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CONVERSION OF SALINE WATER INTO FRESH WATER BY USING SOLAR ENERGY

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Abstract

The use of solar energy in desalination process is one of the most promising applications of the renewable energies. The desalination is more useful for the regions where the scarcity of water is more and evaporation rate is high. This paper includes mainly desalination technologies; Membrane processes include Reverse Osmosis (RO) , Electrodialysis (ED); Thermal processes include Multi Stage Flash (MSF), Multi Effect Distilation (MED), Thermal Vapour Compression (TVC), Multi Vapour Compression (MVC); Freezing process. This paper also includes the purposes, various challenges comes while processing these methods along with the future scope of desalination method. It is also mentioned that the hybrid technology of reverse osmosis (RO) and thermal process playing a great roll in further developing technologies. The primary focus of this paper is on the need of desalination and various processes of desalination suitable for particular region.

Keywords: *Desalination, technologies, RO, ED, MSF, MED, TVC, MVC*

1. INTRODUCTION

India is basically known as country of agriculture. Here 70-80% economy depends on the agriculture. Using the water without planning, and also due to the lack of rain and decreasing land of water, the ground water level is decreasing day by day. It means the volume of water on earth and its level is reducing day by day. Hence in future we will definitely face the problem of water scarcity.

About 71% of the earth's surface is covered with water, amongst them 96.5% of water is present in seas and oceans. The distribution of the remaining 3.5% of fresh water is very uneven. For countries facing chronic shortages, the only available water resources will be treated wastewater or saltwater. At present, only 0.7% of drinking water produced from saltwater.

By 2030, nearly half of the world's population will live in a situation of water stress due to population growth, resulting in the skyrocketing of water needs for human consumption, agriculture and industry, thereby exacerbating usage conflicts. It is estimated that total water demand will more than double by 2050.

To overcome this problem the desalination process becoming very useful in today's world. Desalination is the process hope to rid the world from scarcity of water for more than 50 years during this period. It has been observed in recent years, desalination costs decreasing continuously over recent years as a result of progress in the design and operation of the various systems used in water desalination.

2. DESALINATION:

Conversion of saline water into fresh water by eliminating salt contents from saline water to make it portable. The earliest form of desalination include the processes, boiling then cooling and condensing the sea water as fresh water. In areas along the Arctic Ocean, due to cold climate freezing the water to remove the salt was more practical. When saltwater is frozen, the salt ions sink to the bottom over time, leaving freshwater at the top that may be melted or shaved off.

3. METHODS OF DESALINATON:

A. MEMBRANE PROCESSES
B. THERMAL PROCESSES
C. FREEZING PROCESS

A. MEMBRANE PROCESSES:

a. Reverse Osmosis (RO):

Reverse osmosis is a complicated process which uses a membrane under pressure to separate relatively pure water and other solvents from a less pure solution. In this process salt ions are rejected and the nominal rejection ratio of common ionic salt is 85-98%. It removes the common chemical contaminants including sodium, chloride, copper, chromium lead, etc. RO removes 90 - 92% of beneficial calcium and magnesium.

The membranes used in RO process are generally made from polymeric material like cellulose and acetate or non

polymeric materials like ceramic. The first commercial RO membranes used were cellulose-acetate.

Following are the membranes used in this process:

- Cellulose acetate
- Thin film composite membrane (TFC)

The main challenges found in RO are fouling of membrane, saturation of over impurities on the surface of membrane. The disadvantage of RO is that it require a continue maintenance and the advantages are that it is a fast process with greater efficiency of water, the energy require is less. This process is helpful for the region where greater demand of water is observed. The electric power require for this is generated by using solar power.

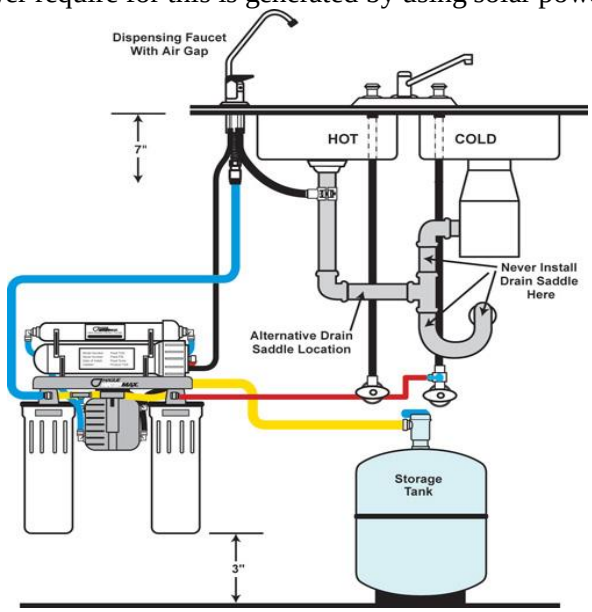

Fig.1

b. Electrodialysis (ED):

Electrodialysis process is helpful for the salinity upto 12g/L. In this process, the anionic and cationic membranes are used to separate the salt from water. Salt contains +ve charge over them, hence they attract towards –ve electrode. And water anions attracts towards the +ve electrode. The spacer sheet is use to seperate both membranes.

The main challenges in this process are formation of leakages in the membrane and bacteria and non ionic matter are remain as it is in the water. So for that the further treatment is required.

B. THERMAL PROCESSES:

Thermal process include the phenomenon of evaporation and condensation. The saline water is first evaporated and those evaporated vapours are then collected in condenser for cooling purpose. The solar energy is use directly or indirectly for this processes.

