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# Effect of Temperature on PV Module and Experimental Study of Cooling by Air Blower.

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***Abstract*****—***Solar energy is being used for decades for both heat and light. The two types of solar power systems are Solar thermal system and Solar photovoltaic system. First system will trap heat to warm the water, while the second system will convert sunlight into electricity. In Solar Photovoltaic system, the PV modules are exposed to sunlight, they generate DC electricity (Direct current). With the help of an inverter, DC is converted into AC electricity (Alternating current) and fed to the building AC distribution board (ACDB ) without affecting the power quality. Solar PV systems generate electric power by absorbing the electromagnetic energy. They have an efficiency of about 10-15%, and the remaining energy is used to heat up the module. These heat losses increase with higher incoming irradiance. The issue of the phenomenon is that the module temperature directly influences the module's performances. As a result the electric output power and the efficiency goes down as the module temperature rises. This can also cause the structural damage of PV modules by shorting its life span and lowering the conversion efficiency.*

*The performance of a PV module is predicted by module temperature as a function of ambient temperature, wind speed, wind direction and solar irradiance. This paper focuses on investigating and controlling the effect of ambient temperature on the surface temperature of a PV module, thereby influencing the amount of output power produced. An experimental approach is carried by providing ventilation on the surface of the PV panel with the help of a blower carried at different velocities of air when the temperature of the panel is increased. Thereby, optimizing the available output power from a PV module by investigating and controlling the effect of ambient temperature on its surface temperature.*

***Keywords:—****Efficiency of photovoltaic module; Ambient temperature; Irradiation; solar PV module temperature; Wind speed; Power output.*

## 1. INTRODUCTION

The increasing energy demands put a lot of pressure on the conventional energy sources. So, there is a need to opt for energy sources which can provide us energy in a sustainable manner. The obvious choice of a clean energy source, which is abundant and eco-friendly is the solar energy. In recent years, the efficiency of solar modules has been improved drastically by the use of new technologies. This has encouraged photovoltaic system to become an essential system in the production of electrical power worldwide. PV system is static, noiseless and free of moving parts which reduces operation and maintenance cost of the system. Being clean and pollution free source of energy PV system has gained much importance. The energy payback time of PV cell lies between 10 to 15 years depending on the efficiency of pv module. If efficiency can be increased then energy payback time can be reduced. will be very significant

There are lots of issues affecting the efficiency of PV cell but major issue is the increase of temperature of PV module ultimately decreases the efficiency of PV cell. So the area of my research work is based on how to increase efficiency of PV cell considering the different parameters like temperature, velocity and controlling the same by setting experimental set up and validate it with mathematical modelling.

## 2. LITERATURE REVIEW

After reviewing number of papers it had been concluded that temperature has detrimental effect on pv cell efficiency. In this, effort and experiment has been done to reduce the temperature of module by doing forced convection using water and air circulation on pv cell array. In this regard A K. Kaiser(1) has proposed the empirical correlation between Ross coefficient, module temperature, electrical efficiency and power output. But still all parameters are not accounted in terms of increasing efficiency, cost material selection and other environmental conditions like wind velocity, dirt and humidity. Till today pv cell efficiency has increased upto 18% only so small increment in output will have significant impact on pv cell efficiency.

V. J. Fesharaki, et al.“The effect of temperature on photovoltaic cell efficiency,” in Proceedings of the 1st International Conference on Emerging Trends in Energy Conservation (ETEC ’11), Tehran, Iran, November 2011.)He discussed on the desired efficiency of the PV module can be achieved by changing the ambient temperature around the PV module.

R. Siddiqui et al. “Deviation in the performance of solar module under climatic parameter as ambient temperature and wind velocity in composite climate,” International Journal of Renewable Energy Research, vol. 2, no. 3, pp. 486–490, 2012).They are focused on the solar modules are manufactured at STC, but when they are used under real time conditions, the environmental issues like ambient temperature as well as wind speed also affect the performance of the module for that particular locality.

