2. Inclined solar panel basin solar still in passive and active mode

Principal Investigator: - Ravishankar. S

Abstract:

In this research work, an attempt has been made to study the effect of integration of Flat plate collector (FPC) and inclined solar panel basin (ISPB) still has been carried out. (Active mode) The results were compared with ISPB still without integrating with FPC (Passive mode).The maximum fresh water produced from passive ISPB still and active ISPB still is 3 kg and 4.1 kg respectively. The daily thermal energy efficiency of passive ISPB still and active ISPB still is 26.43 % and 37.77% respectively. The daily exergy efficiency of passive ISPB still and active ISPB is 4.31 % and 6.45 % respectively. When ISPB still is integrated with FPC the daily yield, thermal efficiency and exergy efficiency of the still is increased. While ISPB in active mode, it increases the daily fresh water production rate, thermal efficiency and exergy efficiency up to 27.56 %, 30.03% and 37% respectively than the ISPB in passive mode.

From the literature it is very clear that, very less experimental works reported on inclined solar still in active mode and hence the main objectives of this research work is integrating Flat plate collector water heater to the inclined solar still.

1. Design and construction of the proposed experimental set-up:

1.1 construction of ISPB still in Passive and Active mode

Schematic diagram and experimental setup of an inclined solar panel basin solar still in passive and active mode is shown in Fig. 1 and Fig. 2. It consists of a basin made of PV panel mounted at an inclined position. The dimension of solar still is 1365mm× 670mm× 150 mm. The solar still and collector cover was fabricated using 4mm thickness transparent glass. The

ISPB still was fully sealed by silicon paste to avoid the vapor losses from still basin to the surroundings.

