MITIGATION OF SOLAR CELL HEAT BY USING SUNSCREEN FILM

Parlin Siagian*, **Hamdani**, **M. Erpandi Dalimunthe**
Electrical Engineering Department, Universitas Pembangunan Panca Budi, Indonesia
Corresponding author: parlinsiagian@dosen.pancabudi.ac.id

ABSTRACT

Solar power plants (PLTS) generate electricity from solar cells that are exposed to sunlight. The high and low voltage produced is dependent on the amount of sunlight that hits the solar cell panel. The intensity of exposure to sunlight that is too high will cause heat in the solar cell panels. Excessive heat above 50C will have an impact on decreasing the ability of solar cell panels. Previous studies have discussed a lot about the effect of sunlight that is too high to reduce the ability of solar cell panels. Solar cell cooling techniques have been discussed in previous studies. This research was made to mitigate excessive heat in solar cell panels. The technique used is to reduce the intensity of sunlight hitting the panel by coating the top that receives sunlight with sunscreen. With this layer, excess solar heat in the solar cell will be partially reflected into the air. The sunscreen filter will lower the output voltage of the solar panel because the sun's energy reaching the surface of the panel is reduced. The voltage drop generated by solar panels occurs because of the presence of a screen that reduces the lumen of light that penetrates the sunscreen.

Keywords: Film, Mitigation, Solar Cell, Sunscreen, Temperature

INTRODUCTION

The growth of the world's population will naturally be followed by the increasing demand for electrical energy. The increase in the need for electrical energy is due to technological developments that require the use of equipment used to petrify human life almost entirely using electric power.(Anggita & Pasaribu, 2018)(Manyika et al., 2013) Electric power is increasingly needed by humans both living in urban areas and remote or rural areas. Therefore, sources of electrical energy must be available wherever humans are. The availability of electrical energy will make human life easier and more advanced (Geographic, 2022).

Energy is a part that will never be separated from human life, everything on this earth requires energy to do something, but the energy currently used by humans is not yet maximized, we still depend on fossil energy which is limited and will eventually run out, even though it is still There are many other alternative energies that can be utilized, such as solar energy sources. In an effort to utilize solar energy sources, an application of photovoltaic technology is needed to meet human energy needs (Irena International renewable Energy Agency, 2018).

The increasing demand for electrical energy by humans must be followed by the availability of sources of electrical energy generation in all places that are easily accessible by humans and cheap in price. So that it is necessary to add electrical energy generators both in number and the technology used (PLN Persero, 2021).

One alternative source of electrical energy is PLTS (Solar Power Plant).(Mulyadi, 2018) The factor for choosing PLTS as an alternative source of electrical energy is because Indonesia has a very adequate source of solar energy, where the smallest average solar energy source in Indonesia is 4.53-4.57 kWh/m2/day (Harahap, 2021). To support the use of this type of generator, it is necessary to monitor performance on a regular basis. This monitoring will be difficult to do if the human resources are inadequate and access to PLTS is difficult. So it is necessary to create a system that facilitates monitoring the performance of PLTS.

This system measures PV mini-grid conditions and the parameters that affect PV mini-grid performance. These parameters are photovoltaic voltage, photovoltaic current, photovoltaic surface temperature, PLTS environmental temperature and solar irradiance (Harahap, 2021).

LITERATURE REVIEW

Effect of Temperature on Solar Cell

The sun is the main energy source for most of the processes that occur on the surface of the earth, one of these processes is the use of solar energy to be used as a source of electrical energy, where by using solar panels solar energy is captured and converted into electrical energy whose output is in the form of voltage and voltage. electric current (Yandri, 2012).

The voltage and electric current produced by solar cells are influenced by two physical variables, namely the intensity of solar radiation and ambient temperature. The amount of current and output voltage of a PV mini-grid system, depends on the temperature, cloud conditions (shadow) and wind speed in the surrounding environment where the solar panels are placed (Hattu, Wabang, & Palinggi, 2018).

