SUBJECT: WATER DEMOND AND SUPPLY CODE 652

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Q NO 1

DESALINATION:

Desalination is the process of removing salt (sodium chloride) and other minerals from the sea water to make it suitable for human consumption and/or industrial use. The most common desalination methods employ reverse-osmosis in which salt water is forced through a membrane that allows water molecules to pass but blocks the molecules of salt and other minerals.

METHODS FOR DESALINATION

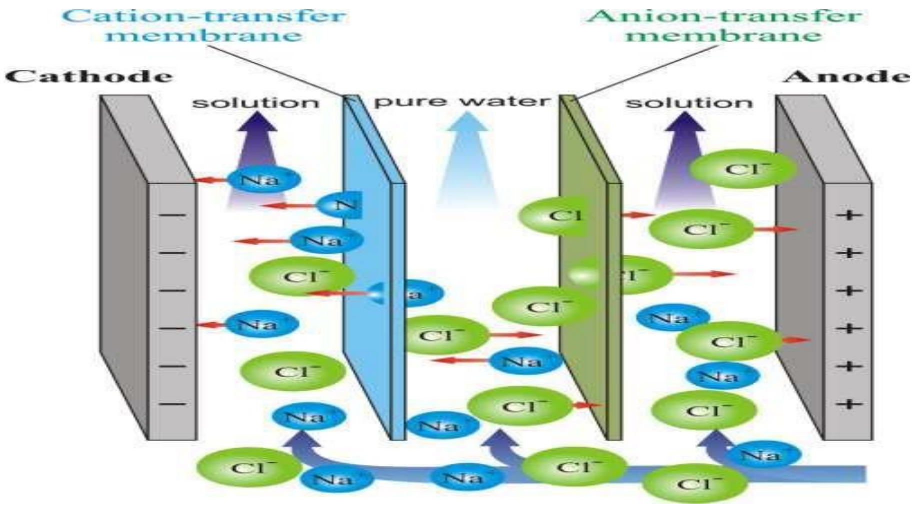
- Distillation (Evaporation)
- Electro dialysis
- Freezing
- Reverse osmosis

DISTILLATION:

- Salt water is heated in one container to make the water evaporates, leaving the salt behind.
- The desalinated vapor is then condensed to form water in 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.
- Water has a lower boiling point than the contaminants and minerals within it. This means that if you boil untreated water, the water will turn into vapor and leave everything else behind. Then the condenser lets the steam return to liquid water in a separate area from where it started. This is the concept behind purifying water through distillation.

ELECTRO DIALYSIS:

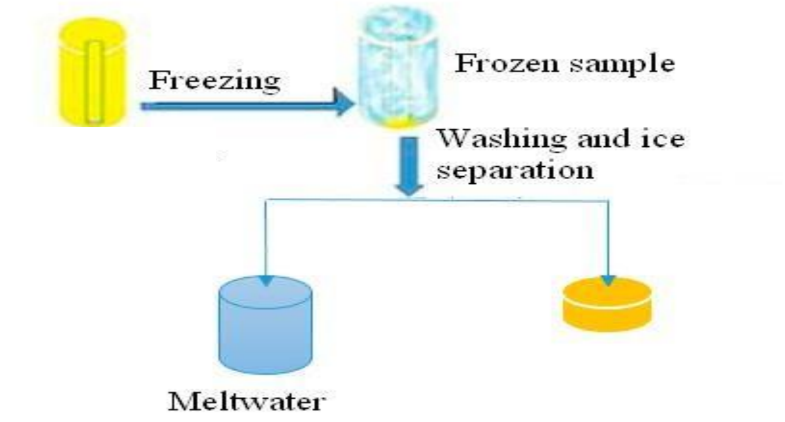
- Electro dialysis utilizes a membrane, and sends an electric charge through the solution.
- It draws metal ions to the positive plate on one side, and other ions (like salt) to the negative plate on the other side.



FREEZING METHOD:

Desalination by freeze crystallization is a freezing-melting process in which water is crystallized to ice and separated from saline solution. This area is observing a renascence to mitigate the staggering and sea rejected brine that has a negative environmental impact.

