6. Photo voltaic panel submerged and partially submerged in water

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Abstract

This work presents the experimental analysis of improving the thermal, electrical efficiency and yield of a single slope solar still. The PV efficiency decreases with increase in water depth inside the basin while the solar still efficiency is higher in the case of fully submerged condition. The maximum yield from solar still obtained is about 8 kg/m^2 with PV under fully submerged condition and during the off shine hours the solar still efficiency is higher as compared to partial submerged condition. Similarly, with decrease in water temperature the panel efficiency is increasing. The maximum hourly yield from solar still with and without PV were found to be 1.3 and 0.45 kg/m2 respectively.

From the recent literatures, it was found that no studies on experimentation of partial and full submerge of photovoltaic panel in water. In this work, a new novel solar still with photo voltaic panel by partially and fully submerged in water is experimentally studied. The effect of full and partial submerge of the entire photo voltaic panel in water is experimentally studied in order to analyse the thermal performance, thermal efficiency, yield as well as electrical efficiency of the system. Meanwhile, the present study is also compared to those of conventional single slope solar still for validating the results. The effect of water flow over the cover surface is also studied for enhanced condensation of the proposed distillation system.

1. Experimental setup

Fig. 1 and 2 shows the schematic diagram and experimental photograph of hybrid solar still. The experimental setup is constructed in such a way that two identical solar still made of same material and dimension. The length and breadth of solar still were 1 m x 0.5 m with height of 0.21 m in one side and 0.3 m on the other side. Glass cover with 4 mm thick is placed over the solar still to

condense the vapour formed in the inner surface due to evaporation from the top water surface. Saline water is stored in a tank and continuously fed into the basin to maintain constant water depth inside the basin. Two different conditions were analysed namely, placing the PV panel inside the basin by partially submerging it. Other method is fully submerging the entire PV panel in water and water based nano fluid. To avoid short circuit of current, the terminals in the back side of the PV panel is sealed. Voltmeter and Ammeter were connected in series to measure the voltage and current from the PV panel. To validate the effect of submerging the solar panel water, tests were conducted in open condition.

