Name: Engr. Faiza Sana

Student ID: 14662

Subject Name: Water Demand Supply & Distribution

Question NO.1. Define desalination and briefly describe various desalination methods? Which method is more effective, please elaborate briefly

Answer No.1.

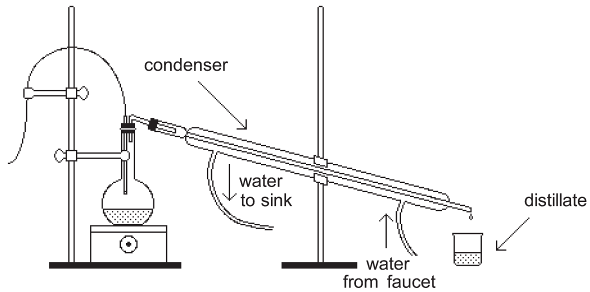
Desalination is a process that takes away mineral components from saline water. More generally, desalination refers to the removal of salts and minerals from a target substance, as in soil desalination, which is an issue for agriculture.

Various method of desalination

1) Distillation(Evaporation)
2) Electrodylasis
3) Freezing
4) Reservoir Osmosis

- <u>Distillation:</u>

  Salt water is heated in one container to make the water evaporate, leaving the salt behind. The desalinated vapor is then condensed to form water in a separate container. Although long known it has found limited application water supply because of the fuel cost involved in converted water to vapor is very high.



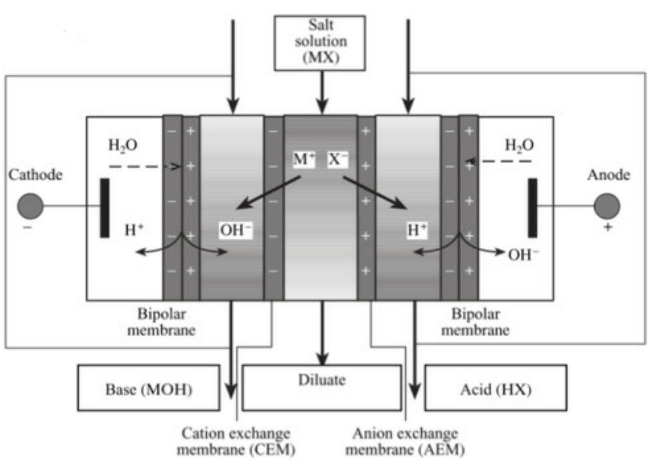
`

Electrodylasis:

The membranes used in electro dialysis are built to allow passage of either positively or negatively charged ions, but not both. Ions are atoms or molecules that have a net positive or net negative charge. Four common ionic molecules in saline water are sodium, chloride, calcium, and carbonate.

Electro dialysis use the driving force of an electrical potential to attract and move different cations (positively charged ions) or anions (negatively charged ions) through a permeable membrane, producing fresh water on the other side

The cations are attracted to the negative electrode, and the anions are attracted to the positive electrode. When the membranes are placed so that some allow only cations to pass and others allow only anions to pass, the process can effectively remove the constituents from the feed water that make it a saline solution.



- **Freezing Method:**

It is based on the principal that water excludes salts when it cristallize to ice

It Involves the Three steps:

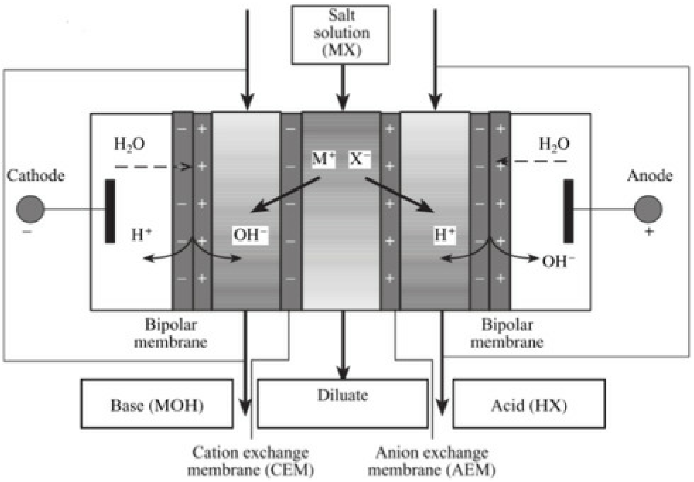
a) Ice formation
b) Ice washing and
c) Ice melting to obatin fresh water with susequest removal of contaminants.

- **Reverse Osmosis Method(RO):**

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

- Reverse osmosis can remove many types of dissolved and suspended species from water including bactterais and is used in both industrial process and also the production of potable water.

- It segnifficienly decreases the salts and other potential impurites in the water resulting in a high quality and great testing water.



