RESEARCH ARTICLE OPEN ACCESS

A NOVEL DESIGN OF SINGLE BASIN DOUBLE SLOPED SOLAR STILL USING HEAT ABSORBING AND PHASE CHANGE MATERIALS

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Abstract:

The purpose of this project is to study an aquatic distillation structure that can clean water from any source, a structure that is cheap, moveable, and depends only on renewable solar energy. Water is directly evaporated by a solar device which is used for distillation. Finally, effort has been studied about the solar still working process and how much amount of distilled water has been collected through this solar still. Then performance and efficiency of the solar still was studied, those values are noted and plotted.

Keywords — Solar still, Solar powered water distillation, encapsulated ball. etc.,

I. INTRODUCTION

A solar still distils water, using the heat of the Sun to evaporate, cool then collect the water. There are many types of solar still, including large scale concentrated solar stills and condensation traps. In a solar still, impure water is contained outside the collector, where it is evaporated by sunlight shining through clear plastic or glass. The pure water vapor condenses on the cool inside surface and drips down, where it is collected and removed.

A solar still, also known as a solar distiller, is a simple device that uses heat directly from the sun. This heat can be used to drive evaporation from humid soil, and ambient air to cool a condenser film in a simple manner to purify brackish/saline water into potable water. A solar still operates on the same principle as rainwater; where evaporation and condensation process take place. The water from the oceans evaporates only to cool, condense, and return to the earth as rain. When the water evaporates, it removes only pure water and leaves all contaminants behind. Solar has still been proven to be the best solution to solve water problems in remote arid areas and developing countries.

Once the solar is still in place, the centre trough is filled with the water. The centre trough usually will have a black bottom, which helps to absorb sunlight. The heat from the sun evaporates the salt water that is sitting in the centre trough. The process of evaporation only lifts pure molecules of H2O into the air of the container, leaving the dirty parts of the water settling in the trough. Next, the process of condensation occurs. This is when the water vapor molecules still hit the glass covering of the solar and condense into water droplets.

After condensation, the water droplets are forced by gravity and slide down the glass or plastic ceiling into a second clean trough along the inside edge of the solar still. They cling to the edge of the glass and follow it all the way down into an outer rim that into the ‘clean water’ area. Because the water is clinging to the angled glass, it does not get mixed back in with the dirty water. This is done with a hose that is connected to the clean vessel’s trough to the outside of the still.

II. OBJECTIVE

The objectives of the project and the problems which were taken as objectives to rectify from the literature are specified.

To reduce the water problem using normal (or) salinity (or) pond water converted into distilled water by the way of solar still and some new methodologies are implemented to increase in solar still performance and also increasing rate of evaporation by the way of implemented in new technology.

III. IMPORTANT PARAMETERS IN SOLART STILL

- Still constructions (ex. Length, width & height)
- Solar radiations.
- Inlet water temperature.
- Evaporation rate.
- Insulations
- Thickness of the work medium
- Collection rate.

TABLE I
NOMENCLATURE OF SOLAR STILL

SL.NO	DESCRIPTION	VALUE
1	Length, m	1.23
2	Width, m	1.23
3	Base Area, m^2	1.51
4	Glass thickness, mm	4.00
5	Cover inclinations angle, ^{o}	15.00

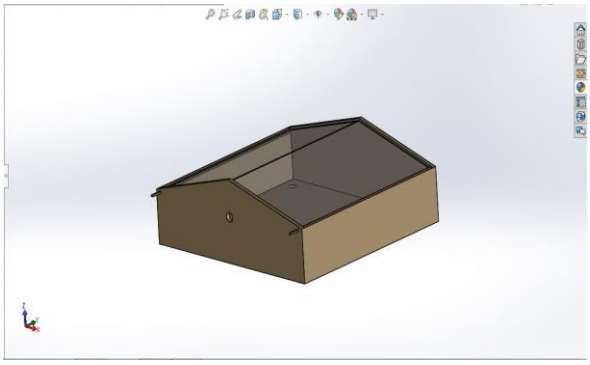

Fig. 1 Isometric view of solar still using Solid Edge

A. Capture Figures

Fig. 2 Example of image fabricated with PCM

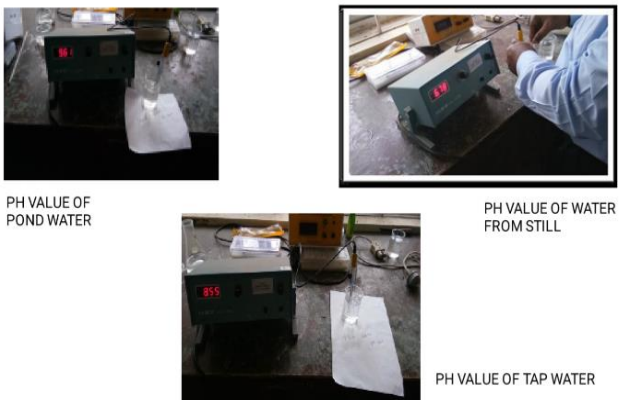

Fig. 3 Example of an image during the PH value

Fig. 4 Example of an image with conductivity check

RESULTS AND DISCUSSION

In this work, a solar distillation in a single basin double sloped is studied theoretically and experimentally. The glass cover on the still was examined. The effect of the predicted solar radiation on the yield of the solar still will be examined. Calculations were carried out for GCT where the latitude is 10.77 and the slope of the inclined surface is 15 & 30. Additionally, the solar radiation values on the tilted surface were calculated using hourly horizontal solar radiation values. The radiation values which were taken from the National solar radiation data base were used for the days (15.03.2020 to 20.03.2020).

