iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 **Issue:** XI **Month of publication:** November 2015

DOI:

Volume 3 Issue XI, November 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Performance Analysis Of Actively Cooled Solar PV Panel Subjected To Concentrated Radiation. (Review)

Mr. Aniket M. Gajbhiye[1], Prof. Bhojraj N. Kale[2]
[1](Research Scholar, DBACER, Department of Mechanical Engineering, Nagpur University, Nagpur, India)
[2](DBACER, Department of Mechanical Engineering, Nagpur University, Nagpur, India)

Abstract: Solar energy is most promisingly utilized in photovoltaic (PV) and in thermal systems for long. Solar radiation strikes PV surface and electricity is generated. The literature shows that PV efficiency of generating electricity decreases with the increase in temperature of PV panel. Several cooling systems are designed, where the heat is extracted from the PV module and used separately. For this purpose mainly water is used as it is readily available, economic and has the good thermal conductivity. The present system is of concentrated and non-tracking type of PV system and very little work is carried out in concentrated and non-tracking type of PV system. In the proposed system to enhance overall performance of the system, different heat extraction methods will be compared by using different types of fluids and Water. The system uses concentrated solar radiation which is non-tracking type. In this system single pass concentrated, non-tracking Photovoltaic panel will be tested by the utilization of different heat extraction (cooling) fluids for checking performance of the system.
Keywords: Solar PV, PV/T System, Solar cell, solar radiation, Semiconductor.

I. INTRODUCTION

The device used in photovoltaic conversion are called solar cells. Solar cell is an Optoelectronic device, which can directly converts incident solar energy into electrical energy. When solar radiation falls on these devices, it is converted directly into dc electricity. The principal advantages associated with solar cells are that they have no moving parts, require little maintenance, and work quite satisfactorily with beam or diffuse radiation.The main factors limiting their use are that they are still rather costly and that there is very little economy associated with the magnitude of power generated in an installation. However, significant developments have taken place in the past in the last few years. New types of cells have been developed, innovative manufacturing processes introduced, conversion efficiencies of existing types increased, cost reduced and the volume of production steadily increased. The Photovoltaic cell is made of semiconductor materials and used to convert sunlight into direct-current electricity. These solar photovoltaic cells when arranged in array are called Solar Photovoltaic (PV) Panels.

II. LITERATURE SURVEY

K.A. Moharram, M.S. Abd-Elhady, H.A. Kandil, H. El-Sherif, 2013 [01] performed an experimental study of the PV system in Egypt, with an objective to reduce the cooling water requirement and thereby cost of the system. In this study, primarily the attention was focused to cool the PV panels. Unlike conventional PVT systems, the PV modules were cooled by spraying water on PV panel by 120 water nozzles using 1 Hp pump. Based on the climatic conditions of Egypt, normal operating cell temperature of PV modules was considered to be 35^0C and maximum allowable temperature of the PV module was fixed to be 45^0C. The cooling system was operated such that, it cools PV modules from 45 to 35 ^{0}C and the cooling cycle repeated after each 15 min. During experimentations, it has been found that the cooling rate of PV modules was 2 ^{0}C/ min.
Mohsen Mahdavi, Adeli,Fatemeh Sobhnamayan, Said Farahat,Mahmood Abolhasan Alavi,Faramarz Sarhaddi, 2012 [02] investigated the performance of the typical P;hotovoltaic /Thermal (PV/T) system with air channel attached to the bottom surface of PV module.The mathematical model for thermal and electrical performance analysis of system is prepared by energy balance. The model shows good agreement with the results obtained by experimentations. The experimental analysis concludes that the electrical efficiency of the system initially increases with increasing radiation intensityelectrical efficiency can be increased from 5.5 % to 7.5%, but then remains constant. 60% of overall efficiency was theoretically predicted and agreed well by experimentations.
Robert A. Taylor Tarun Mittal, Siddharth Saroha, Vishal Bhalla, Vikrant Khullar, Himanshu Tyagi, Robert A. Taylor and Todd P.

Volume 3 Issue XI, November 2015
ISSN: 2321-9653

Otanicar,2013 [03] performed numerical study of solar Photovoltaic/Thermal (PV/T) hybrid collector using nanofluids.In his study, a nanofluid based PV/T hybrid collector is proposed and numerically modelled. Two flow channels were used namely primary and secondary. Nanofluid flowing in the primary channel serves as a coolant for the PV panel and this pre-heated nanofluid then flows in the secondary channel in which it acts as an optical filter to filter the required wavelength region for PV and absorbs rest of spectra. The study was performed on two combinations of nanoparticles with Silicon PV and the best efficiency filters in both the cases were identified. The proposed model was found to have higher thermal efficiency than its contemporaries but compromises a little on the electrical part.

