Renewable Energy based Solar desalinator

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Abstract

The availability of safe drinking water is the most fundamental requirement for human survival on Earth, according to a number of scientific research. Fossil energy prices may be prohibitively expensive in many regions where freshwater resources or water delivery infrastructure are insufficient, whereas solar energy is abundant everywhere. Furthermore, as government rules in the developed world increasingly emphasise the replacement of fossil energy with renewable, low-carbon energy, water-stressed countries are considering the use of solar-powered electricity to generate electricity. Desalination technology, when used in conjunction with present freshwater supplies, can assist in resolving both the water supply and the energy crises.

Water covers around 80 percent of the earth's surface, according to estimates:

- 97.5 percent of the solution is saline.
- Underground deposits containing 2.5 percent of the country's total reserves and frozen as ice
- Fresh water is accessible in the amount of 0.25 percent.

Keywords: Solar Power, Desalination, Low-Carbon Energy, Fossil Energy

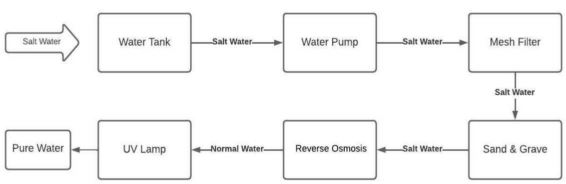
Introduction

Governments in the twenty-first century face a wide range of water-related issues. A quarter of the world's population, or 1.2 billion people, does not have access to adequate water quality. As the world's population grows, water demand will climb at a rate that is twice that of population growth. As global water use has quadrupled, experts predict that mankind will need 40% more water in the next twenty years. Since economic progress leads to an increase in population, the need for ever-expanding irrigation for highly productive agricultural systems necessitates an increase in water scarcity, lack of accessibility, degradation of water quality, and insufficient ground water recharge. In the near future, water shortage will be a serious challenge to world peace and security. There are three ways to address water shortages: maintaining the quality of present supplies, enhancing current water usage efficiency, and finding more freshwater. It is possible to attain these goals through the desalination of saltwater, rainwater harvesting, wastewater recycling, and water importation. In the Mediterranean basin, southern Europe, the Middle East, Asia, and Africa, where there is a paucity of water, water worries are particularly serious. Those who live in isolated rural areas where socioeconomic constraints prevent the speedy installation of water treatment equipment are affected by water shortage. Large-scale desalination plants may not be necessary in remote locations that are not connected to the electrical grid, as the infrastructure is generally lacking in these places. There is a definite need to develop desalination equipment that can work off-grid and on a smaller, village size as a result of this Fortunately, island nations that are regularly invaded by saline water tend to have a lot of wind power on hand. Due to their proximity to the equator, the world's driest regions get more solar radiation than any other part of the globe, making them prime candidates for harnessing the sun's energy. These conditions necessitate the use of renewable energy sources.

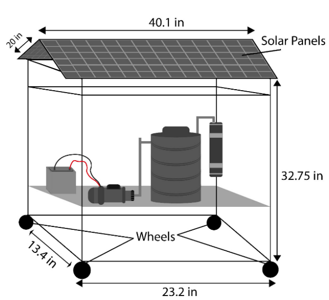
Working Principle

The solar-powered desalination system uses three processes to transform salty seawater into potable drinking water. To begin, a mesh-based intake will be used to allow the user to stream salty water through it. Plastic granules, stones, flora and so on are separated from the water by this method. This water travels through a three-tiered sand and gravel filter to remove weeds and large salt particles. Afterwards, the water is forced through the three sand and gravel layers. Water that is still salty but devoid of particles can be produced using this procedure. The second filtration stage uses reverse osmosis to remove salt from the water. In order to separate salty water from fresh water, membrane filters employ three types of membranes. This water will be stored in a tank located slightly above the system for a long time. UV lamps are activated at stage 3 of filtration when water exits the tank and reaches your faucet, killing any bacteria and viruses that may be present in the water. This water, in general, should be drinkable at this point. As a result of the three-step method, the consumption of chlorine can be reduced. The whole system and all of its pumps will be powered by a single battery. In this situation, two 15-watt solar panels can be used to provide solar electricity for charging the battery. People can drink clean water in an emergency since the entire system is portable and can be set up close or on the beach.

