A Short Review on Solar Photovoltaic / Thermal Water Collectors

A.K Rakhesh*, A. Srivishnu, P.S Saravanun, M.Vignesh, M. Sridharan
Department of Mechanical, Saranathan College of Engineering
Tiruchirappalli - 620012

Abstract
Solar energy is one among wide available renewable energy source. Among various solar energy conversion devices, solar photovoltaic thermal water collector is a device which converts solar energy into electrical and thermal power simultaneously. Numerous research works are conducted during the last two decades by solar PV/T water collector-based researchers. In this study, a short review on performance influencing parameters of various solar PV/T water collectors are discussed. In addition, role of artificial intelligence along with its advantages and future properties were also highlighted.

Keywords - *solar; PV/T; water; collectors; performance; parameters; artificial and intelligence*

I. INTRODUCTION

The PV/T solar system is a combination of PV module and water collector which is used to convert the solar energy falling on it. The solar energy is converted into the electrical energy and the excess amount of heat energy liberated in the solar PV module is maintained by the use of circulating water through tubes and the hot water is obtained as the output .The electrical power produced depends on the factors of module area and irradiance value. Every module has its own specification and the power production will depends on the factors. The circulation of water is made through flow into copper tubes and they are fabricated behind the solar module. The reason for choosing copper tubes is electrical conductivity is higher. The flow pattern for the water tubes are designed and fabricated in such a way that it cover all over the module and it absorbs the maximum amount of heat energy produced in the module .There are many types of combination like series and parallel is formed and the power output is calculated. The best suitable and efficient combination is obtained through this method.

II.LITERATURE SURVEY

H.G.Teo.et.al [1] conducted experiment to increase the electrical efficiency of the PVT module. A hybrid photo voltaic thermal system was designed, fabricated and experiments were conducted. The electrical efficiency of the cell depends and changes based on the increase in the Temperature. The system consists of parallel array of ducts with uniform flow of air. The test was conducted both with and without active cooling. The results were at without Cooling the efficiency was found to be 8-9%. Under active cooling the efficiency was found to be 12-14%. This showed the variation in efficiency with and without cooling of the solar cells.

M.Chandrasekhar.et.al [2] conducted a detailed study which deals with the general aspects of the PV module. The module efficiency is 4-17% of the incident solar radiations. This shows that there is a 50% of wastage of solar radiation falling on it. The wastage or emitted heat increases the temperature of the module which in turn decreases the life time, design and efficiency of the system. To avoid this a cooling system was used. It consists of cotton wicks structure. The experiment was conducted with water, Al_2O_3/ water Nano-fluid and CuO/water Nano fluid. The results were compared based on efficiency.

Kamran Moradi.et.al [3] encrypted a research on the effects of control parameter on the thermal/ electrical performance of the PV/T collectors. This paper gives the idea about the way of increasing the working and efficiency of the PV/T collectors. The thermal part consists of either the use of water or air as medium. The way of passing the air and water was varied and the highest way was obtained. This paper also deals with the recent developments in PV/T technologies with an emphasis of encountered thermal / fluid management and combination issues.

Ahmad Fudholi et.al [4] set forth a work on photo voltaic thermal water collectors with different mass flow rates for different solar irradiance value. The electrical and thermal performance were determined were 500-800 W/m2 for solar radiation level. The mass flow rates were in the range of 0.011 - 0.041 kg/s. The results were spiral flow absorber at 800 W/m2 and mass flow is 0.041 and the efficiency were for PVT is 68.4%, for PV it is 13.8%, and for thermal it is 54.6 %. It also produced a primary-energy saving efficiency ranging from 79% to 91% at a mass flow rate of 0.011–0.041 kg/s.

J.Siecker.et.al [5] has conducted experimental analysis on cooling the operating surface in order to increase the efficiency of the module. This paper deals with various methods of decreasing the module temperature and how effectively it can be used as other source of energy or output. Some of the systems studied and explained are such as hybrid solar photo voltaic/ thermal system cooling by forced water

circulation, hybrid solar photo voltaic cooling by forced water spraying and solar panel with thermal electrical cooling. The results were based on the advantages, disadvantages and area of application. The study is purely based on the surface temperature. This paper helps in choosing the simple easily adaptable technique for future solar panel and power generation process.
K.A Moharram.et.al [6] developed a cooling system for cooling the solar panel. The objective is to minimize the amount of water and electrical energy. Two model has been developed to determine the maximum allowable temperature of the PV panel and how long it will take to cool the panel to operating temperature. Based on the heating and cooling rate models, it is found that cooling of the panels starts when the temperature of the PV panels reaches a maximum allowable temperature (MAT) of 45 C.

