

# **WASTEWATER TREATMENT PLANT**



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# **Wastewater Treatment**

## **❖ Purpose:**

- To manage water discharged from homes, businesses, and industries to reduce the threat of water pollution.**
- Water discharged from homes, businesses, and industry enters sanitary sewers.**
- Water from rainwater on streets enters storm water sewers.**
- Combined sewers carry both sanitary wastes and storm water**

# Wastewater Treatment

- ❖ **Pre-treatment**
- ❖ **Preliminary treatment**
- ❖ **Primary treatment**
- ❖ **Secondary treatment**
- ❖ **Tertiary Treatment**

# Wastewater Treatment

## ❑ **Pre-Treatment:**

- Occurs in business or industry prior to discharge
- Prevention of toxic chemicals or excess nutrients being discharged in wastewater.
- Water moves toward the wastewater plant primarily by gravity flow.
- Lift stations pump water from low lying areas over hills

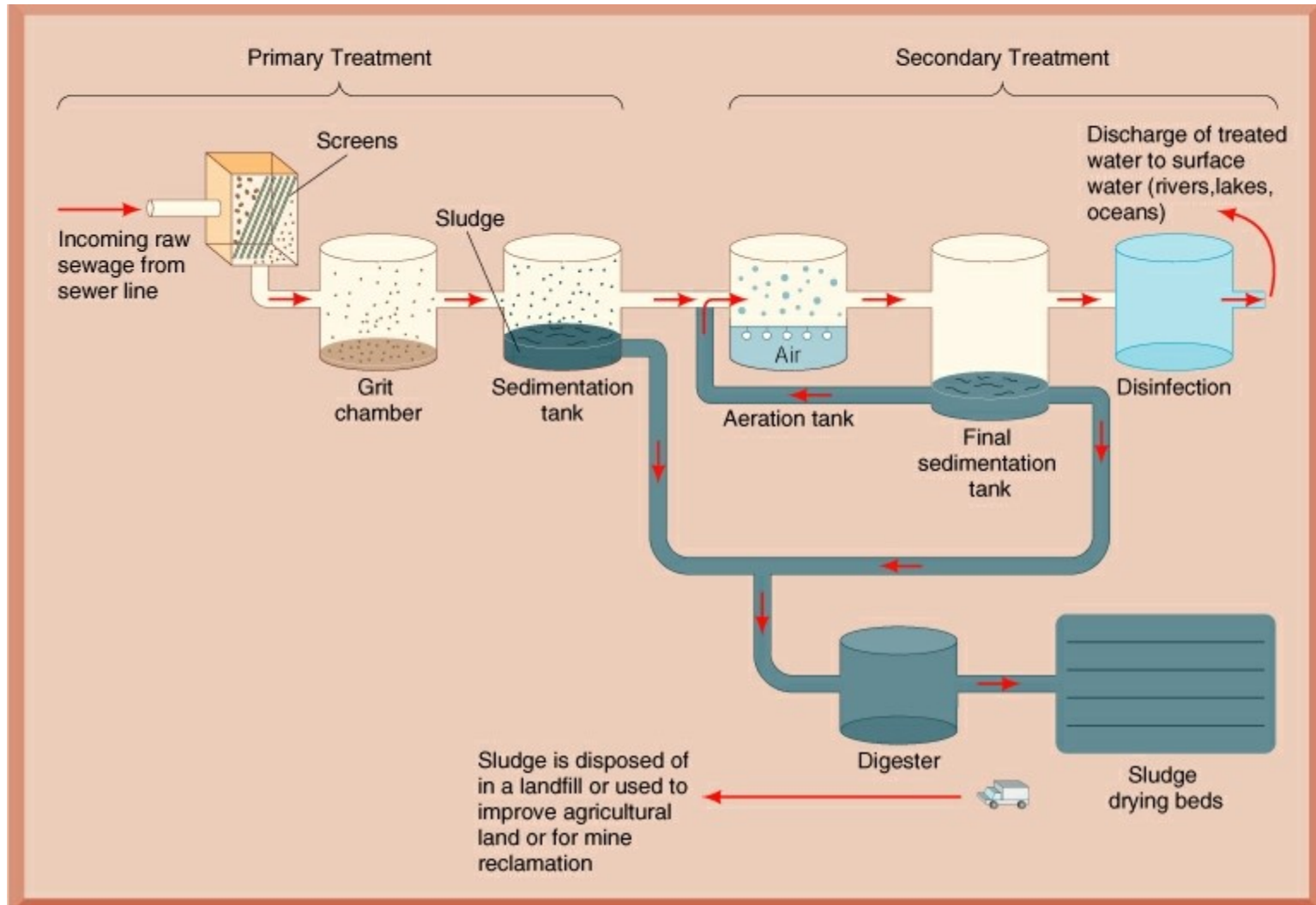
## ❑ **Preliminary Treatment:**

- removes large objects and non-degradable materials
- protects pumps and equipment from damage
- bar screen and grit chamber

