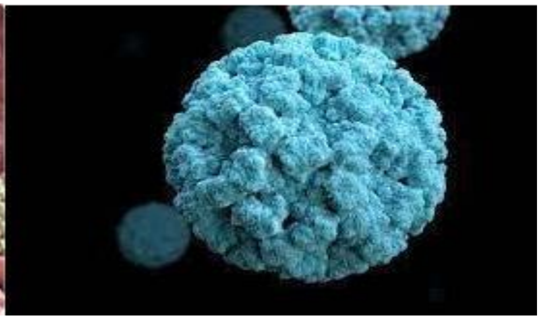



Viruses such as Norovirus and rotaviruses are found in water bodies.

- **<u>Norovirus</u>** and **<u>rotavirus</u>** are a very contagious virus that causes vomiting and diarrhea. Anyone can get infected and sick with norovirus. Norovirus is sometimes called the "stomach flu" or stomach bug.



Norovirus



Rotavirus

- Protozoans such as Entamoeba, Giardia, and Cryptosporidium may be found in water. These microorganisms can cause symptoms such as nausea, vomiting, diarrhea and stomach cramps. In healthy adults, these illnesses are usually mild and do not last long. In infants, children, the elderly, and persons with weakened immune systems, these illnesses can be more severe.

<u>Method For Water Treatment Process</u>

The methodology for raw water treatment is the process of removing or reducing the contaminants and impurities from raw water to make it suitable for various purposes, such as drinking, industrial, or agricultural use. The methodology for raw water treatment depends on the quality and quantity of the raw water source and the intended use of the treated water. There are different methods of raw water treatment, such as aeration, coagulation/flocculation, sedimentation, filtration, disinfection, UV disinfection, cartridge filtration, and others. Each method has its own advantages and disadvantages, and they can be combined or used separately depending on the specific needs and conditions.

Some of the common steps involved in the methodology for raw water treatment are:

1. Aeration

Aeration is the process of adding air into raw water to allow aerobic biodegradation of the organic materials at the cascade aerator. The cascade aerator is a fountain like device by which oxygen is added into water in saturated amount by surface agitation. This is the process of removal of Oduor, gases (like Co2, H2S) and COD by air. Also form disinfection action by sunrays.

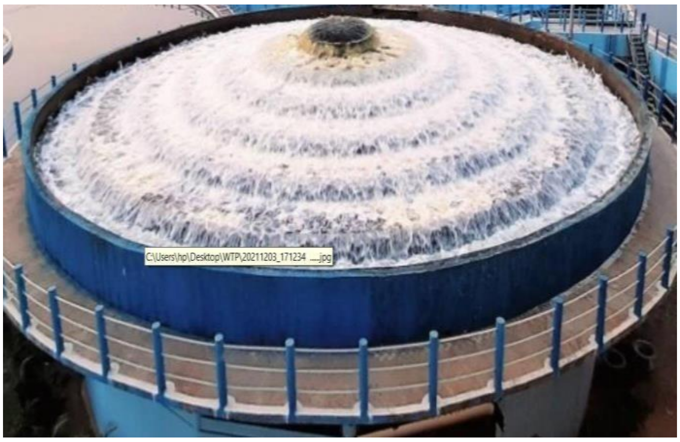


Fig: AERATOR Advantages:

- Aeration can increase the dissolved oxygen level in the water, which supports the survival of aquatic organisms and maintains a healthy ecosystem.
- Aeration can also reduce unpleasant Odors, taste, and color by releasing volatile compounds into the air.
- Aeration can remove dissolved gases, such as carbon dioxide, hydrogen sulfide, methane, and radon, which can affect the water acidity and pH balance.

Disadvantages:

- Aeration requires energy consumption and produces noise and air pollution.
- Aeration may not be effective against some contaminants that are not volatile or soluble in air, such as heavy metals, pathogens, or nitrates.
- Aeration may also require pre-treatment or post-treatment to remove turbidity, suspended solids, or disinfection by-products.

Significance:

- Aeration is an important stage in the water treatment process because it improves the water quality and safety for various purposes.
- Aeration can also enhance the performance of other water treatment processes, such as filtration, disinfection, or biological treatment.

2. Flocculation and Coagulation

Flocculation and Coagulation in water treatment are used to remove suspended solids through a process that destabilizes the suspended particles in water solutions at flash mixer. These processes involve adding chemicals to the water that cause the particles to clump together and form larger aggregates called flocs, which can be easily separated from the water by sedimentation or filtration. Alum is most widely used coagulant. Although ferric chlorides can also be used as coagulant, other chemicals like ferric sulphate or sodium aluminate are also an option for floc formation.

