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SUBJECT: WATER DEMAND SUPPLY AND DISTRIBUTION

Question 1) Answer:

Desalination:

It is a process of taking away the mineral components from saline water which is hazardous for drinking purposes and can be then reused for drinking, agricultural and industrial purposes.

It is process of turning sea water into portable fresh water.

Various Method of Desalination:

1) **Distillation:**

Distillation is a phase separation method whereby saline water is heated to produce water vapor, which is then condensed to produce freshwater. In distillation process, the water is boiled and then the steam is collected, leaving the salt behind. It is based on the principles of boiling or evaporation and condensation. Water is heated until it reaches the evaporation state. The salt is left behind while the vapor is condensed to produce fresh water. The most common thermal desalination processes are:

- multi-stage flash distillation (MSF),
- Multiple-effect distillation (MED),
- vapour-compression evaporation (VC),
- cogeneration,
- solar water desalination

2) **Membrane Process:**

A membrane process is any method that relies on a membrane barrier to filter or remove particles from water. Fluid is passed through the membrane because of the pressure difference between one side of the membrane and the other. Contaminants remain on one side.

Membrane processing is a technique that permits concentration and separation without the use of heat. Particles are separated on the basis of their molecular size and shape with the use of pressure and specially designed semi-permeable membranes.

Membrane process are of three types:

- **Electro dialysis:**

Electro dialysis is applied for the removal of dissolved ionic substances from **water.** In **electro dialysis**, filters or membranes selectively impervious to cations or anions are placed alternately between the electrodes

- **Reverse osmosis:**

  It is the process in which pressure is used to drive water through a selectively permeable membrane, leaving the salt behind.

  RO is a membrane separation process in which the water from a pressurized saline solution is separated from the solutes (the dissolved material) by flowing through a membrane without the need for heating or phase change.

  A typical large saline water RO plant consists of five major components, a saline water supply system, a feed water pre-treatment system, high-pressure pumping, RO modules (membrane separation) and post-treatment system.

  Distillation, however, is energy-intensive and involves capturing the condensation of boiling water. Reverse osmosis, on the other hand, forces your water through a series of fine membranes to remove particles and chemicals.

  Reverse osmosis is a much more practical solution for most consumers since it produces a greater amount of water more reliably. Accessing that water is as simple as opening your faucet. Reverse osmosis water will give you all the benefits of completely purified water while also reintroducing the minerals that are good for you and add taste to the water, making it the better choice for drinking water.

  RO water is comparable (or better) than distilled water. Distillation systems are not designed to remove chlorine and other chemicals completely from water. Organics such as herbicides and pesticides, with boiling points lower than 100°C, cannot be removed efficiently and can actually become concentrated in the product water. It does have the ability to remove 95-99% of total dissolved solids (TDS), and it greatly improves the smell, taste and appearance of your water. The RO filtration process consumes no additional energy. RO water is also very affordable, costing only pennies per gallon. Another upside is that some people claim cooking with it creates better-tasting food

  Distilled water systems can be more costly to maintain than RO systems. The water distillation process can take longer than say RO water. It needs to operate using electricity for water heating and some systems will waste 5 gallons of water (or more) to produce one gallon of pure water. Many distilled water systems use a high consumption of energy which can show on your electric bills. Some also argue that distilled water doesn't taste as good as other forms of purified water. And others argue that distilled water leeches minerals like magnesium from the body.

  RO systems do not require electricity and only uses your homes incoming water pressure to purify drinking water. The only maintenance needed is yearly filter replacements. RO purification is as good as or better than distilled method because of simpler maintenance and at a fraction of the cost.

Question 2) Answer:

Merit and Demerit of Dead End System:

Merit:

1. It is suitable for old towns and cities having no definite pattern of roads
2. Dead end system requires less number of cutoff valves.
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. Relatively Cheap
5. Determination of discharges and pressure easier due to less number of valve

Demerit:

1. Due to many dead ends, stagnation of water occurs in pipes.
2. The pressure is not constant and is very less at remote parts.
3. 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.
4. 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.
5. In this system, Limited discharge is available for firefighting

Merit and Demerit of Radial System:

Merit:

1. The water distributed with high velocity and high pressure.
2. Head loss is very small because of quick discharge
3. It gives quick service
4. Calculation of pipe sizes is easy

Demerit:

1. Cost of the project is more because of number of individual distribution reservoirs

Merit and Demerit of Grid Iron System:

Merit:

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.
5. It is suitable for cities with rectangular layout, where the water mains and branches are laid in rectangles
6. Water is kept in good circulation due to the absence of dead ends
7. In the cases of a breakdown in some section, water is available from some other direction.

