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Name:

Sana-ul-Musawir Asif

Reg: No:

14390

MS (T.E)

Q1

Define desalination, and briefly describe various desalination methods. which method is more effective, Please elaborate briefly:

Answer:

Desalination:-

Desalination is the process of removing Salt and other minerals from Saline water to render it suitable for drinking, irrigation and for industrial use.

Methods of Desalination:-

Following are the methods used for desalination of Saline water to make it suitable for drinking, irrigation and domestic use

- Distillation
- Electrodialysis
- Freezing
- Reverse Osmosis

Now we will discuss these methods one by one

- Distillation :-

In this method Salt water is heated in Certain Container to make it evaporate and Leaving the Salt behind

The desalinated vapours are then Condensed to form water in other Container

Although it is a Simple method of water desalination but it has found limited application in water supply because high fuel Costs are involved in Converting Salt water to vapors.

- Electrodialysis :-

Electrodialysis utilizes a membrane and Send electric charge Through the Solution

It draw metal ions to +ve plate one one Side and other ions like Salt to the negative (-ve) plate on other Side

- Freezing Method

This method is based on the principal that water exclude salts when it Crystalizes to ice

It involves three steps
→ Ice formation
→ Ice washing
→ Ice melting
to obtain fresh water with subsequent removal of contaminants
Lowering the temprature further pulls even more water out of out of liquid into ice, leaving the salt outside as separate salt Crystals
One advantage of this metted is that Salt water freezes at Lower temperature that pure water

- Reverse Osmosis:-

Revese osmosis is water purfacation techanlogy that uses a semi permeable membrane to remove ions, molecules and large particles from saline water

Dissolved and Suspended species like becteria Can be removed by this method.

Continued (R.O)

This method is used for both industrial and for potable water production

This technology reduces the salt and potential impurities to significant level thus resulting in high quality and great tasting water

There are Five steps are involved in R.O

- **Step 1 :**

In This step a 5-micron filter is used to remove sediments like clay, silt and stones in order to make sure that no damage is done to the membrane by these sediments

step 2:

In this step chemicals like clorine and other chemicals which are harmfull to human health are removed by Carbon filter

step 3 :

This step focussing from passing water on dense and Compacted Carbon filter. Most of the Contaminants are reduced here

step 4 :

In this method heavy and radioactive metals are removed by passing water through membrane Impurities are drained out of reverse osmosis system and clean water is separated

step 5 :

In this step, the bacteria, chlorine and bad odour is removed to make water perfect for Consumption

Which desalination method is more effective

In order to answer this, we would analyze two things ie efficiency / level of desalination and Cost of desalination process.

From health points of view reverse osmosis is best method of water desalination because of its efficiency to remove all harmfull metals and chemicals
Although Cost of this method may be more but from health points of view this method is good.

In developed Countries another method of vaccum distilation is used also which provide fresh water at lower Cost
Salt water is enclosed at low pressure to reduce its boiling points, making it easier to vaporize and separate the salt from water

While in developing Countries like pakistan the method of distillation is good enough.
Higher fuel Costs may be reduced by using Solar energy to directly heat the water to boiling points
In developing / underdeveloped Countries in which cost is also taken into account Significantly this distilation process is cheaper one.

Q: 2

Briefly describe the merit and demerits of of four water distribution System which Layout will you recomend for newly proposed township in hilly area.?? Support your answer with justification

Answer:

The four distribution system of water are as under

- Dead End System
- Radial System
- Grid Iron System
- Ring System

We will explain advantages and disadvantages of all these Layouts one by one

- **Dead End System:**
  Suitable for towns and cities having no definite pattern of roads

→ Advantages / Merits of dead end System

- Relatively cheap
- Determination of discharge and pressure is easier due to less number of valves
- Required dimension of pipe is economical
- Laying of pipes is simple

→ Disadvantage / Demerits of dead End System

- Due to many dead ends, stagnation of water occurs in pipes
- Area having work of pipes repair will be without water until work Completes
- Bacterial growth is encourged at dead ends due to stagnent water
- Difficult to maintain clorine residual at dead ends
- Water available for fire fighting will be limited as it is being Suplied by only one water main
- Pressure at the end of line may become undesirably low as additional areas are Connected

- Radial System:-
Water is pumped into distribution reservior kept at middle of area and Supply pipes are radialy laid ending toward porphery

→ Advantages / Merits of Radial System

- It gives quick Service
- Stagnation does not occur
- Calculation of pipes Size is easy.

→ Disadvantages / Demerits of Radial System

- Cost of the project is more because of number of individual

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distribution reservioues

- Laying of pipes will be done by skill labours.

- Grid Iron System

Suitable for cities with rectangular layout water mains and branches are laid in rectangles

→ Advantage / Merits of Grid Iron System

- water is kept in good Circulation due to absence of dead ends
- In Case of breakdown / repair in some sections water is available from other direction
- Water reches all points with minimum head loss
- At the times of fires, by manipulating the cut-off valves plenty of water is may be diverted for fire fighting

→ Disadvantages / Demerits of Grid Iron System

- Proper designing is relatively difficult
- Cost of pipes laying is more because relatively more length of pipes is required
- More numbers of valves are required
- Calculation of pipes size is difficult

- Ring System :-

Main is laid all along peripheral roads and submain branch out from mains

→ Advantages of Ring System:-

- Determination of size of pipe is easy
- Water can be supplied to any points from at least two directions
- Large quantity of water for fire fighting as compared to grid iron system

→ Disadvantages of Ring System / Layout

- Length of the main pipe is much larger then grid iron system
- Proper designing is relatively difficult
- Cost of pipe laying is more
- More number of valves is required.

