International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 05 | May - 2022 Impact Factor: 7.185 ISSN: 2582-3930

Investigation of Water Based Photovoltaic Collector

Jitendra Satputel[1], Prathamesh Vartak[2], Sayali Boritkar[3], Sameer Patil[4], Ritesh Taldevkar[5]
[1]Assistant Professor, Department of Mechanical Engineering, Suman Ramesh Tulsiani Technical Campus Faculty of Engineering, Khamshet, Pune, Maharashtra
[2,3,4,5]UG Students, Department of Mechanical Engineering, Suman Ramesh Tulsiani Technical Campus Faculty of Engineering, Khamshet, Pune, Maharashtra

Abstract: ***The inspiration of combining photovoltaic (PV) and solar thermal collector to provide electrical and heat energy is not new, however it isan area that has received only limited attention. With concern growing over energy sources and their usage, photovoltaic thermal (PVT) has become an area which is receiving much more attention. It comprised of the PV efficiency and thermal efficiency. The total of the both efficiencies, which is known as PVT efficiency was used to evaluate the overall performance of the system. Based on the testing performed on the collector, it was shown that both efficiencies increased when the mass flow rate increased. Therefore, the total efficiency (PVT efficiency) and primary-energy saving efficiency increased simultaneously when the mass flow rate increased. The water based PVT collector with Spiral flow absorber produced PVT efficiency of 58% to 64 % with 10% -12% PV efficiency and of42% -50% thermal efficiency, also it produced primary-energy saving efficiency from about 75% to 84% at the mass flow rate from 0.012 kg/s to 0.040 kg/s and solar radiation of 700W/m². On the other hand, the PVT exergy is between 100 to 170 W with thermal exergy of 50 to 120 W and electrical exergy of 60 to 63 W. Again, the entropy generation is between 92 and 129 W showing that it decreased with increased mass flow rate. Exergy, Analysis, Spiral Flow Absorber, Photovoltaic Thermal (PVT) Collector.***

Keywords: ***Exergy, Analysis, Spiral Flow Absorber, Photovoltaic Thermal (PVT) Collector.***

I. INTRODUCTION

Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics, solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis.
It is an essential source of renewable energy, and its technologies are broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power.
Active solar techniques include the use of photovoltaic systems, concentrated solar power, and solar water heating to harness the energy.
Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light-dispersing properties, and designing spaces that naturally circulate air.

II. PROBLEM STATEMENT

- A photovoltaic power system designed to supply usable solar power by means of photovoltaic
- In PV system major amount of solar power will be wasted by heat losses which leads to decrease in efficiency.
- Attempt is planned to improve the PV efficiency by circulating fluid to maintain optimum performance.

Solar panels absorb the sunlight as a source of energy to generate electricity or heat. A photovoltaic (PV) module is a packaged; connect assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 Watts (W) Solar thermal power plants based on Parabolic Trough Collector (PTC) are the most popular solar technologies for power generation. Along with steam generation it is employed in ion, industrial steam generation, and hot water production The efficiency and cost of the parabolic trough collector designs is depend on structural stiffness, choice of materials, assembly tolerances, mirror cleanliness and wear. With compare to conventional flat plate collectors, PTC has shown its more cost effectiveness.

III. OBJEVTIVES

- To design Thermal absorber to extract heat from rear surface of PV.
- To investigate cooling ability and electrical Thermal performance at range of mass flow rate.
- To determine outdoor performance of designed PVT system of various inclination angle.
- To develop renewable energy recovery and storage system.

Future Scope

India has wide scope of generating solar energy. The geographical location of the country gives its benefit for generating solar energy. India receives solar radiation almost throughout the year, which amounts to 3,000 hours of sunshine. Solar energy is environment friendly. When we use, it does not release CO and other gases which pollute the air. Hy designing various types of absorber and using Nano fluids we can The designed photovoltaic system if made generalized it can help to reduce the PVT system temperature so it can absorb more incident radiation and can give significant increase the efficiency of the photovoltaic panels.

Methodology

Solar Absorption: Solar energy is one of the best sources of renewable energy with minimal environmental impact. The conventional direct absorption solar collector is a well-established technology, and it has been proposed for a variety of applications such as water heating; however, the efficiency of these collectors is limited by the absorption properties of the working fluid, which is very poor for typical fluids used in solar collectors. Recently, this technology has been combined with the emerging technologies of Nano fluids and liquid-nanoparticle suspensions to create a new class of Nano fluid-based solar collectors. Botanical et al. reported the experimental results on solar collectors based on Nano fluids made from a variety of nanoparticles (CNTs, graphite, and silver). The efficiency improvement was up to 5% in solar thermal collectors by utilizing Nano fluids as the absorption media. In addition, they compare the experimental data with a numerical model of a solar collector with direct absorption Nano fluids. The experimental and numerical results demonstrated an initial rapid increase in efficiency with volume fraction, followed by a levelling off in efficiency as volume fraction continues to increase. Theoretical investigation on the feasibility of using a no concentrating direct absorption solar collector showed that the presence of nanoparticles increased the absorption of incident radiation by more than nine times over that of pure water Under the similar operating conditions, the efficiency of an absorption solar collector using Nano fluid as the working fluid was found to be up to 10% higher (on an absolute basis) than that of a flat-plate collector. Otanicar and Golden evaluated the overall economic and environmental impacts of the technology in contrast with conventional solar collectors using the life-cycle assessment methodology Results showed that for the current cost of nanoparticles the Nano fluid-based solar collector had a slightly longer payback period but at the end of its useful life has the same economic saving as a conventional solar collector. Sani et al. investigated the optical and thermal properties of Nano fluids consisting of aqueous suspensions of single-wall carbon Nano horns the observed nanoparticle-induced differences in optical properties appeared promising, leading to a considerably higher sunlight absorption. Both these effects, together with the possible chemical functionalization of carbon Nano horns, make this new kind of Nano fluids very interesting for increasing the overall efficiency of the sunlight exploiting device.