Steps involved in reverse osmosis

Step 01:

Removal of sediments fgrom the water in this step all the sediments like clsy silt and stone are reomved from the water.

For this a 5micron filter is used in the sediments are filyterd in order to make sure that no deamges is done to the membrane.

The Micron filter does not let these particles pass by and thus they are suspended.

Step02:

In the second step carbon filter is used to remove the chlorine and other harmful chemical that enter the water source.

The chemicals are harmful to human health and thus it is necessary to remove them.

Steps 03:

The third step focuses on the passing the water from a dense and compacted carbon filter.

Most of the contaminates are remove here.

Step04:

Water passes through the membrane and all the heavy metals present in the water are removed.

Along with metals radioactive metals too are removed in this step the impurities are drained out of the reverse osmosis system and clean water separator.

Step05:

In this last stage the bacteria's chlorine and bad odor are removed from water after passes from this stages it comes out of the fact is perfect for consumption.

This step involved tertiary treatment or polishing.

Note*: <u>In the above mentioned methods of desalination the Reverse Osmosis is considerd to be most affective methods because it gives us the water which is free from bacterias and any other harmful ingredients</u>*.

Question NO.2. Briefly describe merits and demerits of 4 types of water distribution layouts? Which layout will you recommend for newly proposed township in hilly area? Support your answer with justification?

Answer No.2.

Definition.

The layout of water distribution system tells us the network of pipes provided in the area and helps to determine the repair locations if any damages occurs. The distribution of water means delivering treated water to the user from the source. The distribution should take place in such a way that the users or consumers should meet their demand of water with sufficient quantity and quality.

Different methods of laying out distribution system are as follows:

Dead end system

Grid iron system

Ring system

Radial system

1. Dead End Water Distribution System.

Dead end system, the name itself defining that it contains dead ends in the pipe system. So, the water does not flow continuously in the dead end system. In this system the whole pipe network is divided into several sub networks. Those are namely main line, sub mains, branch lines and service connections.

Firstly, one main line is laid through the center of the city or area. Sub mains are laid on both sides of the main line and then sub mains divided into branch lines from which service connections are given. At every starting point of sub main line, a cut off valve is provided to regulate the flow during repair works etc.

On the whole, this network diagram will look like a tree shape, so it is also called as tree system. This type of system is used mostly for the olden cities which are built in irregular manner without any planning. Now a days, this system is not preferable

Merits	De Merits
1. Pipes in this network can be laid easily. 2. The pressure and discharge in each pipe can be determined very easily and accurately which makes design calculations very simple. 3. 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. 4. Dead end system requires less number of cutoff valves	1. The pressure is not constant and is very less at remote parts. 2. Because of dead ends water stagnation takes place which results in deposition of sediment. To remove this sediments, more number of scour valves are to be provided at the dead ends which increase economy. 3. 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. 4. In this system, Limited discharge is available for firefighting.

2. Grid Iron Water Distribution System

Grid iron system also contains main lines, sub mains and branch lines. But in this system dead ends are eliminated by interconnecting all the lines. Hence, the water flow continuously in this system without stagnating. So, this system is also called as interlaced system or reticulation system. It is more suitable for well-planned cities.

Merits	De Merits
1. Water will flow continuously without any dead ends or sediment deposits. 2. Head loss is minimum in this case because of interconnection of pipes. 3. The discharge will meet the required discharge for firefighting. 4. Repair works can be easily done just by closing cutoff valve in that line which do not affect the other users.	1. Because of circulating flow from all directions, the pipes used in this system should be of large diameters and longer lengths. 2. We cannot determine the accurate discharge, velocity or pressure in a particular pipe. So, design is difficult. 3. Laying of pipes will be done by skilled workers which consume more cost. 4. Cutoff valves required should be more in this system.

3. Ring Water Distribution System

Ring system, can also be called as circular system in which the main pipe line is provided around the city or area. From this main line, the branch lines are projected perpendicularly and they are also connected with each other. So, every street of the distributed area will get sufficient quantity of water. For a town with well-planned streets and roads, Circular system is more suitable.

Merits	De Merits
1. No stagnation of water 2. Repair works can be done without affecting larger network. 3. Large quantity of water is available for firefighting.	1. Longer length and large diameter pipes are required. 2. More number of cutoff valves are necessary. 3. Skilled workers are necessary while laying pipes.

4. Radial Water Distribution System

Radial system is quite opposite to the ring system. In this system, whole area is divided into small distribution districts or zones and an individual distribution reservoir is provided for each distribution zone. The reservoir provided is generally of elevated type. From this reservoir the pipe lines are laid radially to the surrounded streets.

All distribution reservoirs are connected with main line which is passing through center of the city. This type of system is suitable for areas with radially designed roads.

Merits	De Merits
1. The water distributed with high velocity and high pressure. 2. Head loss is very small because of quick discharge.	1. Cost of the project is more because of number of individual distribution reservoirs.