Advantages:

- Flocculation and coagulation can remove a wide range of contaminants from the water, such as organic matter, metals, microorganisms, and some chemicals. These contaminants can affect the water color, odor, taste, pH, hardness, and disinfection efficiency. By removing these contaminants, flocculation and coagulation can improve the aesthetic and health quality of the water.
- Flocculation and coagulation can also reduce the amount of disinfectant required for the water, as well as the formation of disinfection by-products, which can be harmful to human health and the environment.

Disadvantages:

- Flocculation and coagulation require energy consumption and produce noise and air pollution. They also generate sludge as a by-product, which needs to be disposed of properly.
- Flocculation and coagulation may not be effective against some contaminants that are not volatile or soluble in air, such as heavy metals, pathogens, or nitrates.

Significance:

- Flocculation and coagulation are significant for ensuring the quality and safety of water supply for various purposes, such as drinking, industrial, or agricultural use.
- They are also essential for protecting the environment by reducing the emission of greenhouse gases or toxic substances from the water.
- Flocculation and coagulation can also enhance the performance of other water treatment processes, such as filtration, disinfection, or biological treatment.

3. Sedimentation

Sedimentation is a physical water treatment process using gravity to remove suspended solids from water at Auto-clarifier. It takes place when particles in suspension settle out of the fluid in which they are entrained and come to rest against a barrier. This is due to their motion through the fluid in response to the forces acting on them: these forces can be due to gravity, centrifugal acceleration, or electromagnetism. Settling is the falling of suspended particles through the liquid, whereas sedimentation is the result of the settling process.

Fig: AUTO-CLARIFIER

Clarifiers are settling tanks built with mechanical means for continuous removal of solids being deposited by sedimentation. A clarifier is generally used to remove solid particulates or suspended solids from liquid for clarification and/or thickening.

Working: -

Although sedimentation might occur in tanks of other shapes, removal of accumulated solids is easiest with conveyor belts in rectangular tanks or with scrapers rotating around the central axis of circular tanks. Mechanical solids removal devices move as slowly as practical to minimize resuspension of settled solids. Tanks are sized to give water an optimal residence time within the tank. If flow rate through the tank is too high, most particles will not have sufficient time to settle, and will be carried with the treated water. Considerable attention is focused on reducing water inlet and outlet velocities to minimize turbulence and promote effective settling throughout available tank volume. Baffles are used to prevent fluid velocities at the tank entrance from extending into the tank; and overflow weirs are used to uniformly distribute flow from liquid leaving the tank over a wide area of the surface to minimize resuspension of settling particles.

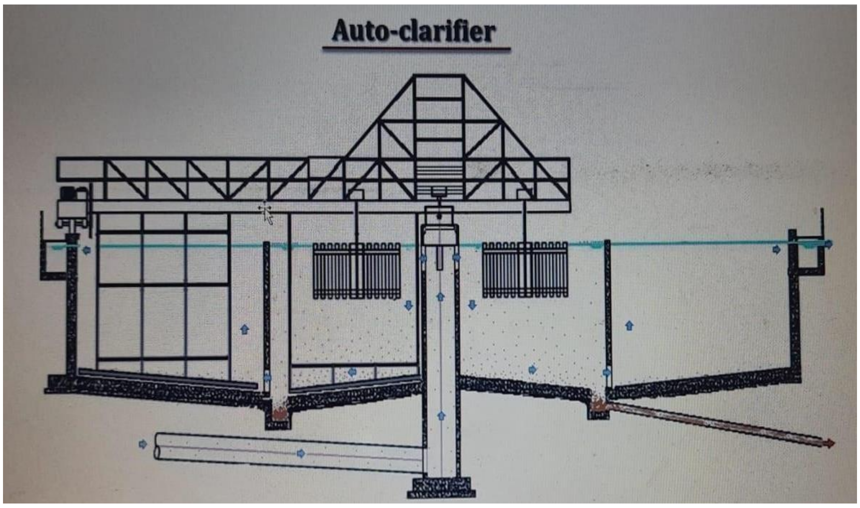


Fig: Cross-section of Auto Clarifier Advantages:

- Sedimentation can reduce the amount of chemicals and energy required for subsequent water treatment stages, such as filtration and disinfection.
- Sedimentation can also remove contaminants that can affect the water color, odor, taste, pH, hardness, and disinfection efficiency, such as organic matter, metals, microorganisms, and some chemicals.

