ABSTRAK

ANALISIS *SHAPE-STABILIZED PHASE CHANGE MATERIAL* BERBASIS *LAURIC ACID-ACTIVATED FLY ASH* SEBAGAI *THERMAL STABILIZER* TERHADAP EFISIENSI PANEL SURYA

(Nadia Melisa Fitri, 2026. Laporan Skripsi: 83 Halaman, 35 Tabel, 33 Gambar)

Indonesia memiliki potensi energi surya yang sangat besar dengan intensitas radiasi harian rata-rata mencapai 6 kWh/m², menjadikannya lokasi strategis untuk implementasi teknologi fotovoltaik. Namun, efisiensi panel surya di wilayah tropis sering kali menurun akibat peningkatan temperatur permukaan panel. Penelitian ini bertujuan menganalisis karakteristik *Shape-Stabilized Phase Change Material* (SSPCM) berbasis *lauric acid* dan *activated fly ash* sebagai *thermal stabilizer* serta mengevaluasi pengaruhnya terhadap temperatur dan efisiensi panel surya. *Fly ash* diaktivasi menggunakan larutan NaOH 2 M, kemudian dicampurkan dengan *lauric acid* melalui metode impregnasi dengan komposisi LA-a hingga LA-e, yaitu 30:70, 35:65, 40:60, 45:55, dan 50:50 (% massa). Karakteristik SSPCM dianalisis melalui *leakage test* dan *Differential Scanning Calorimetry* (DSC), sedangkan pengujian performa dilakukan pada panel surya monokristalin 5 Wp dengan membandingkan panel tanpa SSPCM dan panel terintegrasi SSPCM. Hasil penelitian menunjukkan bahwa komposisi LA-d dengan rasio *lauric acid:activated fly ash* sebesar 45:55 merupakan komposisi optimum, dengan *leakage rate* terendah sebesar 0,043% dan entalpi pelelehan tertinggi sebesar 56,21 J/g. SSPCM LA-d memiliki rentang pelelehan 41,48–49,08 °C, sehingga sesuai untuk meredam kenaikan temperatur panel surya. Integrasi SSPCM LA-d mampu menurunkan temperatur rata-rata panel dari 49,64 °C menjadi 47,07 °C, atau sebesar 2,57 °C. Selain itu, efisiensi rata-rata panel meningkat dari 5,58% pada panel tanpa SSPCM menjadi 8,11% pada panel dengan SSPCM, atau meningkat sebesar 2,53 poin persentase. Berdasarkan hasil tersebut, SSPCM berbasis *lauric acid-activated fly ash* berpotensi digunakan sebagai material penstabil termal untuk meningkatkan kinerja panel surya.

Kata Kunci: Efisiensi panel surya, SSPCM, *lauric acid*, *activated fly ash*, *thermal stabilizer*

ABSTRACT

ANALYSIS OF SHAPE-STABILIZED PHASE CHANGE MATERIAL BASED ON LAURIC ACID-ACTIVATED FLY ASH AS A THERMAL STABILIZER ON SOLAR PANEL EFFICIENCY

(Nadia Melisa Fitri, 2026. Thesis Report: 83 Pages, 35 Tables, 33 Figures)

Indonesia has great solar energy potential, with an average daily solar irradiation reaching 6 kWh/m², making it a strategic location for the implementation of photovoltaic technology. However, the efficiency of solar panels in tropical regions often decreases due to an increase in panel surface temperature. This study aims to analyze the characteristics of Shape-Stabilized Phase Change Material (SSPCM) based on lauric acid and activated fly ash as a thermal stabilizer, as well as to evaluate its effect on the temperature and efficiency of solar panels. Fly ash was activated using a 2 M NaOH solution and then mixed with lauric acid through an impregnation method with composition variations of LA-a to LA-e, namely 30:70, 35:65, 40:60, 45:55, and 50:50 by mass percentage. The characteristics of SSPCM were analyzed using a leakage test and Differential Scanning Calorimetry (DSC), while the performance test was conducted on 5 Wp monocrystalline solar panels by comparing a panel without SSPCM and a panel integrated with SSPCM. The results showed that the LA-d composition with a lauric acid:activated fly ash ratio of 45:55 was the optimum composition, with the lowest leakage rate of 0.043% and the highest melting enthalpy of 56.21 J/g. The LA-d SSPCM had a melting range of 41.48–49.08 °C, making it suitable for reducing the temperature rise of solar panels. The integration of LA-d SSPCM reduced the average panel temperature from 49.64 °C to 47.07 °C, with a decrease of 2.57 °C. In addition, the average panel efficiency increased from 5.58% for the panel without SSPCM to 8.11% for the panel with SSPCM, with an improvement of 2.53 percentage points. Based on these results, SSPCM based on lauric acid-activated fly ash has the potential to be used as a thermal stabilizer to improve solar panel performance.

Keywords: *Solar panel efficiency, SSPCM, lauric acid, activated fly ash, thermal stabilizer*