Sem- VI civil

Environmental Engineering – I

15/12/2017

Q.P code 26324

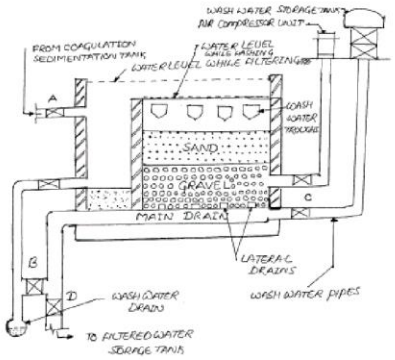
Q1

a
- To supply safe and wholesome water to consumers
- To supply water in sufficient quantities
- To supply water at convenient points and timings
- To supply water at reasonable cost to the users
- To encourage personal and house hold cleanliness of users

b physical characteristics 1. Turbidity 2. Colour and temperature 3. Taste and odour

Chemical : total solids, PH value, Hardness of water, Chloride content etc

c



d

Municipal Solid wastes: Solid wastes that include household garbage, rubbish, construction & packaging materials, trade refuges etc. are managed by any municipality.

Bio-medical wastes: Solid or liquid wastes including containers, products generated during diagnosis, treatment & research activities of medical sciences.

Industrial wastes: Liquid and solid wastes that are generated by manufacturing & processing units of various industries like chemical, petroleum, coal, metal gas, sanitary & paper etc.

Agricultural wastes: Wastes generated from farming activities. These substances are

mostly biodegradable.
Fishery wastes: Wastes generated due to fishery activities.
E-wastes: Electronic wastes generated from any modern establishments. They may be described as discarded electrical or electronic devices. Some electronic scrap components, such as CRTs, wires, circuits, mobile, computers etc.

Q2

a For water supply scheme, when water withdrawn from surface source then the construction called intake structure is provided to draw/collect & drain/discharge water into the intake pipe from the source.

Types of intake structures: reservoir intake structures, river intake structures, canal intake structures, lake intake structures

