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Effect of glass thickness on performance of double slope inward solar desalination still for freshwater production.

Efecto del espesor del vidrio sobre el rendimiento del destilador solar de desalinización de doble pendiente hacia el interior para la producción de agua dulce.

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ABSTRACT

This paper deals with the effect of thickness of glass material which covered on double slope solar desalination still, performance of the solar still affected by thickness of the glass, which result in to major heat losses in the system. Two inward double slope desalination still with different glass thickness were designed, constructed and experimentally tested their performance. The glasses are inclined 20^0 from the center of the still. The solar energy collecting area of still is $1m^2$.The result shows that the variation in glass thickness will affect the efficiency of the still, desalination still with 4mm thickness gives 48% higher fresh water productivity compare to 6mm glass thickness.

Keywords- solar desalination, fresh water production, glass thickness, solar energy, double slope inward still.

RESUMEN

Este trabajo trata sobre el efecto del espesor del material de vidrio que cubría el alambique de desalación solar de doble vertiente, el desempeño del solar aún afectado por el espesor del vidrio, lo que da lugar a importantes pérdidas de calor en el sistema. Se diseñaron, construyeron y probaron experimentalmente dos destiladores de desalinización de doble pendiente hacia adentro con diferentes espesores de vidrio. Los vasos están inclinados 200 desde el centro del alambique. El área de recolección de energía solar del

destilador es de 1m2. El resultado muestra que la variación en el espesor del vidrio afectará la eficiencia del destilador, el destilador de desalinización con un espesor de 4 mm da un 48% más de productividad de agua dulce en comparación con el espesor del vidrio de 6 mm.

Palabras clave: desalación solar, producción de agua dulce, espesor de vidrio, energía solar, destilador de doble pendiente hacia adentro.

INTRODUCTION

Potable water is essential for human life. Most of the sea shore areas peoples are affecting due to lack of drinking water. Solar desalination is a process to convert saline water to drinking water .To improve the efficiency of the still most of the researchers are ,coupled solar flat plate [G. Jims john wessley et.al;2014, Mousa Abu-Arabia,Mohammad et.al;2018, M.M. Morad et.al;2015] and solar concentrator with desalination stills, but glass cover is very necessary component in the case of still and collectors [Amit Kumar Singh et.al;2019, S A Kedar et.al;2018, Amir Mahmud et.al;2018, Qiuming Ma et,al;2018, Gustavo Otero et,al;2016].Glass cover thickness also affect the efficiency of fruits drying, in fruit drying 4mm glass thickness 35.4% higher than 6mm glass thickness efficiency(27.8%)[Ramadhani Bakari et,al;2019].In stepped solar still also lesser glass thickness is gives more output in this study we analyze the total water production per unit energy in the case of double slope solar still by using 6mm and 4mm glass cover[J.s. Gawande and Bhuyar].

EXPERIMENTAL SETUP

The double inward slope solar desalination still having $1m^2$.base area. two stills are designed symmetrically and constructed. One still having glass cover with 6mm and other with 4mm.the glass plates are tilted 20^0 each sides from the centre of the still shown in figure 1.J-type thermocouples are usedto measure temperature at inlet and outlet water and inside and outside of the glass .the inlet of the solar still is connected to saline water tank and outlet is connected to fresh water bottle

Figure 1. Double slope desalination still

. Vane type digital anemometer is used to measure weather data. Thermocouple and anemometer featuresare shown in Table 1 and 2. from Table1, the maximum temperature range of thermocouple is 0 to750^{0}c and also the j- type thermocouple have good warranty .

Table 1: Features of thermocouple

Sr. No.	Item	Specification
1	Type of thermo-couple	J – Type Iron constantan thermocouple
2	Alloy of positive wire	Iron (100% Fe)
3	Alloy of negative wire	Constantan (55% Cu –45% Ni)
4	Temperature range	0 – 750 ^{0}C

Table 2: Features of anemometer

From Table 2, vane type digital anemometer is cost effective product and the resolution andaccuracy is matching with his experiment.

