Reg No. 14398
Instructor Name: Engr. Nadeem Ullah
Discipline: MS Civil Engineering
Course Title: Water Demand Supply and Distribution

Question 1

Desalination refers to the removal of salts and minerals from a target substance

Methods of Desalination

1. Distillation (Evaporation)
2. Electro dialysis
3. Freezing
4. Reverse osmosis

Distillation (Evaporation)

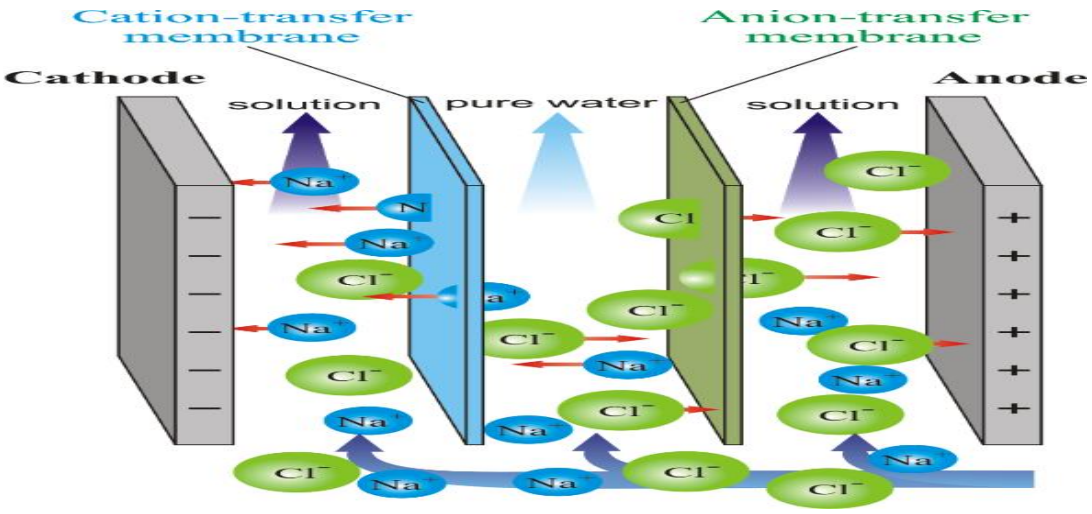
Water containing salt is heated in a container to the point that water evaporates leaving behind the salt. The desalinated vapor is then condensed to get water in another container. This desalination procedure is performed in various stages, with the temperature and pressure decreasing in each stage until the desired result is achieved. The heat obtained from the condensation also serves to distill the water again.

Drawback of this method is that fuel cost of converting salt water to vapor is high.

Electro dialysis

Electrodialysis utilizes a membrane,and sends an electric charge through the solution

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



Freezing

This method is based on the principal that when water crystalizes to ice, it removes salts. Three steps in this process

1. Ice Formation
2. Ice washing
3. Ice melting to get fresh water

Reverse osmosis

It is a water purification method that uses a semi-permeable membrane to remove ions, molecules and larger particles from saline water.

It decreases the salts and other dissolved impurities from water and results in high quality water.

Reverse osmosis is the most extensive and advanced system. This is the most modern system and used world wide

Question 2

Four types of water distribution layouts

1. Dead End System
2. Radial System
3. Grid Iron System
4. Ring System

Dead End System

Merits

1. In this case the discharge and pressure at any point in the distribution system can be worked out accurately and hence the design calculations are simple and easy.
2. The pipe diameters are to be designed for the population likely to be served by them only. This may make the system cheap and economical.
3. In this system of layout comparatively less number of cutoff valves are required.

Demerits

1. In the case of damage or repair in any section of the system, the water supply to the entire portion beyond that point will be completely cut-off. Thus large portion of the distribution area will be affected resulting in great inconvenience to the consumers of that area.
2. There are number of dead-ends in the system due to which free circulation of water is prevented and stagnation of water results. This stagnation of water may lead to degradation in its quality. Further there may be accumulation of sediment at the dead ends.

Radial System

Merits

1. It gives quick service.
2. Calculation of pipe sizes is easy.

Demerits

1. generally only any one of these four systems of layout may not be suitable for the entire city or town.

Grid Iron System

Merits

1. There is free circulation of water, without any stagnation or sediment deposit. Thus chances of pollution of water due to stagnation are not there.
2. Due to interconnection water is delivered at every point of distribution system with minimum loss of head.

3. In the case of damage or repair in any section of the system, the water supply to only very small area of the distribution system is affected.

Demerits

1. In this system of layout a large number of cutoff valves are required.
2. This system of layout requires longer lengths of pipes.
3. The procedure for calculating the sizes of pipes and for working out pressures at various points in the distribution system is laborious, complicated and difficult.

Ring System

Merits

1. Water can be supplied to any point from at least two directions.
2. No Stagnation of water

Demerits of

1. Longer length and larger diameter pipes are required

Dead end system will be suitable due to hilly township. As other systems are complicated and expensive.