1

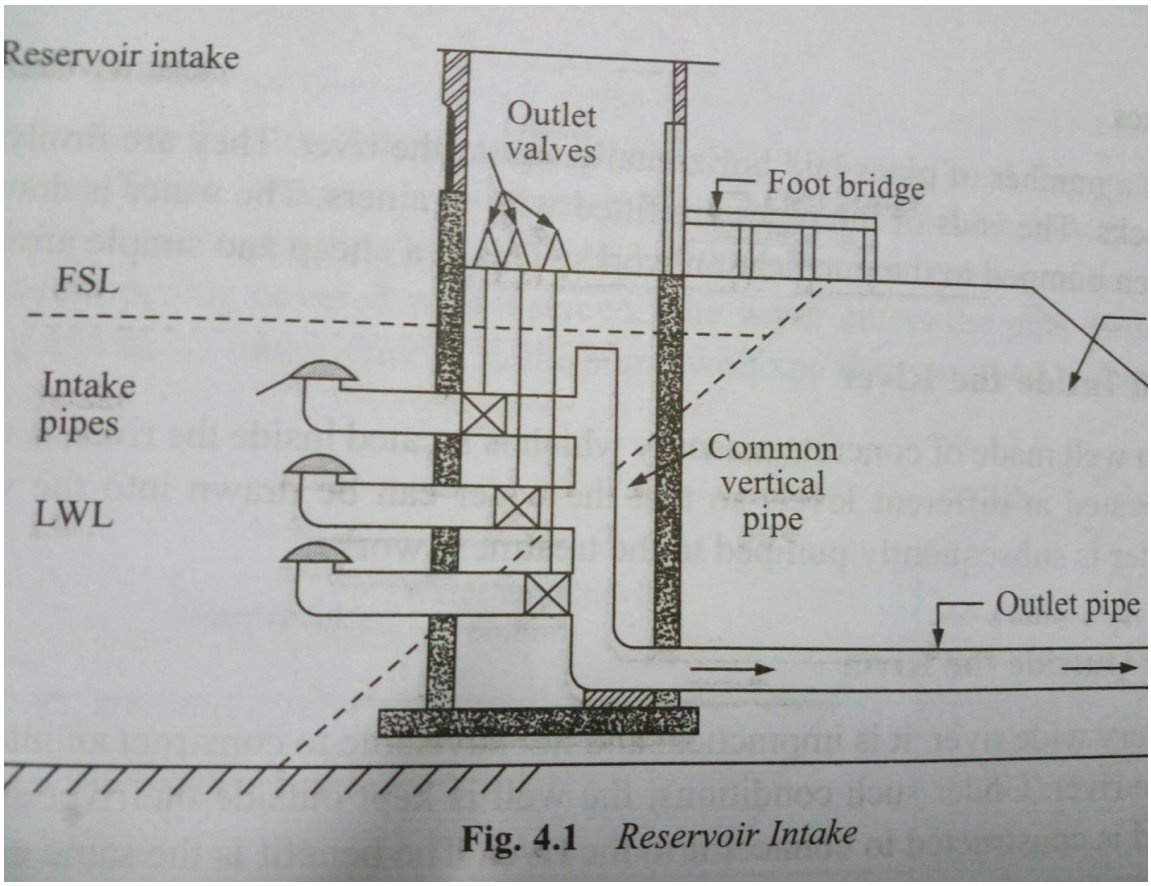


Fig. 4.1 *Reservoir Intake*

2

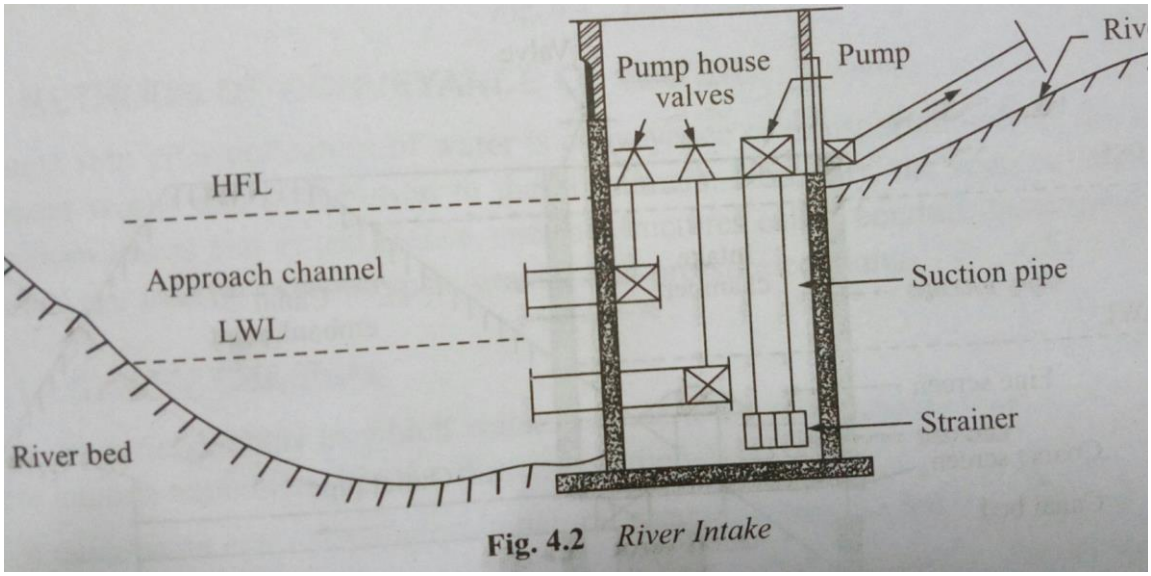


Fig. 4.2 *River Intake*

Dead end or tree system

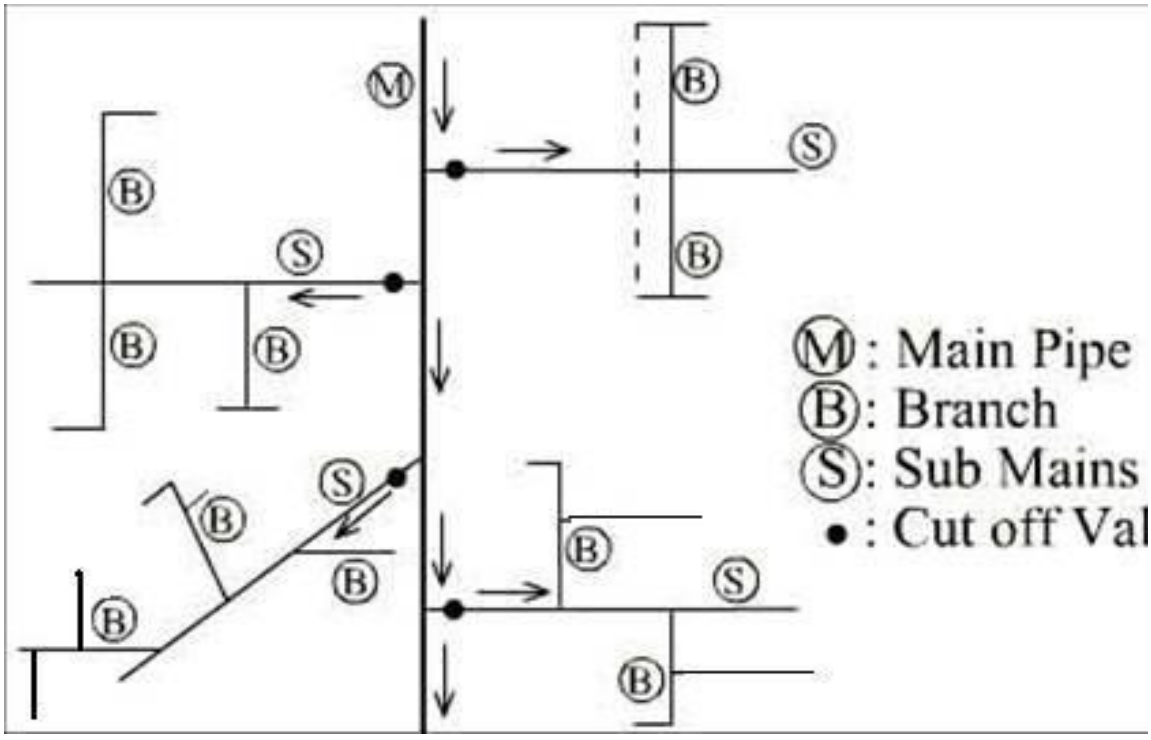
b This system is suitable for irregular developed towns or cities. In this system water flows in one direction only into submains and branches. The diameter of pipe decreases at every tree branch

ADVANTAGES

1. Discharge and pressure at any point in the distribution system is calculated easily 2. The valves required in this system of layout are comparatively less in number. 3. The diameter of pipes used are smaller and hence the system is cheap and economical 4. The laying of water pipes is used are simple.

