

(Introduction to Environmental Studies)

B. Tech 3<sup>rd</sup> Semester

# **WATER POLLUTION Part-2 (Treatment)**

## **Unit 5**

### **Environmental Pollution**



Department: Chemistry

Subject: Environmental Studies (CHM 2041)

# Contents

- Introduction to water pollution control strategy
- Need of wastewater treatment
- Methods of water treatment
- Preliminary water treatment (Screening, grit removal, oil and grease removal, coagulation and flocculation)
- Secondary/ biological water treatment (Activated sludge process, Trickling filter, UASB reactor)
- Tertiary treatment
- **Common measures to control pollution**

# Why do we need to treat wastewater ?

- To prevent groundwater pollution
- To prevent sea shore
- To prevent soil
- To prevent marine life
- Protection of public health
- To reuse the treated effluent

For agriculture

For groundwater recharge

For industrial recycle

- Solving social problems caused by the accumulation of wastewater



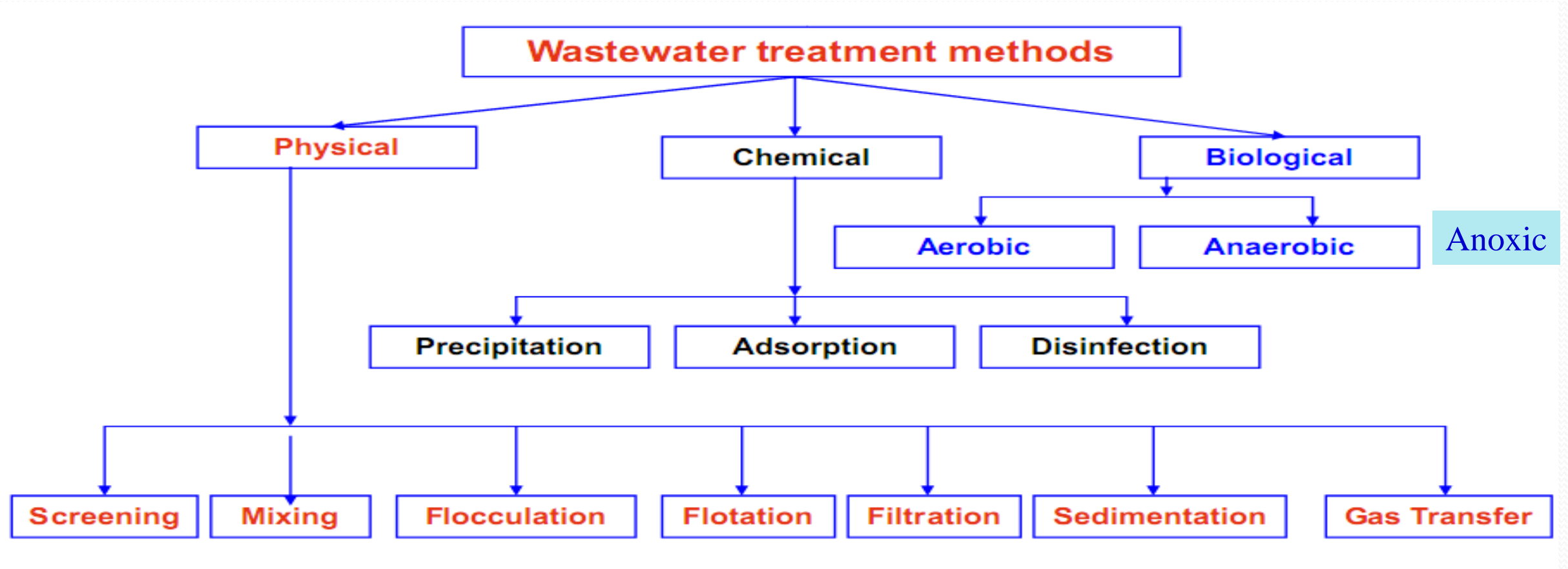
# Control measures and prevention of water pollution

Following strategies are adopted for controlling water pollution:

