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Program: B.Tech (civil). ***Subject: Environmental Management.***

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Question # 01: *You are a giving convincing a client regarding wastewater treatment in a housing society which in future will accommodate up to a million residents in future. Also you are in favour of having a wastewater treatment plant in that colony. How are you going to convince the party regarding the waste water treatment? And your preferred choice.*

ANS: *I will convince a client regarding wastewater treatment in a housing society and explain that what is waste water treatment and which treatment method is suitable for housing society (for that residential area). So let's start to explain waste water treatment and suitable treatment method.*

- ***Wastewater treatment:*** *Wastewater treatment is the process of converting wastewater (that is no longer needed or is no longer suitable for use) into water that can be discharged back into the environment. Waste water is generated by a number of activities including bathing, washing, using the toilet, and rainwater runoff.*

Reuse of wastewater: *Wastewater reuse or water reclamation is the process of converting wastewater into water that can be reused for other purposes. Reuse may include irrigation of gardens and agricultural fields or replenishing surface water and groundwater.*

Advantages of reuse:

- *reduce water bills*
- *use fewer water resources*
- *irrigate the garden during drought or water restrictions*
- *cut down the amount of pollution going into waterways*

Disadvantages of reuse:

- *The extent of centralized wastewater treatment services available.*
- *Reuse of wastewater is not economically feasible because of the requirement for an additional distribution system.*
- *whether you are replacing an existing system or starting from scratch*
- *Hard to implement at large scale.*

There are two types of wastewater treatment method aerobic and anaerobic wastewater treatment.

But we select Aerobic wastewater treatment for the housing society (for that residential area) which is suitable for that area.

- ***Aerobic wastewater treatment:***
  Aerobic treatment of wastewater is a biological process that uses oxygen to break down organic contaminants and other pollutants like nitrogen and phosphorous. Oxygen is continuously mixed into the wastewater or sewage by a mechanical aeration device, such as an air blower or compressor. Aerobic microorganisms then feed on the wastewater's organic matter, converting it into carbon dioxide and biomass which can be removed.

- ***Aerobic wastewater treatment used for:***
  Aerobic treatment is usually used to polish industrial wastewater pre-treated by anaerobic processes. This ensures the wastewater is fully degraded and can be safely discharged in accordance with strict environmental regulations. Aerobic treatment processes are suitable for a range of industries and residential areas such as food & beverage, chemical and municipal.

- ***How do aerobic wastewater treatment systems work (process)?***
  Because these organisms require oxygen, aerobic systems require some means of supplying oxygen to the biomass by adding wastewater treatment ponds (which work by creating a large surface area for introducing air to the wastewater) and/or by incorporating some type of mechanical aeration device to introduce oxygen into the biomass.

Depending on the chemical makeup of the wastewater in relation to the effluent requirements, a biological wastewater treatment system might be composed of several different processes and numerous types of microorganisms. They will also require specific operational procedures that will vary depending on the environment needed to keep biomass growth rates optimal for the specific microbial populations. For example, it is often required to monitor and adjust aeration to maintain a consistent dissolved oxygen level to keep the system's bacteria multiplying at the appropriate rate to meet discharge requirements.

- ***Advantages and Disadvantages of aerobic wastewater treatment:***
  - ***Advantages:***
    1. *Aerobic treatment of wastewater is a stable, simple and efficient process that produces high-quality secondary effluent.*
    2. *Minimum odor*
    3. *Reduction of greenhouse gases (especially methane) compared to anaerobic treatment.*
    4. *Final discharge may contain DO(dissolved oxygen) which reduces the immediate OD (oxygen demand) on receiving water*
  - ***Disadvantages:***
    1. *higher capital cost for aeration equipment, higher operating cost, higher maintenance requirements*
    2. *Energy cost of aeration at an adequate rate to maintain the DO levels needed*
    3. *Some organics can't be efficiently decomposed aerobically*
    4. *Consultation with knowledgeable professionals is advisable.*

Question # 02*: You are working on a site which possess a different treatment plants. A group of university students visit your site. You are going to explain the trickling filter process from the schematics to these students as they cannot go near the filter due to safety and health reason. Furthermore, give an idea about its design and equations employed for designing this type of treatment plant. And before proceeding to next plant, conclude your talk on advantages and disadvantages of trickling filter.*

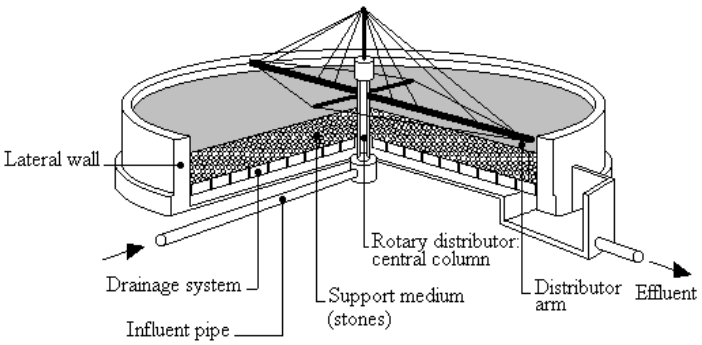
Ans: *First I will explain to students about trickling filter and then working process with the help of schematic, and then discuss about design and design equations of trickling filter.*

- ***<u>Trickling filter:</u>***
  Trickling filter, in wastewater treatment, a bed of crushed rock or other coarse media roughly 2 metres (6 feet) deep and up to 60 metres (200 feet) in diameter. Settled sewage is sprayed over the bed surface and is further purified as it trickles downward, coming in contact with filmy layers of microorganisms (slime) attached to the media. The microorganisms absorb the organic matter in the sewage and stabilize it by aerobic metabolism, thereby removing oxygen-demanding substances from the sewage. Trickling filters remove up to 85 percent of organic pollutant from sewage.