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



REVERSE OSMOSIS:

In reverse osmosis desalination, water is taken from the sea and receives a first treatment to eliminate impurities, oil, seaweed, rubbish, and so on. Once free of organic substances, the saltwater can be subjected to reverse osmosis. After the filtering, we have two streams: one brine and the other freshwater. The brine solution is diluted before being returned to the sea, avoiding high concentrations of salt which could harm the ecosystem. The fresh water passes through a demineralization and chlorination process, after which it is stored in tanks and then sent to the distribution network for consumption.

Reverse osmosis is not only the most advanced desalination system in the world today, it is the most efficient and beneficial for the planet: it generates up to four-and-a half-times fewer greenhouse gas emissions than all other technologies, it doesn't harm the marine environment, and it's able to recover a large part of the energy used in the process.

- 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 portable 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 filters used. The sediments are filtered in order to make sure no damage is done to the membrane.
- The micron filter does not let these particles pass by and sources.

2nd step:

- In the second step carbon filter is used to remove the chlorine and other harmful chemicals that enters 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 odor 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

Reverse osmosis method is more effective in the desalination process. applying reverse osmosis technology. Membrane processes use semi permeable membranes and pressure to separate salts from water. Reverse osmosis plant membrane systems typically use less energy than thermal distillation, which has led to a reduction in overall desalination costs over the past decade.

Q NO 3

RESERVOIRS:

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.

1 DISTRIBUTION RESERVOIR:

Distribution or service reservoirs are used in a distribution system to provide storage to meet fluctuations in demand of water, to provide storage for firefighting and emergencies such as breakdowns, repairs, etc., and to stabilize pressures in the distribution system.
These reservoirs may be constructed of brick masonry, stone masonry, and cement concrete-plain, reinforced or pre-stressed and steel. These reservoirs are always covered to avoid contamination and prevent algal growths. Further suitable provisions are made for manholes, mosquito-proof ventilation, access ladders, scour and overflow arrangements and water level indicator.

The various purposes served by service or distribution reservoirs are as follows:

1. If pumps are used, the provision of these reservoirs makes it possible to run the pumps at uniform rate.
2. In the case of gravity system of supply of water, the provision of these reservoirs will result in the reduction of the size of distribution mains.
3. These reservoirs provide the facility of storage of water for meeting the fluctuations in the hourly demand of water.
4. They help in maintaining constant pressure in distribution mains. In their absence the pressure in distribution mains will fall as the demand of water will increase.
5. The provision of these reservoirs results in an overall reduction in the size of pumps, pipes and treatment units. Thus the distribution system becomes economical.

6. These reservoirs serve as storage for emergencies such as breakdown of pumps, bursting of mains, heavy fire demand, interruption in power supply, temporary floods, etc.

The various accessories provided for elevated reservoirs are as indicated below:
(i) Inlet pipe for the entry of water.
(ii) Outlet pipe for the exit of water.
(iii) Overflow pipe for the exit of water above full supply level.
(iv) Ladders to reach the top of reservoir and then to the bottom of reservoir for inspection.
(v) Manholes in top cover or roof of reservoir for providing entry to the inside of reservoir for inspection.
(vi) Ventilators for free circulation of air.
(vii) Washout pipe (or drain pipe) for removing water after cleaning of reservoir.
(viii) Water level indicator for indicating from outside the depth of water in reservoir.

Volume of Water Requirement

As per IS code, 135 liters is needed for daily use per person per day. Breakup of the IS assumptions

- Drinking – 5 liters
- Cooking – 5 liters
- Bathing & Toilet – 85 liters
- Washing Clothes & Utensils – 30 liters
- Cleaning House – 10 liters

Water Tank Size & Capacity Calculation

For a typical family (4 members),

Total water requirement is 135 liters x 4 = 650 liters per day.

We all know Volume of water formula as 1 m^3 = 1000 liters of water.
In order to get the size of the water tank, you need to mention at least one dimension (Length, Width or Depth of the water tank).

If you are planning to construct a water tank in car parking area there may be some restriction on length.

That's the reason why we are planning to construct the underground water tank while foundation work.

