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Internal Assesment Test -II–Dec-2021

Sub:	Municipal and Industrial Waste Water Engineering					Sub Code:	17CV71	Branch:	CIVIL	
Date:	16/12 / 2021	Duration:	90 min's	Max Marks:	50	Sem/Sec:	V11			OBE

<u>Answer All Questions</u>

		MARKS	CO	RBT
1	Calculate the diameter and discharge in a sewer of circular sewer laid at a gradient of 1 in 500 when running half full. With the velocity of 1.9 m/sec. Use Mannings formula taking N=0.012	[10]	CO2	L3
2	Define BOD and Explain with a neat sketch, the salient features of oxygen sag curve	[10]	CO2	L2
3	What is self-purification of stream and explain the different zones of self-purification process in dilution method of sewage disposal with a neat diagram	[10]	CO2	L2
4	Explain sewage sickness and sewage farming and the prevention methods of sewage sickness	[10]	CO2	L2
5	Draw and explain briefly the flow Diagram of Municipal waste water treatment plant with their operation units	[10]	CO3	L2

1 Calculate the diameter and discharge in a sewer of circular sewer laid at a gradient of 1 in 500 when running half full. With the velocity of 2 m/sec. Use Mannings formula taking N=0.012

$$d = 0.5\,D \text{ and } \theta = 180^\circ$$

$$\therefore \quad a = \frac{1}{2} \times \frac{\pi}{4} D^2 = \frac{\pi}{8} D^2$$

$$p = \pi D \frac{\theta}{360^\circ} = \pi D \frac{180}{360} = \frac{\pi D}{2}$$

$$\text{and} \quad r = \frac{\pi}{8} D^2 \times \frac{2}{\pi D} = \frac{D}{4}$$

$$\text{Now} \quad v = \frac{1}{N} r^{2/3} s^{1/2}$$

$$\therefore \quad 2 = \frac{1}{0.012} \left(\frac{D}{4}\right)^{2/3} \left(\frac{1}{500}\right)^{1/2} = 1.4789\, D^{2/3}$$

From which $D = 1.573$ m

$$\text{Hence} \quad Q = a \times v = \frac{\pi}{8} (1.573)^2 \times 2$$

$$= 1.942 \text{ cumecs}$$

2. Define BOD and Explain with a neat sketch, the salient features of oxygen sag curve

Biochemical oxygen demand or B.O.D. is the amount of dissolved oxygen needed by aerobic biological organisms in a body of water or wastewater sample to break down organic material present in a given water or wastewater sample at certain temperature (200C) over a specific time period (5 days).

Oxygen Sag Curve:

The oxygen sag or oxygen deficit in the stream at any point of time during self purification process is the difference between the saturation DO content and actual DO content at that time.

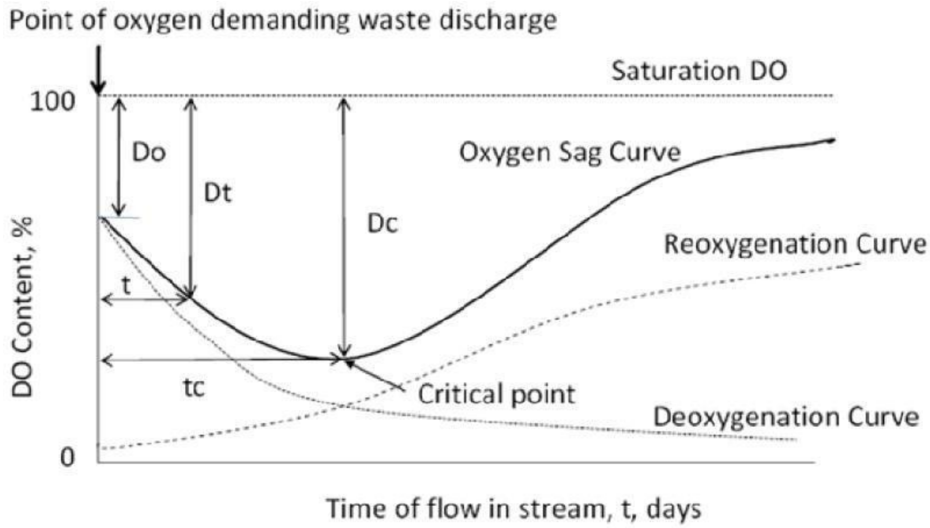
OR

The amount of resultant oxygen deflect can be obtained by algebraically adding the de - oxygenation and re -oxygenation curves. The resultant curve so obtained is called oxygen sag curve

Oxygen Deficit, D = Saturation DO – Actual DO

The saturation DO value for fresh water depends upon the temperature and total dissolved salts present in it and its value varies from 14.62 mg/L at 0oC to 7.63 mg/L at 30ºC, and lower DO at higher temperatures.