DISADVANTAGES

1. There is stagment water at dead ends of pipes causing contamination. 2. During repairs of pipes or valves at any point the entire down stream end are deprived of supply 3. The water available for fire fighting will be limited in quantity



Grid iron system

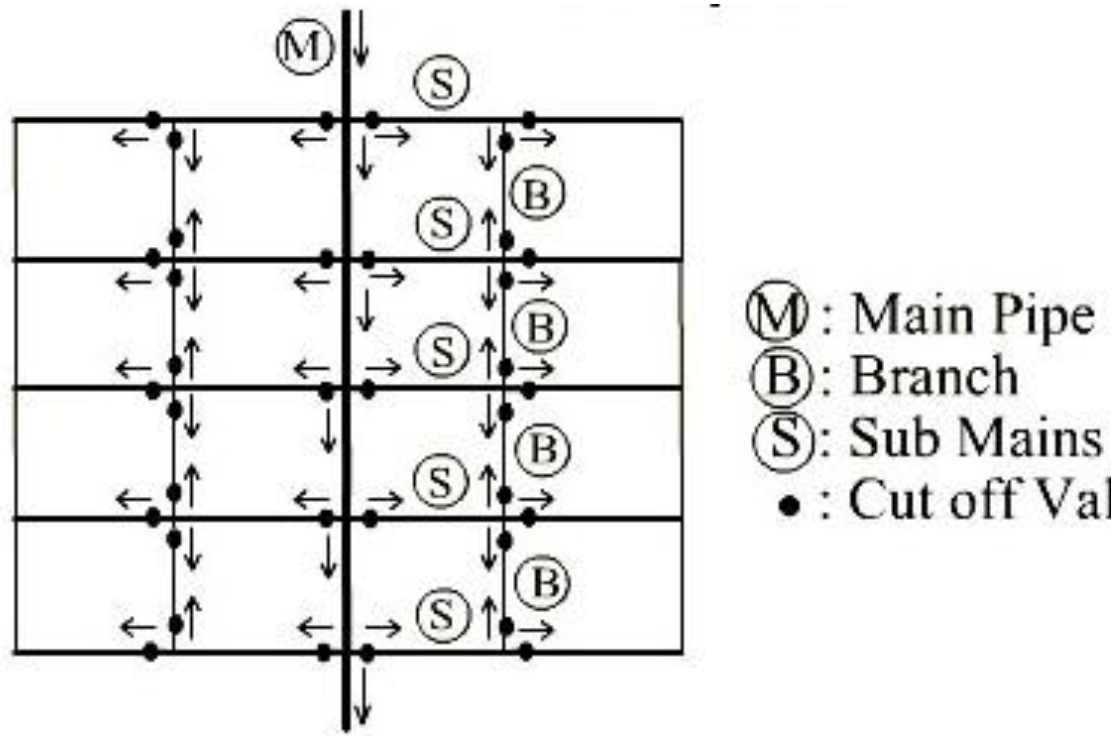
From the mains water enters the branches at all Junctions in either directions into submains of equal diameters. At any point in the line the pressure is balanced from two directions because of interconnected network of pipes