Sr. No.	Item	Specification		
1	Type of anemometer	Vane type digital anemometer		
2	Operating temperature	0 to 50^0 C		
3	Operating humidity	Less than 80% RH		
4	Measurement in m/s	Range	Resolution	Accuracy
	0.4 – 30 m/s	0.1 m/s	± 2%+0.2m/s)	0.4 – 30 m/s

RESULTS AND DISCUSSION

Graphs have been plotted using solarimeter reading and fresh water productivity with respected to time.The fresh water productivity is 2030ml and 1370 ml for 4mm and 6mm respectively.

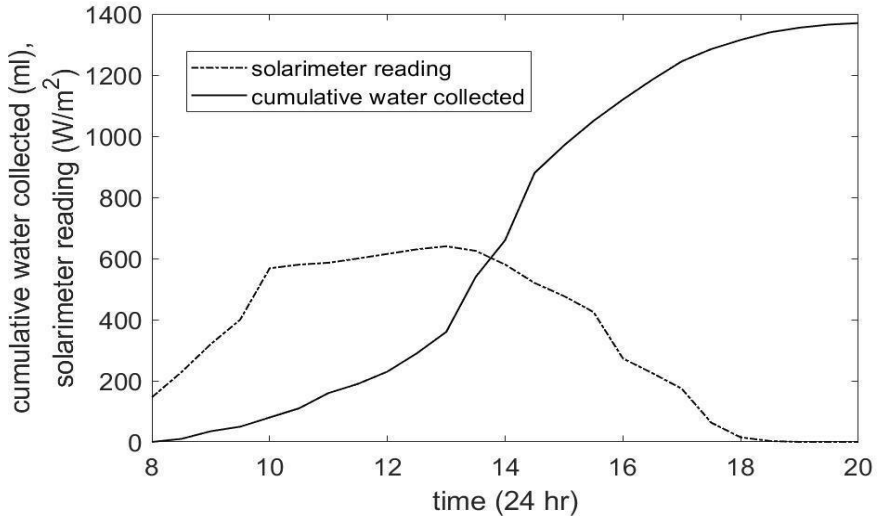

Figure 2:4mm glass cover data

The energy flux measured by the solari meter at every half an hour interval starting from 8 a.m.to 8.p.m.The maximum solar radiation received 1.30 pm.The two experiments are carriedout atsame time and date.As,expected ,the solari meter had recorded high amount of radiation in the timeinterval from 10 am to 3 pm.

