

# IQRA NATIONAL UNIVERSITY

## Wastewater Engineering

### Final Term Assignment

Name = Mujahid Afridi

I.D = 7775

Section = (A)

Teacher = Engr.Nadeem Ullah

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(1)

Q 1: What is wastewater treatment and its importance? Why rectangular tanks are preferred over circular tanks for removal of settleable solids during preliminary treatment?

### Wastewater treatment:

Wastewater is used water. It includes substances such as human waste, food scraps, oils, soaps and chemicals. In homes, this includes water from sinks, showers, bathtubs, toilets, washing machines and dishwashers. Businesses and industries also contribute their share of used water that must be cleaned.

### Importance of wastewater treatment:

Essential for life, clean water is one of the most important natural resources on the planet. Wastewater, which is basically used water, is also a valuable resource, especially with recurring droughts and water shortages in many areas of the world. However, wastewater contains many harmful substances and cannot be released back into the environment until it is treated. Thus the importance of wastewater treatment is two to restore the water supply and to protect.



(2)

Rectangular tanks are preferred over circular tanks for removal of settleable solids during preliminary treatment is that the shape of the rectangular clarifiers provides a longer path for the wastewater flow and the suspended solids to travel, and subsequently longer detention time which warrants less short circuiting and more sludge settling compared to the centre-feed / peripheral overflow circular clarifiers. In addition, flow distribution among several clarifiers is usually more even and often requires less head loss for rectangular clarifiers.



Q 2:- What is the difference between aerobic and anaerobic wastewater treatment? Briefly describe Activated sludge process with diagram?

Aerobic Treatment	Anaerobic Treatment
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|--|--|
| 1) Application low to medium strength wastewater (<1000 ppm) eg. Municipal sewage, refinery wastewater, etc. | Application to high strength wastewater (>4000 ppm) eg. Food and beverage industry wastewater. |
| 2) Capital Investment relatively high  | Capital Investment relatively low with pay back.   |
| 3) Energy Consumption relatively high  | Energy Consumption relatively low.   |
| 4) Foot-print relatively large   | Foot-print relatively small and compact.   |
| 5) Net sludge yield relatively high  | Net sludge yield relatively low.   |
| 6) Post-treatment typically direct discharge   | Post-treatment required to fulfill wastewater standard discharge requirement.                  |



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## Activated sludge process:

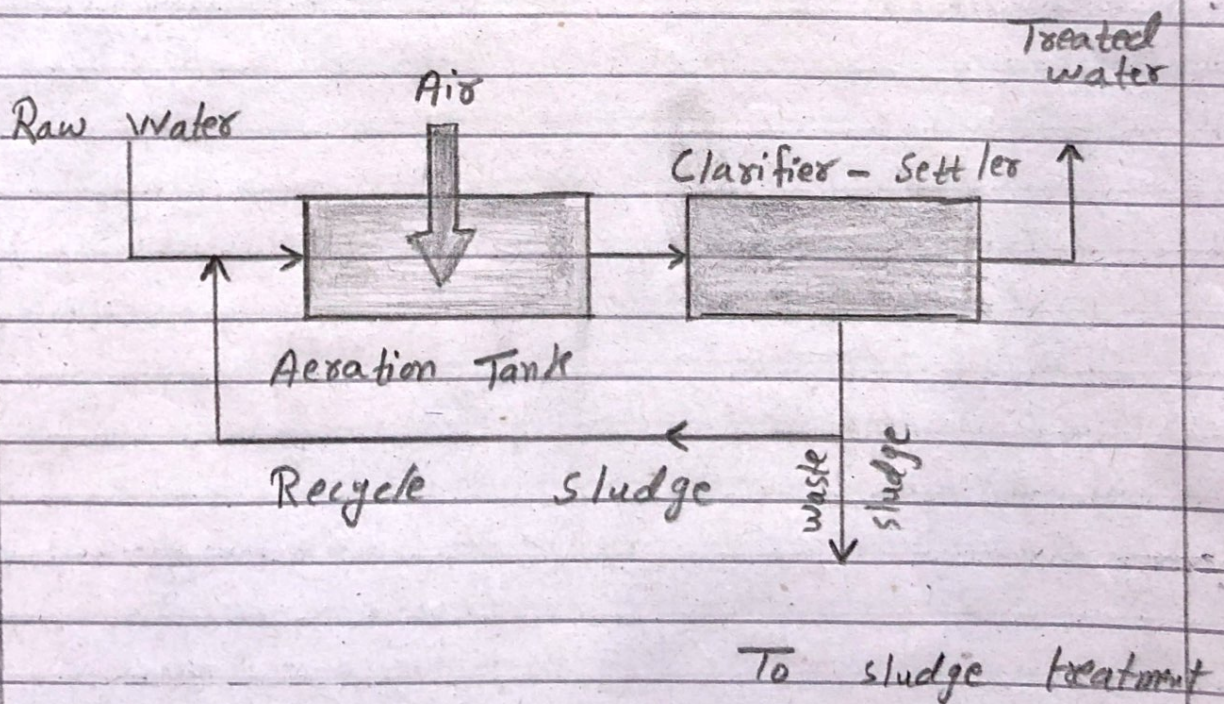
- Process for treating sewage or industrial wastewater using aeration and a biological floc composed of bacteria and protozoa.
- Is a biological process that can be used for oxidizing carbonaceous biological matter, oxidizing nitrogenous matter ( $\text{NH}_3$  and  $\text{N}_2$ ), removing nutrients (N and P).
- Aeration methods - diffused aeration, surface aerators (cones) and pure oxygen aeration.
- The sludge blanket is measured from the bottom of the clarifier.
- The sludge volume index is the volume of settled sludge in mm occupied by 1 gram of dry sludge solids after 30 mins of settling in a 1000 ml graduated cylinder.
- The F/M is amount of BOD feed to the aerator (kg/day) divided by the amount of MLVSS (kg) under aeration.



