Topic: Computational Modelling for performance analysis of solar stills

Mohd Zaheen Khan
(14PhD ME-13)
Department of Mechanical Engineering
Faculty of Engineering, Jamia Millia Islamia

ABSTRACT

A studied has been done over the 9-hour cycle i.e., from 8 A.M. to 5 P.M. for the solar still and calculate their output for an individual hour. By using the energy balance equations, results which is calculated is different from the results obtained from the 9-hour cycle (theoretically) of the approximate method and having the ± 1.5% error. Water depth is 5 to 15 cms, coefficient of heat transfer in wind is 5 to 40 W/m^2 K & the overall coefficient of heat transfer through side and base walls is 0 to 3 W/m^2 K these are variable range which taken for the analysis. In this research work we obtained the distilled water from a new design solar still say, a hemispherical solar still. By using this water-cooling effect on the top of this hemispherical solar still, we generally enhanced the still efficiency from 34% to 42%.

An effort is made to calculate the coefficient of heat transfer for conventional, conical and hemispherical solar still in this study. Keeping the same dimensions, we compare the output results of conical and hemispherical solar still to the conventional solar still. 1.725, 2.28 and 2.076 L/m^2/day are the daily productivity of conventional, conical & hemispherical solar still as the results are shown. Calculation of the mass transfer & heat transfer coefficient are done here. For conventional, conical & hemispherical solar still 32.17, 64.68 and 62.21 W/m^2 °C are the maximum value of heat transfer coefficient.

RESEARCH FINDINGS

The major conclusions of the present study on convective, radiative, evaporative and the total internal heat transfer coefficient are summarized below;

1. Distillate output for each individual hour

- For smaller time intervals the second method has an advantage over the first method for calculating temperature of glass cover. For time slots of one or less minute the results from the second method meet with mathematical solutions.

- Although for requirement of large accuracy, 30 minutes or less is the time interval needed and also the data of ambient temperature and solar intensity is needed at these time slots. For estimating the glass cover temperature first method and second method are quite well.

2. Cooling water effect

For 1/6 ml/sec of water flow rate fed, the efficiency of distillation unit was increased from 34% to 42%. Hence, this indicate that, the hemispherical solar still efficiency increase by 1.25 times by using the water-cooling effect.

- By using water cooling at the top cover, the distilled water productivity is from 4.18 to 4.2 litre per m^2 per day and the productivity is from 3.5 to 3.68 litre per m^2 per day when using the top cover without cooling.
- The enhancement in the yield is from 3.6 to 4.2 litre per m^2 per day from the rate of 0.6 ml/second for fixed flow. So, around 15% enhancement in the yield of distilled water by using the top cover water cooling.

3. New design results

Under the sunshine climatic conditions of New Delhi, India, a new design solar still was researched, analysis and resulted in this work. The comparative results of total internal heat transfer coefficient, which says that the maximum productivity occurs in conical solar still which is 2.28 litre/day.