## **Wastewater Treatment**

- ❖ **Measurement and sampling at the inlet structure**
  - **a flow meter continuously records the volume of water entering the treatment plant**
- ❖ **- water samples are taken for determination of suspended solids and B.O.D.**
  
- ❖ **Measurements of Suspended Solids and B.O.D. indicate the effectiveness of treatment processes**
  
- ❖ **Both Suspended Solids and B.O.D. decrease as water moves through the wastewater treatment processes**

# Wastewater Treatment



# PRE-LIMINARY TREATMENT

## ❖ Bar Screen

- catches large objects that have gotten into sewer system such as bricks, bottles, pieces of wood, etc.



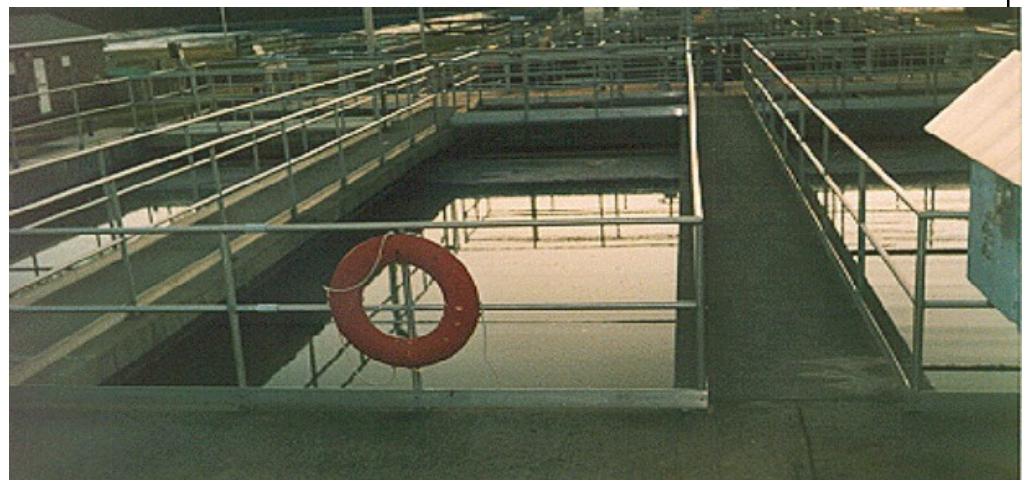
# Preliminary Treatment

## ❖ Grit Chamber

- removes rocks, gravel, broken glass, etc.

## ❖ Mesh Screen

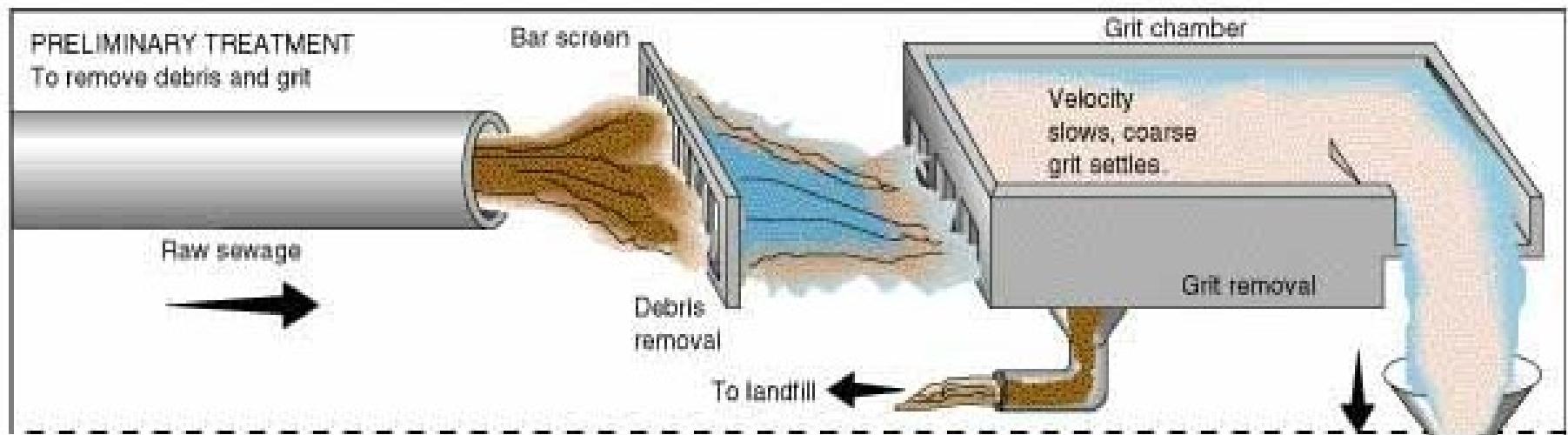
- removes diapers, combs, towels, plastic bags, syringes, etc.





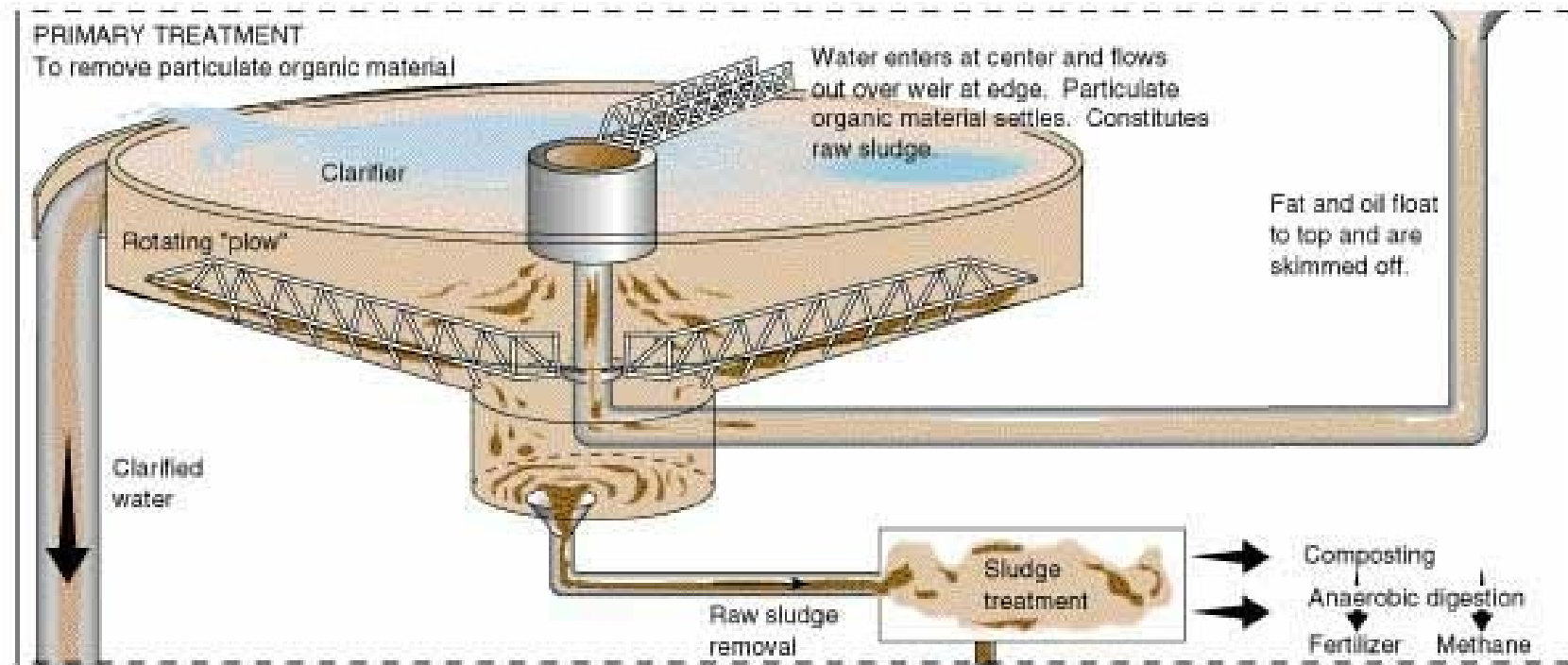
# Wastewater Treatment

## ❖ Preliminary Treatment



# Wastewater Treatment

## ❖ Primary Treatment



# PRIMARY TREATMENT

- ❖ **Primary treatment reduces the suspended solids and the B.O.D. of the wastewater.**
- ❖ **From the primary treatment tanks water is pumped to the trickling filter for secondary treatment.**
- ❖ **Sludge from the primary sedimentation tanks is pumped to the sludge thickener.**
  - **more settling occurs to concentrate the sludge prior to disposal**
- ❖ **Secondary treatment will further reduce the suspended solids and B.O.D. of the wastewater.**

# SECONDARY TREATMENT

- ❖ Secondary treatment is a biological process
- ❖ Utilizes bacteria and algae to metabolize organic matter in the wastewater
- ❖ Secondary treatment systems are classified as **Aerobic suspended –growth treatment** and **Anaerobic suspended-growth treatment.**

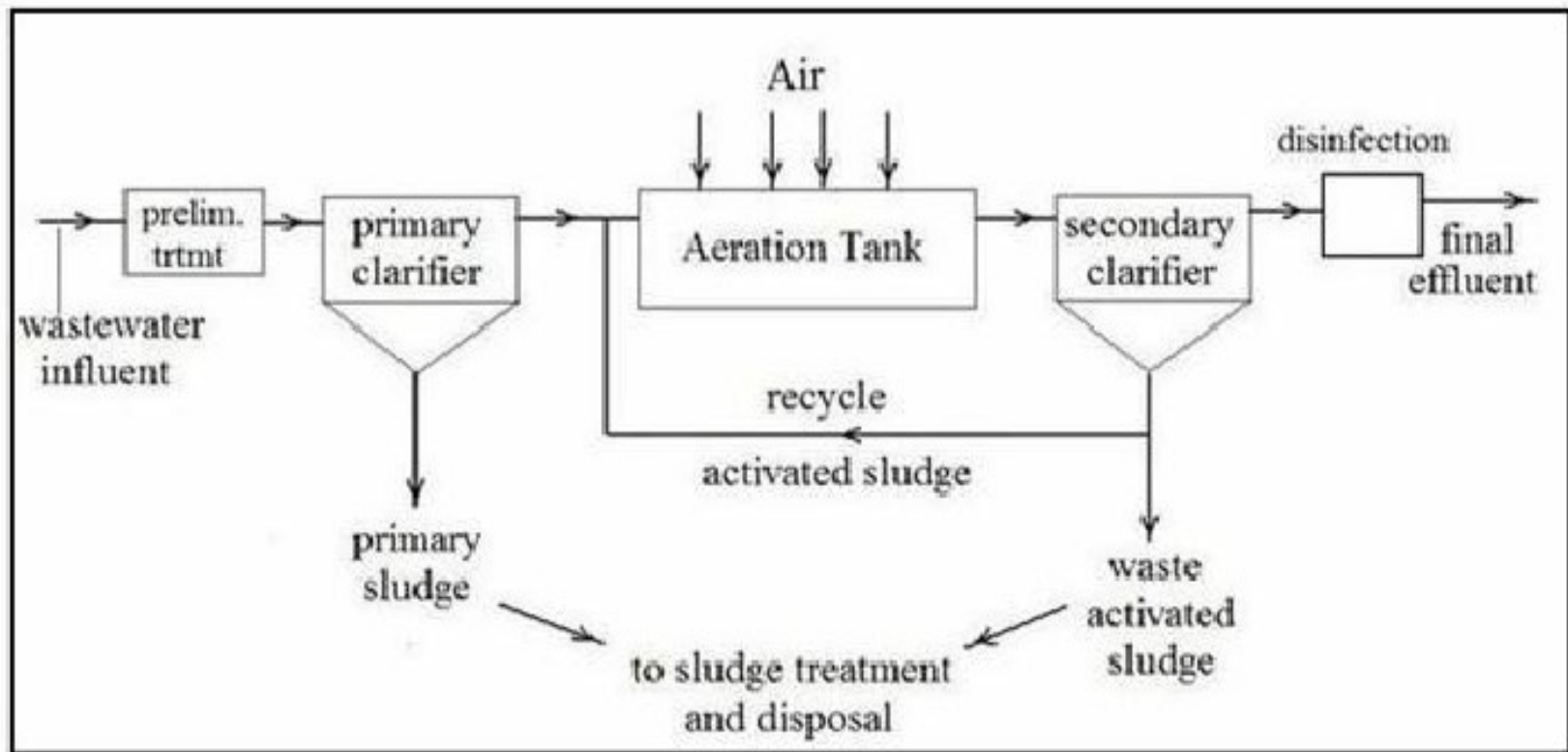
# SECONDARY TREATMENT

## AEROBIC SUSPENDED –GROWTH TREATMENT

- ✓ Activated sludge process
- ✓ Aerated lagoons
- ✓ Trickling Filter
- ✓ Aerobic digestion

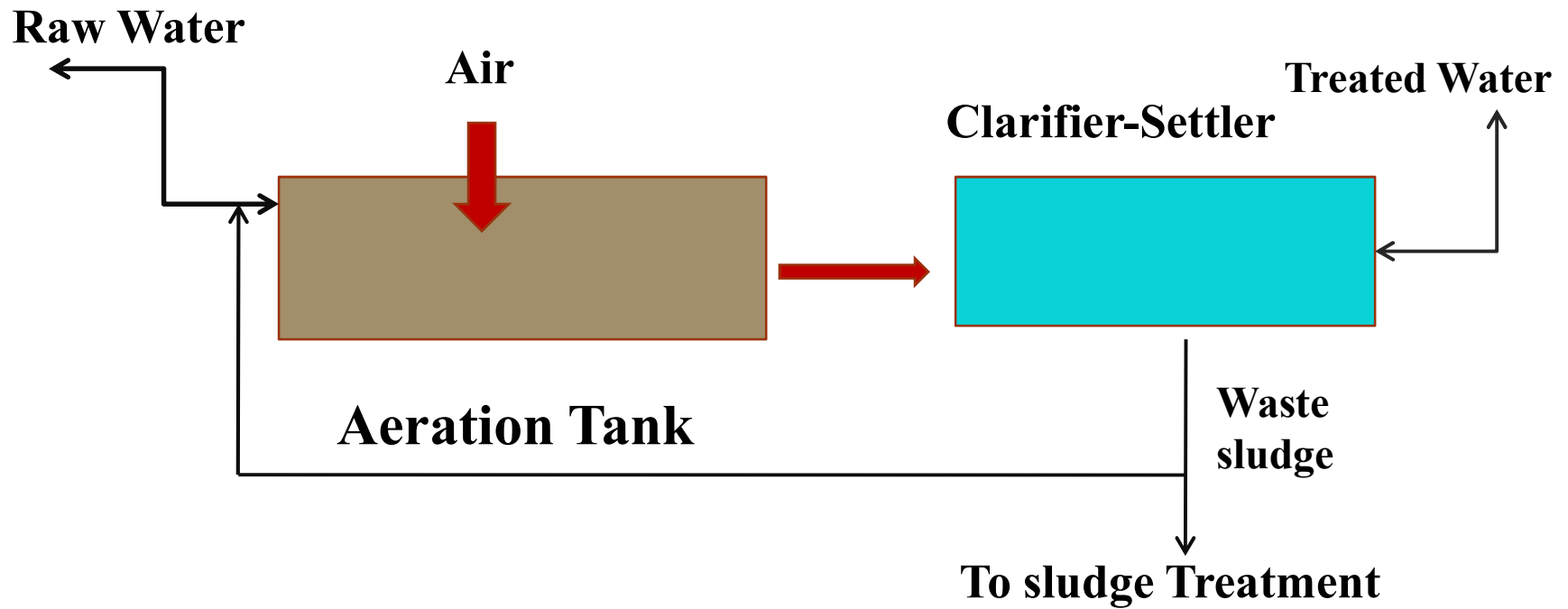
## ANAEROBIC SUSPENDED-GROWTH TREATMENT

Anaerobic filters or fixed-film consists of column filled with solid media for the treatment of organic matter in sewage.



