STUDIES ON FINNED BASIN SOLAR STILL

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ABSTRACT
In the present work an attempt has been made to improve the heat transfer rate from basin liner to the water. Fins are used in the basin of the still to increase the heat transfer rate. Performance of a finned basin still is compared with that of a conventional still. It is observed that the productivity of the still increases with increasing the numbers of fins. When number of fins increase thrice, productivity increases by 25% as compared with the conventional still. Daily productivity increases with increasing number of fins in the basin.

Key words: Basin Solar Still, Fins and Evaporative Heat Transfer Coefficient

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1. INTRODUCTION
Access to safe, fresh and clean drinking water is one of the major problems in many regions of the world [El Kharraz et al. (2012) Droogers et al. (2012)]. In underdeveloped and developing countries, more than 768 million people drink water from unreliable sources. Solar still can solve part of the problem in those area where sun’s energy available in plenty. Solar still are simple in design, have zero operating and low maintenance cost. Detailed reviews of different designs were reported by Kumar et al. (2015). Many attempts were made by Velmurugana et al (2011), Muftah et al (2015) to improve the productivity of the still. Velmuruga et. al (2009), El-Sebaii et al (2014), Ali et. al (2014), El-Sebaii et. al (2015) and Sadhana et al (2015) have used extended surfaces in the basin of the still to enhance the heat transfer rate and so the productivity of the still. In present work attempts have been made to incorporate fins in the basin of the still, effect of number of fins on the productivity of still is also obtained.
2. EXPERIMENTAL SETUP
Two similar double slope solar still are used in the present study. Modification were made in one of stills and performance were measured for both still. For purpose of comparative study both stills were kept on same platform. A modification made in the still adding number of fins of specified size provision was made to change the number of fins in the basin of the still to be modified. The height of the fins is 1 cm, and the pitch between two successive fins is taken 0.09m and kept constant. Fins are made of galvanized iron sheet for its good thermal conductivity and cheaper cost. The basin is covered with 0.05 m thick glass sheet inclined at nearly 26° from horizontal which is the latitude of Allahabad city of Uttar Pradesh in India to maximize the amount of incident solar radiation the tilted glass cover (0.05 m thick) served as solar energy transmitter as well as a condensing surface for the vapour generated in the basin. The stills are made of galvanized iron sheets, with basin area of 0.72 m². The whole basin surface is coated with black paint from inside to increase the absorptivity. Also the still is insulated from bottom to side walls with Styrofoam insulation sheet to reduce the heat loss from the still to ambient. The insulation is paste by the Fevicol-909 adhesive. A distillate channel was provided at each end of the basin.

3. EXPERIMENTAL PROCEDURE
Experiments were conducted at SHIATS Allahabad in month of May from sunrise to sunset. Experimental setup is kept in the North South direction to receive maximum solar radiation throughout the year. The solar radiation, atmospheric temperature, basin temperature, saline water temperature, glass temperature and distilled water productivity were measured. However, the accumulated productivity during the 24 h had also been measured in each test. A constant water level of saline water was maintained by adding makeup water.
4. RESULTS AND DISCUSSIONS

4.1 Effect of Fins in Basin on productivity of solar still

Freshwater productivity of single basin solar stills is very low. To enhance the rate of heat transfer from the basin liner to the basin water, fins were integrated at the basin liner of the still. The effect of the number of fins on productivity and efficiency of the finned basin solar still were also studied. Figure 4.1 shows the variation of solar intensity with time of a day. Maximum average solar intensity is obtained at noon in south facing glass cover.

![Figure 4.1 Variation of solar intensity with time](image)

Figure 4.1 Variation of solar intensity with time

Figure 4.2 and 4.3 shows the variation of temperature of different components of the solar still. Figure 2 shows the variation of water temperature with time for the finned and without finned basin solar still. Water temperature in the finned basin is higher than water temperature in without finned basin double slope solar still. Glass cover temperature in the finned basin is almost equal to the without finned basin double slope solar still. Temperature of the south facing glass cover is higher than north facing glass cover. It is almost unaffected by presence of fin in the basin.

![Figure 4.2 Variation of water temperature with time](image)

Figure 4.2 Variation of water temperature with time
Figure 4.3 Variation of glass temperature with time

Figure 4.4 shows the variation of convective heat transfer coefficient for conventional and modified basin solar still. Fins are used to enhance the heat transfer coefficient; convective heat transfer coefficient is higher for finned basin solar still. Average value of heat transfer coefficients for conventional solar still is 1.5119 W/m²K where as this value increased by 10% up to 1.6649 w/m²k .When a small modification in the basin of still is made by attaching 30 numbers of fins.

Figure 4.4 Variation of convective heat transfer coefficient with time

Figure 4.5 shows the variation of evaporative heat transfer coefficient with time of a day. average value of evaporative heat transfer coefficients for conventional solar still is 29.24 W/m²K and of finned basin is 30.91W/m²K .It is clear from here that used of small and limited no of fins can increase the evaporation heat transfer coefficient by 5.7%.

Figure 4.5 Variation of evaporative heat transfer coefficient with time
Studies on Finned Basin Solar Still

Figure 4.6 shows the variation of distillate output from conventional and modified basin double slope solar still. Since total distillate collected from the still is the sum of distillate collected from north side glass cover and south side cover. Since productivity is directly preop to the temperature difference between evaporative and condensing cover surface. The finned basin solar still has improved both of the daily productivity and daily efficiency by a relative percentage difference of approximately 28% compared to the without finned solar still.

4.2. Effect of number of fins on productivity of solar still

Figure 4.7 shows that as number of fins increase productivity increase. A comparison is made between a conventional still with modified still varying number of fins as ten and thirty. When ten number of fin were used 16.24% productivity increased and when thirty number of fins used daily productivity increase by 24.1%. Water in finned basin filled up to the top edge of the fins. Daily productivity increases with increasing number of fins in the basin. A comparison is also made on the basis of the efficiency of still. Additions of the fins increases the daily efficiency. Daily efficiency of the conventional still was found to be 39.38% where as 48.91% of finned basin modified solar still. On a particular day, on the same plate form, when finned basin with ten number of fins were compared daily efficiency of conventional still was found to be 35.6% and 41.6% of ten finned basin still. As number of fins increases, the daily productivity also increases.
5. CONCLUSION

In the present work an attempt has been made to investigate the rate of heat transfer from basin liner to the basin water as the rate of heat transfer is directly proportional to the surface extended surfaces are used in the basin of the still to increase the heat transfer rate. Effect of number of fins on the productivity of the still is also obtained. It is observed that the productivity of the still increased by 16% when 10 numbers of fins were used. When number of fins increase up to 30, Productivity increased by 24.21% as compared with the conventional still. Daily productivity increases with increasing number of fins in the basin.

REFERENCES