ABSTRAK

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

(Ahmad Zydan Alhabsyi, 2026: 109 Halaman, 30 Tabel, 32 Gambar)

Peningkatan temperatur kerja menurunkan efisiensi panel surya sehingga diperlukan stabilisator termal untuk menjaga kinerjanya. Penelitian ini menganalisis *Shape-Stabilized Phase Change Material* (SSPCM) berbasis *paraffin wax–activated fly ash* sebagai *thermal stabilizer* terhadap efisiensi panel surya. *Paraffin Wax* (PW) dipilih sebagai material penyimpan kalor laten, sedangkan *Activated Fly Ash* (AFA) dari limbah PLTU dimanfaatkan sebagai matriks penyangga yang ekonomis untuk mengatasi kebocoran *paraffin wax* saat mencair. *Fly ash* diaktivasi menggunakan NaOH 2 M dengan rasio 5:1 (v/w), kemudian dikompositkan dengan *paraffin wax* pada lima variasi komposisi PW:AFA (30:70 hingga 50:50). Karakterisasi dilakukan melalui analisis *leakage test* dan *Differential Scanning Calorimetry* (DSC), dilanjutkan pengujian lapangan pada panel surya *monocrystalline* 5 Wp dengan konfigurasi pelat aluminium ganda. Hasil *leakage test* menunjukkan kehilangan massa meningkat seiring kandungan *paraffin wax*; berdasarkan standar stabilitas bentuk < 2%, komposisi 30:70, 35:65, dan 40:60 dinyatakan stabil. Hasil DSC memperlihatkan temperatur leleh 50–54 °C yang sesuai dengan temperatur kerja panel, dengan komposisi 40:60 dipilih karena memiliki panas laten tertinggi (53,78 J/g). Penerapan SSPCM menurunkan temperatur permukaan panel rata-rata 3,29 °C dan meningkatkan efisiensi rata-rata dari 6,17% menjadi 8,05%, sehingga terbukti efektif sebagai *thermal stabilizer* panel surya.

Kata Kunci: SSPCM, *thermal stabilizer, paraffin wax, activated fly ash*, efisiensi panel surya.

ABSTRACT

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

(Ahmad Zydan Alhabsyi, 2026: 109 *Pages*, 30 *Tables*, 32 *Figures*)

The rise in operating temperature lowers the efficiency of solar panels, thus requiring a thermal stabilizer to maintain their performance. This study analyzes a Shape-Stabilized Phase Change Material (SSPCM) based on paraffin wax–activated fly ash as a thermal stabilizer for solar panel efficiency. Paraffin wax was chosen as the latent-heat storage material, while activated fly ash from coal-fired power plant waste was utilized as an economical supporting matrix to overcome paraffin wax leakage during melting. The fly ash was activated using 2 M NaOH at a ratio of 5:1 (v/w), then composited with paraffin wax in five composition variations (30:70 to 50:50). Characterization was conducted through a leakage test and Differential Scanning Calorimetry (DSC), followed by field testing on a 5 Wp monocrystalline solar panel using a double aluminum plate configuration. The leakage test showed that mass loss increased with paraffin wax content; based on the shape-stability standard of < 2%, the 30:70, 35:65, and 40:60 compositions were stable. DSC results revealed a melting temperature of 50–54 °C, matching the panel's working temperature, with the 40:60 composition selected for its highest latent heat (53.78 J/g). Applying SSPCM reduced the panel surface temperature by an average of 3.29 °C and increased the average efficiency from 6.17% to 8.05%, thus proving effective as a solar panel thermal stabilizer.

Keywords**:** SSPCM, *thermal stabilizer, paraffin wax, activated fly ash*, *solar panel efficiency*.