Iqra Natonal University

MID TERM ASSIGNMENT

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June 25,2020

Answer#1:

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

Desalination or desalinization refers to any of several processes that remove the excess salt and other minerals from water in order to obtain fresh water suitable for animal consumption or irrigation, and if almost all of the salt is removed, for human consumption, sometimes producing table salt as a by-product.

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 desalination methods:

1.Distillation (Evaporation)

2. Electro dialysis

3. Freezing

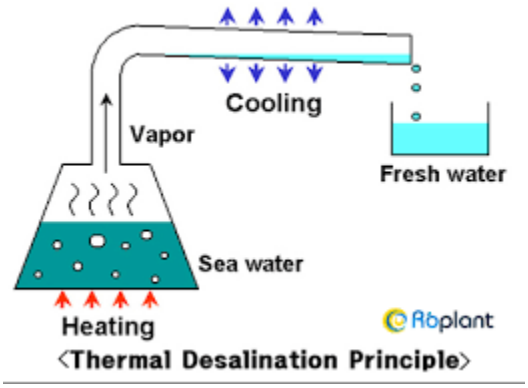
4. Reverse osmosis

Distillation (Evaporation)

Distillation is the process of separating components of a mixture based on different boiling points. Examples of uses of distillation include purification of alcohol, desalination, crude oil refining, and making liquefied gases from air

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.



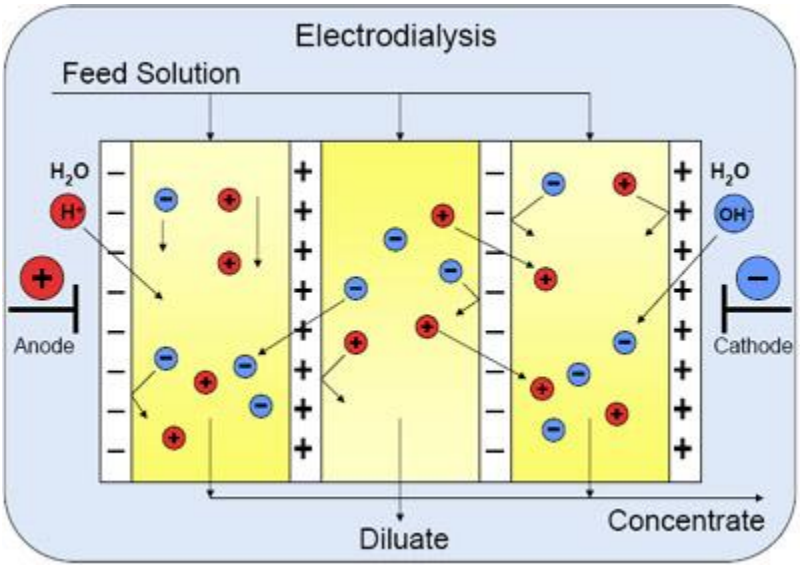
<Thermal Desalination Principle>

Electro dialysis

Electro Dialysis (ED) is a membrane process, during which ions are transported through semi permeable membrane, under the influence of an electric potential. The membranes are cation- or anion-selective, which basically means that either positive ions or negative ions will flow through.

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

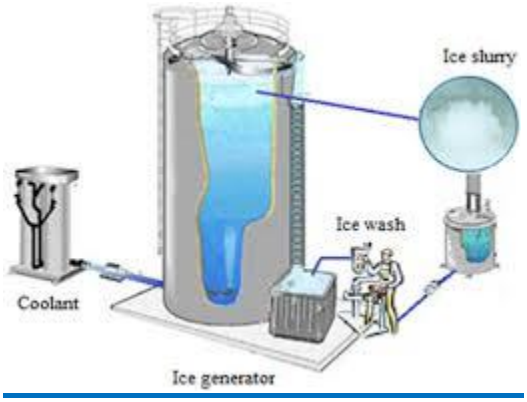
It draws metal ions to the positive plate on one side, and other ions (like salt) to the negative plate on the other side.

