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Enhance the Productivity of the Solar Still by Improving the Operational Parameters

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Abstract: *The productivity of the still is mainly depends upon various operational parameters. In this project a cooling wick is fixed at the top of the glass, and the cooling water is allowed to flow continuously, through the wick, in order to reduce the glass temperature. A mini solar pond and a flat plate collector also integrated with the glass cover cooled solar still in order to increase the inlet water temperature, Here two models were fabricated one is basic model and the another one is still with cooling wick at the top of the glass. Various readings were taken throughout the day and readings were tabulated. The results showing that the glass cooled solar still integrated with flat plate collector gives the higher productivity than the basic solar still. The productivity of the still is improved by 27.32%, the daily water collection of the glass cover cooled solar still integrated with mini solar pond is found that 59.5%.*

Keywords:*solar still,solar pond,flat plate collector,glass cooled solar still.*

I. INTRODUCTION

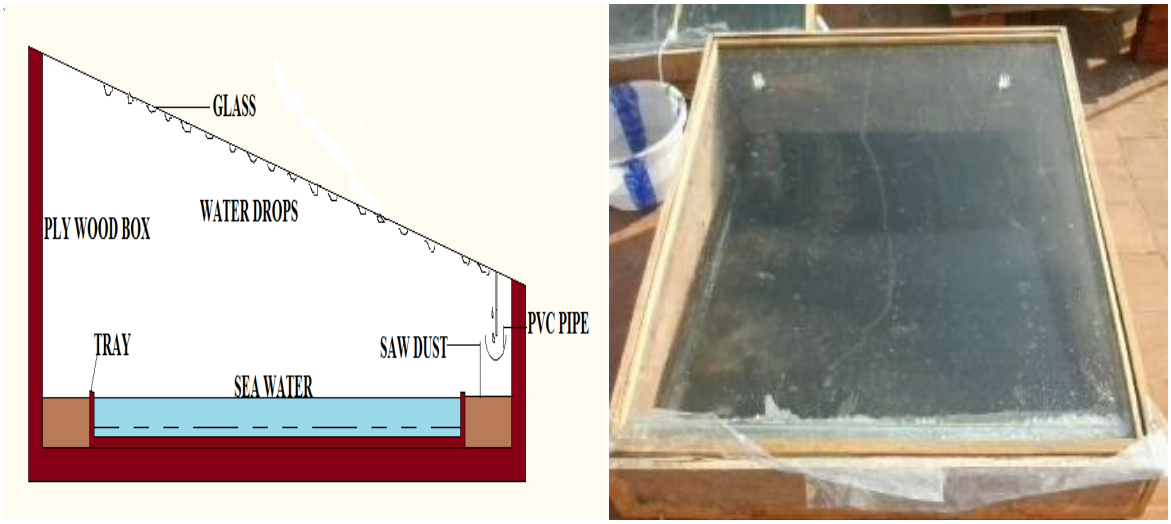
Solar energy is the best source for the desalination of the saline water. In order to increase the productivity of the solar still so many works are carried out. Sahoo et al [1], suggested that the usage of blackened basin surface and the thermocol insulation at the bottom and the sides of the still can increase the productivity considerably. Bassam et al [2], introduced usage of sponge in solar stills. Solar still with sponge cube gives higher productivity Compared to the basic solar still, (i.e.) 273%. Hiroshi tanaka et al [3], defined that the amount of distillate can be increased 48%, While using internal and external reflectors to the single basin solar still. Palakpatel et al [4] analyzed that the various techniques that can be followed to increase the productivity of the solar still. Mufag Suleiman et al defined that the depth of water has an impact on the productivity of the solar still and also defined that the temperature difference between the glass and the water enhances the water collection. Minasian et al [6] connected a wick type solar still and the hot wastage brine from wick directly fed into basin type solar still, which is giving 85% higher productivity compared to the basin type. Nafey et al [7] have used black rubber and black gravel they have increased the productivity as follows 20%, 19%. Kalidasamurugavel et al [8] also defined that the temperature difference between the glass cover and the basin water temperature increases the condensation rate. Kabeel et al [9] found that the area of evaporation and the glass cover temperature plays an important role on the solar desalination process.

Hintesh et al [10] found that by using a hemispherical shaped solar still his productivity ranges from 1.4 L to 1.6 L. And it is having the productivity of 18 %. So these are the various factors which were having a impact on the field of solar desalination.

