BHARATHIDASAN UNIVERSITY

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Programme: M.Sc., Biomedical Science

Course Title : Microbiology

Course Code : BM24AC4

Unit-IV

Potable Water Treatment

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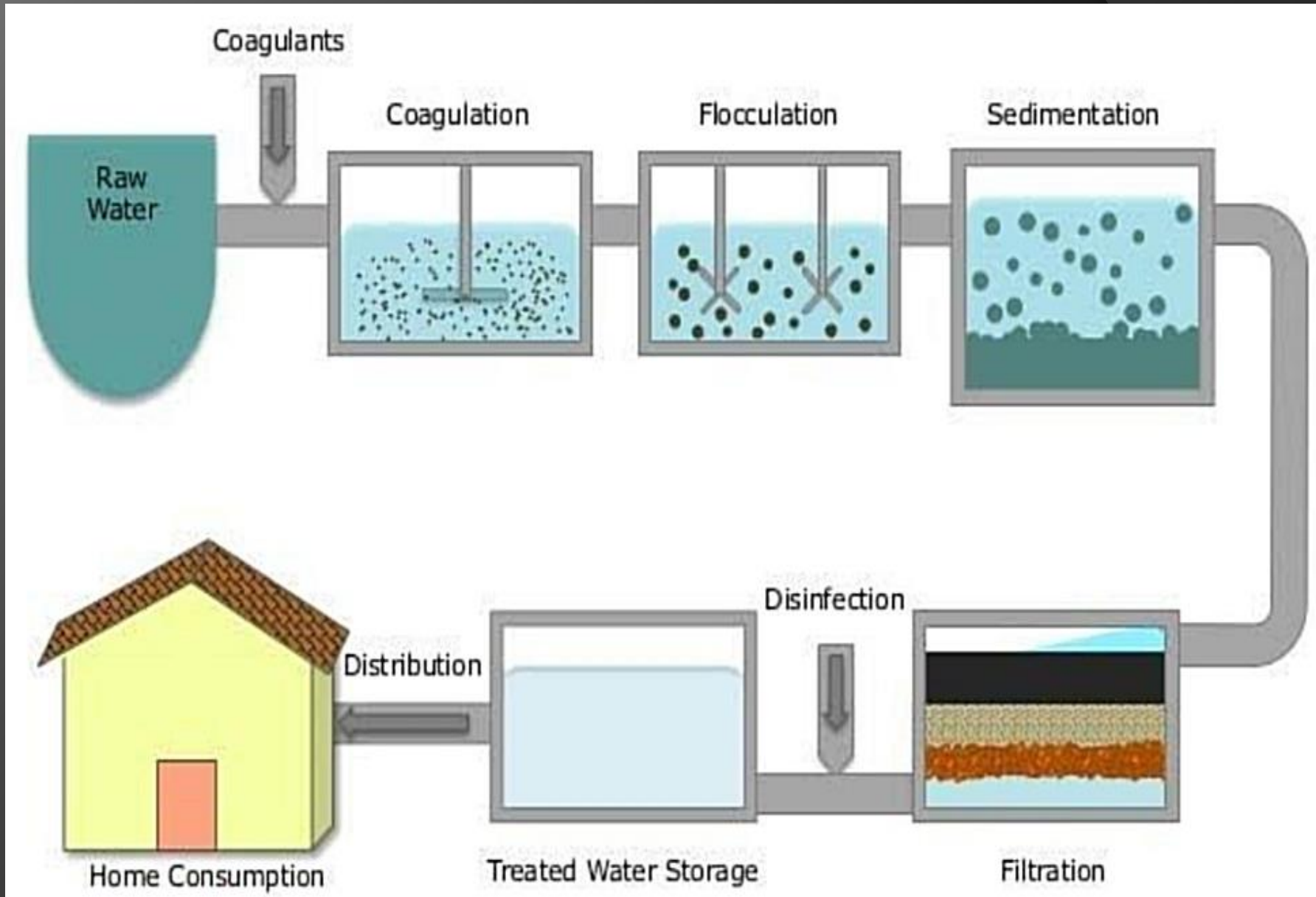
Department of Biomedical Science

POTABLE WATER TREATMENT SEWAGE(WASTE WATER)TREATMENT

POTABLE WATER

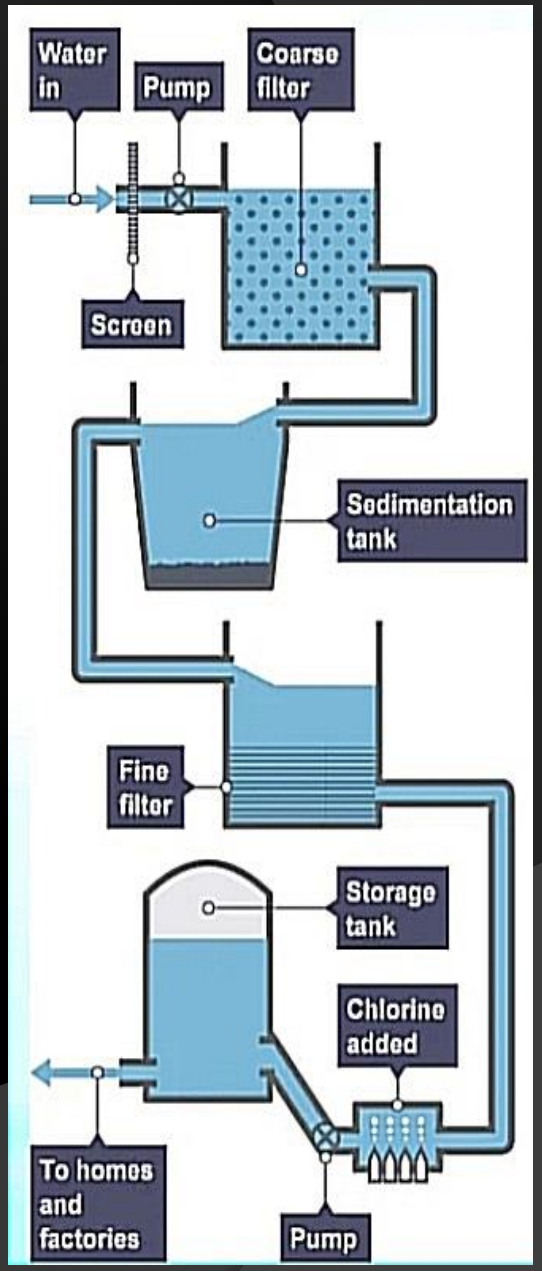
- **"Potable water" is defined as water that is suitable for human consumption (i.e., water that can be used for drinking or cooking).**
- **The term implies that the water is drinkable as well as safe.**
- **"Drinkable water" means it is free from unpleasant odors, taste and colors, and is within reasonable limits of temperature.**
- **"Safe water" means it contain no toxins, carcinogens, pathogenic micro-organisms, or other health hazards.**


Coagulants
Raw Water
Coagulation
Flocculation
Sedimentation
Disinfection
Distribution
Home Consumption
Treated Water Storage
Filtration

- Potable water is the water which is filtered and treated properly and is finally free from all contaminants and harmful bacteria.
- It has been filtered, cleaned, or treated to meet the standards for drinking water, this makes the water safe for drinking and cooking.
- Most non-potable water will be raw water from ground wells, springs, ground water, rivers, or lakes that is not treated.
- It is not safe to drink as there are unknown contaminants in untested water.
- It is possible for non-potable water will be raw water, to taste normal, but carry health risks.

