ABSTRAK

RANCANG BANGUN ALAT UJI RESISTANSI TERMAL DAN APLIKASINYA UNTUK ANALISIS SIFAT TERMAL BATA RINGAN BERBASIS SERAT TANDAN SAWIT CAMPURAN ASPAL PENETRASI

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Penelitian ini bertujuan untuk merancang bangun instrumen pengujian resistansi termal menggunakan metode *steady-state* berbasis mikrokontroler serta menganalisis karakteristik termal bata ringan inovasi berbahan serat tandan kosong kelapa sawit (TKKS) dengan campuran aspal penetrasi. Perangkat uji dikembangkan menggunakan sensor suhu DS18B20 dan sensor daya PZEM-004T yang diintegrasikan dengan Arduino sebagai unit pemroses data. Proses validasi alat dilakukan dengan menguji bata ringan *Autoclaved Aerated Concrete* (AAC) komersial sebagai material kontrol, menghasilkan faktor koreksi (*correction factor*) sebesar 0.253 untuk kompensasi rugi panas (*heat loss*). Hasil pengujian menunjukkan bahwa spesimen inovasi terbaik, yaitu Sampel 4, memiliki nilai konduktivitas termal (k) sebesar 0.159 W/m.K. Nilai ini menunjukkan performa yang kompetitif karena mendekati kemampuan isolasi bata AAC standar (0,140 W/m.K). Melalui simulasi termodinamika pada hunian Tipe 60, pengaplikasian material Sampel 4 terbukti mampu mereduksi beban termal bangunan hingga 59.2% dibandingkan bata CLC konvensional. Inovasi ini memberikan potensi penghematan biaya listrik operasional AC sebesar Rp 770343,00 per bulan, sekaligus membuktikan potensi limbah serat sawit sebagai material bangunan hijau yang efisien secara termal dan ekonomis.

Kata kunci: Alat uji resistansi termal, Bata ringan, Serat tandan sawit, Aspal penetrasi, Konduktivitas termal.

ABSTRACT

DESIGN AND DEVELOPMENT OF A THERMAL RESISTANCE TESTING DEVICE AND ITS APPLICATION FOR ANALYZING THE THERMAL PROPERTIES OF LIGHTWEIGHT CLAY BASED ON PALM FIBER MIXTURE WITH PENETRATING ASPHALT

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This research aims to design and construct a thermal resistance testing instrument using a microcontroller-based steady-state method and to analyze the thermal characteristics of innovative lightweight bricks made from oil palm empty fruit bunch (EFB) fiber mixed with penetration asphalt. The testing device was developed using DS18B20 temperature sensors and a PZEM-004T power sensor integrated with Arduino as the data processing unit. The tool validation process was conducted by testing commercial Autoclaved Aerated Concrete (AAC) bricks as control material, resulting in a correction factor of 0.253 for heat loss compensation. The experimental results showed that the best innovative specimen, Sample 4, possessed a thermal conductivity (k) value of 0.159 W/m.K. This value demonstrates competitive performance as it closely approaches the insulation capability of standard AAC bricks (0.140 W/m.K). Through thermodynamic simulation on a Type 60 dwelling, the application of Sample 4 material was proven to reduce the building's thermal load by up to 59.2% compared to conventional CLC bricks. This innovation provides a potential saving in AC operational electricity costs of Rp770343.00 per month, while also demonstrating the potential of palm fiber waste as a thermally efficient and economical green building material.

Keywords: *Thermal resistance testing tool, Lightweight brick, Palm empty fruit bunch fiber, Penetration asphalt, Thermal conductivity.*