Solar Irradiance

Solar irradiance consists of two words, namely solar which means the sun and irradiance which means the amount of light energy from one object that hits one square meter of another object every second. Solar irradiance is the power per area received from the sun in the form of electromagnetic waves with units of W/m2.(Wid, 2019) Solar irradiance can be measured after absorption and scattering by the atmosphere, by being perpendicular to the incoming light. Irradiance itself is a function of the distance of the sun, the solar cycle, and changes in the path of the solar cycle (Yuliananda, Sarya, Teknik, & Teknik, 2015)(Suryana & Ali, 2016).

Photons that carry this energy have wavelengths from energetic X-rays and gamma rays to visible light to infrared and radio. This can be measured for any luminous object, including stars, the Moon, and the overly bright high beams of oncoming cars. Humans emit infrared light primarily; Infrared image of man shows a very active heart and mind. Solar irradiance is the output of light energy from the entire disk of the Sun, measured on Earth. It sees the Sun as we see it as a star, not as an image (Musthafa, 2015).

Measuring spectral radiation is important because different wavelengths (or colors) of sunlight are absorbed in different parts of our atmosphere. We feel warm because of visible and infrared radiation that reaches the surface.(Mottar, Butcher, & Parkinson, 2016) Ultraviolet light creates the ozone layer and is then absorbed by that ozone. Higher ultraviolet light creates the thermosphere, which is ionized by light at the shorter wavelengths of the extreme ultraviolet (EUV). Since radio communication is affected by the formed ions, changes in the solar EUV output are a major concern of Space Weather (Luh, Mustia, Suyanto, Bagus, & Kusuma, 2018).

Energy from other sources also enters our atmosphere. A table of some of them is shown below. Note that the energy input from Joule heating, the merging of the ionosphere to the magnetosphere, can be nearly the same as from the solar EUV.
Sources of energy for the Earth's atmosphere can be seen in the table below:

Table 1. Energy sources in the atmosphere.(Nasa, 2022)

Source: Solar Radiation	Energy Flux	Solar Cycle Change		Deposition Altitude	Ion?
TSI (mostly Visible & Infrared)	1366 W/m2	1.2 W/m2	0.1%	Surface	Low
MUV (200-300 nm)	15.4 W/m2	0.17 W/m2	1%	15-50 km	Low
FUV (126-200 nm)	50 mW/m2	15 mW/m2	30%	30-120 km	Mod.
EUV (0-125 nm)	10 mW/m2	10 mW/m2	100%	80-250 km	High
Source: Particles	**Energy Flux**	**Solar Cycle Change**		**Deposition Altitude**	**Ion?**
Galactic Cosmic Rays	0.7 µW/m2	0.7 µW/m2	50%	0-30 km	High
Solar Protons	2 mW/m2	2 mW/m2	100%	30-90 km	High
Auroral protons & electrons	1 mW/m2	20 mW/m2		100-120 km	Mod.
Joule Heating	20 mW/m2	2 W/m2		100-150 km	Mod.

Several factors affect the intensity of solar irradiance

a. The solar cycle is a cycle of once every eleven years when the number of sunspots varies. During the period of the most active, or solar maximum, the number of sunspots increases to its peak, while during the period of lowest activity, or solar minimum, the number of sunspots decreases to its lowest point. The last solar maximum period was in 2001. The solar cycle doesn't always last exactly eleven years; this cycle can appear as early as 9 years, and no later than 14 years (“https://www.bis.sidc.be/silso/ssngraphics,” 2022)

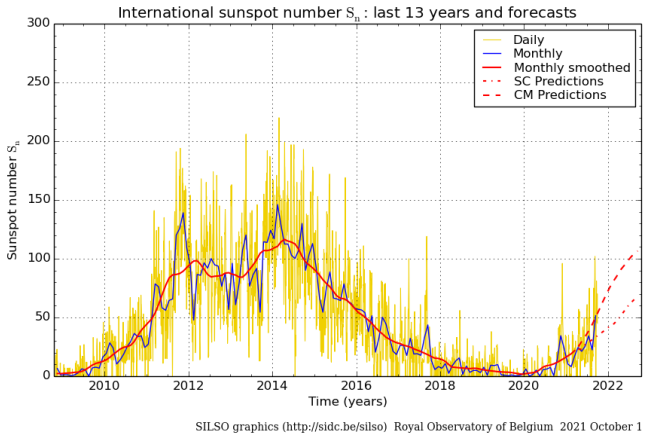

Figure 1. Daily and Monthly Sunspot Count (last 13 years)(“https://www.bis.sidc.be/silso/ssngraphics,” 2022)

b. Absorption and reflection, some of the solar irradiation that reaches the earth will be absorbed and the rest reflected by the atmosphere. Usually the absorbed radiation is converted into heat energy, and causes an increase in the ambient temperature. But PLTS or nature, can convert the absorbed radiation into other forms such as electricity or chemical bonds, such as in the photovoltaic cell effect or photosynthesis in plants.