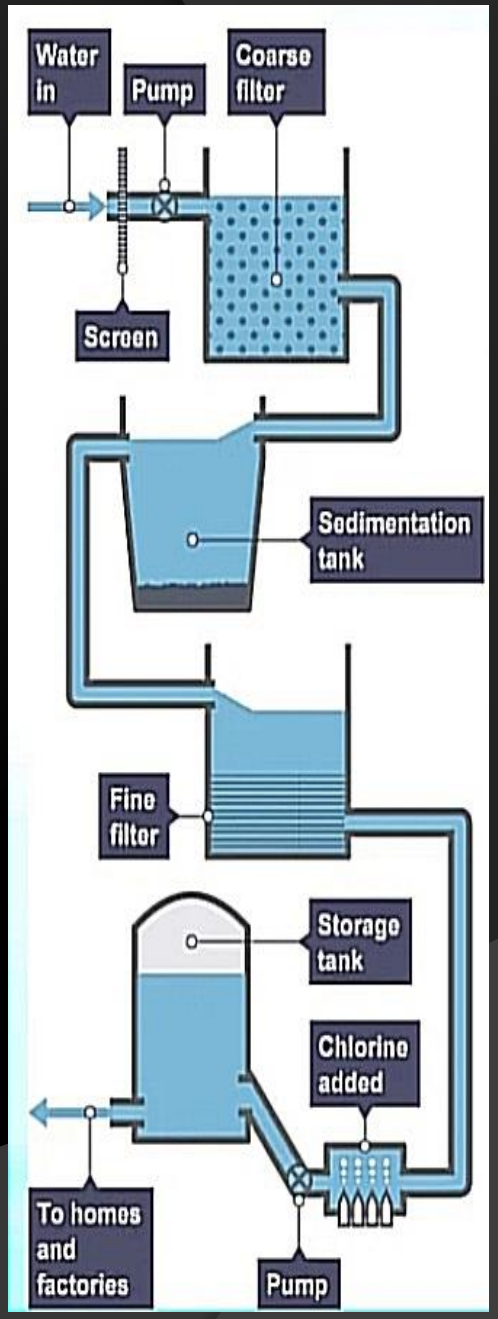
PURIFICATION PROCESS

- Water which contains dissolved salts may not be fit for drinking . It may also **contain harmful microorganisms**.
- The water from the source passed through screen filters which remove large insoluble particles like twigs, leaves etc..
- Alum is added at this point . Earlier you studied how alum helps in settling fine particles of clay which may be suspended in water. This process is called **“coagulation”.**
- The water is then allowed to a settling tank. Heavy sediments settle down here. This process is called **“sedimentation”.**



Cont..

- The clear water from the top is now passed through beds of sand filters to remove any left over insoluble solids. This step is called **“filtration”.**
- Finally, a small amount of chlorine gas is passed through water in a chlorination tank; Chlorine kills any harmful microorganisms. That may be present in water.
- The water is now safe for drinking. It is stored and then supplied to the people in the city through a network pipes.