Demerit:

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. Exact calculation of sizes of pipes is not possible due to provision of valves on all branches.
4. Laying of pipes will be done by skilled workers which consume more cost.
5. Cutoff valves required should be more in this system.

Merit and Demerit of Ring System:

Merit:

1. This system also follows the grid iron system with the flow pattern similar in character to that of dead end system. So, determination of the size of pipes is easy.
2. Water can be supplied to any point from at least two directions.
3. No stagnation of water
4. Repair works can be done without affecting larger network.
5. Large quantity of water is available for firefighting.

Demerit:

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

Layout for Township in Hilly Areas:

Water distribution systems in hilly areas are always divided into several zones due to the undulating terrain. The present approach of dividing water distribution systems lacks an assessment index and is characterized by a low degree of automation. To enable the automatic division of the water supply pipe network. It prioritizes economic index as the objective function in the evaluation of the division of water distribution systems in hilly areas, and then selects the optimal division scheme by generic algorithm in a large number of candidates.

The layout that can be used for township in hilly areas are Grid Iron System because Water will flow continuously without any dead ends or sediment deposits and In the cases of a breakdown in some section, water is available from some other direction.

Question 3) Answer:

Types of Reservoirs in water Supply System:

1. **Surface Reservoirs:**

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. It consist of circular or rectangular tank.

These reservoirs are used for storing and distributing clear water. These are constructed on high natural grounds and are usually made of stones, bricks or plain or reinforced cement concrete. The side walls are designed to take up the pressure of the water, when 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 are constructed with R.C.C. slab or square stone blocks. To obtain water tightness bituminous compounds are used at all construction joints. These reservoirs should be provided with R.C.C. roofs resting on columns

2. **Elevated Storage Reservoirs:**

Storing the pumped water into an elevated storage tank is a sound procedure for matching the renewable energy production. Water can subsequently be distributed by gravity.

When sufficient high ground above the distribution area is not available for the construction of ground reservoirs, from where water can flow under gravitational force in the distribution system, elevated reservoirs are constructed. The elevated reservoirs reduce the initial cost of pumps, reduce the peak demands on the pumps and reduce the maximum pressure required at the pumps discharge.

A water tank is used to store water for daily requirements like drinking, washing etc. An elevated water tank is a large water storage container constructed for the purpose of holding water supply at certain height to provide sufficient pressure in the water distribution system. Liquid storage tanks are used extensively used by municipalities and industries for storing water, inflammable liquids and other chemicals. These tanks have various types of support structures like RC braced frame, steel frame, RC shaft, and even masonry pedestal.

Now-a-days R.C.C. elevated tanks are very popular, because they have long life, require very little maintenance and give decent appearance in the locality. Recently pre-stressed R.C.C. tanks are coming up, because they are even economical than plain R.C.C. tanks.

Calculation of Storage Capacity:

The total storage capacity of a distribution reservoir consist 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
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.
3. **Fire Storage:**
   The third component of the total reservoir storage is the fire storage.

Question 4) Answer:

Pumps lift water from underground and discharge it directly into a distribution system. It delivers a constant flow of water at a constant pressure for any given set of conditions. The term water supply pump refers to all centrifugal pumps which transport drinking or service water either directly to a supply network or through long-distance pipes to a supply area.

It takes energy to lift fluid from one level to another. The pressure used to lift fluid is called Static Head. The energy used to lift fluid is independent of velocity. The power to lift fluid is a linear function of velocity.

Requirements to be met by water supply pumps:

- High efficiency (continuous operation)
- Reliable bearing arrangement which does not impair the water quality
- Low noise level

Various types of pumps are used depending on the flow rate (Q), head (H) and installation conditions.

Pumping System are Generally Design for:

1. Head

In a system with flow, the total head is the difference between the discharge and the suction head plus the friction head and the sum is less than the shut-off head. Suction and discharge static head are often combined. The difference between discharge and suction static head is the total static head

2. 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).

Calculation of pump Curve:

Pump curve can be calculated by the curve provided by the Pump and Motor Manufacturing Companies.