The DO in the stream may not be at saturation level and there may be initial oxygen deficit (D). At this stage, when the effluent with initial BOD load Lo, is discharged in to stream, the DO content of the stream starts depleting and the oxygen deficit (D) increases. The variation of oxygen deficit (D) with the distance along the stream, and hence with the time of flow from the point of pollution is depicted by the Oxygen Sag Curve. The major point in sag analysis is point of minimum DO, i.e., maximum deficit. The maximum or critical deficit (Dc) occurs at the inflexion points (as shown in fig) of the oxygen sag curve.



Deoxygenation, reoxygenation and oxygen sag curve

De-oxygenation curve: The curve which represents (or) showing the depletion of D.O with time at the given temperature

Re-oxygenation Curve: In order to counter balance the consumption of D.O due to the de – oxygenation, atmosphere supplies oxygen to the water and the process is called the re – oxygenation.

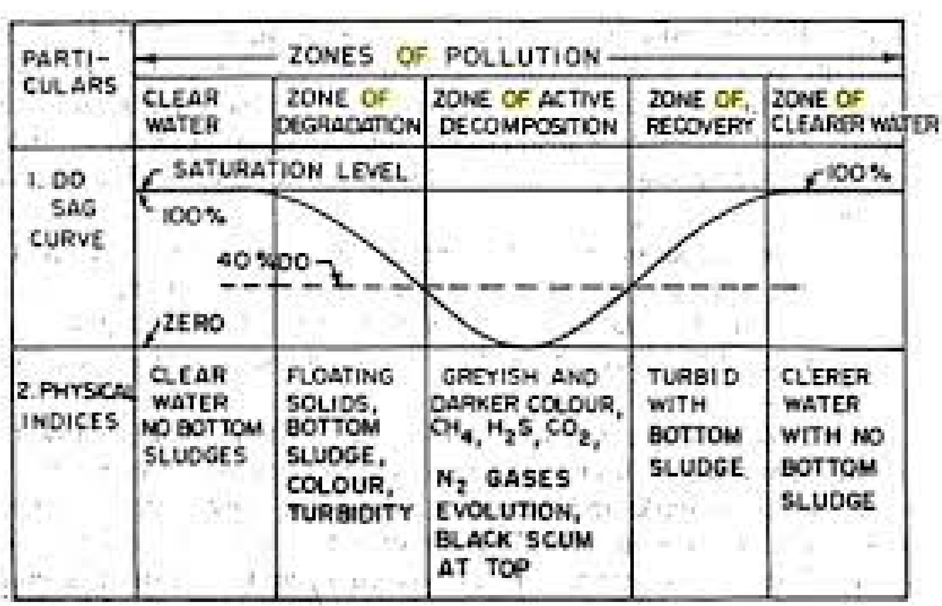
When wastewater is discharged in to the stream, the DO level in the stream goes on depleting. This depletion of DO content is known as de-oxygenation. The rate of de- oxygenation depends upon the amount of organic matter remaining (Lt), to be oxidized at any time t, as well as temperature (T) at which reaction occurs. The variation of depletion of DO content of the stream with time is depicted by the de-oxygenation curve in the absence of aeration. The ordinates below the de-oxygenation curve indicate the oxygen remaining in the natural stream after satisfying the bio-chemical demand of oxygen. When the DO content of the stream is gradually consumed due to BOD load, atmosphere supplies oxygen continuously to the water, through the process of re-aeration or re-oxygenation, i.e., along with de-oxygenation, re-aeration is continuous process.

