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Final-Term Assessment

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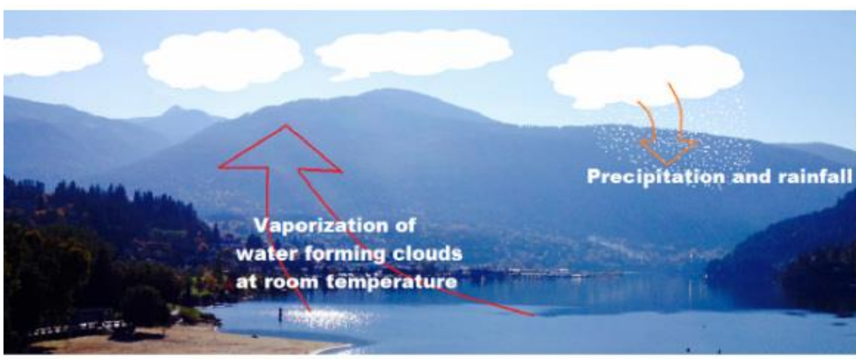
Q 1: Desalination:

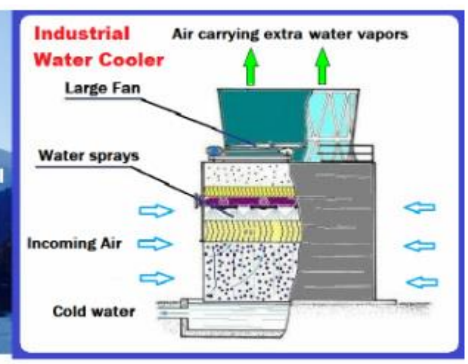
Desalination or desalinization refers to any of several processes that remove the excess salt and other minerals from water in order to obtain fresh water suitable for animal consumption or irrigation, and if almost all of the salt is removed, for human consumption, sometimes producing table salt as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

Demandforfreshwater(domesticuse,industry,agricultureetc.)
Lackofconventionalwatersources
Availabilityofsaltwater
AvailabilityofInfrastructure(energy,waterdistributionnetwork)
Interestforfinancing(invest,maintenance,energy,…)

Desalination methods:

NaturalDesalination: Major Stages:
1.Evaporation
2. Condensation
3. Precipitation
4. Collection





PrincipalMethods for Desalination

Demand for fresh water (domestic use, industry, agriculture…..)

- Lack of conventional water sources

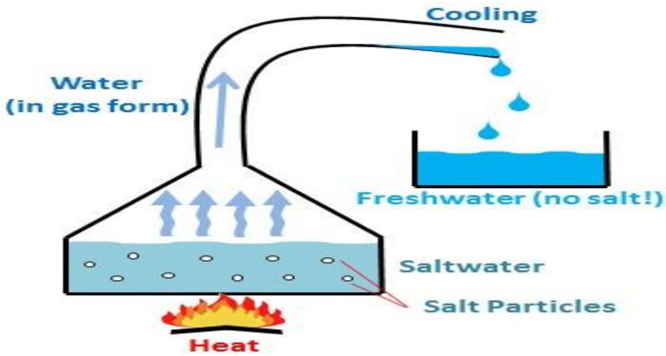
- Availability of salt water
- Availability of Infrastructure (energy, water distribution network)
- Interest for financing (invest, maintenance, energy,...)

PrincipalMethods for Desalination

Distillation(Evaporation)
Electro dialysis
Freezing
Reverse osmosis

Distillation(Evaporation):

Salt water is heated in one container to make the watere vaporate,leaving the salt behind.
The desalinated vaporis 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 vaporis very high.



Electrodialysis: Electrodialysis is a membrane-based process that uses an electric field to filter out the salt. It uses very little energy but is limited to the treatment of low-salinity water.

Freezing Method:

In this method 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 .

ReverseOsmosis(RO):

It is a water purification technology/method that uses asemi-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.

MOST EFFECTIVE METHOD OF DESALINATION:

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.

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Extent of Use

The capacity of reverse osmosis desalination plants sold or installed during the 20-year period between 1960 and 1980 was 1 050 600 m^3/day. During the last 15 years, this capacity has continued to increase as a result of cost reductions and technological advances. RO-desalinated water has been used as potable water and for industrial and agricultural purposes.

Potable Water Use: RO technology is currently being used in Argentina and the northeast region of Brazil to desalinate groundwater. New membranes are being designed to operate at higher pressures (7 to 8.5 atm) and with greater efficiencies (removing 60% to 75% of the salt plus nearly all organics, viruses, bacteria, and other chemical pollutants).

Industrial Use: Industrial applications that require pure water, such as the manufacture of electronic parts, speciality foods, and pharmaceuticals, use reverse osmosis as an element of the production process, where the concentration and/or fractionating of a wet process stream is needed.

