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Section ; B

Subject ; Wastewater  
Engineering

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Ans: 01 "Part: a"

## \* "Wastewater Treatment"

Wastewater treatment is a process used to remove contaminants i.e. "Physical, chemical and Biological" from wastewater or sewage, and convert it into an effluent that can be refined to the water-cycle with minimum impact on the environment or directly reused. The treatment process of the water is treated in a wastewater treatment plant "WWTP" also known as water Resource Recovery Facility (WRRF), or a Sewage treatment plant (STP).

## \* "Importance;"

- Wastewater treatment is fundamental to protect the health of many different ecosystems

- Wastewater properly treated is a source of water for many purposes. Good wastewater treatment allows the maximum amount of water to be reused instead of going to waste and thus also ecosystems and aquatic life are protected.

## \* Rectangular Tank; "Part: b"

Mostly rectangular tanks preferred over circular tanks for removal of settleable solids during preliminary treatment. Because rectangular tanks provide a longer path for the wastewater flow and the suspended solids to travel and subsequently longer detention time which means less short circuiting and more sludge settling compared to the over flow circular clarifiers (Tank). Rectangular Tank less cost and easier to design.

Ans; 02

"Part; i"

## Aerobic Treatment

## Anaerobic Treatment

"i"	With oxygen.	Without oxygen.
"ii"	Carbon in food released mainly as " $CO_2$ ".	Carbon in food released mainly as " $CH_4$ ".
"iii"	Large amount of sludge produced	Sludge production is relatively low.
"iv"	Energy intensive (aeration).	Energy consumption relatively low.
"v"	Suitable for low-medium strength effluents 95% COD removal.	Best for medium-high strength effluents 80% COD removal.
"vi"	E.g; ASP, RBC Trickling filter	Anaerobic Digesters, (AD) CSTR, SBR.

## "Part; b"

### \* Activated Sludge process "ASP";

- It is a process in which oxygen or air is forced into sewage liquor to develop a biological floc, which reduces the organic content in the sewage.

- Micro-organism responsible for treatment by appropriate mixing method are maintained in liquid suspension.

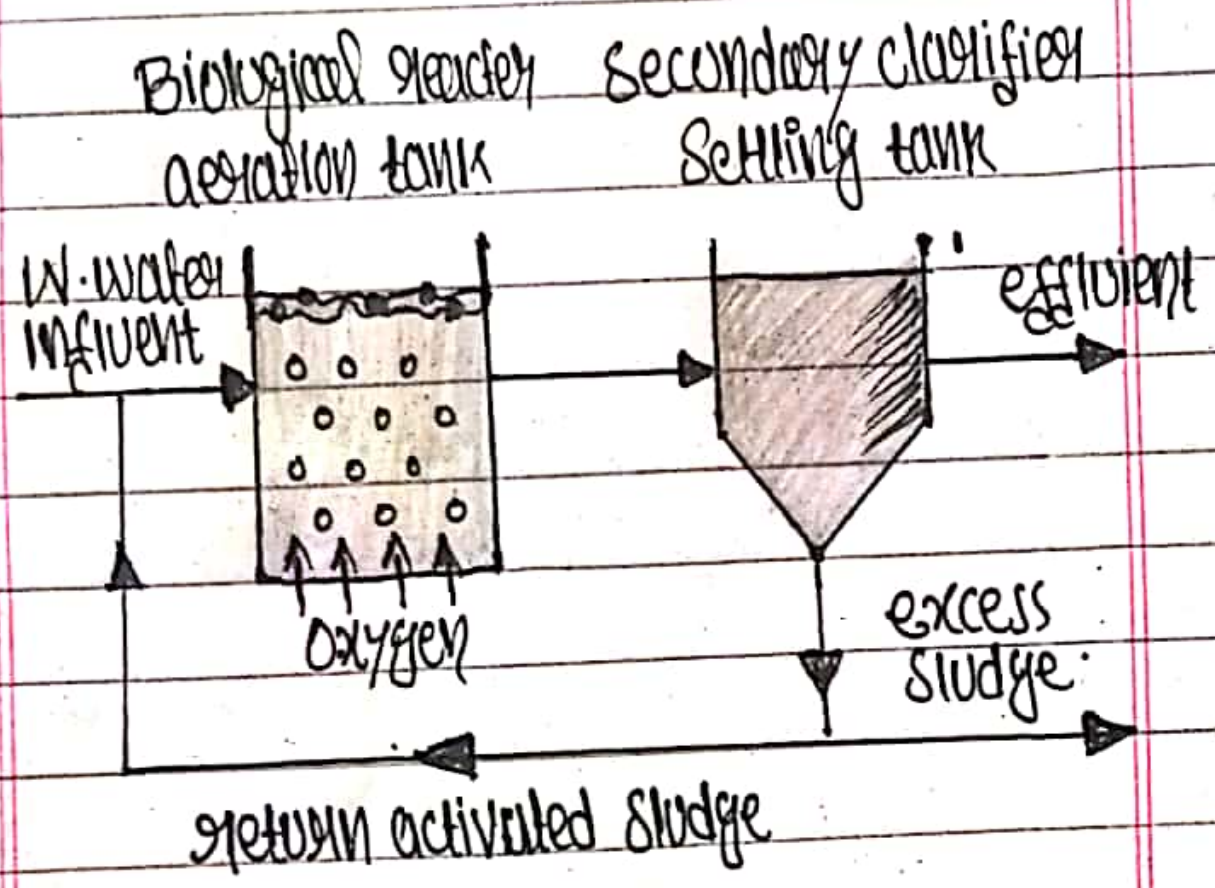
- Aeration tank is the main constituents of ASP in which for growing micro-organism oxygen is provided.

