VTU EXAM PAPER SOLUTION _March 2021

SEMESTER 7TH SCHEME 17:

CIVIL

SUBJECT: Municipal and Industrial Wastewater Engineering 17CV71

17CV71

Module-3

5 a. The BOD of a sewage sample incubated 1 day at 30^{0}C has been found to be 110mg/L. What will be 5 day at 20^{0}C BOD, if $K_{(20)}$ = 0.1/day? **(06 Marks)**

b. Draw the flow diagram of location of unit operations in a waste water treatment plant. **(06 Marks)**

c. Design a rectangular grit chamber for a population of 2 lakhs, assuming per capita sewage = 120 L/day , quantity of grit at the rate of 25 L/min and velocity = 0.3m/sec and d = 0.2mm. **(08 Marks)**

OR

6 a. Design a circular sedimentation tank for the primary treatment of a sewage at 13.5 million lines per day. Check the surface loading. **(06 Marks)**

b. List the advantages and disadvantages of activated sludge process. **(08 Marks)**

c. Explain sludge digestion process with flow chart. **(06 Marks)**

Module-4

7 a. Explain the different techniques required to adopt strength reduction in industrial plant (any five). **(10 Marks)**

b. List the various methods of removal of organic dissolved solids (any five). **(10 Marks)**

OR

8 a. Mention the advantages of the combined treatment. **(08 Marks)**

b. Discuss the acceptable methods for neutralizing excess acidity or alkalinity in waste water. **(08 Marks)**

c. Differentiate between effluent standards to stream standards. **(04 Marks)**

Module-5

9 a. Explain with a flow chart, the processes of cotton textile industry in manufacturing and the treatment methods adopted for waste water generated. **(10 Marks)**

b. With a neat flow diagram, bring out the manufacturing process and sources of waste water generation from sugar cane industry. **(10 Marks)**

OR

10 a. Draw the flow sheet for waste water treatment in a large distillery complex by discussing the characteristics of waste. **(10 Marks)**

b. For a paper and pulp industry discuss the various steps in generation of waste water during the manufacturing and treatment of the waste water before discharging on receiving water courses or sewers. **(10 Marks)**

* * * * *

CBCS SCHEME

USN 1 c p 1 9 c v 0 0 3 17CV71

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021
Municipal and Industrial Wastewater Engineering

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1 a. Classify the different sewerage systems and discuss the advantages and disadvantage of each system. **(09 Marks)**

b. List the factors considered in determining the quantity of Dry Weather Flow. **(04 Marks)**

c. Calculate the ratio of DWF and WWF of a city having the following particulars :
Area = 50000 hectares , Water supply rate = 200 Lpcd , Population = 20×10^5 ,
Intensity of rainfall = 15mm/hour , Average impermeability factor = 0.5.
80% of the water supplied reaches sewer. Comment on the result. **(07 Marks)**

OR

2 a. Explain with neat sketch laying of sewer line. **(05 Marks)**

b. Mention the different types of Manholes and explain one of the Manholes, with neat sketch. **(07 Marks)**

c. The drainage area of a town is 18 hectares. The surface of this area is

Percent of total surface area	Types of surface	Coefficient of runoff
20 %	Hard pavement	0.85
20 %	Roof surface	0.80
15 %	Unpaved sheet	0.20
30 %	Garden and Lawn	0.20
15 %	Wooded area	0.15

If the time and concentration for the area 40 minutes, find the maximum runoff. **(08 Marks)**

Module-2

3 a. Calculate the velocity of flow and discharge in a sewer of circular section having a diameter of 1 in 500, when N = 0.012 and the sewer is running half full. **(08 Marks)**

b. With a neat sketch, explain Oxygen Sag Curve. **(06 Marks)**

c. Explain the preventive measures required to be adopted for sewage sickness of land. **(06 Marks)**

OR

4 a. A waste water effluent of 560 L/s with a BOD = 65 mg/L , DO = 4.0 mg/L and temperature 23°C enters a river where the flow is $28 m^3$/sec and the BOD = 4.0 mg/L, DO = 8.2mg/L and the temperature 17°C. K_1 of the waste is 0.10 per day at 20°C. The velocity of water in the river downstream is 0.18m/s depth of 1.2m. Determine the following after mixing of waste water with river water : i) Combined discharge ii) BOD iii) DO iv) Temperature. **(08 Marks)**

b. Explain the various techniques adopted in applying sewage effluents to forms. **(06 Marks)**

c. Enumerate on dilution method Vs land disposal method for disposal of sewage. **(06 Marks)**

Q. 1 SOLUTION

Sewerage system consists of pipes,pumps for collection of wastewater, or sewage, from a community. Modern sewerage systems fall under two categories: domestic and industrial sewers and storm sewers.

TYPES OF SEWERAGE SYSTEM

COMBINED SEWERAGE SYSTEM:

A combined sewer system is a sewer that accepts storm water, sanitary water/sewage, then the sewage is treated in STP(sewerage treatment plant). This system is mainly used in the towns where streets are narrow and rain fall is less than the moderate.

ADVANTAGES:

a) less construction cost

b) There will be No chocking problem

c) strength of the toxic water will be reduced.

DISADVANTAGES:

a) Due to sewage the toxicity of storm water will increase.

b) Initial cost of piping will be high.

c) Problem in handling.

