International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 10 Issue 7 ǁ July 2022 ǁ PP. 315-318

Effect of Wick Materials on The Performance of Tubular Solar Still

Amit Kumar and Vivek Sachan
Department of Mechanical Engineering,
Shri Venkateshwara University, Gajraula -244236 U.P., India

ABSTRACT
A solar still is used to convert saline water into potable water by means of the distillation process. With the aim of improve the productivity of tubular solar still, various amendments are incorporated by researchers. In this paper the performance of tubular solar still was experimentally investigated using two wick materials. Cotton cloth and jute are chosen for this investigation. Based on experimental and theoretical observation, cotton cloth is the most suitable wicking material for higher productive solar still.
Keywords: *Tubular solar still and wick materials*

Date of Submission: 01-07-2022 Date of acceptance: 11-07-2022

I. INTRODUCTION

Water is essential to sustain human life and for socio-economic development. Nevertheless, there is limited access to water that meets standard limits of water quality. The quality of water can be improved through desalination. Conventional techniques for desalination are available but they require a large input of energy, mostly from fossil

fuels that contribute to environmental degradation. Consequently, there is a need to use sustainable energy sources, with solar energy being one of the most promising alternatives. Desalination technology is gaining worldwide acceptance as a proven technology for fresh water production. The review of desalination history can be found in literature [1]and reviewed the research papers [2-6]. Identify the low productivity issues of solar still that the distribution of water is not uniform in the bare absorber plate and not proper insulation of absorber plate (back side). To overcome this problem the textile materials like jute, cotton cloth can be spread water over the absorber plate and mica sheet used as insulator.

II. EXPERIMENTAL SET UP AND PROCEDURE

The photographic view of the tubular solar still (TSS) is shown in Fig. 1. The still was constructed of galvanized iron basin size of 0.8 m×0.65 m. The polycarbonate sheet was of simple 3 mm thick glass. The wick materials (cotton and jute cloth) (Fig. 1) being floated with the help of thermocol bars. Wick materials pieces were floated side by side lengthwise on the basin water so that the water surface was completely covered by the wick materials with required clearance from the basin walls. The edges of the wick materials were dipped in the basin water, so that, it remained wet due to capillary action. The distillate was collected in graduated glass bottles. The thermocouple wires were inserted into the stills through a very small hole at the side wall. digital thermometer measures the temperatures of all the points. A digital solar power meter with accuracy of 0.1 W/m^2 was used for reading the solar intensity.

Fig.1 Experimental arrangements of TSS with wick materials (cotton and jute cloth)

HEAT TRANSFER COEFFICIENT

Convective heat transfer coefficients According to Tsilingiri model (2007) [7-8]

Convective heat transfer coefficient

$$h_{cw} = 0.075\left(\frac{\rho.g.\beta}{\mu.\alpha}\right)^{1/3}\left[(T_w - T_g) + \frac{P_w - P_g}{268900 - P_w}(T_w + 273.15)\right]^{1/3}$$

III. EXPERIMENTAL OBSERVATIONS ANALYSIS

Figure 2 shows the variation of water temperature with time of a day. The water temperature inside TSS with wick material (Cotton cloth) slightly higher than TSS with wick material (Jute) because of jute cloth mass is higher than cotton cloth. Higher water temperature increases the evaporation rate.

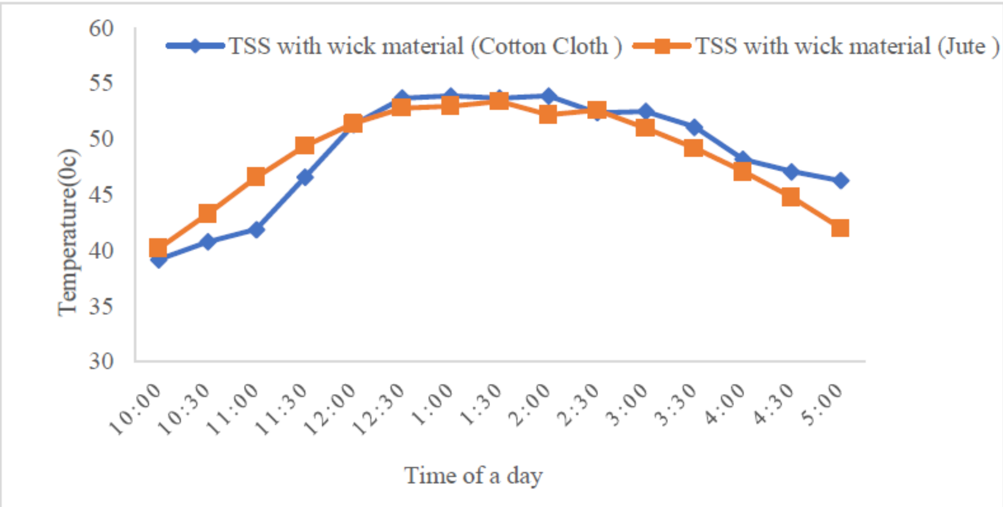

Figure 2 variation of water temperature with time of a day

Figure 3 shows the variation of convective heat transfer coefficients of tubular solar still with cotton cloth and jute. the average value of convective heat transfer coefficient with cotton cloth is higher than jute.