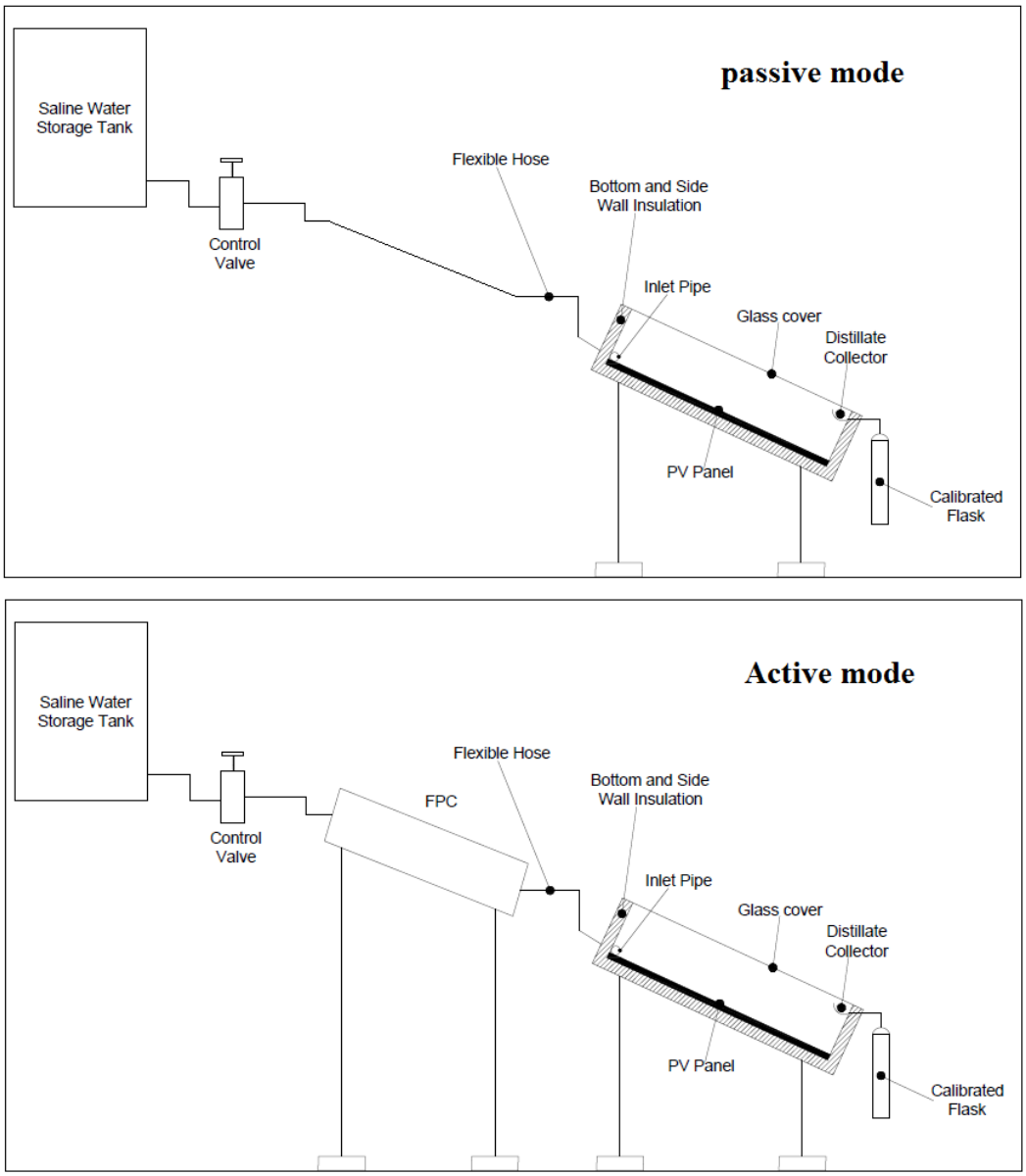

Fig. 1 Schematic diagram of modified PV/T solar still in passive and active mode

Thermo cool is placed outside of the experimental setup to prevent the heat looses from the still to the surroundings. Cotton thread is used as a wick material to increase the evaporation rate which is pasted in the space between the consecutive rows and columns of solar cell. Water flowing arrangement in ISPB still is shown in fig.3. In this setup water flow arrangement is made in such a way that saline water from storage tank flows through the

control valve, PVC pipe and then to the basin of solar still. Water is fed uniformly to the still basin with the help of PVC pipe is holed at equal spaces for even distribution. A constant mass flow rate of 0.0023kg/s of input feed water are kept for both passive and active mode. During the operation of ISPB still hot water generated from the still is again flowing to the water storage tank. Temperature sensors are installed at collector glass cover, PV panel and exit water to measure the temperatures at corresponding points. In order to collect the condensate from the inner glass surface, a distillate collector is placed at the bottom of the glass cover. In active mode, FPC is integrated with passive ISPB still.

1.2 Description of the Flat plate collector solar water heater

A Flat plate collector solar water heater was fabricated comprising of flat solar collector, storage tank and control valve. The flat collector of 900 mm X 600 mm X 4 mm was fabricated by using of the 20 mm thickness wooden box covered with 4 mm thick window glass. This water heater was mounted on supporting steel structure. 10 mm diameter and 1 mm thick copper tube in flat shape with three winding (with 50 mm gap between successive windings) was used to circulate water in the collector. Cylindrical storage tank made up of plastic with 50 liters capacity was mounted on a steel stand. The spiral tube water heater was faced south direction with the inclination equal to latitude of Chennai (13°). K type thermocouples were used to measure surface of absorber plate, inlet water, outlet water and ambient temperatures with multi channel digital display device. Measuring jar and stopwatch was used to measure the mass flow rate. The accuracy and error limits of the various measuring instruments were listed in the table 1. TES 1333 solar power meter, AM4836 cup anemometer and digitalmultimeter were used to measure the solar intensity, wind velocity and voltage, current generated from the solar panel. Cost analysis for passive ISBP still and Active ISBP still is listed in table 2 and table 3 respectively.

Experiments were carried out by two different conditions i) inclined solar panel basin still in passive mode ii) inclined solar panel basin still in active mode.

Fig. 2 Experimental set-up of inclined Solar panel basin solar still in passive and active mode

2. CONCLUSIONS

The current investigational study is related to the solar panel basin inclined solar still integrated with FPC arrangements for efficient distillation in Indian climate in peak summer conditions.

From the experimental study the following conclusions are arrived:-

1. The amount of fresh water production from the active inclined solar still is 27.56% higher than that of passive inclined solar still.
2. Panel efficiency of passive inclined solar still is 10% higher than that of active inclined solar still.
3. The maximum daily distillate yield, thermal efficiency and exergy efficiency of passive ISPB still is 3kg, 26.43% and 2.2% respectively.
4. The maximum daily distillate yield, thermal efficiency and exergy efficiency of active ISPB still is 4.1 kg, 37.77% and 3.5% respectively.

5. From the experimental investigation it is found that, active solar still performance is better than the passive solar still. Daily thermal efficiency and exergy efficiency of active solar still is 30% and 37% higher than the passive solar still.

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2. Manokar, A. Muthu, D. Prince Winston, A. E. Kabeel, S. A. El-Agouz, Ravishankar Sathyamurthy, T. Arunkumar, B. Madhu, and AmimulAhsan. "Integrated PV/T solar still-A mini-review." *Desalination* (2017).