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TECHNOLOGIES USED FOR DESALINATION OF SEAWATER INTO DRINKABLE WATER

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Abstract- Water is the basic need which is used for variety of purposes like drinking, washing, bathing recreation as well as numerous other varied industrial applications. The increasing amount of discharged sewage, urbanization, use of chemicals in agriculture and various anthropogenic activities effects the quality of underground water. The availability of fresh water sources is limited. Water shortage and unreliable water quality are major obstacles to achieve sustainable development and improvement in quality of life. Seawater accounts for 94% of the Earth's water and support numerous commercial activities. The main drawback is their high salinity. Desalinization of salt water is done to eliminate dissolved minerals including salts from feed water resources that are salty. This paper includes review of various methods used for sea water desalination.

Keywords– Water, Seawater, Desalination, Reverse osmosis, solar distillation method, freezing process, electro dialysis

I. INTRODUCTION

The worldwide availability of fresh water is very limited but the demand of water in the country is increasing at a rapid rate due to increased use of water for irrigation, industrialization, population growth and improving the standard of living. This increased demand for water has put pressure on water supply system, which has lead to overexploitation of water resources, and breaks in the balance of the ecosystem. Safe drinking water is essential to humans and other life forms but increased amount of discharged sewage, chemicalization of agriculture and industry, as well as anthropogenic activities all affects the quality of underground water. The only inexhaustible source of water is the seawater which covers 94% of the earth's surface but this water contains about 3.5% salts. Brackish water is totally unfit for drinking. When there is no other source of water there is no alternative except to do the desalination of available water.

II. METHODS OF DESALINATION

The most widely used methods which are adopted for the conversion of salt water into fresh water are a) Reverse osmosis b) Solar distillation method c) Freezing Process d) Electro dialysis Two thousand years ago, Greek sailors used to get fresh water from sea water by distilling seawater. Among these processes, RO method employed in the bulk of the plants (90%) to desalinate seawater worldwide (Marc et.al. 2010). Reverse Osmosis RO) is a pressure driven membrane process where a feed stream flows under pressure through a semi-permeable membrane, separating two aqueous streams, one rich in salt and other poor in salt. Water will pass through the membrane, when the applied retained. As a result, a low salt concentration permeate stream is obtained and a concentrated brine remains at the feed side pressure is higher than the osmotic pressure, while salt is retained .Brackish water sources are often groundwater; these groundwater can be naturally saline aquifers or groundwater that has become brackish due to seawater intrusion or anthropogenic influences (e.g., overuse and irrigation). Surface brackish waters are less common but may occur naturally or through anthropogenic activities. Brackish waters can have a wide range of TDS (1000–10,000 mg/L) and are typically characterized by low organic carbon content and low particulate or colloidal contaminants. Solar energy can be used to convert saline water into fresh water with simple, low cost and economical technology and thus it is suitable for small communities, rural areas and areas where the income level is very low. Two types of solar power MD is classified as direct and indirect systems. In direct systems are those where the heat gaining and desalination processes take place naturally in the same device, (Solar still). In indirect method, the plant is separated into two subsystems, a solar collector and a desalination unit. The solar collector can be a flat plate, evacuated tube, solar pv cell or solar concentrator and it can be coupled with any of the distillation unit types which use the evaporation and condensation principle, Recent developments have demonstrated that solar powered desalination processes are better than the alternatives membrane desalination technology.

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Fig 1-Water Scarcity problems

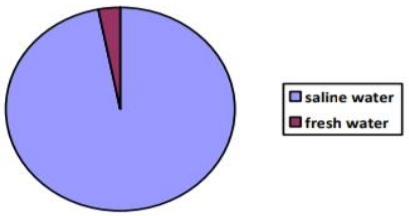

Chart-1 sea water and fresh water available on earth

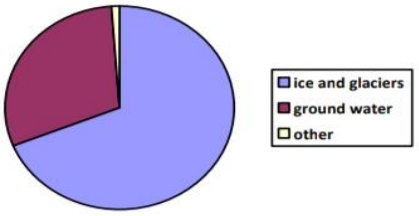

chart -2 fresh water on earth

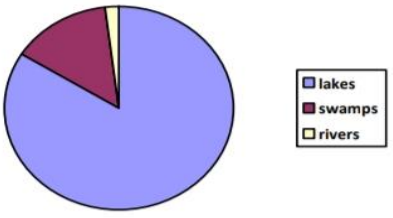

Chart-3 fresh water on surface

A. REVERSE OSMOSIS

Reverse osmosis is a water purification process that uses a semi-permeable membrane (synthetic lining) to filter out unwanted molecules and large particles such as contaminants and sediments like chlorine, salt, and dirt from drinking water.

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Fig1.Reverse osmosis

B. SOLAR DISTALLINATION METHOD

Solar distillation is a process in which the energy of the sun is directly used to evaporate freshwater from sea or brackish water. The process has been used for many years, usually for small-scale applications.

