SEMESTER DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY MARCH -2013

PART A

I)1.Per capita demand of water:

Rate of water Per capita per day is the amount of water supplied per person per day to satisfy the various demands.It is expressed as littres per capita per day(lpcd).Factors affecting per capita demand are,

(a)Social and economic status of consumers

(b)Climatic condition

(c)Industries and commerce

(d)quality of water etc

2.Aeration of water:

Aeration is essentially a physical or mechanical method by which water is brought in close contact with air so as to absorb oxygen for the reduction of taste,odour etc. by virtue of oxidation and expulsion.

3. sewerage: This term denotes the network of sewers and other devices used in the system for carrying sewage .In a broader sense the sewerage system includes the collection , conveyance, treatment and disposal of sewage.

Sewer: The underground conduit conveying sewage is called sewer.

4. Runoff co-efficient:This relationship appears to be independent of the long-term average rainfall at a particular location.

5.Aerosol:It is a colloidal suspension o particles dispersed in air or gas.It is a substance enclosed under presure and released as fine spray by means of a propellant gas.

PART B

1.Pipe corrosion:

Corrosion of pipes may be defined as the conersion of metal to a salt or oxide with loss of desvirable properties sucvh as strength ,smoothness etc. Corrosion may occur over the entire length or may be localized.This is an adverse phenomenon which has vto be prevented in the pipe lines.v

Causes of corrosion:

According to the most widely accepted theory,this phenomenon is electro-chemical in nature.They are,

a)The anodic reaction:

In this phase,metal ions carrying one or more positie charges ae released into water.In turn,the same number of electrons carrying single negative charge released to the metal.Consequently there is a loss of metal at the anodic area.This is also known as corrosion due to bimetallic action.For iron it can be expressed as ,

$Fe(metal)=Fe^{++}(metal\ ion)+2e$

b)The cathodi reaction:

As a result of anodic reaction ,negatively charged electrons remain in the metal,the accumulation of which stops the release of positive ions from the metal.But ,soon the electrons are eliminated by reaction with H+ ions in the water.The reaction is expressed as ,

$2H+2e=H_2\,(gas)$

c)Depolarization:

If hydrogen accomulated on metal surface is not quickly eliminated,the corrosion action will be stoped by polarization.But the accumulated hydrogen gas reacts with the dissolved oxygen in the water to form H_2O.

d)Reaction of metal ions:

Most of the metal ions reacts with the ions present in water forming an insoluble coating on the pipe surface protecting it from further corrosion.But in thecase of iron,only rust is formed which has little protective value.

The other factors responsible for corrosion are stated as,

- Presence of carbon dioxide releases iron from the anode causing electrolytic corrosion.
- Corrosion due to bacterial action particularly due to sulphate reducing bacteria and iron consuming bacteria.
- Corrosion due to water motion in which turbulent flow and increase of pressure cause cavitation on the inner surface of the pipe.

Prevention of pipe corrosin:

I. Proper selection of material:The pipe material which are more resistant to corrosion like concrete ,asbestos cement etc.can be selected.
II. Protecting coating:The coating are either metallic type or non metallic type.The principle metallic type is galvanizing by hot dip process.Non metallic type are tar.asphalt,cement mortars etc.
III. Cathodic protection:In this type,the entire pipe line is made to act as cathode,so that emerging currents from anodic areas are suppressed and thus corrosion is prevented.
IV. Addition of alkalinity:It is increased by adding lime and pH value of water is raised ,thus reducing corrrosion.
V. Inhibition:Use o meta phosphate etc are made in this method.When addedin small doses of 0.5 to 2ppm,they inhibit corrosion by deposition of ions on the pipe surace.

2.Rapid sand filter:

The difficulty of slow sand filter is overcome in rapid sand filter.The disadvantage of slow sand filter is that they require a large space for installation as the rate of filtration is very slow.

Construction:

These filter units are very small in size and are located in a building called ffilter house.Number of filter units are constructed in one or two rows. Each unit is a rectangular block of size 5m x4m to 10m X8m.Depth of bank is about 3m.Ratio between the length and width may be 1.25 to 1.33

Filter bed consists of uniformly graded coarse sand .The thickness of sand bed is from 0.6 to 0.75m.The effective size of sand varies from 0.35 to 0.6mm and uniformity coefficient does not exceeding 1.60

A gravel bed of depth 0.45 to 0.6 m supports the filter medium.The size ofgravel is from 5 to 25mm,the smaller size being placed at top.Gravel prevents sand from entering into drains and thus causing them to choke.Each filter unit is also provided with various valves .

Working:

The effluent from sedimentation with coagulation unit is applied to the filter through valve A.Valves B,D and E are closed and then water is allowed to percolatethrough sand bed.Water is filtered by the action of different mechanisms of filtration.The filtered water is collected in the under drainage system is taken to the clear water reservoir through manifold drain pipe by opening the valve C.

Cleaning:

After some time of filtration,the filter bed is clogged and loss head increases with a corresponding in the rate of filtration.When the loss of head reaches about 2.5m,it requires cleaning .As the rate of loading is very high,the filter bed clog s quickly.There is no possibility of the development of dirty skin in the case of rapid sand filter.

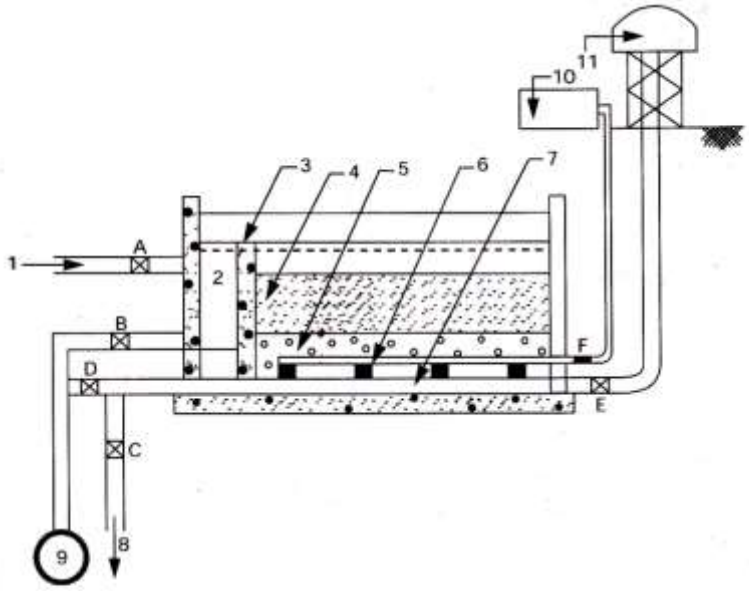
For cleaning purpose,

1.Valves A and C are closed ,2)Valve F is opened,3)Send compressed air from the bottom into the filter medium,which agitates and separate the impurities from the sand particles,4)Then open valve E and send wash water under pressure in upward direction through filter medium so as to wash away all the impurities.,5)The dirty wash water is taken awayinto the wash water drain through valve B,6)Then Close valves B ,E and F.,7)Open valve A and allow water to pass through sand bed.But this water initially contains impurities and hence is to be drained away.For this ,open valve D,and initially filtered water is drained away.Then close valve D.,8)Open valve C and clear filtered water is collected into the clear water reservoir.