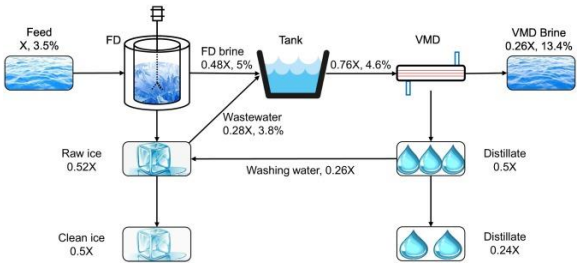


Freezing

Desalination by freezing processes is based on the fact that, in physical chemistry, ice. crystals formed are made up of essentially pure water when the temperature of saline. water is lowered to its freezing point and further heat is removed. In fact, it is the nature.

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



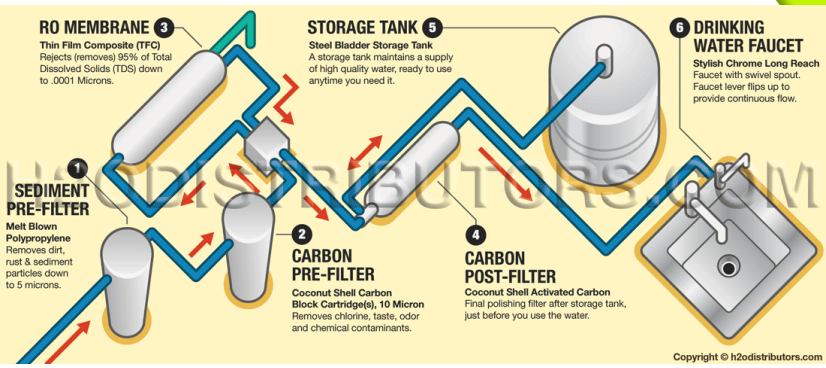


Reverse osmosis

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.



There are generally four stages in the reverse osmosis process:

1. Sediment Filter:
2. Carbon Filter:
3. Reverse Osmosis Membrane: ...
4. Polishing Filter:

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.

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

2nd Step –

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

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

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.

Along with the metals, radioactive metals too are removed. In this step, the impurities are drained out of the reverse osmosis system and clean water is separated.

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.

Method is more effective for disalination

Reverse osmosis is an effective means to desalinate saline water, but it is more expensive than other methods. As prices come down in the future the use of reverse osmosis plants to desalinate large amounts of saline water should become more common.

"The better you can clean water before it goes into reverse osmosis, the better it runs," Fravel says.

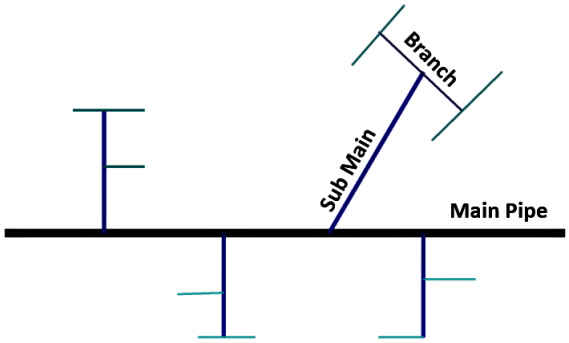
Q2. Briefly describe merits and demerits of 4 types of water distribution layouts?

Which layout will you recommend for newly proposed township in hilly area?

Support your answer with justification?

Merits and Demerits of Water Distribution Layouts:

1. Dead End system:



Advantages:

They are relatively cheap.

Due to a smaller number of valves determination of discharges and pressure is easier.

The design calculation is simple and easy.

A smaller number of cut-off valves are required and the operation and maintenance cost is low.

Pipe laying is simple

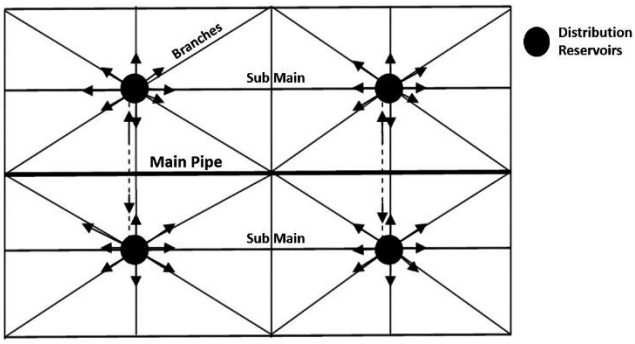
Disadvantages:

Stagnation of water in pipes occur due to many dead ends.

