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Evaluasi Kinerja Panel Insulasi Komposit Limbah Kertas Koran, Karton, dan Serbuk Kayu pada Test Box Eksperimental
GIGIH DUTYMA FIDDIEN, composite insulation panel, lignocellulosic waste, thermal performance, experimental test
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

INTISARI

Pemanasan global dan peningkatan temperatur lingkungan memperbesar risiko kenaikan suhu ruang pada bangunan, terutama di wilayah beriklim tropis. Penelitian ini bertujuan untuk mengevaluasi kinerja termal panel insulasi komposit berbahan limbah lignoselulosa, yaitu kertas koran, karton, dan serbuk kayu, dengan menggunakan perekat *polyvinyl acetate* (PVAc) dan pati tapioka pada variasi ketebalan 6 mm, 8 mm, dan 10 mm. Pengujian dilakukan secara eksperimental menggunakan model ruang uji (*test box*) untuk membandingkan kemampuan masing-masing panel dalam menurunkan suhu udara ruang terhadap model pembanding tanpa insulasi. Data suhu direkam secara kontinu menggunakan data logger, kemudian dianalisis secara deskriptif kuantitatif komparatif berdasarkan suhu rata-rata dan suhu puncak pada periode beban panas puncak pukul 12.00–16.00 WIB.

Hasil penelitian menunjukkan bahwa panel insulasi komposit berbahan limbah lignoselulosa pada umumnya mampu menurunkan suhu ruang dibandingkan model pembanding. Kinerja termal panel dipengaruhi oleh jenis bahan penyusun, ketebalan panel, dan jenis perekat. Secara umum, panel dengan ketebalan 10 mm menunjukkan performa yang lebih baik dibandingkan panel 8 mm, sedangkan hasil pada variasi 6 mm perlu diinterpretasikan secara hati-hati karena dipengaruhi kondisi pengujian, terutama hujan, kelembapan tinggi, dan kerusakan sampel pada beberapa panel berperekat tapioka. Ditinjau dari jenis bahan, panel berbahan kertas koran menunjukkan performa termal paling baik, diikuti serbuk kayu, sedangkan panel berbahan karton cenderung kurang konsisten. Variasi KP-PVAc_10 merupakan konfigurasi terbaik dengan penurunan suhu rata-rata sebesar 1,2 °C dan suhu puncak sebesar 1,9 °C. Temuan ini menunjukkan bahwa panel insulasi komposit berbahan limbah lignoselulosa berpotensi dikembangkan sebagai material insulasi termal alternatif yang berkelanjutan untuk bangunan di iklim tropis, dengan mempertimbangkan kesesuaian bahan, ketebalan, jenis perekat, dan ketahanan terhadap kelembapan.

Kata kunci: panel insulasi komposit, limbah lignoselulosa, kinerja termal, *test box* eksperimental, iklim tropis

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ABSTRACT

Global warming and rising ambient temperatures increase the risk of indoor heat buildup in buildings, particularly in tropical climates. This study aims to evaluate the thermal performance of composite insulation panels made from lignocellulosic waste materials, namely newspaper, cardboard, and sawdust, using polyvinyl acetate (PVAc) and tapioca starch as binders at thickness variations of 6 mm, 8 mm, and 10 mm. The experiment was conducted using a test box model to compare the ability of each panel to reduce indoor air temperature against a control model without insulation. Temperature data were continuously recorded using a data logger and analyzed through a comparative quantitative descriptive approach based on average temperature and peak temperature during the peak heat period from 12:00 to 16:00 WIB.

The results show that lignocellulosic waste-based composite insulation panels generally reduced indoor temperature compared to the control model. The thermal performance of the panels was influenced by the type of constituent material, panel thickness, and binder type. In general, 10 mm thick panels performed better than 8 mm panels, while the results for the 6 mm variation should be interpreted with caution due to testing conditions, particularly rainfall, high humidity, and sample damage in several panels bonded with tapioca starch. In terms of material type, newspaper-based panels exhibited the best thermal performance, followed by sawdust-based panels, while cardboard-based panels tended to be less consistent. The KP-PVAc_10 variation was identified as the best-performing configuration, achieving an average temperature reduction of 1.2 °C and a peak temperature reduction of 1.9 °C. These findings indicate that composite insulation panels made from lignocellulosic waste have strong potential to be developed as sustainable alternative thermal insulation materials for buildings in tropical climates, with careful consideration of material selection, thickness, binder type, and moisture resistance.

Keywords: *composite insulation panel, lignocellulosic waste, thermal performance, experimental test box, tropical climate*