Desalination of water

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Introduction

Only 1 percent of the earth's water is liquid freshwater; 97 percent of available water resources are contaminated by salt. This makes desalination an essential component of efforts to address water shortages, especially in densely populated coastal regions.

Introduction(cont'd)

Egypt faces nowadays severe challenges to our ability to meet our future water needs,So we as a nation will need to make additional water resources available to all segments of our nation's and provide additional water resources at a cost and in a manner that supports urban,rural and agricultural prosperity and environmental protection;Meeting these challenges may lead us to use saline water for a greater national focus on water conservation.

What is Desalination

Desalination is a process that removes salts and other dissolved solids from brackish water or seawater.

Brakish water and seawater

- Brackish water is not as salty as seawater.
- Brackish water usually has a salt concentration between five and 20 parts per thousand (ppt) and seawater generally has a concentration of salt greater than 20 ppt.
- Brackish waters may also be found in aquifers

Water type and TDS

Water type	TDS(mg/l)
Sweet waters	0-1000
Brackish waters	1000-5000
Moderately saline waters	5000-10000
Severely saline waters	10000-30000
Seawater	More than 30000

Desalination Techniques

Most common desalination techniques

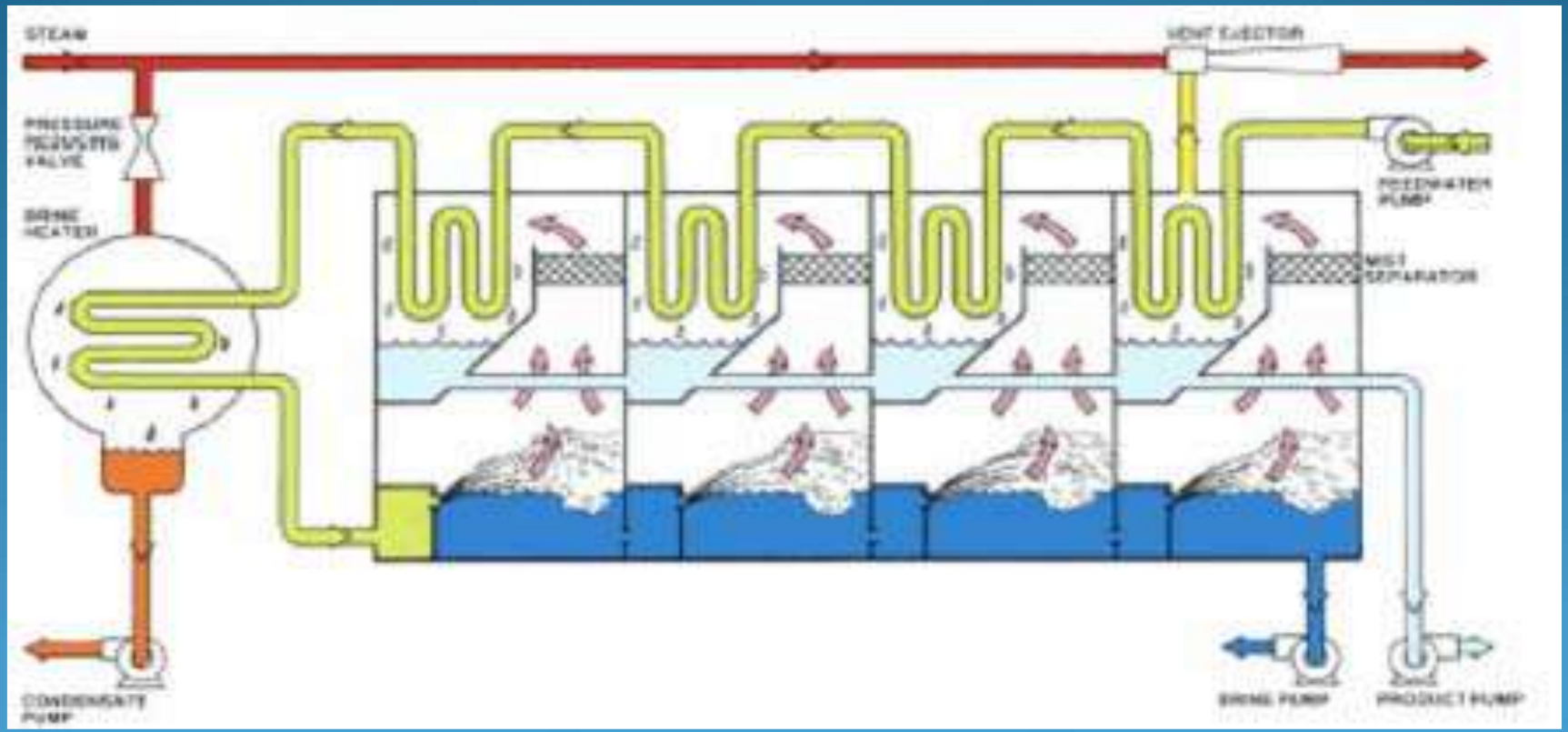
- Distillation processes:
  - Multi-stage flash distillation (MSF).
  - Multiple-effect evaporator (MED|ME).
  - Vapor-compression evaporation (VC).
- Membrane processes :
  - Electrodialysis reversal (EDR).
  - Reverse osmosis (RO).