P K Dash Inst. Journal of Engineering Research and Applications. ISSN: 2248-9622, vol.5, Issue 1 (part 1), January 2015.He is discussed about Crystalline solar cells are the main cell technology used and consists of temperature coefficient of maximum output power of about -0.5% per degree Celsius. The rated power as generally indicated on the module’s label is measured at $25^0$C and with any temperature increase above $25^0$C will take into account a power loss of 1% for every $2^0$C increase. He found from the analysis that CdTe photovoltaic modules seems to be better option in hot climates considering the temperature loss to be minimum due to low temperature coefficient.

## 3. METHODOLOGY

Overheating of the panel due to excessive solar radiation and climatic temperature is the main problem for photovoltaic cell efficiency. The following method is suggested for maximizing the efficiency of the photovoltaic cell.

Model is based on convective heat transfer phenomena, where we consider forced convection criteria of heat transfer from the surface of the photovoltaic cell.

### *Experimental set up*

An experiment was performed with solar photovoltaic module consisting of Model No: TEL12P10, manufactured by Topsun Energy Ltd., Gujarat, INDIA. as shown in figure no.1.

- A Digital Multimeter (MECO; 9A06) is used to measure the current.
- A Digital Multimeter (MASTECH; M266) is used to measure the voltage values at different temperatures.
- A type –k thermocouple is used to check the surface temperature of the PV module.
- An Anemometer (MASTECH; MS6250 )is used to measure the wind speed.
- A Luxmeter (MASTECH;MS6610 ) is also used to measure the irradiance at different temperatures.
- An alternating current (AC) blower (SKIL; 3.3$m^3$/min ) is used to control the air flow rate passing over the surface of the PV panel.
- A load of 1 amp is made by using a coil.
- A diffuser is made from an aluminium sheet, by taking the dimensions of the solar PV module.

The specifications of the PV module are:

- Watts peak : 10Wp at 17.5 volts
- solar type: monocrystalline

cell area: 0.3239 sq.meters,

**Table 1. Experimental Results: 0 deg. Inclination for the Photo Voltaic Cell**

| Velocity (m/s) | Tempera-ture (F) | Cur-rent | Voltage |
|---|---|---|---|
| 0 | 110 | 0.45 | 19.38 |
| 1.1624 | 106.9 | 0.46 | 19.78 |
| 1.9927 | 99.6 | 0.47 | 19.83 |
| 2.3249 | 96.1 | 0.475 | 19.85 |
| 3.4961 | 95.1 | 0.48 | 19.89 |
| 3.6534 | 94.2 | 0.482 | 19.92 |

