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ANALYSIS OF TILT ANGLE AND BATTERY CHARGING TIME OF ELECTRICAL POWER REQUIREMENTS FOR WOOD CUTTING EQUIPMENT PURPOSES

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ABSTRACT

Solar panels are a tool that serves to convert sunlight into electrical voltage, sunlight itself contained energy in the form of photons. In this photon hit the surface of the electron solar cell panel that will be excited and cause electricity. This is known as the photoelectric principle. Every day the earth rotates on its axis while orbiting along the ellipse. Where along the plane of the earth's orbit is called the ecliptic plane so that it affects the geothermal received. So in this study analyzed the angle of the panel with the battery charging time needed on wood cutting equipment. The results of testing and observation show that the most effective tilt angle with the highest power is an angle of 30°. Where the intensity of sunlight received by solar panels is very influential that determines the amount of electrical output or power generated by solar panels. Due to erratic weather and average power generated during 7 hours of measurement and observation produces 55.29 Watts then the power passed on the scc (controller) for the battery charging time for 7 hours then (7 hours × 55.29 Watt = 387.03 Watts / h) after being calculated to get a total load of 328.98 Wh and the length of battery charging time at full condition (full) is 1.64 Hours (h) with the slope angle sample taken is an angle of 30° with power highest.

Keywords*:* Batteries, Controllers, Solar Panels, Wood Cutters.

1.1 INTRODUCTION

Solar energy or sunlight can be obtained well in Indonesia because Indonesia is a tropical country. For this reason, sunlight energy is an alternative energy that can be used to save current electrical energy through energy conversion. Conversion is knowledge that transforms or processes energy into new energy or another to be utilized. Behind the high demand for energy today where the times advance or technology, sunlight energy is the most efficient alternative energy and is needed to be utilized and is very friendly to the environment.

The use of sunlight energy is very appropriate to be carried out to support in a down economic situation because the use of sunlight energy has the potential and economic value for people's productive activities in the field of renewable technology. The conversion of sunlight energy into electrical energy is needed in daily activities and converting can be done using solar cells or solar panels.

A solar panel or solar cell is a photovoltaic cell of an electrical device that converts light energy directly into electrical energy by the photovoltaic effect. The function of solar cells is to capture energy from sunlight, which will later be converted into electrical energy that is channeled to a 12V battery and used or applied to wood cutting tools. With the background above, the author wants to analyze an electrical device using solar energy, namely with the title " Analysis of Tilt Angle and Battery Charging Time of Electrical Power Requirements for Wood Cutting Equipment Purposes ".

2.1 BASIC THEORY

Photoelectric Effect is obtained from observations on a metal plate that releases photon particles of light energy when exposed to solar light photons continue to urge metal atoms and photon energy particles occur which are light energy waves. Solar panels utilize sunlight as a source of electricity generation, the main tool for capturing, changing and generating electricity is Photovoltaic or what is called the Solar Cell Panel Module. With this tool, sunlight is converted into electricity through the process of negative and positive electron flow in the solar cell due to the difference in electrons, the result of the electron flow will be DC electricity which can be directly used to charge the battery, the battery according to the voltage and amperes needed, the main component of the solar cell is installed facing the sun with high intensity then connect it with the battery/battery for the storage medium of DC

current electrical energy, For the use of AC current we connect with the AC converter and are ready to be used for household purposes and other production purposes according to the voltage needed.

Figure 1. Solar Panels

Every day the earth rotates on its axis while performing an orbit along the length of the ellipse. as figure 1 shows where along the plane of the earth's orbit is called the ecliptic plane. the earth rotates with an inclination of 23.45 against the plane of circulation with that angle of inclination. this is what causes the change of seasons where on March 21 and September 21 the line from the center of the sun to the earth passes through the equator in all parts of the earth so that there is an equivalence of time between day and night, which is the same – equal 12 hours. On December 21, winter occurred in the north of the earth, where the slope of the north pole reached the highest angle to the sun (23.45) while on June 21, the opposite process occurred.

3.1 RESEARCH METHOD

The process of designing and manufacturing solar panels applied to wood cutting machines needs to carry out design, so the preparatory stages are carried out, namely literature studies and field surveys to find out the factors that affect the design of solar panels applied to the wood cutting machine. The following are the factors in the process of this study.