Following are the types of thermal process:

a. Multi-Stage Flash (MSF):

It is done by flashing the portion of water into steam in multiple stages. The efficiency of multi stage flash is high and this is commonly used process where the thermal desalination plant is present.

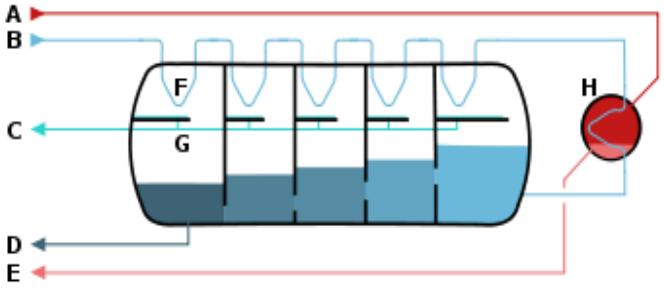

Fig.2

A-Steam in
B- Seawater in
C- Potable water out
D- Waste out
E- Steam out
F- Heat exchange
G- Condensation collection
H- Brine heater

b. Multi Effect Distillation (MED)

It is multistage process in which tubes are used for evaporation and condensation of water inside. The challenges of this process are corrosion and deposition of calcium carbonate on condenser tubes.

In Fig. given below the pink area is indicated that they are the vapours similarly the blue portion is the water in liquid form. The whole mechanism is processing from top to bottom.

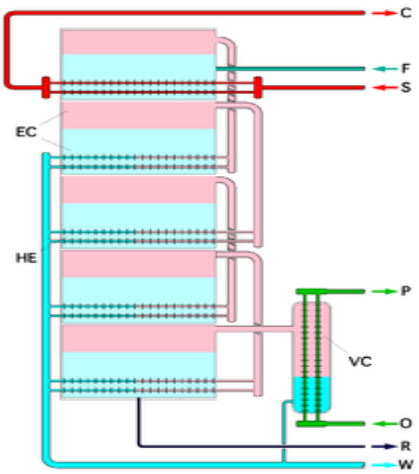

Fig.3

F- feed water in.
S- heating steam in.
C- heating steam out.
W- Fresh water (condensate) out.
R- brine out.
O- coolant in.
P- coolant out.
VC is the last-stage cooler.

c. Thermal Vapour Compression (TVC):

It is the method in which the steam ejectors are mostly use, the compression of vapours is performed by high pressure motive steam ejectors, hence it is known as thermal vapour compression. The efficiency is depend upon how much efficient instrument we are using.

d. Mechanical Vapour Compression (MVC)

The compression is mechanically powered by something such as a compression turbine, blower, compressor and ejector. If the compression is performed by mechanically driven compressor then it is known as mechanical vapour compression.

C. FREEZING PROCESS

In this method, the saline water is freezes in the specific moulds (cube or rectangle). So that the salt ions and bulky impurities are settle down at bottom and the pure water remains at top. It require less energy and corrosion is avoided upto certain extent. It require the proper supervision while carrying the mixture of ice and water during this process, because it is very difficult to move and process.

4. HYBRID TECHNOLOGY

The combination of RO and thermal process may results in low cost of pretreatment, good quality of water. Due to this combination the extra falling impact on membrane of RO method has been reduces. The balance is made forever in this process which become beneficial for the long life duration of the equipment. The consumption of the fuel is also reduces.

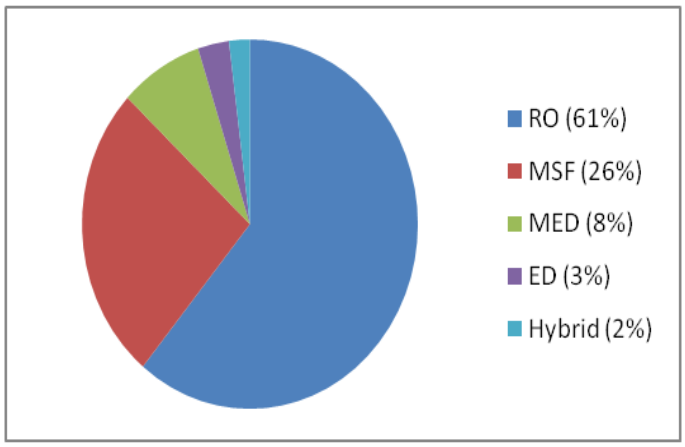

Fig.4

The above Fig shows the use of various desalination processes in percentage around the world.

5.PURPOSE:

- To fulfill the future demand of water.
- To reduced the scarcity of water in future.
- To increase the use of non conventional sources (solar energy) instead of conventional sources (coal).
- To increase the efficiency of water.
- An advanced mechanical vapor compression desalination with vvc system in desalination and purfying water industry

6. CONCLUSION

This paper conclude that the desalination has become the only way which minimize the water scarcity over earth. Various technologies has been over looked here; from that we have conclude that the thermal process has becoming the better one than the RO process for large desalination plant. For the large demand of water the RO has became most accessible process. But the hybrid plant is found to be better solution over cost and fuel. As we are using the solar power to generate energy required for all the processes, the consumption of natural sources like coal can be prevented. Since the treated water is not only using for domestic purpose but also the irrigation can be done over it; hence the economic condition of India will become strong in irrigation field.

7. FUTURE SCOPE/USES

- As nearly 60% of the world's populations live less than 100 km away from a marine coast, desalination has become an undeniable alternative resource for the present and the upcoming decades.
- The only way desalination can be a good option to solve the water crisis.
- If we treat saline water, not only we will manage our drainage problem, but also we will create supplemental water.
- After treatment the fresh water is used for irrigation and domestic purpose as well as for commercial purpose.

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