WATER TREATMENT STEPS

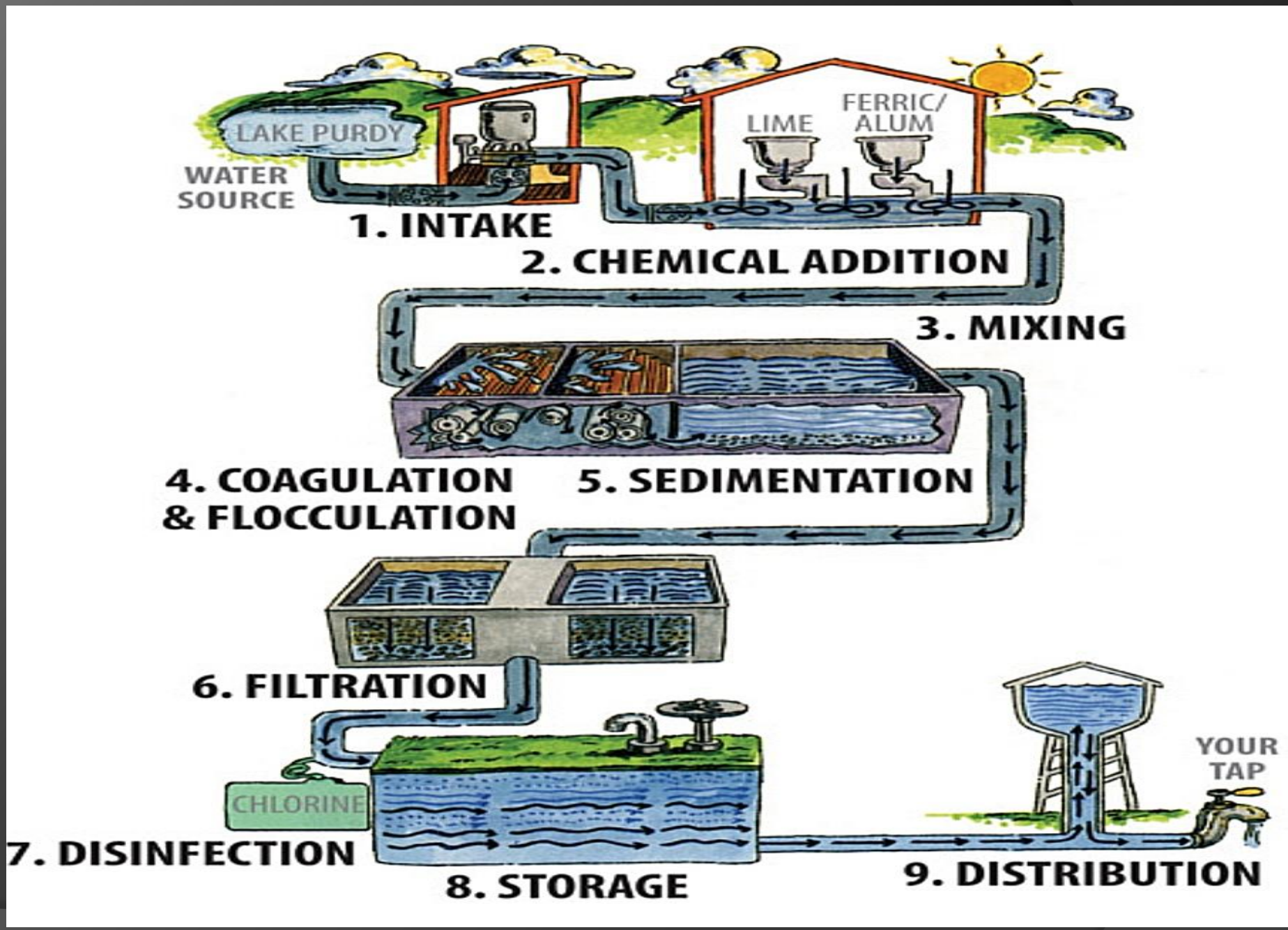
COAGULATION

FLOCCULATION

SEDIMENTATION

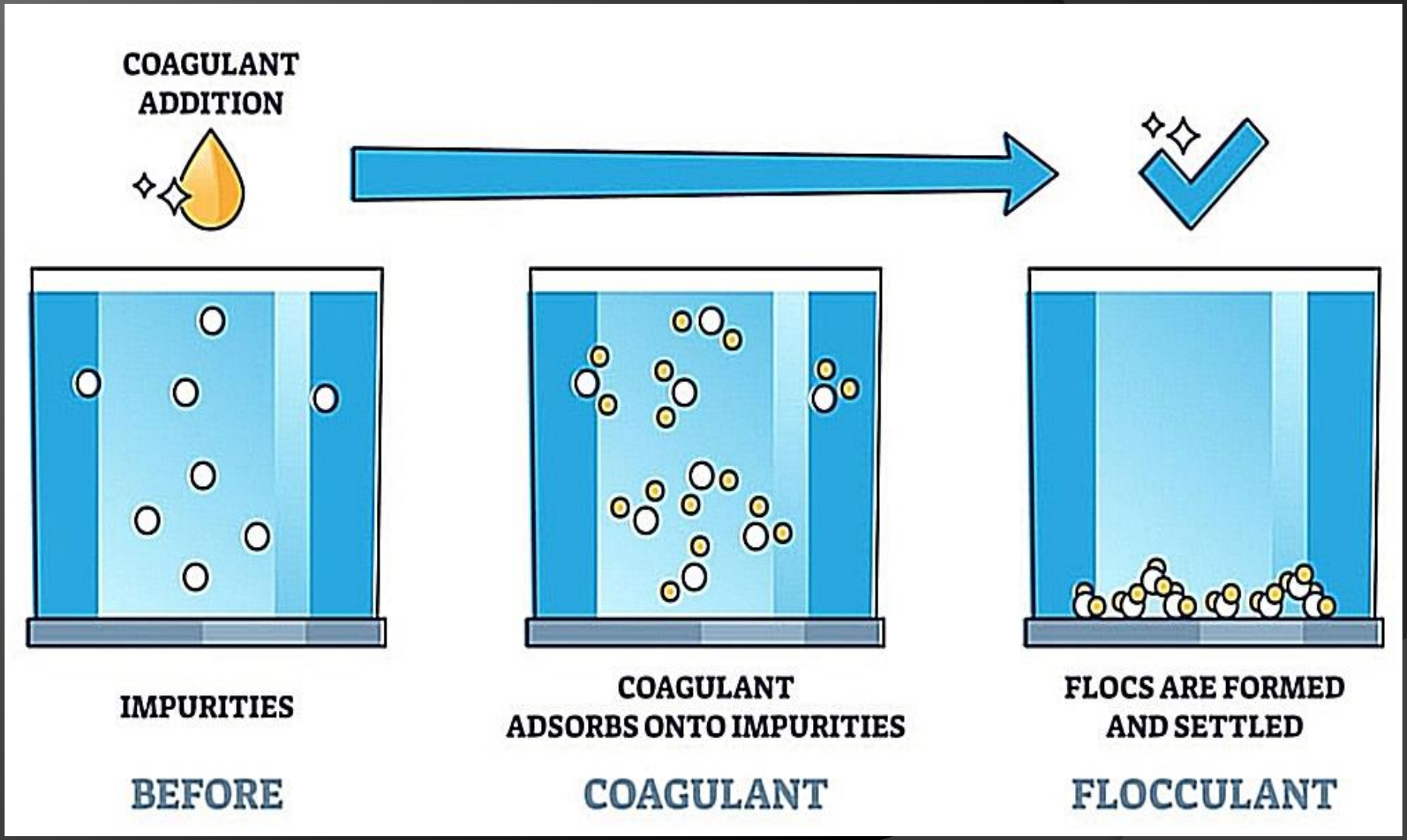
FILTERATION

DISINFECTION


LAKE PURDY
WATER SOURCE
1. INTAKE
LIME
FERRIC/ ALUM
2. CHEMICAL ADDITION
3. MIXING
4. COAGULATION & FLOCCULATION
5. SEDIMENTATION
6. FILTRATION
CHLORINE
7. DISINFECTION
8. STORAGE
YOUR TAP
9. DISTRIBUTION

COAGULATION

- First step in water treatment , chemical with a positive charge are added to the water. It can be neutralizes the negative charge of dirt & other dissolved particles in the water.
- Coagulation is one of the common methods used by water treatment plants to provide safe, clean drinking water to public water customers.
- This method is often used alongside processes including filtration, disinfection and sedimentation to remove select contaminants from water.
- Factor affect- Temperature, pH, effluent quality, dosage and coagulant type.
- Common chemicals used in this steps include specific types of salts, aluminum, or iron.


