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# Temperature Decreasing Circulation of Solar Panels Using Water Flow

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**Abstract:** This study aims to provide a clear picture of the efficiency of using solar panels as an alternative energy source compared to conventional energy, as well as to keep the temperature of the solar panels stable. Where the solar panel itself has a maximum body and temperature that affects the results of the solar panel. Solar panels experience a decrease in their ability to generate electricity when they overheat or exceed their effectiveness limits. Therefore, seeing the effectiveness of solar panels working at a temperature of 25 degrees Celsius, there is a desire to take advantage of the excess heat generated from solar panels by cooling the solar panels by flowing water through a capillary tube. Where the experimental results can be seen in the graph of solar panels that have not used cooling. showed a decrease in the absorption of solar panels, precisely at 11.30 am and had a voltage of 20.2V with a temperature of 3.1°C. shows a decrease in the power produced on the day of the study where at 11.30 am there was a decrease in power to the voltage from 20.4V to 19.00 V and it can be said that this was caused by an increase in temperature in three days which was also influenced by the heat earlier.

**Keywords:** Keyword1, Keyword2 … Keyword8

## 1. Introduction

According to data from the Ministry of Energy and Mineral Resources (ESDM), the capacity of PLTS installed in Indonesia is still very small, reaching only 16.02 MW until 2016, while the target for PLTS implementation by the Ministry of Energy and Mineral Resources is 6.4 GW in 2025 [2]. For this reason, the opportunity for the implementation of PV mini-grid installations by the wider community and industry is very open. Seeing this opportunity, as one of the strategic issues in the field of engineering science is: "Sustainable technology with new and renewable energy" in this case optimizing solar thermal energy in Indonesia. The average solar panel has a good work effectiveness at a temperature of 25 °C (source of panel specifications) while the average temperature in Indonesia ranges from 30-35 °C. Given this, it is necessary to have cooling to maintain the effectiveness of the solar panels. From the research, there are several variables that can be planned to stabilize the temperature on the panels using solar panels such as the effect of cooling solar panels with water coolers, analysis of the heat of cooling water and the use of hot cooling water on solar panels and other possibilities considering the temperature is too hot on the surface of the panels. solar panels will reduce the performance of solar panels or what is often called the thermal effect [4].

If the solar panel is too hot on the surface it will result in a voltage loss that occurs, or the solar panel has decreased

ability to generate electricity. The solar panels will overheat or exceed their effectiveness limits, so a cooling method for solar panels was developed through a water cycle that works or flows behind the solar panels, by cooling the solar panels, through this research with the aim of maximizing the efficiency of solar cell panels in generating electricity and analyze the Solar Panel system (Photovoltaic).

Berwal, Anil K., *et al.* expected through large-scale solar projects and decentralized rooftops. One of the Photovoltaic (PV) power plants with a capacity of 50 kW installed on the roof of the Saraswati library building Deenbandhu Chhotu Ram University of Science & Technology has been analyzed for its technical and financial feasibility [1]. Zainal, *et al* he PV cooling system reduces the PV panel temperature to the optimum temperature, while the FL-based CV MPPT algorithm tracks the maximum power of the PV panel [2]. Zhafarina, *et al.* The results obtained that in manual calculations obtained fill factor of 0.7594 and output power of 250.884 Watts [3]. Bayrak, *et al* [4] investigated the electrical performance and thermodynamics analysis under the shading shapes and shading ratios of photovoltaics panels which have in 75 W power [4]. Amelia, A. R., *et al* system installation.

This present study investigates the effects of operating temperature on monocrystalline PV panel at Perlis, Malaysia. A selected model of PV panel firstly was simulated using PVSYST software in order to evaluate its output performance [5]. Apribowo, C. H. B., *et al.* The existence of 15 kW PLTS become an attention to do advanced analysis in order that production of the specific electric energy or final yield (Y F) and performance ratio (PR) from a PLTS can be monitored based on installation location [6]. Duffie, *et al.* energy big as 4.58–5.14 Watt. In the experiment with the optimum tilt of using single axis solar tracker is 59° and tilt without single axis solar tracker is 50°, obtained power increase in 11.5% of the use solar tracker.