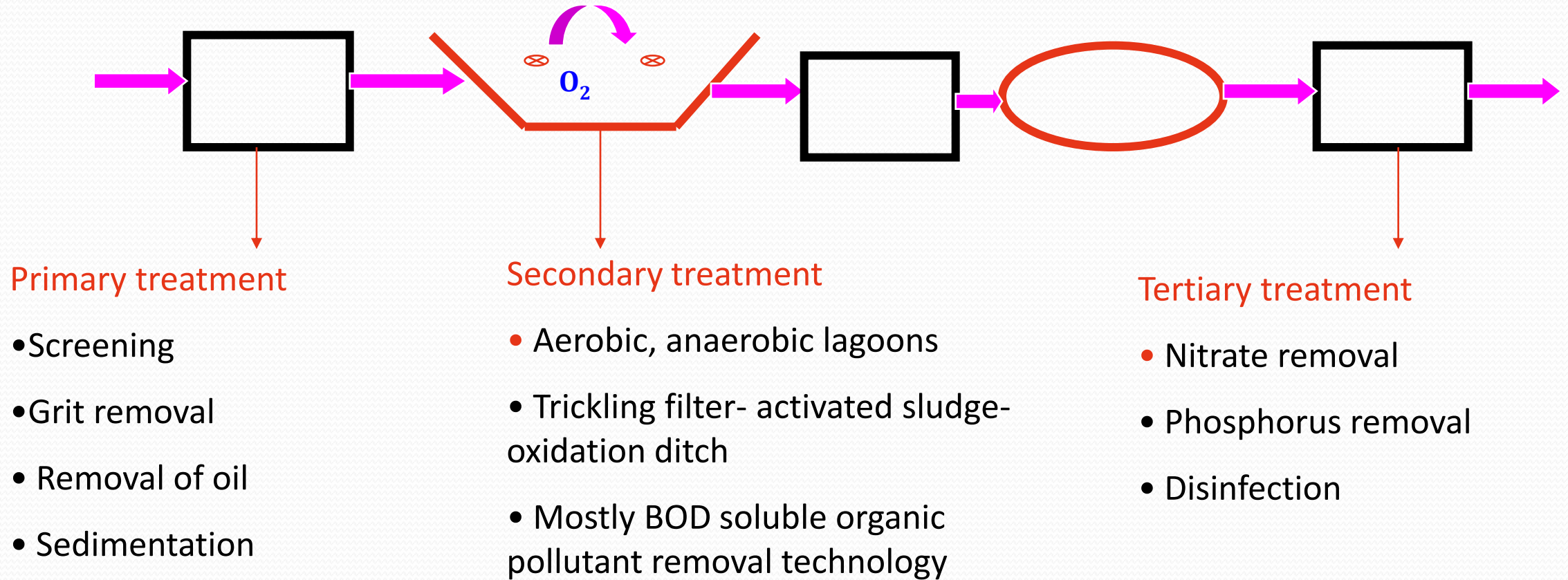
- Two approaches are used: input control and output control.
- **Input control** means 'reducing generation of pollutants' while output control means 'controlling pollutants after being produced'.
- **Output control** further involves two strategies: volume reduction and strength reduction.  
**Volume reduction:** means reducing total volume of pollutant
- **Strength reduction:** means reducing harmful effects of pollutants.
- Both, volume and strength of the polluted water can be reduced by different types of water treatment plants (WTP). This includes
  - Sewage Treatment Plants (STP) and
  - Effluent Treatment Plants (ETP).



# Wastewater treatment Methods



# Wastewater Treatment Process





# Preliminary Treatment

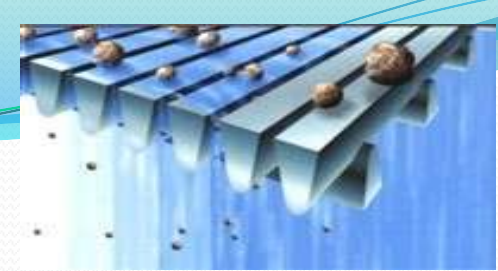
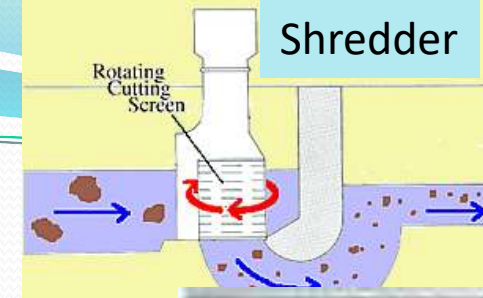
This involves the removal of floating material, settle able inorganic solids, and greasy materials.

💧 **SCREENERS** - Device with opening and further classified as coarse (75-150mm), medium (20-70mm) and fine (<20mm).

