COURSE TITLLE: WATER SUPPLY AND DEMAND

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

1.1 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".

1.2 DESALINATION METHODS:

1.2.1 DISTILLATION

Saltwater 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.

1.2.3 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.

1.2.4 FREEZING: 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

1.2.5 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.

Looking towards the specs of these desalination process, distillation requires large amount of energy. Whereas, the electro dialysis is suitable for water having low concentration of salts. However, reverse osmosis suitable for desalinating sea water at less energy cost as compared to distillation process. Furthermore, for every 2 liters of desalinated water, RO plant makes 1 liter of potable water (when minerals are added) and 1 liter of brine which is discharged into the ocean. However, the membranes become degraded through excessive wetting and other types of contamination, and the process is not as efficient at present as most thermal desalinization types are. To conclude, recently researchers were able to create a solar distillation technique that involves focusing sunlight on particular spots of a selectively permeable membrane, boiling water collected there and forcing it through to the opposite side of the membrane, where it is collected as new.

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?

2.1 DEAD END SYSTEM

Advantages of Dead End System	Disadvantages of Dead End System
Pipes in this network can be laid easily.	The pressure is not constant and is very less at remote parts.

The pressure and discharge in each pipe can be determined very easily and accurately which makes design calculations very simple.	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.
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.	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.

2.2 GRID IRON SYSTEM

ADVANTAGES OF GRID IRON SYSTEM	**DISADVANTAGES OF GRID IRON SYSTEM**
Water flows continuously without any dead ends or sediment deposits.	Because of circulating flow from all directions, the pipes used in this system should be of large diameters and longer lengths.
Head loss is minimum in this case because of interconnection of pipes.	We cannot determine the accurate discharge, velocity or pressure in a particular pipe. So, design is difficult
The discharge will meet the required discharge for firefighting.	Laying of pipes will be done by skilled workers which consume more cost.
Repair works can be easily done just by closing cutoff valve in that line which do not affect the other users	Cutoff valves required should be more in this system.

2.3 ADVANTAGES OF RING SYSTEM

ADVANTAGES OF RING SYSTEM	**disadvantages OF RING SYSTEM**
No stagnation of water	Longer length and large diameter pipes are required.
Repair works can be done without affecting larger network.	More number of cutoff valves are necessary.
Large quantity of water is available for firefighting	Skilled workers are necessary while laying pipes.

2.4 ADVANTAGES OF RADIAL SYSTEM

ADVANTAGES OF RADIAL SYSTEM	**DISADVANTAGES OF RADIAL SYSTEM**
The water distributed with high velocity and high pressure.	Cost of the project is more because of number of individual distribution reservoirs.
Head loss is very small because of quick discharge.	

Generally only any one of these four systems of layout may not be suitable for the entire city or town. In actual practice for any area depending upon the various factors such as relative levels of different zones of the city or town, layout of its roads and streets, etc., a combination of two or more of these four systems of layout may be more suitable and the same may therefore be adopted. If we talk specifically regarding the adoption of a single system, then in my opinion ring system would me most suitable. The reason for adopting this system is that when we look at the

topography of an elevated area, it is accessed by a road laid around specific hills. Moreover, this system is capable of supplying water with adequate head, thus, access of water to end user with high pressure is ensured. Although the initial cost of this particular system is high, however, the maintenance cost is low as in hilly areas continuous water supply most be ensured. In addition to that, this system accommodates two or more main sources as which proves beneficial if one of them gets damaged. Moreover, hilly areas are accessed circumferentially rather than radially, therefore, the system is suitable as in this system the town center is accessed conveniently. To conclude, mostly in mountainous terrain radial layout is witnessed but they susceptible to landslides and maintenance works are cumbersome if any damage are caused. Apart from high economical costs (of excavations and cost of pipes) the ring type layout is suitable for higher population densities in hilly areas especially hill stations guaranteeing undisturbed flows.

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

Distribution reservoirs or service reservoirs, are the storage reservoirs, which store water for distributing during emergencies (such as during fires, repairs, peak demand etc.) and also to help in absorbing the hourly fluctuations in the normal water demand. It should be located as close as possible to the center of demand. Water level in the reservoir must be at a sufficient elevation to permit gravity flow at an adequate pressure.

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

3.1 **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. Stored water is used for numerous purposes, including irrigation, industry, domestic use, hydropower generation and flood control. Surface reservoirs are particularly important in regions with lengthy dry seasons and high rainfall variability, as well as areas where seasonal water availability is predicted to increase as a result of a changing climate.

Surface reservoirs are therefore one of the most important adaptation technologies in regions with limited and varying water availability.

Environmental Benefits: These type of reservoirs ensure water security through bridging seasonal (or unexpected) water shortages and stress, reducing pressures on groundwater and avoiding potential depletion. They also supports the production of renewable energy (usually large multipurpose reservoirs.

Socioeconomic Benefits: these type of reservoirs increase water storage, resulting in increased water security and reliable supplies for socioeconomic activities, as well as sufficient supplies during periods of low water flows and drought. They also deliver a number of additional benefits such as protecting downstream communities from flooding events, hydropower generation and inland navigation. Moreover, they offer recreational benefits as well.