Distillation Tehniques

Multi-stage flash distillation

Multi-stage flash distillation (MSF) is a water desalination process that distills sea water by flashing a portion of the water into steam in multiple stages of what are essentially countercurrent heat exchangers . Multi-stage flash distillation plants produce (64%)percent of all desalinated water in the world.

Multi-stage flash distillation



Multi stage flash distillation

Multiple Effect Distillation

Multiple-effect distillation (MED) is a distillation process often used for sea water desalination. It consists of multiple stages or "effects". In each stage the feed water is heated by steam in tubes. Some of the water evaporates, and this steam flows into the tubes of the next stage, heating and evaporating more water. Each stage essentially reuses the energy from the previous stage.

Vapor Compression Distillation

- Vapor-compression desalination

The VC operates mainly at a small scale, on small locations. The main mechanism is similar to MED except that it is based on compression of the vapor generated by evaporating water to a higher pressure,which allows reuse of the vapor for supplying heat for the evaporating process.

Membrane Techniques

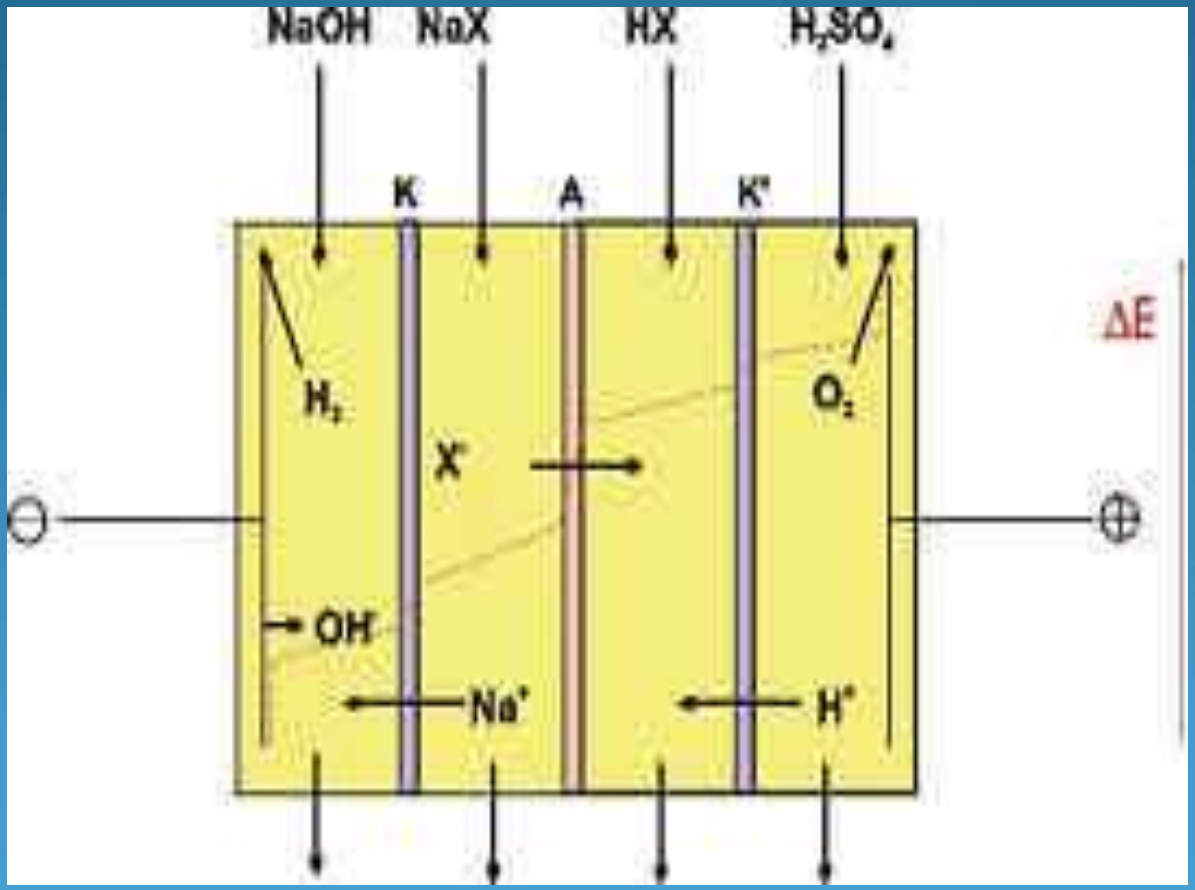
Membrane Techniques

Image for membranes used in this technique

Electrodialysis reversal

EDR desalination is an electrodialysis reversal water desalination membrane process that has been commercially used since the early 1960s. An electric current migrates dissolved salt ions, including fluorides, nitrates and sulfates, through an electrodialysis stack consisting of alternating layers of cationic and anionic ion exchange membranes. Periodically, the direction of ion flow is reversed by reversing the polarity applied electric current.

Electrodialysis reversal

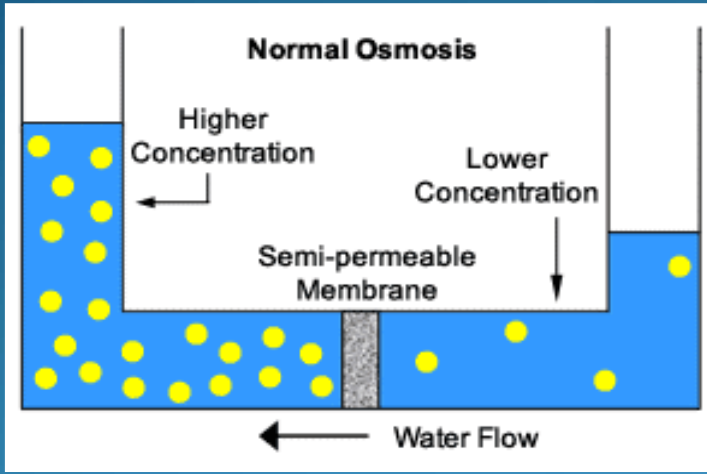


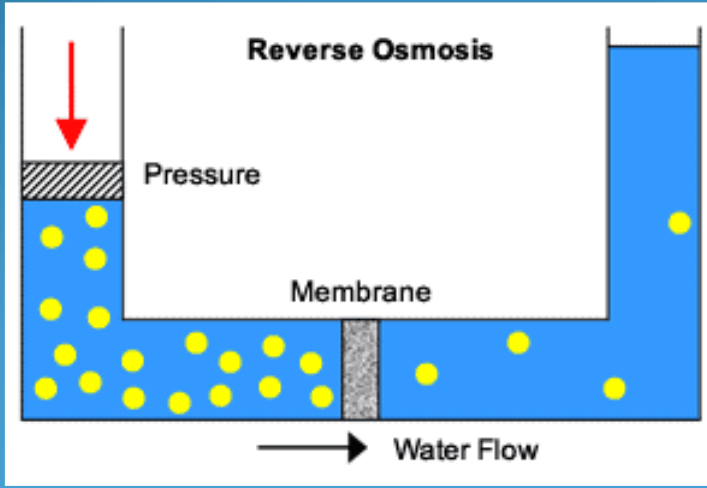
Electrodialysis

Reverse Osmosis

Reverse osmosis (RO) is a filtration method that removes many types of large molecules and ions from solutions by applying pressure to the solution when it is on one side of a selective membrane. The result is that the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side. To be "selective," this membrane should not allow large molecules or ions through the pores(holes), but should allow smaller components of the solution (such as the solvent) to pass freely.