c. The atmosphere is a layer of gas that surrounds a planet, including Earth, from the planet's surface too deep in outer space. On Earth, the atmosphere exists from a height of 0 m above ground level, up to about 560 km above the Earth's surface. The atmosphere is composed of several layers, which are named after the phenomena occurring in these layers. The transition from one layer to another is gradual. Earth's atmosphere consists of nitrogen (78.17%) and oxygen (20.97%), with a small amount

of argon (0.9%), carbon dioxide (variable, but about 0.0357%), water vapor and other gases. The atmosphere protects life on Earth by absorbing ultraviolet radiation from the Sun and reducing temperature extremes between day and night. 75% of the atmosphere is within 11 km of the planet's surface ("https://www.bis.sidc.be/silso/ssngraphics," 2022).

Photovoltaic Effect

Photovoltaic is a semiconductor device that converts photons (light) into electricity. This conversion is called the photovoltaic effect, in other words the photovoltaic effect is the electric potential energy that builds up between two dissimilar materials when a common junction is illuminated by photon radiation.

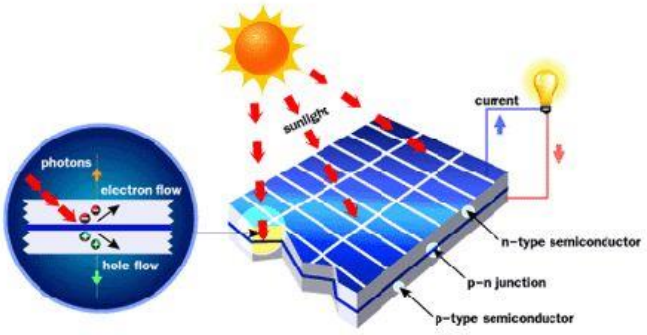

Figure 2. Simple Schematic of Photovoltaic System (ADI, Hantoro, & Roekmono, 2016)

Solar Irradiance consists of photons that have different energy levels. This difference in energy levels determines the wavelength of the light spectrum. When photons hit the surface of the PV cell, they can be refracted, or absorbed and passed through the PV cell. The photons absorbed by the PV cell are what will trigger the generation of electrical energy (Ibrahim, Gyuk, & Aliyu, 2019).

Temperature

Temperature is the degree of hotness of an object to other objects or the environment. Temperature is measured with a measuring instrument called a thermometer; there are several types of thermometers. In analysis, η_{NORM}(G,T) determined experimentally for each module and, as it is a unitless ratio, the performance of the modules is directly compared at different irradiance levels and module temperatures.. To determine η_{NORM}(G,T), minute average data for P(G,T), G and T of each module is put into a two-dimensional temperature and radiation container. Illumination sized 100 W/m^2. The lowest bin is 0 to 100 W/m^2 and more size, 1200 to 1300 W/m^2. The temperature bin has a width 10^{o}C. The lowest temperature container is 0 to 10^{o}C and the largest, 60 to 70^{o}C. P_{STC} and η_{STC} determined using the average power of the data points between 900 and 1100 W/m^2 and 20 to 30^{o}C (Pv, 2012).

The cooling component at the rear of the solar panel gives better results indicating that an increase in photoelectric conversion efficiency can be obtained by lowering the temperature. The conclusion that illustrates the better performance of the cooling system compared to ordinary panels is that cooling reduces the temperature by up to 4^{o}C to the maximum. Maximum 6.4% increase in output power and 2.6% increase in output efficiency (Sharma, Sellami, Tahir, & Mallick, 2021).