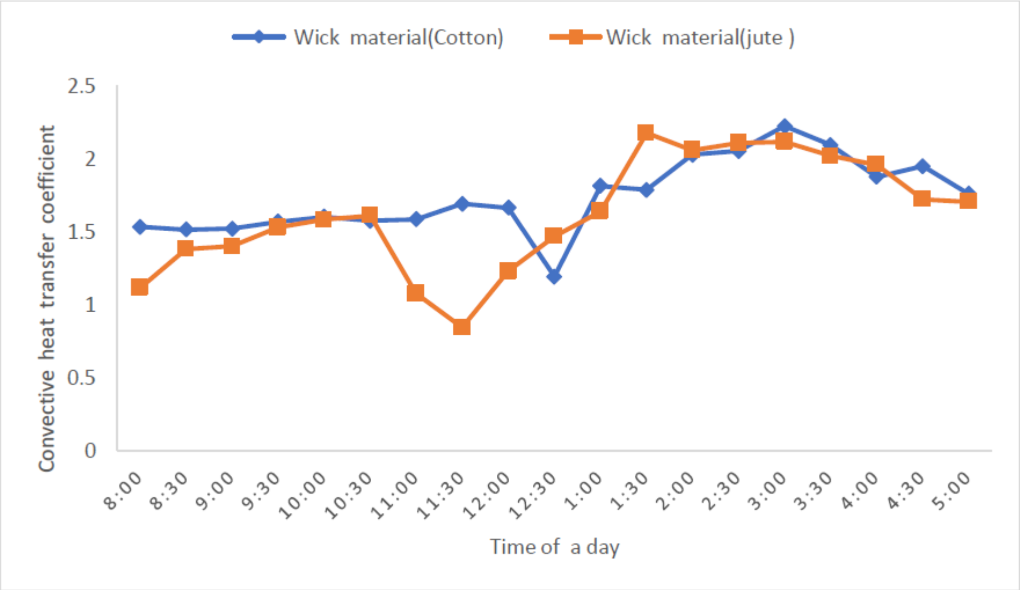

Figure 3 variation of convective heat transfer coefficients with time of a day

Figure 4 shows the effect of wick materials and mica sheet on the productivity of TSS. The productivity of tubular solar still (mica sheet, thermocol and cotton in the basin) is higher than tubular solar still (mica sheet, thermocol and jute in the basin)

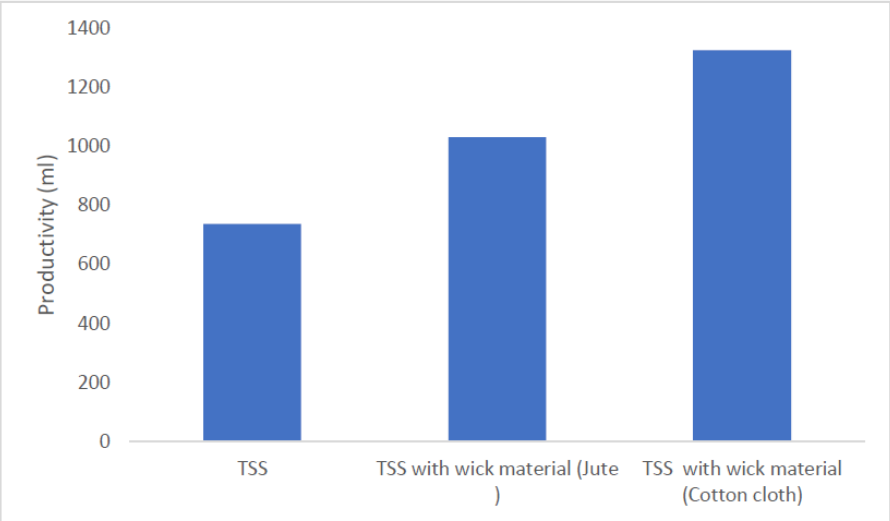

Figure 4 Compression of productivity of TSS

IV. Conclusion

On the bases of experimental observation following points below:

- The productivity of tubular solar still increases 80 % using mica sheet thermocol and cotton in the basin.
- Efficiency of tubular solar still with mica sheet and thermocol with cotton in the basin is 17 %.
- The productivity of tubular solar still increases 40 % using mica sheet and jute in the basin.
- Efficiency of tubular solar still mica sheet and thermocol with jute in the basin is 11 %.

REFERENCES

[1]. E. Delyannis, Historic background of desalination and renewable energies, Sol. Energy75 (2003) 357–366.
[2]. K. Kalidasa Murugavel, K. Srithar, Performance study on basin type doubleslope solar still with different wick materials and minimum mass of water,Renew. Energy 36 (2011) 612-620.

[3]. Pankaj K. Srivastava, S.K. Agrawal, Experimental and theoretical analysis of single sloped basin type solar still consisting of multiple low thermal inertiafloating porous absorbers, Desalination 311 (2013) 198-205.

[4]. K.K. Matrawy, A.S. Alosaimy, A.F. Mahrous, Modeling and experimental

[5]. study of a corrugated wick type solar still: comparative study with a simple

[6]. basin type, Energy Convers. Manag. 105 (2015) 1261-1268.

[7]. Z.M. Omara, A.E. Kabeel, A.S. Abdullah, F.A. Essa, Experimental investigation of corrugated absorber solar still with wick and reflectors, Desalination 381 (2016) 111-116.

[8]. Abhay Agrawal, R. S. Rana Theoretical and experimental performance evaluation of single-slope single-basin solar still with multiple V-shaped floating wicks Heliyon 5 (2019) 1-38

[9]. Tsilingiris, P.T.(2007) The influence of binary mixture thermophysical properties in the analysis of heat and mass transfer processes in solar distillation systems. Solar Energy, 81:1482-1491.

[10]. Tsilingiris, P.T.(2009) Analysis of the heat and mass transfer processes in solar stills. Solar Energy 83:420-431