3.2 ELEVATED STORAGE 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.

The storage capacity of these reservoirs depends on following three factors

a) **BALANCING STORAGE:** It is the quantity of water required to be stored in the reservoir for balancing fluctuating demand against constant supply.

b) **BREAKDOWN STORAGE:** It is associated with water storage in case of any emergency.

c) **FIRE STORAGE:** It is the requirement of water required for extinguishing fire.

- The total final storage can be found by adding these three parameters

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

The primary purpose of providing a pump is to:

a) Transfer liquid from source to destination.

b) Circulate liquid around a system.

The reasons are to maintain head and ensure less losses in a closed conduit system. Moreover, pumps also ensures adequate discharge with velocities to the destination by maintaining sufficient pressure in a water supply system.

The pump curve depicts the performance of a pump. The pump curve depends mainly on two parameters

I. Flow.

II. System head.

System head is the summation of static head (Vertical distance between the source and destination) and friction head (Resistance to flow in pipe and fittings).

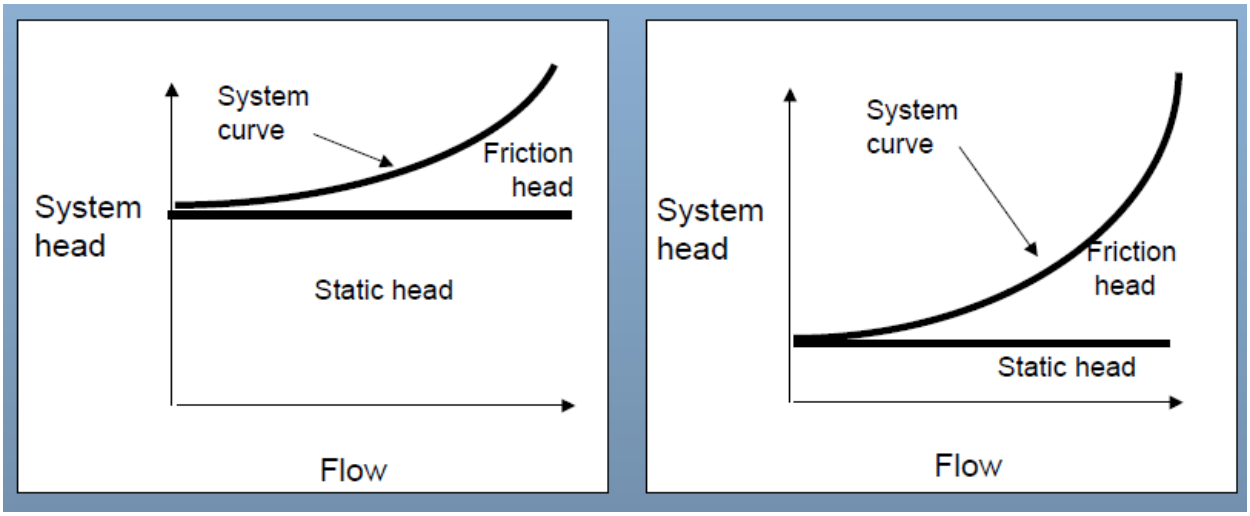

Fig describing a pump curve

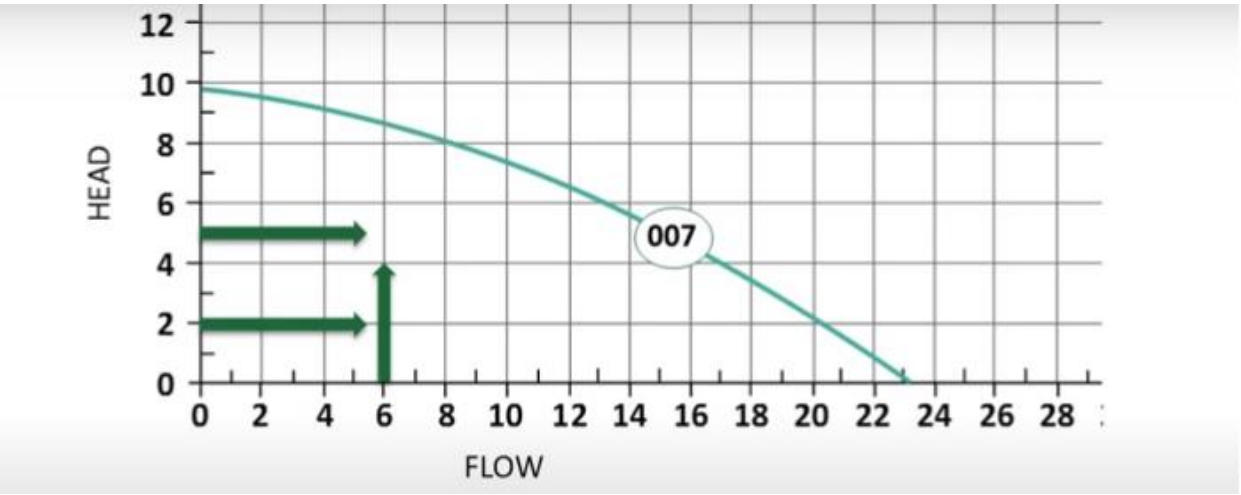

Fig of a pump curve

The pump curve describes the head and flow. The curve depicts the different circulators. We can use a 007 circulator we need a discharge of 6 gpm at a head up to 8ft. Also the 007 can provide a flowrate of 18 gpm with a 2ft head.
