

Solar Desalination: A Comparative Analysis

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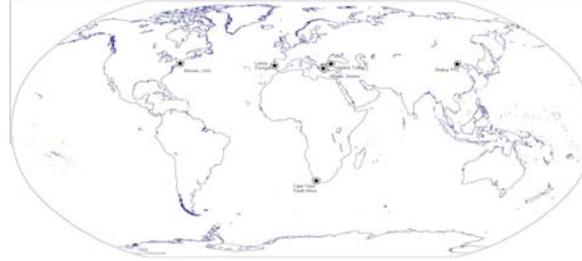
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"Water touches, and is touched by, all of our daily actions, and many serious problems involving water face all current and future generations."

- Peter Gleick



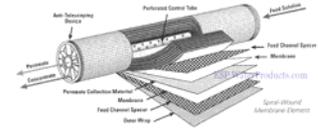
- 600 gallons of water are required to make a pound of hamburger
- 72 gallons of water are required to make a cup of coffee



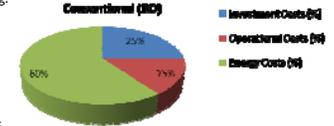
Abstract

In the light of increased water usage and depleting natural water supplies, the world is facing an impending water shortage. To combat this, many countries have turned to desalination to derive usable water from the sea. In this report, we have researched the current desalination technologies available in order to provide a comparative analysis of different methods of solar desalination and other methods of conventional desalination for the benefit of those who are undecided or ignorant to all viable options. From our research, we have concluded that although solar desalination is not a viable option at the present, further research in efficiency and longevity of solar panels will make solar assisted desalination the most economically advantageous of methods.

Reverse Osmosis



Reverse-Osmosis is one the simplest forms of desalination, it only involves pushing a solution through a filter. Pressure is applied to one side of the system and pushes the seawater through a membrane and the salt is essentially filtered. However, this process is only simple in the idea that drives the process, in order for the process to be successful intricate mathematical calculations must be computed otherwise the system will not function properly. This requires a skilled laborer to operate the Reverse-Osmosis operation. The membranes are also complex polymers that require precise manufacturing.



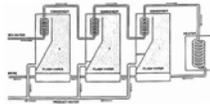
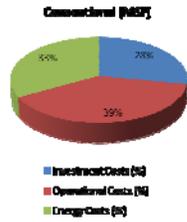
Advantages

One of the simplest forms of desalination in theory. Simply pushes the water through a filter.

Disadvantages

Requires a skilled laborer to operate. The membranes are also complex polymers that require precise manufacturing.

Multi-Stage Flash



In Multi Stage Flash Distillation, seawater is pumped into a brine heater where the water is heated. The heated water is then passed to another container that is significantly lower in pressure; this pressure change causes the seawater to instantaneously (flash) boil and converts to steam. Only a small percentage of the water is converted due to the pressure change so the water often goes through several "stages" of pressure drops in order to extract the water.

Advantages

Relatively low investment costs.

Disadvantages

High maintenance cost, since it requires extensive training.

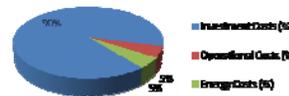
Solar Desalination



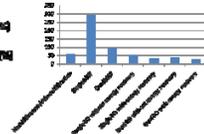
With conventional Solar Desalination, a basin is filled with seawater; this basin has covered by a curved or sloping surface transparent to solar radiation. The water condenses on the covering and is collected.

The cost distribution of Solar Distillation is dramatically different from that of Reverse Osmosis and MSF. The main cost is in the initial investment. However, once the system is operational it is extremely cheap to maintain and the energy has little or even no cost. This system can have a "no cost" energy supply because the sun's energy is completely free and if the situation allows it, the plant can run completely off solar radiation in an ideal environment. Because of the amount of space required for a solar desalination plant, most of the initial cost is determined by land values (S. Al-Hallaj et. al., 171). The price of the solar panels are also a main determinant of the cost of the plant.

Investment Costs (%)



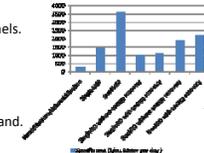
Specific Power (kJ/kg)



Cost of product water (\$ per m³)



Specific cost (\$/cu. Meter per day)



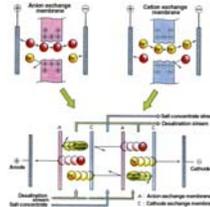
Advantages

No energy costs due to the use of solar panels. Costs of solar panels are decreasing. Very low maintenance.

Disadvantages

Requires a lot of space. Initial investment cost due to the price of land. Current costs of panels are expensive. No economy of scale.

Electrodialysis



Electrodialysis involves running a large amount of electric current through a container of seawater. This creates a salt-poor layer on one side and a salt-rich layer on the other side. This method is very efficient because it does not require a change of state for the water however it does require massive amounts of electricity that can get very expensive.

Advantages

Does not require any of the solution to change its state of matter. Simply separates the solute from the solvent, in this case salt and water respectively.

Disadvantages

Requires massive amounts of electricity to produce the desired effect. May not be financially feasible for many countries suffering from water shortages.

Dual-Purpose Power Plants



Dual-Purpose Power Plants create both water and electricity. A power plant's turbine gives off excess steam which is used to power the desalination plant, making it one very efficient use of energy and resources.

Advantages

Produces both electricity and clean water. Very efficient use of energy.

Disadvantages

Trade off between energy produced and water produced. Price of water determined by price of fuel. High Overhead

Conclusion

With technology constantly improving, and current prices of conventional fuel sources increasing, it can be safe to say that solar-assisted desalination will be one of the most efficient and affordable options in the near future. The hunt for water will never end, but with a positive mind towards technology and research, supply can be kept well ahead of demand and the future world can experience a time without the fear of looming water shortages.