The complete operation of cleaning requires about 10 to 15 minutes.It is of great importance that the valves should be operated correctlyas described above to filter the water effectively,which requires skilled operation and supervision.The rate of filtration is high and is about 3000 to 6000 lit/hr/m^2 o filter area.

Operational troubles:

Due to continous filtration and inadequate washing ,mud accumulates in the bed,and results in the formation of mud balls,effecting seriously the working of the filter.They may be removed by surface washing and washing with caustic soda.Also fine sand in top layers shrinks,resulting in the development of cracks called cracking of filters.In such a case the sand is removed ,washed and then replaced along with fresh sand .



1. INLET
2. INLET CHANNEL
3. OVER FLOW WEIR
4. SAND MEDIUM
5. GRAVEL BED
6. LATERAL DRAINS
7. MANIFOLD DRAIN PIPE
8. TO CLEAR WATER RESERVOIR
9. WASH WATER DRAIN
10. AIR COMPRESSER UNIT
11. OVER HEAD TANK TO SUPPLY WASH WATER A, B, C, D, E AND F ARE VALVES

RAPID SAND FILTER

(fig)

3.Sewage:

The liquid waste of the community is called sewage.It includes the waste from water closets,urinals ,bath rooms,kitchens of the residence and waste water from industries and also from storm water.

The liquid waste from industrial areas is called domestic sewage and that from industries are called industrial sewage.

(b)Garbage: It includes all types of solid and solid waste, food products such as vegetables ,peelings of fruits, waste meat etc.

(c)Refuse:It includes all kind of dry waste of community .ie,street and house sweepings, garbage ,ash etc

(d)Sullage:It is the waste water from bath rooms,kitchens ,wash basins etc.Which is less offensive in nature including storm water .It does not include more offensive and nuisance causing faecal matters from lavatories ,waste water from urinals ,stables etc and industries.

4.Factors affecting dry weather flow:

Dry weather flow is the average discharge of sanitary sewage that flows in a sewer during the dry weather.It has three components in it,namely domestic sewage,industrial sewage ,ground water infiltration.It represents in lpcd and depends on the following factors.

- Rate of water supply:

Generally ,80% of the water supply may be expected to reach the sewers unless there is data available to the contrary.But it is assumed that D.W.F is equal to the rate of water supply.Industrial and commercial buildings are often use water other than from the municipal supply and more often discharge their liquid wastes into the sanitary sewers.In such cases deviations from the general values may occur and estimates of such flows have to be made seperatly.It is however ,desirable that when the industrial waste is fairly large ,it is segregated and disposed of in a suitable manner treated suitably before discharge into sewers.

- Population:

The total quantity of water required by community is the product of population and rate of consumption.Hence population has to be estimated at the end of the design period and that value has to be taken for design purposes.

- Types of area:

TheD.W.F depends on the type of area whether,a)residential,b)Industrial,c)Commercial

- Infiltration of ground water into sewers:

Ground water infiltrates into the sewers through leaky joints.Infiltration depends on nature of soil,sewer material,water tightness of sewer joints,depth at which sewer is laid.

The infiltration is generally expressed in litres per km length of sewer per day and may vary from 2800 to 140000.

- Exfiltration:

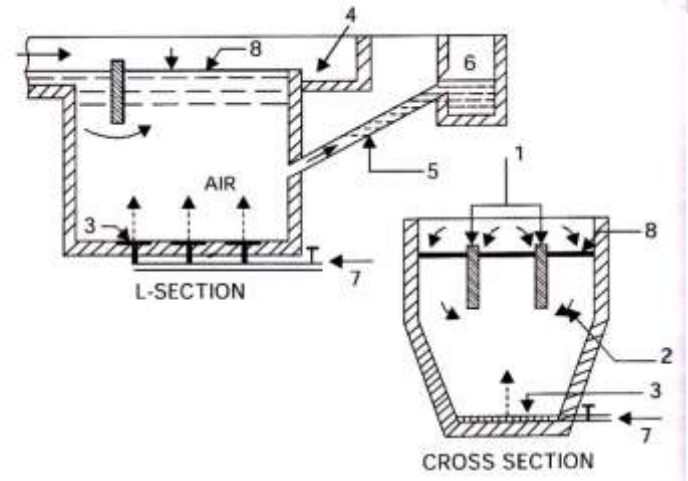
  The leakage of sewage from the sewer into the surrounding soil is called exfiltration.This has to be avoided because it pollutes ground water.So the joints of sewers should be mai\s\de water tight.

5.Skimming tanks:

Objects:It is a chamber in which the floating substances like oil,fat,grease etc is separated and removed.The sewage from hotels ,kitchens,garages,soap factories etc.contains a considerable amount of oils ,grease,fats which interfere with biological actions in treatment units.Hence it is necessary to remove them.This is a preliminary treatment process.

Working:

The skimming tank consists of a chamber into which the sewage is allowed and detained for about 3 minutes and skimmed or agitated by sending compressed air through air diffusers located at the bottom.Now the oils,fats and greases whose specific gravity is less than one,are separated from the water and they float to the top surface.The floating substances are now collected in the outlet channel and then removed.



SKIMMING TANK

6.Sludge:Sludge is thick mud,sewage or industrial waste.All dumping of sludge will be banned by 1998.

Sludge digestion:

Sludge digestion is the process of decomposition of organic matter under anaerobic condition.The anaerobic digestion is employed not only for the treatment of organic sludge but also for different types of concentrated organic wastes. The two basic processese involved in anaerobic digestion are liquefaction and gasification.Thus the sludge is finally splitup into three components namely solid digested sludge,supernated liquor,biogas containing methane carbondioxide ,hydrogen sulphide etc which can be used as fuel.

The primary sludge and secondary sludge are digested anaerobically in a sludge digestion tank.

Sludge digestion tank is an RCC cylindrical shaped tank with hopper bottom.The top is covered with a floating steel drum to collect the gas.The raw sludge from primary sedimentation tank and secondary sedimentation tank is pumped into the sludge digestion tank.Initially the digester can be seeded with previously digested sludge for effective and immediate starting of the anaerobic process.The tkme required for the digestion depends on temperature,pH value ,seeding mixing and stirring of the sludge in digester.