3. What is self-purification of stream and explain the different zones of self-purification process in dilution method of sewage disposal with a neat diagram

The automatic purification of natural water is known as self purification. The self purification of natural water systems is a complex process that often involves physical, chemical, and biological processes working simultaneously. The amount of dissolved Oxygen (DO) in water is one of the most commonly used indicators of a river health. As DO drops below 4 or 5 mg/L the forms of life that can survive begin to be reduced. A minimum of about 2.0 mg/L of dissolved oxygen is required to maintain higher life forms. A number of factors affect the amount of DO available in a river. Oxygen demanding wastes remove DO; plants add DO during day but remove it at night; respiration of

organisms removes oxygen. In summer, rising temperature reduces solubility of oxygen, while lower flows reduce the rate at which oxygen enters the water from atmosphere.
Zones of Purification When sewage is discharged into water, a succession of changes in water quality takes place. If the sewage is emptied into a lake in which currents about the outfall are sluggish and shift their direction with the wind, the changes occur in close proximity to each other and, as a result, the pattern of changes is not crisply distinguished. If, on the other hand, the water moves steadily away from the outfall, as in a stream, the successive changes occur in different river reaches and establish a profile of pollution which is well defined. However, in most streams, this patterns by no means static. It shifts longitudinally along the stream and is modified in intensity with changes in season and hydrography.

When a single large charge of sewage is poured into a clean stream, the water becomes turbid, sunlight is shut out of the depths, and green plants, which by photosynthesis remove carbon dioxide from the water and release oxygen to it, die off. Depending on the stream velocity, the water soon turns nearly black. Odorous sulfur compounds are formed and solids settle to the bottom, forming a sludge. The settled solids soon decompose, forming gases such as ammonia, carbon dioxide, and methane or marsh gas. Scavenging organisms increase in number until they match the food supply. The oxygen resources are drawn upon heavily and, when overloaded, become exhausted. Life in such waters is confined to anaerobic bacteria (which exist when no oxygen is available), larvae of certain insects such as mosquitoes, and a few worms. There are no fish; turtles are generally the only forms of higher life present. This condition is known as the zone of degradation.
In a second zone, or zone of decomposition, more solids settle out, the water becomes somewhat clearer, and sunlight penetrates the surface. Oxygen is absorbed from the atmosphere at the airwater interface permitting the establishment of aerobic (oxygen available) conditions. The aerobic bacteria continue the conversion of organic matter into nitrates, sulfates. and carbonates. These, together with the carbon dioxide produced by decomposition as well as by bacteria and plant life, are food sources. With sunlight now penetrating the water, and with abundant food, algae begin to flourish and form a green scum over the surface. In the third zone, or zone of recovery, algae become more numerous and self-purification
proceeds more rapidly. Green plants utilizing carbon dioxide and oxygen will liberate in the say time more oxygen than is consumed, thus hastening the recovery of the stream. Simultaneously, the fish that require little oxygen such as catfish and carp, are also found. As the dissolved oxygen increases, more types of fish appear. After recovery, in the zone of cleaner water, fish find the stream highly favorable, as the algae support various aquatic insects and other organisms



4. Explain sewage sickness and sewage farming and the prevention methods of sewage sickness

SEWAGE SICKNESS

The phenomena of soil getting clogged and loses its capacity of receiving the sewage load when the sewage is applied continuously on a piece of land is called **sewage sickness**

PREVENTION OF SEWAGE SICKNESS:-

 Primary treatment like screening & sedimentation should be given to sewage before its application to land so that suspended solids are removed & the pores of soil will not be clogged.

 The sewage should be applied intermittently on land i.e by giving rest to the land for sometime .The land should be ploughed during non supply period of sewage so that soil gets aerated.

 Keeping some portion of land reserved in order to use the same in resting period .Enough area will be required for this purpose.

 By planting different crops on the same land by rotation system of crops .The soil will be aerated & will utilize the fertilizing elements of sewage.

 By providing sufficient under drainage system to collect the excessive sewage quantity.

 By frequent ploughing & rotation of soil.

 By not applying the sewage in excess quantity.

SEWAGE FARMING

The process in which sewage is used for growing crops is known as sewage farming .The fertilizing elements of sewage i. e nitrates, sulphates, & phosphates are used by the roots of crops. The nutrients of sewage make the fields fertile .It is a profitable business & a good income can be generated by sewage farming.

