9. Solar still using jute cloth knitted with sand heat energy storage

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ABSTRACT

One of the best methods in improving the productivity of fresh water from the solar still is incorporating sensible heat energy storage materials. This work aims at improving the yield of fresh water from the single slope solar still using sensible heat energy storage knitted with jute cloth on the entire surface of the material. Experimental investigations were carried out in the single slope solar still with and without jute cloth knitted with the material and for validation of results the solar still without any material is tested for the same experimental condition. Experiments were carried out with different water depth inside the basin. Results show that the yield of fresh water is completely depends on the parameters such as mass of sensible energy material and depth of water maintained inside the basin. The yield of fresh water under least water depth (d_w=0.02m) from the solar still with and without jute cloth knitted with sensible heat storage materials were found to be 5.9 and 5 kg/m^2, respectively.

In this study, the use of sensible heat energy storage and use of jute cloth around the sensible heat storage material is experimentally investigated on improving the performance of single slope solar still. Similarly, the effect of water mass (depth) is experimentally investigated on the effective capillary rise of water in the wick material. Furthermore, the overall thermal efficiency of the modified solar still is analyzed on the effect of water mass.

1 EXPERIMENTAL SETUP, PROCEDUDURE AND UNCERTAINTY

Fig. 1 Experimental photograph of modified solar still with jute cloth knitted to sensible heat energy storage

The experimental setup consists of a basin with side height of 0.3m on one side and 0.4 m on other side with an inclination angle of 13^{o} to keep the glass in an inclined position. Provisions were provided to feed the water into the basin and drain valves are provided the bottom of the basin to take the contaminated water and for cleaning purpose. The cover used for the study is made of glass with a thickness of 3mm. The experiments for the present study using single slope solar still is made in such a way that the glass cover facing North-South direction so as to receive the maximum solar intensity falling on the inclined surface. The fresh water condensed in the inner surface of the glass is glided to the distillate collector kept at the end of the glass. Due to the increase in the temperature of water inside the basin and partial pressure developed vapor is formed in between the water and glass surface and thus condenses. The area of the basin is fabricated with 1m x 0.5m and area of the glass is almost the same as the basin. The experimental photograph of the modified solar still is shown in Fig.1 and the schematic diagram of the experimental test rig is shown in Fig. 2. The jute wick material is wrapped around the sand heat energy storage material. Due to the continuous heat

dissipated from the sand box energy heat storage, water absorbed in the jute cloth will be evaporated. Due to continuous capillary effect and absorption of water in the jute cloth, evaporation would be rapid. Experiments are carried out in the open terrace of Department of Mechanical Engineering, S.A. Engineering College, Chennai. Measurements of various environmental parameters such as solar intensity, wind velocity, ambient temperature, accumulated fresh water yield were measured using Solar power meter (TES1333R), 4836 Cup type anemometer, PT100 thermocouples and calibrated flask respectively. Every 1 hour fresh saline water is fed into the basin to maintain constant water mass inside the basin.

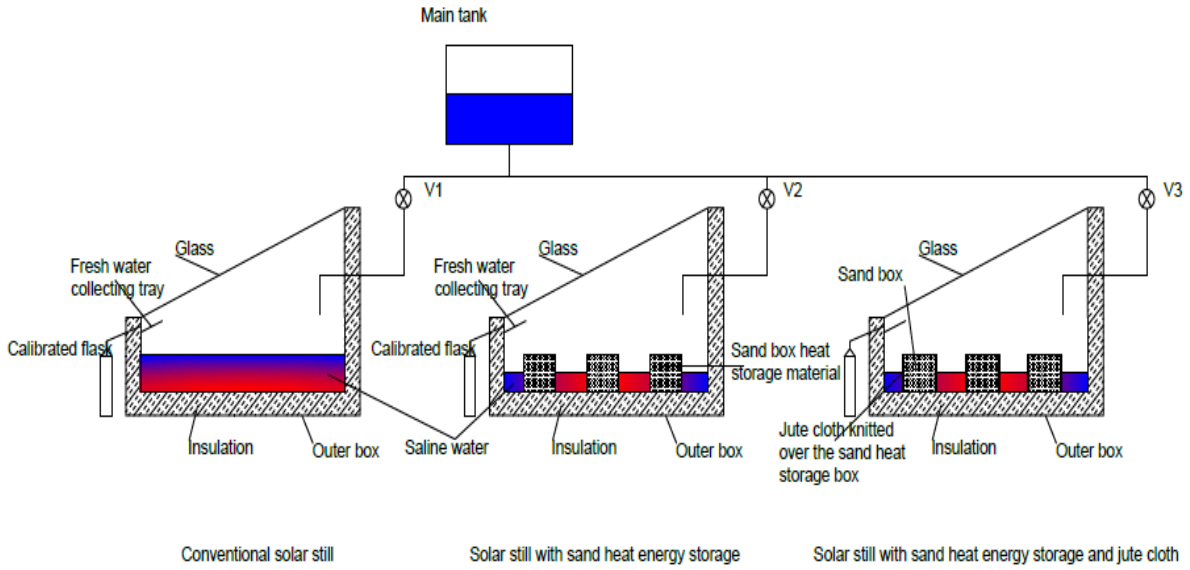

Fig.2 Schematic diagram of conventional and modified solar still with jute cloth knitted with sensible sand heat energy storage

The present study deals with the experimental analysis of solar still with and without jute cloth knitted with sand heat energy storage system and compare it with the conventional single slope solar still. Three different cases were studied in the present system to assess the

performance of solar still. Case (1) deals with varied water mass inside the conventional solar still, while case (2, and 3) deals with the same parameter with and without jute cloth knitted with sand heat energy storage system. During the experimental analysis, the environmental parameters were considered to be similar with a deviation of +/- 3% deviation.

2 CONCLUSIONS

Experimental investigations were carried out in the single slope solar still with and without jute cloth knitted with the material and for validation of results the solar still without any material is tested for the same experimental condition. From the experimental results, the following conclusions are arrived at:-

- The increase in water mass decreases the water and glass temperature and hourly yield for conventional and modified solar still at 4 pm after that the water and glass temperature and hourly yield are increased.
- The yield of fresh water is completely depending on the parameters such as mass of sensible energy material and depth of water maintained inside the basin.
- The average water temperature in the case of sensible heat energy storage as well as jute cloth knitted sensible heat storage were found to be similar and 25% higher as compared to conventional solar still.
- The yield of fresh water under least water depth (d_w=0.02m) from the solar still with and without jute cloth knitted with sensible heat storage materials were found to be 5.9 and 5 kg/m^2 respectively.
- Similarly, the overall thermal efficiency of the modified solar still with sensible heat energy storage and jute cloth is enhanced at a constant water mass of 20 kg maintained inside the basin.