ADVANTAGES

1. In the case of repairs a very small portion of distribution are a will be affected
2. Every point receives supply from two directions and with higher pressure
3. Additional water from the other branches are available for fire fighting
4. There is free circulation of water and hence it is not liable for pollution due to stagnation.

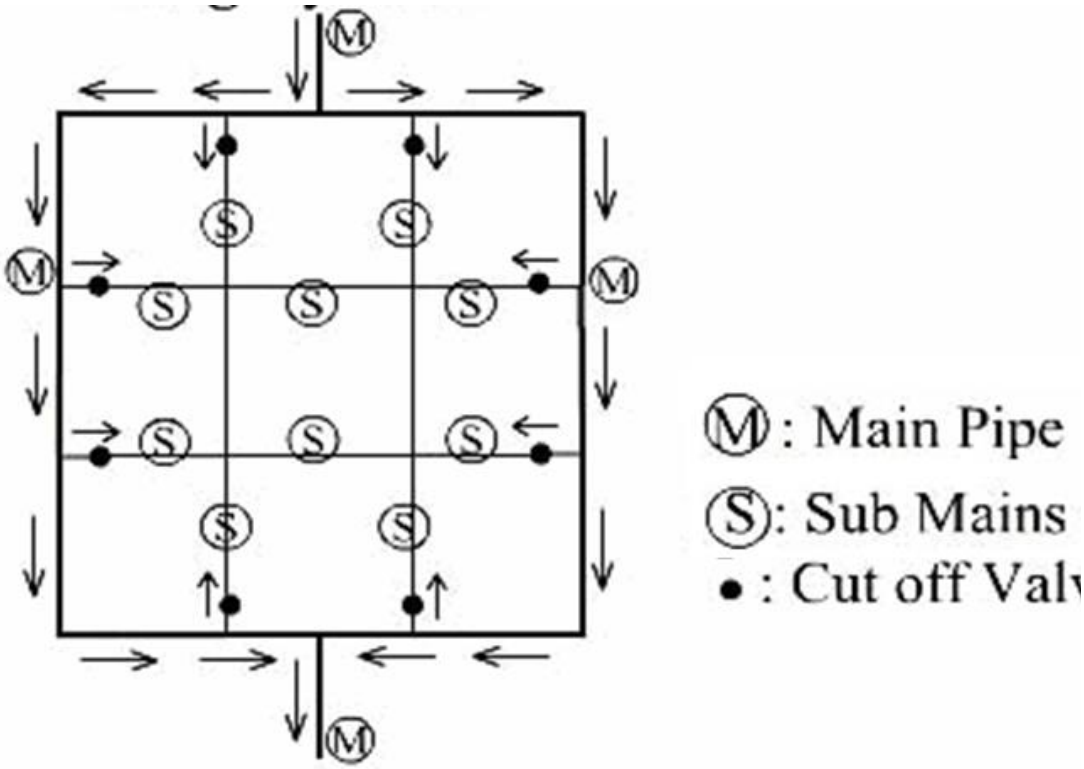
DISADVANTAGES

1. More length of pipes and number of valves are needed and hence there is **increased** cost of construction 2. Calculation of sizes of pipes and working out pressures at various points in the distribution system is laborious , complicated and difficult.