APPLICATION OF SEWAGE METHODS

- FLOODING METHOD
- SURFACE IRRIGATION METHOD
- ZIG ZAG METHOD
- LAGOONING METHOD
- BASIN METHOD
- SUB-SOIL IRRIGATION METHOD
- RIDGE AND FERROW IRRIGATION METHOD.

FLOODING:- The area to be irrigated is divided into various parts surrounded by dykes. The sewage is filled like small ponds in between the dykes. The depth of dose varies from 3.0 cms to 5.0 cms. Depending on the irrigation requirements.

SURFACE IRRIGATION:- This method is most suited in sloping area. Here, parallel drains are constructed in the fields. All these drains are connected to a distributaries drain with the help of regulating device so that sewage may flow in the require drain. Here when sewage flows over the fields, its large quantity is absorbed by the field and only excess quantity reaches another drain.

ZIG ZAG METHOD: In this method the ridges are arranged in a zag-zag method with corresponding furrows by their side

LAGOONING: These are used cheaply for sewage disposal. In this method the sewage is allowed to in a natural depression available or artificial constructed tanks. Detention period is about a month. During this period the sludge is stabilized and dried. The purified effluent passes way from an outlet placed at the other end. Lagoons should be shallow and must be constructed away from the town.

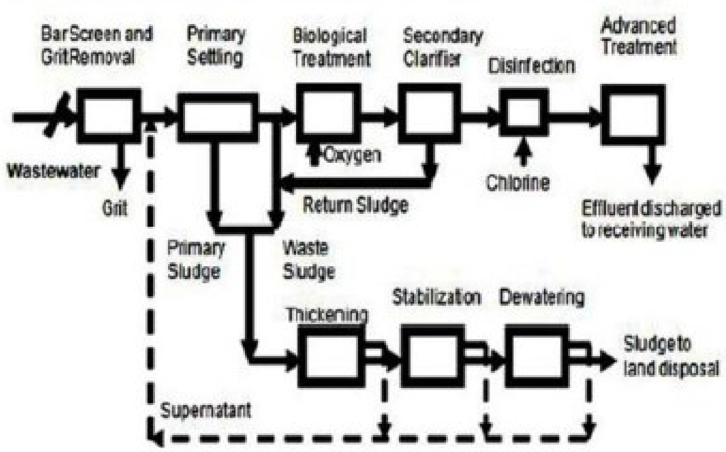
SUB SURFACE IRRIGATION: Here sewage is applied at the roofs of plants, through the open jointed agricultural drain-pipes. These pipes are laid about 1.0 m below the ground level. The sewage rises up due to capillary action. Here soil takes fewer loads but this is an economical method.

BASIN METHOD: In this method big trees are planted in an isolated manner, basins are formed around each tree. These basins are filled with sewage. This method is suitable for fruit gardens.

5. Draw and explain briefly the flow Diagram of Municipal waste water treatment plant with their operation units

Flow diagram of Municipal wastewater treatment plant

The influent or wastewater collected from residences or industries are first subjected to **Screening** process to remove the floating matters present in the sewage. The water which comes out of screening tanks is passed through the **Grit chambers** or **Detritus tanks** to remove the grits or sand particles. Then effluent which comes out of grit chamber is subjected to **Primary Sedimentation tanks** in order to remove the large suspended organic solids which is achieved by settling process where water is allowed to flow in slower rate, then heavy denser particles settles down at the bottom of the tank. The settled organic particles at the bottom of the primary sedimentation tanks is called **primary sludge.** The effluent which comes out of the primary settling tank is subjected to **Biological treatment or Secondary treatment** where, decomposition of organic matter takes place by aerobic bacteria with the supply of oxygen. Then stabilized organic particles along with the water is passed through the **Secondary clarifier** where the stabilized organic particles settles at the bottom of the tank. The sludge which is settled at the bottom of the tank is again recirculated back and mixed with effluent which comes of primary sedimentation tank which is part of **Activated Sludge Process** and remaining sludge is mixed with primary sludge and then subjected to **Sludge digestion process**. In sludge digestion process, wastewater is first subjected to **Thickening**, where number of solid sludge particles are increased by separating from liquid. The liquid which rests over the solid sludge particles are removed out is called as supernatant. The solid sludge which consists of moisture content is removed out in



Dewatering process. The dry form of sludge is used as manure for improving the fertility of soil. The effluent which comes out of secondary clarifier is fed into disinfection tank where chlorine is added to the wastewater to kill germs and pathogenic bacteria's present in the water. Then water which comes out of disinfection tank containing germs are removed out in final or advanced or tertiary treatment process after that, the water can be directly discharged to nearby water courses.

