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Mechanical Characteristics Of Composite Materials Made From Polyester Resin Mixed With Cocopeat On Static Loads

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ABSTRACT

Cocopeat is a binder between coconut fibers in coconut fiber. Cocopeat has high lignin and cellulose content and is resistant to bacteria and fungi. The aim of the research was to determine the mechanical characteristics of cocopeat mixtures with various dosage ratios of 20%, 40%, 60% to 80%. Mechanical characteristic testing is carried out by applying a load to specimens that have been made in accordance with ASTM D 638-03 standards. The maximum load given is 980N. The test results show that the highest stress value is found in the 40% cocopeat mixture composition, which is 8.1902 Mpa and the highest elastic modulus is found in the 20% cocopeat mixture composition, which is $13.8x10^{-3}$ Gpa, while the lowest tensile stress value is found in the 60% cocopeat mixture. and the lowest modulus of elasticity was found in a composition of 80% cocopeat mixture, namely 5.12×10^{-4} Gpa. Thus, more and more cocopeat powder is added to composite materials made from polyester resin. This causes a decrease in the value of stress and modulus of elasticity.

I. Introduction

Various kind of insulation systems have been applied to fish storage areas or fishing vessel holds, including styrofoam, polyurathane and electric refrigeration systems [1][2]. The use of polyurethane as one of the materials of an insulation system is very popular today. This material can be applied to various shapes of hatches because it is liquid and is very easy to insert into the hatch walls, so it can penetrate all parts of the hatch walls before hardening.

Good quality insulation is able to withstand heat penetration from outside so that ice as a cooling medium does not melt quickly, so that cooling in the fish storage room can last a long time [3]. This can inhibit the growth rate of putrefactive bacteria so that the preservation process can proceed well. A good fish preservation process allows fishing vessels to carry out fishing operations for longer periods over a wider area.

From field observations, one of the wastes that can be used as fish hatch material is coconut powder (cocopeat). Cocopeat is a binder between coconut fibers in coconut fiber. Cocopeat has high lignin and cellulose content. The ingredients contained in cocopeat make it resistant to bacteria and fungi. Cocopeat has a pH of 5.2-6.8 and is very difficult to break down [4][2].

Coconut waste has great potential to be used as a reinforcement for composite materials. The specialty of this material is that apart from producing a new composite material that is natural and environmentally friendly, it also has a higher level of tenacity than polyester matrices and other plastic materials. When coconut fiber is made into a composite with Polyester, it has heat insulating properties [5][6][7]. Cocopeat has the potential to be used as a substitute raw material for hatch walls. With special handling, a composition will be found that allows it to be used as a raw material or mixture of materials for fishing vessel holds.

Thus, in this research it is necessary to test the mechanical characteristics of the Cocopeat mixture with various dosage ratios of 20%, 40%, 60% to 80%. This research hopes that cocopeat

can later be used as a raw material for hatch walls or as an insulator mixture that is cheaper, but still has properties that are resistant to dynamic loads and is easy for traditional fishermen to make themselves.

II. Research methods

This research began with field observations and also related literature which was continued with problem identification, the composition of the mixture of materials and procedures in the research as well as the research steps shown in Figure 1.