The system is less successful in maintaining satisfactory pressure in remote areas and is therefore not favoured in modern waterworks practice

One main pipeline provides the entire city, which is quite risky

2. Radial System:



Advantages:

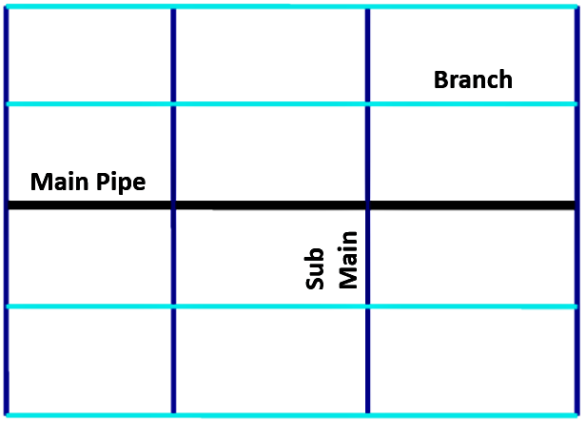
It gives quick service and there is no stagnation.

This system of layout ensures high pressure in distribution and it gives quick and efficient water distribution.

Disadvantages:

It may, however, be stated that generally only any one of these four systems of layout may not be suitable for the entire city or town.

3. Grid Iron System:



Advantages:

Since the water in the supply system is free to flow in more than one direction, stagnation does not occur as readily as in the branching system.

In case of repair or break down in a pipe, the area connected to that pipe will receive the water, as water will flow to that area from the other side.

Water reaches all points with minimum head losses. At the time of fires, by manipulating the cut off valves, plenty of water supply may be diverted and concentrated for firefighting.

The free circulation of water, without any stagnation or sediment deposit, minimises the chances of pollution due to stagnation.

Because of the interconnections water is available at every point with minimum loss of head.

Enough water is available at street fire hydrants, as the hydrant draws water from the various branch lines.

During repairs, only a small area of distribution is affected.

Disadvantages:

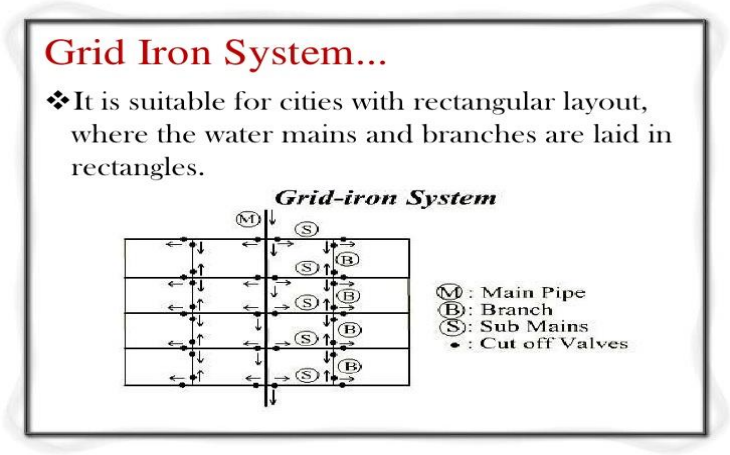
Cost of pipe laying is more because relatively more length of pipe is required. More number of valves are required. The calculation of pipe sizes is more complicated.

A large number of cut-off valves are required.

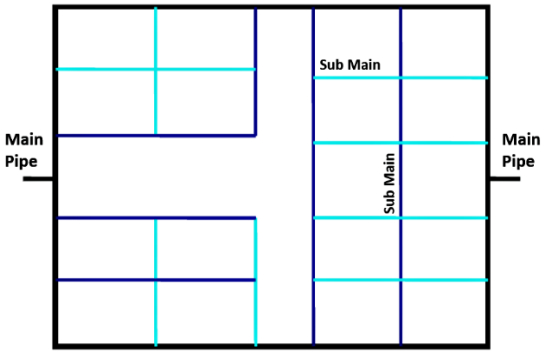
The system requires longer pipe lengths with larger diameters.

The analysis of discharge, pressure and velocities in the pipes is difficult and cumbersome.

The cost of pipe laying is higher.



4. Ring System:



Advantages:

Determination of pipe sizes is easy. Water can be supplied to any point from at least two directions. The advantages and disadvantages of the ring system is same as grid iron system.