For Hilly area, what system / layout is best

Actually water distribution in hilly areas are always devided into several zones due to undulating terrain

Since as in hilly areas Gravity flow is occured significantly so by keeping

This in mind I think that Radial Layout of distribution is best because in this system also gravity flow is dominant and

the area is also devided into rectangles ie into difrent zones.
Also in Hilly areas this type of storage reservoirs are used like are used in radial system

So I think Radial system is best

Date: 14390

Q: 3

What are the difrent types of reserviours used for water supply system?? Brefly deseribe its importance and its storage capacity Can be determined

Answer:

Types of reserviours:-

On the Basis of elevation from ground Surface it is of two types

- Surface Reservoirs
- Elevated Reservoirs

Surface Reservoirs:-

These are also called ground reservoirs
Mostly Circular or rectangular Tanks
In Case of Gravity system like in hilly areas underground reservoirs are large Sizes are generally constructed on high natural grounds and are usually made of stones, bricks, PCC or RCC

Side walls are Constructed strong enough to take the pressure when the reservoir is full and also to bear earth pressure, when it is empty
position of ground water table is also taken into Consideration

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The floor of these tanks are constructed with RCC with water proofing agents
Also water tightness agents like bitumen compounds are used at joints
For aeration and inspection, manholes, ventillation pipes and stairs are provided

Importance of Surface reservoirs:

Surface reservoirs are usually provided where gravity flow takes place like in hilly area

These tanks are constructed usually on small hill and distribution pipes are laid as per required direction.
In these tanks water is either stored from streams etc or pumped into it from under ground source.

- Elevated Reservoir:
Elevated storage reservoirs also reffered to as overhead tanks are constructed at areas for distribution of water where gravity system is not applicable like in plain area
These are rectangular or circular in shape
Actually Elevated tanks are constructed to make / provide Sufficient pressure head
These ESR, are constructed where only pumping or Combine gravity and pumping system of water distribution is adopted

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Importance of ESR:

Actually these are used in plain area where gravity flow does not take place significantly Gravity flow occur due to to elevation ie pressure head is present while in plain terrain in order to achieve ~~sufficient~~ sufficient head, reservoirs are elevated

- Calculation of storage capacity of Reservoirs.

Total storage capacity of reservoirs is is the sumation of

i) Balancing storage ii) Breakdown storage
iii) Fire storage

- Balancing storage:-

Quantity of water required to be stored in the reservoir for equilizing or balancing fluctuating demand against constant supply is known as balancing storage
It is also called equilizing or operating storage

- Breakdown storage:-

Often called emergency storage in order to tied over emergencies posed by either failure of pumps, electricity or any other mechanism

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About 25% of total storage capacity of reservoir or 1.5–2 times of the hourly supply may be considered as enough provision for accounting this storage

- Fire storage::

This is the requirment of water for extinguishing fires

Fire demand may be Calculated by any of these formulas

① $Q_F = 65\sqrt{P}(1-0.01\sqrt{P})$

P = Population of area

Q_F = Fire demand.

②

$Q_F = 53\sqrt{P}$

P = Population of area

Q_F = Fire demand

③

$Q_F = 390 \times C\sqrt{A}$

C = Constant depend upon type of Construction

A = Area under consideration (all stories)

Q_F = Fire demand (m^3/d)

Continued

So ⇒

Storage Capacity of Reservoir =

balancing storage + Breakdown storage + Fire demand

Q: 4

Why pumps are used in water supply schemes and how to calculate pump Curve to meet water demand.

Answer:

Pumps are used in both pumping or Combined gravity and pumping System

In plain Terrain usually water is extracted from underground Sources. So in order to bring the water to Surface, pump is used. and also to push the water to ESRs. Pumps usually forces the water to attain sufficient head for transmission and distribution

Sometimes pumps are directly connected to Supply lines without storage reservoirs. So these pumps Pushes the water throughout Supply lines

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Also pump delivers a constant flow of water at constant pressure for any given set of condition

Pumps are ideal for use in distribution system since they do not produce pulsating surges of flow and pressure.

How to Calculate Pump Curve to meet water demand..??

Pump Curves are the curves that represent the relation b/w the performance of pump to the needs of system

A pump performance curve indicates how a pump will perform in regards to pressure head and flow.

Curve is defined for specific operating speed (rpm) and a specific inlet/outlet diameter

By the help of curves we can easily decide about our required pump by matching specific head for certain inlet/outlet dia

and by comparing horsepower v/s performance curve.

A pump performance curve is simply a graph or chart that represent the performance capabalities

14390

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of a given water pump

Pump manufacturer perform number of tests and findings are then reflected on graph which we refer as pump Curve