Reverse Osmosis



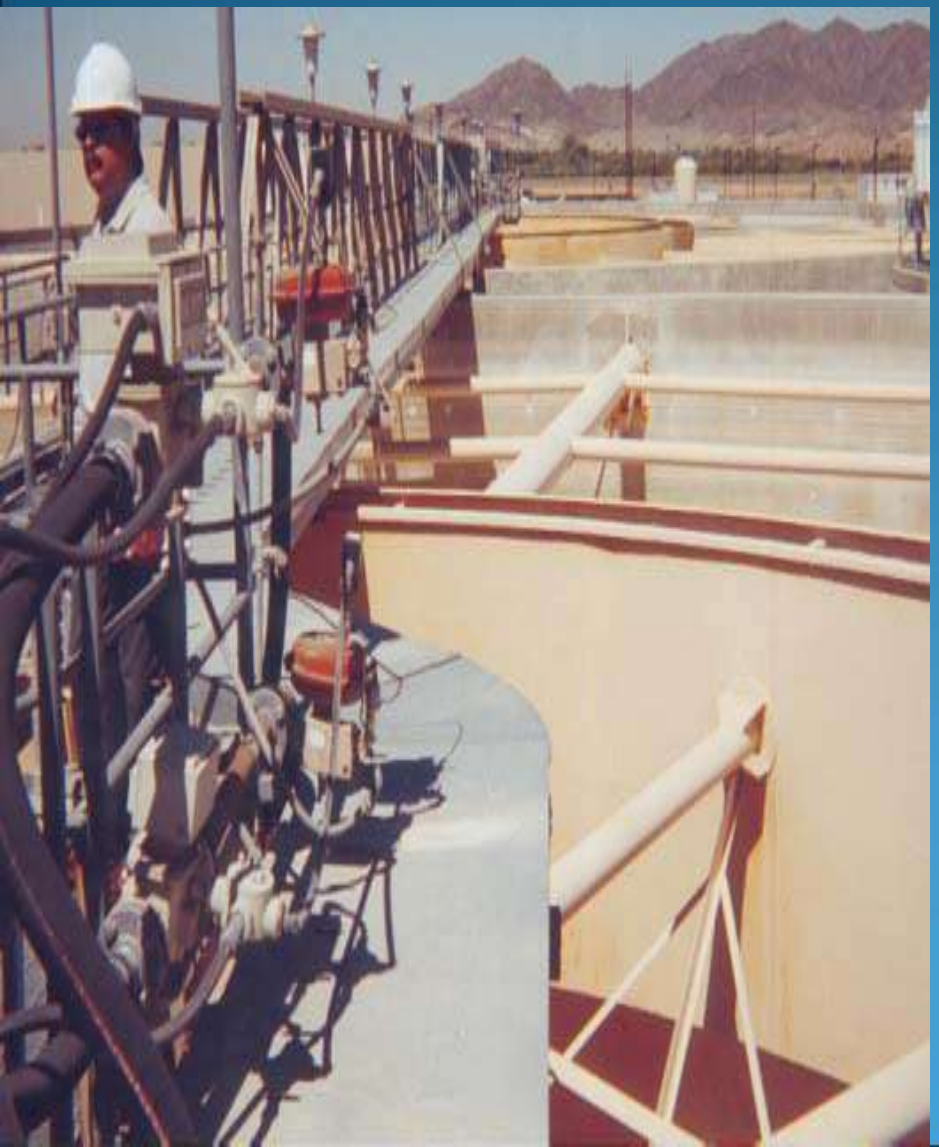


4200 m3/day Reverse Osmosis Unit for Industrial Water Application

Advantages and disadvantages of desalination techniques (see attatched file)

Desalination plants

Desalination plants



Desalination plants

Desalination plants

Considerations in desalination

- Cogeneration
- Economical
- Environmental

cogeneration

- Cogeneration is the process of using excess heat from power production to accomplish another task.
- Theoretically any form of energy production could be used. However, the majority of desalination plants use either fossil fuels or nuclear power as their source of energy.
- Most plants are located in the Middle East or North Africa, due to their petroleum resources.

Economics

- A number of factors determine the costs for desalination:capacity and type of facility, location, feed water, labor, energy, financing, and concentrate disposal.
- In places far from the sea, like New Delhi, or in high places, like Mexico City, high transport costs would add to the high desalination costs.one needs to lift the water by 2,000 metres,or transport it over more than 1,600 kilometres to get transport costs equal to the desalination costs.Thus, it may be more economical to transport fresh water from somewhere else than to desalinate it.
- Desalinated water is also expensive in places that are both far from the sea and high, such as Riyadh.

Environmental

- Discharges of brine into sea water has the potential to harm ecosystems.Examples of such locations are the Persian Gulf, the Red Sea.
- Qatar, Bahrain, Saudi Arabia, Kuwait and Iran have 120 desalination plants between them. These plants flush nearly 24 tons of chlorine, 65 tons of algae-harming antiscalants used to descale pipes, and around 300kg of copper into the Persian Gulf every day.
- To limit the environmental impact of returning the brine to the ocean, it can be diluted with another stream of water entering the ocean

Conclusion

- Desalination process provides safe water and ensure the sustainability of the nation's water supply.
- Egypt should do our best to use our sources such as solar energy and wind to use it as an inexpensive techniques for seawater desalination.

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Thanks