IV. COMPONENTS

1. PV Panel

A bevel gear is a type of mechanical gear. These gears where the axes of the two shafts intersect and the tooth beating faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. The pitch surface of bevel gears is d cone.

Fig. 01: PV Panel

2. Thermocouple

A belt and pulley system is characterized by two or more pulleys in common to a belt. This allows for mechanical power, torque, and speed to be transmitted across axles. If the pulleys are of differing diameters, a mechanical advantage is realized.

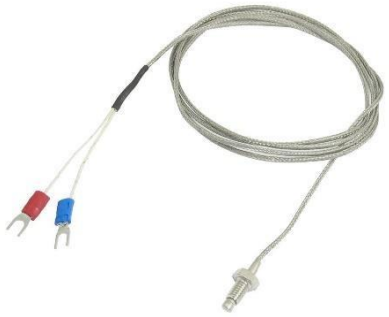

Fig. 02: Thermocouple

3. Multimeter

The scotch yoke (also known as slotted link mechanism) is a reciprocating motion mechanism, converting the linear motion of a slider into rotational motion, or vice-versa. The reciprocating part is directly coupled to a sliding yoke with slot that engages a pin on the reciprocating part.

Fig. 03: Multimeter

4. PV/T Collector

The drill bit is usually a rotary cutting tool, often multi-point. The bit is pressed against the work-piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work-piece, cutting off chips from the hole as it is drilled**.**

Fig. 04: PV/T Collector

V. APPLICATIONS

1) Solar water heating systems provides homes in sunny climates with hot water.
2) As opposed to traditional systems that use natural gas, solar water heating harness the power of the sun to heat water.
3) They function by collecting solar thermal energy to raise the temperature oh heat transfer fluid.
4) It is based suited for Residential application.
5) Solar air collectors are mainly used in food industries.

VI. WORKING

It works on the principle of using long parabola shaped mirrors, which reflects the concentrated sun radiations towards a receiver. This receiver then absorbs the incoming radiations to convert water to steam, which is used to generate electricity.

Solar panels absorb the sunlight as a source of energy to generate electricity or heat. A photovoltaic (PV) module is a packaged; connect assembly of typically 6x10. Photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 Watts (W).

VII. LITERATURE SURVEY

Weibiao Huang , Mohammad Marefati [1] In this paper, a more detailed and accurate study of their performance requires more and more up-to-dateresearch. In the present work, energy, exergy, enviroeconomic and exergoeconomic analyses of various solar thermal collectors are investigated. These solar thermal collectors include FPC, LFR,PTC and PDC. To investigate the performance of these solar collectors two different working fluids, i.e. water and Oil.

Abazar Abadehb , Oussama Rejebc, Mohammad Sardarabadi*,Christophe Menezoc, Mohammad Passandideh-Fardb, Abdelmajid Jemnid [2] In this study, an economic and environmental analysis of using different nanofluids as coolants of a PVT system, is investigated experimentally. The results are compared to thoseof a conventional PV unit. Selected nanofluids are TiO2/water, Al2O3/water and ZnO/water.

Jiangjiang Wang, Yuzhu Chen, Noam Lior, Weihua Li a [3] This paper proposed a novel hybrid CCHP system integrated with CPC-PVT solar collectors, presented the thermodynamic analysis on the design and off-design operating conditions, and obtained the energy and environmental benefits achieved by the hybrid system.

Mesut Abuşkaa, Seyfi Şevik [4] This study was conducted to evaluate energy-exergy and economicenvironment performance of different type SACs in Manisa Province,Turkey. An experimental results showed that the vgrooved surface has the better efficiency than flat SAC.

Arash Kazemiana, Amin Taherib, Amirhasan Sardarabadib, Tao Maa, Mohammad Passandideh-Fardb, Jinqing Pengc [5] In this Paper they explain the effect of mixtures of EG and purewater were investigated on the performance of the glazed and unglazed PVT/PCM from energy, energy, and environmental viewpoints.