Micro-organism form floc particles, ranging in size from 50-200  $\mu\text{m}$ , removed by gravity settling. and as a treated effluent leaving relatively clear liquid.

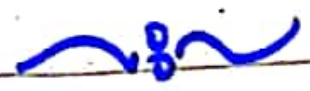
- In process "Recycled Activated Sludge" (RAS), a part of settled bio flocs are recycled back to the aeration tank.
- In process "Wasted Activated Sludge" (WAS), the remaining settled bio flocs are removed from the system.
- APS involves production of activated mass of micro-organisms capable of stabilizing waste under aerobic treatment.
- In aeration tank, through "Mixed liquor suspended solids (MLSS)", contact time is provided for mixing and aerating influent wastewater with microbial suspension.

By "APS" typically "99%" of suspended solids and upto "90%" of dissolved organics are removed.

- The main associated with "Aps" is high consumption of energy, High electricity consumption particularly for aeration are required.



# Activated sludge process (ASP)



Ans: 03: "Part: a"

## "Assimilative Capacity of Receiving Bodies";

This refers to the ability of a body of water to cleanse itself;

It is the capacity to receive wastewater without deleterious effects and without harm humans and aquatic life who consume the water. -

It is level to which water body are natural control the toxicity without harming the aquatic life.

Although wastewater is properly treated before it is disposed to the natural water streams have still impurities/pollutants that need to be removed. So that the receiving waterbodies may not be unsuitable for use or harm the aquatic life.



## "Part: b"

### \* "AC help in wastewater Treatment"

The following four parameters mainly help in assimilative capacity of receiving bodies.

### \* "Temperature"

Plays an important role in assimilative capacity of receiving water. Have a direct relation. i.e. Increase in temperature will increase the biological decomposition of organic matter and thus assimilative capacity will improve. Increase in temperature also causes to increase the dilution process and thus improve assimilative capacity.

## \* "Flow velocity"

"Dilution  $\propto$  Flow velocity"

Higher the flow velocity will encourage quick dilution and dispersion of pollutants, thus assimilative capacity improve.

## \* "Dissolved oxygen"; (DO)

Biological decomposition  $\propto$  (DO)

Dissolved oxygen is replenished by re-aeration. Re-aeration may be provided by maintaining sufficient flowing velocity.

## \* "Depth of flowing water"

Assimilative Capacity  $\propto 1/W_{\text{depth}}$

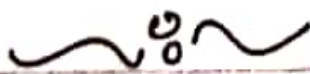
Increase in depth result to decrease dissolved oxygen in the water and thus reduces purification process.

Ans: 04 ;

## Sludge Management

Sludge refers to the residual, semisolids, material left from municipal wastewater or industrial wastewater treatment process.

Sustainable sludge handling/ managing may be defined as a socially acceptable cost effective method that inserts the requirement of efficient recycling of resources while ensuring that harmful substances are not transferred to humans or the environment i.e. water, air and soil.



## \* "Advantages in wastewater engineering;"

- It reduces pathogens and volume to be disposal.
- Sustainable management of organic waste.
- Protects wildlife, aquatic life and also prevents diseases.
- Producing Bio gas.
- Reduction of odor and diseases causing agents.

~v~

Ans; 05"Part 'a'"

"Environmental Impact Assessment; (EIA)"

"EIA" is a technique and a process by which information about environmental effects of a project is collected, both by the developer and from other sources, and taken into account by the planning authority in forming the judgment on whether the development should proceed.

"OR"

A formal process to predict the environmental consequences of human development activities and to plan appropriate measures to eliminate or reduce adverse effects and to enhance positive effects.

To predict problem

"i" To enhance positive effects

"ii" To find ways to avoid/mitigate them.

## "Part; b"

### \* "Important parameters;"

Wastewater contains a large number of contaminants and may be categorized as physical, chemical and Biological contaminants. From experience and theory to define such characteristics different parameters have been established. Thus the quality of influent wastewater to a treatment plant will depend on the source ~~and~~. Thus for a local wastewater treatment plant the following most important parameters should be considered.

### "1" "Biological Oxygen Demand" (BOD)

The "BOD" is the amount of oxygen to break down the organic matter in water consumed by aerobic micro-organisms.

"BOD" is the actual parameter and is an indication of the amount of organic matter consumed within "5 days" as from testing. This value is used to measure the efficiency of a treatment plant, in terms of organic removal. Greater "BOD" values are ~~undesirable~~ undesirable and would affect the ecological cycle by reducing the normal dissolved oxygen to critical levels for aquatic life.

## "ii" "Chemical oxygen demand" (COD)

The COD is an alternative measure of the amount of organic matter. The amount of oxygen used up by a strong oxidising agent is measured. When evaluating wastewater from industries this value is of greater importance. Since these effluents tend to be toxic to micro-organisms thus affecting the validity of BOD results.

## "Total Suspended Solids"; (TSS)

The TSS is measured to indicate the amount by mass of fine suspended particles. Low level of TSS must contain when the effluent are discharged in the water course, since TSS causes turbidity, thus affecting the amount of light to aquatic plants and also causes visual pollution.

## "Total Kjeldahl Nitrogen"; (TKN)

Wastewater usually contains high level of nitrogen containing compounds.

The nitrogen exists mostly in free forms; ammonia, organic nitrogen, and reduced agent. The TKN value hence indicates the amount of nitrogen of all its three forms.

These 3 forms must be removed since in critical level they can promote the eutrophication process and harms aquatic species.