Disadvantages:

- Sedimentation requires large tanks or basins to provide enough time and space for the solids to settle.
- Sedimentation also produces sludge as a by-product, which needs to be disposed of properly.

Significance:

- Sedimentation is an important stage in the water treatment process because it improves the water quality and safety for various purposes.
- Sedimentation can also protect the environment by reducing the emission of greenhouse gases or toxic substances from the water.
- Sedimentation can also enhance the performance of other water treatment processes, such as filtration, disinfection, or biological treatment

4. Filtration

The filtration process of water is a method of removing particles and microorganisms from water by forcing it to pass through porous materials. The filtration process of water can be used for various purposes, such as drinking, irrigation, industrial, or environmental applications. It is based on Piezoelectric concept. It is the ability of certain materials to generate an electric charge in response to applied mechanical stress. The clear water passes through Rapid Gravity Sand filters that have different pore sizes and are made of different materials (such as sand, gravel, and charcoal).

Fig: RAPID GRAVITY SAND FILTERS

5. Water Testing

Water testing in water treatment plants is the process of measuring and analyzing the physical, chemical, and biological characteristics of water to ensure its quality and safety for various purposes, such as drinking, industrial, or agricultural use. Water testing can be done by manual methods or by continuous systems employing automatic instrumentation.

Water quality standard are tested manually in Water Analysis Laboratory based on various physical and chemical parameters.

S. No.	CHARACTERISTICS	ACCEPTABLE	REJECTION
1.	TURBIDITY	1	10
2.	COLOUR	5	25
3.	TASTE & ODOUR	unobjectionable	Objectionable
4.	pH value	7.0 to 8.5	<6.5 or >8.5
5.	Total Alkalinity	200	600
6.	TDS (mg/l)	500	2000
7.	Total Hardness(mg/l)	200	600
8.	Calcium(mg/l)	75	200
9.	Magnesium(mg/l)	<= 30	150
10.	Chlorides(mg/l)	200	1000
11.	Sulphate(mg/l)	200	400
12.	Iron(mg/l)	0.1	10
13.	Manganese(mg/l)	0.05	0.5
14.	Fluorides(mg/l)	1.0	1.5
15.	Nitrates (mg/l)	45	45
16.	Residual Chlorine(mg/l)	0.2	>1.0

(i) Physical Tests

Physical water tests are methods of measuring and analyzing the physical characteristics of water, such as color, turbidity, and odour. Here is a brief description of each test:

- **Colour** is the appearance of water due to the presence of dissolved or suspended substances, such as minerals, organic matter, algae, or pollutants. Color can affect the aesthetic and health quality of water, as well as the efficiency of other treatment processes. Color can be measured by comparing the water sample with a standard color scale or by using a colorimeter.

- **Turbidity** in water is because of suspended solids and colloidal matter. It may be due to eroded soil caused by dredging or due to the growth of micro-organisms. High turbidity makes filtration expensive. Turbidity can affect the clarity and color of water, as well as the transmission of light and oxygen. Turbidity can also harbor pathogens and interfere with disinfection and filtration processes. Turbidity can be measured by using a turbidimeter.

- **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. 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. Odour can be measured by using an olfactometer or by comparing the water sample with a standard odour scale.

Here are some of the advantages, disadvantages, and significance of physical water tests in water treatment:

Advantages:

- Physical water tests can provide quick and easy information about the general condition and appearance of water.
- Physical water tests can also indicate the presence of some contaminants that can affect the aesthetic and health quality of water, such as organic matter, metals, microorganisms, and some chemicals.
- Physical water tests can also help determine the type and intensity of treatment required to meet the desired standards for water quality.

Disadvantages:

- Physical water tests may not be sufficient to assess the quality and safety of water for various purposes.
- Physical water tests may not detect some contaminants that are not volatile or soluble in air, such as heavy metals, pathogens, or nitrates.
- Physical water tests may also require pre-treatment or post-treatment to remove turbidity, suspended solids, or disinfection by-products.