Treatment process as a whole classified into 4 types

1) Priliminary treatment process
2) Primary treatment process
3) Secondary or Biological treatment process
4) Tertiary or final or advanced treatment process

Preliminary treatment process:

This treatment process consists of separating the floating materials like dead animals, tree branches, papers, pieces of rags or wood etc., present in the sewage and also to remove heavy settable inorganic solids. This process also helps in removing oil and grease particles present in the sewage. This process reduces the BOD of wastewater by about 15 to 30%.

The units used in preliminary process are

a) **Screening** - For removal of floating matters like papers, rags, pieces of clothes etc.
b) **Grit chambers or Detritus tank** – For removal of grits and sand particles.
c) **Skimming tanks –** For removal of oil and grease particles present in the sewage.

Primary treatment process: This treatment process consists of removing large suspended organic solids. This is usually achieved by **sedimentation process**. The liquid effluent from primary treatment process consists of large amount of suspended organic matters having BOD of 60% of original. The organic solids which are separated out in the sedimentation tank are often stabilized by anaerobic decomposition in a digestion tank. This residue is used for landfills or soil conditioners.
Secondary treatment process: This treatment process further treats the effluent which is coming out from primary sedimentation tanks. This treatment process is achieved by biological decomposition of organic matter which can be carried out either under aerobic or anaerobic condition.
Treatment process in which organic matter is decomposed by aerobic bacteria is called aerobic decomposition. Units which are used in this treatment process are
Filters – Interment sand filters as well as trickling filters. Intermittent sand filters are used for treatment of wastewater by attaching microorganisms to the filter medium and treated water is collected in the underdrains at the bottom of sand filter and is transported to a line for further treatment or disposal. Trickling filters are used to remove organic matter from wastewater. Trickling filter is an aerobic treatment system that utilizes microorganisms attached to the medium to remove organic matter from wastewater.
Aeration tanks – Wastewater is is mixed with microbes in the aeration tank and oxygen is supplied. Microbes consume that supplied oxygen and decomposes the organic matter present in the wastewater and thus water is cleaned.
Oxidation ponds – Oxidation ponds are also known as stabilization ponds or lagoons. Within an oxidation pond heterotropic bacteria degrade organic matter in the sewage which results in production of cellular material and minerals. The production of these supports the growth of algae in the oxidation pond.
Aerated lagoons: Aerated lagoons or aerated basins is a holding and treatment pond provided with artificial aeration to promote the biological decomposition of wastewater. Treatment process in which organic matter is decomposed anaerobic bacteria is called **anaerobic decomposition**. Units which are used in this treatment process are,
a) **Anaerobic lagoons**: These are also called as manure lagoon which are manmade earthen basins filled with animal waste that undergoes anaerobic decomposition and it will be converted into excellent manures.
b) **Septic tanks**: These are water-tight box made of concrete or fiber glass to separate solids and liquids by settling process. Tanks are used for reception and processing of sewage which is achieved by sedimentation along with anaerobic sludge digestion. The effluent from the secondary biological treatment will usually contain a little BOD of 5 to 10% of original
Final or Advanced or Tertiary treatment process: This process removes remaining organic load after secondary treatment and to kill pathogenic bacteria present in the sewage and this achieved by chlorination
Tertiary Treatment
Tertiary treatment or advanced waste water treatment includes operation and process used to remove organic load left after the secondary treatment and in particular to kill the pathogenic bacteria. It is normally carried out by chlorination.
Tertiary treatment may be aimed at the reuse of wastewater. The common processes that are used in this treatment are:
i. Removal of refractory organisms through adsorption.
ii. Removal of dissolved inorganic substances through chemical precipitation, ion recharge, reverses osmosis, electro dialysis, membrane filtration process and distillation, nutrient removal such as nitrogen and phosphorus etc