PENGARUH VARIASI UKURAN DAN KOMPOSISI PARTIKEL BAMBU BETUNG *(Dendrocalamus asper*) TERHADAP SIFAT FISIKA DAN MEKANIKA KOMPOSIT *REINFORCED POLYURETHANE FOAM*

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INTISARI

Kebutuhan akan material ramah lingkungan mendorong pengembangan busa poliuretan yang diperkuat (*reinforced polyurethane foam*/RPUF) dengan bahan alami. Salah satu bahan penguat alami potensial adalah partikel bambu karena sifatnya yang ringan, kuat, dan terbarukan. Komposisi dan ukuran partikel merupakan faktor penting yang menentukan karakteristik komposit RPUF. Oleh karena itu, penelitian ini bertujuan untuk mengevaluasi pengaruh komposisi dan ukuran partikel bambu betung terhadap sifat fisika dan mekanika RPUF.

Komposit RPUF dibuat dengan menggunakan teknik cetak terbuka (*free-rise foaming*). Penelitian dilakukan menggunakan rancangan acak lengkap yang melibatkan variasi komposisi (2,5, 5, 7,5 %) terhadap berat total dan ukuran partikel (lolos 60 tertahan 80 mesh, lolos 80 tertahan 120 mesh, lolos 120 tertahan 200 mesh). PUF tanpa tambahan bahan penguat digunakan sebagai kontrol. Karakteristik dilakukan terhadap kerapatan, stabilitas dimensi, penyerapan air, kekuatan tekan, dan kekuatan lengkung. Data dianalisis dengan ANOVA dua arah dan diuji lanjut menggunakan *Honestly Significant Difference* untuk menentukan kombinasi perlakuan terbaik terhadap sifat RPUF.

Hasil penelitian menunjukkan tidak terdapat interaksi antara komposisi dan ukuran partikel bambu. Peningkatan komposisi partikel bambu secara nyata meningkatkan kerapatan, sementara ukuran partikel bambu yang lebih besar secara nyata menurunkan penyerapan air. Dibandingkan dengan kontrol, RPUF menunjukkan peningkatan kerapatan, penurunan penyerapan air, serta peningkatan kekuatan lengkung. Semua nilai stabilitas dimensi seluruh perlakuan sudah memenuhi standar. Kombinasi terbaik diperoleh pada komposisi partikel bambu 5% dengan ukuran lolos 60 tertahan 80 mesh, yang mampu menurunkan penyerapan air hingga 48,49%, meningkatkan kekuatan tekan sebesar 4,45%, dan kekuatan lengkung sebesar 24,32% dibandingkan kontrol. Hasil ini menunjukkan bahwa partikel limbah bambu betung berpotensi sebagai bahan penguat alternatif yang mendukung efisiensi material dan keberlanjutan dalam aplikasi RPUF.

Kata Kunci: *polyurethane foam*, penguat alami, limbah bambu, sifat fisika-mekanika, material berkelanjutan

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THE EFFECT OF VARIATION IN SIZE AND COMPOSITION OF BETUNG BAMBOO (*Dendrocalamus asper*) PARTICLES ON THE PHYSICAL AND MECHANICAL PROPERTIES OF REINFORCED POLYURETHANE FOAM COMPOSITES

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ABSTRACT

The increasing demand for environmentally friendly materials has driven the development of reinforced polyurethane foam (RPUF) using natural materials. One of the potential natural reinforcing materials is bamboo particles because of their light, strong, and renewable properties. The composition of particle and its size are important factors that determine the characteristics of RPUF composites. Therefore, this study aims to evaluate the effects of the composition and particle size of betung bamboo on the physical and mechanical properties of RPUF.

RPUF composites were made using an open molding technique (free-rise foaming). The study was conducted using a completely randomized design involving variations in composition (2.5, 5, 7.5%) to total weight and particle sizes (passing 60 retained 80 mesh, passing 80 retained 120 mesh, passing 120 retained 200 mesh). PUF without additional reinforcement was used as control. Characterization was carried out on density, dimensional stability, water absorption, compressive strength, and bending strength. Data were analyzed using two-way ANOVA and further tested using Honestly Significant Difference to determine the best combination of treatments on RPUF properties.

The results showed no interaction between the composition and size of bamboo particles. Increasing the composition of bamboo particles significantly increased the density, while larger bamboo particle sizes significantly decreased water absorption. Compared to the control, RPUF showed an increase in density, decreased water absorption, and increased bending strength. All dimensional stability values of all treatments met the standards. The best combination was obtained at a composition of 5% bamboo particles with a passing size of 60 retained 80 mesh, which was able to reduce water absorption by 48.49%, increase compressive strength by 4.45%, and bending strength by 24.32% compared to the control. These results indicate that betung bamboo waste particles have the potential as an alternative reinforcing material that supports material efficiency and sustainability in RPUF applications.

Keywords: polyurethane foam, natural reinforcement, bamboo waste, physico-mechanical properties, sustainable materials

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