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Research Paper | Engineering

Experimental Setup to Increase the Efficiency of Solar Panel by Using the water Circulation

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ABSTRACT *Solar energy has the greatest potential of all the sources of renewable energy. It potential is 178 million MW per year. This is about 20,000 times worlds demand. In the case of the developing countries the energy sector assumes a critical importance in view of the increasing energy needs requiring huge investments of meet them. In this paper, experimental setup is being carried out to improve thermal efficiency and reduce the rate of thermal degradation of a solar panel module is by reducing the operating temperature of its surface is discussed. This can be achieved by cooling the module and reducing the heat stored inside the panel.*

KEYWORDS : Efficiency, Temperature, Water flow, solar panel, inlet & outlet temperature

INTRODUCTION

Environmental problems due to extensive use of fossil fuels for electricity production and combustion engines have become increasingly serious on a world scale in recent years. To solve these problems, renewable energy sources have been considered as new sources of clean energy. Solar energy is one of the most important sources among the renewable energies. Generally, solar energy conversion systems can be classified into two categories: thermal systems which convert solar energy into heat and photovoltaic systems which convert solar energy to electricity.

Intensive efforts are being made to reduce the cost of photovoltaic cell production and improve efficiency and narrow the gap between photovoltaic and conventional power generation methods such as steam and gas turbine power generators. In order to decrease the cost of PV array production, improve the efficiency of the system and collecting more energy for unit surface area different efforts have been made.

The performance of the PV system is affected by several parameters including temperature. The part of absorbed solar radiation that is not converted into the electricity converts into thermal energy and causes a decrease in electrical efficiency. This undesirable effect which leads to an increase in the PV cell's working temperature and consequently causing a drop of conversion efficiency can be partially avoided by a proper method of heat extraction.

Today's technology allows for the harnessing of solar energy through cells known as solar cells. These are also called photovoltaic cells. Photovoltaic cells are placed in direct sunlight and as the sun hits these cells, a chemical reaction takes place to produce electric currents. These currents are then converted into electricity that can be used to power everyday items or even households

SOLAR PHOTOVOLTIC MODULE (SPV)

The power generated by a single cell is small and therefore several cells are interconnected. In series/parallel combination to get the required voltage and current. When a number of solar cells are connected in series to get a specific voltage the unit so formed is called as Solar Module. Charging batteries is the primary use of SPV module. Therefore normally 36 cells are joined in series to form a standard module, Which is capable of charging 12 volts battery. A terminal box is provided on the backside of the module for external connections.

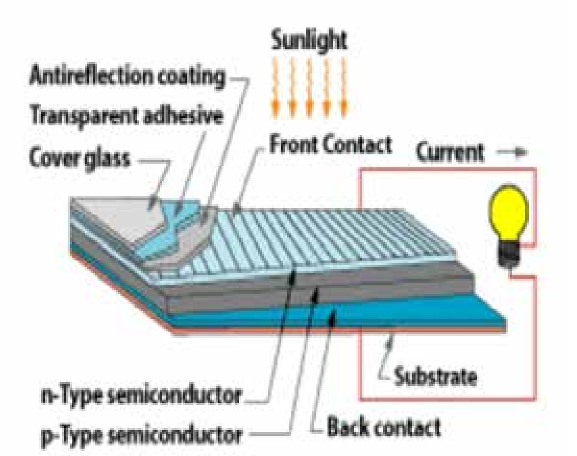

Figure 1: Construction of solar panel

A Bypass diode is connected across +ve and –ve in the terminal box. Cathode of the diode will be at +ve terminal and Anode will be at –ve terminal of the module. This diode protects the module cells from overheating due to shadowing of the module or any cell breakage Generally the rating of bypass diode is 1.52 times of the maximum current of module. Voltage Vrrm of the diode should be double the string open voltage. For Indian Railways Solar Photovoltaic Module is manufactured as per RDSO Specification No. IRS:S 84/92 with latest amendment. A typical solar module is shown in Fig 2

Figure 2: Different types of solar modules (4 cell, single module, multi module

PROBLEM FORMULATION:

We have study the research paper of solar panel. It suggest when the surface temperature of the solar cells is increased, the power generation efficiency is degraded. There are two major causes for the decreasing of power generation efficiency by the surface temperature rise of the solar cell. First, current reduction in the solar cell when the temperature rise which is nature of semiconductor itself. Second, power decrease due to discrepancies of resistance between the internal resistances of the solar cell which is changed by the rise of surface temperature and the external load resistance of the circuit which is connected to the solar cell.