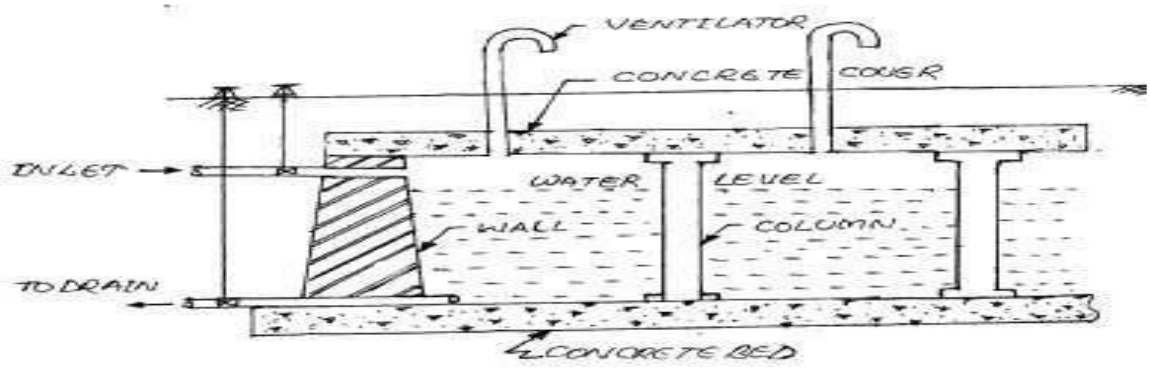
Question 3

Different types of Reservoirs
Considering the elevation it is classified into:
1. Surface reservoirs
2. Elevated reservoirs

Surface Reservoirs

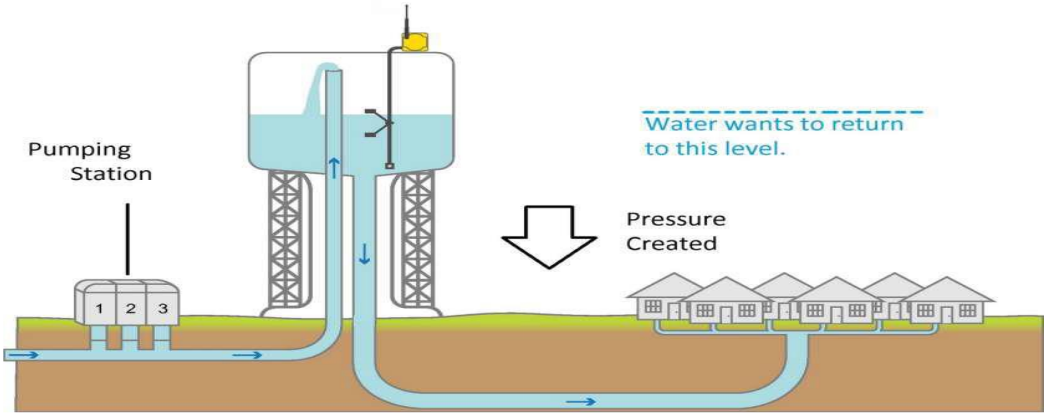
1. These are also called ground reservoir.
2. Mostly circular or rectangular tank.
3. Under ground reservoirs are preferred especially when the size is large.
4. In case of gravity system, underground reservoirs are generally constructed on high natural grounds and are usually made of stones, bricks, plain or reinforced cement concrete

5. The side walls are designed to take up the pressure of the water, when the reservoir is full and the earth pressure when it is empty.
6. The position of ground water table is also considered while designing these reservoirs.
7. The floors of these reservoirs may be constructed with R.C.C slab or stone blocks with sufficient water proofing.



Elevated Storage Reservoirs

1. Elevated Storage Reservoirs (ESRs) also referred to as Overhead Tanks are required at distribution areas which are not governed and controlled by the gravity system of distribution.
2. These are rectangular or circular in shape.
3. If the topography of the town is not suitable for gravity system, the elevated tank or reservoir are used to provide sufficient pressure head.
4. They are constructed where combine gravity and pumping system of water distribution is adopted.



Importance of Reservoirs

- Reservoirs store water for distributing water during emergencies (such as during fires, repairs, peak demand etc.

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

Balancing Storage:
The quantity of water required to be stored in the reservoir for equalizing or balancing fluctuating demand against constant supply is known as the balancing storage.

Breakdown Storage:
The breakdown storage or often called emergency storage is the storage preserved in order to tide over the emergencies posed by the failure of pumps, electricity, or any other mechanism driving the pumps.
A value of about 25% of the total storage capacity of reservoirs, or 1.5 to 2 times of the average hourly supply, may be considered as enough provision for accounting this storage.

Fire Storage:
The third component of the total reservoir storage is the fire storage. This provision takes care of the requirements of water for extinguishing fires. Fire demand maybe calculated by the given formulas:

$$Q_F = 65\sqrt{P}(1-0.01\sqrt{P})$$

Q_F = fire demand l/s
P = population in thousands

$$Q_F = 53\sqrt{P}$$

Q_F = fire demand l/s
P = population in thousands

$$Q_F = 320 * C\sqrt{A}$$

Q_F = fire demand flow m^3/d
A = areas of all stories of the building under consideration (m^2)
C = constant depending on the type of construction;

QUESTION 4

Pumps are generally used in water supply scheme to

1. Transfer liquid from source to destination.
2. Circulate liquid around a system.

Pumping systems are generally designed for:

1. Head: Sum of kinetic and potential energy of liquid expressed in unit of length (meters / feet)

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

3. Pressure: The flowing liquid / water should have sufficient pressure at the destination and is normally expressed in pounds per square inch (psi).