"Efficiency Variation of Solar Panel using PV Technology"

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Abstract – *Photovoltaic solar cell generates electricity by receiving solar irradiance. The temperature of photovoltaic modules increases when it absorbs solar radiation, causing a decrease in efficiency. This undesirable effect can be partially avoided by applying a heat recovery unit with fluid circulation with the photovoltaic module. Such unit is called photovoltaic/thermal collector (PV/T) or hybrid (PV/T). The objective of the present work is to design a system for cooling .The solar cell in order to increase its electrical efficiency and also to extract the heat energy.*

Here we designed a setup in which array of water tube is fitted to back of solar panel to reduce its temperature and bring temperature to normal operating point. Before this we checked the solar panel under normal operating condition. After getting result for various model we compared our back water cooling tube array results with the ordinary solar panel.

1. INTRODUCTION

We got motivated from the literature stuff we studied. Earlier we did not know the concept of efficiency variation with temperature change of solar panel but after getting guidance of our project guide and other professor and after going through research paper we got a idea that we can apply our engineering knowledge to the problem. Keeping in mind the energy crisis the world is facing and the sustainable energy need and its generation, we realize that we are not completely utilizing/converting the energy.To keep the panel temperature in control such that the panel efficiency we will get will be maximum. To generate the maximum output (voltage production) at any varying temperature. Utilization of the heated water from copper pipe for sterilization of medical instruments and washing purpose.

2. Problem statement

The heat accumulation increases in solar panels thus decreasing its efficiency of producing voltage and affecting total voltage production, thus we need to develop cooling mechanism for solar panel to keep its efficiency maximum.

3. LITERATURE SURVEY

Different research and studies were carried out in increasing the efficiency of solar panel by using different techniques. Krauter identified and suggested a technique of reducing reflection to cool the PV by replacing the front glass layer with a thin layer of 1 mm running directly over the PV panel face. As a result, the temperature of PV panel reduced to 22° C. The main drawback of this technique is the non-homogeneous thickness of the water flowing over the surface of the panel which is necessary to improve the performance level of the technique.

Hosseini studied and indentified a technique that the temperature of the solar panel can be reduced by spraying the water over the surface of the panel continuously. The main drawback of this technique is the researcher does not take into account the pump power that they were able to achieve an increase in the electrical system performance by 17% from 8 am to 5 pm in summer.

After readjusting the water pump and providing the continuous flow over the surface of the panel they improved their output.

Dorobantu and Popescu obtain the electricity of about 9.5% by cooling the surface of the solar panel by using thin film layer of water on the surface of water and hence obtain better efficiency due to decreasing the losses due to reflection.

Moharram also implemented the same water sprey technique to improve the efficiency of the system. They calculated the maximum allowable temperature to be 45°.They also observed that for operating this technique for 5 min and decrease the temperature by 10°

4. SYSTEM DESIGN

4.1HARDWARE REQUIREMENTS

4.1.1Mechanical

Sr.No	Components	Dimension
1.	Solar Panel	30*35*2 cm
2.	Copper tube	Dia(6mm) ,

		Thick(1mm)
3.	Container	30*30*5 cm
4.	Sump	30*15*15 cm

Table. No 4.1.1

4.1.2 Electrical

Sr.No	Components	Dimension
1.	Multi meter	Digital
2.	Temperature sensor	Thermocouple