SEPARATE SEWERAGE SYSTEM:

In this system the sanitary sewage and storm water are carried separately in two sets of sewers. The sewage is conveyed to waste water treatment plant (WWTP) and the storm water is discharges into rivers without treatment.

ADVANTAGES:

a) The rain water will not become toxic.

b) More efficient than combined system.

DISADVANTAGES:

a) Problem of chocking.

b) Flushing system will be required for cleaning purpose.

PARTIALLY COMBINED OR PARTIALLY SEPARATE SYSTEM:

A partially separate system is a combination of a combined sewerage system and separate sewerage systems. This type of sewerage system helps decrease the load from a combined sewerage system because only the water from initial rain falls(water from acid rain) is added to sewage water and after than this system work as separate system.

ADVANTAGES:

a) The sizes of sewers are not very large as some portion of storm water is carried through open drains.

b)Combines the advantages of both the previous systems. Silting problem is completely eliminated.

c) storm water will be less toxic as compare to previous two systems.

DISADVANTAGES:

a) The storm water is unnecessary put load on to the treatment plants to extend.

b) The toxicity of sewage water will increase.

Q.1 b FACTORS AFFECTING DWF:

FACTORS AFFECTING DRY WEATHER FLOW:

1. Rate of water supply
2. Population growth
3. Type of area served
4. infiltration of ground water

Factor # 1. Rate of Water Supply:

It is evident that a considerable part of the water supplied to the public through public water supply system emerges as domestic or sanitary sewage. As such the quantity of domestic or sanitary sewage produced depends on the rate of water supply. The quantity of domestic or sanitary sewage produced will usually be slightly less than the quantity of water supplied.

This is due to the fact that some quantity of water is lost in consumption, evaporation, etc. However, besides the water supplied to the public through public water supply system, sometimes water from private sources such as domestic wells etc., may also be used by the public for their domestic needs.

This additional quantity of water used by the public will also produce certain amount of domestic or sanitary sewage which will also enter the sewers. The additional quantity of domestic or sanitary sewage may be assumed to be approximately equal to the quantity of water lost in consumption, evaporation, etc.

With this assumption it may be considered that the rate of domestic or sanitary sewage produced is nearly equal to the rate of water supplied to the public through public water supply system. However, in actual

practice the quantity of domestic or sanitary sewage may be assumed to be equal to about 70 to 80% of the quantity of water supplied to the public through public water supply system.

From the above discussion it is thus clear that if the rate of water supply through public water supply system is known, the probable rate of domestic or sanitary sewage produced can be estimated. The rate of water supply through public water supply system is, however, not constant but it increases with the increase in population.

The increase in the rate of water supply will result in an increase in the rate of domestic or sanitary sewage produced. It shows the variation in the rate of water supply and the corresponding rate of domestic or sanitary sewage produced with population for normal Indian conditions. The rate of domestic or sanitary sewage produced has been considered as approximately 80% of the rate of water supply.

Factor # 2. Population Growth:

Alike water supply project a sewerage project is also designed to serve not only the present population but also the prospective or future population which may occur at the end of a reasonable period usually termed as design period. The prospective or future population for which the sewerage project is designed is termed as design population.

For arriving at the design population various methods of forecasting or estimating the prospective or future population are adopted as indicated below:

i. Arithmetical increase method
ii. Geometrical increase method
iii. Incremental increase method
iv. Changing rate of increase method
v. Graphical method
vi. Comparative method or Curvilinear method
vii. Decreasing rate of growth method or Declining growth method
viii. Logistic method
ix. Zoning method
x. Ratio and correlation method

However, these methods can be used to predict the future population only if the population data for the past few decades is available. If such information on population is not available then the densities of population as suggested in the Manual on Sewerage and Sewage Treatment prepared by Central Public Health and Environmental Engineering Organisation may be adopted.

In cities where Floor Space Index (FSI) or Floor Area Ratio (FAR) limits are fixed by the local authority the same may be used for working out the population density. FSI or FAR is the ratio of total floor area (of all the floors) to the plot area.

The densities of population on this concept .

Design Period:

Sewerage projects are normally designed to meet the requirements over a period of 30 years after their completion. In other words a design period of 30 years is normally considered for a sewerage project. However, the period of 30 years may be modified in respect of certain components of the project depending on their useful life or the facility for carrying out extensions when required and rate of interest, so that expenditure far ahead of its utilisation is avoided.

Factor # 3. Type of Area Served:

The quantity of sewage or wastewater produced from an area would depend on whether the area to be served is residential, commercial or industrial. As indicated earlier the quantity of sewage or wastewater produced from a residential area depends on the quantity of water supplied to the public through public water supply system, and it may be assumed to be equal to about 70 to 80% of the quantity of water supplied to the public through public water supply system.

The quantity of industrial sewage or wastewater produced from an industrial area depends on the type of industries and the corresponding manufacturing or industrial processes. A careful study of the processes involved in different industries is therefore required to be made to determine the quantity of industrial sewage or wastewater. A similar study is required to be made to determine the quantity of sewage or wastewater produced from commercial undertakings.

Factor # 4. Infiltration and Exfiltration:

Some quantity of groundwater or subsoil water may infiltrate into sewers through defective joints, broken pipe and other similar entry points. The infiltration of groundwater or subsoil water into sewers may take place when the head of groundwater or subsoil water surrounding the sewers is more than the head of sewage or wastewater flowing through the sewers.