Activated Sludge Wastewater Treatment Flow Diagram

# ACTIVATED SLUDGE PROCESS



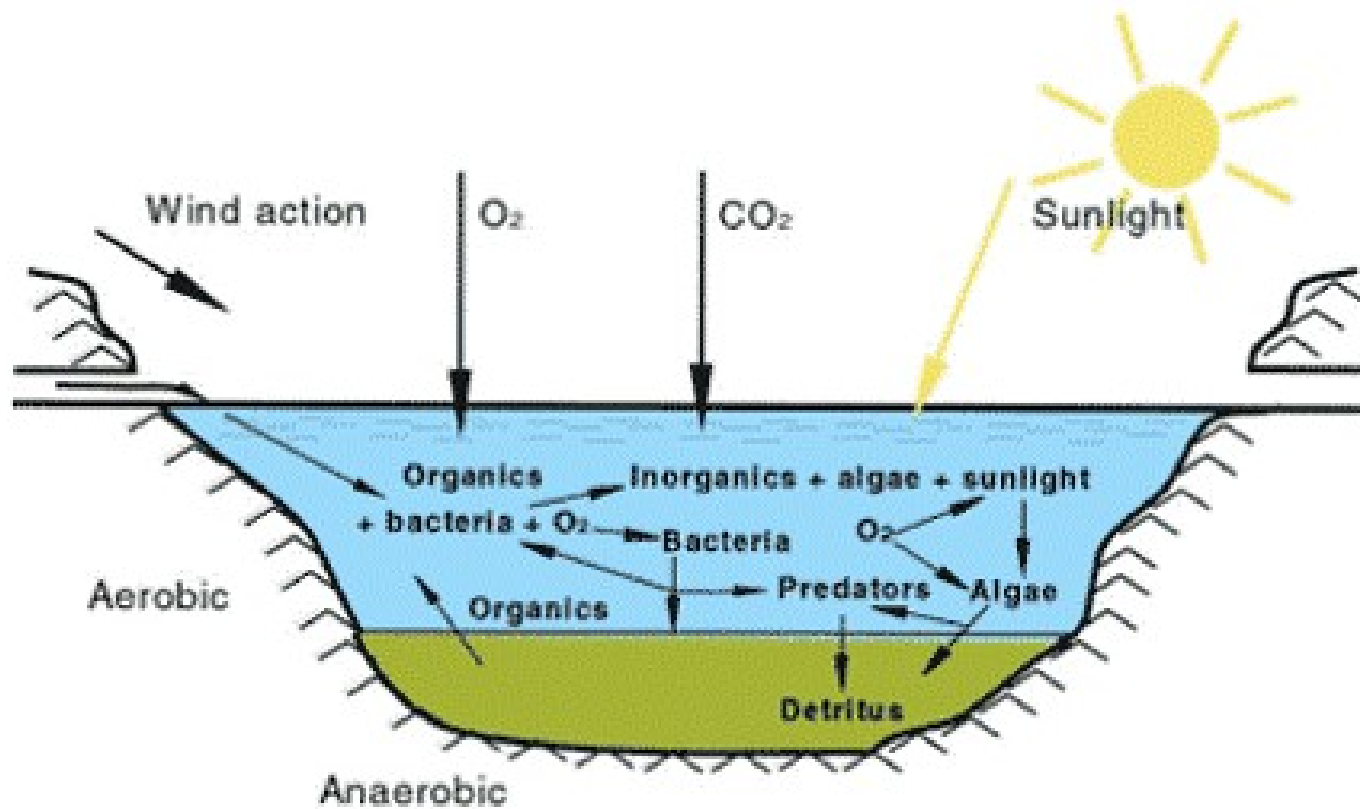
## Activated sludge process

- The effluent from the primary clarifier goes to aeration tank.**
- Aeration tank also receives microorganisms from the secondary settling tank known as activated sludge.**
- Oxygen is pumped into aeration tank for maintaining aerobic conditions.**
- After few hours of agitation, the waste water goes to secondary settling tank where solids settle at the bottom .**
- The sludge is produced, dewatered and disposed off.**
- Sludge can be used for landfills or disposed off in ocean or used in croplands, pastures, etc.,**



## **AERATED LAGOONS**

- ❑ Lagooning describes the process of placing effluents in a shallow impermeable water basin to allow degradation to take place. This type of containment is used for wastewater with low organic contents. The cleaning of the effluents takes place as a result of bacterial action, algae or aquatic vegetation.**
- ❑ Oxygenation for bacterial oxidation of organics comes from photosynthesis by algae and a bit from wind. CO<sub>2</sub> released by bacteria is used by the algae. Excess biomass and other settleables are treated by anaerobic bacteria at the bottom.**