Imtiaz Ali Lagharia M. Samykanoa, A. K. Pandeyb, K. Kadirgamac, V. V. Tyagid [6] Through this paper they focus on the performance of Air, Water and Bi-fluid based PVT systems with and without PCM. 3E Analysis of Air, water and bi-fluid based PVT systems was presented Energy and energy equations of PV, PVT and PVT-PCM integration systems.

Mohamed S. Yousefa,b,⁎, Hamdy Hassana,c, H. Sekiguchid [7] In this paper, an experimental assessment of single slope solar still by using hollow pin fins and steel wool fibers as absorbing materials is energetically, energetically, economically and environmentally assessed.

Michael J. Adedejia, Tonderai L. Ruwab, Muhammad Abidc*, Tahir A. H. Ratlamwalad, Mustafa Dagbasie [8] In this paper they did Three integrated multigeneration systems were simulated using the EES software. All the systems are however efficient multigeneration systems with impressive amounts of CO2 mitigation.

A.K Rakhesh, A. Srivishnu, P.S Saravanun, M.Vignesh, M. Sridharan[9] From this paper we know importance of parallel and series connected pv/t water collector also the use of AI in this system.

H. Fayaza, R. Nasrina,b, N.A. Rahima, M. Hasanuzzaman [10] In this paper the experiment carried in indoor condition using FEM based software COMSOL MultiphysicsIt has performed the numerical simulation. Performance evaluation and comparison of a PVT system operated by water and MWCNT-water nano-fluid have been presented both numerically and experimentally in this research. **Sadık Zuhura,⁎, İlhan Ceylanb, Alper Ergün [11]** From this paper ,we get results for envir-o-economic analysis show that the saving achieved by the system due to CO2 reduction was approximately 0.1perhour.

VIII. CONCLUSION

Various authors have carried out studies on the improvement of heat transfer of the Nano fluid. A variety of the Nano fluids are prepared by one or two step method. The mostly used base fluids are water and ethylene glycol. It was seen that, with application of Nano fluid in PVT, increases electrical efficiency and overall performance. It was also understood that, Nano fluid helped maintain desired temperature of PV panel. A photovoltaic thermal collector was fabricated and its performance was calculated using 0,01% and 0.03% volume fraction by weight CuO/water nanofluid It has been proved that with the help of the nanofluid there is significant increase in the thermal efficiency up to 40 78% and Electrical Efficiency of 11.81%.If heat exchanger is redesigned for the new nanofluid the thermal efficiency can be improved.

REFERENCES

[1] Weibiao Huang , Mohammad Marefati “Energy, exergy, environmental and economic comparison of various solar thermal systems using water and Thermia Oil B base fluids, and CuO and Al2O3 nanofluids.
[2] Abazar Abadehb , Oussama Rejebc, Mohammad Sardarabadi*,Christophe Menezoc, Mohammad Passandideh-Fardb, Abdelmajid Jemnid “Economic and environmental analysis of using metal-oxides/water nanofluid in photovoltaic thermal systems (PVTs)”
[3] Jiangjiang Wang, Yuzhu Chen, Noam Lior, Weihua Li a “Energy, exergy and environmental analysis of a hybrid combined cooling heating and power system integrated with compound parabolic concentrated-photovoltaic thermal solar collectors”
[4] Mesut Abuşkaa, Seyfi Şevik “Energy, exergy, economic and environmental (4E) analyses of flat-plate and V-groove solar air collectors based on aluminium and copper”
[5] Arash Kazemiana, Amin Taherib, Amirhasan Sardarabadib, Tao Maa,∗, Mohammad Passandideh-Fardb, Jinqing Pengc “Energy, energy and environmental analysis of glazed and unglazed PVT system integrated with phase change material: An experimental approach”
[6] Imtiaz Ali Lagharia M. Samykanoa, A. K. Pandeyb, K. Kadirgamac, V. V. Tyagid “Advancements in PV-Thermal Systems with and without Phase ChangeMaterials as Sustainable Energy Solution: Energy, Energy and Energy economic (3E) Analysis approach”
[7] Mohamed S. Yousefa,b,∗, Hamdy Hassana,c, H. Sekiguchid “Energy, energy, economic and enviro-economic (4E) analyses of solar distillation system using different absorbing materials”
[8] Michael J. Adedejia, Tonderai L. Ruwab, Muhammad Abidc*, Tahir A. H. Ratlamwalad, Mustafa Dagbasie “Energy, Economic and Environmental analysis of Photovoltaic Thermal Systems for Absorption Cooling Application”
[9] A.K Rakhesh, A. Srivishnu, P.S Saravanun, M.Vignesh, M. Sridharan " A Short Review on Solar Photovoltaic / Thermal Water Collectors”
[10] H. Fayaza, R. Nasrina,b, N.A. Rahima, M. Hasanuzzaman "Energy and energy analysis of the PVT system: Effect of nano-fluid flow rate”
[11] Sadık Zuhura,∗, İlhan Ceylanb, Alper Ergün " Sadık Zuhura,∗, İlhan Ceylanb, Alper Ergün”