Recommended distribution system for Hilly Areas.

For hilly area gravity flow system is suitable with Dead End piping system because of frequent elevation difference and scattered population to maintain pressure in the pipe. Economical because more power is required for pumping of water in the pipes all due to gravity flow.

Question No.3. What are different types of reservoirs used in water supply systems? Briefly describe its importance and how its storage capacity be calculated?

Answer No.3.

DEFINATION

A reservoir is a man-made lake or large freshwater body of water. Many people think of a reservoir as a lake and might even use the words interchangeably. However, the key difference is that reservoirs are artificial and made by humans, while lakes are naturally occurring bodies of water. Reservoirs are great because they provide a supply of water for when naturally occurring bodies of water, like lakes or rivers, run dry. We'll talk more about what kinds of reservoirs there are, and what we use them for next.

Types of Reservoirs

There are different types of reservoirs; Valley-dammed reservoirs, Bank-side reservoirs, Surface reservoirs, Elevated reservoirs.

1) Valley-dammed reservoirs

Valley-dammed reservoirs are created in valleys between mountains. Usually, there is an existing lake or body of water. The mountain sides are used as the walls of the reservoir to hold the water. A dam, or artificial wall in the reservoir, is built at the narrowest point to hold in the water.

To create a valley-dammed reservoir, the river that will fill the reservoir must be diverted, so the ground can be cleared to lay a foundation for the dam. Next, a concrete lining is put in place, and dam construction can begin. It can take years to build a dam, but once it's done, the water pools in the valley, and a large source of water becomes available

2) Bank-side reservoirs

Bank-side reservoirs are reservoirs that are made by diverting water from local rivers or streams to an existing reservoir. Although this can be applied to many different geographical areas, unlike the valley-dammed reservoir, which requires a valley, diverting water from a river can create problems. The River Thames in London is one example of a bank-side reservoir.

Depending upon there elevation w.r.t ground it may be classified as

3) Surface reservoirs.

These are also called ground reservoir.

Mostly circular or rectangular tank. Underground reservoirs are preferred especially when the size is large. 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. 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. The position of ground water table is also considered while designing these reservoirs. To obtain water tightness bitumen compounds are used at all construction joints. For aeration of water and inspection, manholes, ventilation pipes and stairs are provided.

SURFACE RESERVOIR

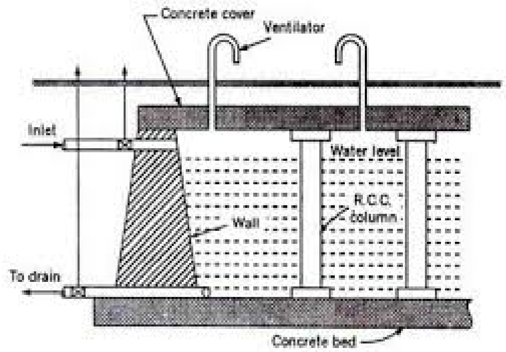
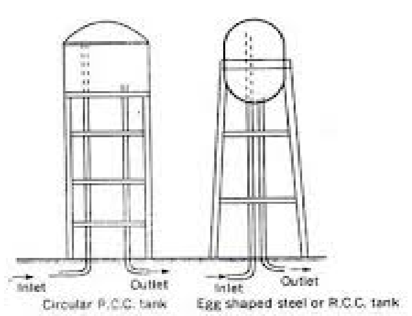


Fig. 18.12. Underground Masonry and R.C.C. Reservoirs.

4) Elevated reservoirs

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. These are rectangular or circular in shape. 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.



Circular R.C.C. Tank. *Egg Shaped Steel or R.C.C. Rank.*

Fig. 18.15. Various Shapes of Elevated Tanks.

ELEVATED STORAGE RESERVOIRS

The total storage capacity of a distribution reservoir is sum of Balancing Storage, Breakdown Storage & Fire Storage.

1) 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 (or equalizing or operating storage).

2) Break Down 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.

3) 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.

To calculate the storage capacity of any reservoir we have 2 methods by which we determine the capacity of a reservoir:

1. Analytical Method:

In this method an analysis of demand and inflow of water per month of the year is made.

The following data are required:

(I) Total inflow of the stream during each month of a critical low flow year (or dry year) at the reservoir site.

(ii) Total loss of water due to evaporation, percolation, etc., during each month of the year.

(iii) Total precipitation (if any) during each month of the year.

(iv) Total amount of water required to be released from the reservoir during each month of the year to satisfy the prior water right requirements of the residents on the downstream of the reservoir.

(v) Total demand of water during each month of the year.

The following procedure is adopted to determine the capacity of the storage reservoir:

(I) From the total inflow of the stream during each month, the total loss of water due to evaporation, percolation, etc., and the total amount of water to be released to meet the downstream requirements during that month are subtracted and the total amount of precipitation (if any) during the same month is added. This gives the adjusted or net inflow of the stream for different months of the year.