On the other hand exfiltration is a term which indicates the leakage of sewage or wastewater from sewers into the ground surrounding the sewers. Exfiltration may occur through defective joints, broken pipe, etc., when the head of sewage or wastewater flowing through sewers is more than the head of groundwater or subsoil water surrounding the sewers. While due to infiltration the quantity of flow through sewers increases, exfiltration results in decrease in the quantity of flow through sewers. Thus exfiltration is reverse of infiltration.

Both infiltration as well as exfiltration are undesirable. The infiltration unnecessarily increases the quantity of sewage or wastewater. The exfiltration pollutes the underground or subsoil source of water, if any. Since infiltration and exfiltration take place mainly due to imperfect joints, these can be prevented to some extent by constructing watertight joints.

From the point of design of sewers infiltration is much more important than exfiltration.

The quantity of groundwater or subsoil water which may enter sewers through infiltration depends on the following factors:

(i) Depth of sewer below the groundwater level (or head of subsoil water)

(ii) Length of sewer

(iii) Size of sewer

(iv) Nature and type of soil through which sewer is laid

(v) Sewer material

(vi) Care exercised in the construction of the sewer.

The rate of infiltration of groundwater or subsoil water into sewers may be considered in the following three ways:

(a) Area Basis:

In this case the rate of infiltration is considered per unit of area served by the sewer and it is expressed as litres per day per hectare. Depending on the above noted factors a flat allowance of 5 000 to 50 000 litres per day per hectare may be made for the amount of infiltration of groundwater into a sewer.

For example – if the rate of infiltration is 10 000 litres per day per hectare and if the sewer serves an area of 15 hectares, the quantity of groundwater that will enter the sewer through infiltration would be 10 000 x 15 = 150 000 litres per day.

(b) Length Basis:

In this case the rate of infiltration is considered per unit length of sewer and it is expressed as litres per day per kilometre. For normal conditions, the rate of infiltration of groundwater into a sewer may be taken as 500 to 5 000 litres per day per kilometre length of sewer.

Thus if rate of infiltration is 2 000 litres per day per kilometre length of sewer and the length of sewer is 100 kilometres, the quantity of groundwater that will enter the sewer through infiltration would be 2000 x 100 = 200 000 litres per day.

(c) Diameter—Length Basis:

In this case the rate of infiltration is considered per unit diameter per unit length of sewer and it is expressed as litres per day per centimetre of diameter per kilometre. This is the most logical way of expressing the rate of infiltration because larger the diameter of sewer greater will be the amount of infiltration of groundwater into the sewer.

Estimation of Industrial Sewage:

The quantity of industrial sewage will vary with the type and size of industry, the manufacturing or industrial processes involved, the degree of water reuse, and the on-site treatment methods that are used, if any. As such a careful study of the various industries is required to be made to determine the quantity of industrial sewage.

However, in general the quantity of industrial sewage may also be assumed to be approximately equal to about 80 to 90% of the quantity of water supplied through public water supply system. Some industries

develop their own source of water supply and thus use water other than that is supplied through public water supply system, and may discharge their liquid wastes into sewers.

Estimates of such flows should also be made while determining the quantity of industrial sewage. It may, however, be stated that industrial sewage should be treated to the standards prescribed by the regulatory authorities before being discharged into sewers.

Estimation of Groundwater Infiltration:

The quantity of groundwater which may infiltrate into sewers will depend on workmanship in laying of sewers and level of water table (or groundwater surface). Since sewers are designed for maximum or peak rates of flow, allowance for groundwater infiltration for the worst condition in the area should be made.

Q. 1 C. DWF/WWF Ratio: A= 50000 HACTARE. Water supply rate= 200 lpcd population= 20x 10^5 Intensity of rainfall= 15 mm/hour I avg= 0.5 , 80% of water supply reaches to sewer.

Q SEWAGE FLOW RATE= 0.80X 200= 160 LPCD

Dry Weather flow= sewage flow= 20 x 10^5 x 160/24x60x60 =3703 l/sec

Ri= 25.4 a/t+b= a=40 b= 30, 15 mm/hour= 25.4x40/t+30 , T=37.7 Minutes

WWF= Q= 28. A.I.Ri= 28. 50000X10^4. 0.5X (0.15CM/HR)= VALUE.

NOW ratio can be calculated.

Q.2 A laying of sewer line neat sketch:

Laying Of Sewer Pipes

All the sewer pipes are generally laid starting from their outfall end towards their starting. ***The laying of a new sewer pipes consists of the following 9 steps:***

1. Marking Of The Alignment

The center line of the sewer is marked along the road with a theodolite and invert tap. **It may be marked either by reference line or with the help of sight rail. The position of the manhole** is also marked.

