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Design and Development of Solar Still

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ABSTRACT:The aim of our project is to develop a solar still which utilizes direct solar radiation from the sun to desalinate saline water which will work on the principle of evaporation and condensation process. The still, consisting of a basin (where the saline water is fed) and closed with the transparent glass cover to permit the solar energy. As the radiation strikes the saline water in the basin through the glass cover, evaporation of water occurs producing the vapours which travel to the top portion where it's get trapped by the glass cover above the basin and thus the condensate is formed in the upper side the glass cover and its slowly drips down and it is collected as the distillate yield.

KEYWORDS:Solar Energy, Distillation, Solar Still, Solar Radiation, Heat Transfer, Pyramid Solar still.

I. INTRODUCTION

Solar still is by far the most reliable, least costly method of 99.9% true purification of most types of contaminated water especially in developing nations where fuel is scarce or too expensive. Solar still is used to produce drinking water or to produce pure water for lead acid batteries, laboratories, hospitals and in producing commercial products such as rose water. Conventional boiling still consumes three kilowatts of energy for every gallon of water, while solar still uses only the free pure power of the sun. Expensive filtration and deionizing systems are even more expensive to purchase and use and will not totally purify the water by removing all contaminants. No additional heat or electrical energy is required in our still and even after the sun sets, solar still continues at a slower pace into the night.

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II. GENERAL PRINCIPLES

1. WATER DEPTH

Water depth affects the efficiency of solar stills with respect to the duration of operation in the following manner. For short durations (less than two days) smaller depth generally increases efficiency. Over longer durations, more depth may be required to prevent the still from drying out. In 2004 carried out a performance study under Indian climatic conditions on active and passive still and inferred that water depth, together with inclination of condensing cover and collector, have a strong effect on the annual yield. In 2006 compared various depths such as 0.05 m, 0.1 m and 0.15 m for both active and passive stills and concluded that productivity was maximized at 0.1 m. The decrease at large depths may occur because it takes more time to warm up the larger volume of water.

2. CLIMATIC CONDITIONS

Solar radiation intensity is the main climatic parameter affecting productivity. At constant efficiency, daily productivity will be proportional to solar irradiation ($\text{kJ/m}^2\cdot\text{day}$). However, wind speed and ambient temperature also affect performance. An experimental study in 2004 showed that the productivity of a solar still increases with wind speed only below the critical speed of 4.5 m/s. In 2014 modelled the effects of various climatic conditions in active and



passive distillation systems, and found that wind increased performance up to this same critical speed of 4.5 m/s beyond which the productivity remained constant. This is because wind enhances heat transfer from the cover and thus condensation up to the critical speed, beyond which there is little further enhancement.

3. WORKING

A solar still operates as a result of solar radiation penetrating its glass cover and heating the saline water in its central trough, some of which is evaporated. This condenses on the underside of the glass which dissipates heat to the surroundings. The fresh water film on the glass runs into collecting troughs on each side of the still. Then again saline water comes into container and same process is repeated.

4. ADVANTAGE

- Sun energy is free of charge.
- Cost effectiveness since there is no moving part so low maintenance cost.
- Provide good quality water for personal and industrial use.

5. DISADVANTAGE

- Low production capacity, not enough for the drinking water needs of the average family.
- Solar distillers can't kill harmful bacteria because it does not boil the water.
- Leakage of vapor through joints.
- The large area tilted glass cover might be repulsion to bugs and insects.

I. PROJECT WORK

6. DESIGN OF STAINLESS-STEEL WATER CONTAINER

The water container is made up of stainless steel to keep it safe against rusting due to saline water. Water in the container absorbs solar energy and gets heated. The heat evaporates the container water which condenses on the glass sheet and finally converts into drops of pure drinking water. The container height is kept shorter to increase its efficiency.

7. DESIGN OF WOODEN FRAME

A Frame made from wood on which water container rest is designed according to the shape of container and glass steam collector.

As both glass steam collector and water container rest on it, is important component which will support the system.

8. DESIGN OF GLASS STEAM COLLECTOR

A glass steam collector is designed in the shape of three-sided pyramid to increase the amount of condensed water drop collection.



III. ANALYSIS CHART TABLE

WITH OUT GLOW PLUG	DBT °C	34	35	34
	WBT °C	24	25	27
	GLASS INNER TEMPERATURE °C	41	36	34
	WATER TEMPERATURE °C	30	32	29
	IN TANK (L)	8.22	7.95	4.7
	WATER OUTPUT (L)	0	0.04	0.2
WITH GLOW PLUG	DBT °C	34	35	35
	WBT WATER °C	24	29	28
	GLASS INNER TEMPERATURE °C	37	41	45
	WATER TEMPERATURE °C	35	46	46
	WATER IN TANK (L)	8.22	7.5	4.32
	WATER OUTPUT (L)	0	0.08	0.23

Figures shows the results of text detection from an image and inpainting by using exemplar based Inpainting algorithm. Figs. 2, 3, 4 (a) shows the original image. (b) is the image obtained by applying first set of criteria. All objects whose area greater than 10000 and filled area greater than 8000 are eliminated and major axis lengths are in between 20 to 3000 are considered to be text. Still, some small non-text objects are detected.