(ii) By subtracting the adjusted or net inflow from the demand the deficiency or the amount of water required from the storage to meet the demand for different months is obtained. However, if the demand is less than the adjusted or net inflow it indicates a surplus.

(iii) The total deficiency during the successive months gives the required capacity of the storage reservoir.

(iv) If provision is to be made for two or three successive dry years, the capacity obtained in step (iii) is increased accordingly.

This method of determining the capacity of a storage reservoir is indicated in Illustrative.

2. Mass Curve Method:

The mass curve method is more commonly used for determining the capacity of a storage reservoir.

Mass Curve and Determination of Capacity of a Storage Reservoir Required For a Specified Yield or Demand Using Mass Curve:

Mass Curve of Inflow:

A mass curve of inflow (or mass curve) is a plot of accumulated flow in a stream against time. As indicated below a mass curve of inflow can be prepared from the flow hydrograph of a stream for a large number of consecutive previous years.

Question NO.4. Why pumps are used in water supply schemes and how to calculate pump curve to meet water demand?

Answer No.4.

Why pumps are used in water supply schemes.

To raise or lift the water by means of a pump from one (1) or more points in the water supply system and lifting of water from lake reservoirs, rivers, tube wells & water treatment plants.

Direct pumping into supply main and sub mains and to maintain required pressure.

Lifting water from water source and store it to elevated reservoir and from reservoir to pipe distribution system under gravity.

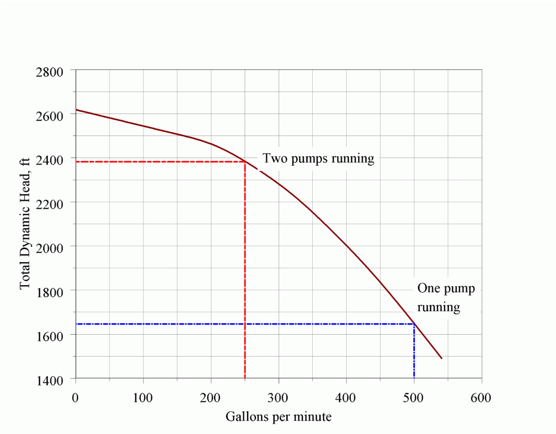
In some systems boosters pump may be needed at certain points to keep pressure at desirable levels stand by emergency pumps are also needed for any breakdown to supply un interrupted supply of water to take care of great demand during incident of fire etc.

Pump curve.

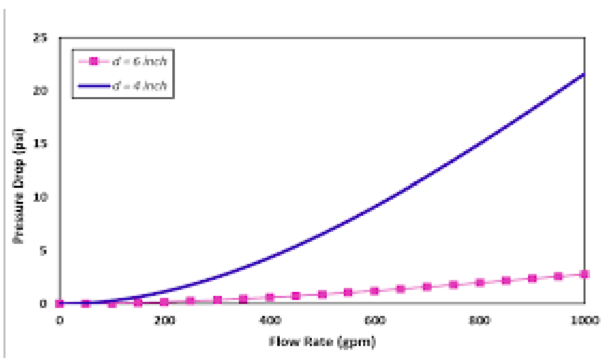
A pump performance curve is simply a graph or chart that represents the performance capabilities of a given water pump. A pump manufacturer conducts a variety of tests and the findings are then reflected on a graph, which we refer to as the pump curve. A pump curve will typically show not just the maximum 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. Once you know how to read a pump curve you will be able to determine Common Information a Pump Curve can provide.

- Total Dynamic Head.
  Total dynamic pump head, most commonly referred to as total head, concisely stated is the height that a water pump is capable of raising a liquid. It is the total vertical distance that the pump is capable of 'pumping'. The greater the pressure, the higher the head. The lower the

pressure, the lower the head.



- <u>Flow Rate</u>
Flow rate, or rate of flow, is the total maximum amount of liquid flow that a pump can produce during a specified period of time. It is almost always measured per minute and most pump curves will show either gallons per minute (GPM) or liters per minute (LPM), or commonly both. The greater the pressure, the higher the flow rate. The lower the pressure, the lower the flow rate.



- <u>NPSHR (Net Positive Suction Head Required)</u>
Net positive suction head required is the minimum amount of pressure or force of energy that is required at the suction port (inlet) to overcome the losses from friction that are caused between the suction head/nozzle (inlet) and the eye of the impeller, without causing vaporization (cavitation) of the liquid being pumped

- <u>Best Efficiency Point</u>
  Every pump has a best efficiency point (BEP) and many pump curves will clearly show the BEP. BEP is the rate of flow and the total head at which a pump efficiency is at a maximum at a given motor speed and impeller diameter.