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SECTION	:	B
SUBJECT	:	WASTE WATER ENGINEERING
INSTRUCTOR	:	ENGR NADEEM ULLAH
EXAME	:	FINAL TERM

Q1. **What is wastewater treatment and its importance? Why rectangular tanks are preferred over circular tanks for removal of settle able solids during preliminary treatment?**

Wastewater treatment is a process used to remove contaminants from **wastewater** or **sewage** and convert it into an effluent that can be returned to the **water** cycle with minimum impact on the environment, or directly reused.

Importance

If wastewater is not properly treated, then the environment and human health can be negatively impacted. These impacts can include harm to fish and wildlife populations, oxygen depletion, beach closures and other restrictions on recreational water use, restrictions on fish and shellfish harvesting and contamination of drinking water.

Decaying organic matter and debris can use up the dissolved oxygen in a lake so fish and other aquatic biota cannot survive;

- Excessive nutrients, such as phosphorus and nitrogen (including ammonia), can cause eutrophication, or over-fertilization of receiving waters, which can be toxic to aquatic organisms, promote excessive plant growth, reduce available oxygen, harm spawning grounds, alter habitat and lead to a decline in certain species;
- Chlorine compounds and inorganic chloramines can be toxic to aquatic invertebrates, algae and fish;
- Bacteria, viruses and disease-causing pathogens can pollute beaches and contaminate shellfish populations, leading to restrictions on human recreation, drinking water consumption and shellfish consumption;
- Metals, such as mercury, lead, cadmium, chromium and arsenic can have acute and chronic toxic effects on species.
- Other substances such as some pharmaceutical and personal care products, primarily entering the environment in wastewater effluents, may also pose threats to human health, aquatic life and wildlife.

The major aim of wastewater treatment is to remove as much of the suspended solids as possible before the remaining water, called effluent, is discharged back to the environment. As solid material decays, it uses up oxygen, which is needed by the plants and animals living in the water.

The use of rectangular tank over circular tank

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 center-feed/peripheral overflow circular clarifiers.

Q-02 **What is the difference between aerobic and anaerobic wastewater treatment? Briefly describe Activated Sludge Process with diagram?**

Anaerobic and aerobic systems are both forms of biological treatment that use microorganisms to break down and remove organic contaminants from wastewater. While both rely on a process of microbial decomposition to treat wastewater, **the key difference between anaerobic and aerobic treatment is that aerobic systems require oxygen, while anaerobic systems do not.** This is a function of the types of microbes used in each type of system.

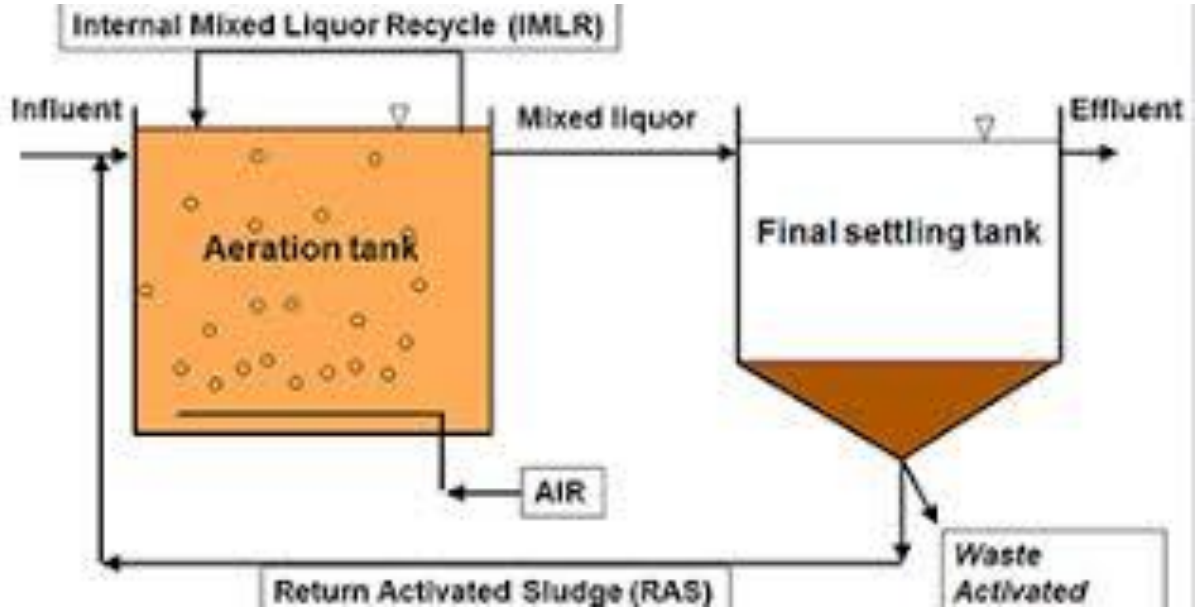
Activated Sludge Process

Microorganisms responsible for treatment are maintained in liquid suspension by appropriate mixing methods.