7.Sedimentation:

Most of the suspended particles in water have specific gravity more that of water.They are kept in suspension because of velocity and turbulence.They slowly settle down to the bottom as soon as the turbulence is reduced by offering storage or lowering the velocity.The process of settling the suspended solids by virtue o gravity is called sedimentation.This can be by two methods namely s=plain sedimentation and sedimentation aided with coagulation.

Plain sedimentation:

In plain sedimentation,suspended particles in water are permited to settle only by gravity.No chemicals are used in this to promote settling.

Water is allowed through inlet into the tank called sedimentation tank and retained for certain period ,so that particles having specific gravity more than 1.2 settle to the bottom.

The particles are under the influnce of two velocities .ie,(1)Horizontal velocity component due to flow o water,(2)Vertical velocity component due to gravity.Consequently particles move with a resultant velocity along the diagonal direction and settle to the bottom before reaching the outlet.Thus the suspended particles are removed.The settling velocitu of particles depends on the following factors:

1.Horizontal flow velocity of water.

2.Size and shape of particles.

3.Specific gravity of particles.

4.Viscosity of water which is temprature dependent.We have little control over the temperature in treatment plants.

“The size and shape of the particles” play a decisive role in the sedimentation.Assuming that the particles are of spherical shape,it can be seen that their weight and volume ($4\pi r3/3$)vary as the cube of their diameter.

The velocity of flow can be reduced by increasing the area of flow and thus the part icle will remain for more time and try to settle.The size of the particle can be increased by adding certain coagulants and thus vary fine particles can also be settled.

PART C

III.(a) Factors affecting per capita demand:

The per capita consumption depends on many factors.These factors are to be suited careully before arriving at the rate of demand for a particular locality.Following are the factors which influence the rate of demand.

1.Social and economic status of consumer:

The people with high social and economic status have better standards of living and consume more quantity of water for kitchen use and bath,sanitary use,cloth washing gardening,floor washing ,cleaning cars etc.Middle class people consume moderata amount of water,while the poor slum dwellers consume very less quantities.The consumption also depends on the unique habits of the people of the locality.

2.Climatic condition:

The consumption o water is generally more during hot and dry climates because of increased use for bathing ,air cooling,drinking,sprinkling lawns ,gardens and roofs etc.On the other hand it is extremely cold weather ,water may be wasted because of keeping the taps in open condition to avoid freezing of pipes.

3.Industrial and commerce:

The consumption is more in the towns of increased industrial and commercial activities.For properly planned and zoned cities ,the requirements can be assessed more accurately by estimating the industrial and commercial demands separately.

4.Quality of water:

If the quality is good ,consumption will be higher ,as the people tend to use more water and also avoid other sources like private wells ,hand pumps etc.

5.Systems of supply:

The consumption is generally more in continuous system ,in which water is made available throughout the day.It is less intermittent system in which water is supplied during fixed hours of the day.However much water is wasted even in intermittent system for the following seasons.

- Water taps are kept open during non supply hours and when supply starts ,water flowing through taps is unattended, resulting in wastage of water.
- The tendency of people to throw away previously stored water as soon as fresh supply is restarted.

6.Pressure in distribution system;

Consumption increases with the increase in distribution pressure ,causing higher rate of flow and availability of water to the upper floors.

7.Policy of metering:

If metering is introduced ,the consumer will be more cautious in using water and consequently there will be less wastage. Thus per capita consumption will also be less.

8.Cost of water: If the water rate are high, lesser quantities may be consumed by the people.

9.System of sewage collection:

The per capita demand is more ,for the towns provided with water carriage system, due to increased use for flushing water closets etc. Consumption is less in conservancy system.

10.Size of the city:

Generally the rate o demand is low for smaller cities. But even for small towns, having water consuming industries, the demand is more.

(b)Infiltration galleries:

Infiltration galleries are the horizontal tunnel like wells constructed in the open cut 3 to 4m deep along the banks or in the bed of the rivers. The galleries are covered with masonry arches of RCC slabs. The side walls are provided with number of deep holes. The spaces between sides of the trench and wells are filled with graded gravel and pebble stones to increase the intake capacity. The floor is provided with longitudinal slope. Water is collected in the sump constructed at the end and pumped out.

The yield may be as much as $1.5X10^4$lit/day per meter length of the gallery.

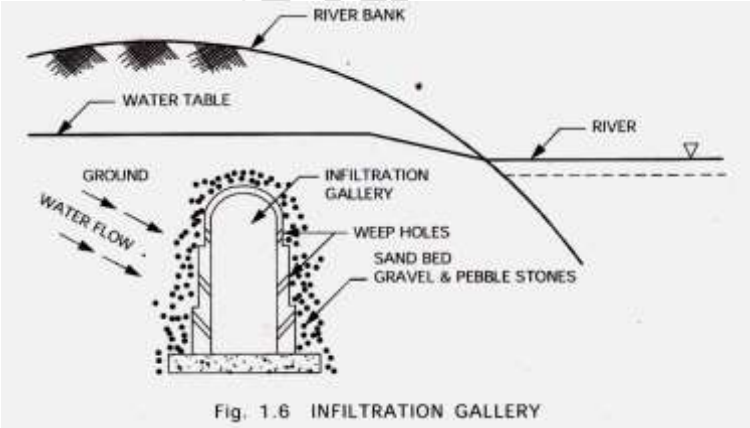
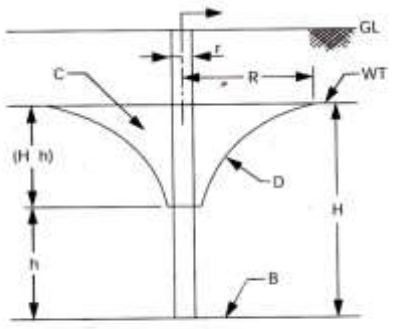


Fig. 1.6 INFILTRATION GALLERY

(fig)

IV.(a)The yield of the water is defined as the amount of water flowing into the well per unit time and is expressed in lit/min(lpm) or m^3/day.



WT - WATER TABLE
C - CONE OF DEPRESSION
D - DRAW DOWN CURVE
B - BOTTOM OF WELL

HYDRAULICS OF GRAVITY WELL

1.Speciic yield:

It is defined as the yield per unit draw down ,ie, yield per one meter draw down.ie,yield per one meterdraw down.

2.Cone of depression:

When pumping is done ,water is drawn from the surrounding water table from all directions.The water table which was originally horizontal all around the well,is now depressed into the shape of the surface of an inverted cone which is known as cone o depression.