Based on the results and calculation of the magnitude of the resources obtained do not much different on the transistor with the order series and parallel circuits. In series with the value of the highest power 3.06 Watt and on a parallel series of 3.05 Watt [7]. Bayrak, *et al* PV with fin system produced the highest power generation of 47.88 W while PV with PCM and TEM produced the lowest power generation of 44.26 W. [8]. Habib, *et al*. The PV system performance analysis consists of the synchronization process, the power curve and the electrical energy that can be generated by the rooftop PV system [9]. Asmi, *et al.* control system method can automatically be seen the difference in the results of a fixed solar panel with a solar panel with a tracker, from the comparison we get a solar panel with a tracker to get more optimal results [10]. Nasution, Sahnur E *et al.* From the results of calculations following the number of solar panels that can be, the energy obtained per day is 144.83 kWh, this means that it is only able to serve about 0.97% of the energy needed by the building [11].

Bostan, Gabriela. C, *et al* We focused our paper on the characterization of a solar cell based on monocrystalline silicon p-n junction, prepared in laboratory conditions, with the tools available at high school [12]. Ford, Michele as it demonstrates, interruptions in supply have a serious impact on residents' capacity to power a modern life [13] Tiwari, et al optimizing the performance parameters of cooling tower This work proposes the application of Taguchi method to achieve maximum cooling of outlet water of counter flow induced draft cooling tower [14]. Irwan, Y. M., *et al* cooling effort of the PV module, brushless Direct Current (DC) fan and DC water pump with inlet/outlet manifold are designed for constant air movement and circulating water flow on the back and front side of the PV module in a representative manner [15]. Elnozahy, Ahmed, *et al* keep the surface temperature of the PV module always close to the ambient temperature.

In addition, this system controls the cleaning period of the front surface of the module 16]. Lo, Chin Kim, et al reflectors must be optimized to achieve maximum results at a given site setting. Therefore, a new simulation tool consisting of several open source software packages with a bifacial solar cell model was developed to accurately predict the annual yield of bifacial solar panels with reflectors [17]. H. Yudha, T., *et al* the process of making, implementing, and ending with the after-life effect of PV. module. The result of this research is an insightful display of PV system applications in Indonesia, starting from the best material choice, best application method, energy return time, and finally the possibility of recycling PV materials after their lifetime [18]. Al Faruqi, *et al*. The output voltage and current generated by the solar panels designed with reflectors are used to increase the solar radiation exposure to the solar panels [19]. Honsberg, *et al* PV modules and discusses some of the problems that arise as a result of interconnection and encapsulation. The most important effects in a PV module or array [20].

## 2. Methodology

This research is experimental in various cooling methods used for photo voltaic (PV) panels. The material used is capillary tubes that carry water which are widely used in PV cooling and which, by using different amounts of copper material and capillary tubes in different layouts, increases the temperature stability of the solar panels.

In figure 1, which is a picture of a solar panel with a cooler. Where the author uses a capillary pipe as a coolant that is flowed by water, the pipe itself is shaped like the letter s, where the distance from one another is about 2 cm, why is it 2cm apart so that water circulation flows smoothly and the use of materials is not too much As for the author uses a capillary pipe as a material for cooling, namely the capillary pipe itself made of copper has cooled the panel plus water flowing in the pipe so that the temperature on the panel can be as fast as possible.

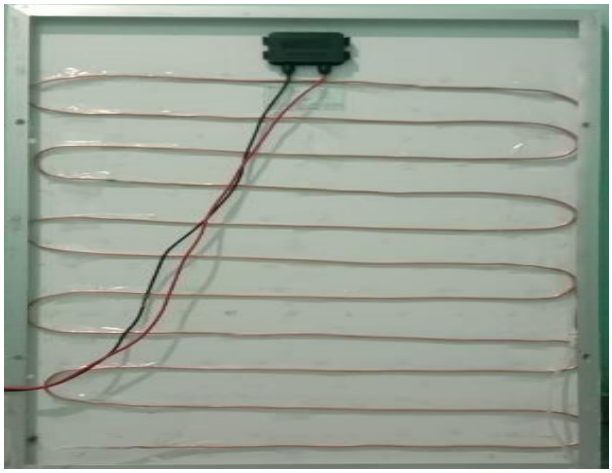

***Figure 1.*** *Panel with cooling circuit*

Installation of solar panels with a height of 3 meters where using 3 rods of upstream iron, as well as the pole itself is installed above the fence, the installation of the panels is installed high and must be in a place that is not blocked by other objects such as trees, roofs, so that the solar panels can be installed absorbs maximum heat. Here the author uses a 100 wp solar panel and a 12-volt water pump, as well as a 40-ah battery, charge control, inverter, where the load is a 12-volt dc lamp and the pump itself.