COAGULANT ADDITION
IMPURITIES
COAGULANT ADSORBS ONTO IMPURITIES
FLOCS ARE FORMED AND SETTLED
BEFORE
COAGULANT
FLOCCULANT

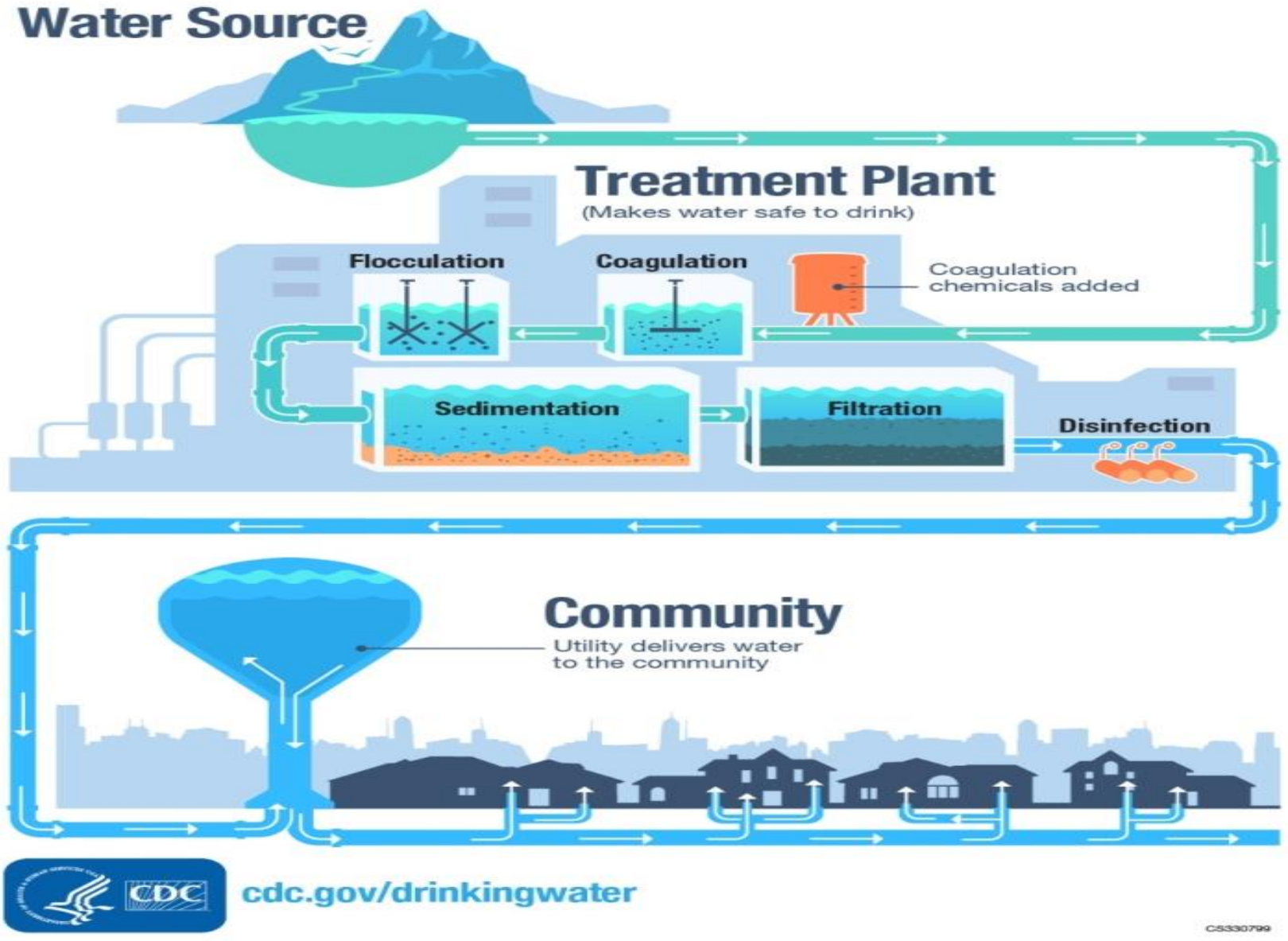
FLOCCULATION

- Follow the coagulation step. Flocculation is the gentle mixing of the water to form larger, heavier particles called "FLOCS".
- A process by which a chemical coagulant added to the water acts to facilitate bonding between particles, creating larger aggregates which are easier to separate.
- The method is widely used in water treatment plants and can also be applied to sample processing for monitoring applications.

SEDIMENTATION

- Use to separate out solids from the water.
- During sedimentation, flocs settle to the bottom of the water because, they are heavier than water.
- Sedimentation is the process of allowing particles in suspension in water to settle out of the suspension under the effect of gravity. The particles that settle out from the suspension become sediment, and in water treatment is known as sludge.

