

Water Demand Supply & Distribution (CE-562)

Lecture - 4



Engr. Nadeem Ullah
Department of Civil Engineering,
Iqra National University Peshawar

Water Desalination

Facts about Earth's Water

- Less than 3% of the world's water is fresh – the rest is seawater and undrinkable.
- Of this 3% over 2% is frozen, locked up in Antarctica, the Arctic and glaciers, and not available for human use.
- Thus humanity must rely on less than **1%** for all human and ecosystem's fresh water needs.

Facts about Earth's Water

- Water is not distributed evenly over the globe. Fewer than 10 countries possess 60% of the world's available fresh water supply: Brazil, Russia, China, Canada, Indonesia, U.S., India, Columbia and the Democratic Republic of Congo.
- However, local variations within countries can be highly significant.
- According to WHO, almost **1 Billion people** (~15% of world population) mainly in developing countries have no access to clean potable water.

Desalination

- Desalination is the process of removing salts and other minerals from the saline water to render it suitable for drinking, irrigation, or industrial uses.



Salinity Levels

Type of saline water

Salinity value
(ppm)

Fresh water

<1000

Slightly saline Water

1000-3000

Moderately saline
Water

3000-10,000

Highly saline water

10,000-35,000



Desalination Basic Considerations

- Demand for fresh water (domestic use, industry, agriculture etc.)
- Lack of conventional water sources
 - Lack of conventional water sources
 - Availability of salt water
- Availability of salt water
 - Interest for financing (invest, maintenance, energy,...)
- Availability of Infrastructure (energy, water distribution network)
- Interest for financing (invest, maintenance, energy,...)

Natural Desalination

Major Stages:

1. Evaporation

2. Condensation

3. Precipitation

4. Collection



Principal Methods for Desalination

➤ Distillation(Evaporation)

➤ Electro dialysis

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

- Lack of conventional water sources

➤ Freezing

- Availability of salt water

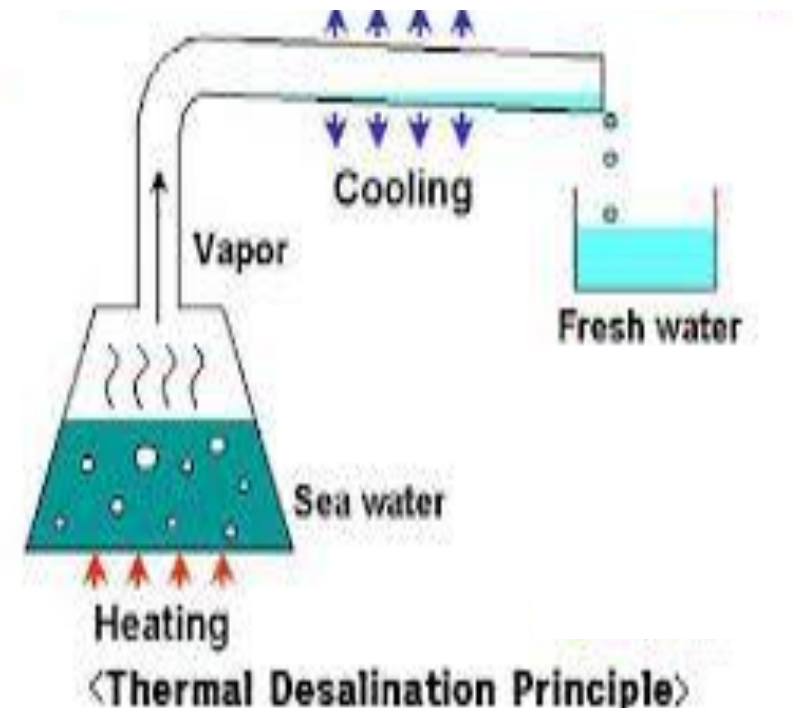
- Availability of Infrastructure (energy, water distribution network)

- Interest for financing (invest, maintenance, energy,...)