II. EXPERIMENTAL SETUP

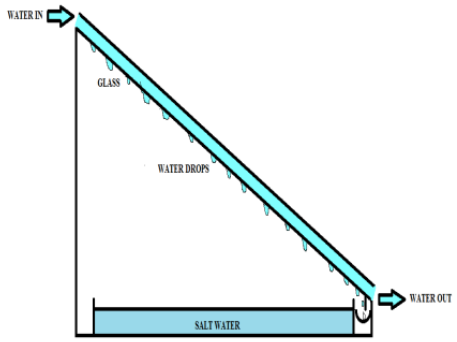
1. Conventional Solar still

Conventional solar still is the basic form of solar still, which is having single slope and single basin. It is having the basin area of 1m*1m. Basin is made of aluminium sheet of 2mm thickness. The saline water is kept in the storage tank and supplied to the basin via PVC hose. When the evaporation process starts, the water level decreases. In order to maintain the water depth the basin is recharged for every half an hour.



2. Glass cooled Solar still

Single basin solar still is fabricated using the aluminium sheet of 2mm thickness at the dimension of 1m×1m of and height of 50 mm. Since the colour of the aluminium is silvery and here it is painted black for higher heat absorption.

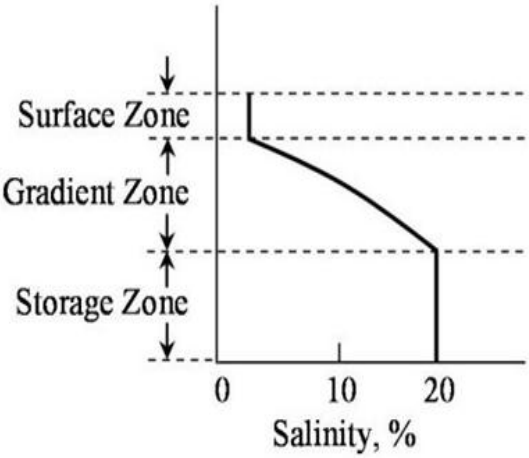


The aluminium basin is painted black in order to increase the absorption of solar radiation. The top of the basin is covered with transparent 5mm window glass inclined to 15% angle with horizontal.

There are certain specifications are needed for the glass to be used in the solar still. They are (a) minimum amount of reflection for solar radiation energy (b) high thermal resistance for heat loss from the basin to the ambient. If the glass to water distances increases, heat loss due to convection become greater which is causing the still efficiency to drop. Here in the glass cooled still one cotton cloth of 2cm wide is fitted on the top of the glass from top to bottom for throughout the length of the glass. And the cover is sealed tightly using silicon sealant to reduce the vapor leakage. A pipe of 10 mm diameter is fitted to the basin for filling saline water. The experiment was carried out by keeping water depth of 1 cm. During the experiment every day the solar radiation, atmospheric temperature and daytime wind speed also measured. The hourly productivity of fresh water output is measured correspondingly, the prevailing conditions are noted down. When the water is maintained at 1 cm of depth, the productivity of fresh water is higher than productivity at 2 cm depth of water.

3. Mini Solar pond

A solar pond is a large area collector of solar energy resembling pond that stores the heat, which is then available to use for practical purposes. Their common features are to store the energy in the incoming solar radiation in the heated depths of the pond, and to suppress the convection currents that would otherwise leads to loss to the surroundings.



Mainly it consists of three zones they are,

- Relatively fresh water zone.
- Increasing salt.
- Saturated salt water.

The main heat loss from the storage zone has thus been reduced, while there are small heat losses by conduction through bottom and sides of the pond. The storage zone heats up and retains this thermal energy until it is withdrawn for use. Temperatures above 80^0c can be obtained in periods of higher solar radiation.The temperature range at the various zones of the solar pond is given below.