Significance:

- Physical water tests are significant for ensuring the proper operation of water treatment systems and the protection of water system equipment.
- Physical water tests can also help prevent unexpected system failures, comply with environmental regulations, save water and energy, and improve plant productivity

<u>(ii) Chemical Tests</u>

Chemical tests are methods of measuring and analyzing the chemical characteristics of water, such as pH, conductivity, alkalinity, hardness, dissolved oxygen, chlorine, and others. Here is a brief description of some of the common chemical tests used in water treatment plants:

- **<u>PH</u>** is a measure of hydrogen ion concentration. It is an indicator of relative acidity or alkalinity of water. pH affects the solubility and availability of nutrients and metals, the growth and activity of microorganisms, and the effectiveness of disinfection and coagulation processes. Values of 9.5 and above indicate high alkalinity while values of 3 and below indicates acidity Drinking water should have pH between 6.5 and 8.5. Harbor basin water can vary between 6 and 9. pH can be measured by using a pH meter or a pH indicator.

Procedure: To measure pH using a pH meter, first calibrate the meter using standard buffer solutions. Then rinse the electrode with distilled water and immerse it in the water sample. Wait until the reading stabilizes and record the pH value. Rinse the electrode again and store it properly.

- **Conductivity:** Conductivity is a measure of the ability of water to conduct electric current. Conductivity is related to the amount and type of dissolved solids in water, such as salts, minerals, and organic compounds. Conductivity can indicate the general quality of water and the need for treatment. Conductivity can be measured by using a conductivity meter or a conductivity probe.

Procedure: To measure conductivity using a conductivity meter, first calibrate the meter using standard solutions. Then rinse the probe with distilled water and immerse it in the water sample. Wait until the reading stabilizes and record the conductivity value. Rinse the probe again and store it properly.

- **Alkalinity:** Alkalinity is a measure of the capacity of water to neutralize acids. Alkalinity is mainly due to the presence of bicarbonates, carbonates, and hydroxides in water. Alkalinity can affect the pH and corrosion potential of water and the performance of coagulation and disinfection processes. Alkalinity can be measured by using a titration method with a standard acid solution and an indicator.

Procedure: To measure alkalinity using a titration method, first fill a burette with a standard acid solution. Then take a measured volume of water sample in a flask and add a few drops of an indicator, such as phenolphthalein or methyl orange. Titrate the sample with the acid solution until a color change occurs. Record the volume of acid used and calculate the alkalinity using a formula.

- **Hardness:** Hardness is a measure of the concentration of calcium and magnesium ions in water. Hardness can cause scaling and clogging of pipes and fixtures, reduce the efficiency of heat transfer and soap action, and increase the consumption of chemicals and energy. Hardness can be measured by using a titration method with a standard EDTA solution and an indicator.

Procedure: To measure hardness using a titration method, first fill a burette with a standard EDTA solution. Then take a measured volume of water sample in a flask and add a few drops of an indicator, such as eriochrome black T or calmagite. Titrate the sample with the EDTA solution until a color change occurs. Record the volume of EDTA used and calculate the hardness using a formula.

- **Dissolved oxygen:** Dissolved oxygen is a measure of the amount of oxygen gas dissolved in water. Dissolved oxygen is essential for the survival and growth of aquatic organisms and the oxidation of organic matter and metals. Dissolved oxygen can also affect the corrosion potential and biological activity of water. Dissolved oxygen can be measured by using a dissolved oxygen meter or a Winkler titration method.

Procedure: To measure dissolved oxygen using a Winkler titration method, first fill a glass bottle with water sample and add manganese sulfate and alkali-iodide reagents. Then stopper the bottle and shake it well to form a brown precipitate. Then add sulfuric acid reagent and shake again to dissolve the precipitate and release iodine. Then fill a burette with sodium thiosulfate solution and titrate the sample until a pale-yellow color appears. Then add starch reagent and continue titrating until a colorless end point is reached. Record the volume of sodium thiosulfate used and calculate the dissolved oxygen using a formula.

- **Chlorine:** Chlorine is a common disinfectant used in water treatment to kill or inactivate microorganisms that can cause waterborne diseases. Chlorine can also oxidize organic matter and metals in water. Chlorine can be added to water as chlorine gas, sodium hypochlorite, or calcium hypochlorite. Chlorine can be measured by using a colorimetric method with DPD reagent

or an amperometric method with a chlorine electrode.

Procedure: To measure chlorine using a colorimetric method with DPD reagent, first take a measured volume of water sample in a test tube and add DPD reagent. Then compare the color of the sample with a standard color scale or use a colorimeter to measure the intensity of color. Record the chlorine concentration corresponding to the color.

Here are some of the advantages, disadvantages, and significance of chemical water tests in water treatment:

Advantages:

- Chemical water tests can provide accurate and reliable information about the composition and condition of water.