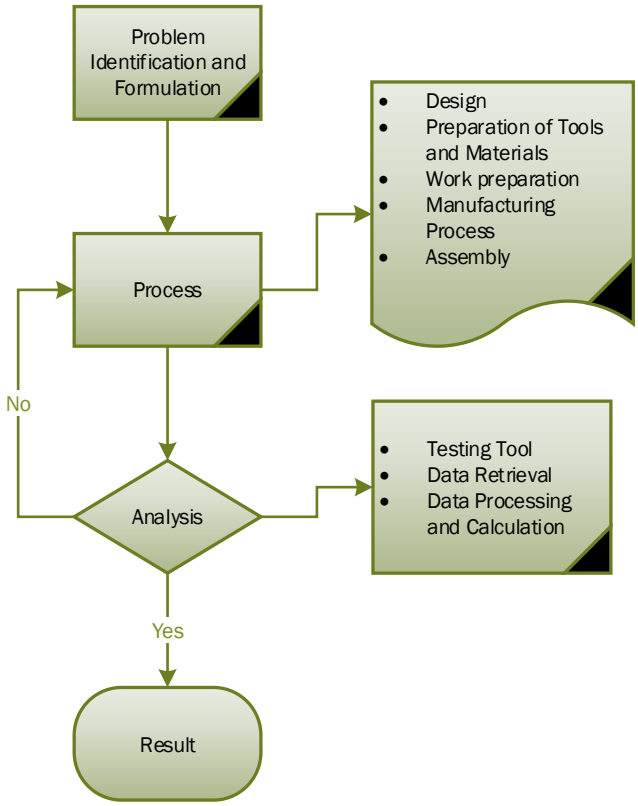

Figure 2. Solar Panel Process Flow

4.1 RESULT AND DISCUSSION

The test was carried out using 50 wp polycrystal solar panels. This data collection is located in indaprasta North Bogor, data collection is carried out for one month on March 20 – April 20, 2021. The data collection process starts from 09.00 WIB – 15.00 WIB per 60 minutes once and once a week with different angles ranging from 30°, 45°, 60°, 75°. The data taken and observed are power, current and voltage from the solar panel to the scc(controller) and from the scc(controller) to the battery.

The first test was carried out with an inclination angle of 30° and directed towards the north with not very strong matahri light\radiation because it was cloudy and the sun was covered by thick clouds. Suplay testing from the solar panel to the scc (controller) carried out on the first day with an inclination angle of 30º, then the second day with a sudur of 45°, the third limit of 60°, and finally the fourth day 75°, Here is the result of the value of voltage, current and power from the SCC to the Battery: (WIT : West Indonesia Time)

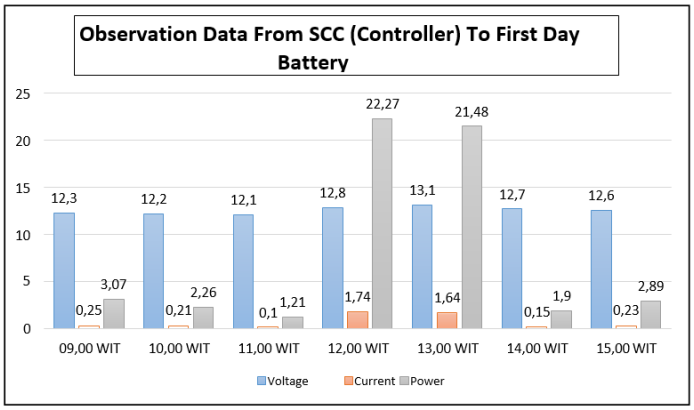

Figure 3. Graph of Observation Data From SCC (Controller) To Battery On Day One

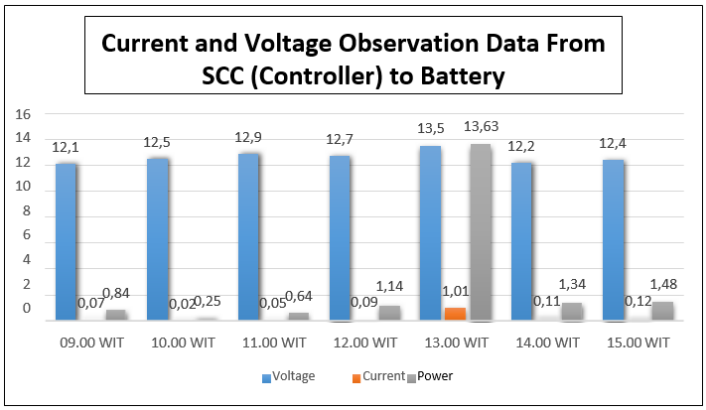

Figure 4. Current And Voltage Observation Data Graph From SCC (Controller) to Second Day Battery

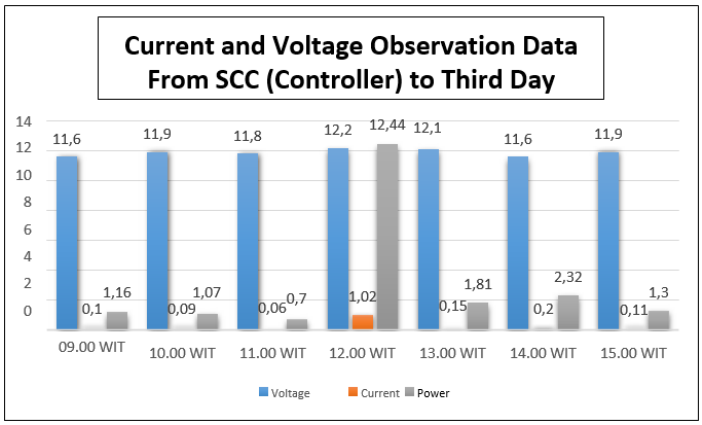

Figure 5. Current and Voltage Observation Data Graph From SCC (Controller) to Third Day Battery

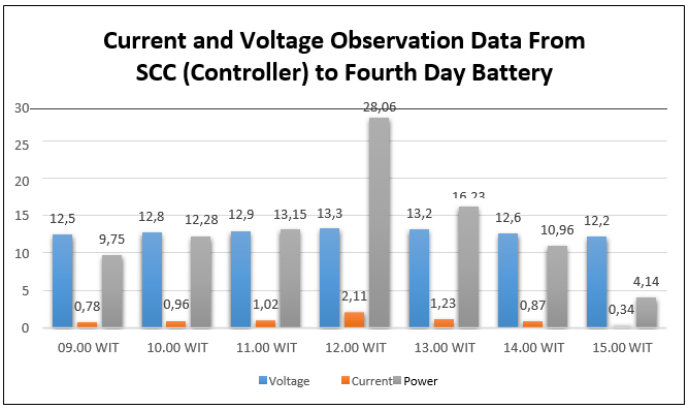

Figure 6. Current and Voltage Observation Data Graph From SCC (Controller) To Fourth Day Battery

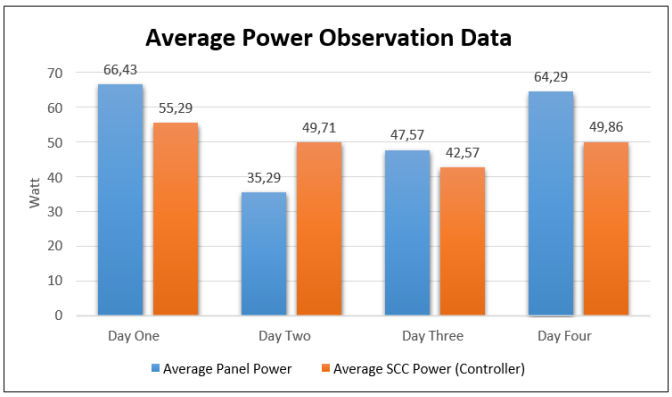

Figure 7. Panel and SCC (Controller) Average Power Observation Data Graph

The graph above shows the results of observations and tests of average power supply from the panel to the scc (controller) and power supply from the scc (controller) to the battery from the first day to the fourth day. The lowest average power from the panel to the scc (controller) on the four days of observation was found in the second, which was 35.29 Watts and the highest on the first day was 66.43 Watts.

Meanwhile, the lowest average power from the scc (controller) to the battery on the four days of observation was on the third day, which was 42.57 Watts and the highest on the first day was 55.29 Watts. The existence of current and voltage restrictions that enter the scc (controller) is what causes the current and voltage data from the scc (controller) to the battery to always be below the current and voltage from the panel to the scc (controller).

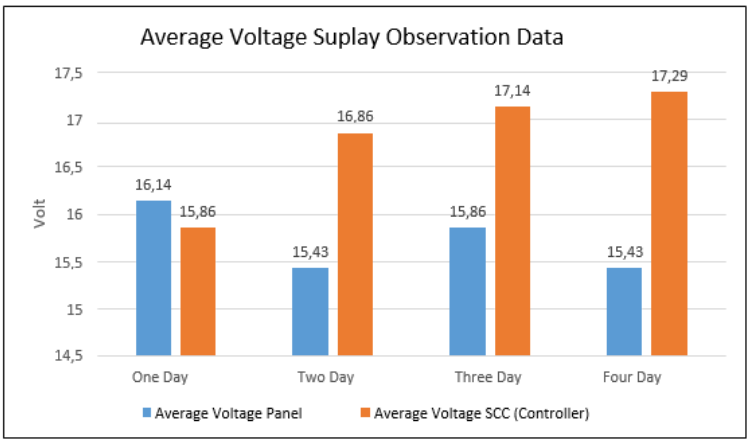

Figure 8. Panel and SCC Average Voltage Suplay Observation Data Graph (Controller)

The table and graph above shows the results of observations and tests of the average voltage supply from the panel to the scc (controller) and the voltage supply from the scc (controller) to the battery starting from the first day to the fourth day. And the lowest average voltage from the panel to the scc (controller) was on the second day, which was 15.43 Volts and the highest on the first day was 16.14 Volts.

Meanwhile, the lowest average voltage from the scc (controller) to the battery on the four days of observation was on the first day, which was 15.86 Volts and the highest on the fourth day was 17.29 Volts.

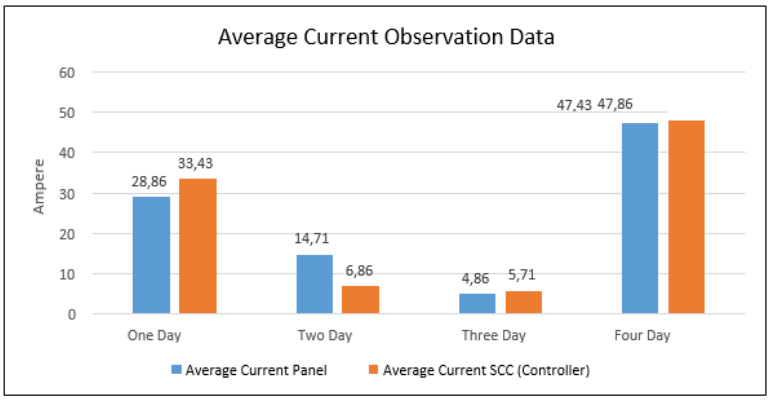

Figure 9. Data Graph of Average Current Observation Results – Average Panel and SCC (Controller)

From the table and graph above, the results of observations and tests of the average current supply from the panel to the scc (controller) and the current supply from the scc (controller) to the battery from the first day to the fourth day. And the lowest average current from the panel to the scc (controller) was found on the third day, which was 4.86 Amperes and the highest was on the fourth day, which was 47.43 Amperes.

Meanwhile, the lowest average current from the scc (controller) to the battery from the four days of testing was found on the third day, which was 5.71 Amperes and the highest was found on the fourth day, which was 47.86 Amperes.

Battery Charging Time When Full

In erratic weather when taking data with the highest average power of 55.29 Watts (Table 4.2), from the table can be determined the value of the installed battery by:

a) Because the average power generated during the 7 hours of measurement and observation produced 55.29 Watts, the power passed on the scc (controller) for the 7-hour battery charging time was then (7 hours × 55.29 Watts = 387.03 Watts / hour).

b) The amount of power passing through the scc (controller) can be known how much it is and the maximum power that the load can use. The installed Scc (controller) can deliver 387.03 Watts of power for 7 hours of sun irradiation for one day. For power generation of solar energy losses (losses) of the system are considered to be 15 %.

EB = EP – (losses - system losses)
= Ep – (15%× EP)
= 387,03 Watt hour – (15% × 387,03 Watt hour)
= 387,03 Watt hour – 58,05
= 328,98 Watt/ hour

So the total energy produced is 328.98 Wh.

Then to calculate the time of charging the battery used 12V 45 Ah battery is to use the following formula:

$$t = \frac{\Sigma \text{ battery power capacity}}{\Sigma \, panel \; power \; per \; day}$$

$$= \frac{60 \text{ Ah } = 12 \times 60 = 720 \text{ Wh}}{328{,}98 \text{ Wh}}$$

$$= 2.18 \, h$$

The time required is 2.18 hours for the battery charge with the angle of inclination sample taken at a 30° angle with the highest power and when the battery condition is full on the first day of observation. The time required is 2.18 hours for the battery charge with the angle of inclination sample taken at a 30° angle with the highest power and when the battery condition is full on the first day of observation. In uncertain weather when taking data with the highest average power when the battery condition is low is 49.86 Watts (Table 4.8), from the table can be determined the value of the installed battery by:

a) Because the average power generated during the 7 hours of measurement and observation produced 49.86 Watts, the power passed on the scc (controller) for the 7-hour battery charging time was then (7 hours × 49.86 Watts = 349.02 Watts / hour).

b) The amount of power passing through the scc (controller) can be known how much it is and the maximum power that the load can use. The installed Scc (controller) can deliver 349.02 Watts of power for 7 hours of sun irradiation for one day. For power generation of solar energy losses (losses) of the system are considered to be 15 %.

EB = EP – (losses - system losses)
= Ep – (15%× EP)
= 349,02 Watt Hour – (15% × 349,02 Watt Hour)
= 349,02 Watt Hour – 52,35
= 296,67 Watt / Hour

Then to calculate the time of charging the battery used 12V 45 Ah battery is to use the following formula:

$$t = \frac{\Sigma \text{ battery power capacity}}{\Sigma \, panel \; power \; per \; day}$$

$$= \frac{60 \text{ Ah } = 12 \times 60 = 720 \text{ Wh}}{296{,}67 \text{ Wh}}$$

$$= 2{,}42 \text{ h}$$

So the time required to charge the battery when the condition is low (low) is 2.42 hours to arrive at full condition (full) with the highest power sample at the angle of inclination taken is 75° where when the battery condition is low (low) on the fourth day of observation.

5.1. Conclusion

The data collection process starts from 09.00 WIB – 15.00 WIB per 60 minutes once and once a week with different angles ranging from 30°, 45°, 60°, 75°. From the results of observations and tests with several angles of tilt, the average power of each angle of inclination used is obtained. And the highest power is obtained from the results of observation and testing of the average power supply from the panel to the scc (controller) and the power supply from the scc (controller) to the battery from the first day to the fourth day. The lowest average power from the panel to the scc (controller) on the four days of observation was found in the second, which was 35.29 Watts with an inclination angle of 45° and the highest on the first day was 66.43 Watts with an inclination angle of 30°. While the lowest average power from the scc (controller) to the battery on the four days of observation was on the third day, which was 42.57 Watts with an inclination angle of 60° and the highest on the first day was 55.71 Watts with an inclination angle of 30°. From testing and observation the most effective and highest power angle of inclination is an angle of 30°. And the intensity of sunlight received by solar panels is very influential which determines the magnitude of the output of electricity or power generated by solar panels.

Due to the erratic weather and the average power generated during the 7 hours of measurement and observation produced 55.29 Watts, the power passed on the scc (controller) for the 7-hour battery charging time then (7 hours × 55.29 Watts = 387.03 Watts / hour) after calculating gets a total load of 328.98 Wh and the length of time for charging the battery when it is full is 1.64 hours (h) with a sample of the angle taken is a 30° angle with power highest And 49.86 Watts then the power passed on the scc (controller) for the battery charging time for 7 hours then (7 hours × 49.86 Watts = 349.02 Watts / hour) after calculating gets a total load of 296.67 Wh and the length of battery charging time at low conditions is 1.82 Hours (h) with the highest power sample at the angle of inclination taken is 75°.

The electrical circuit of the wood cutting equipment unit used at the time of observation of the required voltage of 230 Volts with the power input must reach 600 Watts to move or operate the blade drive motor as wood cutting equipment.

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