Block and Circuit Diagram



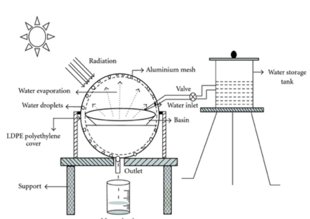
Shelf Housing with RO parts



Reference 6 Solar Module Design

Wind Mill

Spherical Circular Still



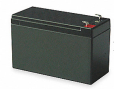
Reference 1

- Collector Plate area: 0.28 m2Brackish Water Storage Capacity: 16 Liters
- Production: 2.3L/m2/day

Device Fabrication & Components

1. Water tank
2. 12V Batteries
3. Water Pump
4. RO System
5. Ultraviolet Sterilizer
6. Micro Fibre Mesh
7. 50W Soler Panel

Water Pump



12 V Battery

RO System

Water Tank

Housing Shelf

Pipe

50W Solar Panel

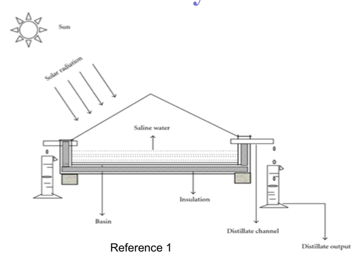
Arduino Kit

Pyramid Solar Still

Collector Plate area: 1.21m²

Brackish Water Storage Capacity: 60.5 L

Fresh Water Production: 3.4L/m²/day



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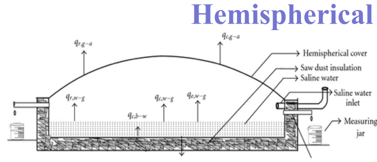
Hemispherical Solar Still

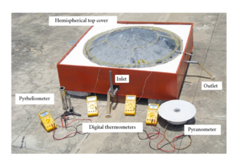


Reference 1

Collector Plate area: 1.21m²

Brackish Water Storage Capacity: 60.5 L

Fresh Water Production: 3.5L/m²/day



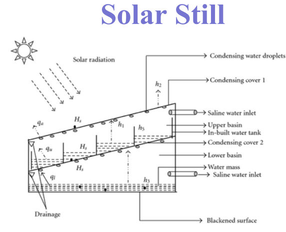
Double-Basin Glass Solar Still

Two stacked basins with dimensions:

- .590m x .440m x .440m
- .600m x .460m x .460m

Brackish Water Storage Capacity: 30L

Fresh Water Production: 3L/m²/day



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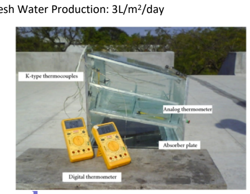

Project Goals

- Create a mobile desalination system.
- Utilize renewable energy sources (Solar and Wind)
- Make the system work from any location.
- Allow complete access to the unit for part replacement and future upgrades.

Conclusion

Potable water is thought to be a hard thing to come by, especially in dry and remote places. Conventional desalination technologies are good at meeting water needs, but they are thought to be very energy-consuming. If you need a lot of water, you can use traditional desalination technologies. They're bad for small water needs, though, because they aren't very efficient. Conventional desalination processes are very costly to run and require a lot of maintenance, so they can't be used in remote areas.

References

1. https://www.hindawi.com/journals/isrn/2012/569381/
2. https://www.sciencedaily.com/releases/2021/04/210427122414.htm
3. https://www.scientificamerican.com/article/can-solar-desalination-slake-the-world-s-thirst
4. https://news.mit.edu/2020/passive-solar-powered-water-desalination-0207
5. https://www.solaripedia.com/files/1222.pdf
6. https://youtube.com/shorts/iV7UjCq4-GE?feature=share