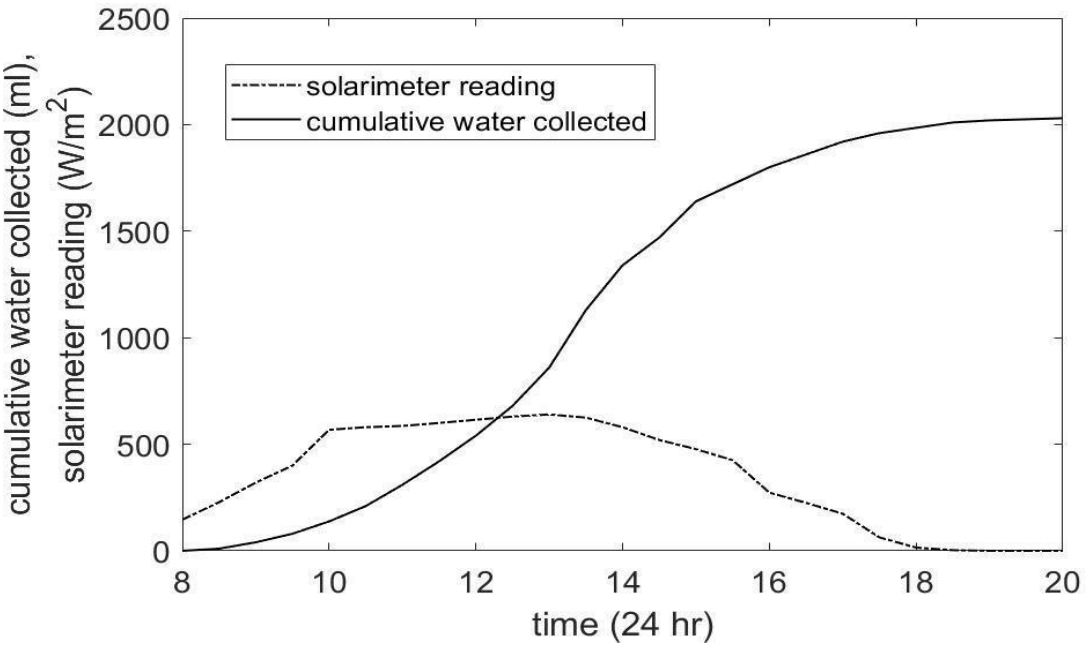

Figure 3: 6mm glass cover data

CONCLUSION

Two double slope solar still with different glass cover thickness (4mm and 6mm)where installed and tested .solar still with 4mm provided 48% higher productivity shown in figure (3)compared to 6mm glassthickness. It can be concluded that lesser glass cover thickness provided maximum fresh water productivity per unit energy.

REFERENCES

Amir Mahmud, Hassan Faith, Mahmud Ahmed, Enhancing the performance of a solar driven hybrid solar still/humidification-dehumidification desalination system integrated with solar concentrator and photovoltaic panels, Desalination 30(2018)165–179

Amit Kumar Singh1, Devendra Singh2, Dr. Ajay Kumar Sharma3, Experiment Investigation on Distillation of Brackish Water by a Parabolic Solar Concentrator, International Research Journal of Engineering and Technology (IRJET) , Volume: 06 Issue: 06 | June 2019,1760-1763

G. Jims John Wessley, , P. Koshy Mathews, Experimental analysis of a flat plate solar collector system for Small-scale desalination applications , Advanced materials research vols 984-985(2014) pp 800-806

Gustavo Otero Prado,Luiz Gustavo Martins Vieira, João Jorge Ribeiro Damasceno, Solar dish concentrator for desalting water, Solar Energy 136 (2016) 659–667

J.S. Gawande,. Bhuyar, Effect of Glass Cover Thickness on the Performance of Stepped Type Solar Still, ISSN:2321-115691-8)

K. Kalidasa Murugavel , K. Srithar , Performance study on basin type double slope solar still with different wick materials and minimum mass of water, Renewable Energy 36 (2011) 612-620

M.M. Morad, Hend A.M. El-Maghawry, Kamal I.Wasfy, Improving the double slope solar still performance by using flat-plate solar collector and cooling glass cover, Desalination 373 (2015) 1–9

Mohamed Asbik , Omar Ansari , Abdellah Bah, Nadia Zari , Abdelaziz Mimet d, Hamdy El-Ghetany, Exergy analysis of solar desalination still combined with heat storage system using phase change material (PCM), Desalination 381 (2016) 26–37

Mousa Abu-Arabia,Mohammad Al-harahsheha, Hasan Mousaa, Zobaidah Alzghoula, Theoretical investigation of solar desalination with solar still having phase change material and connected toa solar collector. Desalination 448 (2018) 60–68

Ramadhani Bakari, Rwaichi J. A.Minja, and Karoli N. Njau, Effect of Glass Thickness on Performance of Flat Plate Solar Collectors for Fruits Drying, Hindawi Publishing CorporationJournal of EnergyVolume 2014, Article ID 247287, 8

S A Kedar1, K Arul Raj2, A K Bewoor, Design and Analysis of Solar Desalination System Using Compound Parabolic Concentrator, Materials Science and Engineering 455 (2018) 1-3

Qiuming Ma, Aras Ahmadi, Corinne Cabassud, Direct integration of a vacuum membrane distillation module within a solar collector for small-scale units adapted to seawater desalination in remote places: Design, modeling & evaluation of a flat-plate equipment Journal of Membrane Science 564 (2018) 617–633.

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