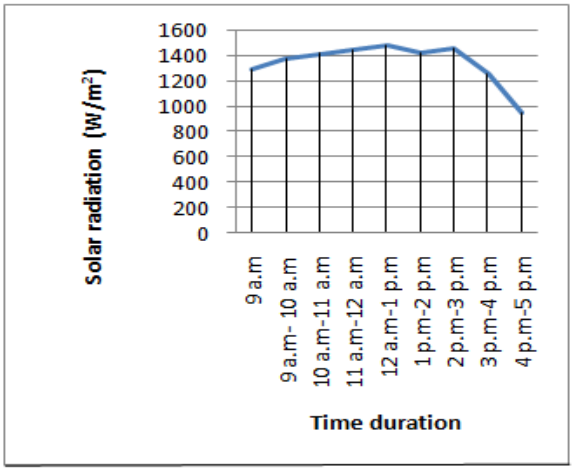
4.Solar Flat plate Collectors

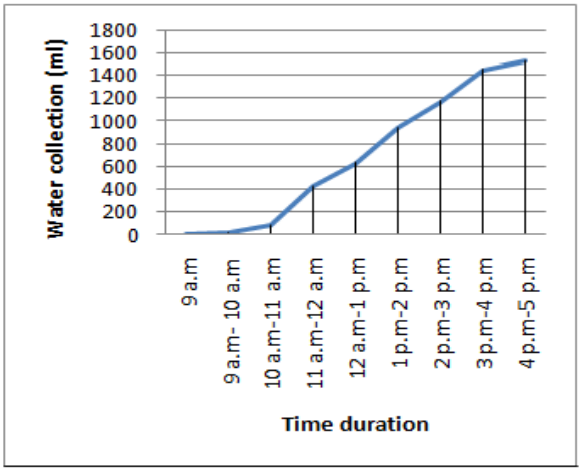
On the many solar collector concepts presently being developed, the relatively simple flat plate solar collector has found the widest application so far. It is the easiest and least expensive to fabricate, install and maintain, moreover it is capable of using both the diffuse and the direct beam solar radiation. Flat plate collectors easily attain temperatures of 40 to 70^0c. Solar collectors transform solar radiation into heat and transfer that heat to medium (water). Then solar heat can be used for heating water.

Flat plate collector consists of an absorber, a transparent cover, a frame, and insulation, transparent cover prevents wind and breezes from carrying the collected heat away. Absorber plates are commonly painted with "selective coatings" because it absorbs and retain heat more than ordinary black paint. Absorber plate is commonly made of aluminium.

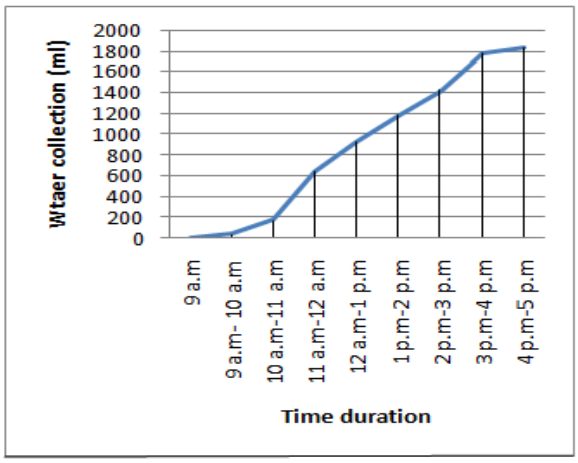
III. RESULT AND DISCUSSION

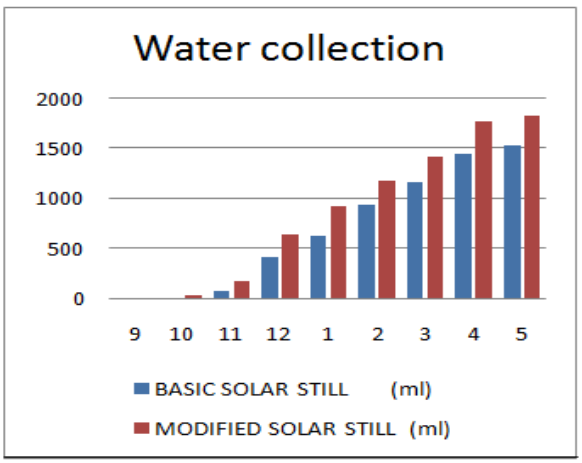
1. Comparison of Basic Solar still and Glass Cooled Solar still





Graph 1. Time Vs Solar radiation**Graph 2.** Time Vs water collection (Basic still)