3.Draw down:

The depth of depression below horizontal plane of water table is called the draw down.In other words it is the difference o water level in the well before and after pumping.Draw down is also called “Depression head” or “Infiltration head”

4.Circle of Influence:

The base of the cone of depression at the top is a circle and this circle is known as circle of inflence.The radius of this circle is called radius of influence.In other words this is area within which the water table is affected due to pumping.Any other well should not be constructedwithin the circle of influence so as to avoid the interference.This phenomenon of intersection of circle of influence is called “interference of wells” shall be avoided so that the yield of well is not affected when other well is pumped.

5.Critical depression head:

The yield of the well increases as the draw down increase.But there is a limit to it and after certain draw down is reached,the velocity of water entering the well disturbs soil particles.This limiting value of the draw down or depression head is called critical depression.The critical depression head depends on nature of soil.The corresponding velocity is called critical velocity and the yield Critical or Maximum yield.

6.Yield of a gravity well:

The formula for flow into the well is obtained by assuming that all the water pumped from the well passes through a succession of cylinders having diameters varying from r and the height varying from h to H.

$$Q=\frac{1.36P(H^2-h^2)}{\text{Log}_{10}R/T}$$

7.Yield for artesian or pressure wells:

The steady flow equilibrium condition is cosidered in the case of confined aquifer.The formula for yield is ,

$$Q=\frac{2.73Pt(H^2-h^2)}{\text{Log}_{10}R/r}$$

Method of determinig yield of a well by pumping test:

The test involves pumping water rom the well at such a rate as to maintain the constant draw down.First,water level is lowered down by heavy rate pumping till maximum working head is reached.The rate of pumping is then slowly adjusted so that water

level in the well remains constant for a considerable period.Now the actual yield of the well is equal to the rate of pumping.The test requires a variable pump,whose rate of pumping can either be lowered or raised.

(b) Parts of reservoir intake:It consists of a circular well constructed in masonry or concrete.The intake pipes covered with screens,are located at different levels, to draw clear water devoid of floating matter.Valves are fitted to the intake pipes to control the entry of water.The pipe just below the existing water level in the reservoir is opened and the other pipes are closed at any time,to avoid high entryvelocities due to the large heads.Water is collected in the intake ipes,and then conveyed by the gravity.A gangway connects the top of dam and control the room over the well.The valves are operated from the control room.

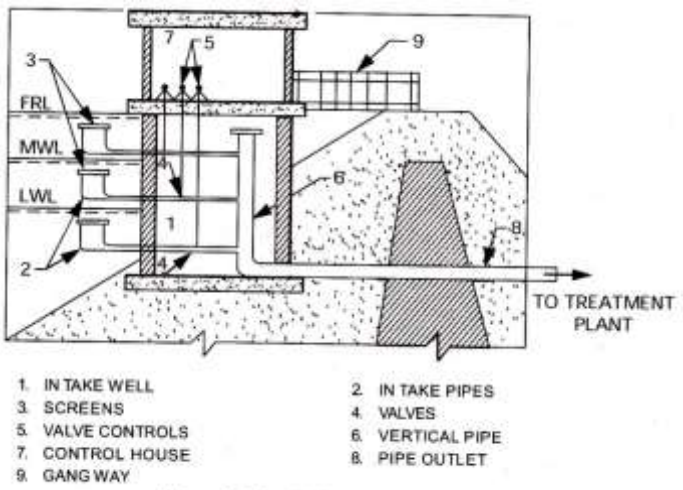


Fig. 1.16 RESERVOIR INTAKE

UNIT II

(a)The following tests are perormed during water analysis.

I. Physical test
II. Chemical test
III. Bacteriological test

Chemical Test:Generally the following tests are conducted to determine chemical characteristics.

- Total solids:These includes the solids in suspension,colloidal and dissolved form.The quantity of suspended solids is determined by filtering the sample through a fine filter and then weighing the dry residue left.The quantity of dissolved and colloidal solids is determined by evaporating the filtered sample and weighing the residue. Sum of the suspended solids ,dissolved and colloidal solids gives the value of the total solids. The solids in water should be preferably less than 500mg/l and should not exceed 1000mg/l. To find the organic solids, the sample is evaporated first, residue weighed and then fused in muffle furnace. The organic matter is ignited leaving behind only inorganic matter. The difference between initial weight and the weight of inorganic matter gives the weight of the organic matter.
- Hardness:Certain material in water react with soap causing precipitation.This precipitate appears as a scum.No lather can be formed untill enough soap has been dissolved to react with all the materials.The characteristic of water which prevents lathering of soap is called hardness.It is of two forms,temporary and permanent hardness.Temporary hardness is caused by bicarbonates of calcium and magnesium.It is removed by simple boiling.It is also called Carbonate hardness.
  Permanent hardness ,also called non carbonate hardness is caused by chlorides ,sulphates and nitrates of calcium and magnesium.
  Hard water consume more soap and hence not suitable or laundries.Hard water is also unfit for usage in boilers as it causes boiler scales.Hardness can be found by soap test.The standard soap solution is added in the sample of water and the mixture is agitated vigorously.Five minutes are allowed for lather formation. The difference of total amount of soap solution and lather factor gives the hardness. At present hardness is generally determined by Versenate method also called EDTA method, which is more accurate. In this method the sample of water is titrated against EDTA or its sodium salt , until wine red color changes to blue. Eriochrome Black –T is used as an indicator in this test. If the total hardness of water is greater than its total alkalinity , the carbonate hardness will be equal to total alkalinity.
- Chlorides: They are present mostly in combination with sodium and to a less extent with calcium and magnesium. These are most stable components. Water with excess of chlorides is not suitable for heart and kidney patients. The presence of chlorides may also be due to the mixing of sewage and saline water. The clorides can be determined by titrating water with Silver Nitrate and Potassium dichromate. The method is called Mohr's method. Chloride content of treated water should not exceed 250mg/l.
- Flourides: It may occur naturally in water or may be present in water due to pollution by industrial wastes. Flourides upto 1mg/l in drinking water is beneficial and safe as they reduce dental decay. But if the concentration exceeds 1.5mg/l ,disfigurement involving unsightly staining of the teeth called, mottled enamel of teeth or even skeletal damage in both

children and adults, called Flourosis are caused. Hence it is necessary that flouride levels have to be closely controlled. Concentration of flouride is found by colourimetric method using zirconium SPADNS solution.

