PHE- 21CV43

Internal Assessment – 2

1. **Explain different types of disinfection methods with merits and demerits**

1) Boiling of Water

- This method includes the heating of water to raise the temperature thereby killing the bacteria's present in water.
- It is one of the effective methods of disinfection.
- This method is practically not possible to treat the huge quantity of public watersupplies.
- There is no provision provided to care about the future contamination of treated waterin the distribution pipes.
- This method commonly not used in any conventional water treatment plant.
- However, during the water borne epidemics, public is advised to drink water onlyafter boiling it in their houses.

2) Treatment with Excess Lime

- When excess lime is added to the water, it raises the pH value and makes thewater extremely alkaline.
- This extreme alkalinity is detrimental to the survival of bacteria, thus killingthem partially or completely.
- At pH 9.5 to 9.99, can completely removes the bacteria's present in water.
- After the disinfection treated with lime, it needs excess removal of alkalinity from water before supplied to the public. Re-carboantion can be employed for the removal of excess lime or alkalinity present resulted water.
- By this method, can't achieve the protection against the future contamination of water in a distribution network.
- Because of its higher alkalinity leads in a water when water is treated with lime, hence this method is not used in these days.

3) Treatment with Ozone (O3)

- Ozone is a faintly blue gas with plungent odour and is an excellent disinfectant.
  It can be produced by passing a high tension electric current through a stream of air in a closed chamber.

  Advantages:
- Ozone is a unstable compound and after the treatment nothing will remains in thewater as a sludge.
- Removes colour, taste, odour and bacteria.
- Ozonised water is tasty and chlorinated water is bitter to tongue.
  Disadvantages:
- Process is costly than chlorination.
- Needs electricity.

- Future contamination protection is nil because ozone is unstable compound.
- Ozoniser is a complicated apparatus is required.
- Less efficient in killing bacteria than chlorine.

4) Chlorination

Chlorine is universally used for disinfecting of public water supplies. it is cheap, reliable, easy to handle, easily measurable.
it is capable of providing residual disinfecting effect for a longer period, thus providing complete protection against future contamination of water in the distribution system.
its only disadvantage is that, when used in excess amounts it imparts bitter and bad taste to the water which may not be liked by certain sensitive – tongued consumers.
Advantages of using Free Ammonia Chlorine as a Disinfectant

The liquid chlorine is now a day's invariably and universally adopted for disinfecting public supplies.

- it can be easily stored for a long period
- it is quite cheap and easily available
- it occupies less space for storage
- it can be easily and cheaply transported
- the chlorine dose to be added can be easily measurable the initial cost of installation is also less
- powerful disinfectant and have residual disinfectant for larger time need careful handling
- no sludge is formed in its application

2. Explain different types of sewerage system with diagram

Classification of Sewerage System

1. Combined system
2. Separate System
3. Partially separate system

Combined System
When only one set of sewer is laid carrying both the sanitary sewage and the storm water is called as combined system. Sewage and storm water both are carried to the treatment plant through combined sewers.
Merits
1. Size of the sewers being large, chocking problems are less and easy to clean.
2. House plumbing can be done easily and it proves economical as one set of sewers are laid.
3. Because of dilution of sanitary sewage with storm water nuisance potential is reduced and can be easily and economically treated.

Demerits
1. Size of the sewers being large, difficulty in handling and transportation.
2. Load on treatment plant is unnecessarily increased.
3. It is uneconomical if pumping is needed because of large amount of combined flow.
4. Unnecessarily storm water is polluted.

Suitable conditions for combined system

1. Rainfall in even throughout the year.
2. Both the sanitary sewage and the storm water have to be pumped.
3. The area to be sewered is heavily built up and space for laying two sets of pipes is not available.
4. Where Effective or quicker flows have to be provided.

Separate System

In this system, two sets of sewers are laid .The sanitary sewage is carried through one set of sewers called sanitary sewers, while the storm water is carried through another set of conduits called drains. The sewage is carried to the treatment plant and storm water is directly dischargedinto the river or streams for disposal

Merits

1. Size of the sewers is small.
2. Sewage load on treatment unit is less.
3. Rivers or streams are not polluted.
4. Storm water can be discharged into rivers without any treatment.