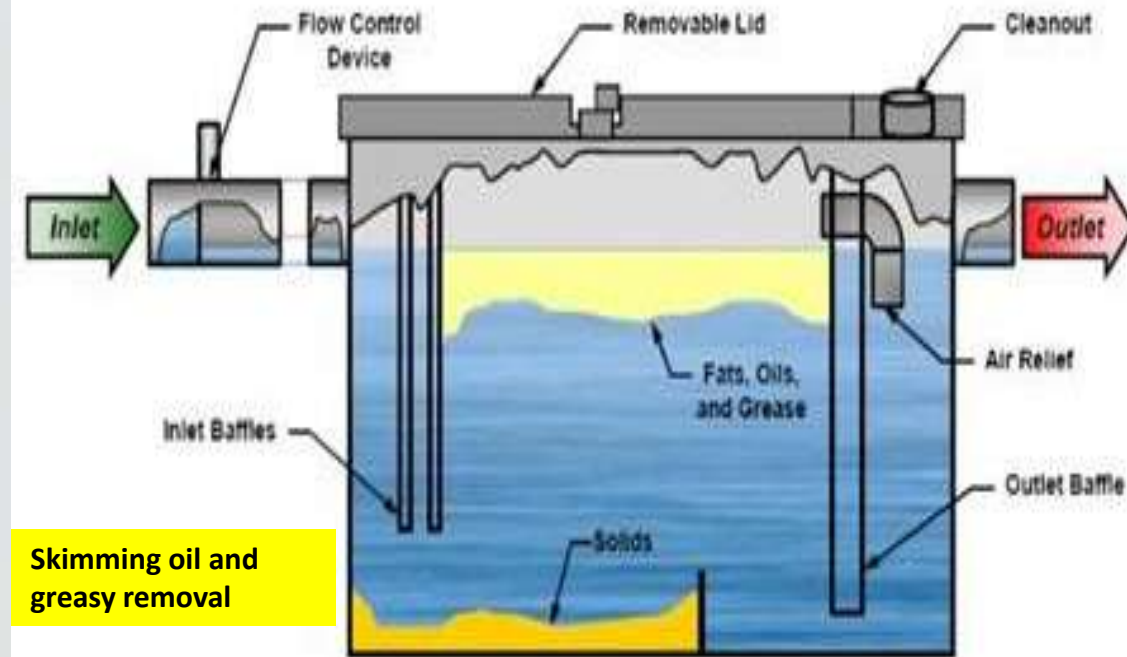
💧 **SHREDDER** - Special device that cut and retain floating and suspended material.

💧 **GRIT CHAMBERS** - Heavy inorganic material can be removed. Based on principle of sedimentation.

💧 **SKIMMING TANK** - Greasy material can be removed using skimming tank which is divided into 3 compartments.



Screening bar/plate



Hydromechanical Grease Interceptor

# Sedimentation tank or Grit Channel

- It is aimed at removal of suspended organic solids that cannot be removed in preliminary treatment. It involves the process of sedimentation.
  - Sedimentation is the separation from water by gravitational settling if suspended particles are heavier than water
- Sedimentation tank have inlet zone, settling zone, outlet zone, sludge zone.



**Principle:** Suddenly increase in flow cross sectional area of the influent wastewater from  $a$  to  $A$  at constant flow rate, the horizontal velocity of the wastewater carrying sand and silt drop down from  $V$  to  $v$  when it enter in to the settling chamber with high cross sectional area from a pipe (small cross sectional area) thus the horizontal momentum of the sand and silt suspended in in the water decreases and the gravitational force over come the horizontal momentum, as a result the particulate matter move down ward due to gravity and settled in the bottom, and clean water in the out pipe of the grit channel



# Coagulation and Flocculation

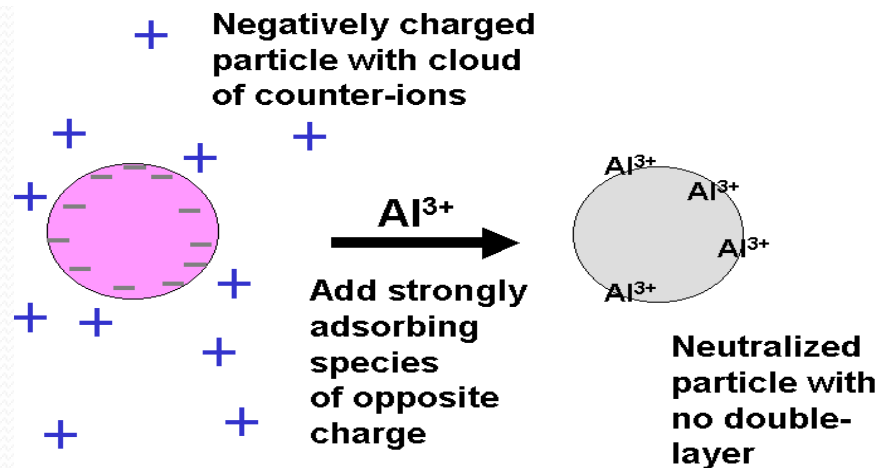
- ✓ Colloids have a net negative surface charge (size  $10^{-6}$  to  $10^{-9}$  m)
- ✓ Electrostatic repulsive force prevents them from agglomeration

❑ **Coagulation** is the destabilization of colloids by addition of chemicals that neutralize the negative charges