Water Treatment Steps

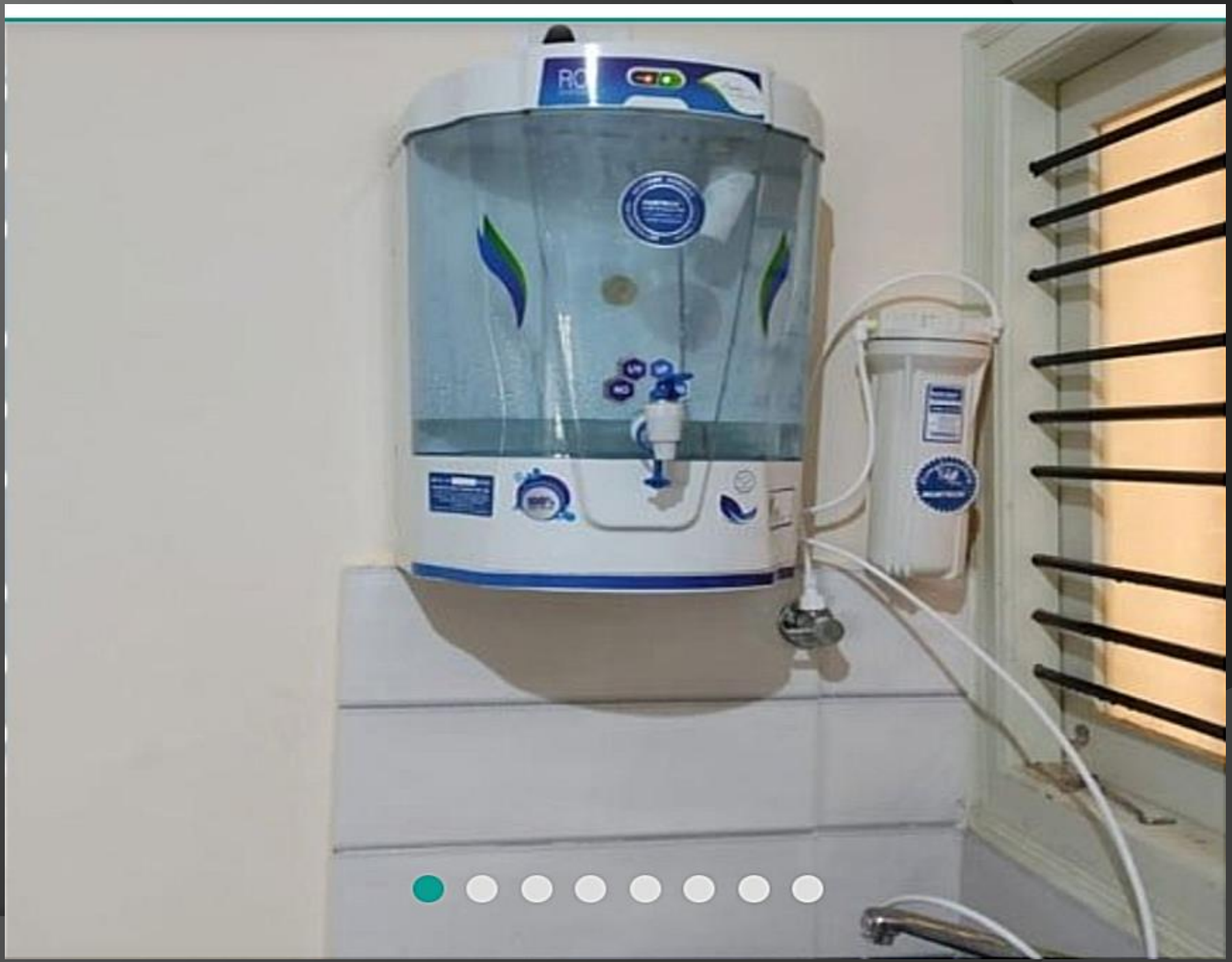


FILTRATION

- **The process in which solid particles in a liquid or gaseous fluid are removed by the use of a filter medium that permits the fluid to pass through but retains the solid particles.**
- **Once the flocs have settled to the bottom of the water the clear water on top is filtered to separate additional solids from the water.**
- **During filtration, the clear water passes through filters that have different pore sizes and are made of different materials(such as sand, gravel, and charcoal).**

REVERSE OSMOSIS

- It is another purification method that removes additional particles from water.
- Reverse osmosis which is also commonly referred to as RO is a type of filtration method used for the removal of molecules and ions from a certain solution.



BENEFITS OF RO

It is technique has a wide application in treating liquid wastes or discharges.

It is beneficial in the medical field.

It is used in purifying water to prevent diseases.

It helps in desalinating seawater.

DISINFECTION

- After the water has been filtered, water treatment plants may add one or more chemical disinfectants (such as Chlorine, Chloramine or Chlorine dioxide) to kill any remaining parasites, bacteria, or viruses.
- **Disinfectants** are added to water to kill disease-causing microorganisms.
- **Surface water**- collects on the ground or in a Stream, River, Lake, Reservoir or Ocean.
- **Ground water**- is located below the surface of the earth in spaces between rock and soil.

SEWAGE TREATMENT

SEWAGE TREATMENT

- **Sewage treatment is the process of removing contaminants from wastewater and household sewage (Wastewater) generated from residential area is called "Sewage".**
- **sewage contains:**
  - **Sullage : It is waste water generated from kitchen, bathroom, laboratories etc.**
  - **Human and animal excreta from toilet and animal farm.**
  - **Run-off waste water from street during raining.**
  - **Some industrial effluent.**

Wastewater is treated in 3 phases: primary (solid removal), secondary (bacterial decomposition), and tertiary (extra filtration).

Key Points-

- **Primary treatment** is the first phase of sewage treatment: wastewater is placed in a holding tank and solids settle to the bottom where they are collected and lighter substances like fats and oils are scraped off the top.
- **Secondary treatment** is where waste is broken down by aerobic bacteria incorporated into the wastewater treatment system.
- **Tertiary treatment** is designed to filter out nutrients and waste particles that might damage sensitive ecosystems; wastewater is passed through additional filtering lagoons or tanks to remove extra nutrients.

PRE-TREATMENT

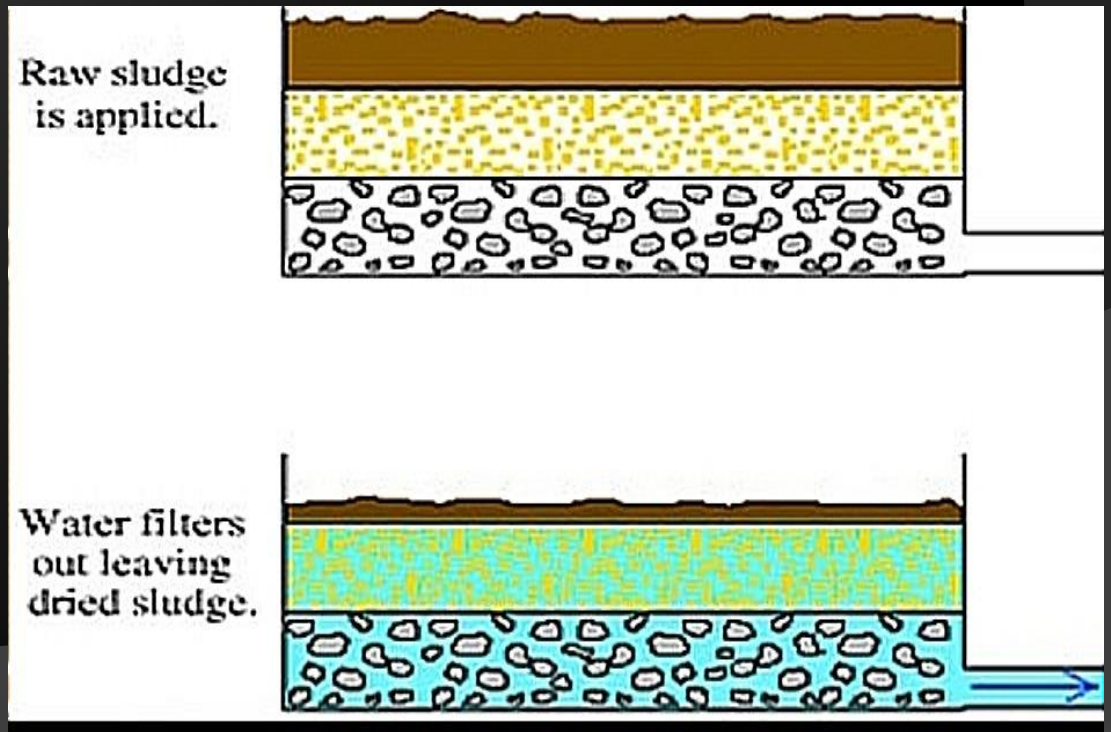
- It is the very first step just before the actual treatment.
- It has two parts with the first one involving screening of large materials such as bottles, cans, logs and rags.
- The second part uses a comminutor which is a mechanical device that has cutting edges that reduce solids to smaller particles.
- After the water passes through the grit chamber where the smaller solid materials such as sand, pebbles and broken glass are removed.
- This step is essential since it prevents the entry of large waste material into the water treatment plant leading to clogging or blockages.