The power emitted by photovoltaic is greatly affected by temperature. An increase in the temperature of the photovoltaic can cause a decrease in the photovoltaic rating, or what is commonly called derating. Derating reduces the output power that the photovoltaic would

otherwise produce. It can be seen in Figure 3 Isc or short circuit current in photovoltaic will increase slightly with increasing photovoltaic surface temperature while V_{oc} or open circuit voltage will decrease drastically. So that the maximum power of the photovoltaic will decrease if the temperature increases (Jusran et al., 2020)(S. Zen, 2014).

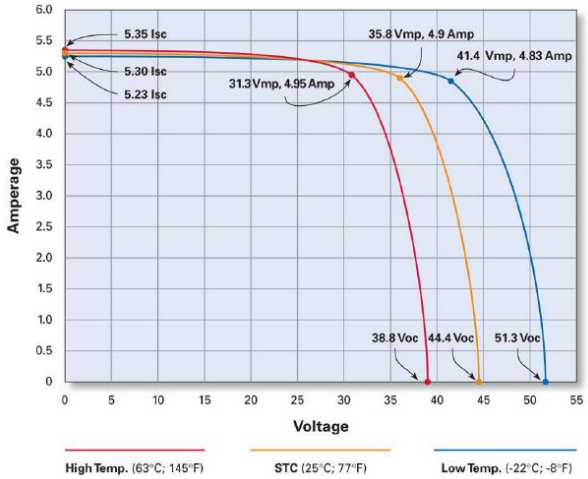

Figure 3. I-V Curve with Photovoltaic Temperature

This section contains theories or concepts and previous research that are relevant to the research. The citation writing technique of the theory or concept used is using the APA style, namely by displaying the author's last name and year of publication. Each citation used must be included in the bibliography. In writing, it is allowed to use tables and figures.

METHODS

Research Material

The research material is based on the nature of the sunscreen film which will reflect the sun's heat. A solar panel that receives sunlight will be coated on its surface with a sunscreen film. The materials used in this study include:

1. Solar panels 2 pieces
2. Batery
3. Solar Charge Controller (SCC)
4. Film solar filter
5. Inverter
6. Printer
7. MPPT
8. Temperature and humidity sensor
9. Clamp multimeter bluetooth
10. Measuring temperature
11. Cable

Observed Parameters

The parameters observed in this study are:

1. Solar panel output voltage
2. Solar panel temperature

Data Collection Technique

The data revealed in the research can be divided into three types, namely: facts, opinions and abilities. This study aims to see the decrease in heat on the solar panel after the installation of a sunscreen film at a high intensity of sunlight. The temperature on the solar

panels was compared between those using sunscreen film and those without filming at all. Observations were made at the same time and under the same conditions as the intensity of the sun's light, thus in this study the data collection technique was obtained by observing and conducting experiments or measuring the temperature on solar panels when generating electricity under the intensity of the sun, so that conclusions were obtained.