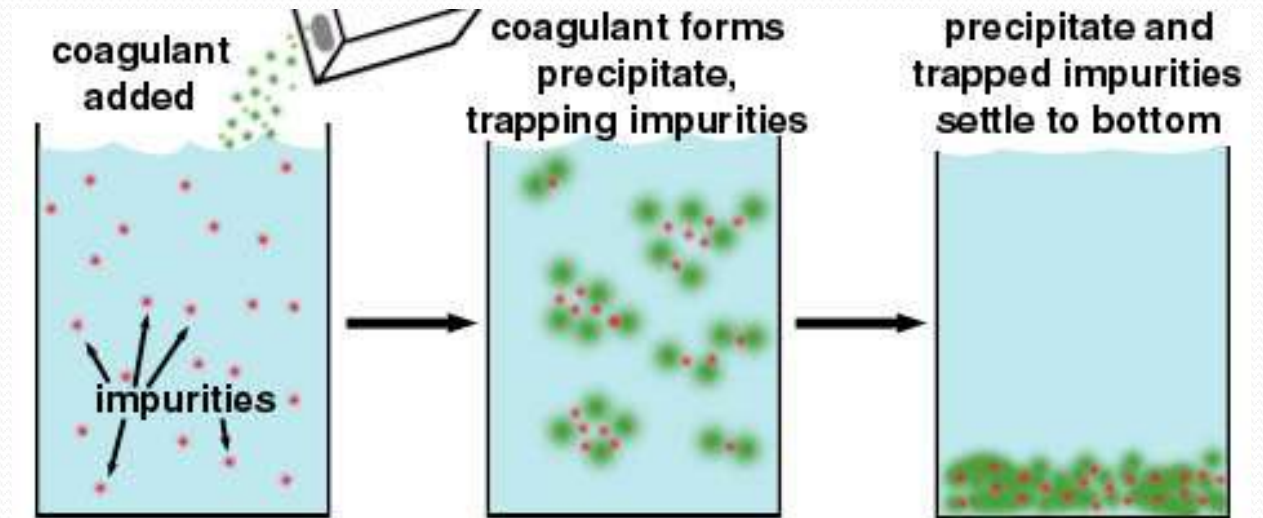
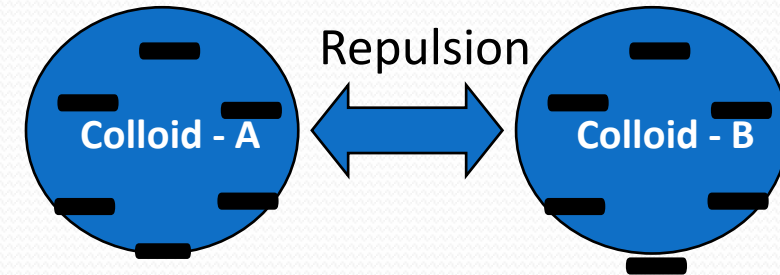
❑ The chemicals are known as coagulants, usually higher valence cationic salts ( $\text{Al}^{3+}$ ,  $\text{Fe}^{3+}$  etc,  $\text{AlSO}_4$ ,  $\text{FeCl}_3$ )

■ Coagulants can be used to reduce the electrostatic repulsive forces

■ The electrostatic repulsion reduced by the addition of countercharged ions [ $\text{Al}^{3+}$ ]



M. Hubbe



**Flocculation** is the agglomeration of destabilized/neutralized particles into a large size particles known as flocs which can be effectively removed by sedimentation due to gravity.

# Secondary/Biological Treatment

It is required to remove dissolved and fine colloidal organic matter. This process involves the use of microorganisms that decompose the unstable organic matter to stable inorganic forms.

## SECONDARY TREATMENT OR BIOLOGICAL TREATMENT

### AEROBIC

### ANAEROBIC

### POND PROCESS

#### SUSPENDED

#### ATTACHED

#### SUSPENDED

#### ATTACHED

- a) activated sludge
- b) aerated lagoons

- a) trickling filters
- b) packed bed reactors (PBR)

