Iqra National University

Department of Civil Engineering

Final- Term Examination 2020

SUBMITTED BY; KAUSAR RAFIQ ID; 15475

Discipline: MS Civil Engineering

Course Title: Water Demand Supply and Distribution

Instructor Name: Engr. Nadeem Ullah

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Q1. Define desalination and briefly describe various desalination methods? Which method is more effective, please elaborate briefly?

Answer;

Definition: Desalination simply means removal of salt and minerals from water or any substance to make it suitable for drinking, indutrial uses and irrigation purposes. OR

Desalination is a process that extracts minerals from saline water.

Description:

As we all know that sea water can not be used for drinking or any industrial purpose because of presence of high amount of minerals. The minerals can cause serious health problems if taken in. It can damage the kidney and will also cause dehydration.

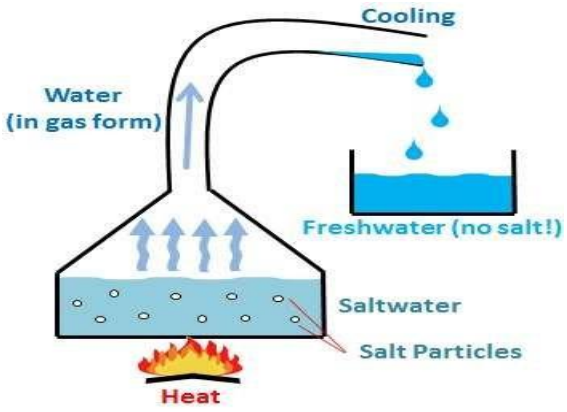
Desalination happens naturally and through man made machines. The term is frequently used for producing freshwater from seawater as the process involves separating salts and other minerals from the ocean water thereby desalinatiing it.

Desalination Methods:

1. Distillation
2. Electro dialysis
3. Freezing
4. Reverse osmosis

1. Distillation:

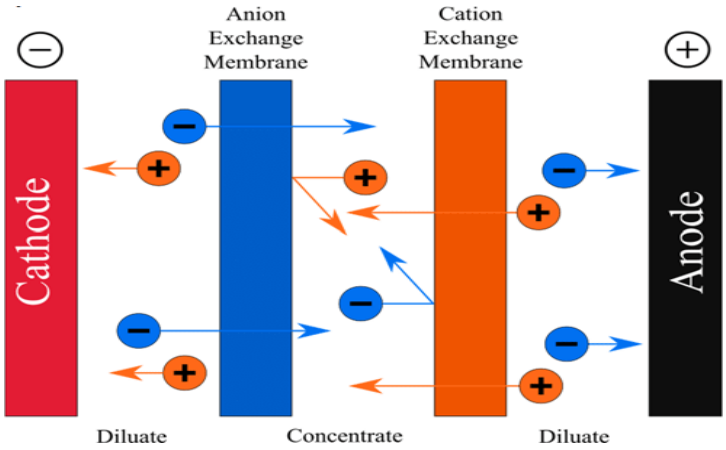
Salt water is heated in one container to make the water evaporate, leaving the salt behind. The desalinated vapor is then condensed to form water in a separate container. Although long known, it has found limited applications in water supply because of the fuel costs involved in converting salt water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



2. 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.



3. Freezing Method:

It is based on the principle that 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.

4. Reverse Osmosis:

Reverse osmosis (RO) is a water purification 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 bacteria, and is used in both industrial processes and the production of potable water.
It significantly decreases the salts and other potential impurities in the water, resulting in a high quality and great-tasting water.

Steps Involved in Reverse Osmosis

1st Step

Removal of sediments from the water. In this step all the sediments like clay, silt and stones are removed from the water. For this, a 5-micron filter is used. The sediments are filtered in order to make sure that no damage is done to the membrane.

2nd Step

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

3rd Step

The third step focuses on passing the water from a dense and compacted carbon filter. Most of the contaminants are removed here.

4th Step

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

5th Step

In this last stage, the bacteria, chlorine, and bad odour are removed from water. After water passes from this stage, it comes out of the faucet and is perfect for consumption.
This step involves tertiary treatment or polishing.

Most effective method for desalination:

The most effective method today that I know of is reverse osmosis, which basically means pushing the salt water through a filter that

has holes large enough for water molecules to pass through but too small for salt or other molecules to pass through.

The oldest method is to heat the water until steam comes off it, collect the steam and cool it until it condenses back into pure water. This process is called distillation, and the water is called distilled water.

Q2. 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:

Layouts of Distribution System: There are in general four different types of pipe networks; any one of which either single or in combination, can be used for a particular place. They are:

- Dead End System
- Radial System
- Grid Iron System.
- Ring System

1. Merits and Demerits of Dead End System:

Merits:

- Pipes in this network can be laid easily.
- Relatively cheap.
- Determination of discharges and pressure easier due to less number of valves.
- Simple design calculation.

