Photovoltaic Thermal Technologies- A Detailed Review

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Abstract— Many Researches and Developments have been carried out in respect of photovoltaic thermal technologies. Many of the Researches have been put forward and it is evaluated by the professionals and academics. Various types of advancement on the PVT have been introduced, to enhance the Efficiency of solar still, solar collector and photovoltaic solar cell. Solar still assisted with photovoltaic thermal technology helps to enhance the distillate output. This article gives a review on the Research and Development in photo voltaic thermal technology.

Key words: Thermal Technologies, Solar Collector

I. Introduction

A photovoltaic thermal hybrid system is the integrated unit of Photo Vltaic and thermal system which produces. both heat and Electricity. In other words the

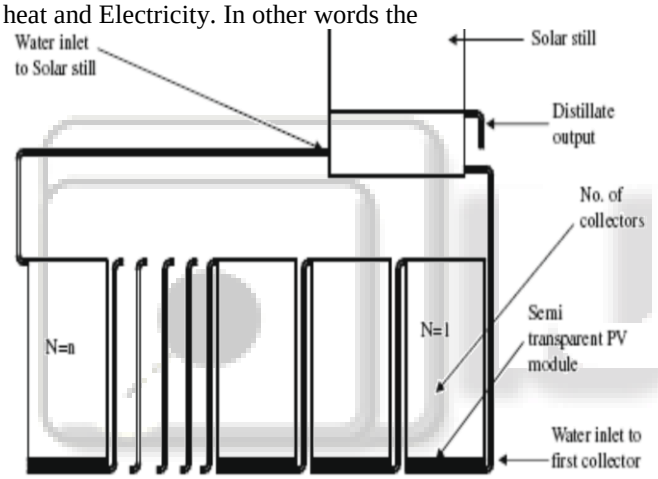
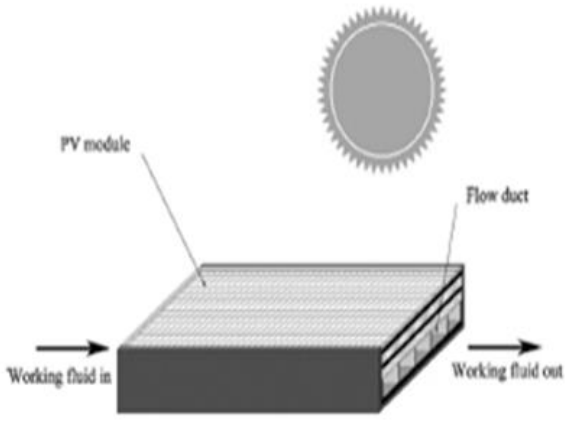


Fig. 1: PVT Collectors Connected In Series Which Are Integrated With Solar Still

Fig I shows the PVT collectors connected in series which are integrated with solar still.



Production of heat and electricity is carried out simultaneously. PVT hybrid solar system in categorized on the Basis of air, water collector, Mono crystalline / polycrystalline / Amorphous silicon solar cells, flat plate collector or concentrator, natural and forced fluid flow. Some of the PVT technologies use air and water for cooling the photovoltaic solar cell to bring down its temperature to operating temperature which ensures maximum rated power output. In much system, number of collector has been optimize to yield maximum distillate output.

II. Early Development (Previous Work)

Solar cell converts 40-50% incident solar radiation into heat which reduces Photovoltaic solar cell Efficiency and corresponding effect on efficiency can be seen on coupled solar still and solar collectors. So it is necessary to maintain the temperature PV module at its operating temperature to ensure maximum electricity production. This produced electricity can be used to run the solar DC pump to circulate working fluid Fig. II PVT Hybrid collector through collectors and solar still as summarized by Shivkumar and Arvind Tiwari, so it is very necessary to maintain the temperature of Photo voltaic solar cell less than 500C, by using PVT hybrid collector as shown in fig II

III. Introduction Of Different Flow Rates In PVT Systems

The work was reported by M.S. Gour et.al. (1) About optimization of number of collector coupled with solar still. It had been observed that number of collector equal to four which yields maximum. The observed yield of active solar still was approximately 7.9 kg for 50 kg water and 0.055 kg/sec. This yield is much higher than the passive solar still. Ahmad Fudholi et. Al (3) constructed the combined PV module and collector unit to determine the performance of PVT water collector under the solar radiation ranging from 500- 800 w/m2. For different solar radiation flow rates were ranging from 0.011 kg/sec. to 0.041 kg/sec. PVT collector was experimentally tested to determine the photovoltaic solar cell efficiency and thermal collector efficiency. As per the results spiral flow absorber shows efficient performance at solar radiation intensity 800 w/m2 and mass flow rate of 0.041 kg/sec.

IV. Stimulation Model of PVT

Feng shan et.al (2) studied the Hybrid photovoltaic thermal system using the refrigerant as a working fluid and prepared stimulation model for the analysis of the PVT performances under the climatic condition Nanjing.

M. Bouberki et.al (3) evaluated the numerical stimulation of on active solar still coupled with PVT solar water heater and in addition of reflectors. The solar still is coupled with PVT system increase solar still distillate output by 17.36%, 28.34% and 33% respectively for winter, spring and summer.