M.J.M. Pathak 2013 [04] perform exergy analysis of different PV panel and PV/T combinations for applications in the limited roof area. Simulation results were presented for three different cities viz. Detroit (low temperatures and low solar flux (9.2 ^{0}C and 3.63 kWh/m2/d), Denver (low temperatures and high solar flux (8.2 ^{0}C and 4.58 kWh/m2/d), and Phoenix (low temperatures and high solar flux (8.2 ^{0}C and 4.58 kWh/m2/d). During this study, side by side four systems (separate PV, Separate Thermal, PV and Thermal and conventional PVT) were studied. Investigations conclude that the PVT system produces almost twice as much as energy produced by PV and T separate systems. The highest overall exergy efficiency of the system recorded was around 35% for climatic conditions of Denver. The investigators also suggest consideration of location and system load demand will lead to more optimum PVT designs for limited rooftop space.

Chao-Yang Huang 2014 [05] suggested a simulation model of PV panel and PVT system using TRNSYS. The performance of 1.44 kW Photovoltaic thermal hybrid systems has been evaluated in different locations in Taiwan. In this study, 1.44 kW of PVT system with 9.78 m2 PV panels of 14.7 % electrical efficiency were used in the typical unglazed type system. The electrical and thermal efficiency of this system was found to be 11.7~12.4% and 26.78~28.41% respectively.

J. Tamayo Vera 2014 [06] suggested a mathematical model for performance investigations of water cooled PV panel PVT system. The collectors design and performance were studied simultaneously using an elitist multi-objective evolutionary algorithm Non-Dominated Sorting Genetic Algorithm-II. In this study, two conventional PVT models with and without glazing (PV modules mounted on absorber plate and water tubes extract heat from the plate) were considered for modelling. A 2-dimensional optimization problem has been formulated for each PVT arrangement. During this study, four decision variables were identified viz. Cooling-water mass-flow rate, the number of segments, the PV layer’s packing factor and the air gap thickness. The investigation concludes that, the PVT can achieve above 80% overall efficiency if designed as suggested.