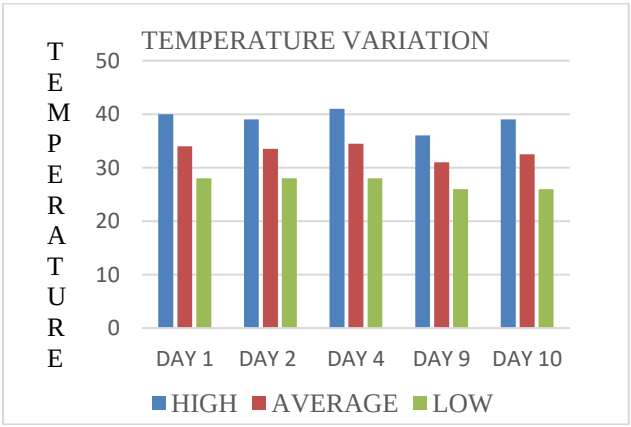

Fig. 5 A sample line graph plotted with temperature variations

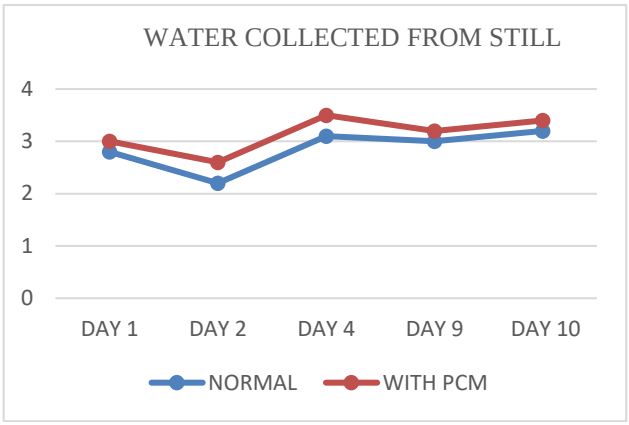

Fig. 6 A sample line graph plotted with collection rate in normal and PCM

TABLE II
COMPARED VALUE OF WATER

Description	***Drinking water***	***Pond water***	***Tap water***	***Distilled water from still***
Ph Value	6.5-8.5	9.59	8.36	6.78
Conductivity	0.8	0.97	0.85	0.00
Total Hardness	<500	443	425	0.00

FINAL DISCUSSION

In this work, we have still studied the solar working process and how much amount of distilled or purified water can be collected through this solar still. If performance and efficiency of the solar can be fined, then those values are noted and plotted in a table as tables, graphs between the temperatures and collection rate per day. Then which are the parameters that affected the solar still distillations and how to reduce or remedies for causes? However, to increasing the performance of the solar still, these are all the things discussed in detail. Finally, output water or water from still can be checked. A few parameters are pH values and conductivity of water by using pH meters and conductivity testing equipment. After that, the values are finalized and form the table below.

CONCLUSIONS

In this project, the efficiency of solar was studied using glass covers materials and their production rate was studied. According to experiments, the following points maybe concluded: The important factor which affects productivity of the solar still is solar radiation. When higher solar insulation is received, the productivity of the solar increases. The maximum amount of distillate obtained from the still on 20.03.2020 is 3.4l/m^2 day. The heat losses due to leakage of the saturated water from the still. As the vapor pressure inside the still is higher than the atmospheric pressure, the saturated air escapes to the outside.

The coming air from the outside to the still is no more saturated, and it takes some time to be heated and saturated. This causes to reduce the productivity of solar still. Early in the morning, the evaporation can start and the productivity of the solar still increases. The cost of the solar still depends on solar radiation intensity, it changes due to the location of the solar still. In this respect, the choosing of the location is an important factor.

FUTURE SCOPE

Transportation of solar still is quite different because of the glass cover, and it is replaced by other material to avoid the transportation difference. In industrial chemical wastage also reduces and recycling through that kind of solar still and purifications process. The polycarbonate and polyethylene sheets are more scientific than the glass due to the very low thickness and mechanical stability; however, the polymeric sheets didn't have thermal stability. Thus, they elongate due to the constant exposure to the solar radiation. This effect reduced the production rate of the still.

And also, water inlet temperature is increasing, which means of pre-heating using water heater, validating the result when compared with experimental, analytical and software analysis using Ansys fluent software.

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