Desalination process

- Multi stage flash distillation
- Multiple Effect distillation.
- Reverse osmosis
- Solar technologies

Fig2.solar distillation plant

C. FREEZING PROCESS

The freezing desalination process is a freezing/melting process used to reduce the salts and impurities from brackish water to produce freshwater. The fundamental concept of this process is that while heat is released from saline water, the water temperature decreases until its temperature reaches the freezing point.

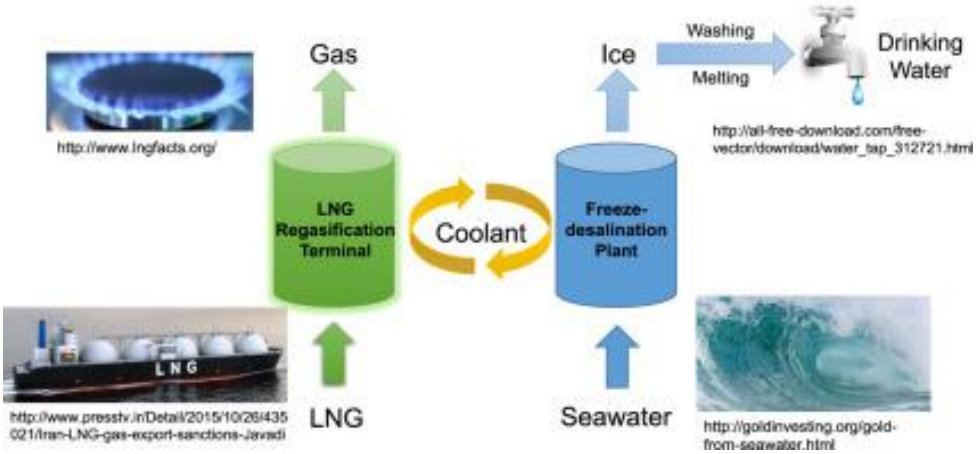

Fig3. Freezing Process

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D. ELECTRO DIALYSIS

Electrodialysis reversal desalination, commonly abbreviated EDR, is a water desalination process in which electricity is applied to electrodes to pull naturally occurring dissolved salts through an ion exchange membrane to separate the water from the salts.

Fig4. Electro dialysis

DESALINATION PROCESS DIFFERENCES

Process	Advantages	Disadvantages	Efficiency	Accuracy	Cost
Reverse Osmosis	- Removes dissolved solids, salts, and impurities effectively.	- Requires high -pressure pumps, increasing energy consumption.	High, can remove up to 99% of contaminants	High, produces consistent water quality	High initial cost, moderate maintenance cost
Solar Distillation	- Requires only sunlight and water, making it energy-efficient.	- Slow process that can only produce small amounts of water.	Low, produces small amounts of water	Moderate, depends on weather and equipment	Low initial cost, low maintenance cost
Freezing Process	- Can produce high-quality water with minimal energy usage.	- Requires specialized equipment and expertise.	Moderate, depends on equipment and process	High, produces consistent water quality	High initial cost, high maintenance cost
Electrodialysis	- Can remove specific ions from water.	- Can be expensive to operate and maintain.	High, can remove up to 99% of contaminants	High, produces consistent water quality	High initial cost, high maintenance and energy cost

III. ADVANTAGES

- Provides people with potable water(clean & fresh drinking water).
- Provides water to the agriculture industry.
- Water quality is safe(not dangerous or hazardous to any living thing).
- Uses tried-and-tested technology(the method is proven and effective).
- Helps preserve current freshwater supplies.
- Unlimited ocean water as source.
- Help with habitat protection.

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CONCLUSION

As per the tested results it can be concluded that, TDS parameters are low as compared to drinking water parameters of WHO Global standard. Also bore well water that is groundwater has an average TDS of 1350ppm. If we mix both of them, then the resultant TDS value will be 690 ppm which is within the permissible drinking limits of WHO standards. Therefore, this water can be used for drinking purpose. This also concludes that the model is feasible and practical in the areas where there is shortage of fresh drinking water. The desalination of sea water using solar thermal power plant and tidal power can be used in order to produce clean energy, drinkable water& salt and will help in controlling environmental problems such as cyclones, flood.

FUTURE SCOPE

In future, There is ongoing research and development in desalination technologies, such as improving membrane materials and energy efficiency, which will make the process more efficient and cost-effective. The integration of renewable energy, such as solar and wind power, into desalination processes will help reduce energy costs and environmental impact. There is an increasing trend towards building larger desalination plants, which can benefit from economies of scale and reduce costs. The use of advanced treatment technologies, such as reverse osmosis and membrane bioreactors, can allow for the recycling and reuse of wastewater, reducing the need for fresh water intake. Decentralized or point-of-use desalination systems, such as small-scale plants or household units, are likely to become more popular in areas where access to freshwater is limited. Collaboration between public and private sectors can help drive innovation and investment in desalination projects, especially in developing countries where water scarcity is a major issue.

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