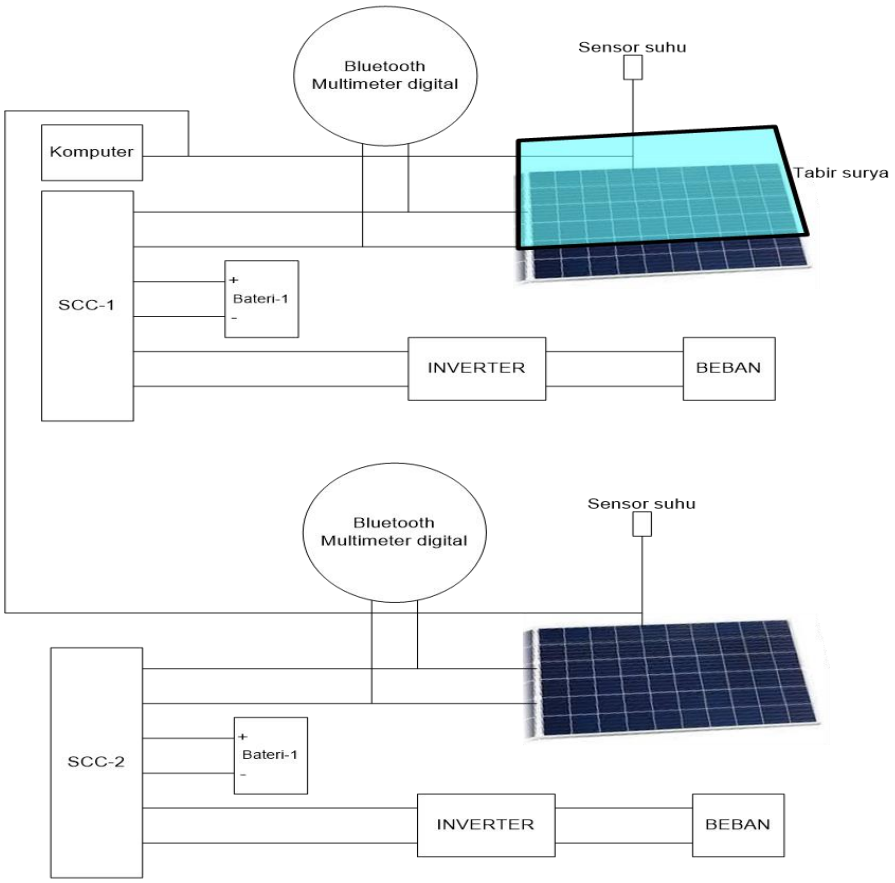

Figure 4. Experimental Circuit

RESULTS AND DISCUSSION

Research result

After testing, the results obtained that show the relationship between the temperature of the solar panel and the resulting output voltage. These results indicate that the effect of sunscreen can reduce the surface temperature of the panel but the resulting voltage will be different from without using sunscreen.

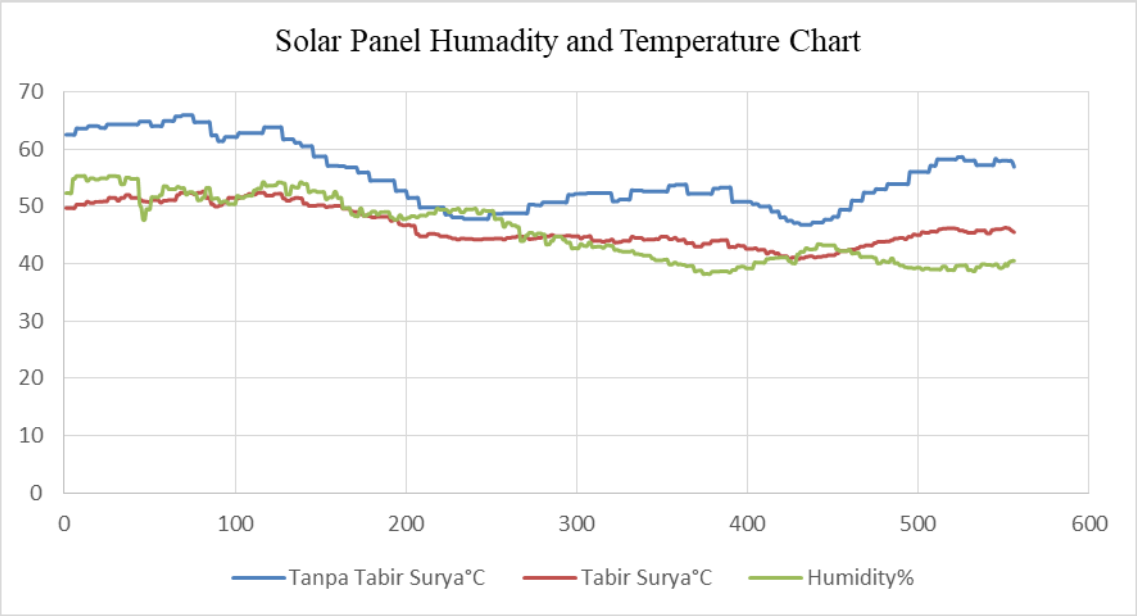

Figure 5. Graph of Solar Panel Surface Temperature

The graph in Figure 13 shows the temperature relationship when sunscreen is installed on the surface of the solar cell panel. The temperature in this test was higher when without sunscreen. As a result, the surface of the solar cell panels will get hotter.

