Final Term Assesment

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SUBMITED TO:

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SUBJECT:

Water Demand Supply and Distribution

Answer1:

Desalination is a technique where the excess salts are removed from sea water or brackish water converting it into safe potable or usable water or desalination is a water supply option that is used widely around the world and involves taking the salt out of water to make it drinkable.

Desalination Methods:

a) Distillation

Distillation is the process of separating the components or substances from a saline water by using selective boiling and condensation. Distillation may result in essentially complete separation (nearly pure components), or it may be a partial separation that increases the concentration of selected components in the saline water.

b) Electro dialysis

Electrodialysis (ed) is used to transport salt ions from one solution through ion-exchange membranes to another solution under the influence of an applied electric potential difference.

It draws metal ions to the positive plate on one side, and other ions (like salt) to the negative plate on the other side

c)Freezing method

It is based on the principle that Saline Water Sample water excludes salts when it crystallizes to ice. It involves three steps: Ice formation, ice washing, and ice melting to obtain fresh water with subsequent removal of contaminants

d)Reverse osmosis

Reverse osmosis (RO) is a water purification process that uses a partially permeable membrane to remove ions, unwanted molecules, and larger particles from drinking water. In reverse osmosis, an applied pressure is used to overcome osmotic pressure, a colligative property that is driven by chemical potential differences of the solvent, a thermodynamic parameter.

Reverse osmosis Membrane methods are the most effective and fouling can be mitigated. The most robust systems are Reverse Osmosis since they are the most used in the world

Answer 2

Methods of Setting Water Distribution System Layouts:

There are four principal methods to design a distribution system:

- Dead end system
- Grid iron system

- Ring system
- Radial system

1)Dead End Water Distribution System.

Description
In the dead-end system (also called tree system), one main pipeline runs through the center of the populated area and sub-mains branch off from both sides. The sub-mains divide into several branch lines from which service connections are provided.

Advantages:

- Pipes in this network can be laid easily.
- The pressure and discharge in each pipe can be determined very easily and accurately which makes design calculations very simple.
- The diameters of pipes of main, sub mains and branches can be designed based on the required demand of population. So, cost of the project can be reduced.
- Dead end system requires a smaller number of cutoff valves.

Disadvantages:

- The pressure is not constant and is very less at remote parts.
- Because of dead ends water stagnation takes place which results in deposition of sediment. To remove this sediment, more number of scour valves are to be provided at the dead ends which increase economy.
- If there is any damage occurs in the branch line, the whole portion should be stopped to repair that which creates discomfort to the other users in that sub main line.
- In this system, Limited discharge is available for firefighting.

2)Grid Iron Water Distribution System.

Description:
In this system the main supply line runs through the centre of the area and sub mains branch off in perpendicular directions. The branch lines interconnect the sub-mains. This system is ideal for cities laid out on a rectangular plan resembling a gridiron. The distinguishing feature of this system is that all of the pipes are interconnected and there are no dead ends. Water can reach a given point of withdrawal from several directions, which permits more flexible operation, particularly when repairs are required

Advantages:

- Water will flow continuously without any dead ends or sediment deposits.
- Head loss is minimum in this case because of interconnection of pipes.
- The discharge will meet the required discharge for firefighting.
- Repair works can be easily done just by closing cutoff valve in that line which do not affect the other users.
- In case of breakdown in some section, water is available from some other direction.
- Disadvantages

- Because of circulating flow from all directions, the pipes used in this system should be of large diameters and longer lengths.
- We cannot determine the accurate discharge, velocity or pressure in a particular pipe. So, design is difficult.
- Laying of pipes will be done by skilled workers which consume more cost.
- Cutoff valves required should be more in this system.

3)Ring Water Distribution System.

Description:
In a circular or ring system, the supply main forms a ring around the distribution area. The branches are connected cross-wise to the mains and also to each other. This system is most reliable for a town with well-planned streets and roads. The advantages and disadvantages of this system are the same as those of the gridiron system. However, in case of fire, a larger quantity of water is available, and the length of the distribution main is much higher.

Advantage:
- Water can be supplied to any point from at least two directions.
- No stagnation of water
- Repair works can be done without affecting larger network.
- Large quantity of water is available for firefighting.

Disadvantages:
- Longer length and large diameter pipes are required.
- More number of cutoff valves are necessary.
- Skilled workers are necessary while laying pipes.

4)Radial Water Distribution System:

Description:
In this system, the whole area is divided into a number of distribution districts. Each district has a centrally located distribution reservoir (elevated) from where distribution pipes run radially towards the periphery of the distribution district. This system provides swift service, without much loss of head. The design calculations are much simpler.

Advantages:
- It gives quick service.
- Stagnation does not occur.
- The water distributed with high velocity and high pressure
- Head loss is very small because of quick discharge.

Disadvantages
- Cost of the project is more because of number of individual distribution reservoirs.

Recommended layout for distribution of water in hilly area:

Radial distribution system

Water distribution systems in hilly areas are always divided into several zones due to the undulating terrain. so area is divided into different zones. The water is pumped into the distribution reservoir kept in the middle of each zone and the supply pipes are laid radially ending towards the periphery.