- pH value :It is hydrogen ion concentration and it is a measure of acidity or alkalinity in water.pH value is conveniently defined as the logarithm of the reciprocal of hydrogen ion concentration in water.It vary between 0 and 14.The value in the range 0 to 7 indicates the acidity and that between 7 and 14indicates alkalinity. The neutral water has a value of exactly 7.
  pH values are determined either by colourimetric method or potentiometric method.In colourimetric method,water sample is added with colour indicator and then compared with standard colours of known pH value.
  The potentiometer measures the potential exerted by Hydrogen ions and thus indicates their concentration.Now a days,digital pH meters are also available by means of which the direct readings can be taken quickly.
- Lead and arsenic:These are usually not present in natural waters.But these may mixed up in water from lead pipes or from tanks applied with lead point.These are highly poisonous and dangerous to thehealth of public.
- Dissolved gases:It is the test to find out the amount oxygen,nitrogen and residual chlorine.

Bacteriological tests:The examination of bacteriological impurities is the most important one from public health point o view.Diferent types of microorganism may be present in water of which may of them are harmless to the mankind.But some species are harmful as they causes diseases.To conduct bacteriological examination in Environmental Engineering laboratories the following equipment is required.

- Microscope
- Inccubator
- Cooled incubator
- Hot air oven
- Auto clave
- Balance
- pH meter
- colony counter
- Centrifuge
- An Laboratory glass ware
  In bacteriological analysis the following tests are done.

1.Total count method:

It provides an estimate of total number o bacteria in a water sample.A known volume of sample is allowed to spread over a petridish containig sterilized agar medium.The petridish is then incubated for 24 hours at 37^{o} C temprature during which the bacteria multiply and orm visible clusters or colonies which can be counted under a colony counter.This number is multiplied by dilution ratio to get the bacteria stength in a given sample.

2.E-coli test:

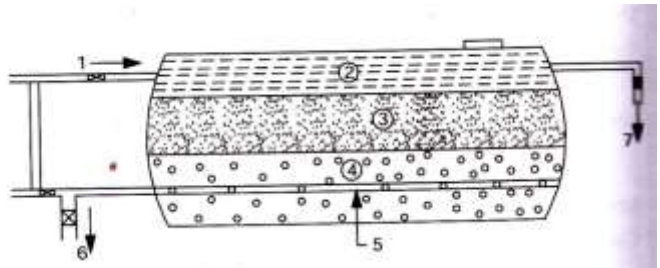
Escherichia coli are the bacteria belonging to the coli-aerogens group which will be present in the intestine of all wam blooded animals including human beings.They jelp the digestive process and are harmless.They are excreted along with faecal discharges.If these organisms are detected in water samples, it is to be understood that the water is polluted with faecal discharges and sewage.When once sewage pollution takes place ,there is every possibility that the water may contain other pathogenic organisms also.Thus this test is very significant in the bacteriological analysis. The test is conducted in three stages.

- Presumptive test
- Confirmed test
- Completed test

(b)Features and Operation of pressure filter:

They are similar to rapid sand filter,but in the case water is filtered under pressure greater than that of atmosphere.Pressure is about 3 to 7 $kg/cm^2$and is developed by pumping.

It consist of a closed horizontal or vertical steel tank in which filter medium ,gravel bed and under drainag system are provided.The diameter of tank varies between 1.5 to 3m and length between 3.5 to 8m.The water mixed with coagulant is directly fed ti the filter.Filtered water is collected through under drainage system.When filter is clogged,it is cleaned by back washing.The rate of filteration is very high and is about 6000 to 15000 $1/hr/m^2$ of filter area.The efficiency of removal of suspended matter and bacteria is very low and hence not suitable for treatment of public water supply.However,they are suitable for treatment in swimming pools ,industrial plants etc.



1. INLET VALVE
2. WATER TO BE FILTERED
3. SAND BED
4. GRAVEL BED
5. CENTRAL DRAIN
6. FILTERED WATER
7. TO WASH WATER DRAIN

PRESSURE FILTER

UNIT VI.

(a)Advantages and disadvantages of intermittent and continuous system:

This classification of system is made depending upon whether water is supplied continuously or during fixed hours of the day.

Continous system:

In this water is supplied continously throughout the day.This is a better system than the other and should be adopted as far as possible.

Advantages:-

- As water is continously circulating,it is fresh;and is not polluted because the pollutants cannot so easily enter the pipelines as there is internal pressure.
- The storage of water in containers ,susceptible for pollution ,can be avoided.
- Water will always be available for fire fighting purpose.
- Water need not be stored in containers.
- Consumers use more water for washing water closets and cleaning floors etc.and hence more sanitary and hygienic condition can be maintained.
- Use of air relief valve,pressure relief valves can be avoided as there is a continous circulation of water in the pipes.
- Because of uniform distribution throughout the day,the rate of low is smaller compared to the intermittent system and hence smaller diameter pipes are sufficient,thus reducing the cost of pipes.

Disadvantages:-

- There is a possibility of using more water than what is actually needed by the consumers.Thus wastage of water is more .This can be checked by introducing metering policy.
- The quantity of water wasted due to leakage etc.in the pipe lines will be more.
- On the whole,it is a costly system.

Intermittent system:-

In this system ,water is supplied to the public,only during fixed peak hours of the day.During the remaining period,the supplyis cut off.

Advantages:-

- The supply can be made to high level areas with sufficient pressure ,by zoning the city.
- Repair works can be easily taken up during non supply hours.
- Wastages can be avoided as consumers are compelled to use carefully,the small quantities of water which they store in containers.However there is a possibility of wasting water water due to opening of taps during non supply hours and unattended to during supply hours.
- It is relativly a cheaper system and hence being adopted widely in our country.But it is not advisable to continue this system as long term policy.

Disadvantages:-

- Though this system is intended forminimizing wastages.It is not often achieved because of the following taps opened during nonsupply hours.Further there is a tendancy of people to throw away water collected in the containers in the in their absence.
- It does not cover fire riska during non supply hours and thus bring about huge loss to lie and property.
- It is an inconvenient system for the people as they have to eagerly wait for the supply.
- As the complete demand has to be met within the limited hours,capasity of pumps and sizes of the pipes are larger.
- Number of air relief valves and pressure relief valves have to be installed and operated regularly.
- During non supply hours,partial vaccum may be created leading to the suction of waste water from outside,thus contaminating the pipe lines.
- Possibility of contamination of water stored in containers is more.