Table. No 4.1.2

4.2 SOFTWARE REQUIREMENT

Sr.No	Software	Specification
1.	Excel	Microsoft Excel 2007
2.	CATIA	V5

Table. No 4.2.1

5. MECHANICAL DESIGN

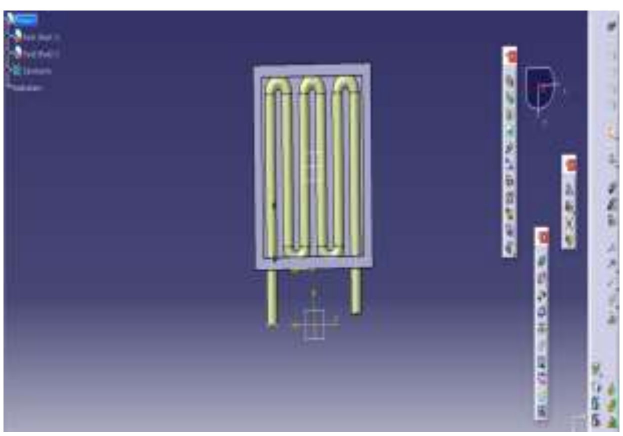


Fig. No 5.1Back view of solar panel

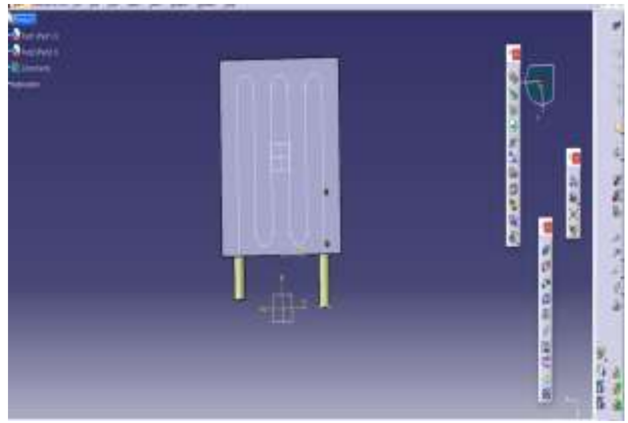
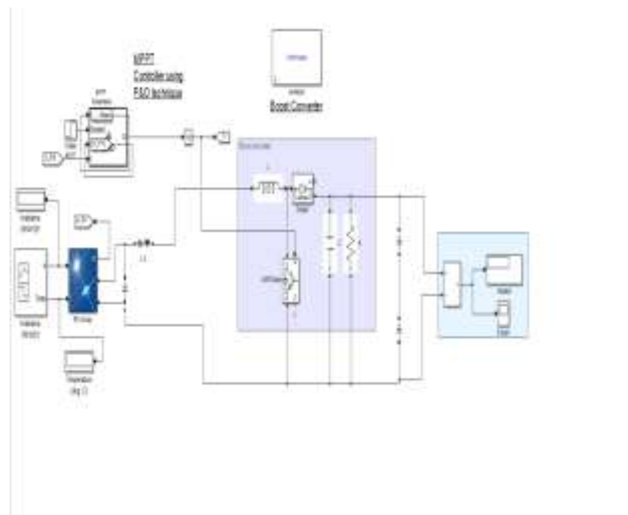


Fig. No 5.2 Front view of solar panel

6. CIRCUIT DIAGRAM



7. Calculations

Solar panel specification:

1. Rated power(Pmax) =10 ± 3%
2. Open circuit voltage (Voc) = 21.5V
3. Short circuit current (Isc) = 0.67 A
4. Voltage at maximum power (Vmp) = 17.7A
5. Current at Maximum Power (Imps) = 0.57 A
6. Maximum system voltage = 600A

7.1 Formulas

AA=A($dish$)×cos{43.33−δ/2}

δ=23.45{360/365×(284+n)}

Where;

AA=Aperture Area

A (dish)=Area of dish

n: Number of days of year η=P(out)$heatinput$

Heat input= AA×$solarirradiance$

For 1st day; δ=23.45{360/365× (284+105)}

δ=9.4145

Area of dish=30x35cm=0.1050 m2

AA=0.1050×cos {43.33−9.41492}

AA=0.100461 m2

η=P(out)/$heat\ input$

η=10 $WattAA$ ×$Solar\ irradiance$

ηmax =10309.6108×0.100461

ηmax =10/31.10381

ηmax=0.32154

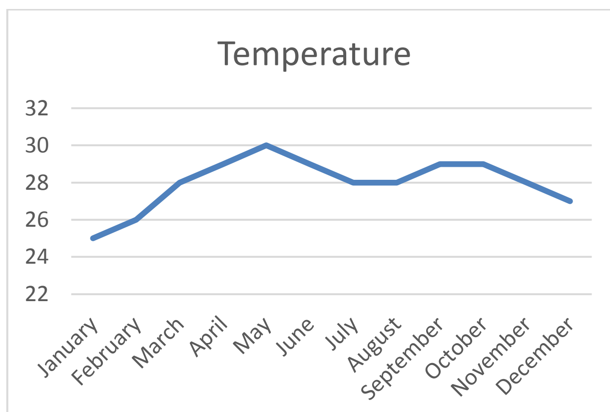
8. IMPLEMENTATION DETAILS

Firstly the solar panel is tested without the cooling system (PV Technology) and then the voltage variation of solar panel with temperature variation is being measured by using Multi meter. A working experimental setup is developed to determine how long it takes to cool down the module based on proposed cooling system. The water circulation tank use natural convection to circulate water. An experimental validation of hat rate model and cooling rate model has been done. Based on heating and cooling rate model it is found that the PV panel yields the highest output energy if cooling of the module starts. The work done in this project proposes modeling of photovoltaic model in which temperature and sun's irradiance, of the PV array is taken into account. To check the correctness of the solar PV model predicted values of solar radiation data are compared with calculated weekly values. The radiation effect of solar radiation on the tilted surfaces and vertical surfaces for different orientations from horizontal, have also been calculated. The calculated values and results are found to be very close agreement with measured values. The method presented in this project can be used to do approximation hourly, global, diffuse solar radiation on inclined and vertical surfaces and horizontal surfaces and at different angles with greater accuracy for any location.

This tells us the power generation capacity rated of power plant with the actual power generation capacity of the plant.