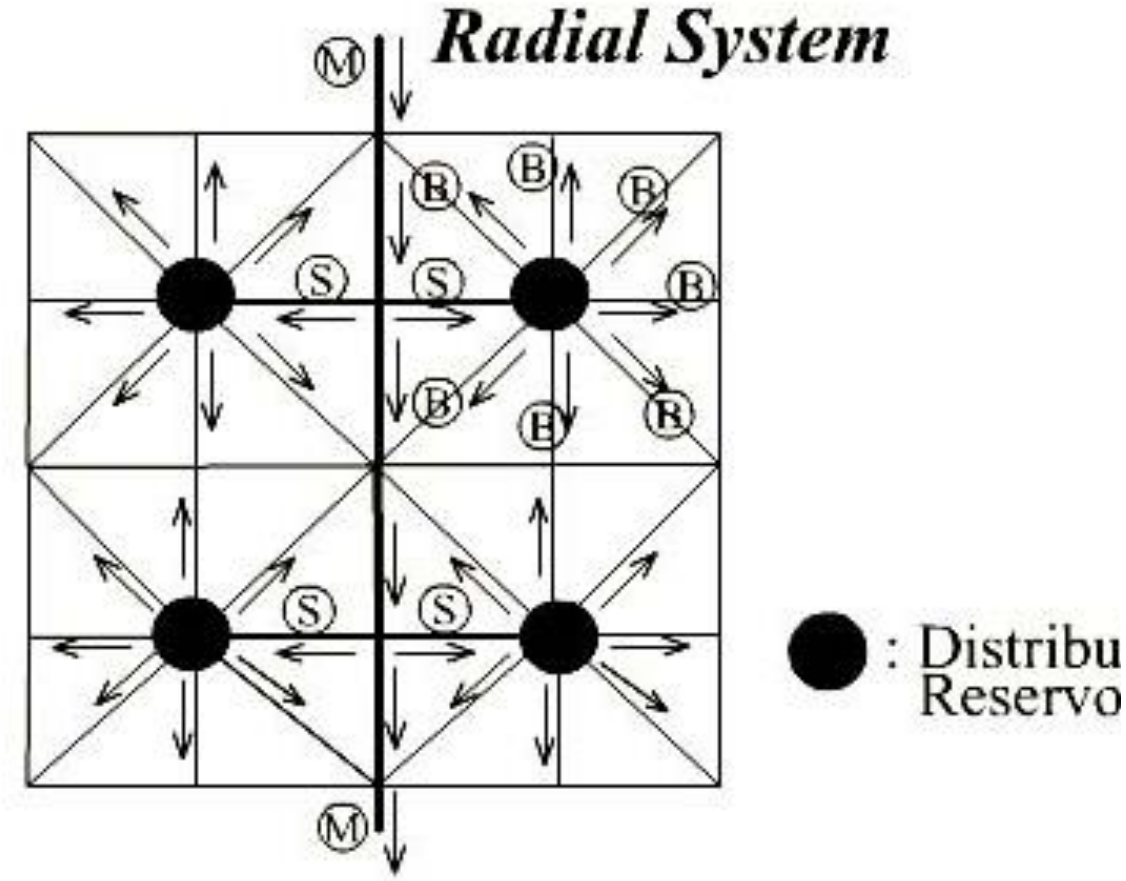


Circle (or) ring system

Supply to the inner pipes is from the mains around the boundary. It has the same advantages as the grid-Iron system. Smaller diameter pipes are needed. The advantages and disadvantages are same as that of grid-Iron system.



This is a zoned system. Water is pumped to the distribution reservoirs and from the reservoirs it flows by gravity to the tree system of pipes. The pressure calculations **are** easy in this system. Layout of roads need to be radial to eliminate loss of head in bends. This is most economical system also if combined pumping and gravity flow is adopted



Q3

a Avg. demand of town= 10.125 $X10^6$ lit/day
Max. demand of town= 15.19 $X10^6$ lit/day
Rate of filtration= 210 X 24 lit/day = 5040 lit/day
Total surface area of filter required = max. daily demand/ rate of filtration
= 15.19 X 10^6/ 5040
=3013. 89 sqm.

Out of 5 only 4 are used
Surface area of each unit = 3013. 89/4 = 753.47 sqm

Keeping the length of the slow sand filter as 2.5 times its width

2.5 X B^2 = 753.47 sqm
B= 17.36 m
L= 17.36 X 2.5

b

- Water available in various sources contains various types of impurities and cannot be directly used by the public for various purposes, before removing the impurities. For potability water should be free from unpleasant tastes, odours and must have sparkling appearance. The water must be free from disease-spreading germs. The amount and type of treatment process will depend on the quality of raw water and the standards of quality of raw water and the standards

of quality to be required fullfiled.