(b)Grid Iron System:

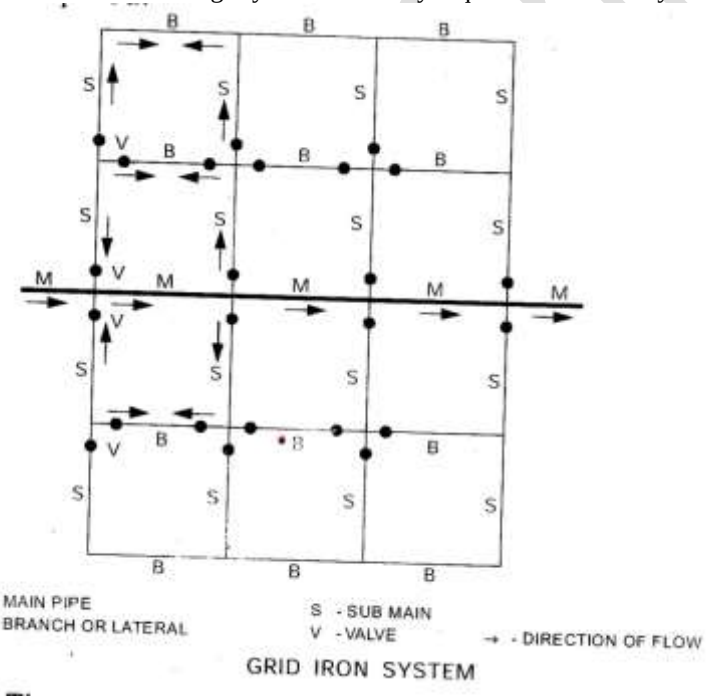
Depending on the method of layout of the pipelines distribution systems are classified into many types. One of them is Grid Iron System.This system is also known as Interlaced system or Recticulations. In this system, the mains ,submains and branches are interconnected with each other. The water circulates freely throughout the system. This system is suitable for well planned towns and cities with a regular grid of main roads and cross roads.

Advantages:

- There are no dead ends and hence stagnation of water and its consequences are eliminated.
- In case of any breakdown or repair for any main or sub main ,water supply need not to be stopped to that area, as it can be made available from an other main or sub main.
- In case of fire ,large quantities of water can be drawn from all directions.
- Since water reaches every point from more than one route,the frictional losses and the sizes of pipes can be reduced.

Disadvantages:

- More number of valves and longer lengths of pipes are required. At every junction four valves are required.
- The overall cost is more.
- Design calculations are slightly tedious as they require network analysis.



(fig)

UNIT III

VII.(a)There are mainly two system of sewage collection and disposal.

1)Dry or conservancy system

2)Water carriage system

In water carriage system, we have water closets provided with flushing arrangements. The faecal matter is flushed with sufficient quantity of water. Thus water is used as a medium for conveying sewage through under ground sewers. Finally this sewage is treated and then disposed by sufficient methods.The dry refuse is collected by bin system and then disposed by proper method.

Advantages:

- It is a hygienic and decent system.
- Faecal matter is immediately flushed into the sewers and hence no possibility of bad smell and fly nuisance.
- The sewage is properly treated and then disposed; as such there is no risk of epidemics.
- No changes for ground water pollution.
- Sullage is also carried through sewers and hence no chance for installation unlike open drainage system.
- No involvement of human agency in the collection, conveyance and disposal.
- The treatment plant yields solid component which can be used as good manure; a liquid component is useful for sewage farming and gaseous component is useful as fuel.
- The water-closets can be attached to living rooms and hence of building.
- Requires less area of treatment and disposal
- On the whole , it is a modern ,decent,aesthetic hygienic and scientific system and deserves adaptation.

Disadvantages:

- Its initial cost is high
- It may require pumping of sewage at certain stages.
- It requires skilled supervision and maintenance.

(b)The sewerage systems are classified into the following types.

- Combined system
- Separate system
- Partially separate system or partially combined system

Combined system: In this, only one set of sewers is laid which carry the domestic and industrial sewage and also the storm water.

Suitability: The system is suitable for areas with small and evenly distributed rainfall. It is suitable for situations where the combined sewage has to be pumped and also for heavily bsuilt up areas with a little space for laying sewers.

Merits:

- Strength of sewage is less due to dilution by storm water and thus treatment is easier.
- Sedimentation of solids in sewers is avoided as the discharge in the sewer is more.
- Cleaning of sewer is easier ,because of bigger size.
- Easy to lay only one larger sewer in congested areas and plumbing is also easy.
- Simple and economical method.

Demerits:

- Cost of excavation for a larger sewer is more.
- Pumping of combined sewage is uneconomical.
- During heavy rains, the over flowing of sewers will cause pollution.
- Possibility of silting during dry weather due to sluggish flow.
- Initial cost is more.

Partially separate system:

In this, there two separate sets of sewers. One set carries domestic and industrial sewage and also a part of storm water during heavy rains. The other set carries only storm water during normal rains.

Suitability

As it is a compromise between combined system and separate system ,it is suitable for situation with average condition of distribution and intensity of rainfall and occasional heavy rains.

Merits:

- It is an economical system and provides reasonable sizes of sewers.
- House plumping is simple.
- As a part of rain water is allowed into the sewer carrying sewage, necessity of flushing is reduced.

Demerits:

- Self cleansing velocity may not be developed during dry weather
- Cost of pumping is more.
- There are possibilities of over flow.

UNIT VIII

(a)Circular sewer:

It is the most commonly used section for sewers. It is suitable for diameter up to 1.5 m. It can be constructed either by special wedge shaped bricks in mortar or by

Plain or reinforced concrete. Smaller diameter pipes may be of stone ware or cast iron or other materials. The inside surface has to be made smooth by plastering .The circular type sewer

Merits:

1. For running full and half full conditions, it gives maximum hydraulic mean depth for the given area. Hence the maximum velocity is maintained compared to other sections, preventing deposition of solids.

2. Economical in construction

3. Easy to construct

4. Suitable for separate sewerage system where discharge is almost constant

Demerits:

1. Its performance is poor in combined system because of low DWF and consequently low velocity

2. Construction may be difficult in the case of masonry circular sewers.

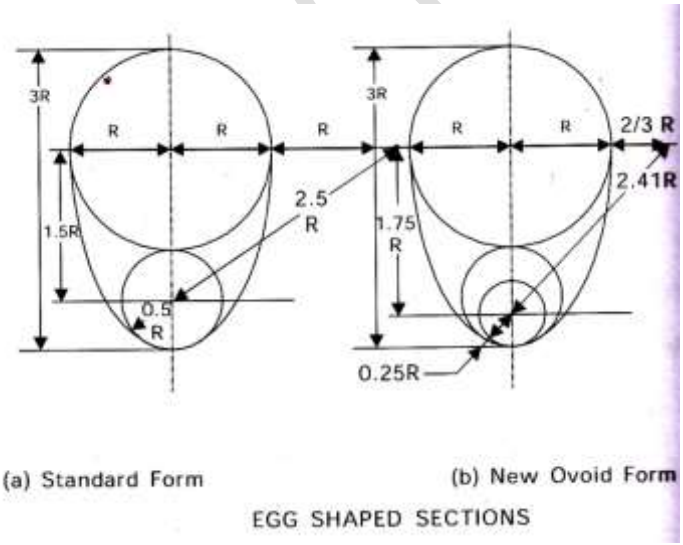
Egg shape section:

Essentially there are two types namely

a. Standard egg shape and

b. New ovoid shape.