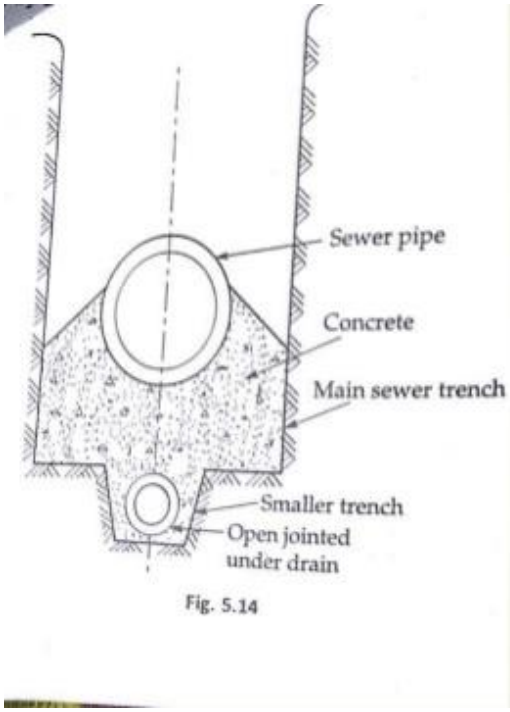


Fig. 5.14

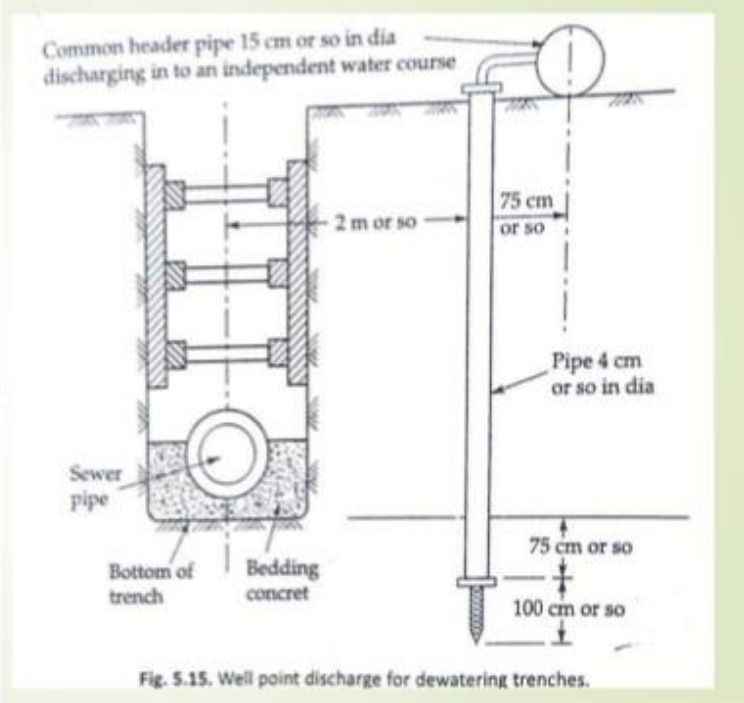


Fig. 5.15. Well point discharge for dewatering trenches.

https://i2.wp.com/civilnoteppt.com/wp-content/uploads/2019/10/1b755-ice_screenshot_20190302-141025.png?resize=378%2C208&ssl=1

2. Excavation Of Trench

After marking the centre line of the sewer, the excavation of trench is started. The excavation may be carried out either by manual labour or by machines like power shovels, track excavators etc.

3. Timbering Of The Trench

When, in ordinary soil, the depth of excavation is more than 2 m, timber bracing or sheet piling is provided on both sides of the trench so that it may not collapse. The extent of timbering required depends upon the **type of soil** and the depth of excavation.

4. Dewatering Of Trench

If water is met with during excavation, it is removed by pumping or any other suitable

5. Preparation Of Sub-grade

For soft **soil**, the bed of the sewer is prepared by plain concrete (1:3:6). The thickness of concrete varies from 15 to 20 cm. The bedding layer is not required in case of rocky or hard soil.

6. Laying And Joining Of Pipes

The sewers are laid along the trench very carefully. Then the joining of the sewer is done as per requirements. After joining, both sides of the pipe are finished with **concrete**.

. Testing Of Leakage

The leakage in the pipe joints or any other points is tested by water test or air test…..Read more(**Testing of leakage in the pipe joint -Air Test & Water Test**).

8. Testing of Straightness Of Alignment And Obstruction

The straightness of the sewer pipe and the presence of any obstruction are tested by placing a mirror at one end of the sewer and a lamp at the other end. If the pipe line is straight, the full circle of light will be observed.

The presence of an obstruction in the pipe can also be tested by inserting a smooth ball at the upper end of the sewer. The dia of the ball is 13 mm less than the internal diameter of the sewer. If there is no obstruction inside the sewer, the ball shall roll down and reach the lower end of the sewer.

9. Back Filling

Lastly, the trenches are filled up with the excavated earth in layers of about 15 cm thick. Each layer is properly watered and rammed.

Q.2 b

What is a Manhole?

According to Dictionary of Construction, a manhole is, “a vertical access shaft from the ground surface to a sewer or stormwater line…, usually at a junction, to allow cleaning, inspection, connections, and repairs.”

What is the Purpose of a Manhole?

As manhole manufacturers, we often get asked about the purpose of manholes and the uses of manholes. And the answer is, that there are many functions of manholes when it comes to sewer or stormwater systems. The four main purposes of a manhole are:

1. To facilitate inspections of the sewer or stormwater system as well as maintenance projects such as cleaning or removal of obstructions within the sewer or stormwater line
2. To assist in ventilation of the sewage system by allowing gases to escape
3. To allow the municipality to join sewer or stormwater systems, change the direction of the sewer or stormwater system, or align the sewer or stormwater system
4. To assist in ensuring the sewer or stormwater line is laid in convenient lengths.

