ABSTRAK

Wanatirta, Bimbi Adytia. 2025. *Studi Komparasi Daya Keluaran Panel Monokristalin dan Polikristalin dengan Penambahan Reflektor dan Sistem Pendingin.* Skripsi. Tanjungpinang: Program Studi Teknik Elektro. Fakultas Teknik dan Teknologi Kemaritiman. Universitas Maritim Raja Ali Haji. Pembimbing I : Septia Refly, S.Pd., M.Si. Pembimbing II : Basyaruddin Ismail Harahap S.Pd., M.T.

Panel surya dikategorikan menjadi dua jenis utama, yaitu monokristalin dan polikristalin, yang memiliki karakteristik efisiensi berbeda. Upaya peningkatan efisiensi daya panel surya dilakukan dengan menambahkan reflektor, namun peningkatan suhu yang ditimbulkan memerlukan tambahan pendingin pasif seperti *heatsink*. Penelitian ini dilakukan untuk mengevaluasi kinerja panel surya monokristalin dan polikristalin dengan perlakuan reflektor serta sistem pendingin pasif berupa *heatsink*. Sistem pemantauan menggunakan mikrokontroler ESP32 dengan sensor tegangan, arus, dan suhu, serta pencatat data real-time. Selama tujuh hari pengujian, reflektor meningkatkan suhu panel secara signifikan, masing-masing hingga 66,12 ºC (monokristalin) dan 67,75 ºC (polikristalin). Panel monokristalin mencatat tegangan tertinggi sebesar 21,07 V, sedangkan polikristalin menghasilkan arus dan daya maksimum lebih tinggi, yakni 135,90 mA dan 2,85 W. Panel polikristalin menunjukkan efisiensi daya yang lebih stabil, dengan selisih rata-rata 3–7% lebih tinggi dibandingkan monokristalin. Daya median pada panel dengan perlakuan tercatat lebih rendah dibandingkan panel tanpa perlakuan, yang mengindikasikan bahwa perlakuan tidak memberikan peningkatan performa secara signifikan. Efisiensi suhu tercatat negatif dengan rata-rata sebesar -8 hingga -9%. Performa panel mengalami penurunan setelah suhu melampaui ambang batas, yaitu 45 derajat pada kondisi tanpa perlakuan dan 50 hingga 52 derajat pada kondisi dengan perlakuan. Penurunan tegangan dan arus mulai terlihat pada suhu 45,44 derajat untuk monokristalin tanpa perlakuan, 50,25 derajat untuk monokristalin dengan perlakuan, serta 44,50 dan 52,38 derajat untuk polikristalin. Selain faktor suhu, bayangan parsial yang dihasilkan oleh posisi reflektor juga turut berkontribusi terhadap penurunan daya, khususnya pada panel dengan perlakuan. Temuan ini menunjukkan bahwa reflektor dengan pendingin pasif belum efektif dalam meningkatkan kinerja panel, bahkan cenderung menurunkannya.

Kata Kunci : *Panel Surya, Monokristalin, Polikristalin, Reflektor, Heatsink, INA219, DS18B20, Komparasi*

ABSTRACT

Wanatirta, Bimbi Adytia. 2025. *A Comparative Study of the Power Output of Monocrystalline and Polycrystalline Solar Panels with the Addition of Reflectors and a Cooling System*. Thesis. Tanjungpinang: Study Program of Electrical Engineering. Faculty of Engineering and Maritime Technology. University of Maritim Raja Ali Haji. Supervisor I: Septia Refly, S.Pd., M.Si. Supervisor II: Basyaruddin Ismail Harahap, S.Pd., M.T.

Solar panels are categorized into two main types: monocrystalline and polycrystalline, which differ in their power conversion efficiency. To improve their performance, reflectors are applied to enhance light intensity received by the panels. However, this enhancement also increases surface temperature, necessitating the integration of passive cooling methods such as heatsinks. This study was conducted to evaluate the performance of monocrystalline and polycrystalline solar panels treated with reflectors and equipped with passive cooling systems in the form of heatsinks. The monitoring system employs an ESP32 microcontroller integrated with voltage, current, and temperature sensors, along with a real-time data logger. Over seven days of testing, the reflectors significantly increased panel temperatures, reaching up to 66.12 °C for the monocrystalline and 67.75 °C for the polycrystalline panels. The monocrystalline panel recorded the highest voltage at 21.07 V, while the polycrystalline panel achieved higher maximum current and power output, at 135.90 mA and 2.85 W, respectively. The polycrystalline panel exhibited more stable power efficiency, with an average difference of 3–7% higher than the monocrystalline type. The median power output of treated panels was recorded as lower than that of untreated panels, indicating that the treatment did not provide a significant improvement in performance. Thermal efficiency showed a negative value, averaging around -8 to -9%. Panel performance declined after the temperature exceeded the threshold, reaching 45 °C under untreated conditions and 50 to 52 °C with treatment. A drop in voltage and current was observed at 45.44 °C for untreated monocrystalline panels, 50.25 °C for treated monocrystalline panels, as well as 44.50 °C and 52.38 °C for polycrystalline panels. In addition to thermal effects, partial shading caused by the reflector's geometry and positioning also contributed to reduced power output, particularly in treated panels. These findings suggest that the use of reflectors in combination with passive cooling is not yet effective in improving solar panel performance and may, in fact, be counterproductive.

Keyword : *Solar Panel, Monocrystalline, Polycrystalline, Reflector, Heatsink, INA219, DS1B20, Comparison*