- a) aerobic
- b) anaerobic
- c) facultative



# Aerobic Suspended Growth Treatment process

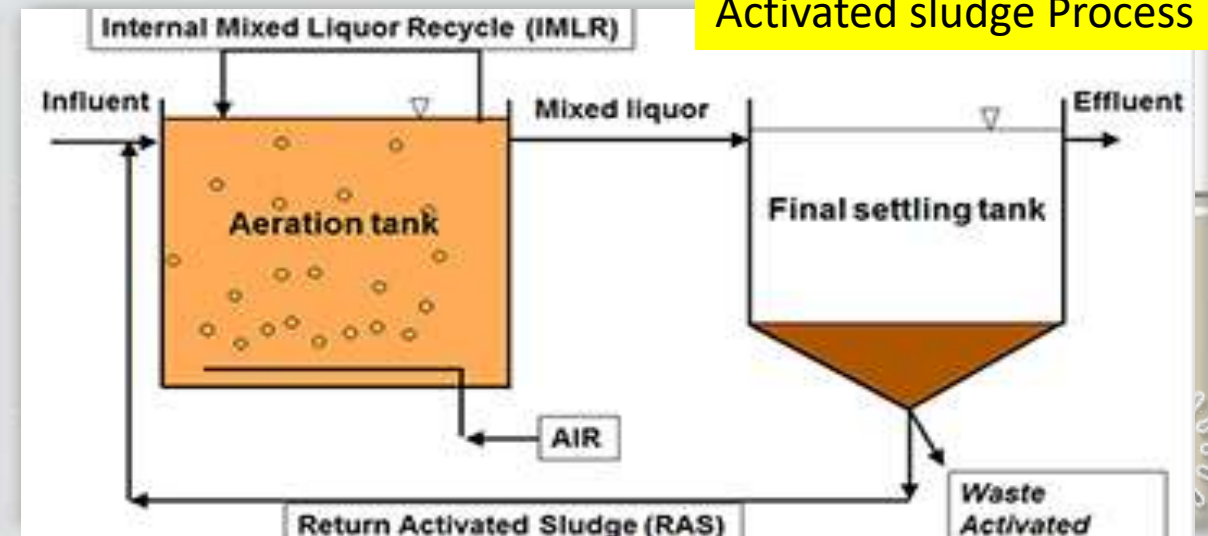
- 1) **ACTIVATED SLUDGE PROCESS:-** The sewage containing organic matter with microorganism is aerated in an aeration tank.

Advantage- cost effective, sludge has higher fertilizer value.

*Organic materials + Nutrients/Mineral + O<sub>2</sub>  $\longrightarrow$  + CO<sub>2</sub> + NH<sub>3</sub> + H<sub>2</sub>O + Biomass + End product*

*Aerobic microbes With favorable Temp , pH & DO*

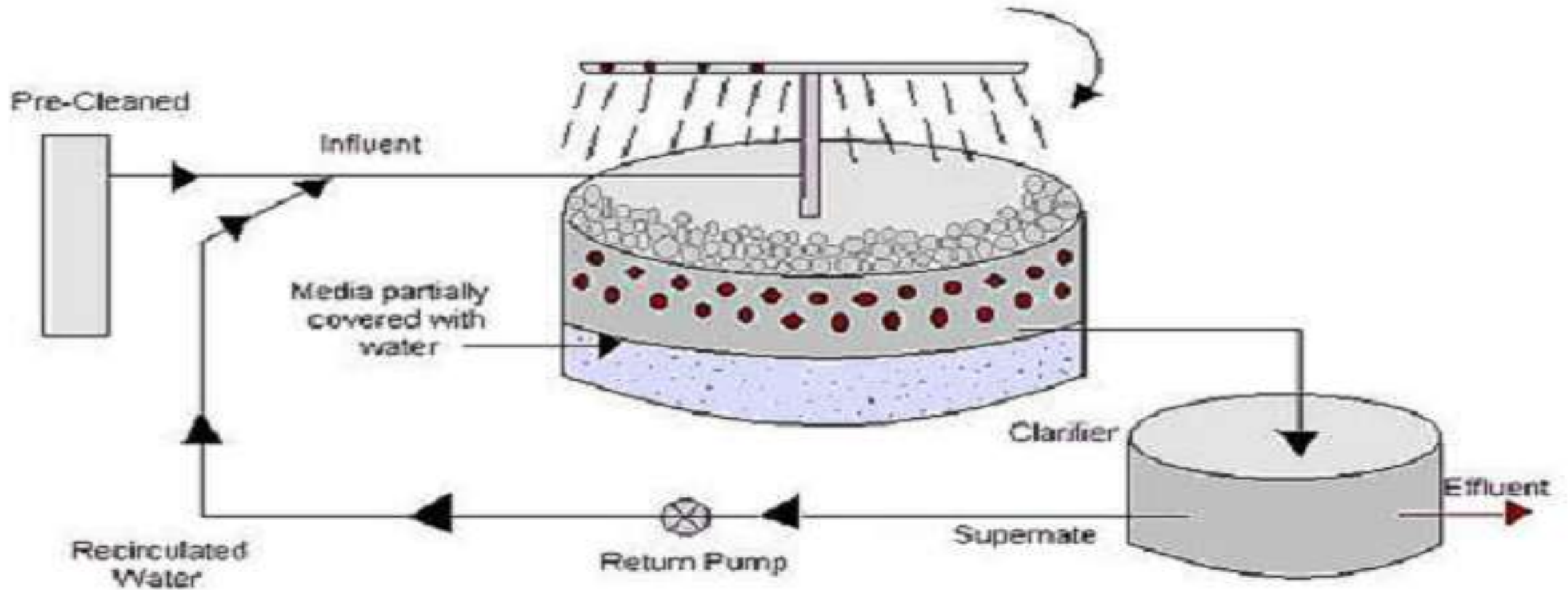
- 2) **AERATED LAGOONS :-** They are also known as aerated ponds, are the facultative stabilization ponds wherein surface aerators are installed to overcome bad odors.