9. RESULTS

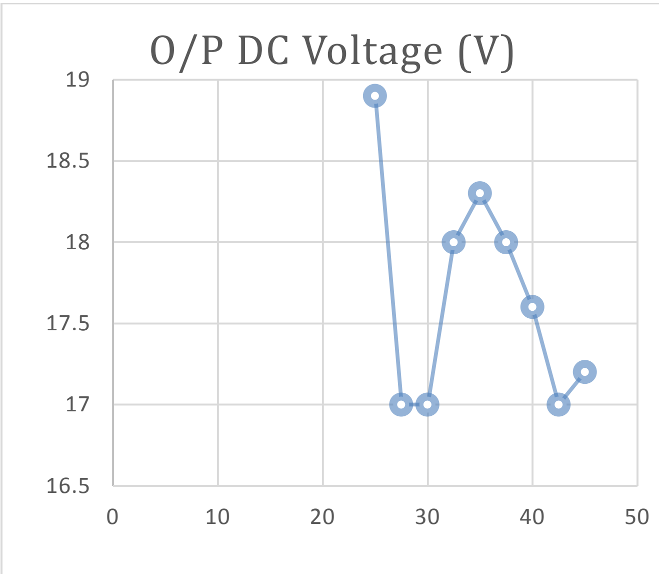
Month	Temperature
January	25
February	26
March	28
April	29
May	30
June	29
July	28
August	28
September	29
October	29
November	28
December	27



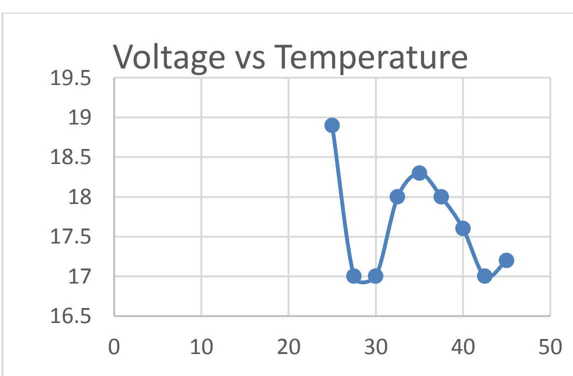
This graph is plotted between two parameters temperature v/s the month.

Irradiance (W/m^2)1	Temperature (° C)	O/P DC Voltage (V)
1000	25	18.9
1000	27.5	17
1000	30	17
1000	32.5	18
1000	35	18.3
1000	37.5	18

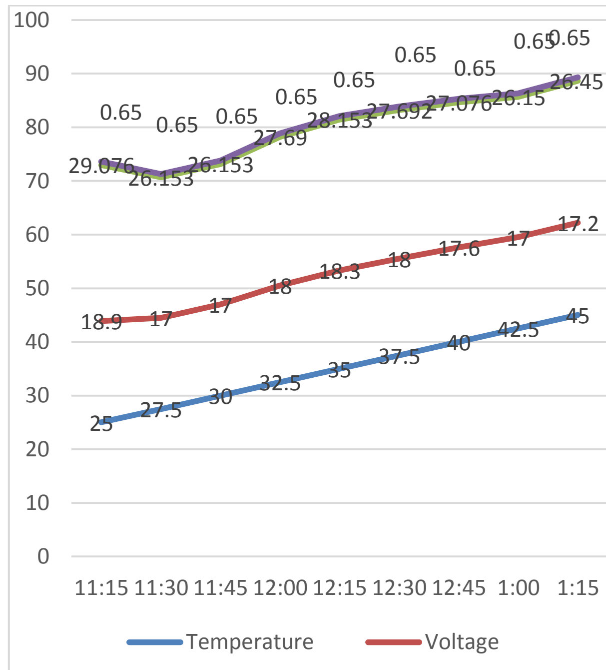
1000	40	17.6
1000	42.5	17
1000	45	17.2



Power	Voltage	Temperature
10	18.9	25
10	17	27.5
10	17	30
10	18	32.5
10	18.3	35
10	18	37.5
10	17.6	40
10	17	42.5
10	17.2	45



Time	Temperature	Voltage	Power	Current
11:15	25	18.9	29.076	0.65
11:30	27.5	17	26.153	0.65
11:45	30	17	26.153	0.65
12:00	32.5	18	27.69	0.65
12:15	35	18.3	28.153	0.65
12:30	37.5	18	27.692	0.65
12:45	40	17.6	27.076	0.65
1:00	42.5	17	26.15	0.65
1:15	45	17.2	26.45	0.65



10. CONCLUSION AND FUTURE SCOPE

This project can be use by Solar power operated Companies to improve their power efficiency. By hospitals to utilize the heated water through cooling pipe for sterilization purpose. Environmental authorities to decrease the low efficient renewable source utilization. By every customer who make use of solar panel for power production.

11. REFERENCES

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