Demerits:

- It gives limited supply during the fighting.
- The water may be polluted at the dead end.
- prevent the free circulation of water due to numerous end.

2. Radial System:

Merits:

- It gives quick service.
- Stagnation does not occur.

- The initial cost is low.

Demerits:

- The clients at the distant end of the distributor face serious voltage fluctuations due to load distribution changes.
- The end of distributor near to the substation gets heavily loaded.

3. Grid-iron System:

Merits:

- In the cases of a breakdown in some section, water is available from some other direction.
- Water is kept in good circulation due to the absence of dead ends.

Demerits:

- Proper designing is relatively difficult.

4. Ring System:

Merits:

- gives the user a greater security of supply
- Water can be supplied to any point from at least two directions.

Demerits:

- Ring is very expensive n requires more materials
- High maintenance cost.

Best layout for hilly areas:

The gravity system is the most reliable system for hilly areas. This system is uesful in hilly areas where the source of supply is located above the level of the city. Suvh that adquate pressure is obtained in the network directly . there are multiple well protected conduits carrying the flow to the community.

Justifications:

- The system is based on the simple phenomenon of water flow under gravity from a point of higher elevation (source) to a point situated on a lower elevation.
- The system had the capability to provide uniform emitter discharge throughout the command area spread on several terraces with varying elevations and irregular shapes.
- Due to higher elevation frictional losses are minimum.

Q3. What are different types of reservoirs used in water supply systems? Briefly describe its importance and how its storage capacity be calculated?

Answer:

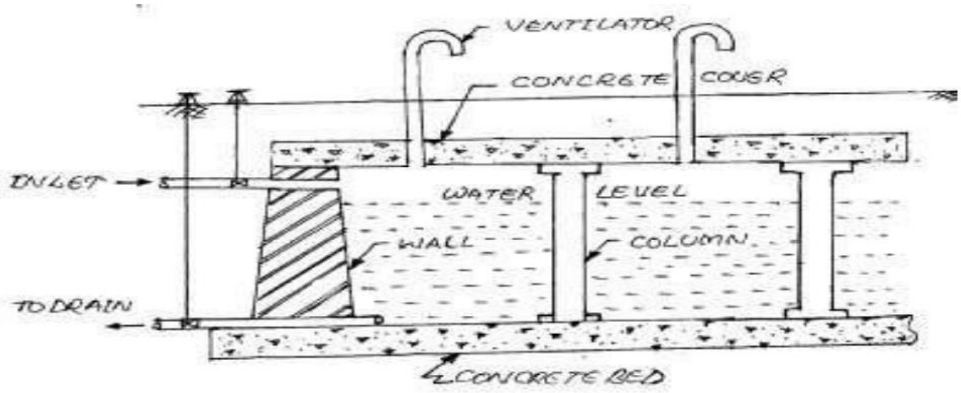
Types of Reservoirs used in water supply system:

Depending upon their elevation with respect to ground it may be classified into two types.

1. **Surface Reservoirs**

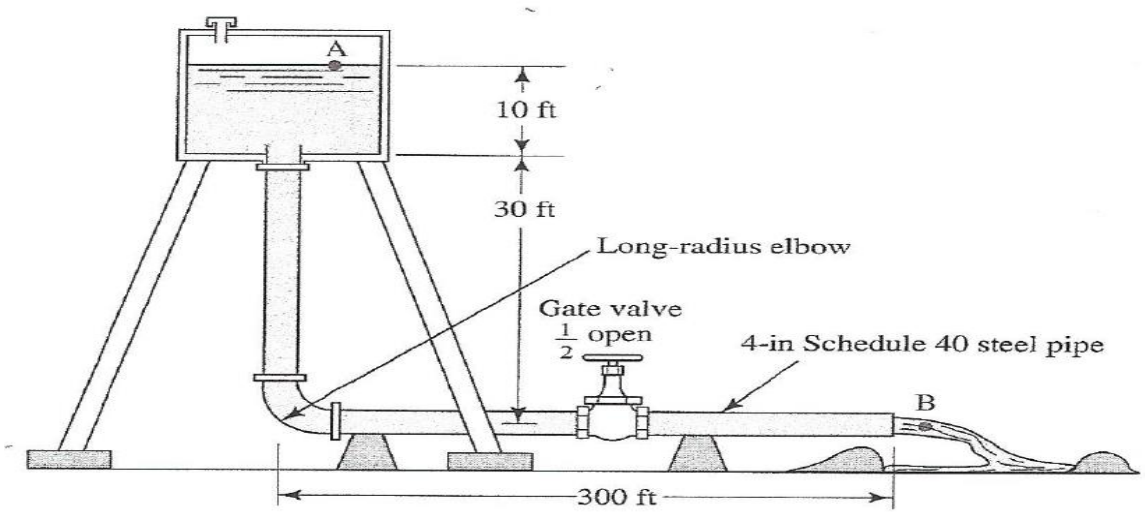
These are also called ground reservoir. Mostly circular or rectangular tank. Underground reservoirs are preferred especially when the size is large. In case of gravity system, underground reservoirs are generally constructed on high natural grounds and are usually made of stones, bricks, plain or reinforced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



2. 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.