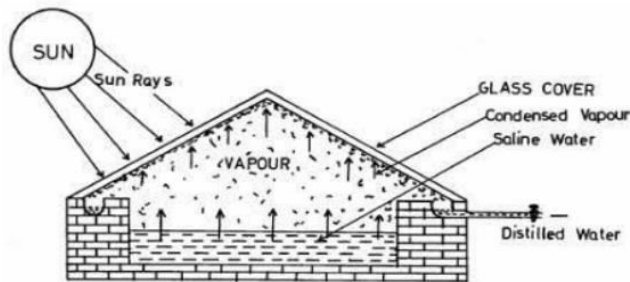


Fig. 1. Concept of Solar Still

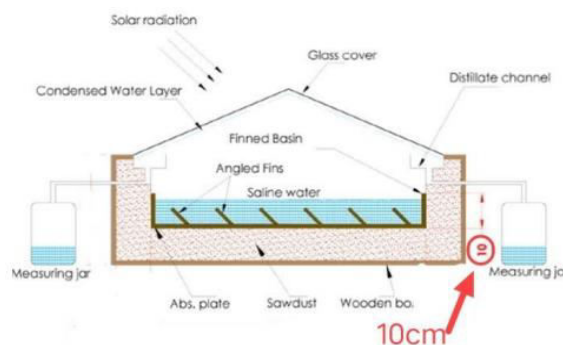


Fig. 2. Water depth



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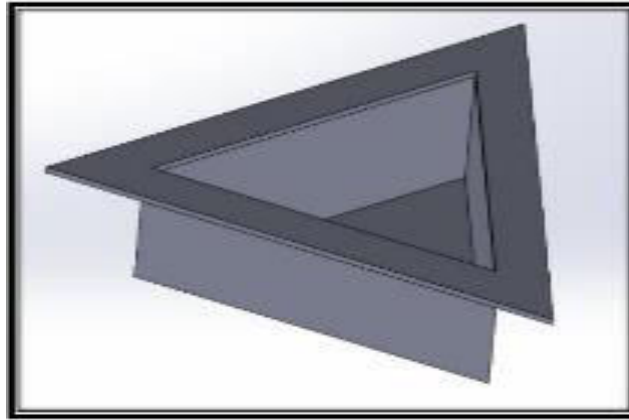


