Some studies on the performance of solar distillation still

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***Abstract*: Solar distillation still is one of the applications of utilization of solar energy to get pure drinking water from brackish and contaminated water at low cost. Solar distillation still can be used to provide pure drinking water for poor and rural people in the regions where high intensity of solar energy is available. This paper is the result of development of an experimental set up of a single basin solar still and experimentation on it. Various parameters effecting the performance and efficiency of the distillation still are tabulated and studied. Relevant graphs by using the collected data were prepared to find the results and there by to draw the conclusion.**

Key words: Water distillation, Solar still

I. INTRODUCTION

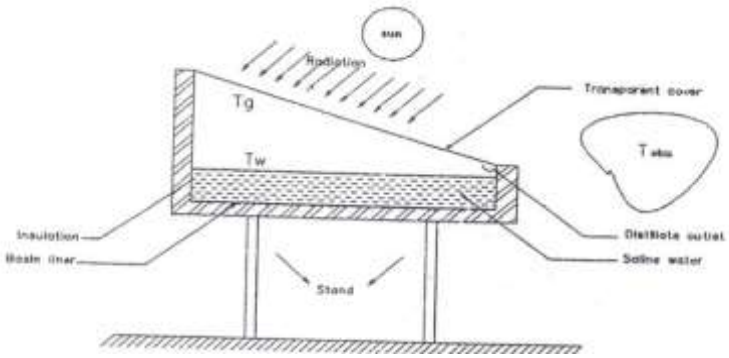
With the increased population and global warming there is an imbalance between the supply and demand of fresh drinking water. As per the survey it is very difficult, almost impossible to get pure drinking water in another decade. It has posed a very big challenge to the government and private agencies to provide clean, fresh drinking water to the public at lower cost. Not only the rivers in India are getting contaminated but also the sources such as wells, tanks also polluted due to the seepage of drainage water. About 70-80% illnesses are related to water contamination and poor sanitation. Various water purification devices have been developed. But the initial and maintenance cost are high. Only upper middle class people can afford to have such devices. Conventional water distillation plants operate at very high cost. Thus providing water for poor and rural people is still an impossible task. Solar distillation is an answer for getting pure water for locations where there is high solar intensity and scarcity of water. Solar distillation stills can be placed at each house and community level for producing drinking water. Thus an attempt was made to develop an experimental set-up to produce clean drinking water using solar energy for distillation purpose. Further the analysis is made on the data collected.

The basic principle of solar water distillation is simple, cost effective and efficient. The solar distillation still works on the same principle as that of nature giving the rain water. The heat from the sun's radiation is utilized to evaporate the water in the still and the evaporated water gets collected on the inclined glass surface. After condensation the pure water is collected in the tray. The use of solar energy for such stills, instead of conventional energy sources reduces the cost of distillation particularly in the regions of low population densities, low rain fall and abundant solar energy availability. The productivity of pure water by solar distillation depends obviously on the intensity of radiation peak period of sunshine and type of still being used. Single slope stills provide cheap and effective solutions for pure water production.

II.EXPERIMENTAL SETUP

The figure below shows the schematic diagram of a single basin solar distillation still developed by the author. The still consists of a sheet metal basin of base area 1 sq. m. The basin is covered by a 4 mm thick glass. The glass cover is placed at an angle of 200 with horizontal. To prevent the leakage of vapour a rubber gasket is used between basin and glass cover. The bottom and vertical sides of the still are insulated with thick thermo Cole sheet to prevent the heat transfer to the atmosphere. The black surface is provided on the basin for absorbing the radiation. The saline water is allowed to flow into the basin through a gate valve.

The radiation energy is transmitted through the glass cover. Some part of the radiation is reflected of absorbed by the glass cover. The black liner of the basin absorbs the heat of radiation and transmits through the water. The absorbed radiation is transferred to the water by convection and the remainder is transferred to atmosphere through bottom insulation. The water warms up and heat transfer takes place between water surface and the glass cover by radiation, convection and evaporation. The evaporated water gets condensed on the inner inclined surface of the glass cover.



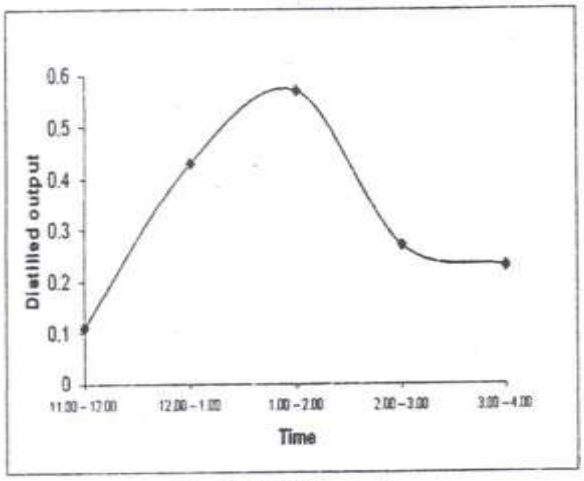
The condensed water flows down the slope and collects in the tray fixed to the lower edge of the glass cover. This water can be collected in a beaker through a drain pipe.