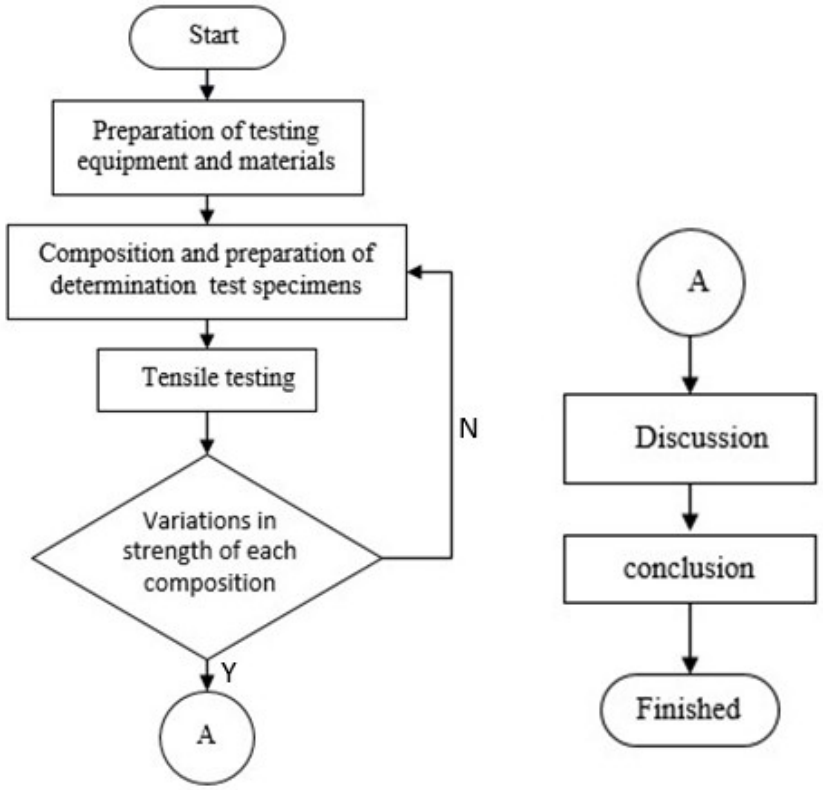

Fig.1 . Research flow chart

Before the process of making cocopeat specimens, they are dried by drying them in the sun for 1-2 hours, then the cocopeat is mixed with resin in the composition that has been determined as shown in table 1. The next step, the mixture of each composition is poured into the mold that has been provided, each mixture composition is devided into three experiments.

Table 1. Speciment test

No	Compositions	Polyester resin (ml)	C*ocopeat* (ml)	Experiment
1	Composition A	100	20	3 experiments
2	Composition B	100	40	3 experiments
3	Composition C	100	60	3 experiments
4	Composition D	100	80	3 experiments

The specimens planned for this research are as shown in Figure 2, tensile testing was carried out in accordance with ASTM D 638-03 standard.

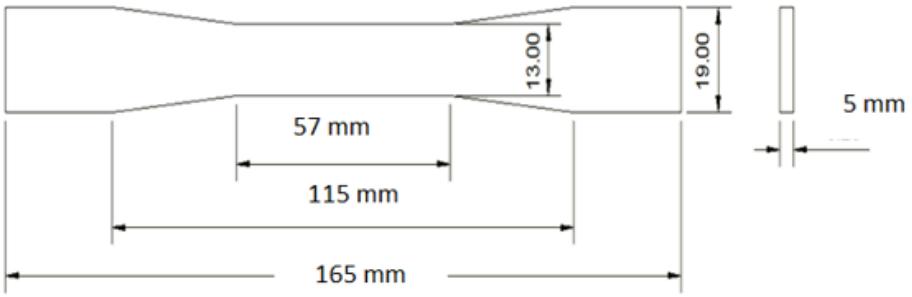

Fig. 2. ASTM D 638-03 standard tensile test specimen

The test is carried out by measuring the maximum tensile load until the material breaks. In this research, the tensile testing machine used has a tensile force of up to 980 N with an adjustable tensile speed. This test equipment is equipped with a personal computer to make data collection easier. The test results obtained from this test equipment in the form of changes in length and load received by the specimen are shown by the software and can be saved in Excel format.

Data processing Measurement of test results on specimens received by the strain gage will be converted by the loadcell into an electrical signal and transmitted to the conditioning signal, then the signal is increased by the amplifier, the signal in analog form is converted into a digital signal by the labjack. The digital signal will be read by the software in the form of a graph of load (load, kgf) and stroke (stroke, mm). The data read by the software is saved in Excel format. The load vs stroke graph is then processed into a stress vs strain graph so that you can get the Elastic Modulus value simultaneously.

III. Research result.

The findings of this research dealing with the mechanical characteristics of cocopeat powder obtained data in the form of numbers (values), graphs and pictures. Tests carried out include tensile tests on the material. Image of tensile test results as shown in figure 3

(a) (b)

Figure 3. Tensile test specimen. (a). Specimen before testing.
(b). Specimen after testing

A. Tensile Test Results of 20% Cocopeat Mixture

Testing of specimens with a composition of 20% cocopeat was carried out in three experiments. This is done to determine the average tensile stress and modulus of elasticity values for the specimen as shown in Figure 4. Each test specimen is named a, b and c to make it easier to store and process the data.