Demerits

1. Sewers being small, cleaning is difficult.
2. Frequent choking problem will be there.
3. System proves costly as it involves two sets of sewers.
4. The use of storm sewer is only partial because during non-monsoon seasons, they will be idle and forms the dumping places for garbage and rubbish and may get clogged.

Suitable conditions for separate sewerage systems

1. Where rainfall is uneven.
2. Where sanitary sewage is to be pumped.
3. The drainage area is steep, allowing to runoff quickly.
4. Sewers are to be constructed in rocky strata. The large combined sewers would be more expensive.

Partially Combined or Partially Separate System

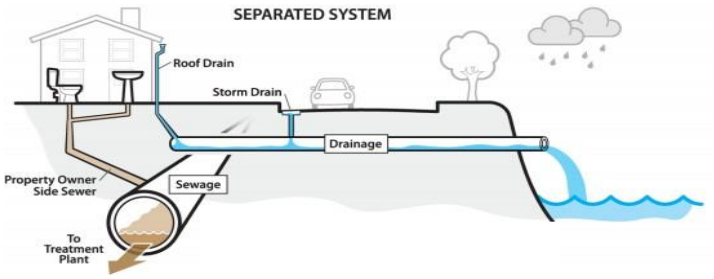
Sometimes a part of storm waters especially that originating from the roofs or paved courtyards of buildings, is allowed to be admitted into the sewers and similarly, the domestic sewage is allowed to be admitted into the drainage. The resulting system is called as partially separate or partially combined system.

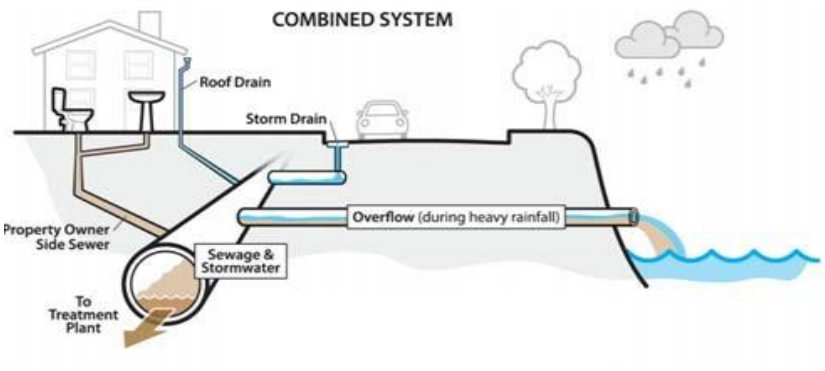
Merit

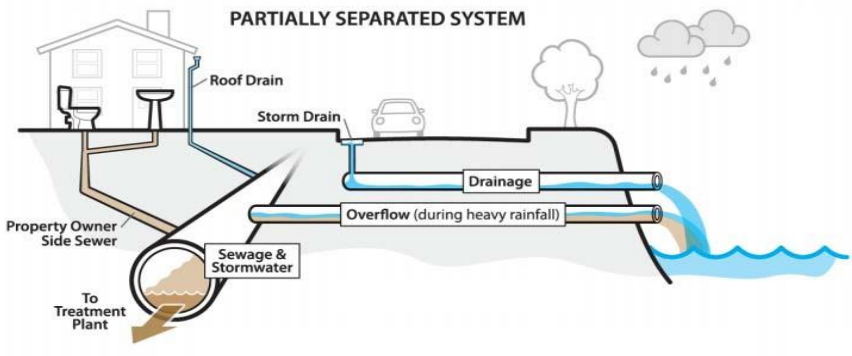
1. The sizes of sewers are not very large as some portion of storm water is carried through open drains.
2. Combines the advantages of both the previous systems.
3. Silting problem is completely eliminated.

Demerit

1. The cost of pumping is increased at the disposal point than separate system because a portion of storm water is mixed with sanitary sewage.
2. During dry weather, the velocity of flow may be low.
3. The storm water is unnecessary put load on to the treatment plants.
4. Pumping of storm water in unnecessary over-load on the pumps.