III. Experimentation and Analysis

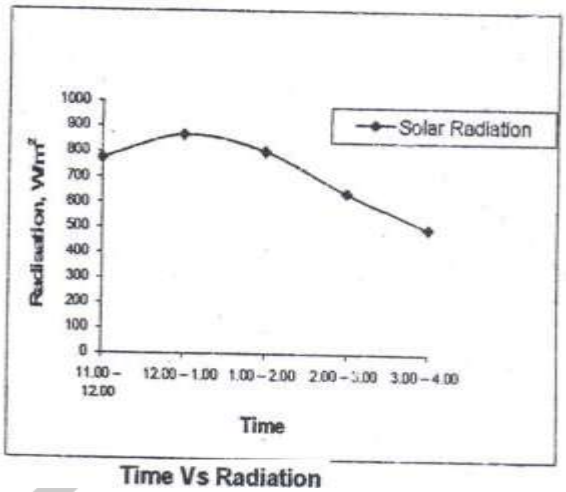
The experimental setup so developed was kept in sunlight during March 2005 between 11 am to 04 pm. The thermo couples with digital display system were used to record the temperature of the water, glass and ambient. The data were collected by keeping various heights of water in the still. The temperatures are recorded at various intervals during the day. The solar radiation intensity was continuously measured with pyranometer. The distillation rate was also measured at the same interval. The obtained data was tabulated and graphs were drawn.

IV. Tabulation

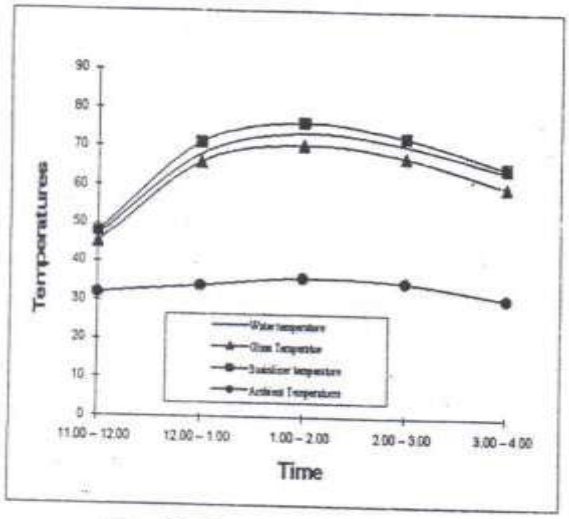
S. No.	Time interval	Solar radiation in W/m2	Temp. of water in 0 C	Temp. of glass in 0 C	Temp. of basin in 0 C	Ambient temp. in 0 C	Mass of distilled water in Kg.
1.	11 am – 12 noon	2820	45	42	46	32	0.10
2.	12 noon – 01 pm	3223	59	57	61	37	0.42
3.	01 pm – 02 pm	3021	70	68	74	39	0.55
4.	02 pm – 03 pm	2159	65	61	69	36	0.29
5.	03 pm – 04 pm	1800	60	57	63	33	0.21



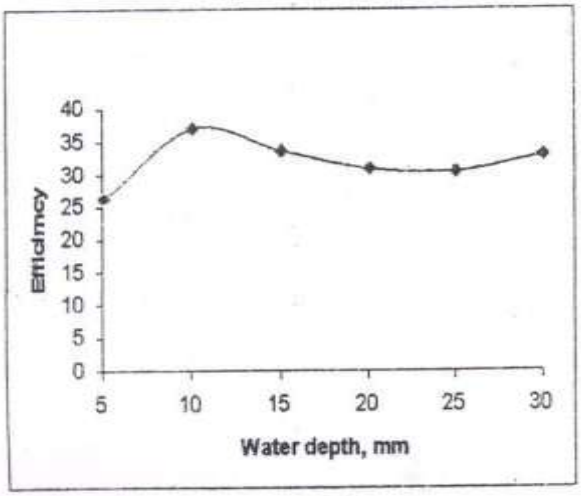
Time Vs Distilled output



Time Vs Radiation



Time Vs Temperatures



Water depth Vs Efficiency

V. Results and Discussion

The experiments were conducted for about ten days in the month of March 2005 between 11a.m. to 04 p.m. and data were collected and tabulated one such tabular column is shown. After analyzing the collected data following inferences were drawn. The measurements of temperatures, solar radiation intensity and the production of distilled water are taken at the interval of one hour to study the effect of each parameter on the solar distillation still performance. In this study various operating conditions such as different water depth, ambient temperature, solar radiation intensity and amount of water collected have been examined. The out put of the solar still mainly depends upon:

Radiation intensity: When the intensity of radiation is high the amount of water distilled is also high as shown in graph.

Ambient temperature: More the ambient temperature more will be the output of the still. The ambient temperature is high between 12 noon to 03 pm.

Depth of water in the basin: The efficiency of distillation is high if the depth of water is low as in graph and the efficiency decreases with the increase in water depth.

Water temperature: As the initial temperature of water increases, there is increase in the output of the distilled water.

VI. Conclusion

The solar distillation still provides an excellent performance during the months of high solar radiation. If the depth of water in the basin is low then the output is high due to the increased evaporation rate. Further during peak hours of high ambient temperature in the day the performance of still is high. The optimum distillation was observed between 12 noon to 03 pm during which high ambient temperature and high solar radiation intensity existed.

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