➤ Reverse osmosis

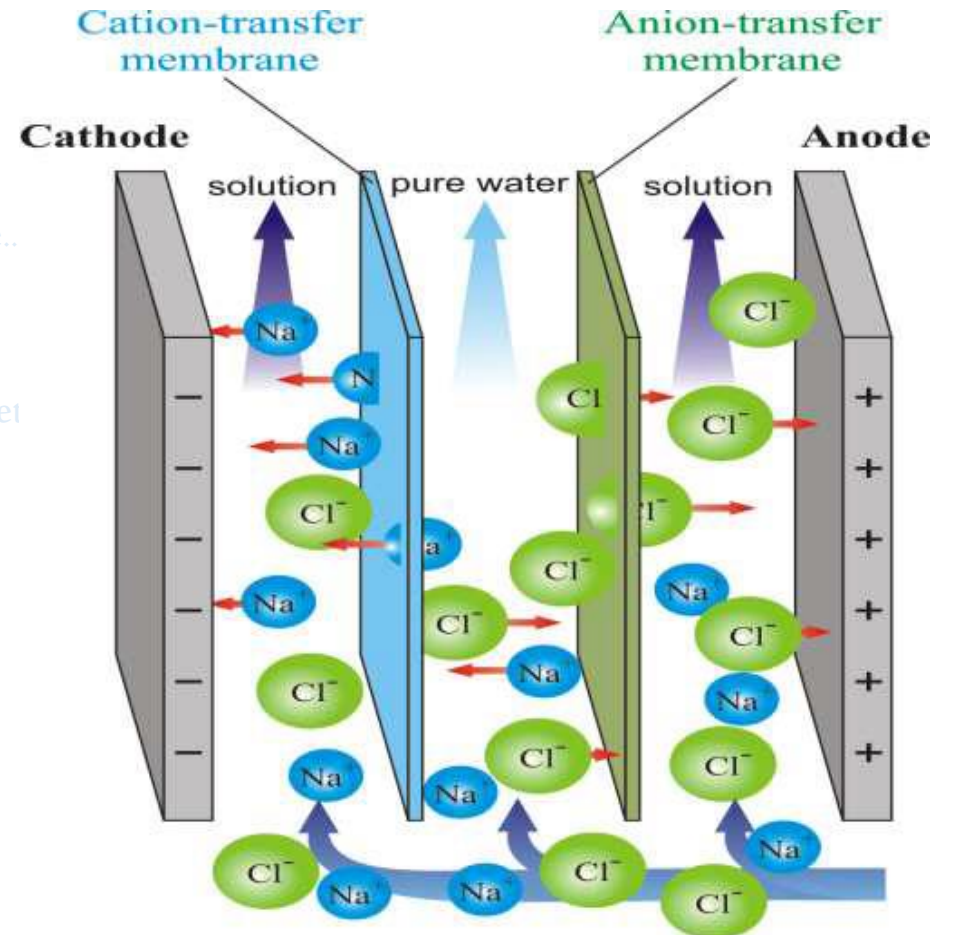
Distillation

- Salt water 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.



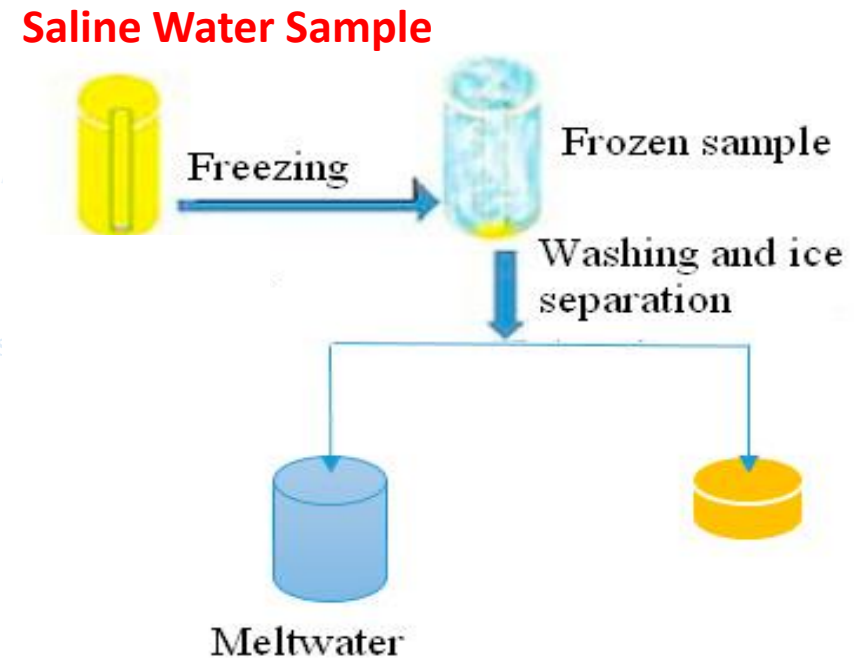
Electrodialysis

- Electrodialysis 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

- 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



Reverse Osmosis (RO)

- **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.

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

Steps Involved in Reverse Osmosis

2nd Step –

- In the second step **carbon filter** is used to remove the chlorine and other harmful chemicals that enter the water sources.
 - Availability of salt water
 - Availability of Infrastructure (energy, water distribution, etc.)
 - Interest for financing (invest, maintenance, energy,...)
- These chemicals are harmful to human health and thus it is necessary to remove them.

Steps Involved in Reverse Osmosis

3rd Step –

- The third step focuses on passing the water from a dense and compacted carbon filter. Most of the contaminants are removed here.

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

- Lack of conventional water sources

- Availability of salt water

- Availability of Infrastructure (energy, water distribution)

- Interest for financing (invest, maintenance, energy,...)