Disadvantages:

Ring is very expensive n requires more materials than radial

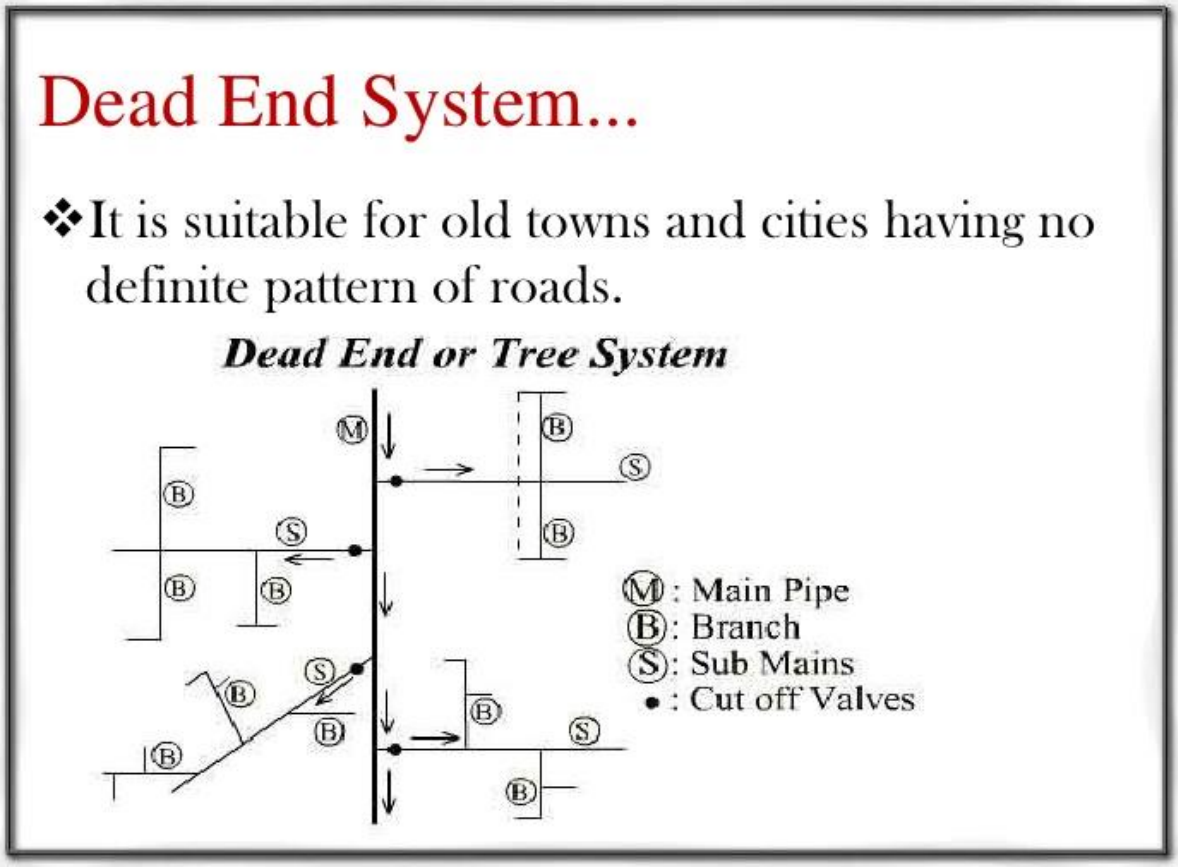
Radial circuit is more economical

High maintenance cost

It is not usable when the client is located at the center of the load

Type of layout used in newly proposed township in hilly area:

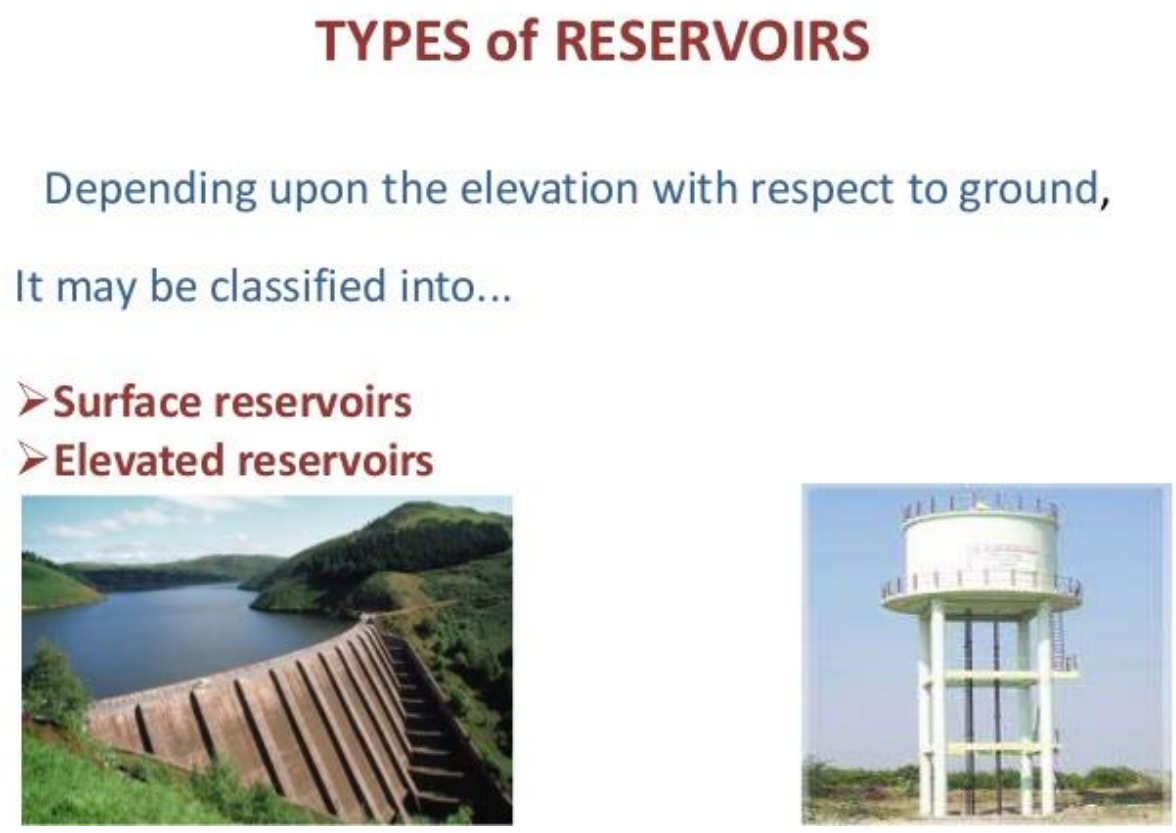
In hilly areas, mostly the areas are unplanned. So, the dead-end system is to be used in hilly area.



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

Depending upon their elevation w.r.t ground it may be classified into:

1. Surface reservoirs
2. Elevated reservoirs



1. Surface reservoirs

Description. **Surface reservoirs** are built structures for water storage that help improve water security for local communities. The types and sizes of **reservoirs** vary, from damming natural water bodies for storage to ground excavation in low-lying plains fed either by rainwater or diverted rivers.

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.

The floors of these reservoirs may be constructed with R.C.C slab or stone blocks with sufficient water proofing.

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 sources

Lakes and reservoirs

- Water is stored by water companies either in its untreated state in impounding reservoirs or lakes, or as wholesome water in service reservoirs

2. Elevated reservoirs

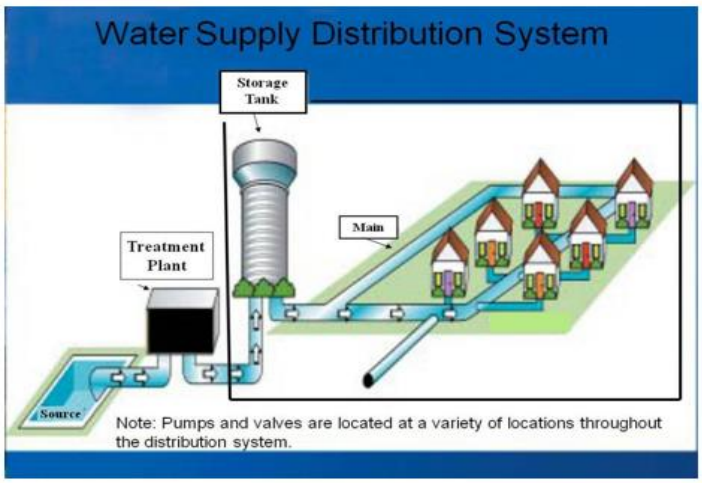
Elevated Storage Reservoirs (ESRs) also referred to as Overhead Tanks are required at distribution areas which are not governed and controlled by the gravity system of distribution.