From the above, volume of water formula,

1 m^3 = 1000 litres

TYPES OF RESERVOIRS

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

1. Surface reservoirs
2. Elevated reservoirs

Types of Reservoirs

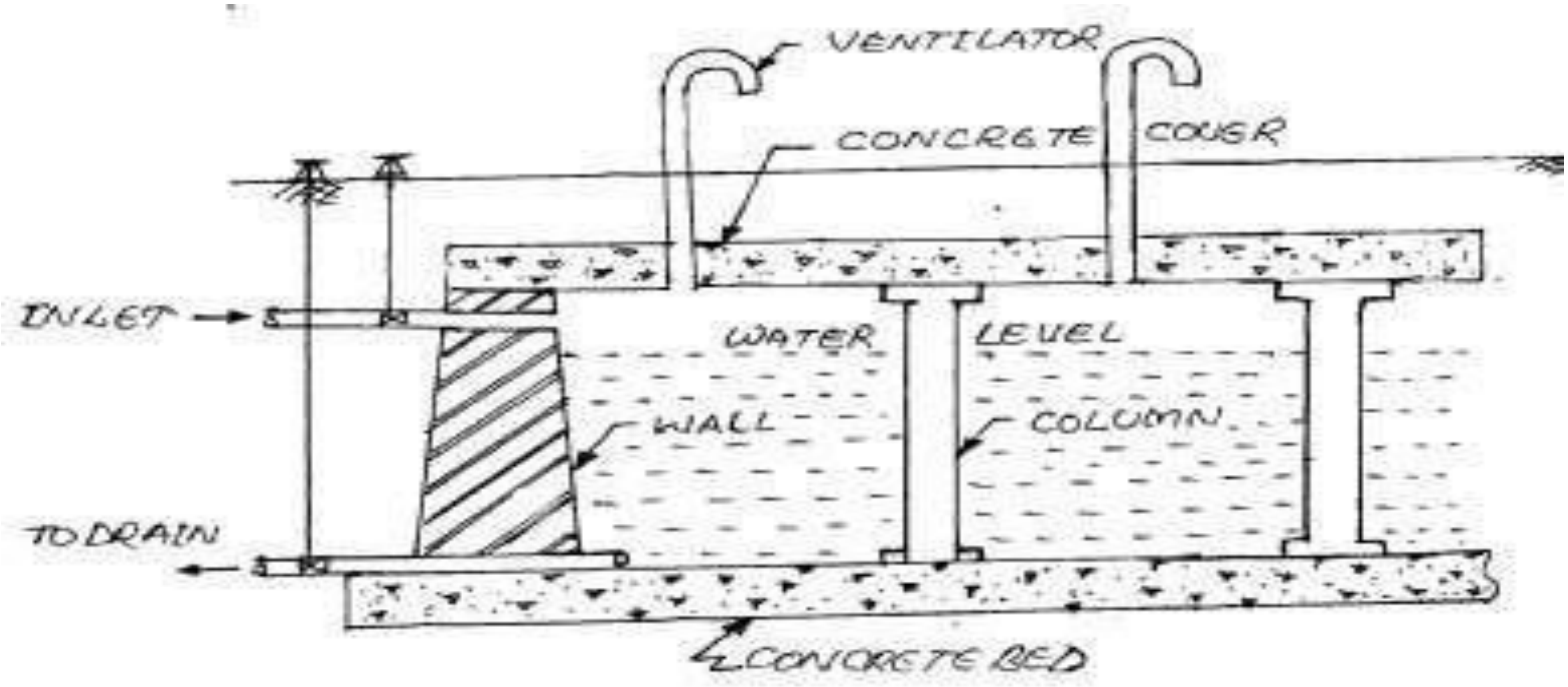
1. **SURFACE RESERVOIRS:**

- 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.
    - 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.