PRIMARY TREATMENT

- In primary treatment, sewage is stored in a basin where solids (sludge) can settle to the bottom and oil and lighter substances can rise to the top.
- These layers are then removed and then the remaining liquid can be sent to secondary treatment.
- Sewage sludge is treated in a separate process called '**Sludge digestion**'.

- **Grit chambers are long narrow tanks that are designed to slow down the flow so that solids such as sand, coffee grounds, and eggshells will settle out of the water.**
- **Suspended solids that pass through screens and grit chambers are removed from the sewage in sedimentation tanks.**
- **These tanks, also called primary clarifiers, provide about two hours of detention time for gravity settling to take place. As the sewage flows through them slowly, the solids gradually sink to the bottom. The settled solids—known as raw or primary sludge—are moved along the tank bottom by mechanical scrapers.**
- **Sludge is collected in a hopper, where it is pumped out for removal. Mechanical surface-skimming devices remove grease and other floating materials.**

BAR SCREENING



Types of Sedimentation Tanks (Clarifiers):

There are different ways of classifying sedimentation tanks.

Based on the shape:

- Rectangular, circular and square.

Based on the flow of sewage:

- Longitudinal, vertical, radial and spiral.

Based on the purpose and position:

- Primary, secondary, coagulation-cum-sedimentation tanks, grit chambers, septic.

Based on the operation:

- Batch type and continuous flow type.

SECONDARY TREATMENT

- Removes dissolved and suspended biological matter.
- Remove~85% of BOD and solids.
- Water can be used for irrigation .
- Most secondary treatment systems use aerobic bacteria, which consume the organic components of the sewage (sugar, fat, and so on).

- Secondary treatment. removes the soluble organic matter that escapes primary treatment. It also removes more of the suspended solids.
- Removal is usually accomplished by biological processes in which microbes consume the organic impurities as food, converting them into carbon dioxide, water, and energy for their own growth and reproduction.

There are three basic biological treatment methods:

The trickling filter

Activated sludge process

Less common methodis the rotating biologicalcontacter.

The oxidation pond.

3WAYS:-

Bio-filtration

- Bio-filtration uses sand filters, contact filters or trickling filters to ensure that any additional sediment is removed from the wastewater.

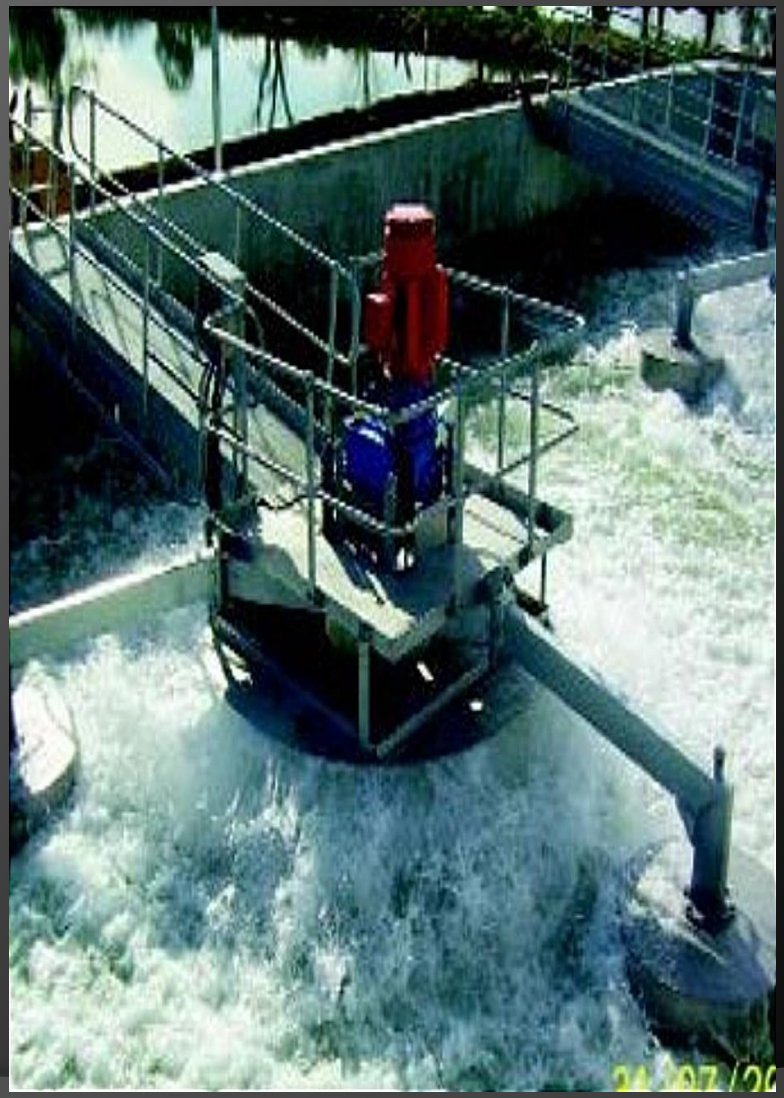
Aeration

- Aeration is a lengthy process which increases oxygen saturation by introducing air to wastewater. Typically, the aeration process can last for up to 30 hours, but it is very effective.