An elevated reservoir stores clean water in a tank on a raised stand or tower. The elevation of the tank provides the water pressure to all points in the pressure zone of the distribution system. Tanks may be cylindrical, rectangular or any other convenient shape.

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 reservoir used water supply system

Under these conditions, more water is released from the reservoir so farmers can water their crops and homes and businesses can function normally. Reservoirs serve other purposes. They are used for boating, fishing, and other forms of recreation. Some of the dams that create reservoirs are used to generate electricity

Storage capacity be calculated

Reservoir Capacity means the gross volume of water which can be stored in the reservoir. "Dead Storage Capacity" means that portion of the Reservoir Capacity which is not used for operational purposes, and "Dead Storage" means the corresponding volume of water.

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

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.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.

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. ¬ 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?

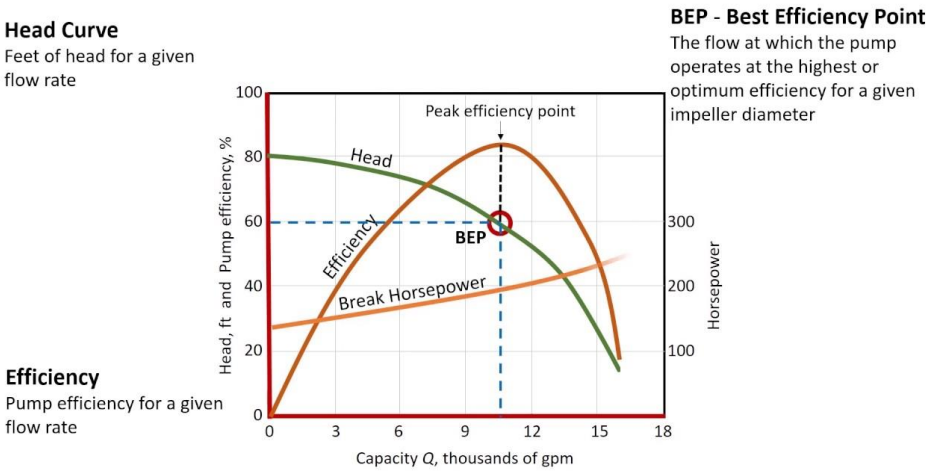
During the late night and very early morning hours, when water demand is lower, high-lift pumps fill the tank. During the day, when water demand is higher, water flows out of the tank to help satisfy the peak hourly water needs. This allows for a uniform flow rate at the treatment plant and pumping station.

Pumps that increase the pressure within the distribution system or raise water into an elevated storage tank are called booster pumps. Well pumps lift water from underground and discharge it directly into a distribution system. The flow rate through a centrifugal pump depends on the pressure against which it operates.

Pump curve

Curves typically include performance metrics based on pressure, flow, horsepower, impeller trim, and Net Positive Suction Head Required (NPSHr).

Pump curves are useful because they show pump performance metrics based on head (pressure) produced by the pump and water-flow through the pump. Flow rates depend on pump speed, impeller diameter, and head.



how to calculate pump curve to meet water demand

The **Formula** for PSI: Feet of Head/2.31 = PSI

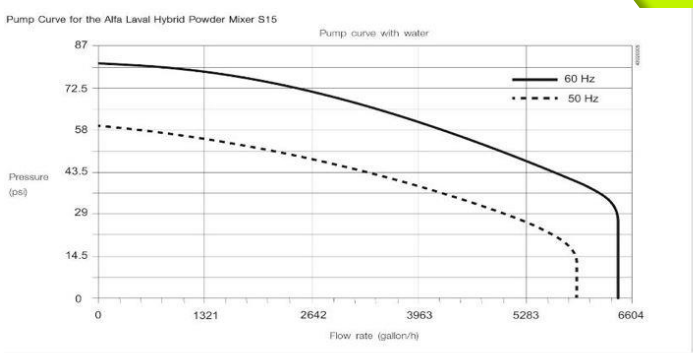
A basic **pump curve** shows a **pump's** performance range. In this **curve**, head is measured in PSI; flow is measured in gallons per hour.

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) .

Pump Curve for the Alfa Laval Hybrid Powder Mixer S15



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