1. **SURFACE RESERVOIRS:**

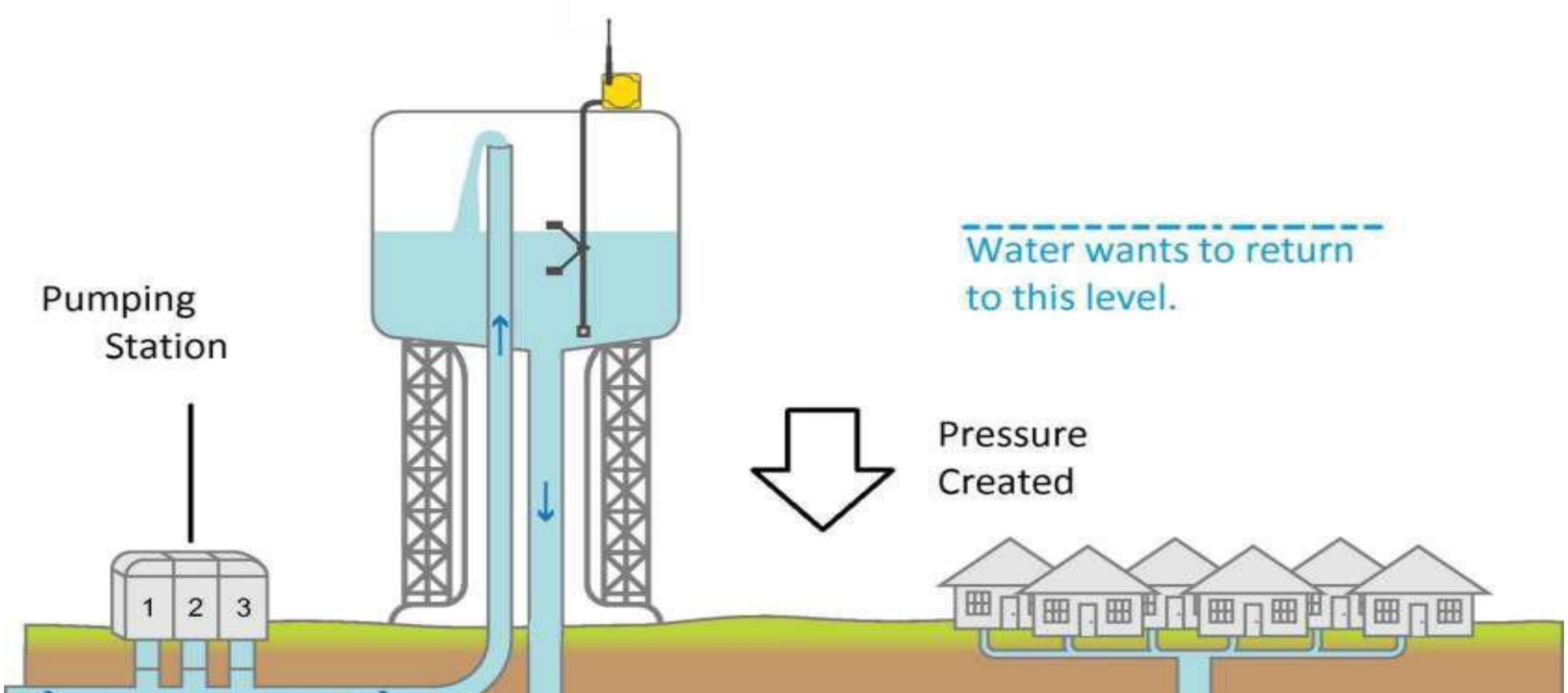
- To obtain water tightness bitumen compounds are used at all construction joints.
- For aeration of water and inspection, manholes, ventilation pipes and stairs are provided.

1. **Surface reservoirs:**



2. **<u>ELEVATED STORAGE RESERVOIRS:</u>**

- 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.



Storage Capacity Reservoirs

- 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

C = constant depending on the type of construction;

Q NO 4:

Pumps are used in water supply schemes because pumps that lift surface water and move it to a nearby treatment plant are called low-lift pumps. These move large volumes of water at relatively low discharge pressures. Pumps that discharge treated water into arterial mains are called high-lift pumps. These operate under higher pressures. 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.

Most water distribution pumps are of the centrifugal type, in which a rapidly rotating impeller adds energy to the water and raises the pressure inside the pump casing. The flow rate through a centrifugal pump depends on the pressure against which it operates. Another kind of pump is the positive displacement type. This pump delivers a fixed quantity of water with each cycle of a piston or rotor. The water is literally pushed or displaced from the pump casing. The flow capacity of a positive-displacement pump is unaffected by the pressure of the system in which it operates.