- Chemical water tests can also detect and quantify contaminants that can affect the health and environment, such as heavy metals, pathogens, or nitrates.

- Chemical water tests can also help determine the type and intensity of treatment required to meet the desired standards for water quality.

Disadvantages:

- Chemical water tests require energy consumption and produce waste and pollution.
- Chemical water tests also require skilled personnel and sophisticated equipment to perform and interpret.
- Chemical water tests may also require pre-treatment or post-treatment to remove turbidity, suspended solids, or disinfection by-products.

Significance:

- Chemical water tests are significant for ensuring the proper operation of water treatment systems and the protection of water system equipment.
- Chemical water tests can also help prevent unexpected system failures, comply with environmental regulations, save water and energy, and improve plant productivity

(iii) Biological Tests:

Biological tests are methods of measuring and analyzing the biological characteristics of water, such as the presence and activity of microorganisms, such as bacteria, fungi, algae, or protozoa. These tests are important for evaluating the quality and safety of water for various purposes, such as drinking, industrial, or agricultural use. Here is a brief description of some of the common biological tests used in water treatment plants:

➢ **MacConkey Test**

The MacConkey test is a biological test that is used in water treatment plants to detect and quantify coliform bacteria in water. Coliform bacteria are a group of bacteria that are commonly found in the intestines of warm-blooded animals and in the environment. Coliform bacteria are used as indicators of fecal contamination and the possible presence of pathogens in water.

Principle of MacConkey Agar:

MacConkey agar is used for the isolation of gram- negative enteric bacteria and the differentiation of lactose fermenting from lactose non-fermenting gram- negative bacteria. **Pancreatic digest of gelatin** and **peptones (meat and casein)** provide the essential nutrients, vitamins and nitrogenous factors required for growth of microorganisms. **Lactose monohydrate** is the fermentable source of carbohydrate. The selective action of this medium is attributed to **crystal violet** and **bile salts,** which are inhibitory to most species of gram-positive bacteria. **Sodium chloride** maintains the osmotic balance in the medium. **Neutral red** is a pH indicator that turns red at a pH below 6.8 and is colour less at any pH greater than 6.8. **Agar** is the solidifying agent.

➢ **Composition of MacConkey Agar**

Ø **Ingredients**	Ø **Amount**
Ø Peptone (Pancreatic digest of gelatin)	Ø 17 gm
Ø Proteose peptone (meat and casein)	Ø 3 gm
Ø Lactose monohydrate	Ø 10 gm

Ø Bile salts	Ø 1.5 gm
Ø Sodium chloride	Ø 5 gm
Ø Neutral red	Ø 0.03 gm
Ø Crystal Violet	Ø 0.001 g
Ø Agar	Ø 13.5 gm
Ø Distilled Water	Ø Add to make 1 Liter

➢ **Procedure:** Using Multiple tube fermentation method

1. Arrange the DS and SS MacConkey broths in a test tube rack.
2. Inoculate a series of tubes containing different dilutions of water sample and MacConkey broth. The dilutions depend on the expected coliform count and should be adjusted accordingly. For example, we can use 10 ml, 1 ml, 0.1 ml, and 0.01 ml of water sample for each set of tubes.
3. Incubate at 37°C for 24 hours.
4. Observe the tubes for color change and gas production. Lactose- fermenting coliforms produce acid and gas from lactose and turn the broth red with gas bubbles in the Durham tubes, while non-lactose- fermenting coliforms do not change the color or produce gas.
5. Record the number of positive tubes (red with gas) for each dilution.

➢ **Observations & Result:** o Lactose fermenting strains grow as red or pink and may be surrounded by a zone of acid precipitated bile. The red color is due to production of acid from lactose, absorption of neutral red and a subsequent color change of the dye when the pH of medium falls below 6.8.

o Lactose non-fermenting strains, such as Shigella and Salmonella are colorless and transparent and typically do not alter appearance of the medium. Yersinia enterocolitica may appear as small, non-lactose fermenting colonies after incubation at room temperature.

Ø **Advantages:**

- Biological water test can measure the cumulative effects of complex mixtures of pollutants that may not be detected by individual chemical tests
- Biological water test can reflect the actual exposure and response of aquatic organisms to pollutants in their natural environment
- Biological water test can provide early warning signs of water quality deterioration or improvement.

Ø **Disadvantages:**

- Biological water test can be influenced by many factors, such as temperature, pH, dissolved oxygen, salinity, and turbidity, that may affect the results and interpretation.
- Biological water test can be time-consuming, labor-intensive, and expensive to perform and maintain.