V. THERMAL MODELLING OF PVT

V.K. Dwivedi et. al (4) fabricated a HPVT double slope active solar still to study their performance. They carried out thermal modeling of HPVT double slope active solar still coupled with two flat plate collectors.

Gajendra Singh et. al (5), designed, fabricated a double slope hybrid active solar still and experimental tested under field condition. In this article analytical expression were derived. Thermal model of distillation system has been Ratify with experimental data.

De Rosa Mattia et.al (14) prepared the model validated experimentally by using experimental data which was collected during tests conducted at the university of Genoa, using a prototype Realized by retrofitting a commercial PV collector.

Arvind Tiwari et. al (13) an attempt was made to compute the performance of air collector (hybrid PVT air collector) with different Configuration i.e. glazed and Unglazed PVT air heater with and without tedlar. The thermal model for unglazed PVT air heating system validated experimentally. It was observed glazed hybrid PVT without tedlar shows best result.

VI. DC POWER UTILIZATION FROM PV MODULE IN PVT

Shiv kumar et. al (6) designed and fabricated the solar still coupled with solar collector. In the system DC pump was used to circulate the water through the system. DC pump was powered by the photovoltaic panel. Experiments were conducted with different depths of water in the solar still i.e. at 0.05, 0.10 and 0.15m. The results were compared with passive solar still.

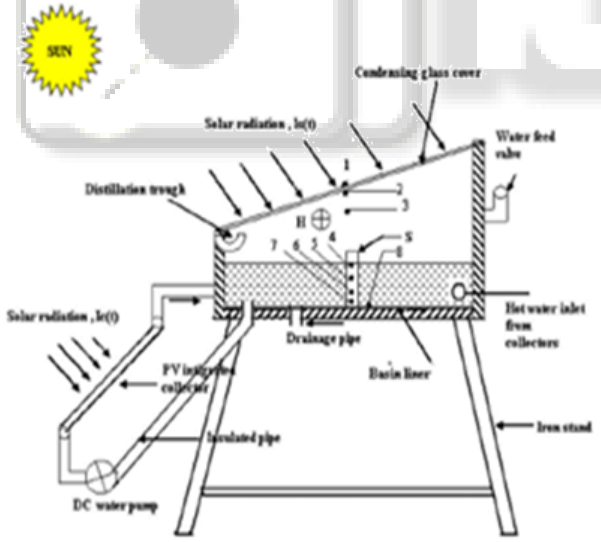


Fig. 3: Schematic of a hybrid (PV/T) active solar still (side view)

Alli Ruhi et.al (8) developed an integrated unit of the DC heater, PV module, and solar still with sea sand layer at the Basin of Solar still. The 50 watts PV-DC heater was used. The use of 50 watts PV-DC heater and sea sand in the solar still seems to be more effective than conventional solar still. This solar still yields two times more distillate than the conventional solar still.

VII. DEVELOPMENT IN PVT APPLICATION

Kamran Moradiet.al (10) reviewed the different application & governing parameters of it. The application were distinguished on the basis are as follows.

A. P.V. Liquid Collector

1) PVT water collectors
2) PVT refrigerant collectors.
3) PVT hybrid water/air collector

B. PVT water collectors

This PVT water collector can be used in the following application

1) Space heating
2) Water heating
3) Water distillation.

C. PVT Refrigerant collectors

This PVT Refrigerant collector can be used in the following application

1) Drying
2) Space cooling
3) space heating
4) Domestic water heating

D. PVT Hybrid Water / Air Collector

This PVT hybrid water / air collector can be used in following application

1) Space heating
2) Water heating
3) Drying

Vineet Tyagi et.al (11) reviewed the trend of Research and development of technological advancement in PVT solar collector and its useful applications. Like solar heating, water distillation, solar green house, solar still, photovoltaic thermal system, solar heat pump / air conditioning system. Building integrated photovoltaic/thermal system and solar power co-generation.

T.T. chow had reviewed the latest development and advancements in the PVT technologies. The study was carried out over a three decades theoretically, practically and experimentally. In his article he mentions about the fundamental theories, conceptual Ideas and basic PVT collector design configuration formulated by various researchers and developers.

Jun-Tae Kim et. al (15) studied the performance of water type PVT collector with fully wetted absorber. The Proto type of an unglazed PVT collector was designed and fabricated. The thermal and electrical performance of PVT collector was observed in the outdoor conditions.

VIII. SUMMARY

In the last three decades the focus was on the performance of PVT collector based on the numerical, theoretical and experimental study. Many of the Researches have been put forward & it is evaluated by the professionals and academics. The study was more focused on determining the heat and mass transfer through conventional collector on the basis of experimentation.

At Present hybrid PVT system are limited in the commercial market. The major Barriers like cost & the reliability of system. As per today's scenario peoples are

using stimulation & thermal model and CFD analysis for optimum output. The designs are optimize by testing the system with different configuration. The results seem to be more effective with hybrid photovoltaic thermal system than the conventional system.

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