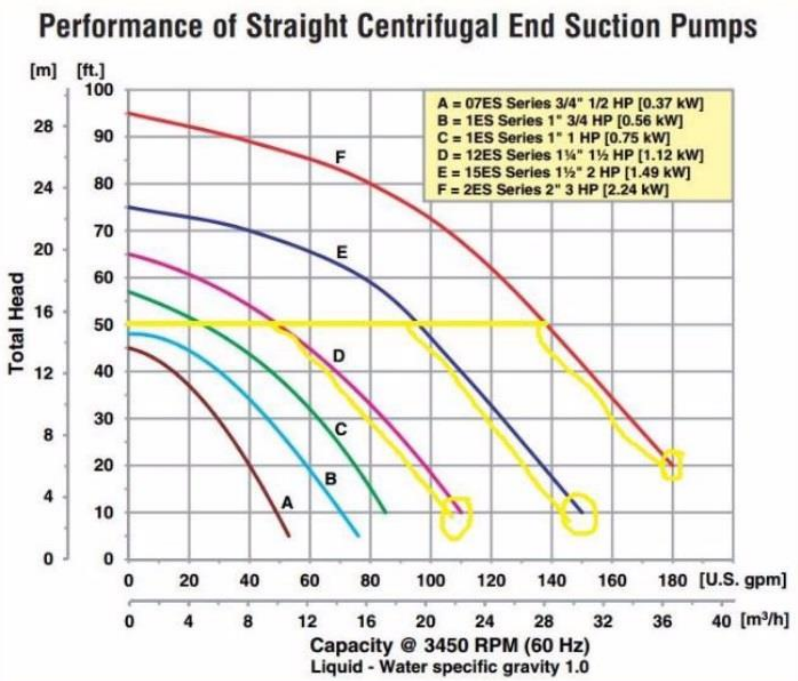
During the late night and very early morning hours, when water demand is lower, high-lift pumps fill the tank. During the day, when water demand is higher, water flows out of the tank to help satisfy the peak hourly water needs. This allows for a uniform flow rate at the treatment plant and pumping station. Water in a distribution storage tank may also be needed for fighting fires, cleaning up accidental spills of hazardous materials, or other community emergencies. The capacity of a distribution storage tank is designed to be about equal to the average daily water demand of the community.

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 what to expect from your water pump: how many feet is it capable of pumping, how many gallons per minute, and what will be the ideal operating performance for efficiency.

Reading a Pump Curve

Let’s look at an example situation to help you pick out the right pump for your application using just pump head and gallons per minute to help us come to a decision on the right pump.



Situation #1: You are replacing an old pump that already has the pipes in place that are 2” going into the pump and 2” going out. The old pump is pumping water from a 5,000 gallon tank and pumping the water to a second tank that is 50 feet above the first tank. Your old pump was pumping approximately 100gpm (gallons per minute) and you would like to try to get a pump that will perhaps get you to 150gpm due to increased production demands.

So we can determine the following**:**

- You need a pump with a 2” inlet diameter and a 2” outlet diameter
- You have a minimum pump head of 50 feet
- You would like a pump that will give at least 150gpm

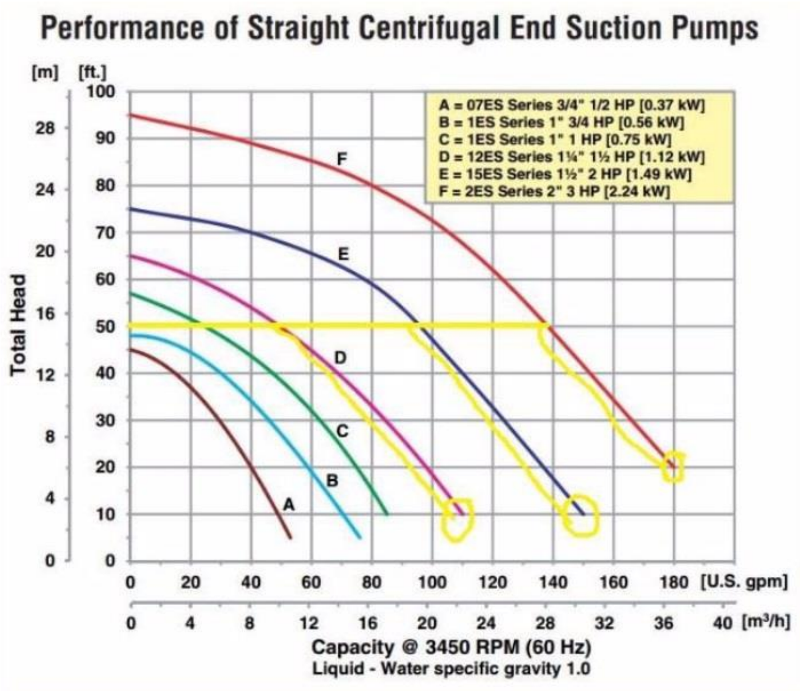
Looking at the pump curve below, which of the following 2” pumps will work for your application?