***Figure 2.*** *Installed Solar Panel*

Solar panels capture solar radiation, which is then converted into a source of electrical energy. and through the solar charge controller module will receive input voltage from the solar panel. The 12 V battery from the battery flows into the pump to raise the water, as well as the temperature sensor and relay, to be used so that the cooling time can be used on time

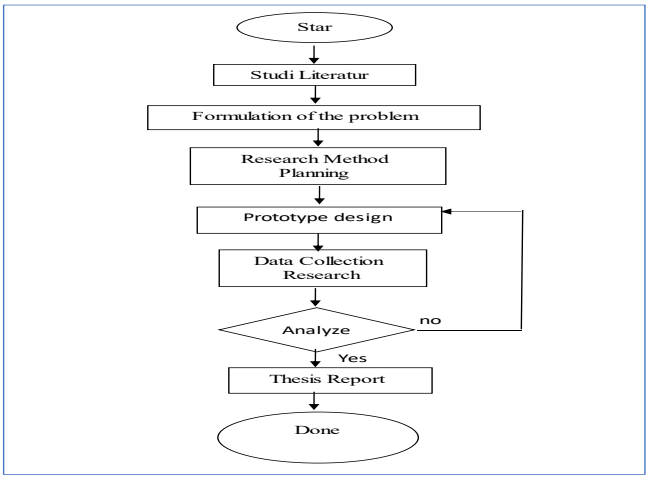


***Figure 3.*** *Research Flowchart.*

## 3. Results and Discussion

In keeping the temperature of the solar panels constant and producing good electricity by using water as a coolant, it requires a control to regulate the cooling so that it can work properly. The experimental results can be used as a comparison with all data taken for 15 (days) The consecutive days start on January 1 to January 15, 2020. The discussion starts from experimenting with solar panels by not using a cooler or lowering the temperature of the solar panel and not using a cooler. Below are two comparison tables that use panel coolers and those that do not.

***Tabel 1.*** *Cooling Wear*

| Day | Time | V | (A) | (W) | °C | (W/m$^3$) |
|---|---|---|---|---|---|---|
| 1 | 9.3 | 18 | 0.5 | 25 w | 31 | 633 |
| 2 | 10 | 18 | 0.5 | 20.4 w | 32 | 755 |
| 3 | 10.3 | 19 | 0.3 | 25 w | 33 | 760 |
| 4 | 11 | 20 | 0.5 | 25 w | 33 | 782 |
| 5 | 11.3 | 19 | 0.2 | 25 w | 33 | 769 |
| 6 | 12 | 19 | 0.2 | 25 w | 31 | 775 |
| 7 | 12.3 | 19 | 0.2 | 25 w | 32 | 763 |
| 8 | 13 | 19 | 0.2 | 25 w | 33 | 812 |
| 9 | 13.3 | 19 | 0.2 | 25 w | 33 | 749 |
| 10 | 14 | 19 | 0.2 | 25 w | 33 | 734 |
| 11 | 14.3 | 19 | 0.2 | 25 w | 31 | 723 |
| 12 | 15 | 19 | 0.2 | 25 w | 32 | 718 |
| 13 | 15.3 | 19 | 0.2 | 25 w | 33 | 607 |
| 14 | 16 | 19 | 0.2 | 25 w | 33 | 588 |
| 15 | 16.3 | 19 | 0.2 | 25 w | 33 | 583 |