Given Example for Curve Drawing

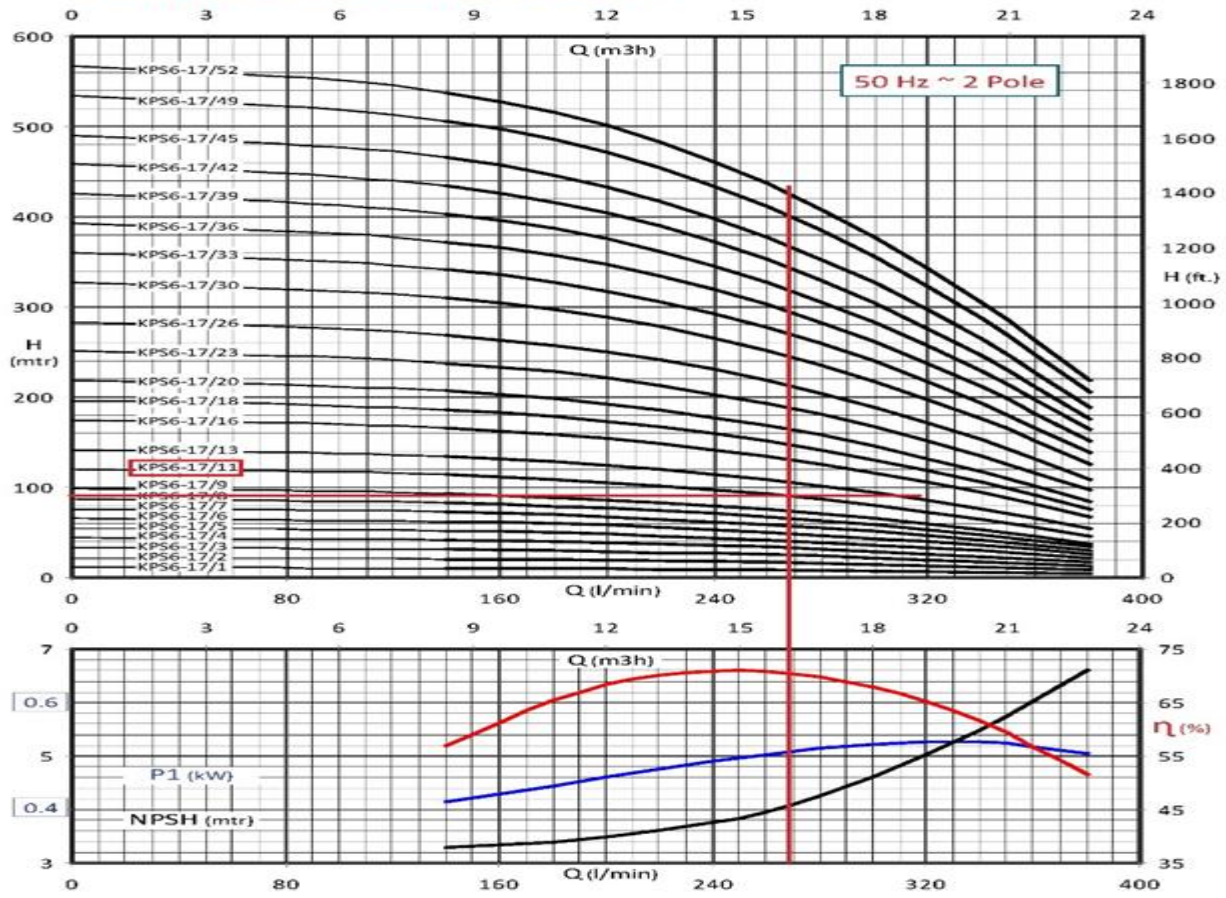
1. Discharge = 3500 IGPH
2. Total Dynamic Head = 270 ft
3. Pump Setting = 250 ft

			SUMMARY OF SYSTEM DESIGN FOR FIX STRUCTURE SYSTEM BASED SOLAR POWER PUMPING SETS, TANK																						
	S.No	Name Of Work	Discharge IGPH	Total Head(ft)	Motor Efficiency (Minimum Reuired 75%)	Pump efficiency (Minimum Reuired 70%)	WHP (HP)	WHP (KW)	Pump Shaft Power (KW)	Motor BPH (HP)	MOTOR BPH (HP) WITH 10% SAFTEY	Pump setting	Motor Input Power (KW)	Total PV Power (Minimum Required) (KW)	PV Generator Peak Power					Motor			Pump		Solar Panel
															No of String in Parralel	No of Module/ String in Series	Module Size (Watts)	Total PV Generation (KW)	String Voltage	MAKE	MODEL	HP	Manufacture	Model	Ulica / Astro/ My Solar
		DISTRICT ADP (2019-20)																							
1	1	WSS M GHULAM ABBAS VILLAGE GARA HAYAT UC JATTATAR	3500	270	78.00%	70.50%	4.78	3.57	5.06	6.78	7.54	250	6.49	11.36	2	15	380.00	11.400	594.00	Komax	KM6 100T	10	Komax	KPS6-17/11	ULICA/Astro/My Solar/IA

Below is the Pump curve of KOMAX pump based on the given data below. Discharge data provided on horizontal axis both above and below, Head provided on Vertical Axis both on left in meter and right in feet.

Pump Performance Curve

tolerances according to ISO 9906 Annex A



KPS6-17

FOR 6 INCH BORE HOLE