Step #1: Start with your required pump head (50 feet) on the left-hand side of the curve

- We can see that pumps A & B are below our required head, so we can rule them out.
- We now have 3 pumps on this curve that meet our total pump head requirement of 50ft.

Step #2: Determine which pump is capable of 125gpm or more

- 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.



Step #3: Decision Time!

You have 3 pumps to choose from that meet your requirements but you still have a few things to consider:

- Pump D:
  - Pro: similar to the pump you are replacing
  - Con: no real increase in performance in GPM (110gpm total)
  - Pro: guaranteed to be lower cost than pumps E & F

- Pump E:
  - Pro: increase of 45gpm compared to your old pump (145gpm total)
  - Pro: gets you close to your desire of 150gpm
  - Con: 5gpm lower than your 150gpm goal
  - Con: higher price than pump D
- Pump F:
  - Pro: increase of 80gpm compared to your old pump
  - Pro: 35gpm greater than pump E
  - Pro: gets beyond your desire of 150gpm (180gpm total)
  - Con: higher price than pumps D & E

Conclusion

As you can see there are many considerations to look at when picking out a pump. And we only looked at one example and a simple one at that!

While there is a lot of information available to you, the consumer, finding the most basic information is not as hard as one would think. Just remember, the best thing to do is to ask an expert if you are not sure! But now that you know the most basic details as you look at a pump curve, you will be better prepared to make the best decision on the right pump.

Q NO 2

1) DEAD END SYSTEM

Advantages:

- The discharge and pressure at any point in the distribution system can be easily calculated.
- The design calculation is simple and easy.
- Lesser number of cut-off valves is required in this system.
- Lying of pipes is easy and simple.
- It is cheap and can be extended or expanded easily.

Disadvantage:

- The disadvantages of the dead end system are:
- 1. During repairs, a large portion of the distribution area is affected.
- 2. There is numerous dead end in this system, which prevent the free circulation of water.
- 3. The water may be polluted at the dead end due to its stagnation.
- 4. It gives limited supply during the fighting.

(2) RADIAL SYSTEM

Advantages:

- Simplest as fed at only end.
- The initial cost is low.
- It is useful when the generating is at low voltage.
- Preferred when the station is located at the center of the load.
- More economical for some areas which have a low load requirement
- Require less amount of cables
- It has a low maintenance

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

3. GRID-IRON SYSTEM

- It is suitable for cities with rectangular layout, where the water mains and branches are laid in rectangles

Advantages:

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

Disadvantage:

- Proper designing is relatively difficult.

4. RING SYSTEM

- The supply main is laid all along the peripheral roads and sub mains branch out from the mains.

Advantage:

- In ring power is supplied from both ends as compared to radial

  • In case of a fault in the radial circuit the entire system goes off unlike in ring where by incase one end gets a fault the other end still keeps on supplying power

  • Compared to the radial system, the voltage drop is less along the distribution line

  • More subscribers can be installed to the system than the radial system

  • Less voltage fluctuations can be seen at client's terminals. Voltage fluctuations in high loaded areas can be reduced using a tie line

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

Water distribution system layout in hilly areas are always divided into several zones due to the undulating terrain. with the building of a mathematical model. The optimum topology from an energy point of view is the water companies to supply water at lower pressure in hilly areas. layout of distribution network, method of water distribution ,storage pumped into the distribution reservoir kept in the middle of each zone.

THANKS