Effectiveness of the Technology

Twenty-five years ago, researchers were struggling to separate product waters from 90% of the salt in feedwater at total dissolved solids (TDS) levels of 1 500 mg/1, using pressures of 600 psi and a flux through the membrane of 18 l/m^2/day. Today, typical brackish installations can separate 98% of the salt from feedwater at TDS levels of 2 500 to 3 000 mg/1, using pressures of 13.6 to 17 atm and a flux of 24 l/m^2/day - and guaranteeing to do it for 5 years without having to replace the membrane. Today's state-of-the-art technology uses thin film composite membranes in place of the older cellulose acetate and polyamide membranes. The composite membranes work over a wider range of pH, at higher temperatures, and within broader chemical limits, enabling them to withstand more operational abuse and conditions more commonly found in most industrial applications. In general, the recovery efficiency of RO desalination plants increases with time as long as there is no fouling of the membrane.

Suitability

This technology is suitable for use in regions where seawater or brackish groundwater is readily available.

Advantages

· The processing system is simple; the only complicating factor is finding or producing a clean supply of feedwater to minimize the need for frequent cleaning of the membrane.

· Systems may be assembled from prepackaged modules to produce a supply of product water ranging from a few liters per day to 750 000 l/day for brackish water, and to 400 000 l/day for seawater; the modular system allows for high mobility, making RO plants ideal for emergency water supply use.

· Installation costs are low.

· RO plants have a very high space/production capacity ratio, ranging from 25 000 to 60 000 l/day/m^2.

· Low maintenance, nonmetallic materials are used in construction.

· Energy use to process brackish water ranges from 1 to 3 kWh per 1 0001 of product water.

· RO technologies can make use of use an almost unlimited and reliable water source, the sea.

· RO technologies can be used to remove organic and inorganic contaminants.

· Aside from the need to dispose of the brine, RO has a negligible environmental impact.

· The technology makes minimal use of chemicals.

Q:2

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

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.
   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.
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.

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

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

Q 3: Types of reservoirs used in water supply systems:

Reservoirs are those water bodies formed or modified by human activity for specific purposes, in order to provide a reliable and controllable resource.

Purpose of Distribution Reservoirs:

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.

According to the situation with respect to ground, the distribution reservoirs are classified in the following three types:

1. Surface Reservoirs:

Surface reservoirs are circular or rectangular in shape. These reservoirs are constructed at ground level or below ground level and hence these are also called ground reservoirs or non-elevated reservoirs. The treated water stored in these reservoirs is pumped to elevated reservoirs from which it is supplied to the consumers.

However, if surface reservoirs are located at high points in the distribution system then water may be supplied to the consumers directly from these reservoirs by gravity, as far as possible surface reservoirs should be located at high points in the distribution system.

It is usual practice to construct a surface reservoir in two compartments, so that one can be used while the other is being cleaned or repaired. The two compartments are connected with each other by control valves. Overflow pipes are provided at full supply level so as to maintain a constant level of water in the reservoir.

Ventilators are provided in the roof slab so as to affect free circulation of air over the water surface in the reservoir. Although treated water is stored in the reservoir, yet some sludge may be present in the stored water which will be deposited in the reservoir. The deposited sludge can be removed by occasional cleaning through the washout pipes provided at the bottom of the reservoir. The outlet pipes are placed at a slightly higher level, say at least 10

2. Elevated Reservoirs:

Elevated reservoirs are constructed at an elevation from ground level. These reservoirs are also known as overhead tanks. These reservoirs may be rectangular, circular or elliptical in shape. However, with the advancement in structural analysis it is possible to construct the elevated reservoirs in any shape to suit the architectural requirements.

An R.C.C. tank known as Intz tank is very commonly adopted these days.

Water is pumped to elevated reservoirs from surface reservoirs and then supplied to the consumers.

3. Standpipes:

A standpipe is a vertical cylindrical tank resting just above the ground. The diameter of standpipe varies from 10 to 15 m and its height varies from 15 to 30 m. Standpipes are made of steel or R.C.C. Steel standpipes are more common as it is very difficult to construct watertight R.C.C. standpipes under heads greater than 15 m. Alike elevated reservoirs, standpipes are also provided with inlet pipe, outlet pipe, overflow pipe, washout pipe and various other accessories for their efficient working, inspection and maintenance.

However, in the case of standpipe the outlet pipe is located in the tank with its entrance being kept above the bottom of the tank at an elevation such that the storage of water created in the tank above this elevation gives the necessary pressure for distribution of water. The volume of water stored in the tank above the entrance of the outlet pipe can only be used and hence it is the useful storage of standpipe.

On the other hand the lower portion of the storage lying below the entrance of the outlet pipe cannot be ordinarily used and it only serves as a support for the useful storage and hence it is termed as supporting storage. However, the supporting storage can also be effectively used by providing boosters or for fire protection with the help of fire engines. Further standpipes are usually located on a high ground so as to successfully utilize its entire storage.

Since large variations in pressure are undesirable in a distribution system, fluctuation of the water level in a standpipe is usually limited to 10 m or less. Generally standpipes of height more than 15 m are not economical since the lower portion of a standpipe serves only to support the upper useful portion.

The economic limit of height for standpipes is reached when the supporting structure for an elevated reservoir becomes less costly than the lower ineffective portion of the standpipe.