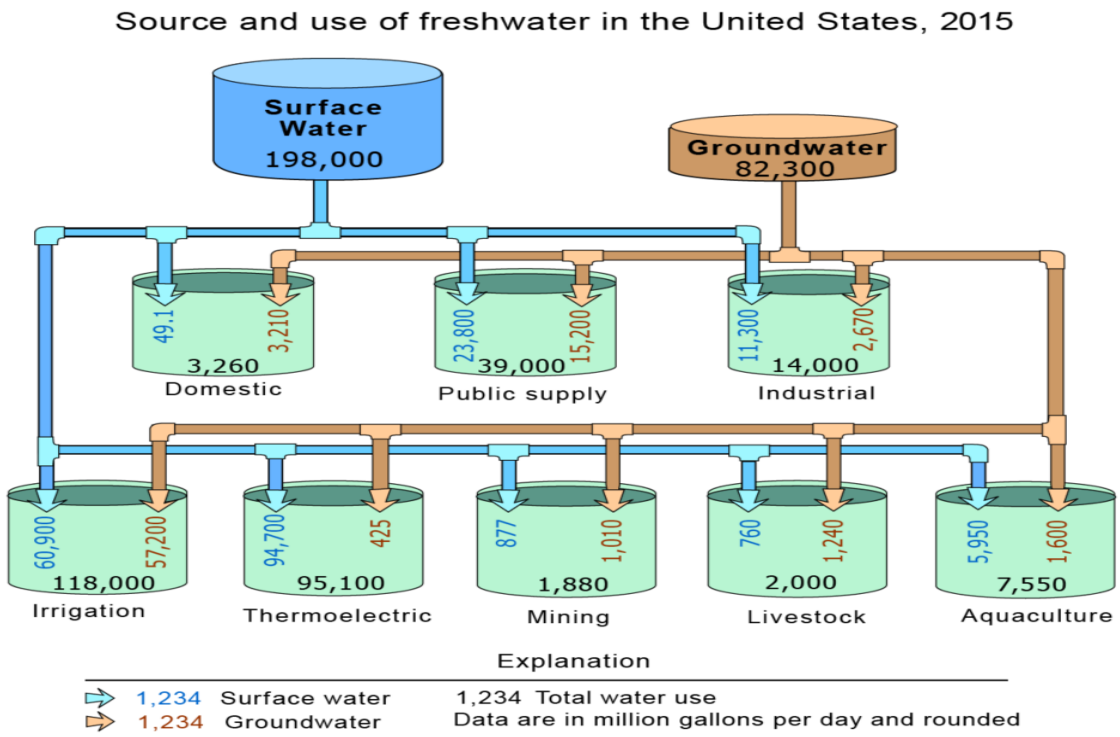


Importance of water Reservoir

The main uses of surface and elevated water reservoirs include.

- Drinking-water and other public uses
- Use of the elevated tank is to provide water storage in districts having no natural and conveniently located hill.
- Thermoelectric-power industry to cool electricity-generating equipment
- The majority of water used for thermoelectric power, public supply, irrigation, mining, and industrial purposes came from surface-water sources
- Supports the production of renewable energy (usually large multipurpose reservoirs.
- Increases water storage, resulting in increased water security and reliable supplies for socioeconomic activities.
- Irrigation uses
- Offers recreational benefits
- Surface reservoir serving both as a means of collecting and of storing.
- Under a potential head and in a manner requiring no further force than gravity to deliver the water where and when required.

- The value of elevated tanks to provide for the storage of water under these desirable conditions.



Calculation of storage capacity.

1. Balancing approach:

Balancing storage is the Fluctuating demand against constant supply is known as the balancing storage

2. Percentage approach:

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 Approach.

Fire demand maybe calculated by the

Given formulas. The total reservoir storage can

Finally be worked out by adding all the three storages.

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

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

Q4. Why pumps are used in water supply schemes and how to calculate pump curve to meet water demand?

Answer.

