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Solar Desalination Using Fresnel lens

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ABSTRACT

The purpose of this research work is to develop a salt water desalination unit that could efficiently produce potable water by evaporation and condensation; integrated with a Fresnel lens solar concentrator. The experimental setup consists of a glass tray powered with a Fresnel lens concentrator for pre-heating the water and a desalination unit. And application of IOT to supply water to the desalination unit.

Keywords— solar energy, solar desalination, sensors, Fresnel lens

I. INTRODUCTION

Clean water is very important because the human body is composed principally of water which comprises about 60% of the body weight. Humans need to drink an average of 2.5 liters of potable water per day in order to prevent dehydration. Without fresh water, human life is not possible, but 97% of the water on the earth's surface is saline in nature. The remaining small percentage of freshwater is available in the ground water, lakes and rivers, which are used to satisfy the needs of living beings. Solar desalination is the process that involves evaporation of a saline solution utilizing solar power, either directly or indirectly, followed by condensation of the generated vapor .This process is a simple technique to produce fresh water from salt water. This process is described as similar to a naturally occurring hydrological cycle, where the formation of the vapors from surface of liquids gets transported by wind to buildup and precipitate, and in the case of solar stills, vapors condensate on the colder surfaces inside the still. Solar stills are basic devices that use the concept of a greenhouse by trapping heat during solar exposure and in turn, heats the stored feed water within the device and increases its evaporation rate. Solar irradiation enters the still through a transparent cover underneath which the feed water is stored. Upon striking the basin, the radiation is mostly absorbed by the basin. From the heated surface, infra-red electromagnetic waves are emitted and get trapped by the transparent cover, giving rise to the temperature within the system. However, the water quantity obtained from solar stills is not as high as its quality. The most affecting parameters on the still productivity and efficiency include the location, available solar intensity, ambient temperature, material and thickness of the glass cover, water depth in the basin, and the wind velocity. The geometrical dimension of a solar still plays an important role in the efficiency of the system. A direct correlation between still height, length, width, and distillate production was tested on conventional single slope solar still. The height of the basin wall was found to have a negative relationship with

production, In other words, lower water depth would give a higher yield of distillate. A linear decrement in productivity was found with increasing water depth. In the case of distillate production, glass cover gave the highest yield among other materials, compared to plastic sheet and Polyethylene terephthalate. An 18% reduction in yield was reported when plastic is used instead of glass.

WORKING PRINCIPLE OF THE SOLAR STILL

Solar still is among the simplest form of solar desalination process which consists of a basin containing salt water. The basin is covered with an inclined glass through which the heat enters and generates vapor from the salt water due to the partial pressure between the basin and the inclined glass lid. The generated vapor is collected as distillate. Bellow shows the process for a still with double slope. It is selected in the design to optimize the availability of solar irradiation throughout the day, without the rotation of glass lid according to sun's travel path. Fresnel lens is used on the top of the glass lid to get more evaporation than the normal glass.IOTs are used to verify the temperature and humidity according to time.

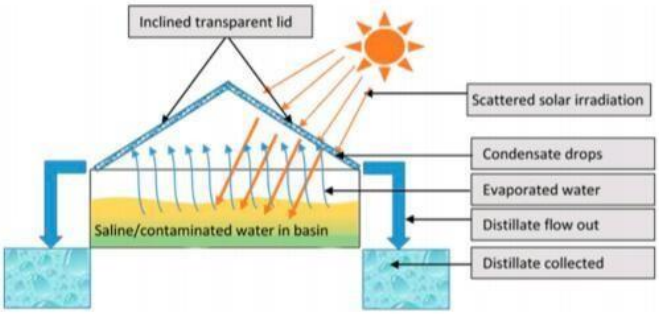
II. MATERIAL SELECTION

The aim of this study is to benefit people with resource scarcity in coastal regions where clean water is limited. Therefore, the selection of cheaper material and easy design have given priority during fabrication .the body of set up is made by glass because it provides higher condensation .aluminum frame is provided at the outer surface of glass to hold the glass .

In the selection between linear and radial Fresnel lens, the different focusing profile of both types of lenses is the key point. For the radial Fresnel lens, the ring shaped focusing surfaces slant to face a center point, with each ring placed concentric to each other. The radial Fresnel lens can achieve a sunlight concentration ratio 3.9 times higher than that of the linear lens with a much smaller receiving area. The Fresnel lenses used in this experiment were made of polymethyl methacrylate (PMMA).

III. EXPERIMENTAL SETUP

A double sloped solar still with a acrylic glass basin size of 80x60x50cm was constructed. This model has been tested with Fresnel lenses on the slope. A frame was constructed to hold the Fresnel lenses parallel to the the top covers, where the focal points of the lenses fall onto the saline water stored in the steel basin during solar irradiation. Saline solution was fed in to the model. The solar still was lifted from the ground by using bricks.



WORKING PRINCIPLE OF A DOUBLE-SLOPED SOLAR STILL[1].

IV. NEEDS FOR THE DESALINATION

Solar desalination consists of the evaporation of a saline solution using solar power, either directly or indirectly, followed by condensation of the vapor generated. In other words, solar distillation is a combination of humidification and dehumidification that is powered by solar energy According to the study, this process is similar to a naturally occurring hydrological cycle. The vapors form on the surface of liquids and are transported by wind to build up and precipitate, and in solar stills, vapors condense on the colder surfaces within the still A conventional solar still is a basic device that uses the principle of a greenhouse by trapping heat during solar exposure, which heats the stored feed water within the device, leading to increased evaporation. Solar radiation enters the still through a transparent cover underneath which the feed water is stored. The basin absorbs most of the radiation that strikes it [1].

Adequate quality and reliability of drinking water supply are fundamental needs. Without fresh water, human life is not possible. Water is one of the most abundant natural resources on earth, covering about three-fourths of its surface. Unfortunately, 97% of the water on the earth's surface is saline in nature. The remaining small percentage of freshwater is available in the ground water, lakes and rivers, which are used to satisfy the needs of living beings. Oceans are the infinite sources of saline water. Salinity can be eliminated by the process of desalination. The separation of salts from sea water requires a huge amount of energy by burning of fossil fuels and can cause harm to the environment. This pollution can be avoided to a large extent by the use of environmental friendly techniques for desalinating the seawater. In conventional process, desalination used fossil fuel as the thermal source for heating but due to rapid decrease in the fuel availability it is necessary to go with the renewable energy for desalination process [7]. a variety of technologies were inverted for desalination from time to time and it has been accepted by people without a thought to environmental consequences. Desalination is the oldest technology for purifying water in the world. The use of desalination for water purification is among the oldest technologies in the world. Different technologies have been devised for desalination and have been accepted by people without knowing possible consequences. people have been desalination water for hundreds of years. While various technologies for desalination were invented from time to time, most people have accepted them without knowing future environmental consequences[12].

V. CONCLUSION

In this paper, we have gone through solar energy in desalination process, it is one of the best applications of renewable energy. Fresnel lens offers a simpler and cheaper method for concentrating solar energy that can be used for pre- heating water. The experimental observations of the behavior of the Fresnel lens concentrator alone as pre-heater device can improve the performance of desalination system.

1. Fresnel lens increases the total production from a solar still.
2. Using multiple Fresnel lenses instead of a single one provides multiple hotspots and causes more evaporation of feedwater,thus leading to higher total production per total solar irradiation by 39%.

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