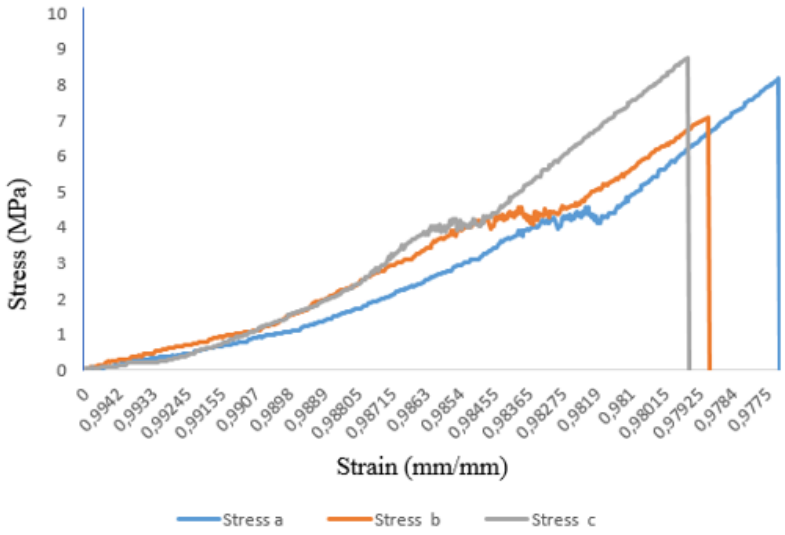

Fig. 4. Stress and strain graphic of 20% Cocopeat Mixture

Data collection is carried out by measuring the tensile load on the material until fracture occurs. The highest stress value in the 20% cocopeat mixture was 8.789 Mpa while the lowest stress was 7.046 Mpa which occurred in specimens c and a. Based on the results of the three tests, the average stress value was obtained at 7.998 Mpa with an average Elastic Modulus of 1.38x10-2 Gpa.

B. Tensile Test Results of 40% Cocopeat Mixture

Figure 5 shows the test results on 40% cocopeat with three measurements. The highest tensile stress value found in specimen b is 8.761 Mpa, while the stress value in specimen c is 8.251Mpa, slightly lower than specimen b. The lowest stress value that occurs in the specimen is 7.556 MPa. From the three tests on the 40% cocopeat composite material, the average stress value as 8.1902Mpa with an elastic modulus value of $7x10^{-4}$ Gpa.

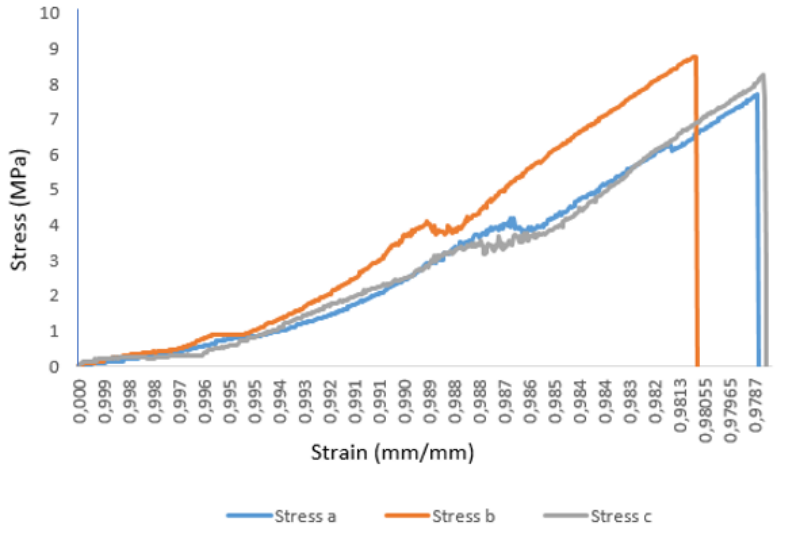

Fig. 5. Stress and strain graph of 40% Cocopeat Mixture

C. Tensile Test Results of 60% Cocopeat Mixture

The results of the tensile strength test on the 60% cocopeat composite material are shown in Figure 6 below, three measurements were also carried out.