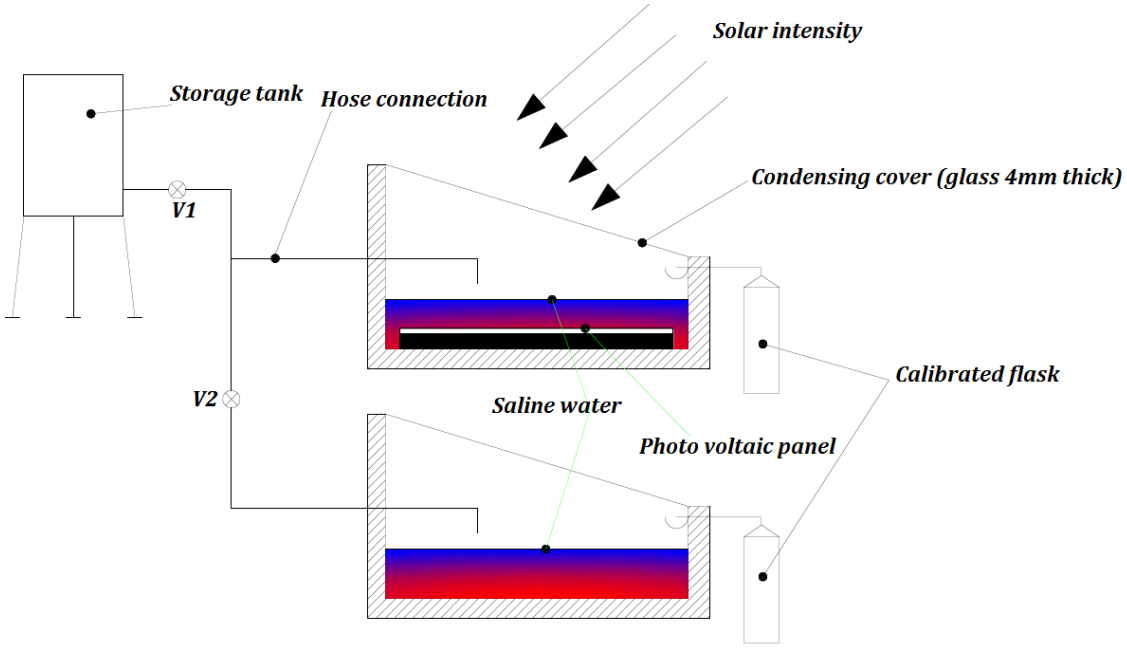

Fig. 1 Schematic diagram of hybrid and conventional solar still

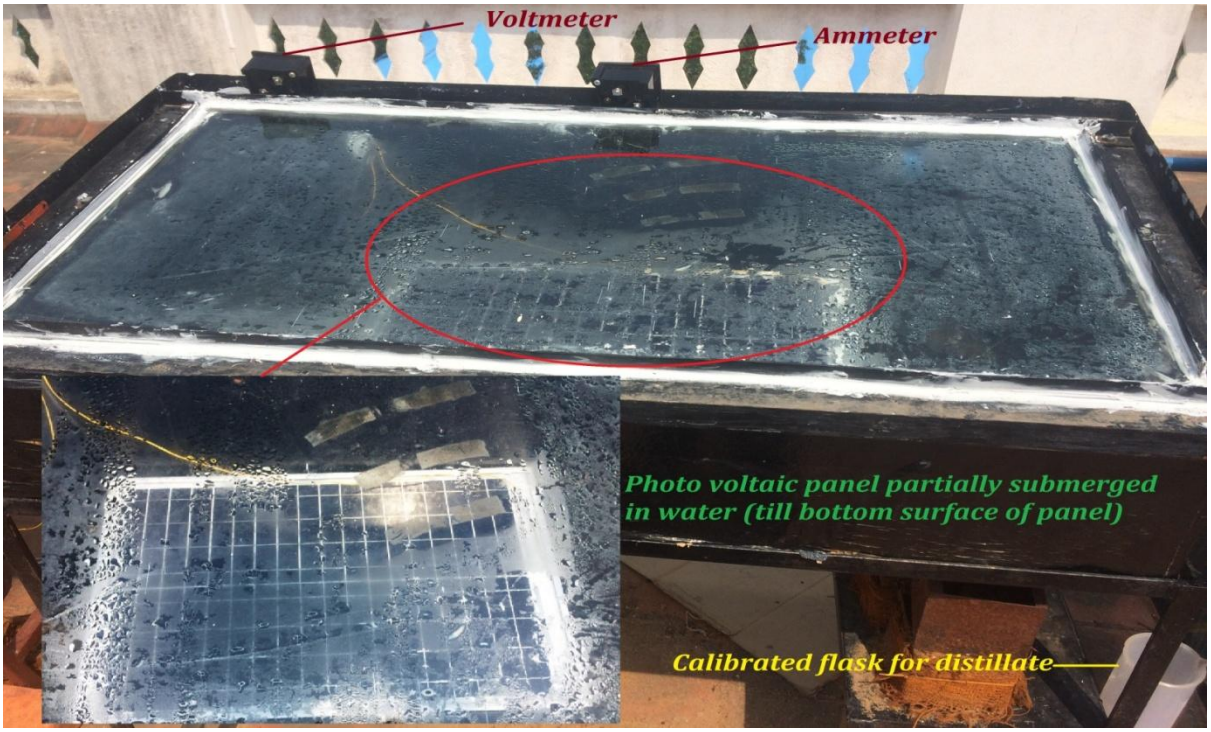

Fig. 2 Experimental photograph of hybrid solar still with water

2. Conclusions

From the experimental analysis the following conclusions were arrived at:-

- The PV efficiency decreases with increase in water depth from 2 to 3 cm under partial and fully submerged condition respectively.
- The yield from solar still decreases with increase in water depth from solar still without PV submerge, whereas, in the case of partial submerged condition and fully submerged condition the accumulated yield increases.
- The accumulated yield from solar still with and without PV is found to be 8 and 3 kg/m2 (dw=3 cm) respectively.
- The maximum instantaneous efficiency from the solar still is 80% and 76% for fully and submerged condition respectively.

CENTRE FOR EXCELLENCE IN ENERGY AND NANO TECHNOLOGY

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PROJECT MEMBERS DETAIL:

S.No	Name of The Project	Lab Utilization	Student Participated in the Project
1	Experimental Study on Novel Hybrid PV Desalination system using Hybrid Nanofluids	Sonication, PV & solar still test rig, solar power meter, temperature sensors, anemometer, calibrated flask	**(ACY 2016-17)** S. Aravindan R. Basheer Ahmed R. Bhuvaneshwar K. Kuralinniyan

PROJECT OUTCOME:

Paper Published

1. Kabeel, A.E., Arunkumar, T., Denkenberger, D.C. and Sathyamurthy, R., 2017. Performance enhancement of solar still through efficient heat exchange mechanism–A review. *Applied Thermal Engineering*, *114*, pp.815-836.
2. Manokar, A, Winston D,Kabeel, A.E& Sathyamurthy, R &Thirugnanasambantham, Arunkumar. (2017). Different parameter and technique affecting the rate of evaporation on active solar still -A Review. Heat and Mass Transfer. . 10.1007/s00231-017-2170-9