# Trickling Filter

## Recirculation of Cleaned Water





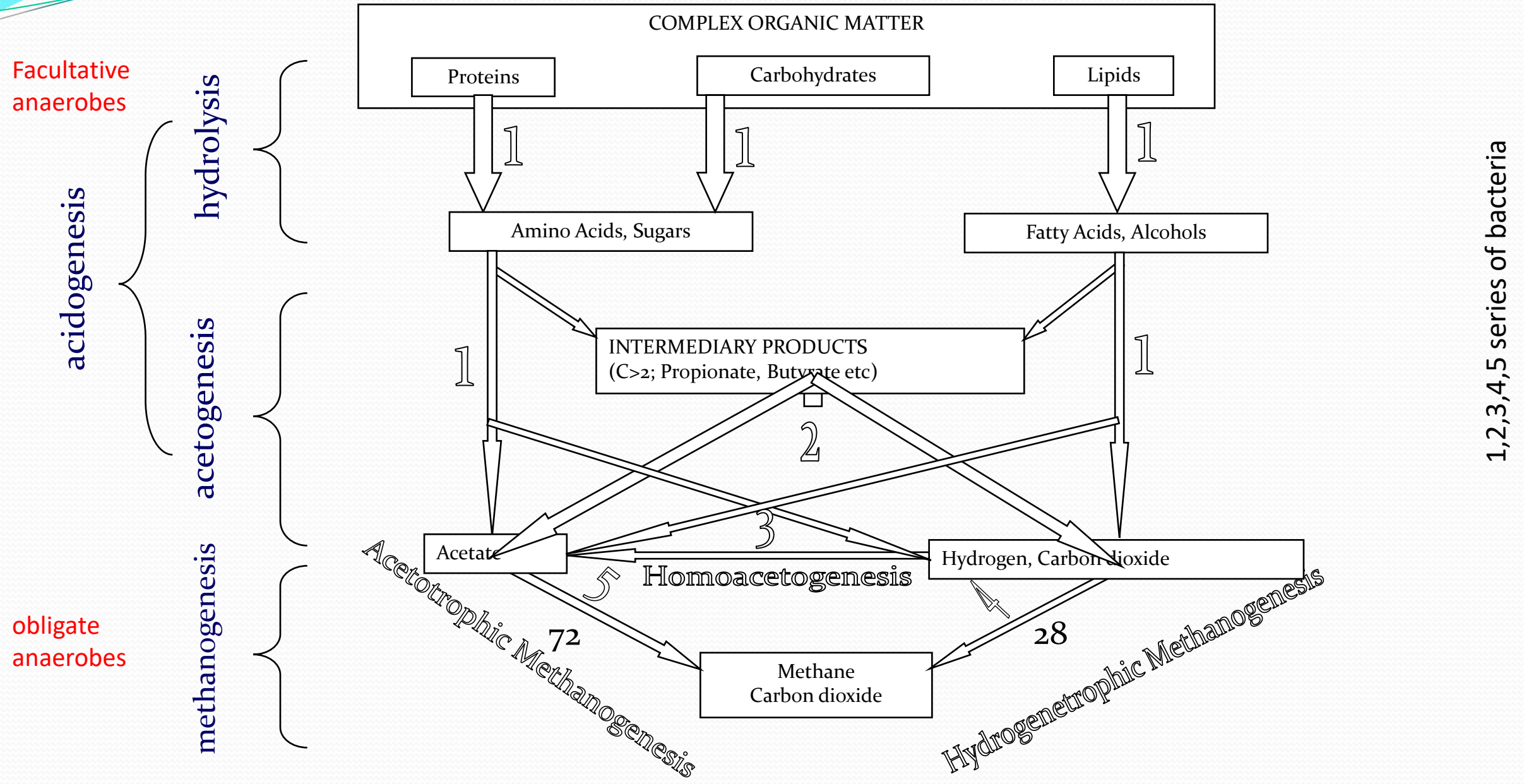
# Anaerobic Wastewater Treatment

Anaerobic treatment is a biological process carried out in the absence of  $O_2$  for the stabilization of organic materials by conversion to  $CH_4$  and inorganic end-products such as  $CO_2$  and  $NH_3$