Importance of resorvior used in water supply system:

In water supply distribution systems, whether water is obtained by gravity or by pumping,

reservoirs are usually necessary for the following reasons:

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.

Storage Capacity of reservoir: As a rule of thumb, the storage Reservoir volume should be at least equal to one-fourth (25%) of average day demand of the community.

The formula is:

Cr= (1/4) (ADD)

Where:

Cr=Reservoir capacity in liters

ADD= Average Day Demand in liters per day

Q 4:

The reasons why we use pumps in water supply system are ……..

Pumps and equipments are used for pumping fluids from one place to another. They are used for a variety of infrastructure systems, such as the supply of water to canals, the drainage of low-lying land, and the removal of sewage to processing sites. A pumping station is, by

definition, an integral part of a pumped-storage hydroelectricity installation.

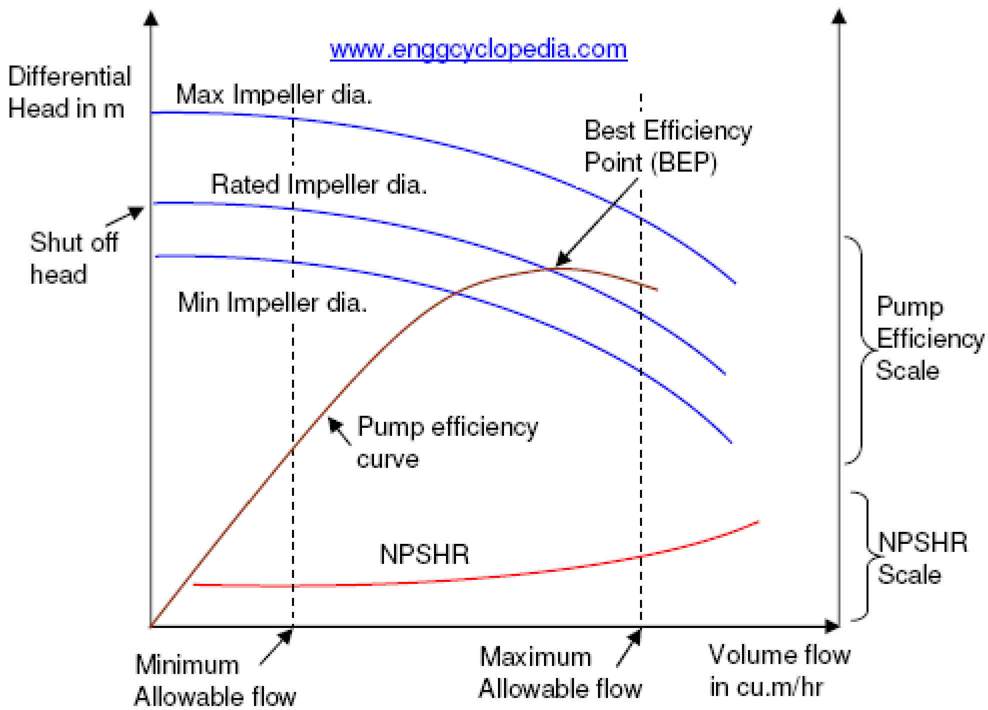
In countries with canal systems, pumping stations are also frequent. Because of the way the system of canal locks work, water is lost from the upper part of a canal each time a vessel passes through. Also, most lock gates are not watertight, so some water leaks from the higher levels of the canal to those lower down.

Obviously, the water has to be replaced or eventually the upper levels of the canal would not hold enough water to be navigable.

Canals are usually fed by diverting water from streams and rivers into the upper parts of the canal, but if no suitable source is available, a pumping station can be used to maintain the water level.

Calculation of Pump Curve:

Pump curves are primarily used to predict the variation of the differential head across the pump, as the flow is changed. But in addition variation of efficiency, power etc, as the flow is changed, can also be represented on the pump performance curves by the manufacturer.



Now to Calculate the Water demand we should understand the constraints which hold the curve.

- Curve of differential head for Rated Impeller Diameter represents the variation of differential head with volumetric flow for the impeller with rated diameter which will actually be provided with the pump.
- Variation of differential head with volumetric flow for Maximum Impeller Diameter is plotted for the impeller with the maximum diameter that can be accommodated within the pump. This impeller can be used in case flow through the pump is increased or if more differential head is required in the future, with the same pump.
- Variation of differential head with volumetric flow for Minimum Impeller Diameter is plotted for the impeller with minimum possible diameter. If the flow or differential head requirement is reduced in future, this impeller can be used with lower power consumption.

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Variation of differential head with volumetric flow for Minimum Impeller Diameter is plotted for the impeller with minimum possible diameter. If the flow or differential head requirement is reduced in future, this impeller can be used with lower power consumption.

It should be note that the pump curves for differential head Vs. volumetric flow rate are plotted for a particular liquid density. If in the future the process liquid or even just liquid density is changed, that effect has to be considered to finally determine the differential pressure. In such as case, revised volumetric flow should be calculated and located on the pump curve and corresponding differential head should be then determined from the curve for the appropriate impeller diameter. This differential head should then be used along with the changed liquid density to determine the differential pressure across the pump.

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