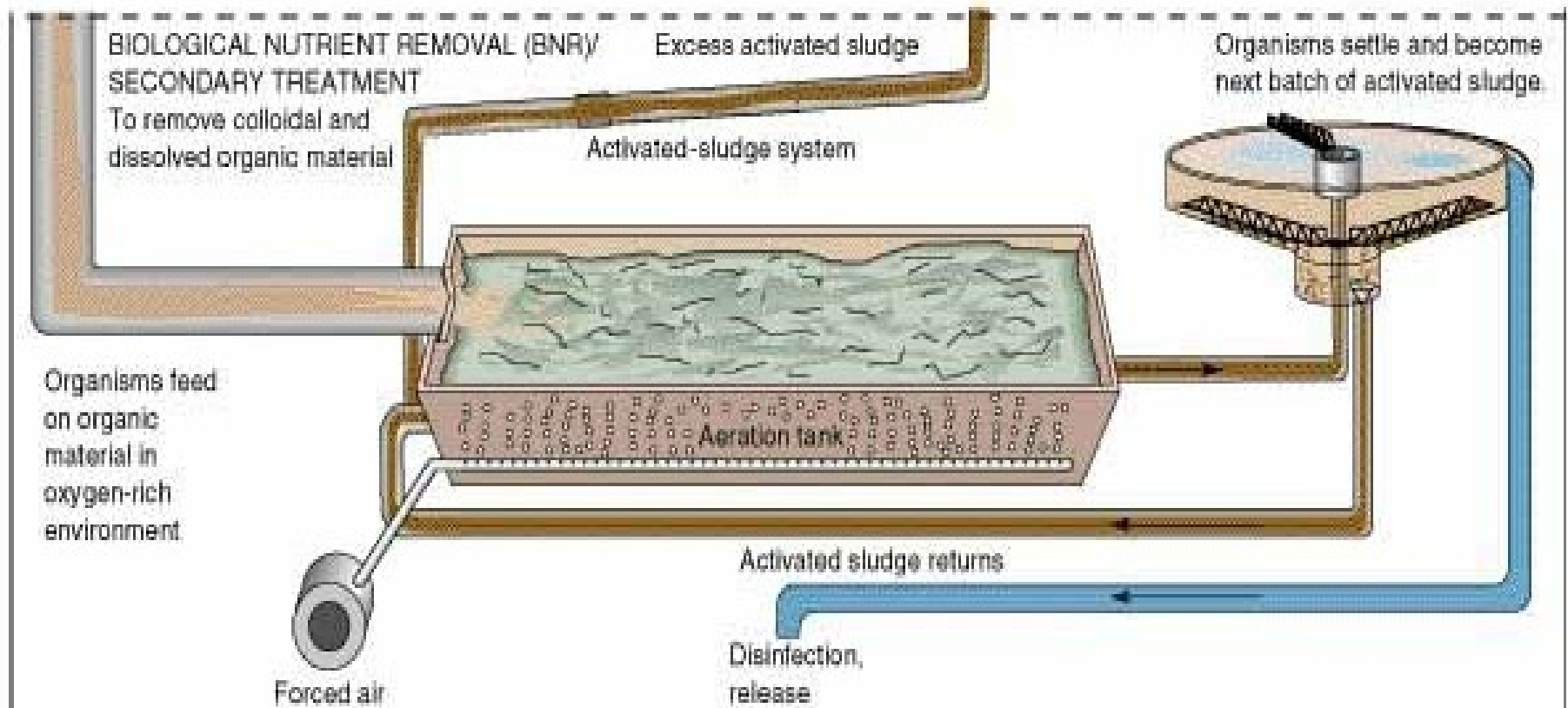


## **AEROBIC DIGESTION**

- ❑ Aerobic digestion is an extension of the activated sludge aeration process whereby waste primary and secondary sludges are continually aerated for long periods of time.**
- ❑ In aerobic digestion the microorganisms extend into the endogenous respiration phase, which is a phase where materials previously stored by the cell are oxidized, with a reduction in the biologically degradable organic matter. This organic matter, from the sludge cells is oxidized to carbon dioxide, water and ammonia.**
- ❑ The ammonia is further converted to nitrates as the digestion process proceed.**
- ❑ The oxygen uptake rate levels off and the sludge matter is reduced to inorganic matter and relatively stable volatile solids.**
- ❑ The major advantage of aerobic digestion is that it produces a biologically stable end product suitable for subsequent treatment in a variety of processes. Volatile solids reductions similar to anaerobic digestion are possible.**

# Wastewater Treatment

## ❖ Secondary Treatment



## **SECONDARY TREATMENT-TRICKLING FILTER**

- ❖ **The trickling filter does not “filter” the water.**
- ❖ **Water runs over a plastic media and organisms clinging to the media remove organic matter from the water.**
- ❖ **It consist of a bed of crushed stones/pebbles covered with slime which consists of aerobic bacteria, algae, fungi, protozoa, worms & insect larvae.**
- ❖ **Sewage is degraded by the aerobic bacteria when it passes through the bed and is collected at the bottom of the filter.**
- ❖ **It helps in better removal of organic matter and also keeps the filter moist when the flow rate is slow**

# TRICKLING FILTER

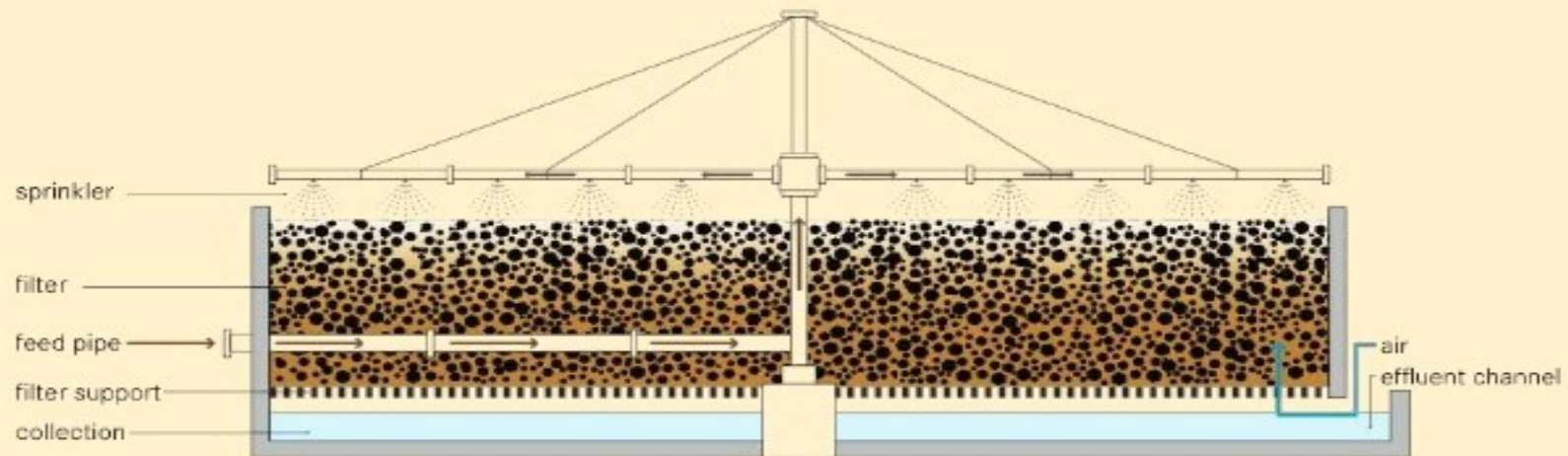
❖ The final clarifiers remove additional sludge and further reduce suspended solids and B.O.D.