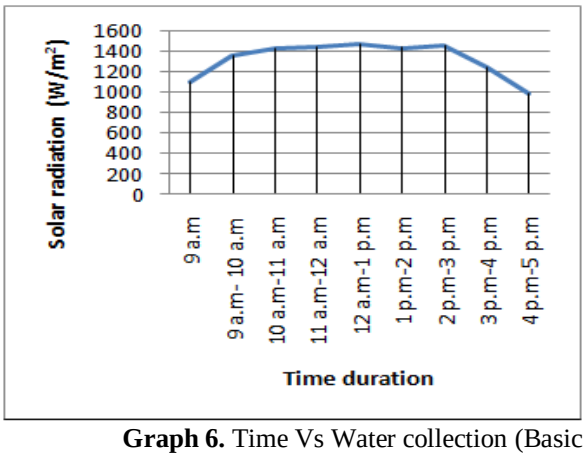


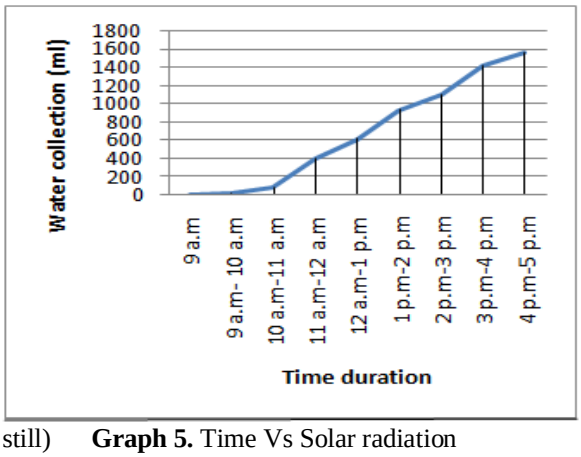


Graph 3 Time Vs Water collection (Modified still) **Graph 4.**Comparison between the Water collection Of Basic Still and Glass cover cooled still

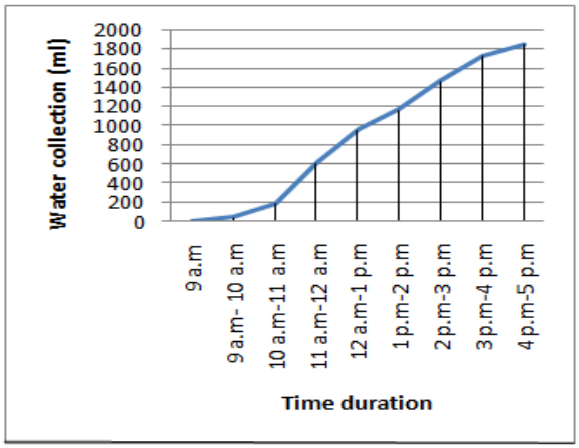
The solar intensity with respect to time is shown in graph 1. The peak solar flux is in 1 pm, in the amount of1490 W/m^2. The cumulative water productivity with respect to time is shown in the graph 2. The daily water productivity of the basic and glass cooled solar still is 1.5liters and 1.7 liters respectively.

2. Comparison of Basic Solar still and Glass cooled Solar still Coupled with Solar pond:

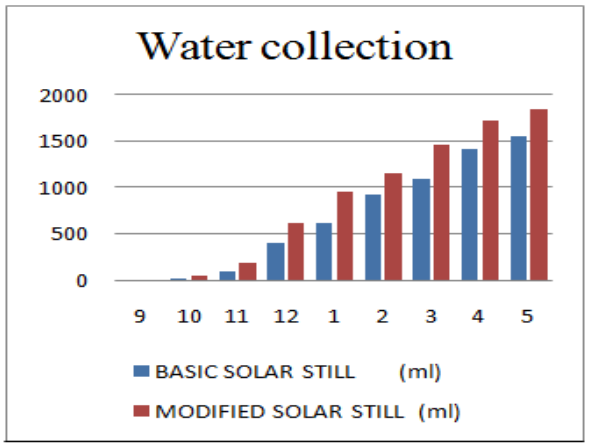




Graph 6. Time Vs Water collection (Basic still) **Graph 5.** Time Vs Solar radiation



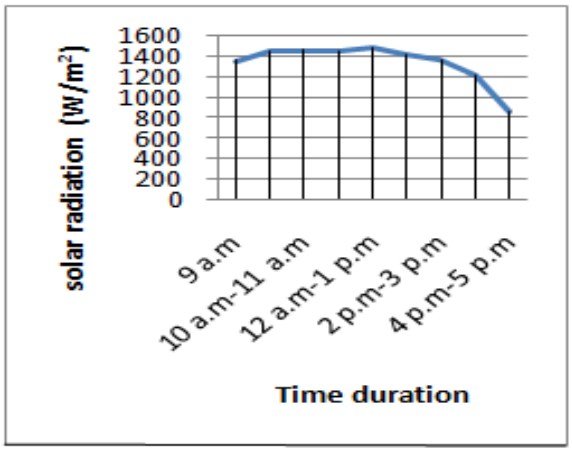
Graph 7. Time Vs Water collection (Glass cover Cooled still with solar pond)