## Process:

- Pre-treatment stage to remove large solids and other undesirable substances.
- Aeration stage, where aerobic bacteria digest biological wastes.
- Settling stage allows undigested solids to settle, forms a sludge that must be periodically removed from the system.

## Diagram:





Q 3:- What is meant by assimilative capacity of receiving water bodies? How does it help in wastewater treatment?

### Assimilative Capacity of Receiving Bodies:

- Assimilative capacity of receiving water bodies refers to the ability of a body of water to cleanse itself; its capacity to receive wastewaters without deleterious effects and without causing damage to aquatic life or humans who consume the water. It is level to which water body or nature control the toxicity without affecting the aquatic life.

- Although wastewater is properly treated before it is disposed of to the natural water streams still it has impurities/pollutants that need to be removed or make them less effective so that the receiving water bodies may not become unsuitable for use or cause damage to the aquatic life.



## Assimilative capacity of water help in wastewater treatment:

### 1) Temperature:

Temperature plays an important role in assimilative capacity of receiving water. Increase in temperature will increase the biological decomposition of organics and thus assimilative capacity will improve. Increase in temperature also causes to increase the dilution process and thus increase the assimilative capacity.

### 2) Flow velocity:

Flow velocity is also critical to assimilative capacity of receiving water bodies. Higher the flow velocity will encourage quick dilution and dispersion of pollutants.

### 3) Dissolved oxygen (DO):

Rate of biological decomposition is directly related to the amount of dissolved oxygen. DO is replenished by re-aeration. Re-aeration may be provided by maintaining sufficient flowing velocity.



Q 4:- Briefly describe sludge management and its advantages in wastewater engineering?

### Sludge Handling processes

- 1) Primary operations
- 2) Thickening
- 3) Stabilization
- 4) Dewatering
- 5) Heat drying.

1) Primary Operations:  
This process includes:

1) Grinding:

It includes particles size reduction.

2) Screening:

It include removal of fibrous materials.

3) Degritting:

It includes removal of sand or other inorganic materials.

4) Blending:

It includes making the sludge homogenous.

5) Storage:

It ensures flow equalization in the system.



## 2) Sludge Thickening:

- Sludge thickening is undertaken to increase percentage of solid content in sludge by removing a portion of liquid fraction.
- Volume reduction of approximately 30-80% can be reached with sludge thickening.
- Various methods of sludge thickening are:
  - (i) Gravity thickening
  - (ii) Flotation thickening
  - (iii) Rotatory drum thickening.

## 3) Sludge Stabilization:

### Anaerobic digestion:

- A biological process that uses bacteria in an oxygen free environment.
- These bacteria converts volatile solids into carbon dioxide, methane and ammonia.



#### 4) Dewatering:

- Dewatering is undertaken to reduce the moisture content of sludge.
- Centrifugation is the method used for separating liquids of different densities, thickening slurries.

#### 5) Heat Drying:

- It involves the application of heat to evaporate water and to reduce the moisture content of biosolids.
- Advantage of this method is to reduce product transportation costs, improve storage capability, and marketability.
- Direct drying involves the wastewater solids come into contact with hot gases, which cause evaporation of moisture. Dryers such as rotary dryers and fluidized bed dryers are used.



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## Advantages:

- High flexibility in operating conditions.
- High effluent quality.
- Low land requirements of CAS, somewhat higher land requirements for EA.
- Possibility of producing electric energy from biogas.



Q 5:- Define environmental Impact Assessment (EIA)? In your opinion, what parameters should be considered while conducting EIA for newly proposed wastewater treatment plant?

### Environmental Impact Assessment:

Environmental Impact Assessment is defined as an activity designed to identify the impact on the biogeophysical environment, on man and well-being of legislative proposals, projects, policies, operational procedures and to interpret and communicate information.

EIA is a systematic process of identifying future consequences of a current or proposed action.

Parameter to be considered while conducting EIA for newly proposed wastewater treatment plant:-

#### 1) Participation:

An appropriate and timely access to the process for all interested parties.



2) Transparency:

All assessment decisions and their basis should be open and accessible.

3) Certainty:

The process and timing of the assessment should be agreed in advanced and followed by all participants.

4) Accountability:

The decisions-makers are responsible to all parties for their action and decisions under the assessment process.

5) Credibility:

Assessment is undertaken with professionalism and objectively.

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