*Anaerobic microbes*  
*With favorable Temp , pH*

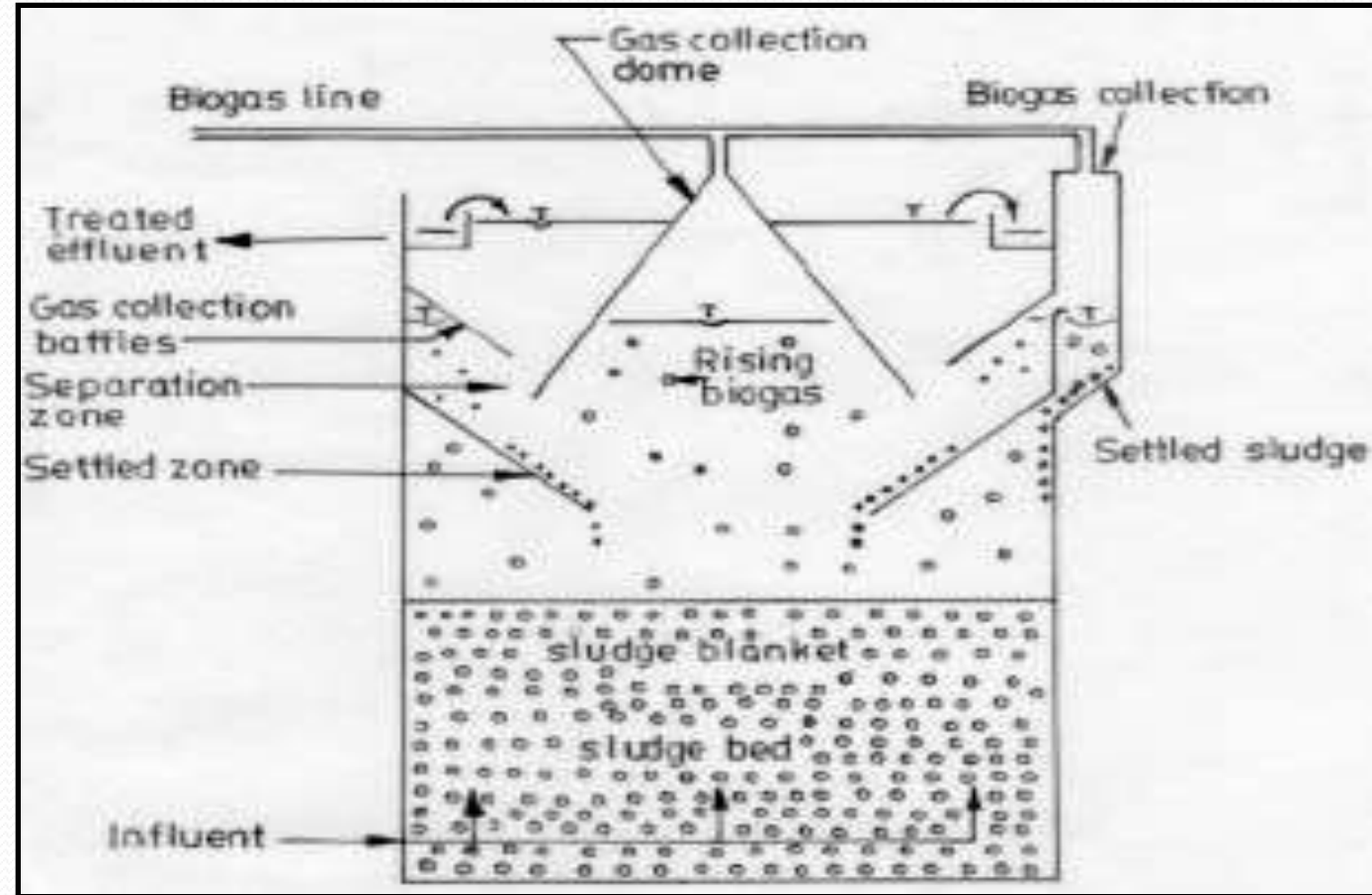
*Organic materials + Nutrients/Mineral*  *+  $CO_2$  +  $NH_3$  +  $H_2O$  +  $CH_4$  +  $H_2S$  + Biomass + End product*

# *Metabolic pathway Anaerobic Digestion/Treatment*



# Upflow Anaerobic Sludge Blanket

- Wastewater flows upward through a sludge blanket composed of biological granules that decompose organic matter
- Some of the generated gas attaches to granules that rise and strike **degassing baffles** releasing the gas
- Free gas is collected by special domes
- The effluent passes into a settling chamber



# Tertiary treatment

Only 1-2 % domestic sewage receives tertiary treatment which is the most advance phase of sewage treatment. The tertiary treatment is needed under the following circumstances

