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Effects of Using 24watt Twisted Fluorescent Lamp, 13 watt Led Bulb and 30 watt Led T8 on Inverter Current, Photovoltaic Panel and Charging Current of Solar System.

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Abstract: An alternative to the use of solar systems is an electricity saving activity that can provide a profit if the load used is in accordance with the level of capacity of the system. Load selection in solar systems is very important in ensuring the stability of the system itself. Energy from sunlight is the main source of direct current power generation but it is subject to the capabilities of the Maximum Power Point Tracking (MPPT) solar charger controller used. The selection of the appropriate load will provide good efficiency as well as more efficient energy savings. In this paper,13Watt LED bulb, 24Watt Twisted fluorescent lamp and 30Watt T8 LED lamp are tested in an experimental study to see the effect of their use on the inverter current, the current flowing through the photovoltaic panel and the current used to charge a battery in the solar system. These data will be used to make comparisons with the energy savings generated by this solar system to provide longer time to use. The brightness of the lamp is also compared using digital Lux meters. The results of this study have shown that the use of 13Watt LEDs is more economical in terms of direct current (Dc) power and contributes to brighter lighting than the 24Watt twisted fluorescent lamp and 30Watt T8 LED lamp used.

Keywords: Photovoltaic, Solar System, LED

1. Introduction

Nowadays, energy-related aspects are becoming extremely important. They involve, for instance, a rational use of resources, the environmental impact related to the pollutants emission and the consumption of non-renewable resources (Pande, 1992). Power generation of solar systems is the choice of some countries on a large scale as the climate is more in their favor. In order to obtain better stability in the solar system, the load selection factor to be used is very important. Once the load type has been identified, then the specifications of the other components can be selected. This study was conducted experimentally where 3 types of lamps namely 13Watt LED bulb, 24Watt twisted fluorescent lamp and 30Watt LED T8 were tested to see the effect on inverter current, photovoltaic panel current and charging current passing through a battery to a solar system. The data obtained can be used to make the selection of the most economical load while providing a brighter quantity of lighting.

LED bulbs offer similar light quality to traditional incandescent, last 25 times as long, and use even less energy than CFLs Electronic chokes in place of conventional copper chokes save electricity (Ghosh, Sengupta & Das, 2016). Using solar panels to produce electrical power is ecosystem friendly; they do not emit greenhouse gases which step up the warming of Earth leading to climate change (**.** Solar PV systems are very reliable and clean source of electricity that can suit a wide range of applications such as residence, industry, agriculture, livestock, etc (Kamal & Singh, 2014)**.**

2. Research Methodology

2.1 Solar System Specification And Lamp Data

In this solar system, the load tested consists of 13Watt LED bulb, 24Watt CFL lamp and 30Watt T8 LED lamps and connected through the AC load section.

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Table 1: Solar System Specification & Lamp data .

Component	Range	Quantities
DC/AC Inverter(Pure Sinewave)	1000Watt	1
Battery	12Volt /100Ah	1
MPPT Controller	30A/40A/50A/60A	1
Photovoltaic panel	165Watt	3
Twisted Fluorescent lamp	24Watt	2
T8 LED 1.2m lamp	30Watt	2
LED bulb	13Watt	2

2.2 Experimental Approach

In this experiment, an observation on the effect of the use of different types of lamps tested on solar photovoltaic current, charging current and inverter current is recorded. These lamps will be tested separately and will be left on for 1 hour. Within 15 minutes, the above data were recorded. This test is done during hot weather starting at noon to allow the solar system to recharge the power that has been used. If the weather is cloudy, the quantity of charging current will be affected, and the battery voltage will decrease significantly. Therefore, to see the best capabilities, this test is conducted in bright and hot weather. The photovoltaic panels are connected in parallel to get better voltage stability. Temperature effects are the result of an inherent characteristic of solar cells. They tend to produce higher voltage as the temperature drops and, conversely, to lose voltage in high temperatures (Dincer & Meral, 2010).

Table 2: Sunlight catchment data by 3 photovoltaic panels

Time	PV Current(A)	PV Voltage(V)	Charging Current(A)	Battery Voltage(V)	Inverter Current(A)	MPPT Watt
1030am	1.74	19.85	1.36	14.65	1.08	27
1100am	1.38	19.90	0.91	14.68	1.05	22
1130am	1.36	19.75	0.88	14.68	1.04	22
1200pm	1.33	19.87	0.86	14.69	1.05	21
0130pm	1.38	19.73	0.89	14.69	1.05	22
0200pm	1.45	19.66	0.92	14.71	1.04	23

2.3 AC Load Testing

2.3.1 Testing Description

- *Lamp selection and criteria*

The selection of bulbs to be carried out is based on the type that is easily available in the market and has lighting that is the buyer's choice. Among the popular now are bulb led lights and T8 LED lights. There are also conventional bulbs that are still on the market also tested to see the difference in current used by the inverter to support the demand for this load power in the alternating current. These lights are tested to see the ability of this solar system to operate thus looking at direct current energy saving, and the capacity of the solar system used. The only way that this increased energy consumption can be contained is if the energy consumption per appliance can be decreased and appliances used more efficiently (Alexandru & Jitaru, 2007).