SEPARATED SYSTEM
Roof Drain
Storm Drain
Drainage
Property Owner Side Sewer
Sewage
To Treatment Plant


COMBINED SYSTEM
Roof Drain
Storm Drain
Overflow (during heavy rainfall)
Property Owner Side Sewer
Sewage & Stormwater
To Treatment Plant


PARTIALLY SEPARATED SYSTEM
Roof Drain
Storm Drain
Drainage
Overflow (during heavy rainfall)
Property Owner Side Sewer
Sewage & Stormwater
To Treatment Plant

3. Explain different methods of sewage disposal with advantages and disadvantages

Methods of sewage Disposal

The solid and a liquid waste are to be properly collected and conveyed at suitable spots for treatment and disposal. The refuse formed in any sanitary system should be rapidly, conveniently and safely carried to its disposal site as to maintain a clean environment. Following are the two methods used for the collections and disposal of refuse of a locality.

1. Conservancy System
2. Water Carriage System

1. Conservancy System

This method is also called as "Dry System". This system is in practice from very ancient times. In this system, the waste products of society had been collected, carried and disposed off manually to a safe point of disposal by the sweepers.

Various types of refuse and storm water are collected, conveyed and disposed off separately. Garbage is collected in dustbins placed along the roads from where it is conveyed by trucks onesor twice a day to the point of disposal. All the non combustible portion of garbage such as sand dust clay etc are used for filling the low level areas to reclaim land for the future development ofthe town. The combustible portion of the garbage is burnt. Human excreta or night soil are collected separately in conservancy latrines. The liquid and semi liquid wastes are collected separately. After removal of night soil, it is taken outside the town in trucks and buried in trenches. After 2-3 years the buried night soil is converted into excellent manure.

In conservancy system, the sullage and storm water are carried separately in closed drains to thepoint of disposal where they are allowed to mix with river water without treatment.

Merits

1. It is cheaper in initial cost because storm water can pass in open drains and conservancy latrines are much economical.
2. The quantity of sewage reaching disposal point is less.
3. The storm water goes in open drains; the sewer section will be small.
4. Night soil which is buried can be used as fertilizers after 2 to 3 years.

Demerits

1. For burying human excreta more space of land is required.
2. Building can't be designed as one compact unit because; latrines are to be provided away from
the living room due to foul smell.
3. There is every possibility the liquid refuse may yet get an access in the sub-soil and pollute the
ground water.

4. In the presence of conservancy system, the aesthetic appearance of the city cannot be increased.
5. Decomposition of sewage causes insanitary conditions which are dangerous to public health.
6. This system depends on the mercy of sweepers every time.

2. Water Carriage System

In thissystem, waste products are mixed up with sufficient quantity of water and are taken out ofthe city by properly designed sewer system where they are disposed off after necessary treatmentin sanitary manners. The treated sewage effluents may be disposed off either in a running bodyof water such as streams or may be used for irrigating crops. The sewage so formed in water carriage system consists of 99.9% of water and remaining 0.1% of solid matter.

Merits

1. It is a hygienic method because all the excremental matters are collected and conveyed by water only and no human agency is employed for it.
2. In this system, the sewage is carried through underground pipes and these pipes do not occupy
floor area on road sides or impair the beauty of the surroundings.
3. In multi storied Buildings where the water closets one above the other can be easily constructed and connected to a single vertical pipe.
4. Land required for disposal work is less as compared with conservancy system.
5. The usual water supply is sufficient and no additional water is required in water carriage system.
6. The system does not depend on manual labour at every time except when sewers are clogged.
7. Sewage after treatment can be used for various purposes.

Demerits

1. The system is very costly in initial stages.
2. The maintenance of this system is very costly.
3. During monsoon, large volume of sewage is to be treated, where as very small quantity is to
be treated in the remaining period of year.

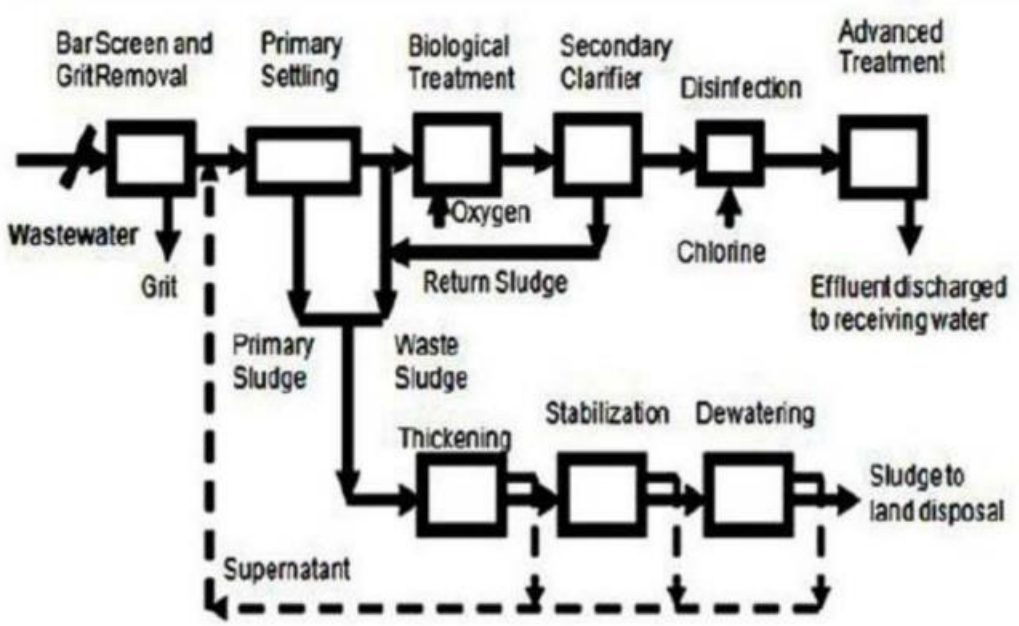
Comparison of conservancy and water-carriage system

Conservancy System	**Water-Carriage System**
Very cheap in initial cost.	It involves high initial cost.
Due to foul smells from the toilets , they are to be constructed away from living room, so building cannot be constructed as compact units.	As there is no foul smell, toilets remain clean and neat and hence are constructed with rooms, therefore buildings may be compact.
The aesthetic appearance of the city cannot be improved	Good aesthetic appearance of city can be obtained.

For burial of excremental matter large area is required.	Less area is required as compared to conservancy system.
Excreta is not removed immediately hence its decomposition starts before removal, causing foul smell.	Excreta are removed immediately with water, no problem of foul smell or hygienic trouble.
This system is fully depended on human agency In case of strike by the sweepers; there is danger of insanitary conditions in city, which may cause spreading of disease	As no human agency is involved in this system ,there is no such problem as in case of conservancy system
As sewage is disposed of without any treatment, it may pollute the natural water courses	Sewage is treated upto required degree of sanitation 14

4. Explain municipal waste water treatment with flow diagram

Flow diagram of Municipal wastewater treatment plant



The influent or wastewater collected from residences or industries are first subjected to Screening process to remove the floating matters present in the sewage. The water which comes out of screening tanks is passed through the Grit chambers or Detritus tanks to remove the grits or sand particles. Then effluent which comes out of grit chamber is subjected to Primary Sedimentation tanks in order to remove the large suspended organic solids which is achieved by settling process where water is allowed to flow in slower rate, then heavy denser particles settles down at the bottom of the tank. The settled organic particles at the bottom of the primary sedimentation tanks is called primary sludge. The effluent which comes out of the primary settling tank is subjected to Biological treatment or Secondary treatment where, decomposition of organic matter takes place by aerobic bacteria with the supply of oxygen. Then stabilized organic particles along with the water is passed through the

Secondary clarifier where the stabilized organic particles settles at the bottom of the tank. The sludge which is settled at the bottom of the tank is again recirculated back and mixed with effluent which comes of primary sedimentation tank which is part of Activated Sludge Process and remaining sludge is mixed with primary sludge and then subjected to Sludge digestion process. In sludge digestion process, wastewater is first subjected to Thickening, where number of solid sludge particles are increased by separating from liquid. The liquid which rests over the solid sludge particles are removed out is called as supernatant. The solid sludge which consists of moisture content is removed out in Dewatering process. The dry form of sludge is used as manure for improving the fertility of soil. The effluent which comes out of secondary clarifier is fed into disinfection tank where chlorine is added to the wastewater to kill germs and pathogenic bacteria's present in the water. Then water which comes out of disinfection tank containing germs are removed out in final or advanced or tertiary treatment process after that, the water can be directly discharged to nearby water courses.

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

Treatment process as a whole classified into 4 types 1) Priliminary treatment process 2) Primary treatment process 3) Secondary or Biological treatment process 4) Tertiary or final or advanced treatment process

Preliminary treatment process: This treatment process consists of separating the floating materials like dead animals, tree branches, papers, pieces of rags or wood etc., present in the sewage and also to remove heavy settable inoganic solids. This process also helps in removing oil and grease particles present in the sewage. This process reduces the BOD of wastewater by about 15 to 30%.
The units used in preliminary process are a) Screening - For removal of floating matters like papers, rags, pieces of clothes etc. b) Grit chambers or Detritus tank – For removal of grits and sand particles. c) Skimming tanks – For removal of oil and grease particles present in the sewage.
Primary treatment process: This treatment process consists of removing large suspended organic solids. This is usually achieved by sedimentation process. The liquid effluent from primary treatment process consists of large amount of suspended organic matters having BOD of 60% of original. The organic solids which are separated out in the sedimentation tank are often stabilized by anaerobic decomposition in a digestion tank. This residue is used for landfills or soil conditioners.
Secondary treatment process: This treatment process further treats the effluent which is coming out from primary sedimentation tanks. This treatment process is achieved by biological decomposition of organic matter which can be carried out either under aerobic or anaerobic condition. Treatment process in which organic matter is decomposed by aerobic bacteria is called aerobic decomposition. Units which are used in this treatment process are
Filters – Interment sand filters as well as trickling filters. Intermittent sand filters are used for treatment of wastewater by attaching microorganisms to the filter medium and treated water is collected in the underdrains at the bottom of sand filter and is transported to a line for further treatment or disposal.
Trickling filters are used to remove organic matter from wastewater. Trickling filter is an aerobic treatment system that utilizes microorganisms attached to the medium to remove organic matter from wastewater.

Aeration tanks – Wastewater is is mixed with microbes in the aeration tank and oxygen is supplied. Microbes consume that supplied oxygen and decomposes the organic matter present in the wastewater and thus water is cleaned.

Oxidation ponds – Oxidation ponds are also known as stabilization ponds or lagoons. Within an oxidation pond heterotropic bacteria degrade organic matter in the sewage which results in production of cellular material and minerals. The production of these supports the growth of algae in the oxidation pond.

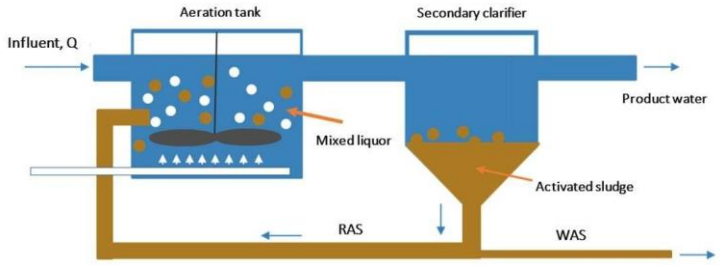
Aerated lagoons: Aerated lagoons or aerated basins is a holding and treatment pond provided with artificial aeration to promote the biological decomposition of wastewater. Treatment process in which organic matter is decomposed anaerobic bacteria is called anaerobic decomposition.

Units which are used in this treatment process are, a) Anaerobic lagoons: These are also called as manure lagoon which are manmade earthen basins filled with animal waste that undergoes anaerobic decomposition and it will be converted into excellent manures. b) Septic tanks: These are water-tight box made of concrete or fiber glass to separate solids and liquids by settling process. c) Imhoff tanks: These types of tanks are used for reception and processing of sewage which is achieved by sedimentation along with anaerobic sludge digestion. The effluent from the secondary biological treatment will usually contain a little BOD of 5 to 10% of original Final or Advanced or Tertiary treatment process: This process removes remaining organic load after secondary treatment and to kill pathogenic bacteria present in the sewage and this achieved by chlorination Tertiary Treatment Tertiary treatment or advanced waste water treatment includes operation and process used to remove organic load left after the secondary treatment and in particular to kill the pathogenic bacteria. It is normally carried out by chlorination.

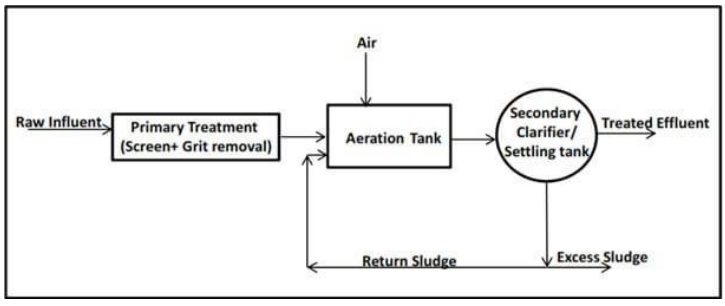
Tertiary treatment may be aimed at the reuse of wastewater. The common processes that are used in this treatment are: i. Removal of refractory organisms through adsorption. ii. Removal of dissolved inorganic substances through chemical precipitation, ion recharge, reverses osmosis, electro dialysis, membrane filtration process and distillation, nutrient removal such as nitrogen and phosphorus etc.

5. **Discuss Conventional activated sludge process and its modification with diagram**

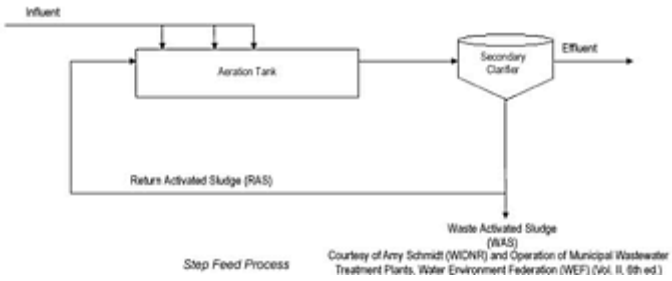
Conventional Activated Sludge - The conventional activated sludge process consists of an aeration tank, a secondary clarifier and a sludge recycle line. Both influent sewage and recycled sludge enter the tank at the head end, move through the tank in plug flow and are aerated for a period of time.



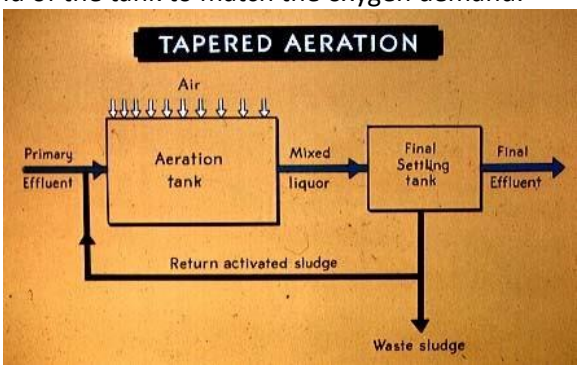
Extended Aeration Activated Sludge - The extended aeration activated sludge process operates in the endigenous respiration phase of the growth curve, which necessitates a relatively low organic loading (low F/M) and long aeration time.



Step Feed Activated Sludge - The Step feed process (sometimes called Step Aeration) is a modification of the activated sludge process in which sewage is introduced at two or more points in the aeration tank while return sludge is introduced only at the head end of the aeration tank. In this modification, the oxygen demand is more uniformly spread over the length of the aeration tank.



Tapered Aeration Activated Sludge - The tapered aeration activated sludge process is a modification of the conventional activated sludge process. Tapered aeration affects only the arrangement of the aeration devices in the aeration tank. In tapered aeration the diffusers or aeration devices are spaced closer together at the head end of the tank to match the oxygen demand.



Contact Stabilization Activated Sludge - The contact stabilization activated sludge process utilizes two aeration compartments to divide the two phases of BOD removal. The first phase, adsorption, takes place in the first aeration tank (contact tank). Mixed liquor from the contact tank then flows to the clarifier. Return sludge flows to the second aeration tank (reaeration tank) where the second phase, absorption, occurs. The reaeration tank provides detention time before flowing into the contact tank.