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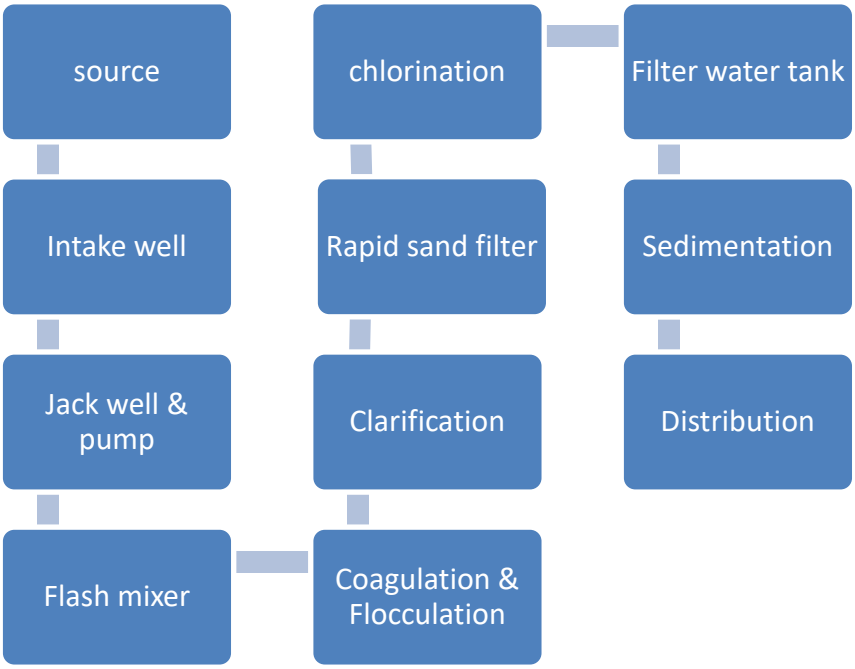


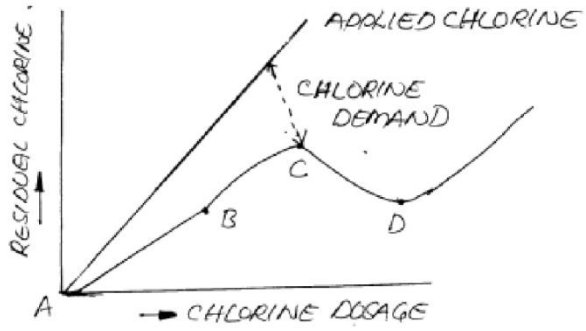
Q 4

a The following are the standard methods by which the forecasting population is done.
i. Arithmetical increase method ii. Geometrical increase method iii. Incremental increase method iv. Simple graph methodv. Decrease rate of growth method vi. Comparative graph method vii. The master plan method

b Taste and odour in water may be due to presence of dead or live micro-organisms, dissolved gases such as hydrogen sulphide, methane, carbon dioxide or oxygen combined with organic matter, mineral substances such as sodium chloride, iron compounds and carbonates and sulphates of other substances. The tests of these are done by sense of smell and taste because these are present in such small proportions that it is difficult to detect them by chemical analysis. The water having bad smell and odour is objectionable and should not be supplied to the public.
The intensities of the odours are measured in terms of threshold number.

c When chlorine is applied to water containing organics, micro organisms and ammonia the residual chlorine levels fluctuate with increase in dosage as shown in Fig.
Upto the point B it is obsorbed by reducing agents in water (like nitrates, Iron etc) further increases forms chloramines with ammonia in water. Chloramines are effective as CL and OCL formed. When the free chlorine content increases it reacts with the chloramines and reducing the available chlorine. At the point ‘D’ all thechloramines are converted to effective N2, N2O and NCl3. Beyond point ‘D’ free residual chlorine appear again. This point ‘D’ is called break point chlorination. Dosage beyond this

point is the same as super chlorination. In super chlorination no such rational measurement is made and the dosage is taken at random.



Fig

Q5
a

Ion exchange proces
Zeolites are compounds (silicates of aluminium and sodium) which replace sodium Ions with calcium and magnesium Ions when hardwater is passes through a bed of zeolites. The zeolite can be regenerated by passing a concentrated solution of sodium chloride through the bed. The chemical reactions involved are

2SiO2 Al2O3 Na2O + Ca(HCO3)2 ----------> 2SiO2 Al2O3 CaO + 2NaHCO3
(Zeolite)
2SiO2 Al2O3 Na2O + CaSO4 ----------> 2SiO2 Al2O3 CaO + Na2SO4
2SiO2 Al2O3 Na2O + CaC12 ----------> 2SiO2 Al2O3 CaO + 2NaCl

Advantages 1. In this process, the sludge is not formed hence problem of sludge disposal does not arise 2. It can be operated easily and no skilled supervision required 3. The hardness of water reduces to zero and hence used for boiler and texile industries 4. The process is economical where salt is cheaply available 5. The load on Zeolite can be reduced by combining it with lime or aeration process

Disadvantages 1. The Zeolite process cannot be used for turbed or acidic water 2. The Zeolite process is unsuitable for water containing Iron and Manganese 3. The Zeolite should be operated carefully to avoid injury or damage to the equipment

Lime soda process :
In this method, the lime and is sodium carbonate or soda as have used to remove permanent hardness from water. The chemical reactions involved in this process are as follows.