The photovoltaic (PV) cells are able to produce energy from the abundant resource of sunlight. Since the Modules are exposed to sunlight they generate heat as well as electricity. Typically a PV module converts only10-15% of the incident power to electricity, while the remaining power is largely rejected as heat.

The warm atmosphere affects the current density/voltage J/V characteristics of the PV modules where their electrical efficiencies are adversely affected by the significant increase of cell operating temperature during absorption of solar radiation (Toe et al., 2012). Applying a cooling system to a PV module reduces the cost of solar energy in three ways. First, cooling improves the electrical production of PV modules. Second, cooling makes possible the use of concentrating PV systems by keeping the PV cells from reaching temperatures at which irreversible damage occurs, even under the irradiance of multiple suns. This makes it possible to replace PV cells with potentially less expensive concentrators.

Finally, the heat removed by the PV cooling system can be used for building heating or cooling, or in industrial applications. To this end, hybrid photovoltaic/thermal (PV/T) solar systems have been investigated as a means of decreasing the temperature of PV modules and boost their electrical efficiency. Work by Nualboonrueng et al. (2012) investigates the effects of amorphous and multi-crystalline silicon materials in the performance of PVTs, work by Beccali et al.(2009) highlights the increased energy savings due to the use of PVTs, while work by Hasan et al. (2012)addresses the development of hybrid PVT-Biogas systems for power generation.

METHODOLOGY

- **Measuring PV Efficiency :**

Efficiency of the tested solar cell was calculated by applying the following relation:

$\eta = (V_m * I_m / I*S) *100\%$

Where:
V_m – maximum voltage [V]
I_m – maximum current [A]
I – intensity of radiation [W/m2]
S – area of the cell [m2]

Fill factor of current – voltage characteristic of solar cells can be calculated by using the following relation:

$FF = V_m * I_m / V_{oc} * I_{sc}$

Where:
V_{oc} – open circuit voltage [V]

I_{sc} – short circuit current [A]

- **Measuring Maximum PV Efficiency :**

Efficiency in photovoltaic solar panels is measured by the ability of a panel to convert sunlight into usable energy for human consumption. Knowing the efficiency of a panel is important in order to choose the correct panels for your photovoltaic system. For smaller roofs, more efficient panels are necessary, due to space constraints. How do manufacturers determine the maximum efficiency of a solar photovoltaic panel though? Read below to find out.

Let us first start out by saying that the maximum power, also known as Pmax, of a 200W panel is 200W regardless of the panel efficiency. It is the area the solar panels use up to get those 200W that determines how efficient the panel is. The panel efficiency determines the power output of a panel per unit of area. The maximum efficiency of a solar photovoltaic cell is given by the following equation:

$$\eta_{max} = \frac{P\ max}{Esw * A}$$

Where,
P_{max} = Maximum power output
E_{sw} = incident radiation flux
A = area of collector

The incident radiation flux could better be described as the amount of sunlight that hits the earth's surface in W/m2. The assumed incident radiation flux under standard test conditions (STC) that manufacturers use is 1000 W/m2. Keep in mind though, that STC includes several assumptions and depends on your geographic location.

EXPERIMENTAL SETUP

An experimental setup been developed to study the effect of cooling by water on the performance of photo vatic (pv)panel. The electrical characteristics of the pv modules are show in the table. A cooling system has been built up as shown in fig 3., and further details can be found in. the cooling system consists of sis main parts as follows.

1. Solar panel
2. Water tank
3. Heat exchanger
4. Centrifugal pump
5. Pipe for collecting water and return it back to the tank.

Figure 3: Solar panel experimental setup

The water pump sucks the water from the middle of the water tank via a suction pipe to avoid sucking any dust. The suction pipe consists of a non-return valve and a strainer to avoid sucking of large particles sucked water passes through the water filter, and then, it is sprayed over the pv module for cooling.

Water is passing using water nozzles, which are installed at the back side of the panel, as shown in the fig. Water is used cooling controlled at the lower part of pv module via drain pipe, and then it returns back to the water tank such that the water cycle is closed.