Ø **Significance:**

- The significance of biological water test is that it can provide valuable information for water resource management and protection.
- Biological water test can help identify the sources and impacts of pollution, evaluate the effectiveness of pollution control measures, and support the development of water quality standards and criteria.

6. Chlorination:

Chlorination is a process of adding chlorine or its compounds to water to disinfect and purify it. Chlorine is a powerful oxidant that can kill or inactivate microorganisms, such as bacteria, viruses, and protozoa, that can cause waterborne diseases. Chlorine can also remove some organic and inorganic contaminants, such as iron, manganese, hydrogen sulfide, and ammonia, that can affect the taste, odor, color, and pH of water.

The different types of chlorination adopted in water treatment are as follows:

- Pre-chlorination.
- Post-chlorination.
- Super chlorination.
- De-chlorination.

Pre-chlorination

Pre-chlorination is the addition of chlorine to the raw water prior to treatment to produce residual chlorine after meeting chlorine demand. The residual chlorine is useful in several stages of the treatment process – aiding in coagulation, controlling algae problems in sedimentation basins, reducing odour problems, and controlling mud-ball formation in filters. In addition, the chlorine has a much longer contact time when added at the beginning of the treatment process, so pre- chlorination increases safety in disinfecting heavily contaminated water.

Post chlorination

Post chlorination is the normal process of applying chlorine in the end, when all other treatments are completed but before the water reaches the distribution system. At this stage, chlorination is meant to kill pathogens and to provide a chlorine residual in the distribution system. Post- chlorination is nearly always part of the treatment process, either used in combination with pre-chlorination or used as the sole disinfection process.

The chlorine dose at post-chlorination stage should be such as to leave a residual- chlorine of about 0.1 to 0.2 mg/L after a contact period of 20 to 30 minutes. This residual chlorine will ensure the disinfection of water if at all any recontamination occurs in the transmission and distribution system. Chlorine dose should not be generally greater than 2.0 mg/L as the excess residual concentration of chlorine may damage the pipelining and pump impellers.

Super chlorination

Super chlorination is a term, which indicates the addition of excessive amount of chlorine (i.e., 5 to 15 mg/L) to the water. This may be required in some special cases when the water is highly polluted, or during epidemics of water borne diseases. The huge quantity of chlorine, which is added in super chlorination, is such as to give about 1 to 2 mg/L of residual beyond the break point in the treated water. Sometimes even higher doses may be used and the resultant -water is re-chlorinated after the end of the desired contact period, by using dechlorinating agents.

§ **De-chlorination**

De-chlorination means removing the chlorine from the water. This is generally required when super-chlorination has been practiced. The de- chlorination process may either be carried out to such an extent that sufficient residual chlorine of 0.1 to 0.2 mg/L only remains in water after de-chlorination. The common de- chlorinating agents are sulphur dioxide gas, activated carbon, sodium Thio- sulphite, sodium meta-sulphate, and ammonia.