During the late night and early morning hours, when water demand is lower, high-lift pumps fill the tank. During the day, when water demand is higher, water streams out of the tank to help fulfill the pinnacle hourly water needs. This takes into consideration a uniform stream rate at the treatment plant and pumping station. Numerous sorts of pumps are utilized in circulation frameworks. Pumps that lift surface water and move it to a close by treatment plant are called low-lift pumps. These move huge volumes of water at moderately low release pressures. Pumps that release rewarded water into blood vessel mains are called high-lift pumps. These work under higher weights. Pumps that expansion the weight inside the circulation framework or raise water into a raised stockpiling tank are called sponsor pumps. Well pumps lift water from underground and release it straightforwardly into a conveyance framework.

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 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. For pumps in a typical water supply and distribution system, only pumps with "normal rising" to "steeply rising" performance curves should be used. Pumps with these characteristics will perform well in parallel operation and will have relatively small capacity change with pressure changes.

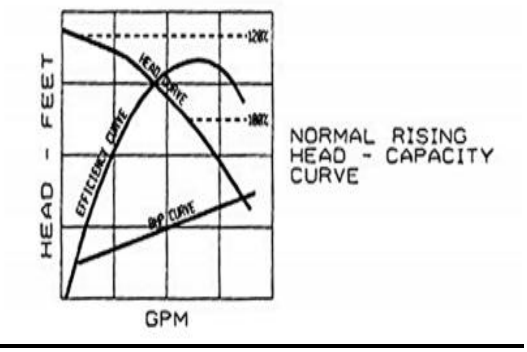


Fig.1 Normal Rising Head Capacity Curve

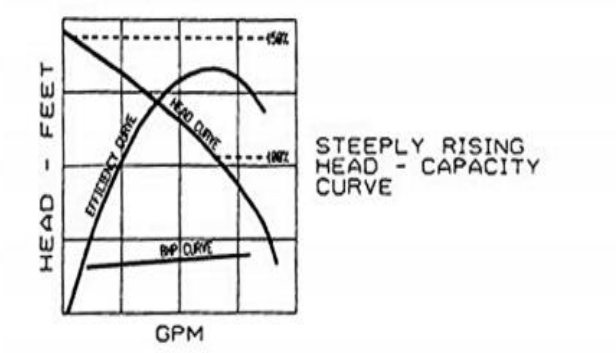
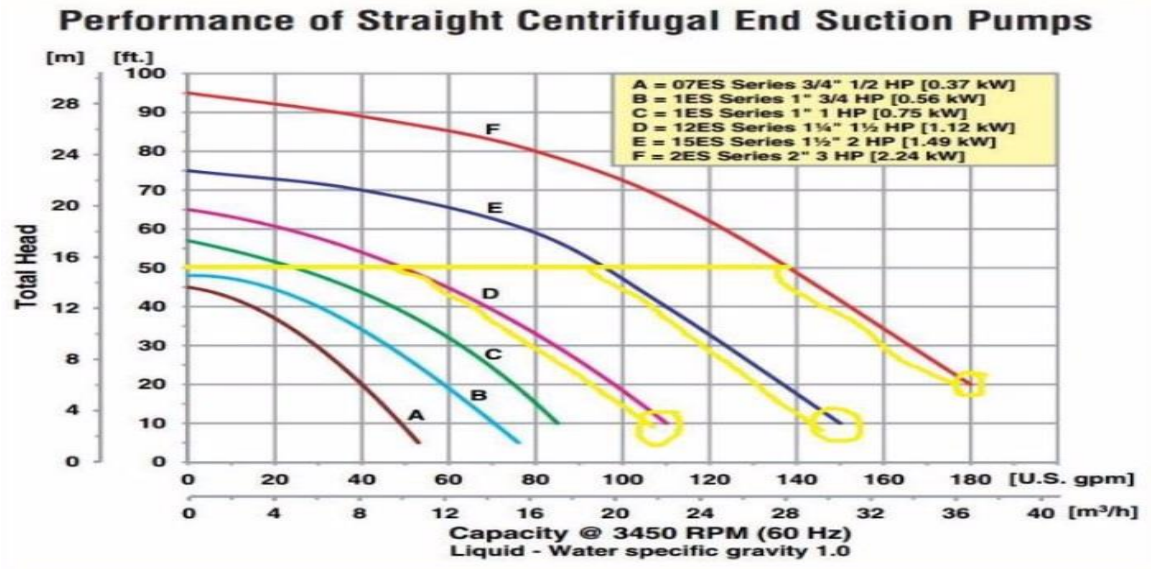


Fig.2 Steeply Rising Head Capacity Curve

Pump Curve reads as:



Determine which pump is capable under pump capacity curve:

- From the left of the curve, starting at 50ft, draw an imaginary line to the right.
- Then follow each pump curve down towards the GPM.
- We can see that pump D will give us the 50 feet of head we require but will only give us 110gpm. It's probably similar to the pump you are replacing.
- Pump E will meet our 50ft head requirement (it's capable up to 75ft) and at 50ft head it will give us 145gpm. Pump F at 50ft of head will give us 180gpm.