# SECONDARY TREATMENT

## TRICKLING FILTER OPERATION

Type of **Attached Growth System**



The wastewater is distributed over “**media**” upon which a **biological film** growth develops containing living organisms that **break down organic material**.

# TERTIARY TREATMENT

- ❖ **To provide final treatment stage to further improve the effluent quality before it is discharged to the receiving environment (Sea, river, lake etc).**
- ❖ **Sand filtration removes residual suspended matter.**
- ❖ **Filtration over activated carbon remove residual matter.**



## **IMPORTANCE OF TERTIARY TREATMENT**

- To remove total suspended solids and organic matter those are present in effluents after secondary treatment.**
- To remove specific organic and inorganic constituents from industrial effluent to make it suitable for reuse.**
- To make treated wastewater suitable for land application purpose or directly discharge it into the water bodies like rivers, lakes, etc.**
- To remove residual nutrients beyond what can be accomplished by earlier treatment methods.**
- To remove pathogens from the secondary treated effluents.**
- To reduce total dissolved solids (TDS) from the secondary treated effluent to meet reuse quality standards.**

# TERTIARY TREATMENT

- ❑ **Nutrient removal (ammonia and phosphorus)**
- ❑ **Nitrification/ Dinitrification**
- ❑ **Ion exchange**
- ❑ **Membrane Process**
- **anaerobic microbiological process with a different microbe where  $O_2$  is toxic (more sludge)**
  - $NO_3^- \rightarrow N_2$  (escapes to atmosphere)
- **$PO_4^{-3}$  if not removed in sludge in secondary process**
  - $PO_4^{-3} + Al^{+3} \rightarrow AlPO_4$  (s) (into sludge)
- **aeration to strip  $N_2$  and re-oxygenate (add DO).**

## **Phosphorus Removal**

### **A) Physical:**

- a) filtration for particulate phosphorus**
- b) membrane technologies**

### **A) Chemical:**

- a) precipitation**

### **C) Biological: •**

- a) enhanced biological phosphorus removal (EBPR)**



## **AMMONIA REMOVAL**

**☐ The most common processes for removal of ammonia from wastewater are**

- i) Air stripping**
- ii) Biological nitrification and denitrification.**

### **☐ Air Stripping**

- i) It consists of converting ammonium to gaseous phase and then dispersing the liquid in air, thus allowing transfer of the ammonia from wastewater to the air.**
- ii) The most important and efficient reactor for air stripping is counter current spray tower.**

## DISINFECTION

- 1) **Uv radiaton** :- killing bacteria , virus and other pathogens . by damaging their genetic structure . • No chemical are used • More Rapid
- 2) **Ozonation** :- Disinfection achieved by formation of free radicals as oxidizing agents • more effective against viruses and bacteria then chlorination .
- 3) **Chlorination** :- chlorine is used in 2 forms – Cl<sub>2</sub> gas form or hypochlorite tablets.
  - Chlorine react with water to form HOCL , which rapidly dissociate to form hypochlorite ion.
  - Chlorine effective against bacteria..

❑ **Ion- exchange** - Ion exchange can be used in waste water treatment plants to swap one ion for another for the purpose of demineralization . The widest application of this process is in domestic water softening.

❑ **Membrane process**

1) **Microfiltration** –

✓ Pore sizes 0.01 – 12  $\mu\text{m}$

✓ Capable of removing bacteria , macromolecules .

2) **Ultra filtration**- Remove organic molecules, virus, bacteria or a molecules weight above about 800 daltons

✓ Pore size 0.002 -0.03 $\mu\text{m}$

3) **Nanofiltration**:- Allow monovalent ions such as sodium or potassium to pass but reject a high proportion of divalent ions such calcium and magnesium .

✓ Pore sizes are typically 0.001 – 0.01 $\mu\text{m}$

✓ Effective for removal of colour – forming organic compounds.

4) **Reverse osmosis** :- Rejects monovalent ions and organics of molecular weight > 50 dalton • Pore sizes <0.002 $\mu\text{m}$  • Used for desalination of sea water.

**☐ SAND FILTER**

- ✓ Sand ,either fine or coarse is generally used as filter media.
- ✓ They consist of fine sand supported by gravel are used in water treatment process of water purification.
- ✓ sand filter is an environmental friendly waste water treatment process.
- ✓ Simple to use and inexpensive.



## ADVANCED TERTIARY TREATMENT

### ❖ Disposal of Sludge or Bio-solids

❖ The sludge undergoes lime stabilization (pH is raised by addition of lime) to kill potential pathogens.

❖ The stabilized sludge is land applied by injection into agricultural fields

THANK  
YOU