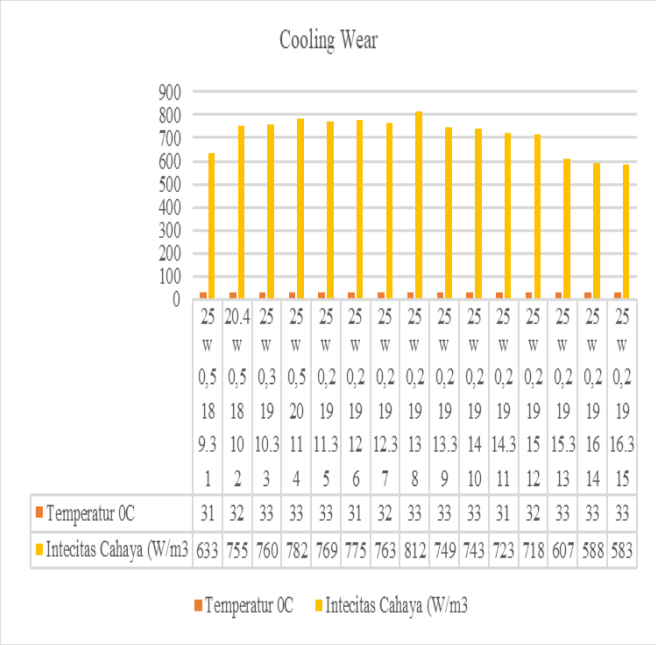


***Figure 4.*** *Cooling.*

***Tabel 1.*** *Uncooled*

| Day | Time | V | (A) | (W) | °C | (W/m$^3$) |
|---|---|---|---|---|---|---|
| 1 | 9.3 | 18 | 0.5 | 25 w | 31 | 633 |
| 2 | 10 | 18 | 0.5 | 20.4 w | 32 | 755 |
| 3 | 10.3 | 19 | 0.3 | 25 w | 33 | 760 |
| 4 | 11 | 20 | 0.5 | 25 w | 33 | 782 |
| 5 | 11.3 | 19 | 0.2 | 25 w | 33 | 769 |
| 6 | 12 | 19 | 0.2 | 25 w | 31 | 775 |
| 7 | 12.3 | 19 | 0.2 | 25 w | 32 | 763 |
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| 9 | 13.3 | 19 | 0.2 | 25 w | 33 | 749 |
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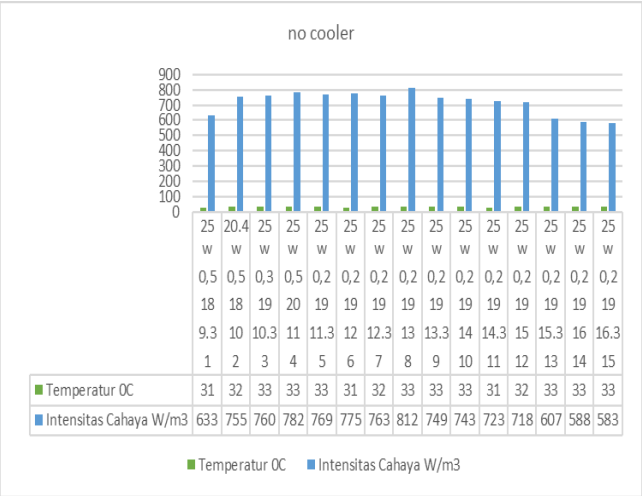


***Figure 5.*** *Uncooled Graphics.*

From the 2 tables above, it can be seen that the difference between using a cooler and not there is explained if the temperature is stable, voltage loss does not occur and with cooling it can maintain the quality of the panel so it doesn't get damaged quickly.Analysis of battery components for energy storage is very important in implementing solar panels. The electrical energy storage system produced by solar panels is stored in a battery with a capacity of 40 Ah which has a voltage of 12 Volts. The voltage data taken in this study was at the time of charging conditions for 8 hours. Referring to the depth of discharge (DOD) of the battery, which is 80%, the capacity of the battery to serve the load becomes:

40 Ah x 30% = 12 Ah

The following is the calculation of battery power during the charge process with a power requirement of 25-Watt DC 12V (light load), namely:

P battery = 12 Ah x 12 Volt

= 144 Wh

P load charge = 25-Watt x 3 hours (charge process)

= 75 Wh P battery

= 144Wh – 75Wh

= 139 Wh

Based on the calculation data, the battery does not experience losses in serving a 25-Watt lamp load for 3 hours of the charge process. The average amount of solar panel output for 3 hours of measurement after going through the solar charge controller which then enters the battery is 1.86 Ampere. Thus, it can be said that to charge a battery with a usable capacity of 12 Ah using the output current from the solar panel it takes 4 hours 86 minutes (for 3 hours per day for 3 days).

## 4. Conclusion

From the research that has been carried out on the design of the tool that has been made, the following conclusions are obtained: With the water flow method located behind the solar panel, the solar panel will stabilize its temperature faster, because it absorbs more quickly into the panel, and the close distance makes it easier to use. the panel cools quickly, and the temperature of the solar panel is stable quickly. So that the voltage loss caused by overheating, is quickly reduced and does not damage the panel itself. Where the coolant that we use is the copper pipe that flows, which is economical and environmentally friendly and easy to get. Where the copper pipe itself can cool the panel, it will stabilize quickly when water flows.

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