Water Supply System

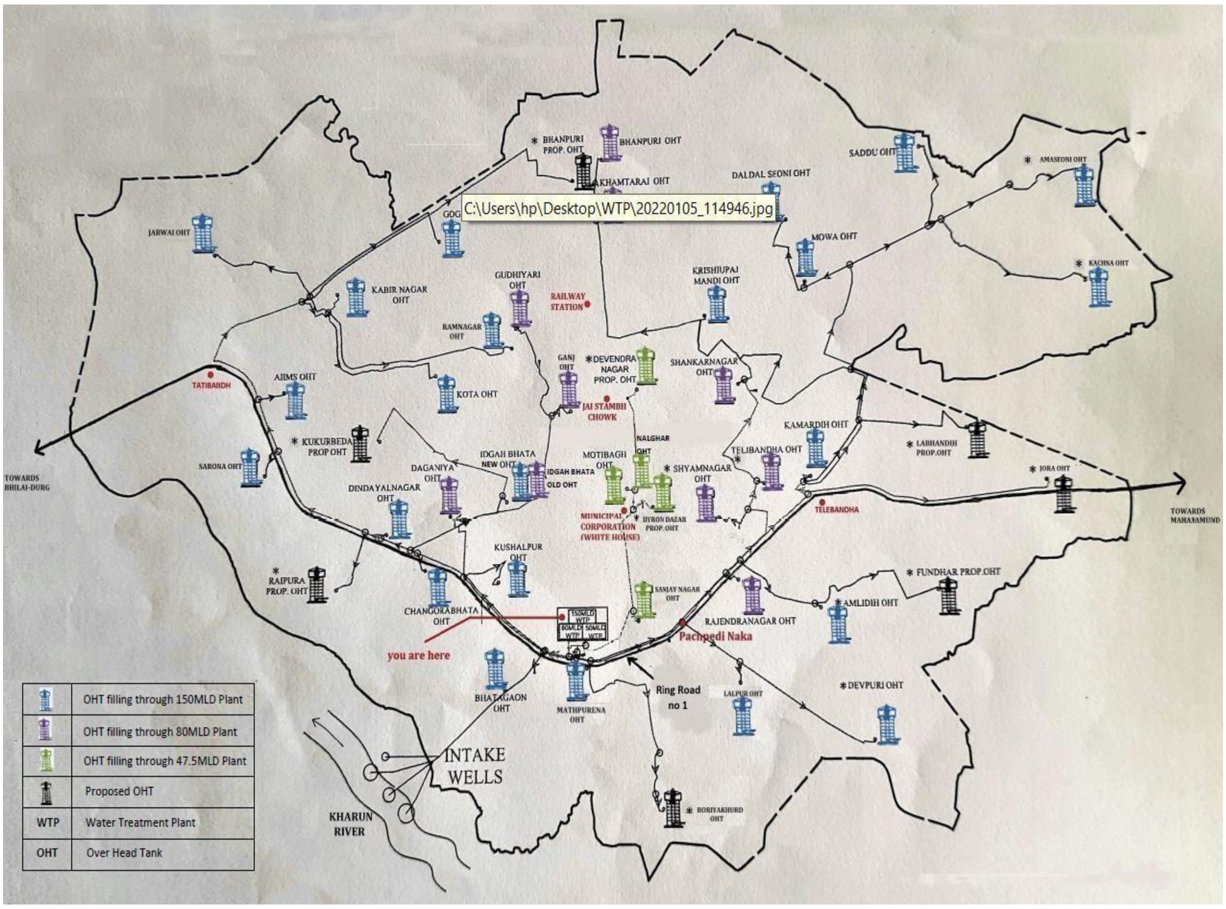
A water supply system is a network of pipes, pumps, valves, meters, and other components that deliver treated water from a water treatment plant to the customers. A water supply system can be divided into three main parts: the transmission system, the distribution system, and the service connection.

Intake wells	Water Supplied to OHT's
1. Kharoon, Neer, Ksheer	Devendra Nagar, Byron Bazar, Nalghar, Sanjay Nagar, Motibag.
2. Sarita	Danganiya, Gang, Gudhiyari, Rajendra Nagar, Telibandha, Sankar Nagar, Khamtarai, Bhanpuri, Edgahbhata old tanki, Shyam Nagar.
3. Sagar	Mathpurena, Lalpur, Amlidih, Avanti-vihar, Saddu, Mowa, Daldal- seoni, Bhatagaon, Changorabhata, Edgh-bhata, DD Nagar, Sarona, Tatibandh, Kabir Nagar, Kota, Gogaon, Jarway, New Krishi Upaj Mandi, Kushalpur, Ramnagar, Kachna, Aama Seoni, Devpuri.

The transmission system: This is the part of the water supply system that carries large volumes of water from the water treatment plant to the distribution system. The transmission system consists of large-diameter pipes, usually made of steel or concrete, that operate under high pressure. The transmission system may also include storage tanks or reservoirs to balance the supply and demand of water and to provide emergency backup.

SUMP & PUMP ROOM

The distribution system: This is the part of the water supply system that distributes water to different areas and zones within a service area. The distribution system consists of smaller-diameter pipes, usually made of iron, plastic, or copper, that operate under lower pressure. The distribution system may also include pumps, valves, hydrants, and meters to control the flow and pressure of water and to measure the water consumption.



WATER DISTRIBUTION SYSTEM

<u>Observations & Results:</u>

We get the data and information that are collected and analyzed to evaluate the performance and efficiency of the water treatment processes and systems. It can help identify and solve problems, optimize operations, ensure quality and safety, and comply with regulations.

Some points of observations and results of water treatment plant are:

- **Raw water quality:** This is the measurement and analysis of the physical, chemical, and biological characteristics of the water source before any treatment. Raw water quality can vary depending on the type and location of the source, such as surface water or groundwater, and the season and weather conditions. Raw water quality can affect the type and intensity of treatment required to meet the desired standard.