$CO_2 + Ca(OH)_2 \longrightarrow CaCO_3 + H_2O$ (removal of CO_2) $Ca(HCO_3) + Ca(OH)_2 \longrightarrow 2CaCO_3 + 2H_3O$ (removal of temporary hardness) $Mg(HCO_3) + Ca(OH)_2 \longrightarrow CaCO_3 + Mg(CO_3) + 2H_2O$ $MgSO_4 + Ca(OH)_2 \longrightarrow Mg(OH)_2 + CaSO_4$ { conversion of $MgSO_4$ to $CaSO_4$} $CaSO_4 + Na_2CO_3 \longrightarrow CaCO_3 + Na_2SO_4$ {removal of sulphates}
$CaCl_2 + Ca(OH)_2 \longrightarrow Ca(OH)_2 + CaCl_2$ $MgCl_2 + Ca(OH)_2 \longrightarrow Mg(OH)_2 + CaCl_2$ { removal of chlorides} $CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaCl$ $MgCl_2 + Na_2CO_3 \longrightarrow Mg\,CO_3 + 2NaCl$ {removal of chlorides}

Advantages of lime soda process

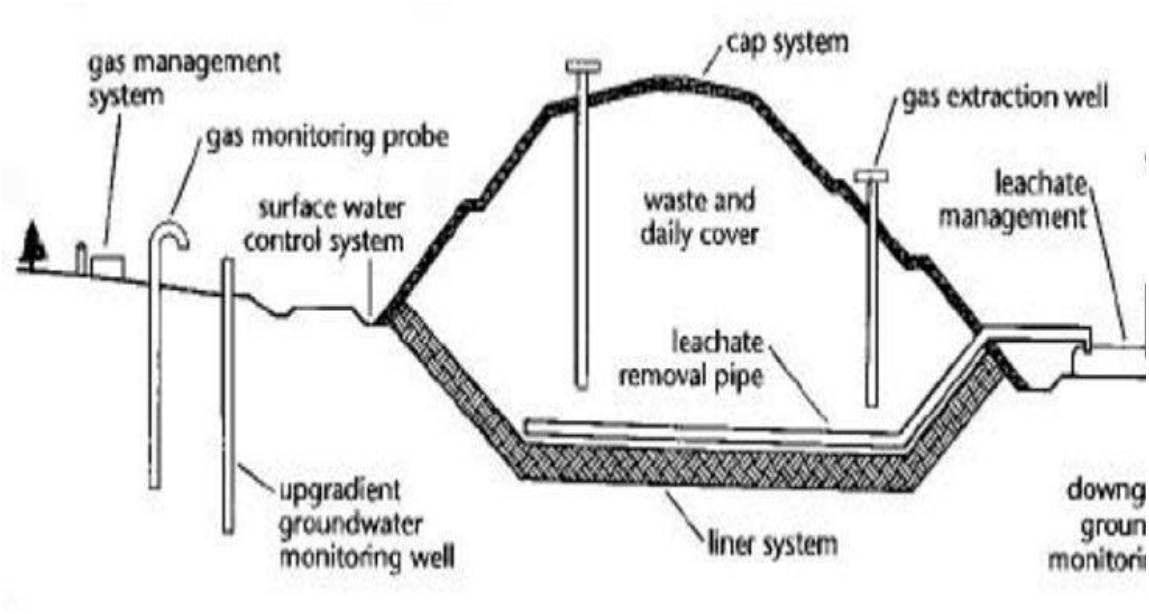
1. The PH value of water treated by this process bring down to 9 and which results in decrease in corrosion of the distribution system. 2. Less quantity of coagulant will be required, if this process is adopted 3. Removal of iron and manganese to some extent 4. Reduction of total mineral content of water 5. Hardness of water is reduced to 40mg/lit (of $CaCO_3$) and magnesium upto 10mg/lit 6. The process is economical 7. This process is most suitable for tubed and acidic waters where it will not possible to adopt zeolite process.