EXPERIMENTAL PROCEDURE

Cooling the solar panels has been performed to determine the influence of cooling and overheating on the performance of the solar cell. cooling of the solar cell was performed for 22 March to 28 march 2015 for the different angle of the solar panel and the measure the panel current, voltage, intensity radiation, temperature experiment started from 10:00am to 4:00 pm at during half hour. The performed experiments are done in January and February. The efficiency η of the pv panel is calculated by

$\eta = (V_m * I_m / I*S) *100\%$

Where:
V_m – maximum voltage [V]
I_m – maximum current [A]
I – intensity of radiation [W/m2]
S – area of the cell [m2]

Solar radiation is measure using a lux meter located at the to upper side of the panels. The temperature distribution of the panel is measured using thermometer located at the back of the panels

EXPERIMENTAL RESULTS

Experimental measurements of the efficiency and the modules temperature of the pv panel, during January and february2015 in measure the voltage, current, temperature and intensity of radiation is measure at different angle 30,32,34,36,38 and 40 on the without heat exchanger. And then in february2015 solar panel with heat exchanger at longitudinal angle at 34 measure the current, voltage, temperature and intensity of radiation during the 10:00 am to 4:00 pm . It is conclude that the proposed cooling system could solve the problem of overheating the pv panels due to excessive solar radiation and maintain the efficiency of the solar panels at an acceptable level by the least possible amount of water.

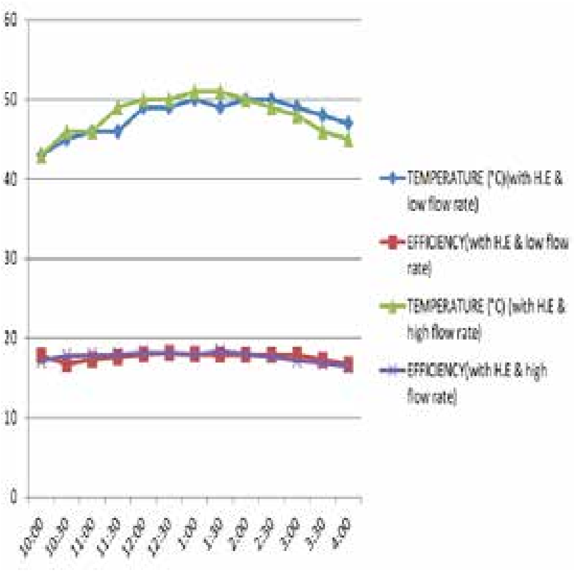

Figure 4: Solar panel Temperature and efficiency comparison with and without water circulation

CONCLUSION

We take reading with different angle of temperature, current voltage, intensity of radiation and the calculate efficiency with heat exchanger and without heat exchanger also.

Overall efficiency of system without heat exchanger 16.91%
Overall efficiency of the system with heat exchanger 17.63%
Increase the efficiency of solar panel 00.72%

Use of heat exchanger with solar panel system temperature reduce, increase efficiency and reduce the thermal pollution are achieve. By changing flow rate and input temperature of heat exchange it may be possible to achieve higher efficiency.

REFERENCES

[1] Ainsworth, W., "A system for converting English text into speech," Audio and | Electroacoustics, IEEE Transactions on , vol.21, no.3, pp. 288-290, | [2] Fushikida, Katsunobu; Mitome, Yukio; Inoue, Yuji, "A Text to Speech Synthesizerfor the Personal Computer," Consumer Electronics, IEEE Transactions on ,vol.CE- | 28, no.3, pp.250-256, | [3] Hertz, S., "English text to speech conversion with delta," Acoustics, Speech, andSignal Processing, IEEE International Conference on ICASSP '86. , vol.11, no., pp. | 2427-2430. | [4] Lynch, M.R.; Rayner, P.J., "Optical character recognition using a new connectionistmodel," Image Processing and its Applications, 1989., Third International | Conference on , vol., no., pp.63-67. | [5] Malyan, R.R.; Sunthankar, S.; Teranchi, H.; Yeghiazarian, A., "Perception of multiauthorhandprinted text," Character Recognition and Applications, IEE Colloquiumon , vol., no., pp.8/1-8/3. | [6] Curtis, K.M.; Race, P.; Aziz, A.A., "Parallelism and the transputer in the automatictranslation of text to speech," Acoustics, Speech, and Signal Processing.ICASSP-89., 1989 International Conference on , vol., no., pp.809-811 vol.2, 23-26 . | [7] Mori, S.; Suen, C.Y.; Yamamoto, K., "Historical review of OCR research anddevelopment," Proceedings of the IEEE , vol.80, no.7, pp.1029-1058. | [8] Jianli Liu; Nugent, J.H.; Bowen, D.G.; Bowen, J.E., "Intelligent OCR editor,"Electrical and Computer Engineering.