Answer 3

Types of Reservoirs in Water Supply system

Depending on the elevation there are mainly two type of reservoirs.

a) Surface Reservoirs.

b) Elevated Reservoir.

a) Surface Reservoirs:

Surface reservoirs are circular or rectangular in shape. These reservoirs are constructed at ground level or below ground level and hence these are also called ground reservoirs or non-elevated reservoirs. The treated water stored in these reservoirs is pumped to elevated reservoirs from which it is supplied to the consumers.
However, if surface reservoirs are located at high points in the distribution system then water may be supplied to the consumers directly from these reservoirs by gravity, as far as possible surface reservoirs should be located at high points in the distribution system.
It is usual practice to construct a surface reservoir in two compartments, so that one can be used while the other is being cleaned or repaired. The two compartments relate to each other by control valves. Overflow pipes are provided at full supply level to maintain a constant level of water in the reservoir.

b) Elevated Reservoirs:

Elevated reservoirs are constructed at an elevation from ground level. These reservoirs are also known as overhead tanks. These reservoirs may be rectangular, circular, or elliptical in shape. However, with the advancement in structural analysis it is possible to construct the elevated reservoirs in any shape to suit the architectural requirements. An R.C.C. tank known as Intz tank is very commonly adopted these days. If the topography of the town is not suitable for gravity system, the elevated tank or reservoir are used to provide sufficient pressure head. They are constructed where combine gravity and pumping system of water distribution is adopted.

Storage Capacity of Reservoir:

The total storage capacity of a distribution reservoir is the summation of following:

1. Operational storage (OS)
2. Balancing/Equalizing storage (ES)
3. Standby storage (SB)
4. Fire suppression storage (FSS)
5. Dead storage (DS).

1)Balancing/Equalizing Storage

The main function of a distribution reservoir is to provide storage to meet the fluctuating demand of water with a constant rate of pumping of water into the reservoir. The quantity of water required being stored in the reservoir for balancing or equalizing this variable demand of water against the constant rate of pumping is known as balancing storage or balancing reserve.

2) Break Down Storage or Emergency Storage:
The break down storage or emergency storage is the storage required to be provided in a distribution reservoir to take care of emergencies which may arise due to failure of pumps, failure of electric supply, etc. It is, however, difficult to assess the magnitude of the storage to be provided to meet this requirement, because it depends on frequency and extent of failures and on time required for carrying out repairs. As such for this storage a lump sum provision of about 25% of the total storage capacity of the distribution reservoir, or about 1½ to 2 times the average hourly supply is usually made.

3) Fire Storage:
A provision of fire storage in a distribution reservoir is required to be made to provide water for firefighting purposes. The firefighting requirements are based on the recommendations indicated there the fire storage for a distribution reservoir may be provided.

Answer 4

Why Pumps are used in water supply Schemes.

A water system needs to move the water produced from the source to its customers. In almost all cases the source is at a lower elevation than the user so the water must be raised to a higher level. Some type of pumping equipment must be used to generate the pressure for raising the water to the higher elevation. Pump is used to fetch water from source like bore well, open well, sump or ground water storage and supply it to pipelines or elevated storage.

Pump Curve to Meet water Demand.

A pump performance curve is simply a graph or chart that represents the performance capabilities of a given water pump. A pump manufacturer conducts a variety of tests and the findings are then reflected on a graph, which we refer to as the pump curve. A pump curve will typically show not just the maximum capabilities of the pump, but just as important, many pump curves will give information helpful in determining the best efficiency point (BEP) for flow rates as well as reflecting the preferred operating range (POR) of the water pump.

Following factors are considered while calculating pump curve:

System Head:
The system head depends on properties of the system the pump is connected to these include the static head and the dynamic head of the system.

The static head is created by any vertical columns of liquid attached to the pump and any pressurized systems attached to the pump outlet. The static head exists under static conditions, with the pump switched off, and does not change based on flow. The height of fluid above the pump's centerline can be determined from the plant layout drawing.
Static Head at any Pressure is given by,

Head in Feet=Pressure(psi)*2.31/specific gravity.

The dynamic head varies dynamically with flowrate (and with the degree of opening of valves). The dynamic head represents the inefficiency of the system losses of energy because of friction within pipes and fittings and changes of direction. This inefficacy increases with the square of the average velocity of the fluid.

Flow / Discharge:
Quantity of water pumped per unit time. It is expressed in gallons / day, Liters / minute etc.This flow rate is calculated

Pressure:
The flowing liquid / water should have sufficient pressure at the destination and is normally expressed in pounds per square inch (psi). the force per unit area of resistance in the system. The pressure rating of a pump defines how much resistance it can handle or overcome.

Pump Power:

$P=QgH/3.6*10^6\ \eta$
where P is the pump power (kW), Q is the flowrate (m3/hr), H is the total pump head (m of fluid), and η is the pump efficiency (if you do not know the efficiency, use $\eta = 0.7$).