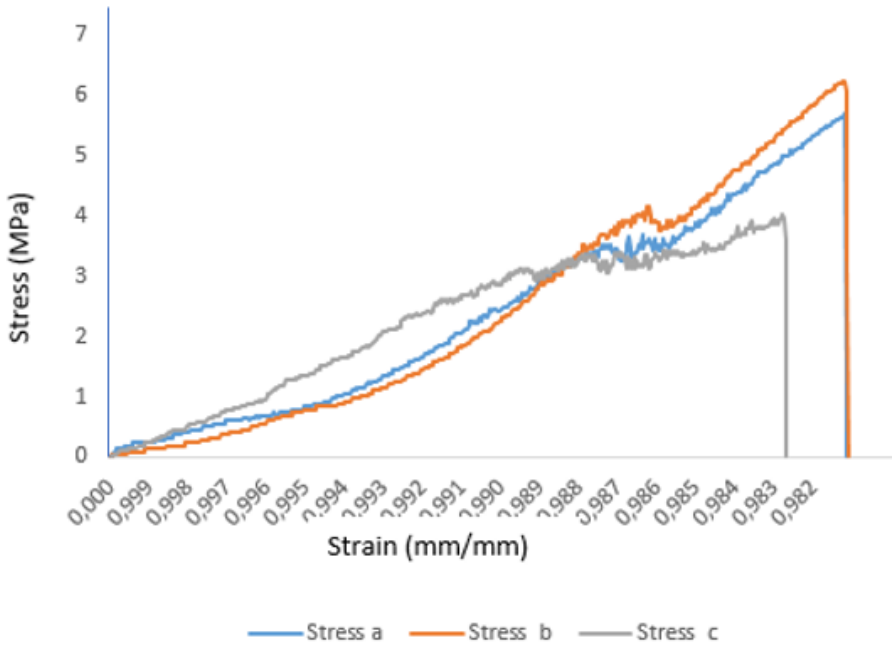

Fig. 6. Stress and strain graph of 60% Cocopeat Mixture

Specimen a has a maximum tensile stress of 5.702 MPa, which is lower than the tensile stress of specimen b and higher than the tensile stress of specimen c. The tensile stress value in specimen b is 6.258 Mpa. while the tensile stress value in specimen c is 4.0177 Mpa. The highest tensile stress value is found in specimen b and the lowest tensile stress is found in specimen c. The average maximum stress result for the three specimens was 5.326 Mpa with an elastic modulus value of $8.73x10^{-4}$ Gpa.

D. Tensile Test Results of 80% Cocopeat Mixture

Figure 7 displays a graph of tensile stress measurements on a specimen of 80% cocopeat mixture

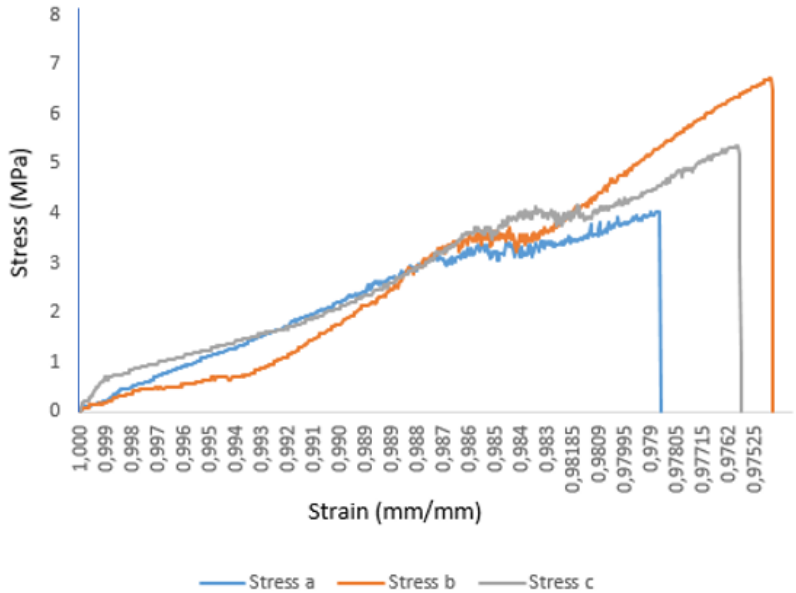

Fig. 7. Stress and strain graph for 80% Cocopeat Mixture

For specimen a, the tensile stress value is 4.021 Mpa, the tensile stress value for specimen b is 6.726 Mpa. Meanwhile, the stress value in specimen c is 5.383 MPa. Of the three specimens,

after the tensile test was carried out, the highest stress occurred in specimen b, while the lowest stress occurred in specimen a. The average stress value of the three specimens is 5.372 Mpa with an elastic modulus of $5.12x10^{-4}$ Gpa.