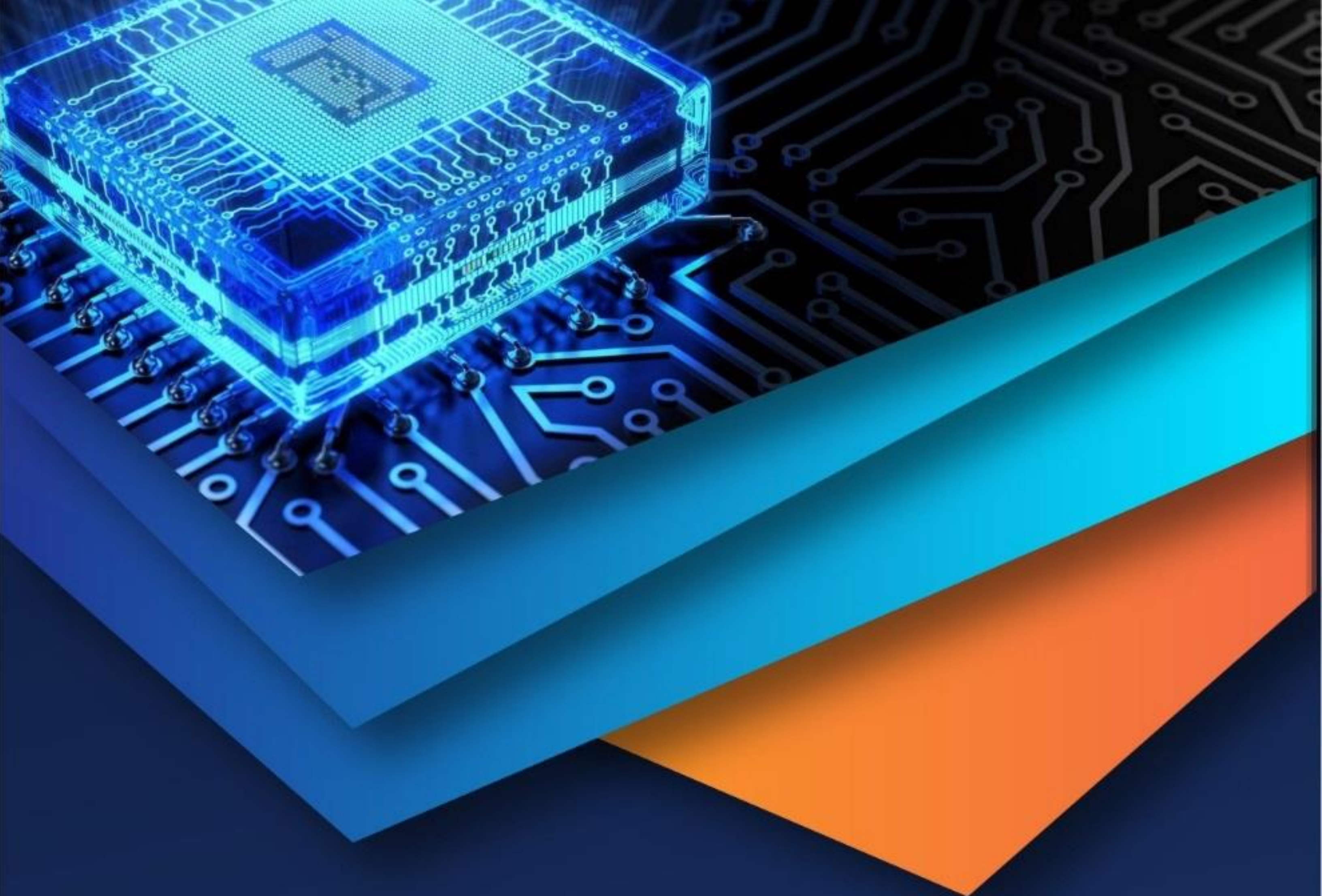
Monia Chaabane, Wael Charfi , Hatem Mhiri , Philippe Bournot 2013 [07] evaluated the experimental performance of concentrated type solar photovoltaic PV system and hybrid PV/T system they observed electrical performance increases with increase in mass flow rate of water.CFD analysis of both PV and PV/T system considerably agreed with experimental results.A thermal efficiency of 16% is obtained and a combined (thermal and electrical) efficiency of 26% is reached.

III. CONCLUSIONS

The literature shows that performance of PV panel i.e., electrical efficiency increases by extracting the heat incident on the PV surface for that purpose coolant such as air and water is widely used. Moreover the electrical efficiency increases with increase in intensity of incident solar radiation thus if concentered system of PV module is tested for different cooling medium more electrical output can be obtained. When mass flow rate of cooling medium increases the time required for maintaining panel temperature decreases.

REFERENCES

[1] K.A. Moharram et al. ‘Enhancing the performance of photovoltaic panels by water cooling’ Ain Shams Engineering Journal (2013) 4, 869–877.
[2] Mohsen Mahdavi Adeli et al, ‘Experimental Performance Evaluation of a Photovoltaic Thermal (PV/T) Air Collector and Its Optimization’ Strojniški vestnik - Journal of Mechanical Engineering 58(2012)5, 309-318.
[3] Robert A. Taylor et al. ‘Numerical study of solar photovoltaic/thermal (PV/T) hybrid collector using nanofluids’ ASME 2013 4th Micro/Nanoscale Heat & Mass Transfer International Conference,MNHMT2013.
[4] M.J.M. Pathak , P.G. Sanders , J.M. Pearce, ‘Optimizing limited solar roof access by exergy analysis of solar thermal, photovoltaic, and hybrid photovoltaic thermal systems’, Applied Energy 120 (2014) 115–124.
[5] Chao-Yang Huanga,Chiou-Jye Huanga, ‘A study of photovoltaic thermal (PV/T) hybrid system with computer modeling’ International Journal of Smart Grid and Clean Energy, vol. 3, no. 1, January 2014, PP 75-79.
[6] J. Tamayo Vera , T. Laukkanen, K. Siren, ‘Performance evaluation and multi-objective optimization of hybrid photovoltaic–thermal collectors’, Solar Energy 102 (2014) 223–233.
[7] Monia Chaabane, Wael Charfi , Hatem Mhiri , Philippe Bournot, ‘Performance evaluation of concentrating solar photovoltaicand photovoltaic/thermal systems’, Solar Energy 98 (2013) 315–321



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY