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Performance Analysis of 68 W Flexible Photovoltaic Cell

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Abstract--- *To afford a good living standard for the individuals, there is a necessity to overcome the energy crisis. Therefore, renewable energy (green energy) sources are used extensively to obtain energy from natural sources like a solar and wind. Tapping of solar energy is given a maximum (but not enough) of consideration because wind power is available in most coastal areas. Due to technological upgrading, cost lessening in materials and government funding for renewable energy (green energy) based power generation, the growth and development of solar PV technology is increasing rapidly. Solar panels have been installed near the buildings to get energy from the sun. There are many types of solar cells are available. This letter introduces Thiemorphus thin film (tinny width) Flexible PV. A performance analysis is done on the panel that calculates its functionality.*

Index Terms--- *Photovoltaic, kilogram, millimeter, watt*

I. INTRODUCTION

Increased growth and development of solar PV technology is increasing rapidly due to technical improvement, cost reduction in materials and government support for renewable energy-based power generation. Solar panels have been installed to obtain energy from the sun. Usually the panels are fitted on the roof of the buildings, either connected to the grid or are standalone [1]. With the advances in technology nowadays, many new kinds of solar panels have been introduced in the market.

They are flexible PV, transparent PV, dye-sensitized photovoltaic cell etc. Flexible PV can be rolled and it may be installed on any surface in a linear or winding manner. This makes installation easier. Modules were built from high efficiency, multi-junction A-C alloy solar cells [2][3]. Many companies are manufacturing flexible PV like Unisolar, Microlink etc. [4].

II. PERFORMANCE ANALYSIS

The analysis usually comprises the performance of the photovoltaic panel that it can reach during its operation. The efficiency of the PV cells is illustrated in *Figure 1*:-

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$$\eta_{pv} = \frac{P_m}{E_x A_c}$$

Where η_{pv} is the efficiency of the solar PV

P_m is the maximum power point power given by

$$P_m = V_{oc} I_{sc}$$

Where V_{oc} is the open circuit voltage and I_{sc} is the short circuit current.

E_x is the input light irradiance

A_c is the surface area of the solar PV

Figure 1. Formula to calculate efficiency[5]

III. INSTRUMENTS USED

In this experiments there are various types of equipment and instruments are used, some of them listed below:

III.I. Flexible PV panel: the used panel is a product of UNISOLAR Company, with following specifications and flexible solar panel is shown in *Figure 9*.

- Rated power: - 68 W
- Voltage (V_{oc}):- 23.1V
- Current (I_{sc}):- 5.1A
- Dimensions: - 2849x394x4 mm^3
- Weight: - 3.9kg

III.II. Solar power meter: this device is used to use to determine the irradiance that is the quantity of sun light striking on the surface of PV. It gives input power to the unit per unit area, which will give input power when multiplied with the area of the panel.

III.III. Voltmeter: - This device was used to take readings of the open circuit voltage (V_{oc}). Its range is 0-100V. Voltmeter is shown in *Figure 5*.

III.IV. Ammeter:- this instrument was used to observe the short circuit current (Isc). It has a range of 0-2.5A. *Figure 2* shows ammeter.

III.V. Rheostat: - This instrument was used as variable resistant in the setup. Rheostat is shown in *Figure 3*.

III.VI. Environmental meter: - This device was used to measure relative humidity & wind speed. It is an Extech instrument with a model number 45,170. EM is shown by *Figure 7*.

III.VII. Infrared thermometer: - this device is employing for measuring the module temperature. It has the range of 01MW and output wavelength of 630 to 670 nm. *Figure 4* shows the thermometer.

III.VIII. Multimeter: this device is used to take readings of the voltage & the current at the output of the module. It has the range of 0-1000V and 0-10A. *Figure 6* shows the Multimeter.

Figure 2. Ammeter

Figure 3. Rheostat

Figure 4. Infrared thermometer

Figure 5. Voltmeter

Figure 6. Multimeter

Figure 7. Environment meter

Figure 8. Setup of the experiment (rooftop)

Figure 9. Flexible PV (façade position)

IV. METHODOLOGY

The panel is placed in two different positions, one is on the façade side and another is on the roof. Flexible PV is placed at a 23 degree angle in the context of the Northern Hemisphere for roof placement so that the panel can always face the sun. For fax placements. The panel can be placed in a vertical position on the doors and window. The panel is connected to a rheostat in which variable resistance occurs, in which the voltage reading is taken by a voltmeter and the current reading is taken by an ammeter.

It will give an voltage for the open circuit & current for the short circuit as output, which in return gives output power. The input is taken as the amount of light falling on the surface of the panel. It is measured by solar energy meter which gives radiation input when multiplying with surface area. Efficiency input power is given as the ratio of output power. Efficiency is set for both excuse and roof. Then the comparison between the ceiling pv and the PV is determined in which there is more efficiency.

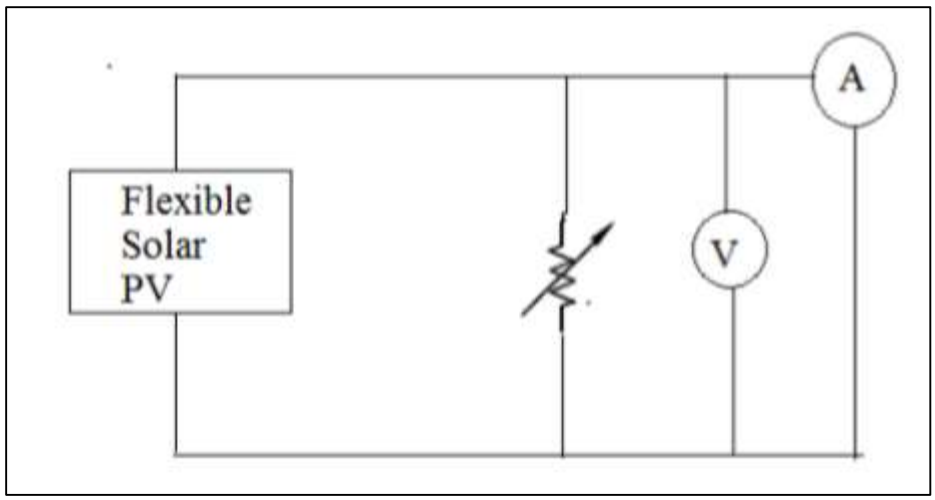

Figure 10. Circuit Diagram

V. CALCULATION

The performance of the flexible PV for façade and rooftop positions are calculated below:

Time	$A_{temp.}$	W_{Speed}	$S_{Intensity}$	$M_{temp.}$	V_{OC}	I_{SC}	V_M	I_M	η
9:00 AM	30.1	0.1	625	33	19.37	1.21	36	1.9	3.34
10:00 AM	35.2	0.2	645	36	20.25	1.62	37	1.7	4.53
11:00 AM	40.2	0.2	957	58	20.4	3	36	2.2	5.69
12:00 AM	42.9	0.1	992	60	19.83	3.23	36	1.92	5.75
1:00 PM	44.2	0.2	981	61	18.12	3.45	37	2	5.67
2:00 PM	45	0.2	977	64	18.13	3.49	30	1.72	5.77
3:00 PM	41	0.3	733	52	17.21	2.52	33	2.4	5.27
4:00 PM	43	0.1	499	45	15.23	1.88	35	2.4	5.11
5:00 PM	29.2	0.1	298	30	18.34	0.52	19	0.9	2.85

Figure 11. Facade flexible PV

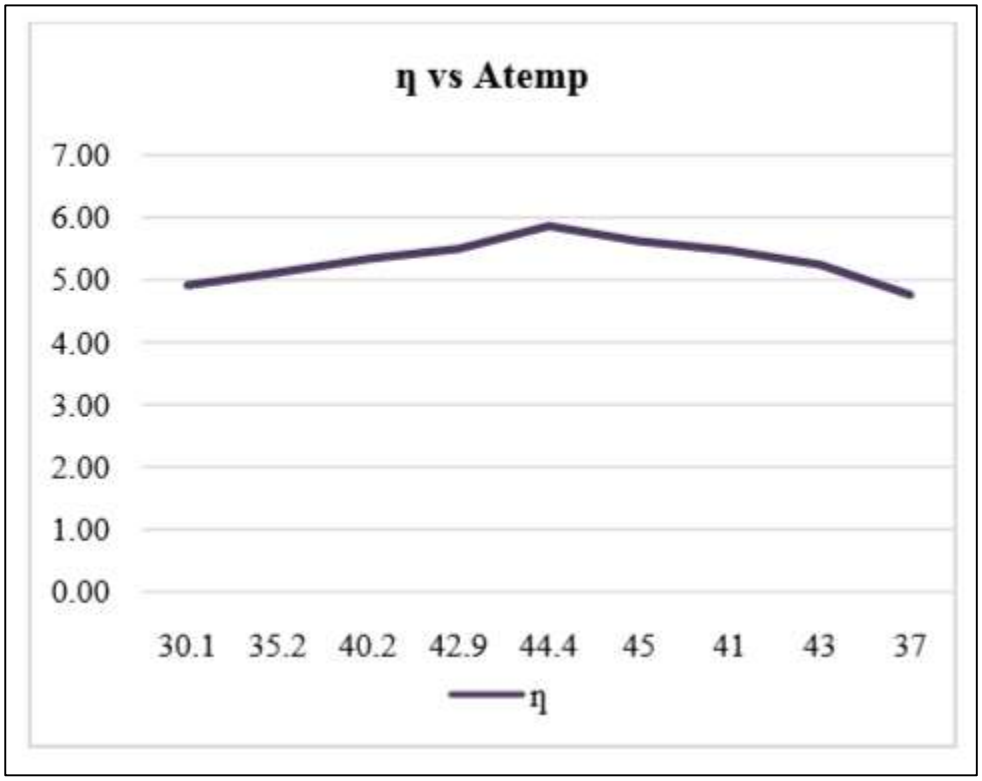

Figure 12. η and ambient temperature

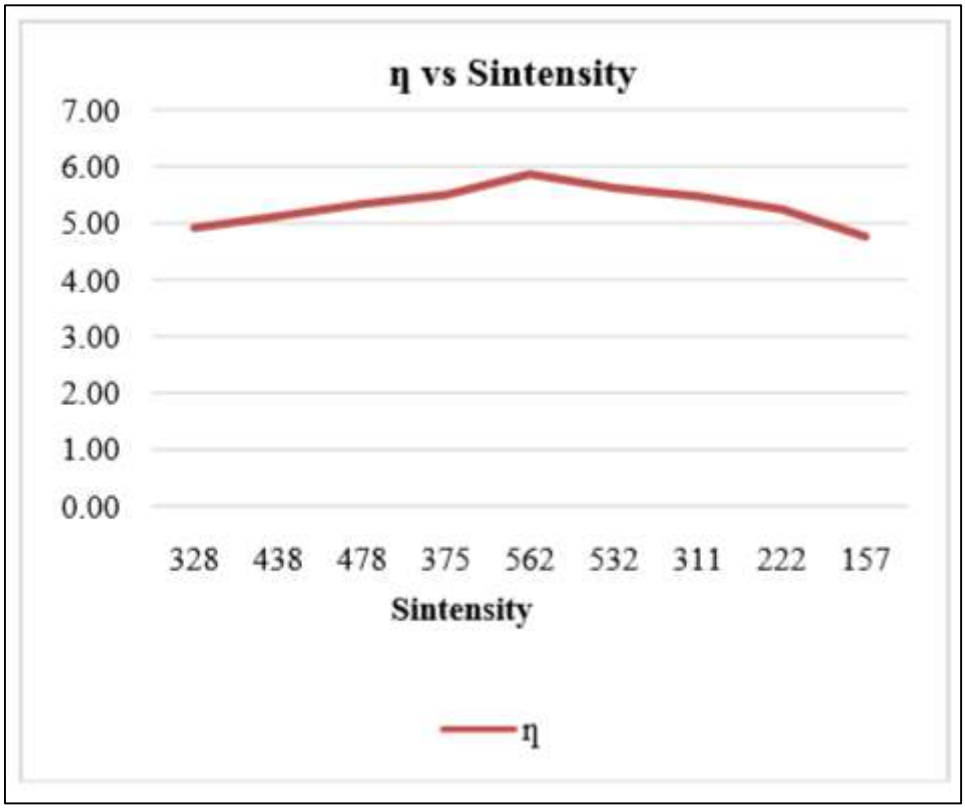

Figure 13. η and solar intensity

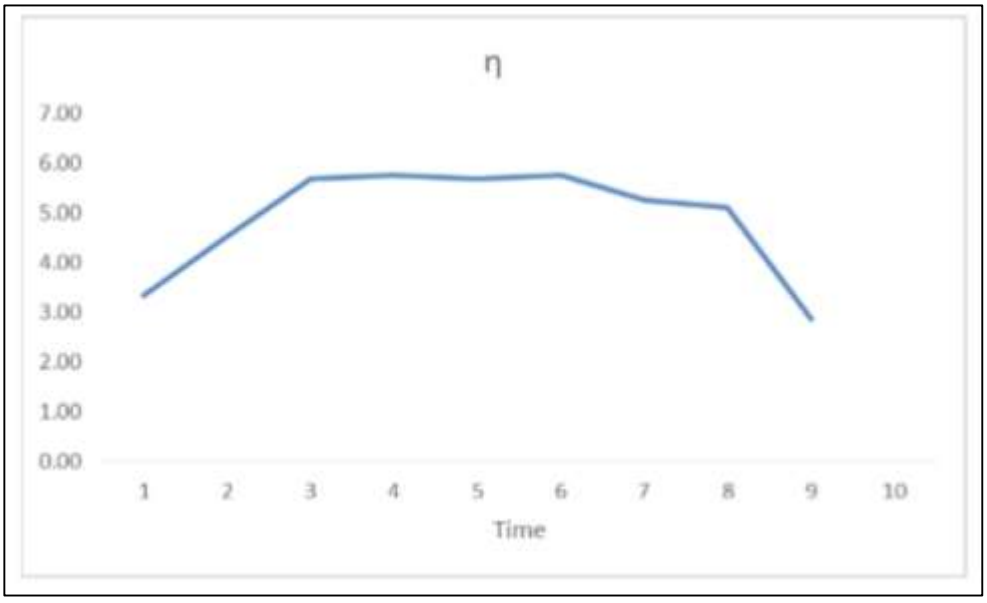

Figure 14. η and time

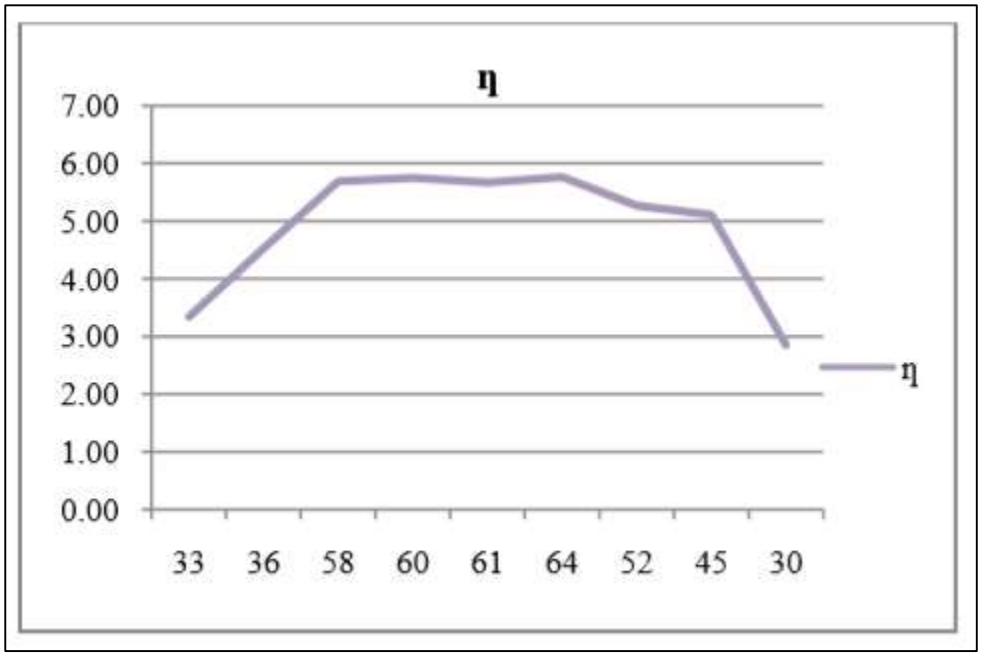

Figure 15. η and module temperature

TIME	A_{temp}	Wspeed	S_{intens}	$M_{temp.}$	V_{oc}	I_{sc}	V_m	I_m	η
9:00 AM	30.1	0.1	328	31	17.23	1.05	34	0.8	4.91
10:00 AM	35.2	0.3	438	35	19.21	1.31	35	0.7	5.12
11:00 AM	40.2	0.2	478	40	17.05	1.68	30	1.4	5.34
12:00 AM	42.9	0.1	375	44	18.23	1.27	35	2.2	5.50
1:00 PM	44.4	0.2	562	48	19.27	1.92	20	1.5	5.86
2:00 PM	45	0.2	532	46	19.07	1.76	30	1.5	5.62
3:00 PM	41	0.1	311	45	17.53	1.09	27	1.4	5.47
4:00 PM	43	0.3	222	34.2	14.21	0.92	29	2.2	5.24
5:00 PM	37	0.1	157	32	12.34	0.68	12	1.5	4.76

Figure 16. Rooftop flexible PV

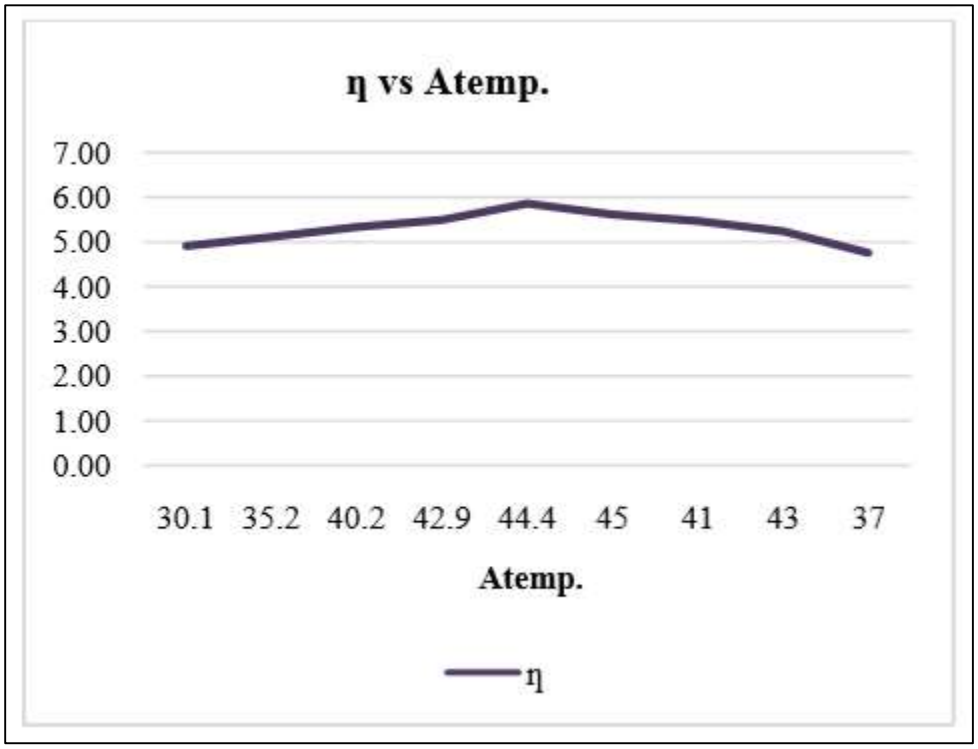

Figure 17. η and ambient temperature

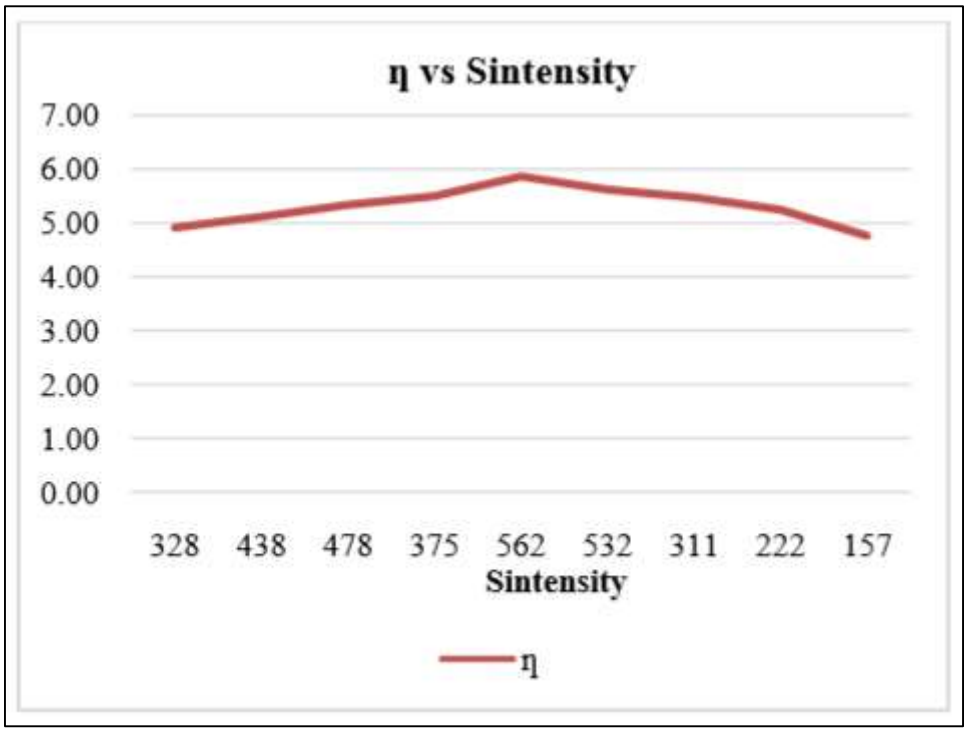

Figure 18. η and solar intensity

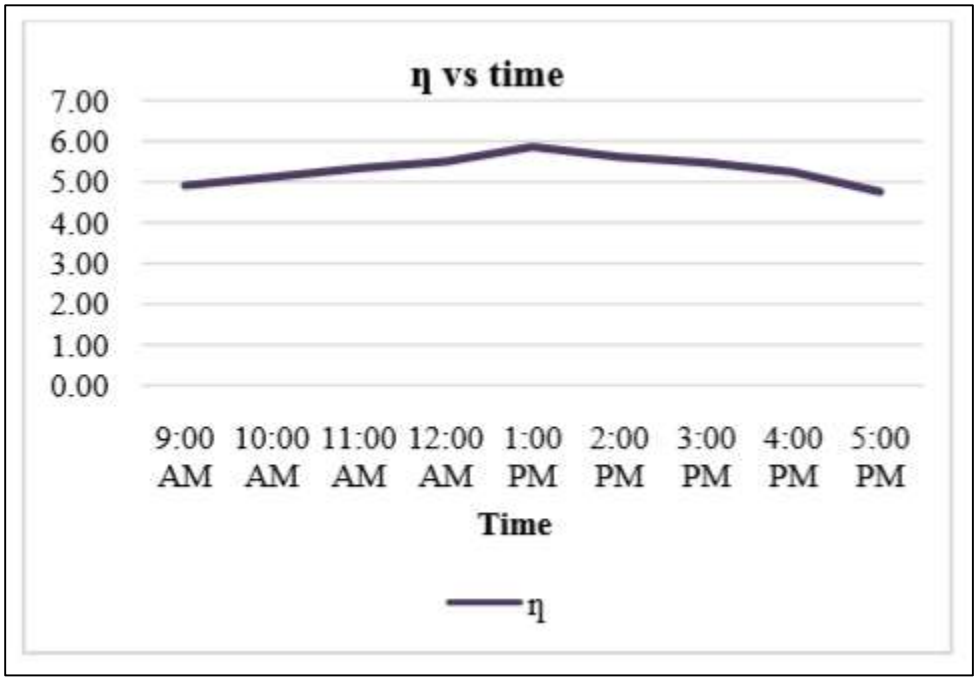

Figure 19. η vs time

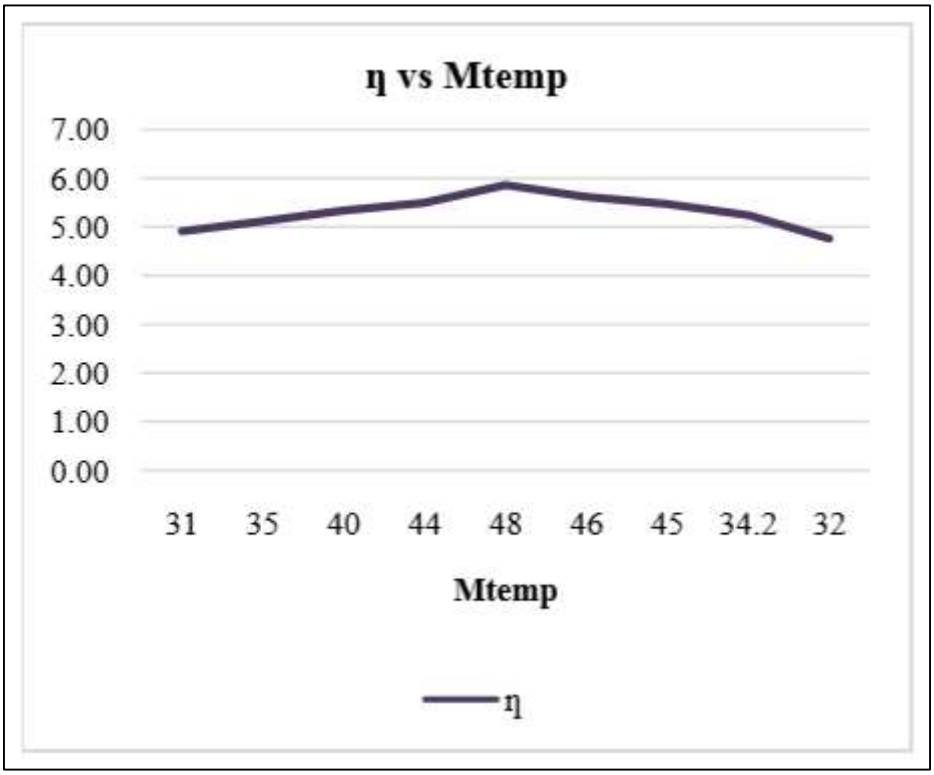

Figure 20. η vs module temperature

VI. CONCLUSION

From the above experiment the overall performance rate (efficiency) of the flexible photovoltaic panel for the rooftop is 4.89 and the performance rate for the façade position is 5.31. So, that the calculated results shows and proves that the flexible photovoltaic panels is best suited for the façade position.

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