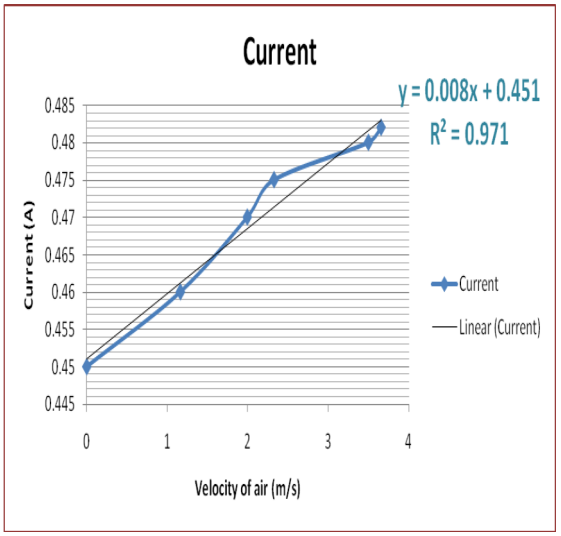


*Figure 1: Variation of Current with Velocity (PV cell inclination = 0 deg.)*

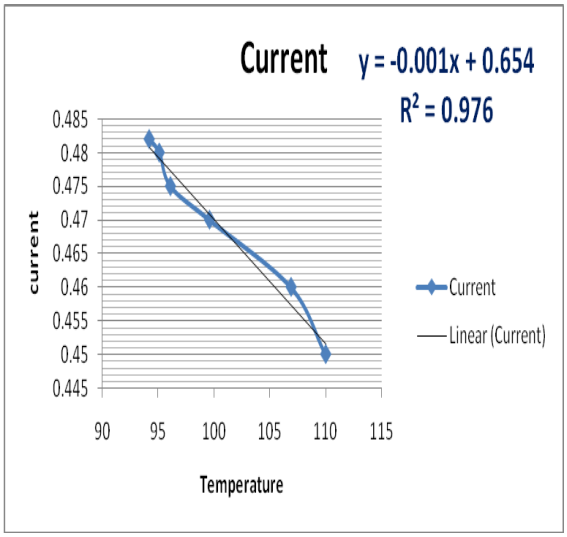


*Figure 2: Variation of Current with Temperature (PV Cell Inclination = 0 deg)*

**Table 2. Experimental Results: 20 deg. Inclination for the Photo Voltaic Cell**

| Velocity (m/s) | Temperature (F) | Current | Voltage |
|---|---|---|---|
| 0 | 110 | 0.45 | 19.38 |
| 1.1624 | 102.2 | 0.46 | 19.78 |
| 1.9927 | 99.1 | 0.47 | 19.84 |
| 2.3249 | 96.3 | 0.475 | 19.86 |
| 3.4961 | 94.2 | 0.48 | 19.89 |
| 3.6534 | 91.1 | 0.482 | 19.93 |

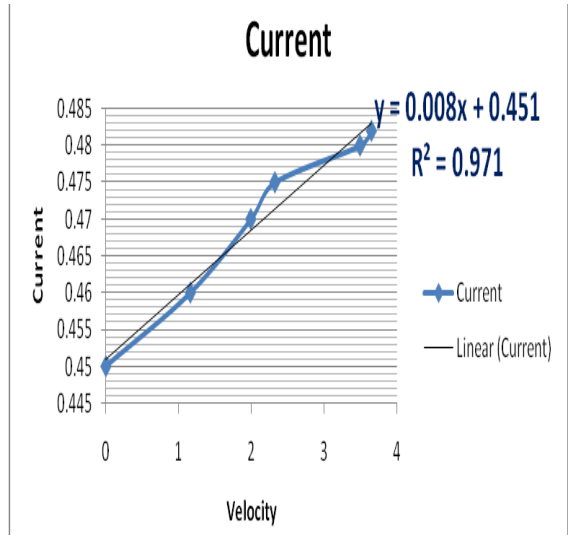


*Figure 3: Variation of Current with Velocity (PV cell inclination = 20 deg)*

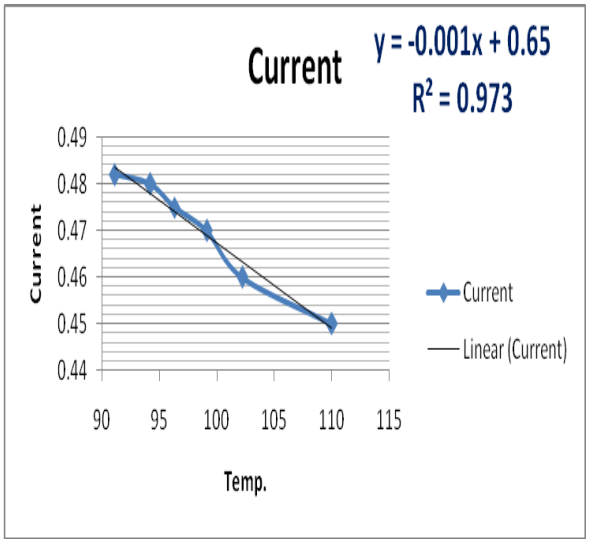


*Figure 4: Variation of Current with temperature (PV Cell Inclination = 20 deg.)*

Photovoltaic panel made of mono-crystalline silicon solar cells is kept on a metal stand designed to obtain different tilt angles. An air blower for circulating the air is fitted to the diffuser for proper air contact with the surface of the panel. The diffuser is made from aluminum sheet by taking the dimensions of PV panel into consideration. At ambient temperatures the power output and efficiency are satisfactory, but as surface temperatures increases the output power is reduced. So, using the blower the air is made to flow on the surface of the panel. This air carries away part of the heat from the surface by convective method and enhances the efficiency of the system. This set up is situated under the direct sunlight avoiding nearby shading effect which will reduce the solar insolation effect on the system.

## 5. RESULT

From the observation it has been concluded that with increase in wind velocity there is increase in output voltage which ultimately increases the efficiency of PV cell.

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