- *Current and voltage measurements*

Lamp testing is carried out when photovoltaic panels begin to receive sunlight catchment. Current measurement is made using the Digital Mini Clamp Meter Model UT210E. Each type of lamp was tested for 1 hour and the following data points are recorded in table 3 below.

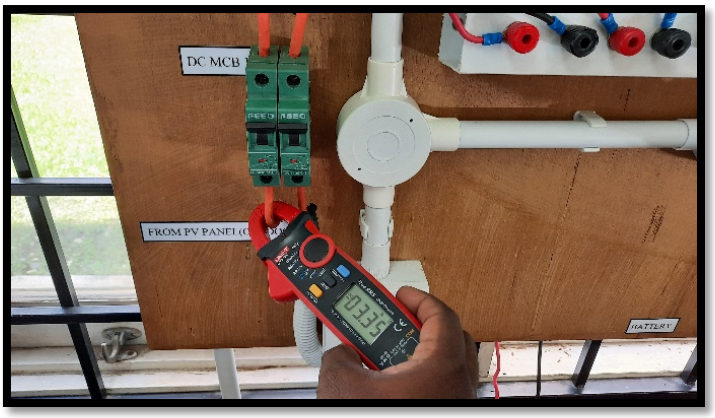


Figure 1. Photovoltaic current measurement

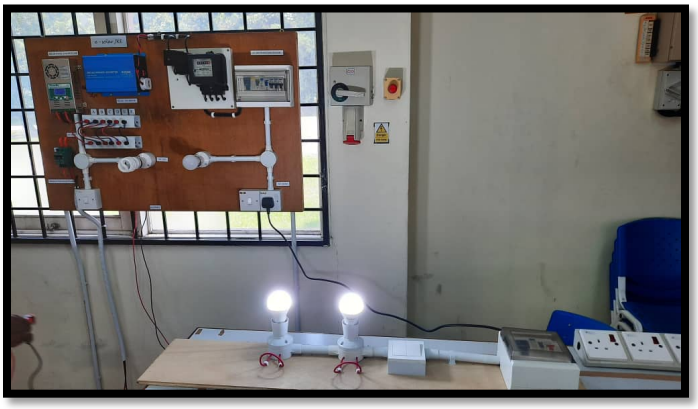


Figure 2. LED 13Watt light testing

3. Results And Discussion

Table 3: Test results for three types of lamps.

Type of lamp /Quantity	Time	Inverter Current (A)	PV Charging Current(A)	PV Solar Current (A)	Battery Voltage (V)	MPPT (Watt)	DB Current (AC)	Lamp Current (AC)
No load	1200pm	0.9	1.3	1.7	14.53	28	0	0
30Wx2 LED T8	1215pm	5.56	4.87	4.96	14.11	85	0.41	0.19
	1230pm	5.35	4.96	5.05	14.26	89	0.41	0.19
	1245pm	5.30	5.21	5.24	14.19	91	0.41	0.19
	100pm	5.36	5.08	5.03	14.27	89	0.41	0.19
	115pm	5.32	4.92	4.92	14.19	86	0.41	0.19
13Wx2 LED Bulb	200pm	3.13	3.23	3.23	14.56	60	0.16	0.08
	215pm	3.16	3.09	3.38	14.58	60	0.16	0.08
	230pm	3.20	3.16	3.34	14.58	60	0.16	0.08
	245pm	3.17	3.23	3.34	14.57	61	0.16	0.08
	300pm	3.15	3.18	3.34	14.57	61	0.16	0.08
24Wx2 TFL lamp	315pm	4.46	4.60	4.73	14.56	84	0.27	0.14
	330pm	4.38	4.47	4.64	14.53	79	0.27	0.14
	345pm	4.46	4.39	4.53	14.36	79	0.27	0.14
	400pm	4.43	4.70	4.80	14.05	83	0.27	0.14
	415pm	4.40	4.60	4.70	14.47	79	0.27	0.14

Table 4: Average Current and Lux Measurement

Lamp Type	Average Inverter current(A)	Average Charging Current(A)	Average PV Current(A)	Lux1	Lux2	Lux3	Average Lux
30W LED T8	5.38	5.01	5.04	2920	3200	2640	2920
13W LED	3.16	3.18	3.33	4890	6130	4190	5070
24W TFL	4.43	4.55	4.68	2070	2490	1770	2110

3.1 Impact On Solar System Current

3.1.1 Average Inverter Current

In the test conducted, the inverter current is measured from its input source, which is the current connected from the battery source. After that the average current for each type of lamp is calculated and plotted in Figure 3.

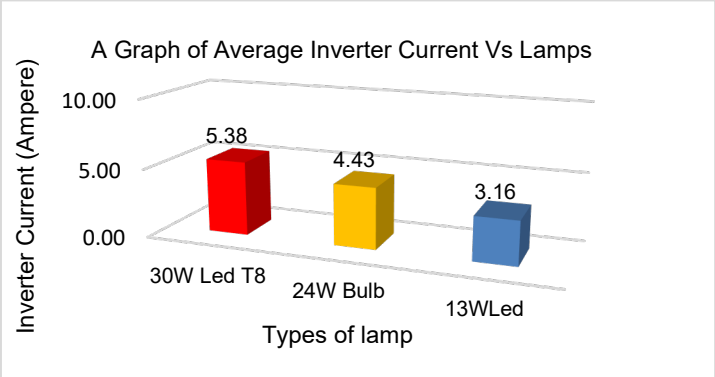


Figure 3. Graph of Average Inverter Current

3.1.2 Average Charging Current

The charging current is measured from the source of the controller MPPT output directly to the battery terminal. The quantity of this current is plotted in Figure 4 for all types of test lights.

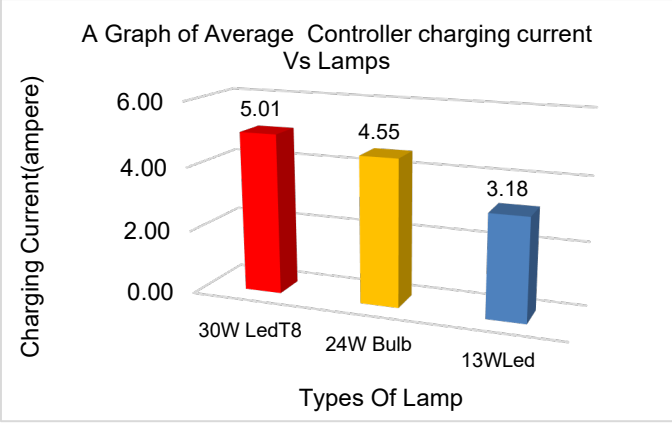


Figure 4. Graph of Average Controller Charging Current

3.2.3 Average Photovoltaic Current

The photovoltaic current is measured from the source of photovoltaic panel to the controller MPPT terminal. The quantity of this current is plotted in Figure 5 for all types of test lights.

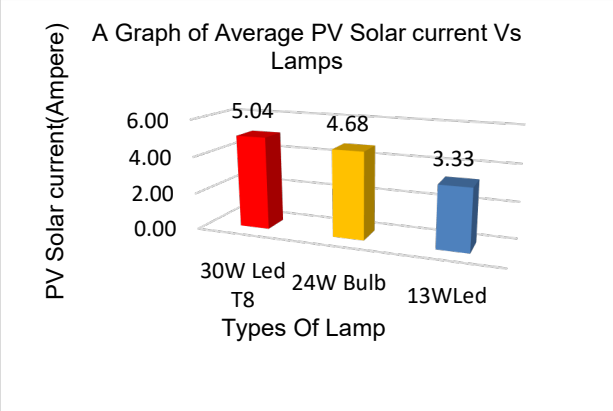


Figure 5. Graph of Average Photovoltaic Current

3.2.4 Average Lighting Data

The average lighting is taken at random with a distance of 1 meter from the lamp. The test results found that 13Watt LEDs contributed to the most illumination of 5070 lux compared to 24Watt TFL and 30Watt T8 LEDs of 2110 lux and 2920 lux respectively. Although this lamp emits the most lighting, but the AC operating current is low at 0.08A compared to 30Watt T8 LED and 24Watt TFL at 0.19A and 0.14A respectively.

4. Conclusion

Lighting systems are said to be energy saving, if the energy consumption is reduced to the barest minimum probably aided by lighting smart sensor control or a reduced energy consumer LED lamps (Sorcar, 1982) **.** From the results of all the lamps tested, LED 13Watt has a low increase rate of inverter current, charging current and photovoltaic current compared to 30W T8 LED and 24W Twisted Fluorescent lamps. From the lighting test results, the average random illumination within 1 meter of the lamp has shown a 13Watt LED illumination reading is brighter than other lamps. This is very meaningful as we only use solar energy sources. A LED light design being developed in produced light bulb's efficiency until 85.63% with a voltage range between 24V-72V and power consumption of 13,44 Watts. It also produced enough illumination levels for lighting at home (Hasanah et al., 2018). The sun rays fall on the solar cell in some particular option for electricity generation as it is available all over and direction then only we get maximum output (Tekade et al., 2017)**.** Apart from that, the ability of the solar system to store energy is also important. Storage batteries with charge regulators are recommended to provide for backup power supply during periods of cloudy days and during nights. Batteries are charged during the day and supply power to the load (Pandher, 2013)**.** PV cells/modules are designed for outdoor use in such harsh conditions as marine, tropic, arctic, and desert environments. The choice of the PV material can have important effects on system design and performance. Both the composition of the material and its atomic structure are influential (Meral & Diner 2011)**.**

5. Acknowledgement

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