The Different Types of Manholes

Types of Manholes. 1) Precast concrete manholes. a) Minimum manhole diameter is 48-inch and maximum manhole diameter is 96-inch, see Standard Details S/1.0, S/1.1 and S/1.2. b) If a manhole larger than 96-inch diameter is required, verify if they are available from all WSSC approved manufacturers of precast concrete manholes and submit design details, calculations and specifications for approval. Show all details on the drawings. 2) Brick manholes. a) Brick manholes are not permitted for new construction. b) When the design requires modifications to an existing brick manhole, see Part Two, Section 18 (Manhole Depth Design), to determine if the existing brick can be modified in place. If not, design the manhole to be replaced with a precast concrete manhole. c) Minimum manhole diameter is 48-inch and maximum diameter is 84-inch, see Standard Detail S/3.0. d) When connecting to an existing brick manhole, include the following in the design. Design only DIP or RCP pipelines between existing brick manholes and new manholes. Do not use PVC pipe to connect to existing brick manholes. Provide a note on the drawings stating the following: "Existing brick manhole. Grout pipe in the existing brick manhole with non-shrink grout and provide bentonite at the connection, see Standard Detail S/3.0a". 3) Cast in place. When precast manhole requires a special design or size, it may be necessary to provide a cast in place structure, see requirements in Part Three, Section 16 (Design of Pipeline Structures). c. Labeling Manholes on the Drawings. 1) When connecting to an existing manhole, indicate if it is precast, brick or cast in place. The information for the type of existing manhole material can be taken from the "As-Built" drawings or if necessary, site visits to determine the type of manhole.

Manholes typically fall into one of three categories, which are shallow, normal, and deep. The type of manhole chosen for a specific area depends on both the size of the sewer or stormwater line as well as the function that the manhole is supposed to serve.

Shallow Manholes

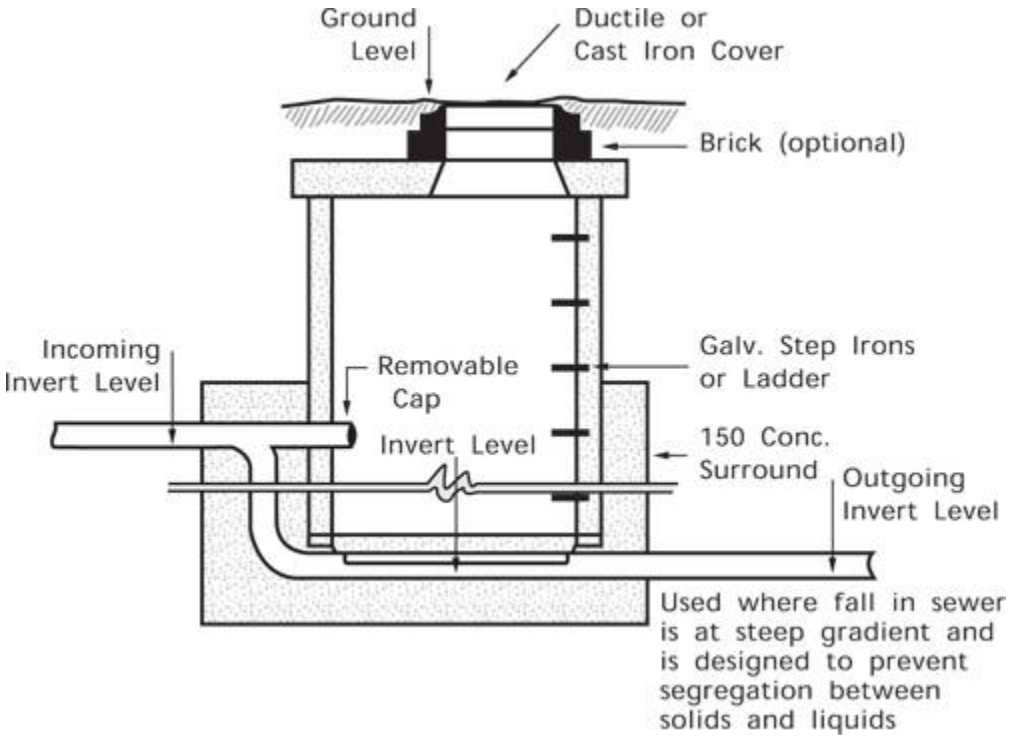
Also known as inspection chambers, shallow manholes are only approximately two to three feet deep. They are typically located at the start of a sewer or storm water branch and are placed in areas that are not heavily trafficked.

Normal Manholes

These types of manholes are typically about 150 centimeters or five feet deep. They are located in the sewer or storm water line and include a heavy manhole cover that is typically square or rectangular in shape.

Deep Manholes

Any manhole deeper than 150 centimeters is considered a deep manhole. These manholes incorporate a method for entry, such as a built-in ladder, always incorporate a heavy manhole cover.



Q.2 C. Ri= 900/t+60

Area= 18 hactare so, Summation= C1AI+ C2A2+ C3A3+C4A4+C5A5=0.85x 0.20A+ 0.80X0.20A+0.20X0.15A+ 0.20X0.15A+ 0.15X0.15XA= SUMMATION= 0.556A

C avg= sum CA/A= 0.556A/A= 0.566

Ri= 900/40+60= 900/100= 9 mm/hour

Q= 1/360. C. Ri. A= GET THE ANSWER.