- Main constituents of ASP are Aeration tank in which oxygen is provided for the micro-organisms to grow. This aeration also helps to keep micro-organisms in suspension.
- Aeration tank is followed by Clarifier / Settler in which the micro- organisms form flocs and settled down at the bottom.

Formation of floc particles, ranging in size from 50 to 200 µm, removed by gravity settling, leaving relatively clear liquid as treated effluent;

- a part of settled bio flocs are recycled back to the aeration tank to maintain certain amount of micro-organisms in the system for efficient operation of the system. This is known as Recycled Activated Sludge (RAS).
- remaining settled bio flocs are removed from the system and is termed as Wasted Activated Sludge (WAS)
- APS involves production of activated mass of microorganisms capable of stabilizing waste under aerobic conditions;
- in aeration tank, contact time is provided for mixing and aerating influent wastewater with microbial suspension, generally referred to mixed liquor suspended solids (MLSS).
- Typically 99% of suspended solids and up to 90 % of dissolved organics are removed by Activated sludge process.
- the main drawback associated with APS is its high electricity consumption particularly for aeration.


Internal Mixed Liquor Recycle (IMLR)
Influent
Mixed liquor
Effluent
Aeration tank
Final settling tank
AIR
Waste
Activated
Return Activated Sludge (RAS)

Q3. What is meant by assimilative capacity of receiving water bodies? How does it help in wastewater treatment?

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 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.

How it helps wastewater treatment

Water assimilation is a natural process as it cleans itself with the pace of time and distance travelled by the sewage water, which helps wastewater treatment industry in many regards such as financially and environmentally.

It is the assimilative capacity of streams that helps in self recovery.

Not much efforts are required in the treatment process when water body goes through assimilation process

Pollution occurs only when the assimilative capacity is exceeded. Some environmentalists argue that the concept of assimilative capacity involves a substantial element of value judgment, i.e., pollution discharge may alter the flora and fauna of a body of water, but if it does not affect organisms we value (e.g., fish) it is acceptable and within the assimilative capacity of the body of water.

A classic example of assimilative capacity is the ability of a stream to accept modest amounts of biodegradable waste. Bacteria in a stream utilize oxygen to degrade the organic matter (or biochemical oxygen demand) present in such a waste, causing the level of dissolved oxygen in the stream to fall; but

the decrease in dissolved oxygen causes additional oxygen to enter the stream from the atmosphere , a process referred to as re aeration. A stream can assimilate a certain amount of waste and still maintain a dissolved oxygen level high enough to support a healthy population of fish and other aquatic organisms. However, if the assimilative capacity is exceeded, the concentration of dissolved oxygen will fall below the level required to protect the organisms in the stream.

More importantly, it results in the inefficient use of limited resources and, by expending materials and energy for something that nature provides free of charge, results in an overall increase in pollution.

Q4. Briefly describe sludge management and its advantages in wastewater engineering?

Sludge refers to the residual, semi-solid material left from, municipal wastewater or industrial wastewater treatment processes.

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

Advantages of sludge handling/managing in wastewater engineering

As wastewater engineering is directly related to environment sludge management is approach towards a better environment

Residual wastes from hospitals, research facilities and other industries can be hazardous to our health and the environment. These harmful elements may require thermal treatment to control the spread of diseases or toxins. Sewage sludge incineration reduces volume (up to 90%) and weight (up to 75%) and breaks down dangerous substances such as pathogens and toxic chemicals. Flue gases from exhaust pipes must be handled properly by utilizing a complex treatment system to prevent hazardous emissions and ashes from contaminating the environment.

Due to excess of new problems in sludge management every year new techniques and professional/experts are emerges in waste water engineering industry to face the challenges and finding the solutions

Q5. Define Environmental Impact Assessment (EIA)? In your opinion, what parameters should be considered while conducting EIA for newly proposed wastewater treatment plant?

EIA is an environmental study comprising collection of data, prediction of qualitative and quantitative impacts, comparison of alternatives, evaluation of preventive, migratory and compensatory measures, formulation of environmental management and training plans and monitoring arrangements, and framing of recommendations and such other components as may be prescribed.

(Pakistan Environmental Protection Act, 1997)

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.

The following consideration should keep in mind while conducting EIA for the newly proposed waste water treatment plant.

Environmental Damages should be minimum such as do not affect water body greenery and energy consumption which affect the environment should be controlled

Environmental Benefits should be maximum and water life should be protected

Ensures that Development is according to:

National Quality Standards (NEQs)

The project should not conflict with Govt. Policies

International Obligations should be strictly followed

Most treatment plants have primary treatment (physical removal of floatable and settle able solids) and secondary treatment (the biological removal of dissolved solids). Some other treatment plants have tertiary treatment option. The purpose of tertiary treatment is to provide a final treatment stage to raise the effluent quality before it is discharged to the receiving environment (sea, river, lake, ground, etc.). More than one treatment process may be used at any treatment plant.