Lovedeep Sahota.et.al [7] explored the various economic performance in renewable energy. N photovoltaic thermal flat plate collector (N-PVT-FPC) (water and air), N photovoltaic thermal compound parabolic concentrator (N-PVT-CPC) water collector, N-PVT-FPC solar still, PVT greenhouse dryer, and building integrated photovoltaic thermal (BIPVT) (rooftop and façade) system.It is found that, thermal modelling of all these RE systems have been carried out and simulated to investigate their performance for the requirement of overall primary energy. It has been observed that integrated solar thermal systems are self- sustained and more economical.

Swapnil Dubey.et.al [8] observed the performance of partially covered flat plate collectors connected in series using theoretical modelling. This paper show the detailed analysis of thermal, energy and electrical energy yield by varying the number of collector by considering different weather condition. Cost analysis has also been carried out. It is observed that the collectors partially covered by PV module combines the production of hot water and electricity generation and it is beneficial for the users whose primary requirement is hot water production and collectors fully covered by PV is beneficial for the users whose primary requirement is electricity generation.

Shiv Kumar.et.al [9] experimented hybrid photovoltaic thermal water heater which was fabricated and tested. In the series and parallel connection under forced circulation mode. The output water temperature has been obtained as 0.5–2.5◦C from parallel configuration higher than the series configuration.It has been observed that theoretical results are found to be in good agreement with the experimental value. Instantaneous energy efficiency is found to be higher for parallel configuration (3.0–15.0%) than for the series arrangement. The overall instantaneous energy efficiency is found in the range of 2.2–4.1% for parallel configuration.

Jinshun Wu.et.al [10] explained the thermal absorber and integration method. These two elements directly influence the cooling effort of PV layers and as a result, the related electrical/ thermal/overall efficiency. Seven thermal absorber and four integration methods are discussed in the paper in terms of their advantage, disadvantage and associated application. Compared to traditional thermal absorbers, such as sheet-and-tube structure, rectangular tunnel with or without fins/ grooves and flat-plate tube, these four types, i.e. micro-channel heat pipe array/heat mat, extruded heat exchanger, roll-bond heat exchanger and cotton wick structure, are promising due to the significant enhancement in terms of efficiency, structure, weight, and cost etc. Results provide useful information for the assistance of further development of solar PV/T modules with high feasibility.

M.Fuentes.et.al [11] has conducted experimental analysis on real performance separate PV and thermal system and PV-T system by comparison. He says that it is not for low temperature solar module. Through Experimental performance both separate PV and thermal and combined PV-T system generates good electricity. He justifies the types of application using for commercial purpose. By configure using converter performance were good working with high efficiency. The results were based on performance on hybrid PV-T solar system. He concluded that combined PV-T system is not expected its shows back of PV-T module by integration on active cooling. The paper helps how the hybrid PV-T system show its real performance for commercial purpose.

Pedro L. Magalhaes [12] has explained the hybrid photovoltaic-thermal collectors which includes solar thermal collectors it's in accordance to ISO standard. The papers model doesn't different between fluid and electricity generation and no electrical generation of PV-T collectors. By Material Power point that absorption factors reduction by electrical generation and parameter through multi-linear regression. Prior model gives more details thermal PV-T collectors. The paper gives with model the thermal and electrical performance is dependent on temperature.

Sakhr M.Sultan et.al [13] has overview on photovoltaic and thermal PV/T Technology. The researches and scientist are carried out its application. The terms are performance, design, fabrication, simulation and experimental and evaluation is to be done with various types PV collector to be used. The various application to be used for energy production on PVT system. The paper shows the PV /T is futuristic energy.

III. CONCLUSION

The hybrid solar PV/T water collector is a device which converts solar energy into thermal and electrical energy simultaneously. [2, 5, 6, 7, 12 & 13]

Energy demand created by standalone PV/T water collector system with respect to increase in population, leads solar PV/T based researchers to identify higher energy system such as series and parallel PV/T water collectors. [8 & 9]

Later researchers suggested series connected PV/T water collector for the situation where electricity demand is high. Similarly, they also suggested parallel connected pv/t water collector for the situation where hot water demand is high. [1, 3, 4, 10, 11]

Recent researchers are working with implementation of artificial intelligence into the field of solar PV/T water collector. [16]

In addition, trending research works are conducted on the basis of implementation of Internet of things in the field of solar PV/T water collector[17].

Thus with the implementation of above mentioned consideration, it is possible to design an effective solar PV water collector system.

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