Q.3 a . N= 0.012 MANNING FORMULA. Slope S= 1/500 VELOCITY 2 M/SEC. When the sewer is running fhalf full. D= 0.5D Q= 180 DEGREE, a= ½. Pi/4 D^2= PI/8 D^2 NOW p= pi.D Q.360= pi.D/2

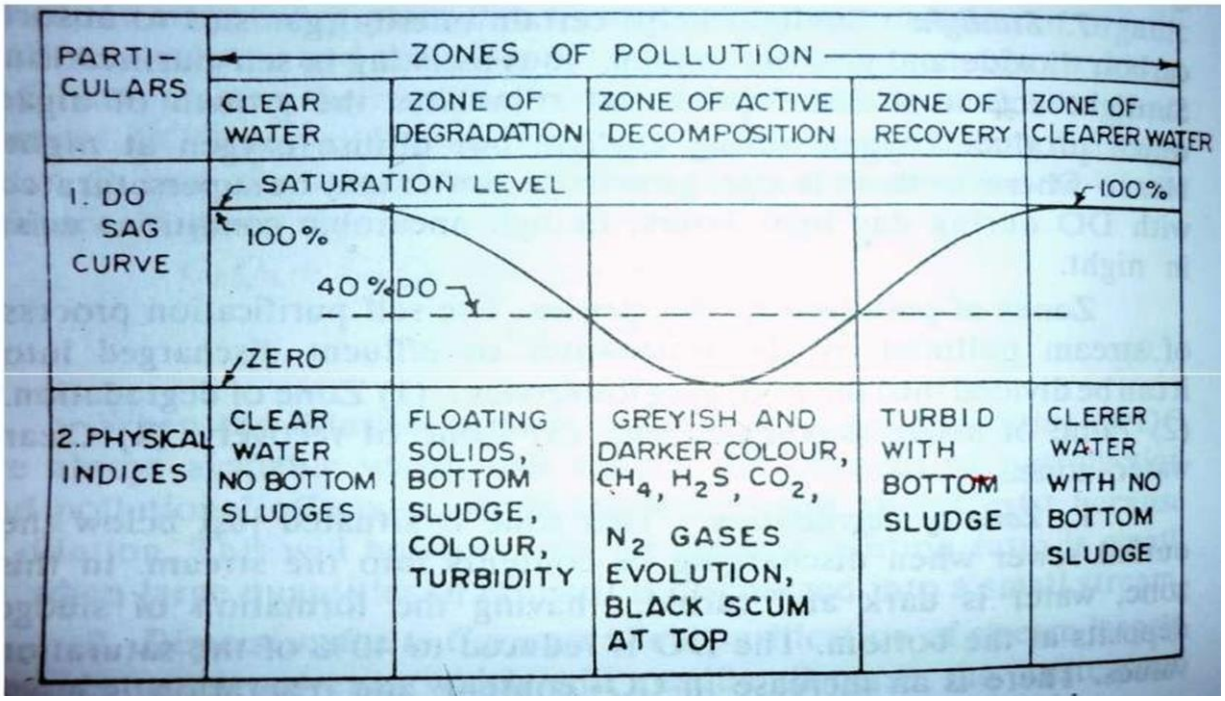
R= pi/8.D^2. 2/pi.D= D/4. V= 1/N. r^2/3. S^1/2= D=1.573M. Q=a.v= pi/8. (1.573)^2x2=1.942 cumecs.

Q. 3 b. OXYGEN SAG CURVE:

- . DILUTION
- 2. DISPERSION
- 3. SEDIMENTATION
- 4. OXIDATION
- 5. REDUCTION
- 6. TEMPERATURE 7. SUNLIGHT

ZONES OF POLLUTION IN STREAMS:

1. ZONE OF DEGRADATION
2. ZONE OF DECOMPOSITION
3. ZONE OF RECOVERY
4. ZONE OF CLEARER WATER.



- The organic matter present in the wastewater is oxidized by aerobic bacteria utilizing dissolved oxygen of the natural waters.
- This process continues till complete oxidation of organic matter takes place.

- The stream which is capable of absorbing more oxygen through re-aeration etc can purify heavily polluted water in short time.
- Reduction occurs in the stream due to hydrolysis of organic matter biologically or chemically.
- Anaerobic bacteria will split the organic matter into liquids and gases, thus paving the way for stabilization by oxidation.
- 1. ZONE OF DEGRADATION

  Situated just below outfall sewer.

  Water is dark and turbid with sludge at the bottom.

  DO reduces up to 40% of saturation level.

  CO_2 content increases.

  Reaeration is slower than deoxygenation.

  Conditions are unfavorable for aquatic life.

  Anaerobic decomposition takes place in this zone.

2. Zone of active decomposition

- Water in this zone becomes grayish and darker than previous zone.
- DO concentration falls to zero.
- CH_4, H_2S, CO_2 and N_2 are present because of anaerobic decomposition.
- Fish life is absent but bacteria are present.
- At the end of this zone DO rises to 40% of saturation.
- Aquatic life starts to reappear.

3. Zone of Recovery

- Process of recovery starts.
- Stabilization of organic matter takes place in this zone.
- BOD falls and DO content increases above 40% value.
- NO_4, SO_4 and CO_3 are formed.
- Near the end of this zone entire aquatic life reappears.
- Water becomes clearer and attractive in appearance.