Fig. 3. Stainless steel water container

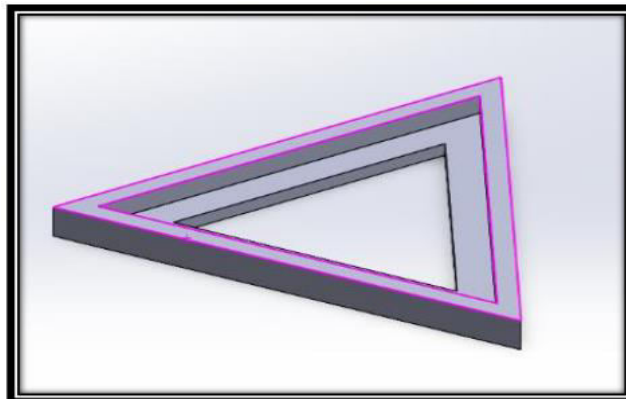


Fig. 4. Wooden Frame

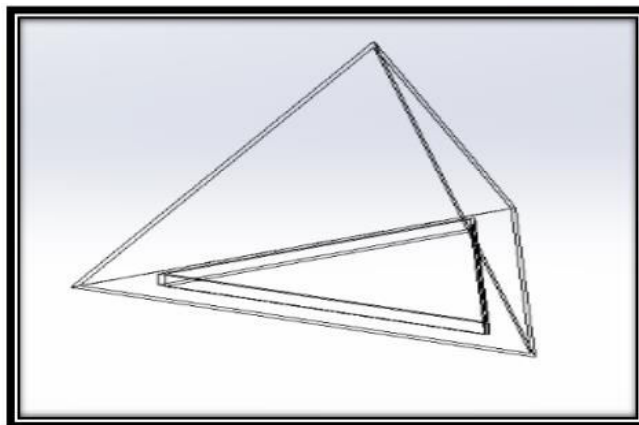


Fig. 5. Glass steam collector

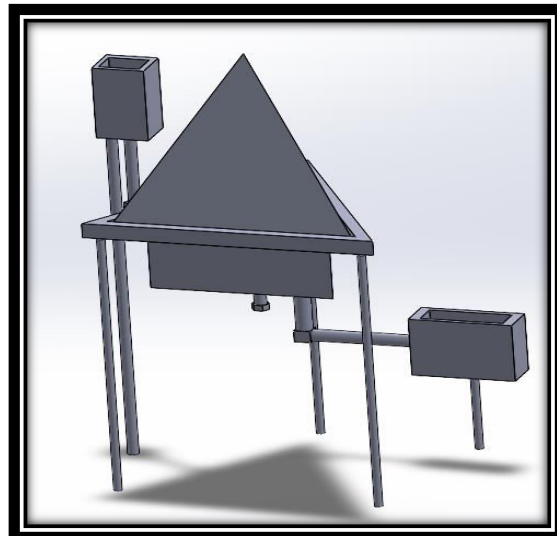
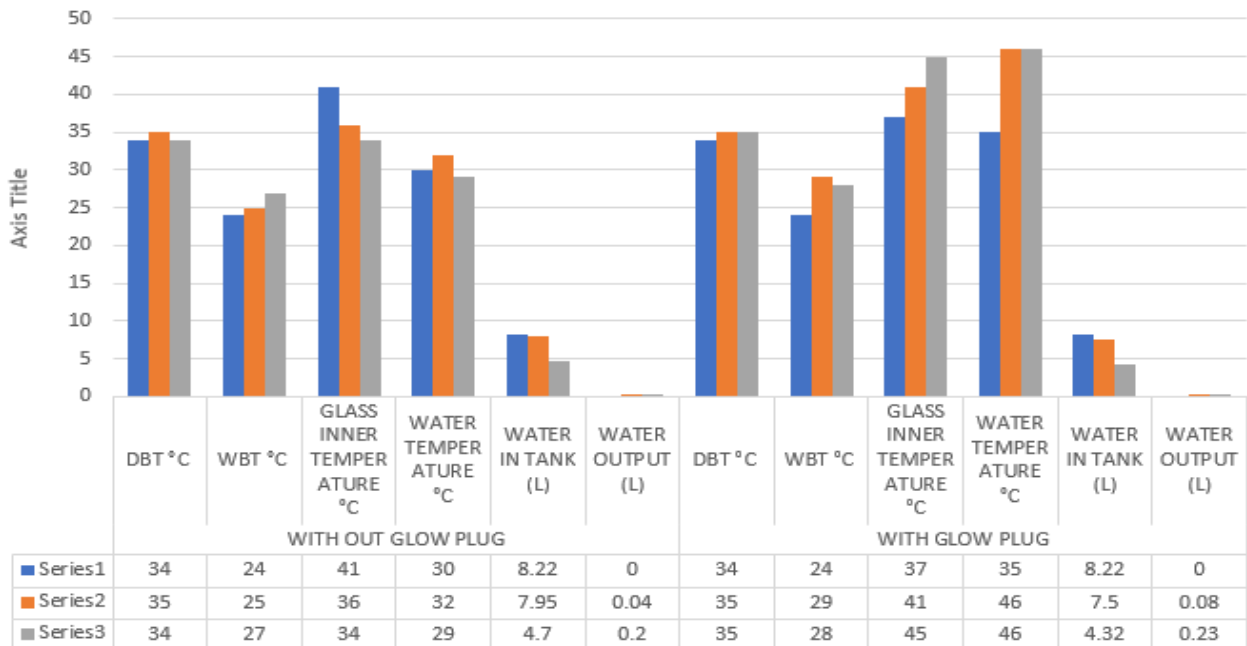


Fig. Assembly of Solar Still

ANALYSIS CHART



IV. CONCLUSION

In conclusion, the design and development of a solar still for purifying seawater using sunlight is a promising technology that has significant potential for addressing the global water crisis. The results of this study indicate that solar stills are an effective means of converting seawater into fresh water through the process of evaporation and condensation. The design of the solar still is crucial for its performance, and various parameters such as the slope of the still, the material used, and the size of the still have a significant impact on its efficiency.

The findings of this research highlight the importance of using renewable energy sources like sunlight for water purification, especially in areas where access to clean water is limited. Solar stills offer a low-cost, energy-efficient, and environmentally friendly solution for water purification. They can be used in a range of applications, including rural and remote areas, disaster relief situations, and small-scale industrial operations.



However, further research is needed to optimize the design and performance of solar stills and to assess their feasibility in different contexts. The development of advanced materials and technologies for solar stills could improve their efficiency and make them more cost-effective. Additionally, the implementation of solar stills should be accompanied by proper education and awareness programs to ensure their proper use and maintenance.

In conclusion, the design and development of solar stills for water purification represent a promising technology that can help address the global water crisis. With continued research and development, solar stills could become an important tool for promoting sustainable water management and ensuring access to clean water for all.

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