The two forms are shown in fig. 3.9. they are constructed with R.C.C. masonry at site. New ovoid shape is an improvement over standard egg-shaped section.



EGG SHAPED SECTIONS

Merits:

1.Self cleansing velocity will be available even during small discharges.

2.Suitable for combined sewerage system as well as separate system.

3.Better hydraulic properties compared to circular sections.

Demerits :

1.Construction is difficult.

2.Less stable than circular sections.

(b)Drop manhole:

Manholes are masonry or RCC chambers constructed on sewer lines or drains for providing access to men so that they can attend to inspection,cleaning,maintanance of sewers.

They are constructed at the points where a sewer takes change of (a)alignment,(b)gradient,(c)diameter and (d)at all junction of sewers.The distance between them varies 30 to 100m. Objects of inspection are ,

I. For inspection, cleaning and maintenance
II. To facilitate junctions and change of directions
III. Incidentally to help ventilation through they are not specifically meant for it.

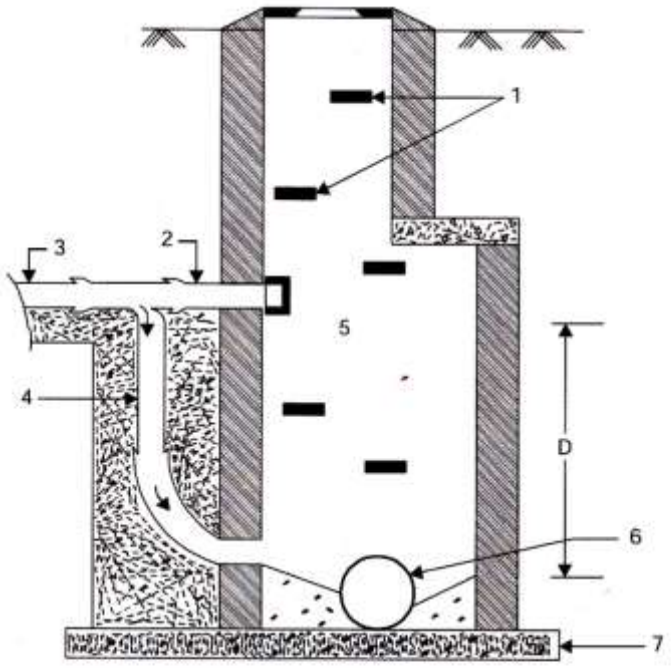
Generally manholes are of two types.

1.Ordinary man hole

2.Drop man hole

Drop man hole:

The drop man hole is constructed when a branch sewer which is at a higher level is to be joined to main sewer at a lower level.This is done by providing a vertical drop pipe outside the man hole so that the sewage from an inlet sewer at a higher level is dropped through this pipe to the floor level.Otherwise the sewage will splash on to the man working inside the man hole.The other constructional details are similar to that of ordinary man hole.

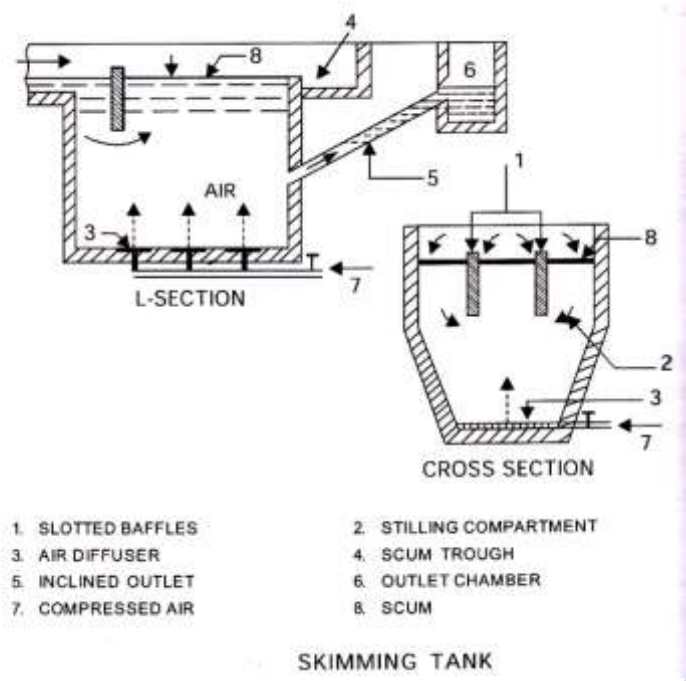


1. CAST IRON STEPS
2. INSPECTION ARM
3. BRANCH SEWER
4. VERTICAL PIPE
5. WORKING CHAMBER
6. MAIN SEWER
7. CONCRETE FOUNDATION

Fig. 3.12 DROP MAN-HOLE

IX(a)Flushing tank:

A flushing tank is device which holds and then quickly releases periodically sufficient quantity of water in to the sewer so that the deposited solids in the sewer are flushed and washed away.Thus it prevents the chances for clogging the sewer.



(Fig)

It consists of a concrete chamber fitted with a U-tube acting as a syphon and inverted bell with a sniff hole.The tank receives water from a tap which is regulated as per the design depending on the period between successive flushings .The discharging leg of the pipe is connected to the sewer. An over flow pipe is also fitted.

As the water rises in the tank some air is entrapped in the bell and further rise in the water level compresses the air inside. It is so designed that when water reaches the over flow level, symphonic action starts automatically and water is quickly released into the sewer causing flushing. The water level now falls to the level when sniff hole is exposed. Air enters through sniff hole and stops symphonic action. Thus the flushing ceases. This processes repeated effecting automatic periodical flushing of sewer.

(b)sources of air pollution:

1.Natural sources

The following are the natural source of air pollutions

a) Electrical storms producing oxides of Nitrogen.
b) Volcanic disturbances contributing hydrogen fluoride, hydrogen chloride,etc.
c) Volcanoes releasing sulphur dioxide, hydrogensulphide etc, these gases are also formed due to the action of sulphur bacteria and ozone photo chemically or by electrical discharge.
d) Wind blowing, causing the spread of dust particles, bacteria, spores and pollen from flowers.
e) Aerosols of natural origin by volcanic action,smoke of forest fires.
f) Radioactivity of the atmosphere due to radio active minerals in the earths crust and the action of cosmetic rays.
g) Natural chemical reactions, bio-chemical reactions releasing carbon dioxide, Hydrogen sulphide etc. into the atmosphere.

