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Estimation and parametric analysis of heat transfer coefficient for a solar still: A review

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ABSTRACT

Solar still is a device which is used to obtain fresh drinkable water from saline water with the use of solar radiations and solar desalination process. There are number of solar still designs and various ways to increase its performance. So, in this review paper an attempt is done to do analysis of the heat transfer coefficient on various parameters (PCM, Specific height, Aspect Ratio, Insulation, Thickness of glass, angle of slope and absorbing plate).

Keywords— *Solar still, Design Parameters, PCM, Absorbing Plate, Fresh Water, Desalination Process, Heat transfer coefficient*

1. LITERATURE REVIEW

(a) **El-Sebaii et al.** The preheating time for evaporating water is minimized with the adoption of suspended absorber plate.
(b) **Naim et al.** Charcol particle act as a good absorber medium.
(c) **Zeinab et al.** A packed layer of glass ball helps the heating operation of still water throughout daytime and after sunset, to increase the freshwater productivity.
(d) **Voropoulos et al.** The implementation of storage tank is not only to increase saline water temperature, but also to increase the temperature difference between saline water and glass temperature.
(e) **Nafey et al.** Emulsion of paraffin wax, paraffin oil and water mixture used as an energy storage material.
(f) **Akash et al.** Black dye absorbing ability is higher than that of black ink and black rubber mat.
(g) **Mohammad and Tabrizi et al.** PCM material increased the productivity in weir still about 31%.
(h) **Omara et al.** At 5mm water depth, 120 mm width of stepped solar still gave 57.3% more productivity than conventional solar still.
(i) **Awad and El- Agouz** The humidification- dehumidification process with the conventional solar still increases hourly productivity by 57% and the hourly efficiency by about 47%.
(j) **Zoori et al.** In weir solar still efficiency of energy and exergy increases 83.3% and 10.5% respectively.
(k) **Yadav et al.** Stepped and weir type solar still increases the distillate output around 60-80%.

2. INTRODUCTION

Water is the basic requirement for every living creature human, animals, plants, bacteria's, etc. Almost 70% of earth covered with water and Most of the water available is saline in nature. Small amount of fresh water is only available on earth for the drinking purpose and by using RO Purifiers we are making it mineral less, which is not fit for drinking purpose. With an increasing Population the demand for food, water and shelter is Increasing rapidly. The availability of pure and clean water is decreasing day by day, we need to find some alternate method which can provide clean and drinkable water.

To fulfil that demand we need to come across some feasible and cheap way to make saline water available for drinking, one of the best ways is Solar Desalination Process. Solar desalination process based on the solar energy which is absorbed by the plate and

desalination process begins. Due to the presence of abundant solar energy we can easily overcome the saline problem of water. This is how we came across towards solar still which aims to desaline the water. An instrument which can convert the saline water into fresh water via solar energy using Solar Desalination Process.

The basic process that includes in the Solar Desalination Process are Convection, Radiation and Conduction too from bottom surface. Our aim is to increase the evaporation rate in the solar still for this we need convection to be maximum so that evaporation rate achieved will be maximum. For that the heat transfer coefficient should be maximum which depends on various factors.

3. WORKING PRINCIPLE OF SOLAR STILL

The solar still working is based on nature's hydrological cycle. Like in nature natural distillation process occurs in which solar radiation incident on the ocean or water body and causes water to evaporate and the evaporated water rises above the earth surface and condense to form clouds and then they start rain.

Similarly, here also the solar radiation will pass through the glass and heats up the water and evaporate it due to which it will rise up and strike to the glass and then slides down the collecting chamber.

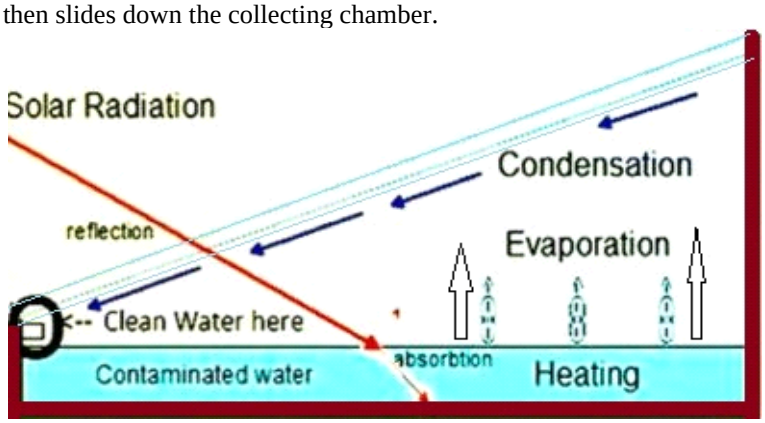

Fig. 1: Schematic Diagram of Simple Solar Still

3.1 Factors Affecting the Performance of Solar Still

The output from solar still depends on the climatic conditions such as solar radiation intensity, wind velocity and temperature. It also depends on the design parameters such as PCM, Angle of slope, Glass thickness, aspect ratio, specific height, insulation, etc. Therefore, we are finding on which of these parameters we are getting higher value of heat transfer coefficient.

3.2 Various Solar Still Designs

Type	Characteristics
Spherical Solar still	• Area, Diameter 0.60m • Radial height 0.28m • Basin capacity 16L
Pyramid Solar Still	• Area 1.21 • Water filled up to 0.05m • Glass wool as insulator
Hemispherical Solar Still	• Diameter 0.95m • Height 0.10m • Solar transmittance equal to 88%
Double Basin Solar Still	• Inner Basin 590 x 440 x 440 mm • Outer Basin 600 x 460 x 460 mm • Top cover inclined at 17˚

3.3 Double-Slope Solar Still Hybrid with Rubber Scrapers

Ali Omran Al-Sulttani, Amimul Ahsan, Ataur Rahman, N.N. Nik Daud, S. Idrus made one of the great designs with double slope with rubber scrapers and operated during daytime under climate conditions. They found out the small slope cover allows more radiation to enter, it is an advantage. Rubber scrapers help to reduce disadvantage from these small slopes. Solar scrappers were used first time in this experiment. The results were compared to compare the advantages between using and without using of solar scrapers of two models. The internal heat transfer coefficient was enhanced as well as the productivity. The value of the total internal heat transfer coefficient was 38.754 W/ ˚C and the daily yield value was 4.24 L/day for the DSSSHS model with productivity improvement was found to be 63% and the angle of inclination was just 3˚.

4. CONCLUSION

- The advantage of using rubber scrapers to increase the productivity of the still is not limited to the increase in the solar intensity entering the still also it did not let the vapours of the solar still and helps in increase in productivity.
- The theoretical yields were found to be a strong correlation and the coefficient of determination

- between the theoretical and experimental yields was 0.997 indicating
- The maximum values of Convective heat transfer coefficient fromwater to glass cover, Hourly theoretical distillate yields (kg), and mexp that obtained for the DSSSHS model were found to be 1.479 W/m2 °C, 29.503 W/m2 °C, and 0.824 L/m2 h, respectively.

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