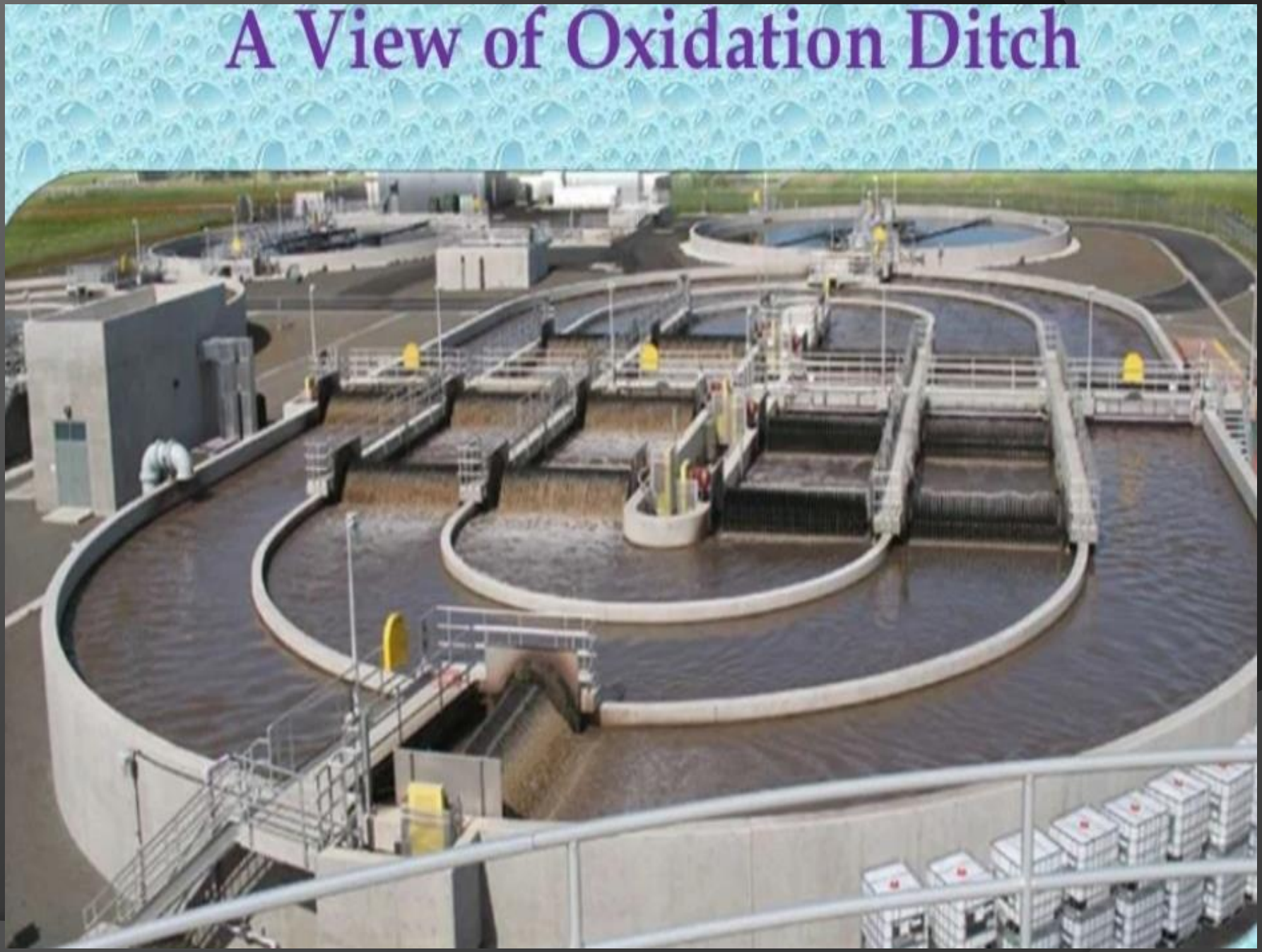
Oxidation ponds

- This method utilizes natural bodies of water such as lagoons, allowing wastewater to pass through for a set period before being retained for two to three weeks.

Aeration basin



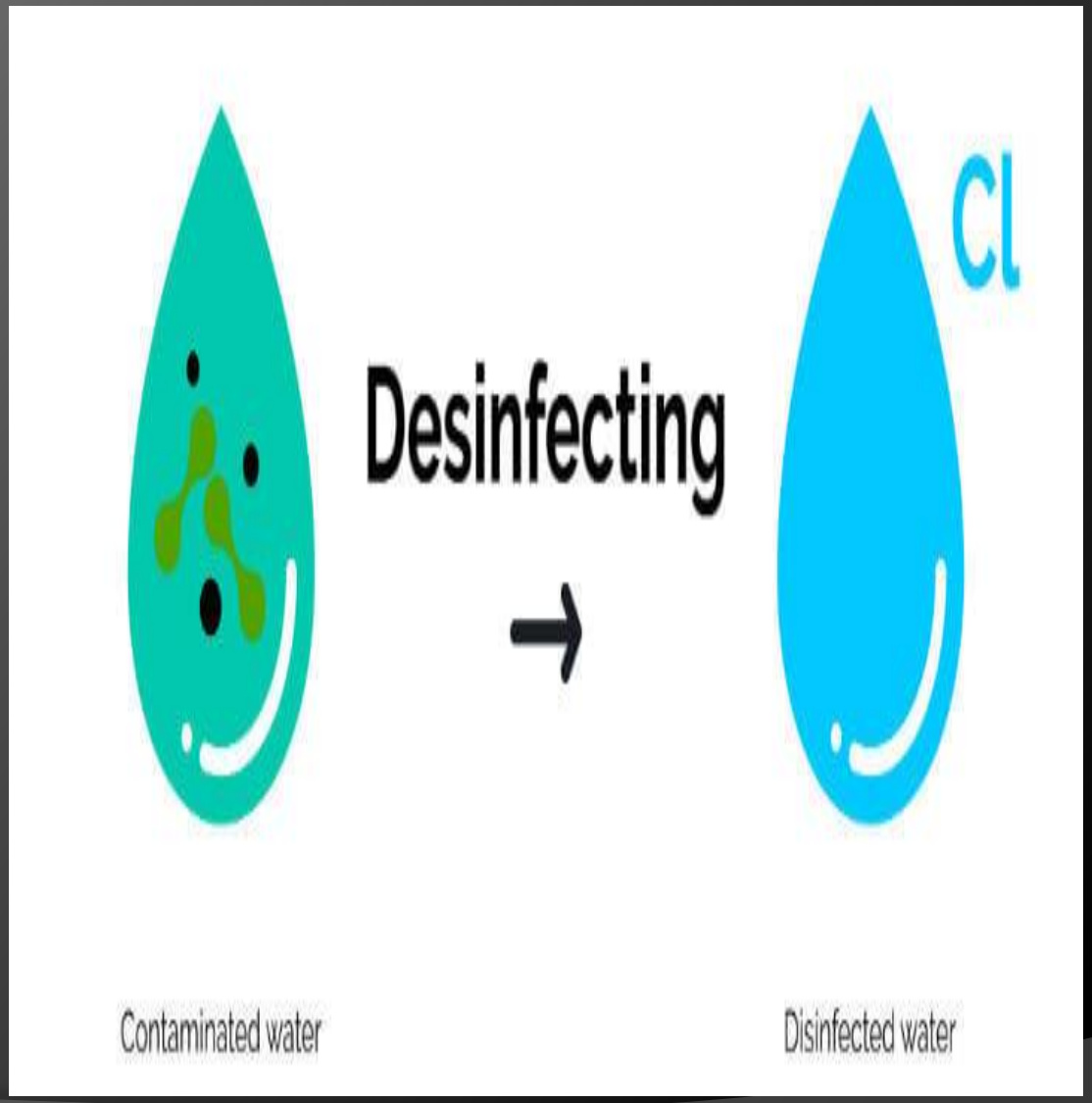
A View of Oxidation Ditch



TERTIARY WATER TREATMENT

- **This is the last step in this basic water management system is mostly comprised of removing phosphates and nitrates from the water supply.(Substrates like activates carbon and sand).**
- **FILTRATION**
- **SLUDGE DRIED BED**
- **CHLORINATION**