- **Water treatment technologies:** This is the description and evaluation of the methods and equipment used to treat the raw water and make it suitable for various purposes, such as drinking, industrial, or agricultural use. Water treatment technologies can include physical, chemical, or biological processes, such as coagulation, sedimentation, filtration, disinfection, or biological treatment. Water treatment technologies can be compared and optimized based on their cost, efficiency, reliability, and environmental impact.

- **Operational practice:** This is the documentation and assessment of the procedures and activities involved in the operation and maintenance of the water treatment plant. Operational practices can include monitoring and control of water quality parameters, chemical consumption and dosage, equipment performance and condition, energy consumption and generation, waste management and disposal, safety and security measures, staff training and management, record keeping and reporting, etc. Operational practices can help improve the productivity and sustainability of the water treatment plant[4].

- **Chemical consumption and rejects management:** This is the measurement and analysis of the amount and type of chemicals used in the water treatment processes and the amount and type of waste or by-products generated from the water treatment processes. Chemical consumption and rejects management can affect the operational cost, efficiency, reliability, and environmental impact of the water treatment plant. Chemical consumption and rejects management can be reduced or reused by using alternative or innovative methods or technologies.

- **Water quality control and assessment:** This is the measurement and analysis of the physical, chemical, and biological characteristics of the treated water after each treatment stage or before distribution or use. Water quality control and assessment can ensure that the treated water meets the desired standards for quality and safety for various purposes, such as drinking, industrial, or agricultural use. Water quality control and assessment can also help detect and prevent any contamination or deterioration of the treated water.

Conclusion:

- Water treatment is the process of improving the quality of water for various purposes, such as drinking, industrial, or agricultural use. Water treatment involves physical, chemical, or biological processes to remove contaminants and hazardous substances from water. Water treatment plants are responsible for collecting, treating, and distributing water to different areas and zones within a service area. This report aimed to study the types and methods of water treatment used in a water treatment plant in Raipur.

- The report found that the raw water source for the plant was Ravishankar Dam, Dhamatari and Bhatagaon Anicut, which had varying levels of turbidity, color, temperature, and pH depending on the season and weather conditions. The plant used coagulation with alum as a chemical coagulant to remove turbidity from the water. The plant also used sedimentation with flocculation to remove suspended solids from the water. The plant used filtration with sand as a filter medium to remove fine particles from the water. The plant used chlorination with chlorine gas as a disinfectant to kill or inactivate microorganisms in the water. The plant also used aeration to remove dissolved gases and volatile substances from the water.

- The report also evaluated the performance and efficiency of the water treatment processes and systems. The report found that the plant was able to produce high-quality water that met the drinking water standards set by regulatory agencies. The report also found that the plant was able to reduce the amount of chemicals and energy required for subsequent treatment stages by using pre-chlorination and intermediate chlorination. The report also found that the plant was able to protect the environment by reducing the emission of greenhouse gases or toxic substances from the water by using aeration.

- The report concluded that water treatment is an important and essential process for ensuring the quality and safety of water supply for various purposes. The report also concluded that water treatment can also protect the environment by reducing the impact of contaminants and pollutants on natural sources. The report recommended that future studies should explore alternative or innovative methods or technologies for treating water and removing unwanted contaminants. The report also suggested that future studies should optimize operational practices and ensure compliance with environmental regulations.

Applications:

Water treatment plants are facilities that improve the quality of water for various purposes, such as drinking, industrial, or agricultural use. Water treatment plants use physical, chemical, or biological processes to remove contaminants and hazardous substances from water. Some of the applications of water treatment plants are:

- Drinking water supply: Water treatment plants can provide safe and potable water for human consumption by removing pathogens, toxins, metals, and other pollutants that can cause waterborne diseases or affect the taste, odor, color, and pH of water. Drinking water supply is essential for public health and well-being.
- Industrial water supply: Water treatment plants can provide suitable water for industrial use by removing impurities, hardness, dissolved gases, and other substances that can affect the quality and efficiency of industrial processes and products. Industrial water supply is important for economic development and environmental protection.
- Irrigation water supply: Water treatment plants can provide adequate water for agricultural use by removing salts, nutrients, pesticides, and other substances that can affect the soil fertility and crop productivity. Irrigation water supply is vital for food security and rural livelihoods.
- River flow maintenance: Water treatment plants can help maintain the natural flow and ecology of rivers by releasing treated water into the river system. River flow maintenance is beneficial for biodiversity conservation and recreation.