- **4. Clear water zone.**
- DO rises to saturation level.
- Oxygen balance is attained.
- Recovery is complete.
- Some pathogenic microorganisms may be present.

Q.4 VARIOUS TECHNIQUES INVOLVES IN SEWAGE EFFLUENTS:

- Physical **Water** Treatment. In this stage, physical **methods** are used for cleaning the **wastewater**. ...
- Biological **Water** Treatment. This uses various biological processes to break down the organic matter present in **wastewater**, such as soap, human waste, oils and food. ...
- Chemical **Water** Treatment. ...
- **Sludge** Treatment.

- **Physical Water Treatment**

  In this stage, physical methods are used for cleaning the wastewater. Processes like screening, sedimentation and skimming are used to remove the solids. No chemicals are involved in this process.

- One of the main techniques of physical wastewater treatment includes sedimentation, which is a process of suspending the insoluble/heavy particles from the wastewater. Once the insoluble material settles down at the bottom, you can separate the pure water.

- Another effective physical water treatment technique includes aeration. This process consists of circulating air through the water to provide oxygen to it. Filtration, the third method, is used for filtering out all the contaminants. You can use special kind of filters to pass the wastewater and separate the contaminants and insoluble particles present in it. The sand filter is the most commonly used filter. The grease found on the surface of some wastewater can also be removed easily through this method.

Biological Water Treatment

This uses various biological processes to break down the organic matter present in wastewater, such as soap, human waste, oils and food. Microorganisms metabolize organic matter in the wastewater in biological treatment. It can be divided into three categories:

- Aerobic processes: Bacteria decomposes the organic matter and converts it into carbon dioxide that can be used by plants. Oxygen is used in this process.

- Anaerobic processes: Here, fermentation is used for fermenting the waste at a specific temperature. Oxygen is not used in anaerobic process.
- Composting: A type of aerobic process where wastewater is treated by mixing it with sawdust or other carbon sources.

Secondary treatment removes most of the solids present in wastewater, however, some dissolved nutrients such as nitrogen and phosphorous may remain.

Chemical Water Treatment

As the name suggests, this treatment involves the use of chemicals in water. Chlorine, an oxidizing chemical, is commonly used to kill bacteria which decomposes water by adding contaminants to it. Another oxidizing agent used for purifying the wastewater is ozone. Neutralization is a technique where an acid or base is added to bring the water to its natural pH of 7. Chemicals prevent the bacteria from reproducing in water, thus making the water pure.

Sludge Treatment

This is a solid-liquid separation process where the least possible residual moisture is required in the solid phase and the lowest possible solid particle residues are required in the separated liquid phase.

An example of this includes dewatering of sludge from industrial wastewater or sewage plant where the residual moisture in dewatered solids determines the disposal costs and the centrate quality determines the pollution load returned back to the treatment facility. You need to minimize both.

A **solid-liquid separation device** such as a centrifuge is used for removing the solids from the wastewater.

Wastewater has a lot of impact on the natural world and it is important to treat it effectively. By treating wastewater, you don't just save the creatures thriving on it, but also protect the planet as a whole.

Jigar Patel, the Director of Business Development at **Oriental Manufacturers**, is a young and passionate businessman who believes in the power of functional designs and its ability to boost productivity and drive growth. Fueled by his passion for innovative designs and all things EPC, Jigar took to blogging and regularly writes on topics related to process machinery production, turnkey solutions, best industry practices, and his personal insights

Q.5. DILUTION VS LAND DISPOSAL

Dilution into sea

- ► More salt concentration- saturated DO in water decreased. 20% less DO present in sea water as compared to river stream. Specific gravity is higher, tempr lower than sewage stream.

- **SLEEK**-bcz of this when sewage discharged into sea water, lighter and warmer sewage will rise up to the surface resulting in the spreading of the sewage at the top surface of sea in a thin film called **sleek, sludge blank:** thin milky layer formed at the top of sea water produce offensive H2S gas by reacting with the sulphate rich water of the sea. Sea water contains a large amount of DO matter which chemically react with the sewage solids, resulting a formation of **sludge banks.**

- Sea contains large volume of water, most of these deficiencies can be overcome if the sewage is discharged deep into the sea, much away from the coast line, with extreme care. Deep into the sea discharge always 1 to 1.5 km away from se shore. Submarine outfall that consist of a long section of pipe to transport the wastewater some distance form the shore. CI pipe used encased thick stone masonary or special type of concrete. Min. dept of water at the outfall point 3 to 5 m.

2. Land disposal

- Wastewater Either raw or partially treated is applied or spread on the surface of land. Method called as disposal by land treatment. Some part of the wastewater evaporates while other part percolates in the ground leaving behind suspended solids which are partly acted upon by the bacteria and partly oxidized by exposure to atmospheric **action of air, heat and light.**

- **Sewage add to the fertilizing value of the land, and crops can be profitably raised on such land, disposal by land treatment is also called sewage farming.**

- **Three principle processes of land treatment of wastewater are: 1) broad irrigation or sewage farming 2) rapid infiltration and 3) overland runoff. First two processes depend upon moving or percolating the water downward through the soil and thus are limited by infiltration and percolating capacity of the land.**

- **Percolating capacity is a function of soil characteristics, infiltration depends upon the degree of clogging at the soil surface.**

- If the waste is sufficiently pretreated , clogging will be minimized and percolation will limit the rate at which liquid can be applied. PR= 6 to 25 mm/min. rapid infiltration is practicable. 2to 6 mm/min irrigation is suitable and below oveland runoff should be adopted.

