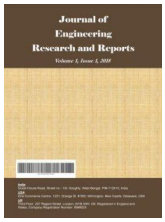

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Comparative Study of Weekly Discharge Rate of Two Solar Batteries Commonly Used in Anambra State

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The purpose of this study is to compare the weekly discharge rate of two solar batteries commonly used in Anambra State. The batteries considered were the Indian made battery with specification Luminous, Deep cycle sealed maintenance free batteries solar application, Lum 12V 100Ah 20hr and 3DGP161433 and Chinese made battery with specification Sun-Test std gel battery, 12V-100Ah, 010716w, Cycle use 14.4-15.0V, Stand by use; 13.5-13.8V and Initial current: less than 30A were used to power 2 stand-alone security lights at the Faculty of Physical Sciences, Nnamdi Azikiwe University, Awka. The technical assessment was based on measuring their output voltages bihourly from 19.00 hr to 7.00 hr and estimation of weekly discharge rate of these batteries for a period of two months (eight weeks). From the analysis, the Indian made solar battery has insignificant discharge tendency for the first eight weeks of its use having its discharge rate of -0.034, -0.038, -0.042, -0.037, -0.039, -0.038, -0.039 and -0.036 Volts/hr per week from week one to week eight respectively whereas the Chinese made solar battery has a relatively high discharge rate of Voltage/hr per week within the first eight weeks of its use having its rate at -0.095, -0.213, -0.103, -0.1, -0.104, -0.1, -0.083 and -0.109Volt/hr per week from week one to week eight. Also, while the Indian made battery is observed to be relatively stable, the Chinese made

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battery was observed to be very erratic and highly susceptible to discharge within the first eight weeks (two months) of its use. Hence, it is concluded that Indian made battery is preferred to that of Chinese made battery for optimal performance of stand-alone PV syste.

Keywords: Solar batteries; Anambra state; luminous; PV system.

1. INTRODUCTION

1.1 Solar Batteries

A battery is an electric cell or a device that converts chemical energy into electricity [1]. Batteries are basically the only method to store direct current (DC) power produced from sources like solar panels, wind generators, micro-hydro or generators [2]. Batteries in PV systems are arguably the most vulnerable component of the entire system [3]. Design and operation faults such as array under sizing and charge controller breakdown can lead to battery failure making the system unable to deliver the anticipated power. The capacity of a battery is not fixed but instead depends on the temperature, discharge current [4], state of life and other factors, which makes the complex electrochemical devices depend on a large number of material properties meeting a defined standard to function correctly [5]. These batteries are mainly used to perform three main functions in PV systems.

1. as a buffer, store to eliminate the mismatch between the power available from the PV generator and the power demand from the load,
2. as energy reserve device and
3. to prevent largely and possibly damaging voltage fluctuations [6].

Dusan & Michal [7] outlined the following as the advantages of solar batteries;

- They provide a portable source of electric power. This power is available in considerable quantity for use on moving equipment or where no power lines are accessible.
- They are capable of delivering very large quantities of power for short periods and being recharged at low rates over extended times.
- They provide the most reliable known source of emergency power, instantaneously when normal power fails. They can thus enable light or power to continue when the need is greatest.
- They provide a source of pure direct current for laboratory and other specific purposes, either as a separate and independent supply or by acting as a filter in a normal supply system.

1.2 Types of Battery

According to Chetan [8], there are varieties of batteries that are available in the market for several types of applications. Each battery type is more suited for one particular application. The type of battery is identified by the chemistry of materials used in making it. The batteries are broadly divided into two categories:

- Non rechargeable batteries or primary batteries
- Rechargeable batteries or secondary batteries.

Non rechargeable batteries. In this battery, the electrochemical reaction is not reversible. This type of batteries are used for one time and once discharged, they cannot be charged again. The non-rechargeable batteries are the most convenient, simple, easy to use and require less maintenance. These batteries are mainly used in toys, torches, e.t.c. examples are magnesium cells, Aluminium cells, Alkaline-manganese dioxide cells, Mercuric oxide cells, e.t.c. The batteries that are required in solar PV systems need to be charged and discharged regularly; therefore non-rechargeable batteries are not used in stand-alone solar PV systems [9].

Rechargeable batteries are energy storage devices that can be charged again after being discharged by applying DC current to its terminals [10]. A rechargeable battery is generally a more sensible and sustainable replacement to one-time use batteries, which generate a current through a chemical reaction in which a reactive anode is consumed. The anode in a rechargeable battery gets consumed as well but at a slower rate, allowing for many charges and discharges [11].

2. MATERIALS

The following materials were used for the study.

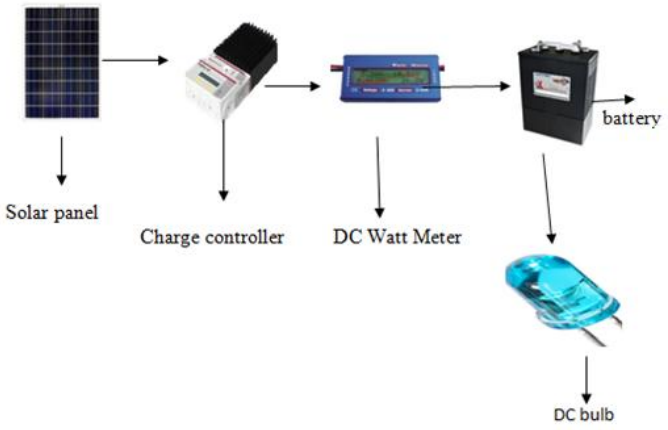

Fig. 1.

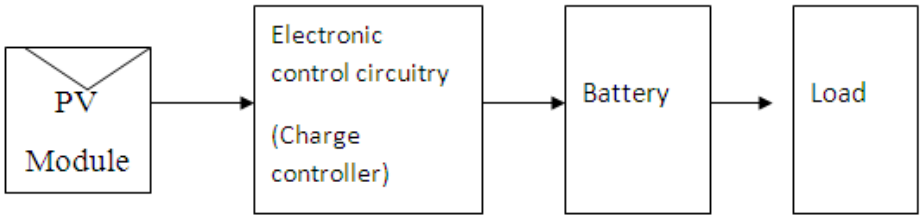

Fig. 2. Block diagram of PV system

2.1 Design Methodology for Stand-Alone PV Security Light

The design of a solar PV system is about determining the number of ratings of components used in a solar PV system to supply reliable electricity to the load which in our own case is the 2 security lights. The design involves calculating the values of different components required to make the complete PV system (namely the PV module, battery, charge controller and the LED bulb) which is capable of supplying electricity to the connected load as required. Here in this study, approximate design methodology was employed (in approximate design, assumptions are made with respect to the component performance with referring to the solar radiation data, seasonal variation in the load, performance variation of PV panel with season ie those parameters mentioned were not put into consideration because the load was small.) since the number of parameters considered here is small and to make the PV system design simple. As compared to the precise design (attention is given to accurate details of all the above factors) parameters, such as the amount of solar radiation, temperature variation at the location, and the variation of load according to the season are not considered.

Sizing: Sizing is an important part of the design of a stand-alone PV system

Step1: The connected load and their energy estimation in watt-hour (Wh) was determined

The load refers to any appliance that needs to be powered by the PV system. Here, the estimation of how much energy required for the operation of the load (LED lamp) was done. Energy consumed by a load in a given day is obtained by simply multiplying its power rating by the number of hours of operation. Thus, the unit of energy would be in watt-hour (Wh). Here, our LED lamp is 20W, therefore,

$$\text{Energy} = \text{Total watts} \times \text{number of hours (Wh)}$$
$$\text{i.e. Energy} = 20\text{W} \times 12\ \text{hours} = 240\text{Wh}$$

Step 2: The size and choice of the charge controller (the voltage and current of the load and battery) were determined

The solar charge controller should be chosen as per the required input and output voltage and

current of load and battery. The chosen charge controller should be able to handle the currents and voltages that are likely to be flowing in the system.

Here, the nominal system voltage of charge controller was checked: It is usually the same as the rated voltage of load and PV array which is 12V.

$$\text{Nominal load current} = \frac{\text{Total DC load}}{\text{Nominal System Voltage}}$$

$$\text{Nominal load current} = \frac{20}{12} = 1.666\text{A} \approx 2\text{A}$$

That is the output side, meaning that the charge controller should be able to handle the approximated current.

Step 3: The battery size (their number, capacity, voltage and Ah ratings) was determined

Here, it is concerned with the number, capacity, voltage and Ah ratings. In battery sizing, several other parameters of batteries have to consider as well, which include;

- System voltage ampere-hour (Ah) capacity of the battery.
- Depth of discharge (DOD) of battery.
- Number of days of autonomy.

To find the Ah capacity to be supplied, the energy is divided by voltage as,

$$\text{Energy} = \text{W} \times \text{h} = \text{V} \times \text{I} \times \text{h}$$

$$\text{Ah} = \frac{\text{Wh}}{\text{V}} = \frac{\text{V} \times \text{I} \times \text{h}}{\text{V}}$$

$$\text{Ah} = \frac{240}{12} = 20\text{Ah}$$

The DOD of batteries indicates how much of the total charge of the battery can be used.

In, solar PV, nominally the deep discharge batteries are used with DOD in the range of 50% to 60%. [8].

The usable charge was estimated if the DOD of battery is given as 50% using

$$\text{Actual capacity (Ah)} = \frac{\text{Ah}}{\text{DOD\%}}$$

$$\text{Actual capacity (Ah)} = \frac{20}{0.5} = 40\text{Ah}$$

The number of days of autonomy was considered: The number of cloudy days for which more energy is to be stored is referred to as "number of days of autonomy. This means that whatever estimation got after considering the DOD, there is a need to increase the capacity of the batteries to store extra energy for the number of days of autonomy.

$$\text{Actual Ah capacity after DOD (Ah)} \times \text{number of days autonomy} = \text{Final required battery capacity (Ah).}$$

That is $40 \times 2 = 80\text{Ah}$

100Ah battery was used in the project because that is lowest Ah in the market.

In general, the equation for estimating battery capacity is given as;

$$\text{Total Ah capacity of battery} = \frac{\text{Energy input} \times \text{Number of days of autonomy}}{\text{DOD} \times \text{System Voltage}}$$

$$\text{Total Ah capacity of battery} = \frac{240 \times 2}{0.5 \times 12} = 80\text{Ah}$$

There was no need to get the total number of batteries. Only one battery was used because the load was small.

Step 4: The PV module (panel) size (their number, power rating, Voltage and current ratings).was determined

Sizing the PV panels: This involves the estimation of daily energy needed to be supplied by PV module and SPV module power.

$$\frac{\text{Total Energy(Wh)}}{\text{Battery Efficiency(80\%)}} = \text{Wh}$$

$$\frac{240}{0.8} = 300\text{Wh}$$

According to Chetan, [8], the efficiency of the lead acid battery is 80%.

PV module sizing then involves estimation of PV module power using equivalent daily sunshine hours.

SPV (solar photovoltaic) module wattage (W) =

$$= \frac{\text{Daily Energy to be supplied SPV module (Wh)}}{\text{Equivalent daily sunshine hours (h)}}$$

$$= \frac{300}{6} = 50\text{Wh}$$

Step 5: The size of wires (in mm) was determined

The accurate selection of system wiring cables is very essential in order that the system is safe. The wiring must not reduce the performance of any of the components of the systems. The cables in a stand-alone system must be sized correctly to reduce the voltage drops in the cable and to make sure that the safe current handling capacity of the cable is not exceeded.

$$\text{Hour of usage for the security light} = 12\text{hrs}$$
(from 19.00hr-7.00hr)

Without a battery, the system will only supply power to the load during the day time only and therefore will not solve the fundamental problem that this research seeks to solve. The battery is sized to cater for energy supply to the loads at night when the sun is not available.

2.2 Installation Methodology for the Two Stand-alone PV Security Lights

Installation is a process in which the different components are connected in a systematic order to make a perfect working solar PV system to meet predefined demands. Different types and a different number of components are used in PV system depending on the requirements. Here, the two stand-alone PV security lights were installed. The stand-alone PV systems as stated before simply mean the self-dependent or autonomous solar PV systems. They do not depend on the grid or any other electric power supply that is why they are also called off-grid PV systems. In this research, there were two types of Installations, the mechanical and the electrical. The mechanical involves installing the materials used for mounting our solar panel. The concrete base was laid with the depth of 2.5ft for mounting the galvanized aluminium steel that is 14ft tall. The solar PV module was mounted of the fixed structure pointing to the south direction. The battery cages were constructed for the safekeeping of our batteries. On the other hand, the electrical installation involves connecting the electrical components of the system with the wires. The charge controller used was rated 12/24V with six terminals for battery, panel and load connections. The battery was connected first to enable the charge controller dictate the right voltage configuration. Then the two wires from the panel were connected to the charge controller and the load of 20W LED lamps was also connected to the charge controllers. The first installation was labelled A which contained the 12V Chinese battery while the second installation B contained the Indian battery also. Both were connected to loads of the same wattage that is the 20W LED lamps each. The set up was monitored for a period of two months (eight weeks) with the specified readings taken at different intervals.

3. RESULTS AND DISCUSSION

The data collected with Dc watt meter were analyzed graphically using Microsoft Excel. The data were collected from 19.00hrs to 7.00hrs of the immediate subsequent day from week one in January to week eight in February of 2017. These 19.00hrs to 7.00hrs of each subsequent day were transformed to 0-12hrs. That is 0, 2, 4, 6, 8, 10 and 12 hours respectively in order to carry out graphical analysis on the data. The output voltages of Indian made battery and Chinese made battery was recorded for each hour of the day (from 19.00hr-7.00hr) and the average of the output voltages of each of the hours was calculated from the first day to the seventh day of each week. That is, at different hours from 0^{th} hour to 12^{th} hour for each week starting from week one in January to week eight in February, the average of the output voltages was computed for both Indian made battery and Chinese made a battery. For the eight weeks of the observation, Table 1 shows the average of the output voltage discharge rate of the Indian made battery while Table 2 shows the average of the output voltage discharge rate of the Chinese made battery.

Careful observation of Table 1 shows that the output voltage discharge rate for the Indian made the battery is relatively very low from 0^{th} hr to 12^{th} hr from week1 in January to the eight weeks in February. Apart from the very low discharge rate of the Indian made battery, the Indian made battery never tripped off throughout the period of the observation.

For Chinese made battery, the output voltages were not steady but observed to be erratic. From the first week of the study (Table 2), the Chinese made battery was observed to have started tripping off at 12^{th} hour of the daily observations. This characteristic of tripping off continued to be on the increase with the Chinese made a battery for the rest of the weeks, the tripping off took place at earlier hours such as 12^{th}, 10^{th} and 8^{th} hours.

Table 1. The output voltage of Indian made battery with time

Week 1 days 1-7	Hour	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Average ouput voltage
19.00 HRS(GMT)	0	12.93	13.02	12.88	12.9	12.92	12.8	12.91	12.909
January	2	12.87	12.94	12.8	12.82	12.85	12.72	12.83	12.833
	4	12.81	12.86	12.73	12.74	12.77	12.66	12.76	12.761
	6	12.78	12.78	12.66	12.66	12.7	12.59	12.7	12.696
	8	12.75	12.73	12.6	12.58	12.62	12.51	12.62	12.630
	10	12.69	12.65	12.54	12.48	12.56	12.44	12.54	12.557
07.00(GMT)	12	12.63	12.57	12.48	12.42	12.49	12.36	12.45	12.486
Week 2 days 8-14	0	13	12.8	12.91	12.82	13	13	12.9	12.919
	2	12.92	12.71	12.82	12.76	13.01	12.91	12.81	12.849
	4	12.84	12.64	12.75	12.68	12.94	12.82	12.74	12.773
	6	12.69	12.56	12.66	12.59	12.88	12.76	12.66	12.686
	8	12.77	12.49	12.56	12.49	12.79	12.68	12.57	12.621
	10	12.62	12.42	12.48	12.42	12.72	12.6	12.47	12.533
	12	12.56	12.36	12.4	12.36	12.64	12.5	12.38	12.457
Week 3 days 15-21	0	12.95	12.9	12.91	12.8	13.1	13.13	12.97	12.966
	2	12.85	12.84	12.83	12.73	13	13.03	12.91	12.884
	4	12.76	12.78	12.75	12.67	12.91	12.94	12.84	12.807
	6	12.7	12.71	12.68	12.57	12.81	12.86	12.78	12.730
	8	12.62	12.64	12.59	12.48	12.7	12.67	12.7	12.629
	10	12.54	12.55	12.49	12.39	12.64	12.57	12.61	12.541
	12	12.44	12.46	12.41	12.33	12.55	12.51	12.53	12.461
Week 4 days 22-28	0	12.8	12.92	12.75	12.94	12.9	12.8	12.85	12.851
	2	12.74	12.82	12.69	12.88	12.82	12.74	12.79	12.783
	4	12.67	12.72	12.62	12.82	12.73	12.67	12.71	12.706
	6	12.61	12.66	12.55	12.74	12.64	12.59	12.63	12.631
	8	12.52	12.59	12.46	12.67	12.56	12.52	12.54	12.551
	10	12.43	12.51	12.39	12.61	12.5	12.44	12.46	12.477
	12	12.37	12.42	12.33	12.52	12.41	12.35	12.4	12.400
Week 5 days 29-35	0	12.9	13	12.97	12.9	12.9	12.8	12.85	12.903
	2	12.84	12.94	12.88	12.84	12.82	12.73	12.78	12.833

Week 1 days 1-7	Hour	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Average ouput voltage
February	4	12.75	12.86	12.79	12.78	12.74	12.65	12.71	12.754
Starts @ day 4	6	12.66	12.77	12.72	12.72	12.64	12.56	12.63	12.671
	8	12.6	12.69	12.64	12.62	12.57	12.49	12.54	12.593
	10	12.5	12.6	12.55	12.56	12.48	12.43	12.44	12.509
	12	12.4	12.5	12.45	12.5	12.39	12.36	12.36	12.423
Week 6 days 36-42	0	13	12.97	12.9	12.95	12.85	12.8	12.8	12.896
	2	12.9	12.91	12.82	12.88	12.75	12.74	12.72	12.817
	4	12.84	12.63	12.75	12.81	12.67	12.68	12.64	12.717
	6	12.77	12.73	12.66	12.72	12.61	12.6	12.58	12.667
	8	12.67	12.64	12.58	12.64	12.55	12.53	12.5	12.587
	10	12.59	12.56	12.48	12.56	12.48	12.44	12.43	12.506
	12	12.52	12.47	12.42	12.47	12.4	12.38	12.37	12.433
Week 7 days 43-49	0	12.9	12.84	12.9	12.89	12.9	12.92	12.78	12.876
	2	12.82	12.7	12.82	12.83	12.82	12.84	12.72	12.793
	4	12.73	12.62	12.73	12.77	12.74	12.76	12.64	12.713
	6	12.66	12.54	12.66	12.69	12.66	12.67	12.57	12.636
	8	12.6	12.46	12.58	12.62	12.6	12.59	12.43	12.554
	10	12.51	12.39	12.51	12.55	12.53	12.52	12.36	12.481
	12	12.41	12.33	12.43	12.48	12.46	12.44	12.3	12.407
Week 8 days 49-56	0	12.8	12.92	12.94	12.9	12.87	12.8	12.9	12.876
	2	12.73	12.84	12.86	12.84	12.8	12.73	12.83	12.804
	4	12.66	12.77	12.78	12.77	12.73	12.65	12.77	12.733
	6	12.58	12.7	12.71	12.69	12.65	12.59	12.69	12.659
	8	12.51	12.62	12.62	12.62	12.58	12.52	12.63	12.586
	10	12.42	12.53	12.52	12.53	12.51	12.44	12.54	12.499
	12	12.35	12.45	12.45	12.46	12.41	12.36	12.48	12.423

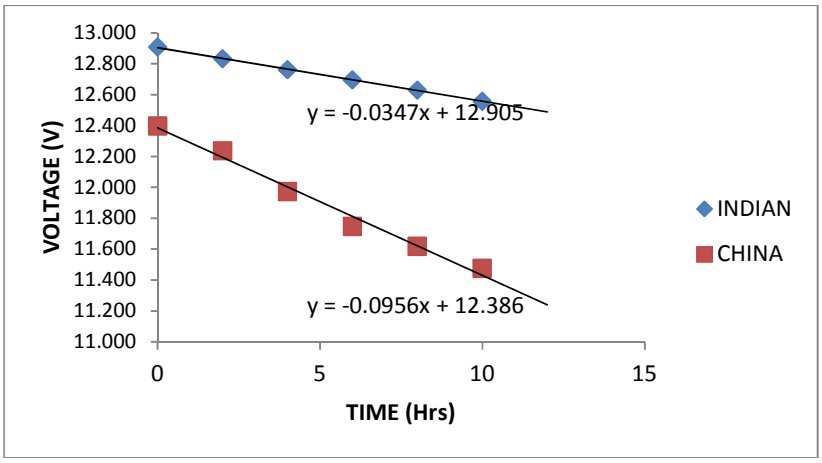

Fig. 1. Graph of average output voltage against time in week one for Indian made battery and Chinese made battery

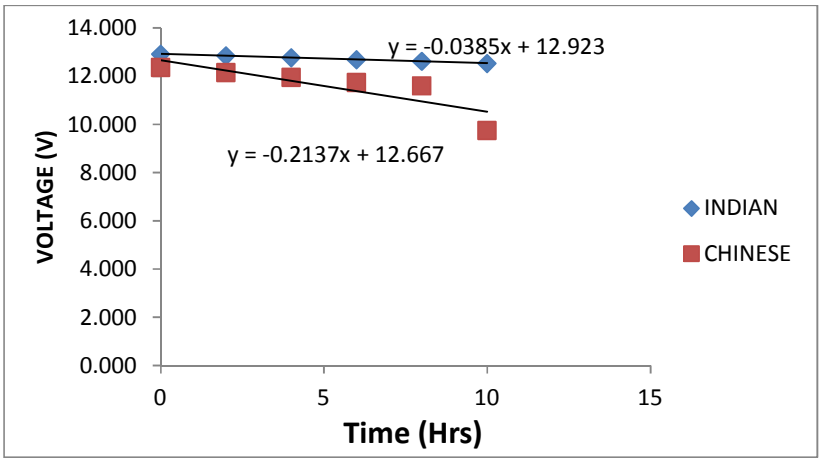

Fig. 2. Graph of average output voltage against time in week two for Indian made battery and Chinese made battery

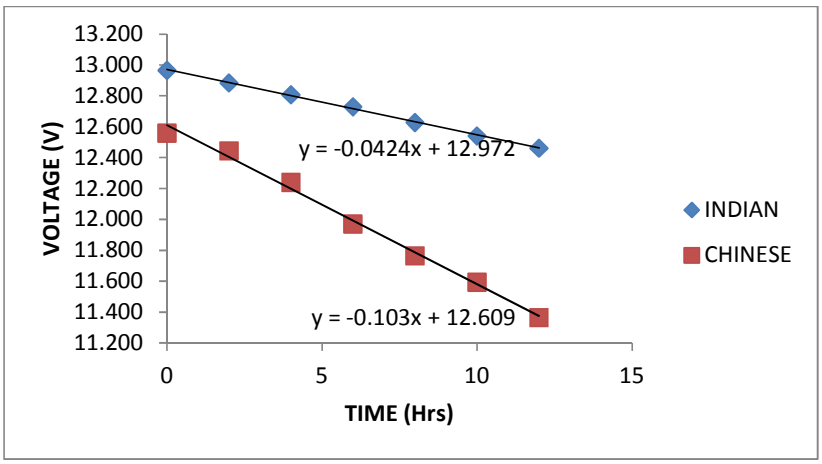

Fig. 3. Graph of average output voltage against time in week three for Indian made battery and Chinese made battery

Table 2. The output voltage of Chinese made battery with time

Week 1 days 1-7	Hour	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Average output voltage
19.00 HRS	0	12.56	12.55	12.47	12.44	12.22	12.02	12.52	12.397
January	2	12.37	12.36	12.27	12.34	12.02	11.82	12.48	12.237
	4	12.17	12.16	11.97	12.14	11.83	11.62	11.92	11.973
	6	11.87	11.86	11.78	11.84	11.64	11.52	11.72	11.747
	8	11.77	11.76	11.58	11.74	11.54	11.42	11.52	11.619
	10	11.47	11.57	11.48	11.64	11.43	11.32	11.42	11.476
07.00HRS	12	Tripped off	11.43	11.41	11.45	11.32	Tripped off	Tripped off	6.516
Week 2 days 8-14	0	12.35	12.39	12.44	12.55	12.49	12.38	12	12.371
	2	12.15	12.09	12.25	12.35	12.29	12.19	11.81	12.161
	4	11.95	11.89	11.95	12.19	12.09	11.99	11.61	11.953
	6	11.7	11.69	11.89	11.87	11.89	11.79	11.41	11.749
	8	11.5	11.49	11.69	11.97	11.69	11.59	11.31	11.606
	10	11.3	Tripped off	11.44	11.65	11.49	11.29	11.11	9.754
	12	Tripped off	Tripped off	11.25	11.52	11.29	Tripped off	11.01	6.439
Week 3 days 15-21	0	12.48	12.74	12.9	12	12.7	12.54	12.56	12.560
	2	12.28	12.7	12.71	12.2	12.5	12.34	12.38	12.444
	4	12.09	12.5	12.51	12	12.25	12.15	12.18	12.240
	6	11.75	12.26	12.21	11.75	11.95	11.95	11.93	11.971
	8	11.7	11.9	12.01	11.55	11.75	11.7	11.74	11.764
	10	11.5	11.8	11.81	11.45	11.55	11.5	11.54	11.593
	12	11.3	11.5	11.51	11.25	11.35	11.3	11.34	11.364
Week 4 days 22-28	0	12.57	12.58	12.37	12.09	12.08	12.15	12.8	12.377
	2	12.37	12.38	12.27	11.89	11.98	11.95	12.6	12.206
	4	12.18	12.08	12.07	11.79	11.79	11.7	12.54	12.021
	6	11.88	11.89	11.88	11.54	11.61	11.5	12.1	11.771
	8	11.68	11.69	11.68	11.34	11.41	11.34	11.96	11.586
	10	11.48	11.49	11.33	Tripped off	11.31	Tripped off	11.9	8.216
	12	11.29	Tripped off	Tripped off	Tripped off	Tripped off	Tripped off	11.55	3.263
Week 5 days 29-35	0	12.9	12.5	12.4	12.7	12.7	12.97	12.94	12.730
	2	12.7	12.31	12.2	12.56	12.86	12.71	12.84	12.597

Week 1 days 1-7	Hour	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Average output voltage
February	4	12.4	12.11	12.01	12.36	12.61	12.47	12.64	12.371
Starts @ day 4	6	12.21	11.81	11.71	12.19	12.26	12.28	12.34	12.114
	8	11.91	11.71	11.51	11.8	12.11	12.08	12.24	11.909
	10	11.71	11.61	11.31	11.7	11.65	11.98	12.14	11.729
	12	11.41	11.41	Tripped off	11.47	11.45	11.91	11.95	9.943
Week 6 days 36-42	0	12.72	12.52	12.75	12.7	12.79	12.94	12.65	12.724
	2	12.52	12.32	12.54	12.65	12.59	12.75	12.45	12.546
	4	12.33	12.26	12.34	12.45	12.39	12.55	12.07	12.341
	6	12.41	12.12	12.09	12.2	12.19	12.39	11.87	12.181
	8	12.04	12.02	11.83	12	11.99	11.94	11.6	11.917
	10	11.93	11.92	11.63	11.8	11.79	11.75	11.35	11.739
	12	11.82	11.72	11.3	11.6	11.59	11.35	11.35	11.533
Week 7 days 43-49	0	12.74	12.8	12.5	12.28	12.58	12.2	12.05	12.450
	2	12.55	12.6	12.31	12.58	12.38	11.82	11.85	12.299
	4	12.34	12.35	12.11	12.38	12.16	11.62	11.65	12.087
	6	12.34	12.15	11.91	12.07	11.83	11.42	11.45	11.881
	8	11.83	11.91	11.81	11.92	11.65	Tripped off	Tripped off	11.824
	10	11.63	11.71	11.61	11.68	11.43	Tripped off	Tripped off	11.612
	12	11.43	11.51	11.51	11.48	Tripped off	Tripped off	Tripped off	6.561
Week 8 days 50-56	0	12.4	12.56	12.57	12.58	12	12.59	12.08	12.397
	2	12.2	12.36	12.52	12.37	11.81	12.39	11.88	12.219
	4	11.9	12.11	12.12	12.12	11.61	12.2	11.68	11.963
	6	11.7	11.81	11.82	11.82	11.41	11.9	11.48	11.706
	8	11.4	11.61	11.62	11.62	Tripped off	11.7	Tripped off	11.563
	10	Tripped off	11.42	11.42	11.42	Tripped off	11.51	Tripped off	6.539
	12	Tripped off	Tripped off	Tripped off	Tripped off	Tripped off	11.31	Tripped off	1.616

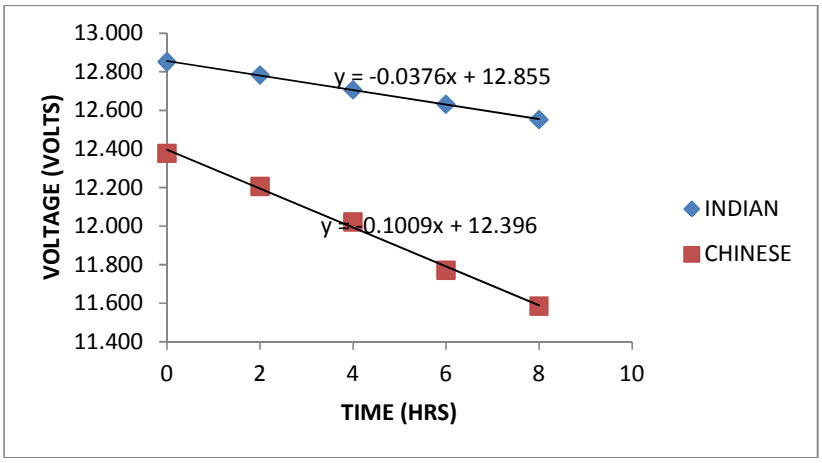

Fig. 4. Graph of average output voltage against time in week four for Indian made battery and Chinese made battery

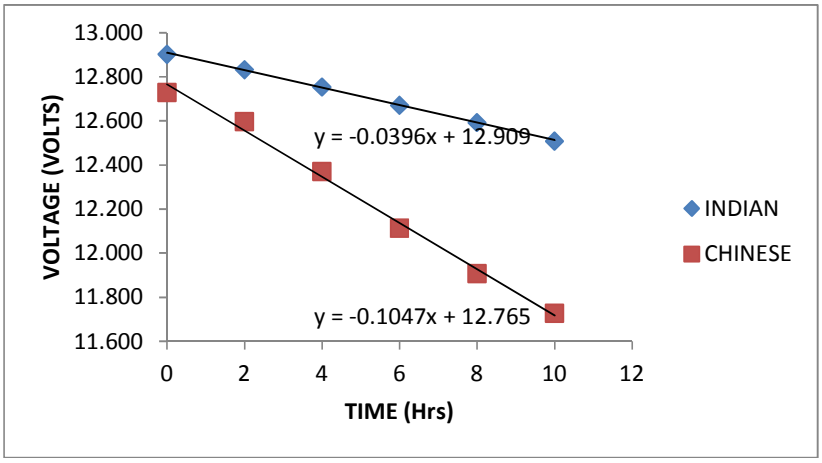

Fig. 5. Graph of average output voltage against time in week five for Indian made battery and Chinese made battery

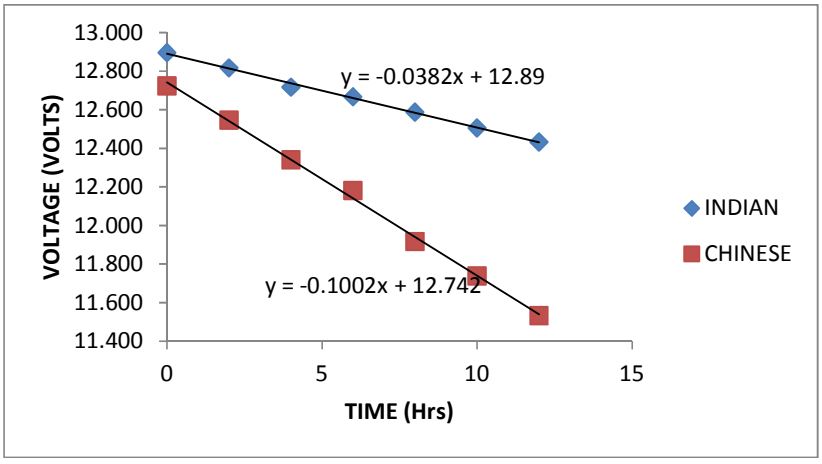

Fig. 6. Graph of average output voltage against time in week six for Indian made battery and Chinese made battery

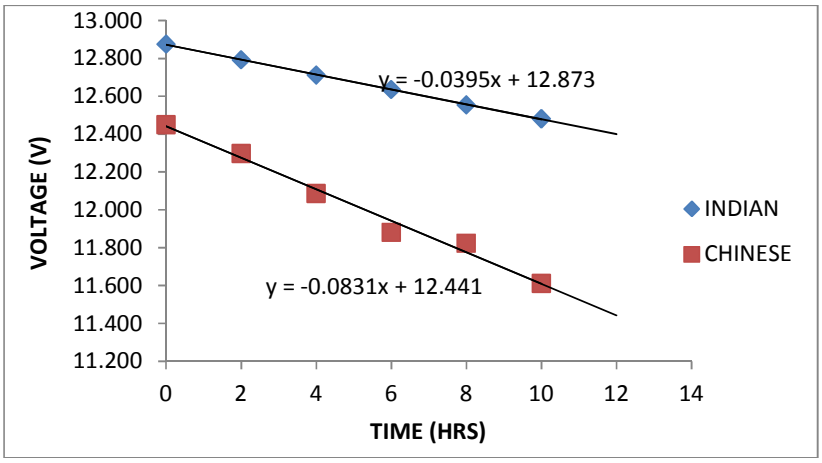

Fig. 7. Graph of average output voltage against time in week seven for Indian made battery and Chinese made battery

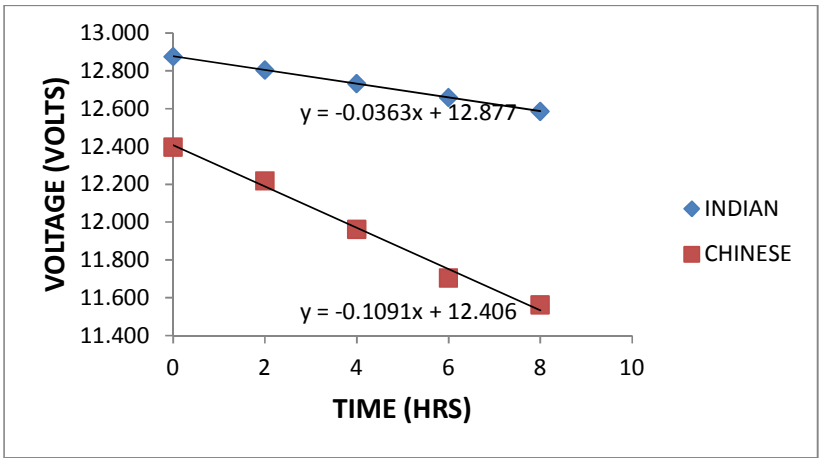

Fig. 8. Graph of average output voltage against time in week eight for Indian made battery and Chinese made battery

For each of the Figs. 1 to 8, the equation of the lines of best fit for both Indian and the Chinese series were computed. The equation shows that for each of the weeks the discharge rate of the Indian battery is significantly low ie -0.034, -0.038, -0.042, -0.037, -0.039, -0.038, -0.039 and -0.036 Volts/hr per week from week one to week eight respectively whereas the Chinese made solar battery has a relatively high discharge rate of Voltage/hr per week within the first eight weeks of its use having its rate at -0.095, -0.213, -0.103, -0.1, -0.104, -0.1, -0.083 and -0.109Volt/hr per week from week one to week eight.

4. CONCLUSIONS

Based on the relevant steps taken on the foregoing research, the following conclusions are hereby drawn. Both the Indian and Chinese made solar batteries are usable in Anambra State metropolitan. In the first two months of the year, the Indian made Solar battery has insignificant discharge tendency of -0.034, -0.038, -0.042, -0.037, -0.039, -0.038, -0.039 and -0.036 Volts/hr per week from week one to week eight respectively and the Chinese made Solar battery has a significant discharge tendency of -0.095, -0.213, -0.103, -0.1, -0.104, -0.1, -0.083 and -0.109Volt/hr per week from week one to week eight. while in use. The erratic performance which characterizes the Chinese made battery is most likely owing to its poor charging capacity thereby completely off in some of its days of use hence the Indian made the battery is preferable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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