Trickling filter's consist of mainly four parts:

1. *Water tight holding tank.*
2. *Distribution system.*
3. *Filter media (0.1 – 0.2mm or 30 – 80 mm).*
4. *Underdrainage system (One-half full & Maintain 600 to 900 mm/Sec Velocity).*

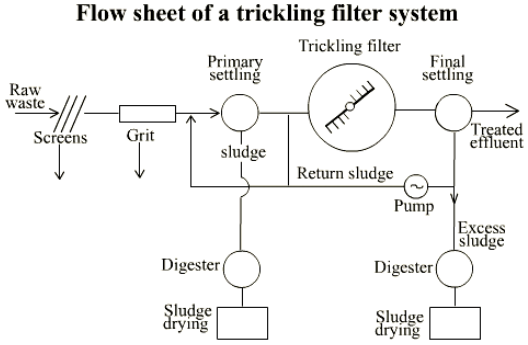
➢ *Design of trickling filter:*



Depth	*1.8 to 2.4 m*
Number	*Minimum Two*
Filter Loading Rate	*Organic Load per filter Bed Volume = 1000 to 2200 kg BOD/hectare-m/day* *BOD/filter media volume = 15 to 30 kg BOD/day/100 m3.* *Surface Area of Filter Bed = 25 40 million Liters/hectare of surface area* *Filter Bed Vol = 7.50 to 22.50 million liters/hectare/day.*

➢ *Process schematic of trickling filter:*

- *Sewage flow enters at a high level and flows through the primary settlement tank*
- *The supernatant from the tank flows into a dosing device, often a tipping bucket which delivers flow to the arms of the filter*
- *The flush of water flows through the arms and exits through a series of holes pointing at an angle downwards*
- *This propels the arms around distributing the liquid evenly over the surface of the filter media*
- *Both absorption and adsorption of organic compounds and some inorganic species by the layer of microbial bio film*



➢ *Design equation of trickling filter:*

Generally trickling filter design is based on empirical relationship to find the required filter volume for a design degree of wastewater treatment.types of equation :

1. *NRC equation (National Research Council of USA)*

2. *Rankins Equation.*
3. *Eckenfilder equation.*
4. *Galler and Gotaas equation*

NRC and Rankin's equation are commonly uses. NRC equation give satisfactory values When there is no re-circulation, the seasonal variation in temperature are not large and fluctuation with high organic loading. Rankin's equations used for high rate filters

NRC equation: *These equation are applicable to both low rate and high rate filter. The efficiency of single stage or first stage of two stages filter, E_2 is given by*

$$E_2 = \frac{100}{1 + 0.44(F_{1.BOD}/V_1.Rf_1)^{1/2}}$$

Where,

- *E2= % efficiency in BOD removal of single stage or first stage,*
- *F1.BOD= BOD loading of settled raw sewage in single stage of the two-stage filter in kg/d,*
- *V1= volume of first stage filter, m3,*
- *Rf1= Recirculation factor for first stage*

Efficiency Estimation:

$$E = \frac{Y_i - Y_o}{Y_i} X\ 100$$

Where,

Y_i = Influent BOD load to TF
Y_o = Effluent BOD from TF.

Recirculation Factor Calculation:

$$F = \frac{1 + R}{(1 + 0.1R)1^2}$$

Where, R = Recirculation percentage

➢ *Advantages and Disadvantages of trickling filter*

- ***Advantages:***
  1. *Effective in treating high concentrations of organic material depending on the type of media used.*
  2. *Simple and reliable process that is suitable in areas where large tracts of land are not available for a WSP treatment system.*
  3. *They are self-cleaning.*
  4. *The effluent obtain is highly nitrifies and stabilized.*
- ***Disadvantages:***
  1. *Additional treatment may be needed for the effluent to meet strict discharge standards.*
  2. *Generates sludge that must be treated and disposed of.*
  3. *Regular operators attention is needed.*
  4. *Highly capital cost.*
  5. *Relatively low loadings required depending on the media.*

Question # 03: *What is renewable energy? Explain any three uses of renewable energy from waste water sludge.*

Ans: Renewable energy*:*

Renewable energy, often referred to as clean energy, comes from natural sources or processes that are constantly replenished. For example, sunlight or wind keep shining and blowing, even if their availability depends on time and weather.

- ***As an Energy Source:***
  When organic waste decomposes in an oxygen-free environment such as deep in a landfill, it releases methane gas. This methane can be captured and used to produce energy, instead of being released into the atmosphere.
- ***Biogas Production:***
  Biogas is produced by anaerobic (oxygen free) digestion of organic materials such as sewage sludge, animal waste, and municipal solid wastes (MSW). As sustainable clean energy carrier biogas is an important source of energy in heat and electricity generation, it is one of the most promising renewable energy sources in the world.
- ***Use in Agriculture:***
  Sewage is widely used on agricultural soils in urban areas of developing countries to meet water shortages. Although it is a good source of plant nutrients, such sewage also increases the heavy metal load to soils, which may impact the food chain.

THE END