- **1. Rapid Infiltration:** slow rate: Slow Rate (SR) systems are the predominant form of land treatment for municipal and industrial waste-water. Such a technology incorporates waste-water treatment, water reuse, crop utilization of nutrients and waste-water disposal. It involves the application of wastewater to vegetated land by means of various techniques, including sprinkling methods or surface techniques such as graded-border and furrow irrigation. Ww is discharged into large basin underlined by sand and soils of high permeability.

- Bottom of the basin covered with grass like bermuda which can persist in wet or dry condition. Grass assists in nitrogen removal and helps in infiltration capacity of the surface.

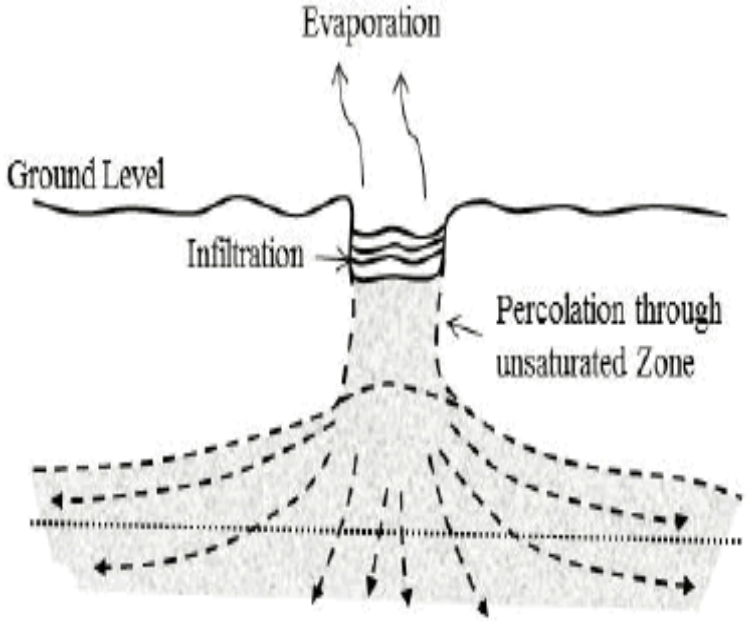


Figure 2: Rapid filtration of land treatment.

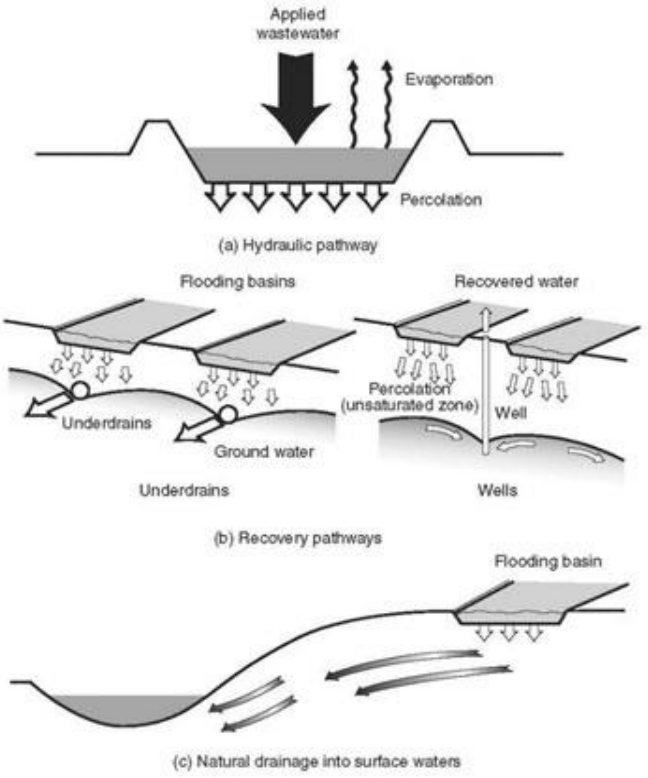


Figure 2. Hydraulic pathway for rapid infiltration (RI)[8]

- **Three methods:**

1. Surface irrigation
   - Basin method
   - Flooding method
   - Furrow method
2. Subsurface irrigation
3. Sprinkler irrigation or spray

- In the subsurface irrigation: ww is supplied directly to the root zone of plants through a system of underground pipes with open joints.
- The technique of overland runoff is applied when soil have poor permeability. Plants or tree cover is essential to minimize and assist in nutrient removal.
- **Process by which purification of sewage** takes place in first two methods: mechanical straining or filtration of organic matter present in sewage. Complex compounds in the sewage are thus converted into harmless minerals salts which serve as a valuable fertilizer.

Sewage farming: The nutrinets present in sewage like N, P,K along withn the micro nutrients as well as organic matter present in it could be used for sewage farming to add the fertility of the soil along with irrigation potential of water content.

Without polluting the soil good sanitary manner, open water courses or contaminated crops raised on the sewage farming; or impairing the productivity of the soil. Hygienic safety is important for the working staff to protect against the infection by pathogens.