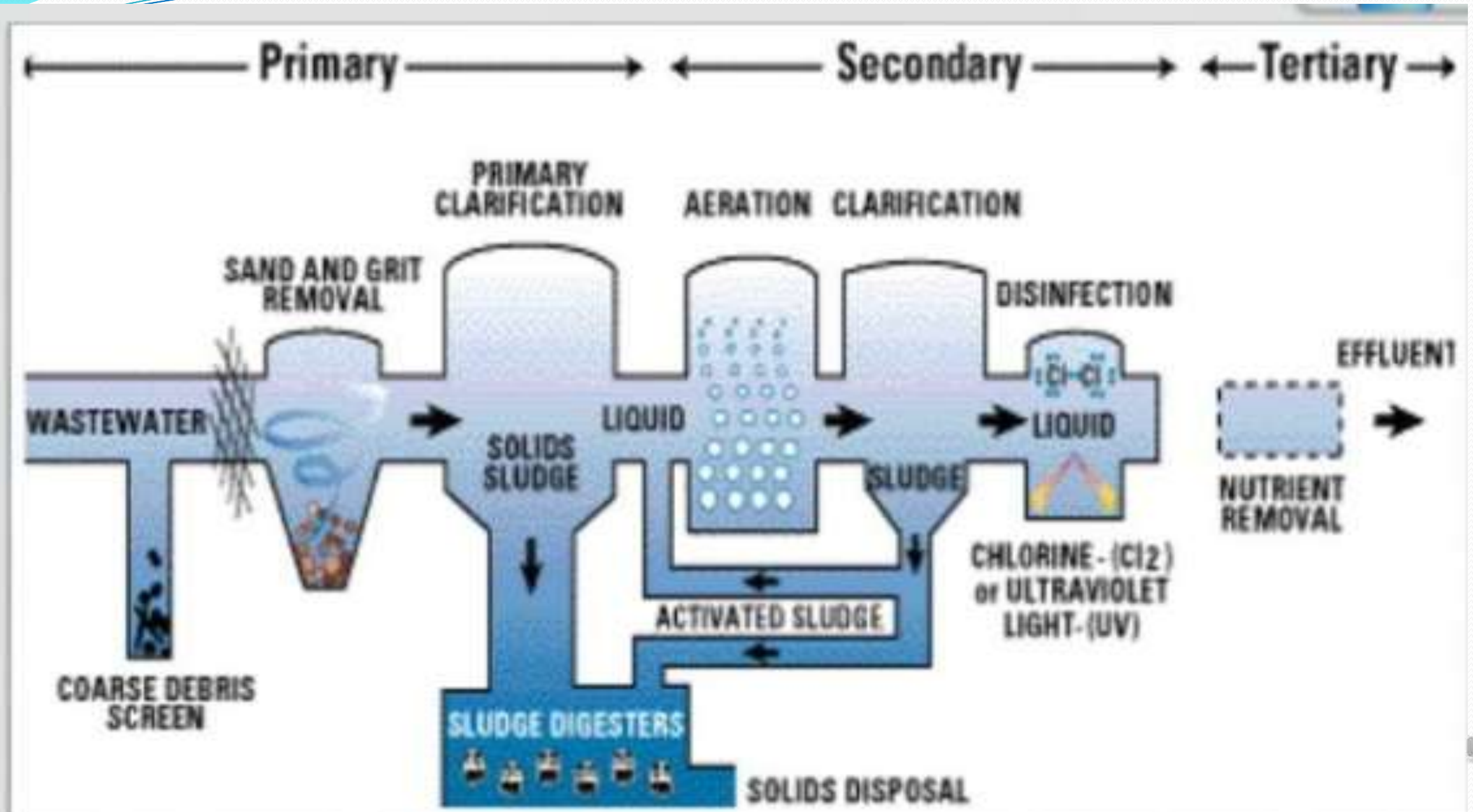
- 💧 When the quality of effluent to be discharged does not meet the standard requirement.
- 💧 When there is necessity to remove dissolved solids by ION EXCHANGERS.
- 💧 To remove nitrogen and phosphorus.
- 💧 To remove pathogenic organisms through DISINFECTION.

Using chlorine gas, bleaching powder to kill the diseases causing microorganism if any





# Flow sheet of wastewater treatment



## Besides it, some common measures to control pollution like:

- ❑ Domestic and industrial waste waters should be discharged into rivers only after proper treatment through STPs and ETPs.
- ❑ Solid wastes must not be mixed with liquid wastes and should not be thrown into to water bodies. They should be separately managed.
- ❑ Sources of drinking water should be protected from pollution. Polluting activities (e.g., industrial use, discharging effluents, bathing, washing, cattle rearing etc.) must be avoided in vicinity of source of drinking water.
- ❑ Water bodies should be regularly cleaned of aquatic weeds, plants and other crude impurities like polythene, metals, garbage etc. Special breeds of fish, which feed on mosquito eggs and bacteria, can be cultured in water bodies.
- ❑ Afforestation must be done for reducing soil erosion and improving local soil hydrology. Use of agrochemicals need to be minimized.
- ❑ Public awareness regarding water pollution and its control measures should be created.





**THANK YOU**