Disadvantages

1. Large quantity of sludge formed during this process to be disposed off by some suitable method 2. This process requires skilled supervision for its successful working 3. If recarbonation is omitted, a thick layer of calcium carbonate will be deposited in the filtering media, distribution pipes

b When water contains fine clay and colloidal impurities which are electrically charged are continually in motion and never settle down due to gravitational force. Certain chemicals are added to the water so as to remove such impurities which are not removed by plain sedimentation. The chemical form insoluble, gelatinous, flocculent precipitate absorbs and entagle very fine suspended matter and colloidal impurities during its formation and descent through water. These coagulants further have an advantage of removing colour, odour and taste from the water.

c Leachate is the liquid that drains or ‘leaches’ from a landfill. It varies widely in composition regarding the age of the landfill and the type of waste that it contains
Leachate generation is a major problem for municipal solid waste (MSW) landfills and causes significant threat to surface water and groundwater. Leachate can be defined as a liquid that passes through alandfill and has extracted dissolved and suspended matter from it
In the case of landfills, every effort is made to prevent pollution. Modern landfills are built with liners and collection systems for the leachate. Leachate is extracted from the landfill to protect nearby groundwater from contamination



Q6

a Physical characteristics

This includes the determination of percent contents of various ingredients of the solid waste.

Bulk Density is generally calculated.

Function of location, season, storage time, equipment used, processing (compaction, shredding, etc.)

Used in volume calculations.

Chemical characteristics

Used primarily for combustion and waste to energy (WTE) calculations but can also be used to estimate biological and chemical behaviours.

Waste consists of combustible (i.e. paper) and non-combustible materials (i.e. glass).

Biological characteristics

Organic fraction often equated with the volatile solids (VS) content of the waste

However, not all organic materials are easily degradable

Biodegradable fraction -

Degradation produces odours

Hydrogen sulfide, H_2S (rotten eggs)

Methyl mercaptans

Aminobutyric acid

Methane is odourless.

b The water borne diseases like typhoid, dysentery, cholera etc the concept of water borne diseases

c Tube settlers and parallel plates increase the settling capacity of circular clarifiers and/or rectangular sedimentation basins by reducing the vertical distance a floc particle must settle before agglomerating to form larger particles

tubular channels sloped at an angle of 60° and adjacent to each other, which combine to form an increased effective settling area. This provides for a particle settling depth that is significantly less than the settling depth of a conventional clarifier, reducing settling

times.

Tube settlers capture the settleable fine floc that escapes the clarification zone beneath the tube settlers and allows the larger floc to travel to the tank bottom in a more settleable form. The tube settler's channel collects solids into a compact mass which promotes the solids to slide down the tube channel.

- Clarifiers/basins equipped with tube settlers can operate at 2 to 4 times the normal rate of clarifiers/basins without tube settlers.
- It is possible to cut coagulant dosage by up to half while maintaining a lower influent turbidity to the treatment plant filters.
- Less filter backwashing equates to significant operating cost savings for both water and electricity.
- New installations using tube settlers can be designed smaller because of increased flow capability.
- Flow of existing water treatment plants can be increased through the addition of tube settlers.
- Tube settlers increase allowable flow capacity by expanding settling capacity and increasing the solids removal rate in settling tanks.

d The following are the some of the fixtures used in the distribution system.

(i) Valves (ii) Fire hydrants and (iii)Water meter

TYPES OF VALVES

In water works practice, to control the flow of water, to regulate pressure, to release or to admit air, prevent flow of water in opposite direction valves are required.

The following are the various types of valves named to suit their function 1. Sluice valves 2. Check valves or reflex valves 3. Air valves 4. drain valves or Blow off valves 5. Scour valve

In addition to the pipes, valves, tapes, various types of pipe fittings such as unions, caps, plugs, flanges, nipples, crosses, tees, elbows, bends etc are used during laying of distribution pipes The common pipe fittings are there.

e The dosage of coagulants, which should be added to the water, depends upon kind of coagulant, turbidity of water, colour of water, PH of water, temperature of water and temperature of water and mixing & flocculation time. The optimum dose of coagulant required for a water treatment plant is determined by a Jar test. For starting the experiment first of all the sample of water is taken in every jar and added the coagulant in a jar in varying amounts. The quantity of coagulant added in each jar is noted. Then with the help of electric motar all the paddles are rotated at a speed of 30-40 R.P.M. for about 10 minutes. After this the speed is reduced and paddles are rotated for about 20-30 minutes. The rotation of paddles is stopped and the floc formed in each Jar is noted and is allowed to settle. The dose of coagulant which gives the best floc is the optimum dose of coagulants.