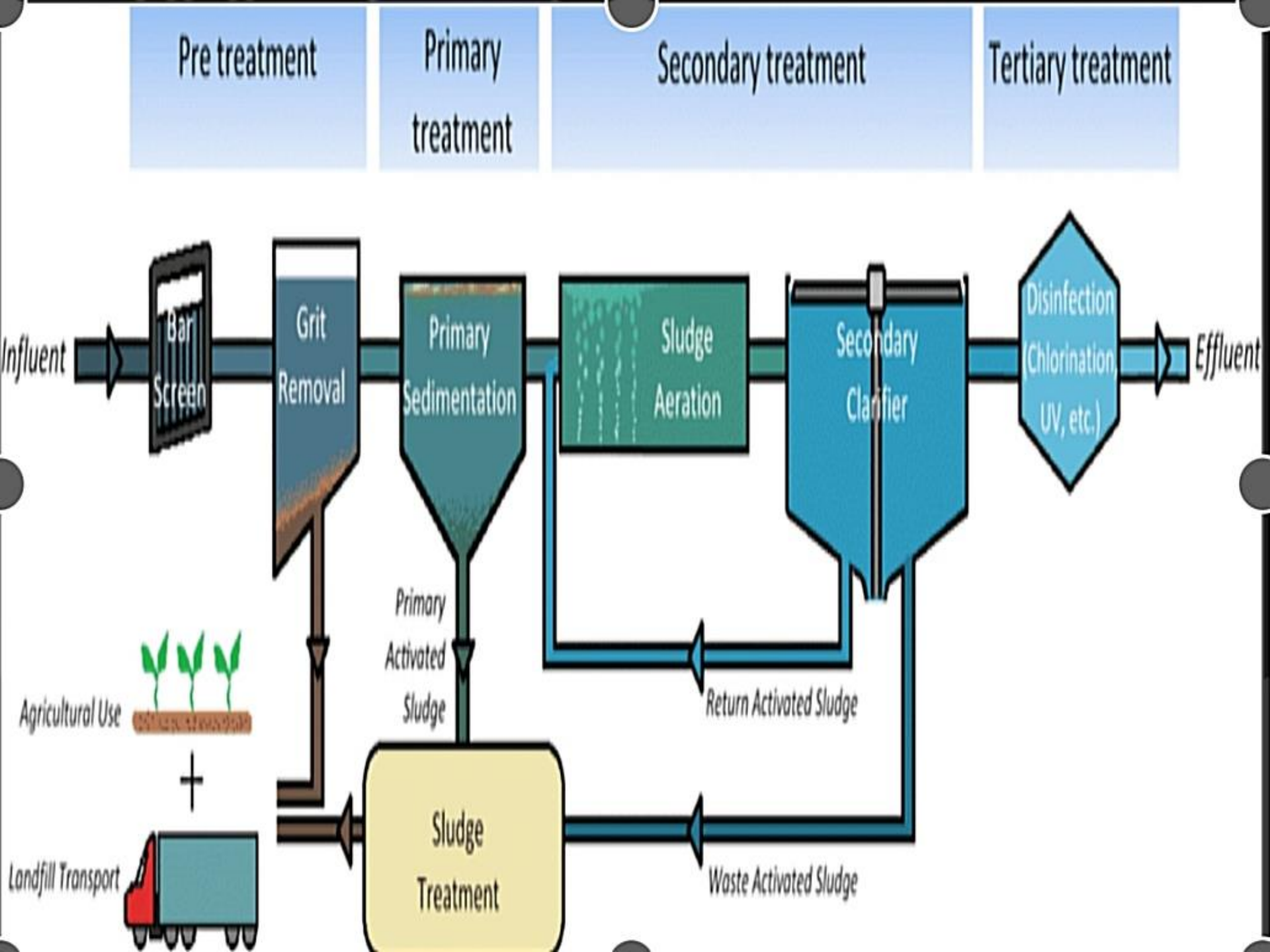
CHLORINATION



- Removal of remaining BOD,N and P.
- Disinfection
- Water is drinkable
- **BOD- Biochemical Oxygen Demand or Biological Oxygen Demand**, is a measurement of the amount of dissolved oxygen (DO) that is used by aerobic microorganisms when decomposing organic matter in water.

Tertiary Treatment

- Tertiary treatment (sometimes called “effluent polishing”) is used to further clean water when it is being discharged into a sensitive ecosystem., Methods involve-
  - Effluent polishing
  - Removal of plant nutrients
  - Land treatment
- Lagooning is another method for removing nutrients and waste from sewage. Water is stored in a lagoon and native plants, bacteria, algae, and small zooplankton filter nutrients and small particles from the water.


Pre treatment
Primary treatment
Secondary treatment
Tertiary treatment
Influent
Bar Screen
Grit Removal
Primary Sedimentation
Sludge Aeration
Secondary Clarifier
Disinfection (Chlorination, UV, etc.)
Effluent
Primary Activated Sludge
Return Activated Sludge
Agricultural Use
Sludge Treatment
Waste Activated Sludge
Landfill Transport

MICROORGANISM FOUND IN SEWAGE

Microorganisms found in sewage

NEMATODES

Schistosomes, Guinea worm,
Tapeworm, Ascaris etc.

BACTERIA

Salmonella typhimurium
Vibrio cholerae
Clostridium botulinum
Escherichia coli
Etc.

PROTOZOA

Giardia lamblia
Entomoeba histolytica
Cryptosporidium parvum
Etc.

VIRUSES

Rotavirus
Hepatitis A
Polio virus
Etc.

FUNGI

REFERENCE

- Pelezar,A Jr M.J. Chan and Kreign, N.R.(2007), Microbiology, Mc Graw Hill, Inc, Newyork.
- https://www.slideshare.net/DolithaChowdhary/potable-water-70025554
- https://www.slideshare.net/ArvindHeer/potable-water-64736215
- https://www.environmentalpollution.in/sewage-treatment/sewage-treatment-processes-primary-secondary-and-tertiary/150
- https://www.biotecharticles.com/Environmental-Biotechnology-Article/Waste-Water-Treatment-Steps-Primary-Secondary-and-Tertiary-Treatment-581.html


THANK
YOU