4th Step –

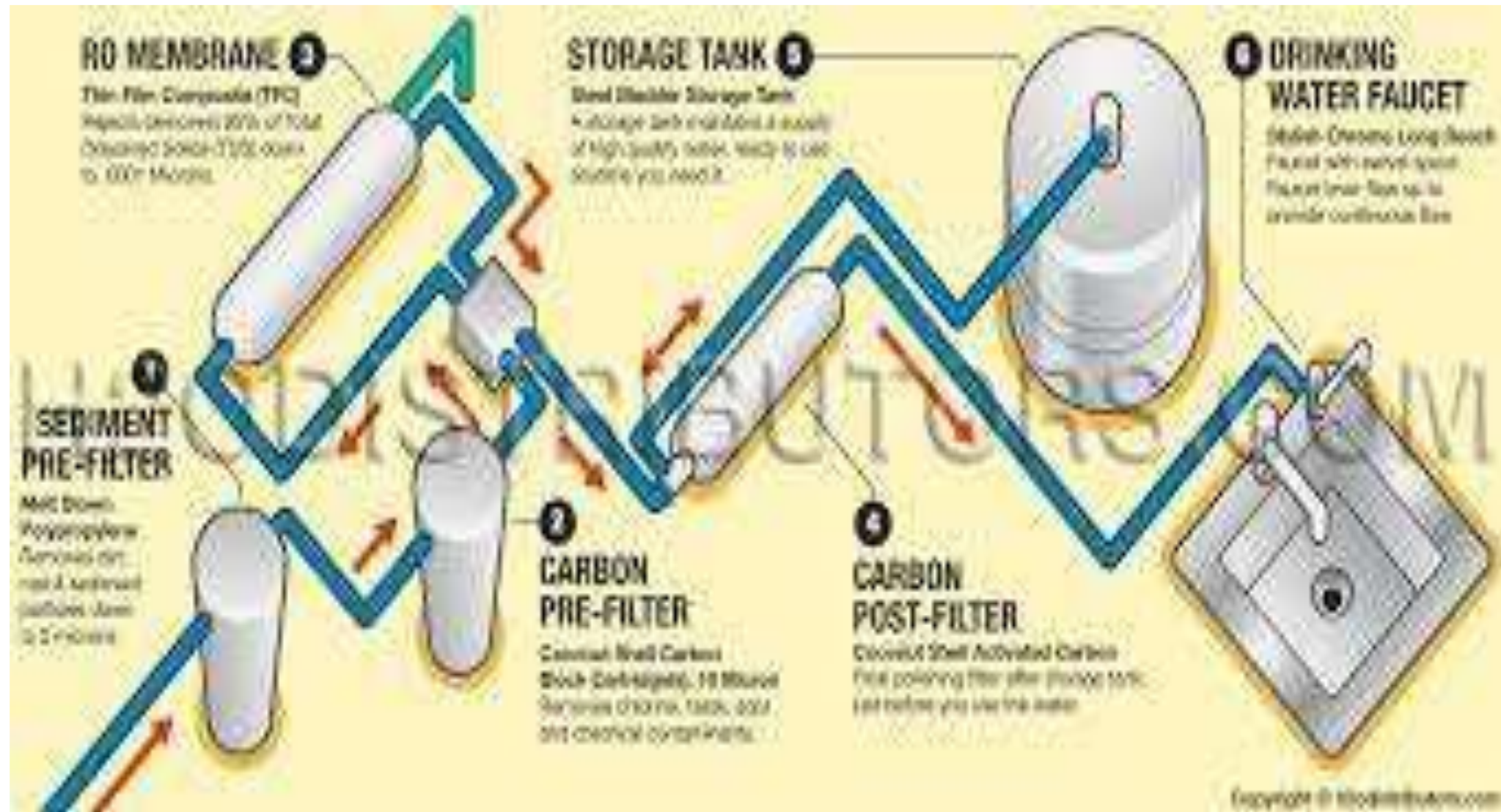
- Water passes through the membrane and all the heavy metals present in the water are removed.
- Along with the metals, radioactive metals too are removed. In this step, the impurities are drained out of the reverse osmosis system and clean water is separated.

Steps Involved in Reverse Osmosis

5th Step –

- In this last stage, the bacteria, chlorine, and bad odour 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.

Steps Involved in Reverse Osmosis



Pros and Cons of Desalination

PROS

- Water scarcity can be easily handled.
- Availability of Water in Areas of Drought.
- Alternative Source of Water
- Production of a High Yield of Water

CONS

- Higher Price
- Greenhouse Gases Emission into the atmosphere
- Seawater desalination may affect the sustainable growth of coastal area.

Future Scope

- Desalination is process primarily done in developed countries with enough money and resources.
- If technology continues to produce new methods and better solutions to the issues that exist today, there would be a whole new water resource for more and more countries that are facing drought, competition for water, and overpopulation.



Thank you