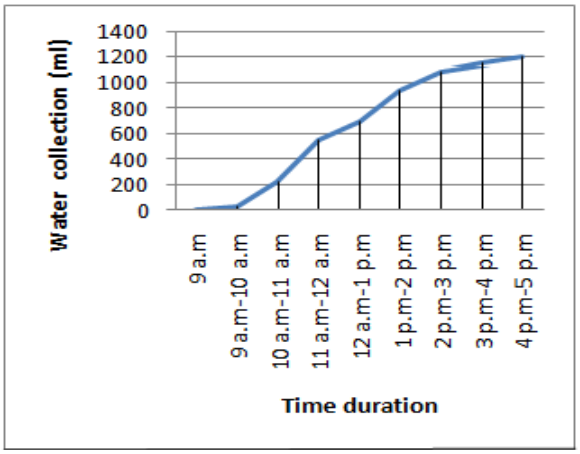
Graph 8. Comparison between water collection of Basic still and Glass cover cooled Solar still with solar pond

Graph 5 shows that the hourly variation of solar radiation with respect to time. The productivity of the basic still and the glass cooled solar still integrated with the solar pond are 1560 ml and 1880 ml respectively. The productivity is improved due to the rise of inlet water temperature.

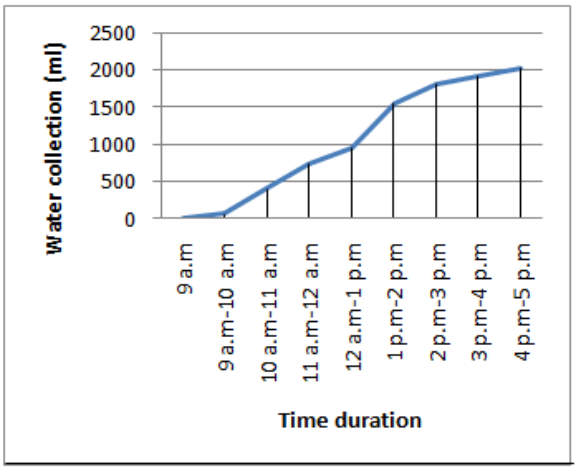
3. Comparison of Basic Solar still and Glass cooled Solar still Coupled with Flat plate collector



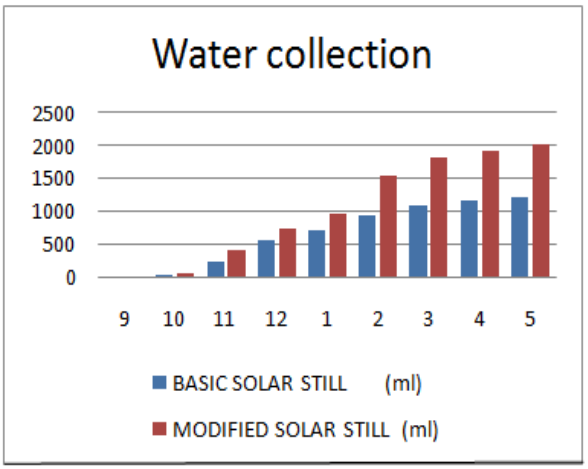
Graph 9.Time Vs Solar radiation



Graph 10. Time Vs Water collection (Basic Still)



Graph 11. Time Vs Water collection (Glass Cover cooled solar still with flat plate collector)



Graph12. Comparison between water collections of Basic still and Glass cover cooled solar still with flat plate collector

Graph 9 indicates the hourly increase and decrease in the solar radiation with respect to time. Condensation rate increases at the evening times due to the temperature difference between the water and the glass temperature. The temperature difference is caused by the reduction of ambient temperature during the evening times. The productivity range in basic and the modified are 1390ml to 2100ml respectively.

IV. CONCLUSION

There are several types of solar stills are available but they are having less productivity. In order to increase the productivity we have designed a new model which is having glass cooled cover. Since here the additional cooling is provided in the glass the productivity of the still is gets increased by 20%, Then the solar still is connected with the solar pond, while the still is connected with the solar pond the productivity is increased by30%, Then the solar still is connected with the solar flat plate collector, Then the productivity of the solar still is increased by 40%. When comparing all the solar stills such as basic solar still, others our modified one gives the higher productivity. Since the combined solar still with the solar pond and the solar flat plate collector gives the higher productivity of 2.1liters per day. Thus our still is having higher productivity than the others.

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