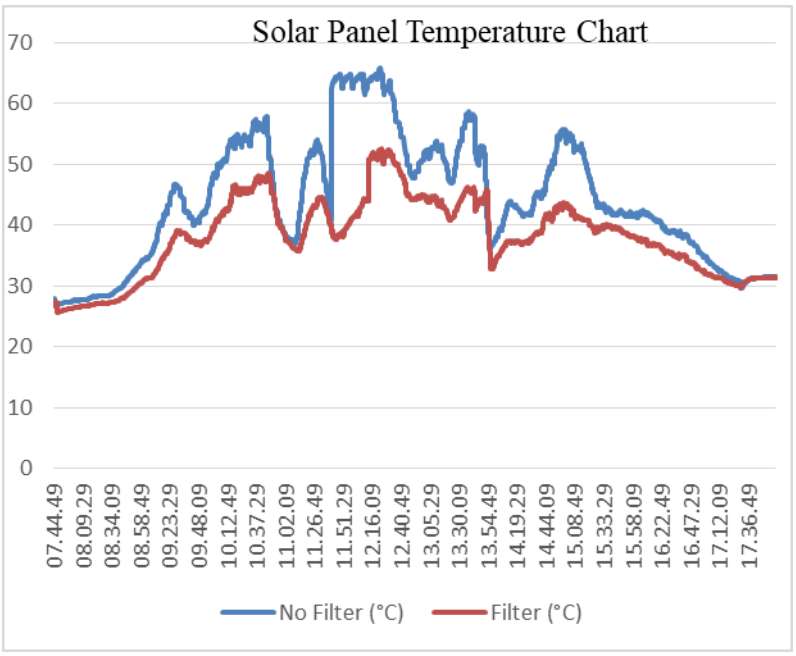

Figure 6. Solar Panel Surface Temperature Graph

From the graph, it can be seen that the surface temperature of the solar panel with the sunscreen filter is lower than without the sunscreen. This is because ultraviolet and infrared rays do not reach the surface of the solar panel.

Effect of Temperature on Solar Panel Output Voltage

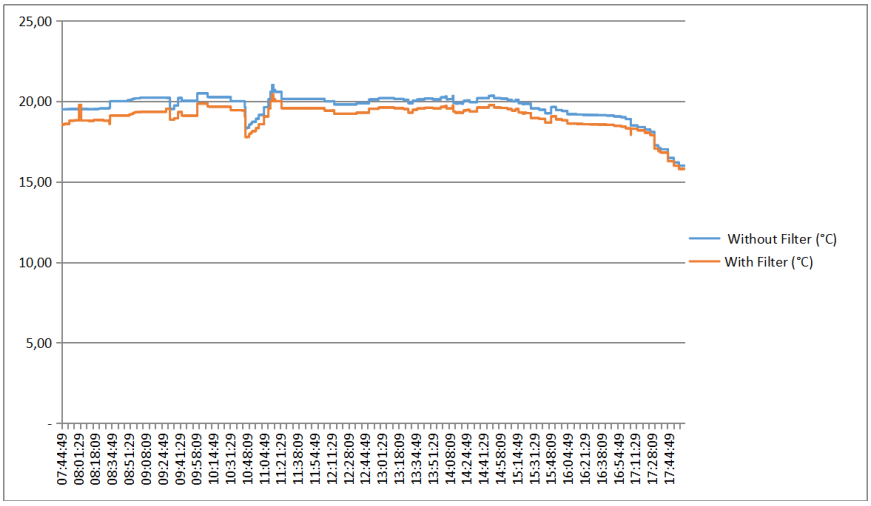

Figure 7. Graph of Solar Panel Output Voltage

Discuses

From the graphic image, it can be seen that the output voltage of a solar panel with a sunscreen filter is slightly smaller than without a filter, this is because the visibility of the light transmission has been reduced due to the installed filter, so that the shadow of the screen will reduce exposure to solar energy which produces an electric. the surface temperature of the solar panel with the sunscreen filter is lower than without the sunscreen. This is because ultraviolet and infrared rays do not reach the surface of the solar panel.

CONCLUSION

To keep the surface temperature of the solar panel from getting hotter than 50oC, a sunscreen filter is installed which will reduce infrared and ultraviolet rays on the surface of the solar panel. When the sunscreen filter is installed, it will reduce the output voltage of the solar panel because the sun's energy reaching the surface of the panel is reduced. The voltage drop generated by solar panels occurs because of the presence of a screen that reduces the lumen of light that penetrates the sunscreen.

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