IV. Discussion

The tensile stress and modulus of elasticity values for each cocopeat composition are shown in Figure 8 and Figure 9. From Figure 8, it can be observed that the highest tensile stress found in the 40% cocopeat mixture is 8.1902 Mpa, slightly higher than the specimen in the composition of a 20% cocopeat mixture is 7.998 Mpa. Nanum is inversely proportional to the elastic modulus value. The highest elastic modulus value occurred in the 20% cocopeat mixture composition, which was $13.8x10^{-3}$ Gpa, while the elastic modulus value in the 40% cocopeat mixture composition specimen was $7.0x10^{-4}$ Gpa.

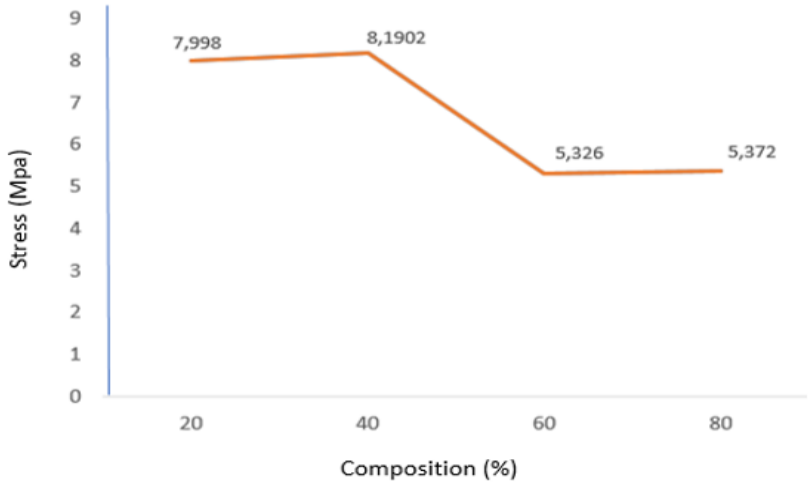

Fig. 7. Graph of stress values for each resin and cocopeat mixture composition

The addition to cocopeat powder up to 60% of the matrix resulted in a significant decrease in the tensile stress value when compared with specimens of 20% and 40% cocopeat mixture, while the elastic modulus value increased. The tensile stress value for a composition of 80% cocapeat mixture is 5.372 MPa, which is lower than the stress value for specimens with a composition of 20%, 40% and 60% cocopeat mixture, as well as the elastic modulus value which also occurs with a value of $5.1x10^{-4}$ GPa.

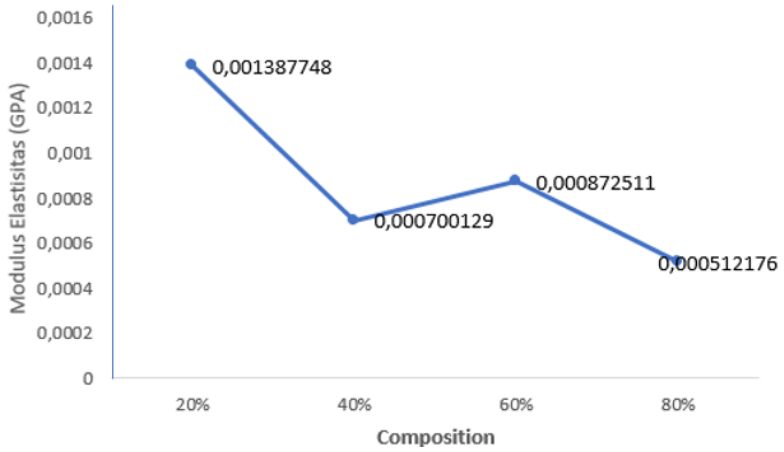

Fig. 7. Graph of the modulus of elasticity value for each resin and cocopeat mixture composition

Mixing cocopeat powder with resin matrix material affects the stress value and elastic modulus value. The more the cocopeat powder mixture, the stress value and the elastic modulus value decrease, this is because there is no homogeneous bond between the matrix and the powder. The best stress value is found in a composition of 40% cocopeat mixture, while the best elastic modulus value is found in a composition of 20% cocopeat mixture.

V. Conclusion

From the results of the tests that have been carried out, it can be concluded that the more cocopeat powder added to the resin matrix composite material can reduce the stress value and elastic modulus. The highest tensile stress value was found in the 40% cocopeat mixture composition, which was 8.1902 Mpa, while the highest elastic modulus value was found in the 20% cocopeat mixture composition, which was 13.8 x 10^{-3} Gpa. The lowest tensile stress value is found in the 60% cocopeat mixture, which is 5.326 Mpa and the lowest elastic modulus value is found in the 80% cocopeat mixture, which is 5.1x10^{-4} Gpa.

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