2.Man made sources:

These sources are produced by the direct and indirect acts of man.The main sources are summarised as follows.

a) The combustion of fuel to produce energy for heating and power.This is carried out mostly in industrial,commercial and domestic premises.Huge quantity of smoke is produced which may contain carbon dioxide ,Carbon monoxide,Sulphur dioxide,Nitrogen oxide etc.
b) The exaust emission from transport vehicle that use petrol,diesel locomotives ,ships and aero planes.Particularly,the exaust gases from automobiles are posing treat to the air quality.They may result in the formation of Smog seriously affecting the visibility and causing related problems.

c) Waste gasses, dust particulate matter and heat from many industrial areas, including chemical manufacture ,iron and steel melting work ,Cement and brick manufacture ,quarries, rise mills, electric power generating stations. These waste gasses include carbon monoxide, Hydro carbons, Sulphur dioxide, Nitrogen monoxides , Nitrogen dioxides, Nitrogen trioxides etc.depending on manufacturing processes.

Ill effects of air pollution on human health:

- Increased symptoms in cardiac and pulmonary diseased patients when sulphur dioxide concentration exceeds 500µgm^3 for 24 hours.
- CO seriously reduces the transfer of oxygen to the tissues when inhaled.The CO combines with haemoglobin of the blood andproduce carboxy haemoglobinin the blood and impairs the transfer of oxygen ,if the level of it reaches 20%.Head ache and lassitude have been reported at 10% level.
- CO_2 at high concentrations can cause death. Its concentration can be reduced by growing plants , which use CO_2 in photosynthetic process for the preparation of carbohydrates required by them.
- Serious odour problems are caused by the emission of hydrogen sulphide by certain industries like Kraft paper ,oil refining industries etc
- Nitrogen dioxide (NO_2)causes respiratory illness in children.
- Photo chemical oxidants above 500 µg/m^3 may cause asthmatics attacks in people. Decreased performance of athlete above 200 µg/m^3 is observed. They also cause irritation of eyes ,nose and throat.
- In general, the air pollution causes increased rate of lung diseases ,cancer ,bronchitis ,mental depressions etc.

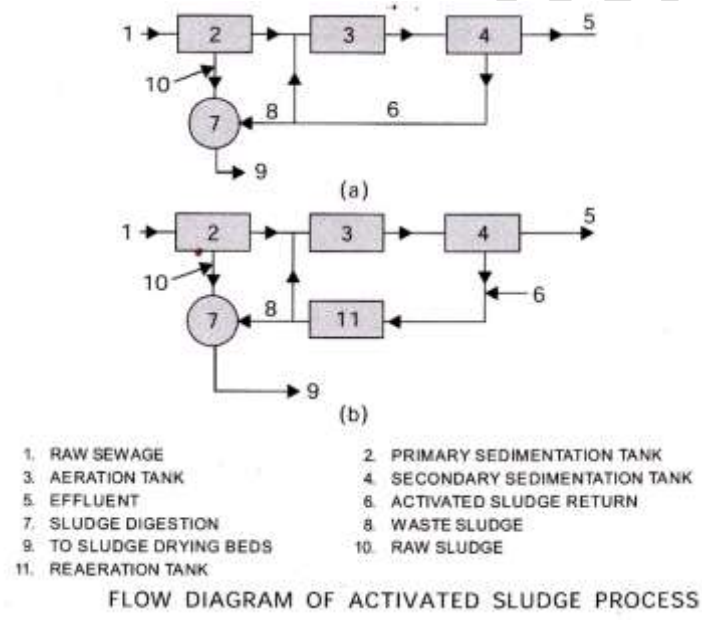
X(a)Activated sludge process in sewage treatment:

This is based on "Suspended growth process " in which an adequate biological mass in suspension within the tank, is maintained by either natural or mechanical mixing. Activated sludge process is an improved method of secondary treatment of the effluent from primary sedimentation tank. The sludge of the sewage which is previously agitated under aerobic conditions containing full of aerobic bacteria is called activated sludge.

In the activated sludge process the primary effluent is mixed with activated sludge and then aerated so as to oxidize the organic matter and convert it into settleable flocs.These flocs can be removed in the secondary sedimentation tank.

Construction and operation:

The conventional activated sludge process consists of a rectangular tank 3 to 4.5m deep,and about 6m wide and 10 to 20 m long.This tank has an arrangement of sending diffused air from bottom or mechanical agitators.



FLOW DIAGRAM OF ACTIVATED SLUDGE PROCESS

The primary effluent is mixed with a portion of returned sludge(activated sludge)and then allowed into the tank. This mixed liquor is then aerated or mechanically agitated in the presence of air. The aerobic bacteria kept in suspension oxidize the sludge. The oxidized sludge is withdrawn and send to secondary clarifier for sedimentation. The operation is a continuous process. The recycling of the returned sludge is shown in the fig.

Advantages of activation sludge process:

- High efficiency in the removal o BOD and solids by about 90%.

- Free from fly nuisance and bad smell
- Area required for construction is small.
- Initial cost is less.
- Loss of head in the process is small.

Disadvantages:

- Operational cost is high
- Skilled supervision is necessary
- The change in the quality of effluent upsets the process.
- Large volume of the sludge is produced.

(b)Functions of state pollution control board regarding water:

I. To plan a comprehensive program for the prevention ,control or abatement of pollution of streams and wells in the State and to secure the execution there of;
II. To advise the state Govt.on any matter concerning the prevention ,control or abatement of water pollution;
III. To collect and disseminate information relating to water pollution and prevention, control or abatement thereof;
IV. To encourage, conduct and participate in investigations and research relating to problems of water pollution and prevention control or abatement of water pollution;
V. To collaborate with the Central Board in organizing the training of persons engaged or to be engaged in the programmes relating to prevention ,control; or abatement of water pollution and to organize mass education programmes relating thereto;
VI. To inspect sewage or trade effluents ,works and plants for the treatment o sewage and trade effluents and to review plans, specifications or other data relating to plants set up for the treatment of water works for the purification thereof and the system for the disposal of sewage of or trade effluents or in connection with the grant of any consent as required by this act.
VII. To lay down, modify or annual effluent standards for the sewage and trade effluents and for the quality o receiving water resulting from the discharge of effluents and classify waters of the state;
VIII. To evolve economical and reliable methods of treatment of sewage and trade effluents, having regard to the peculiar conditions of soil,climate and water resources of different regions and more especially the prevailing flow characteristics of water in streams and wells which render it impossible to attain even the minimum degree of dilution.
IX. To evolve methods of utilization of sewage and trade effluents in agriculture.
X. To evolve efficient methods of disposal of sewage and trade effluents on land, as are necessary on account of the predominant conditions of scant stream flows that do not provide for major of the year the minimum degree of the dilution.