

Characteristics of Polyester Matrix Hybrid Composites Reinforced With Coconut Coir Fiber and Palm Fiber Powder on Bending Test and Sound Absorption

ROMELS C. A. LUMINTANG¹, JEFFERSON MENDE², TERTIUS ULAAN³, VILDOKAMAGI⁴
^{1, 2, 3, 4}Member, University of Sam Ratulangi Indonesia

Abstract- *Palm fiber powder and coconut fiber are two materials that come from the waste from processing coconuts and palm fiber. The potential of these two materials can be utilized for the manufacture of composites using polyester resin. Because of the advantages of these two materials, a study was conducted to obtain the effect of hybrid polyester composites reinforced with fibers and coconut fiber in terms of tensile strength and composite impact values. Composites were made using the hand lay-up method for each volume fraction variation, palm fiber and coconut fiber 10%:10%; 10%:20%; 10%:30%; 20%:10%, 20%:20%; 20%:30% 30%:10%, and 30%:20%. Then, mechanical testing was carried out with the ASTM D638 I standard tensile test, and the ASTM D6110 standard impact test. Based on the results of tensile and impact tests, data analysis was carried out to produce a optimum impact strength dan tensile strength on the composition of the volume fraction mixture of 30% SSK and 10% SI, positive hybrid effect for longitudinal tensile stress and impact strength on the composition of the volume fraction mixture of 10% SSK and 30% SI, 20% SSK and 20% SI and 30% SSK and 10% SI.*

Indexed Terms- *Polyester, Palm fiber, Coconut Coir Fiber, Hybrid Effect.*

I. INTRODUCTION

Previous research on the polymeric composite matrix with coconut fiber reinforcement has been carried out where the addition of coconut fiber and coconut stem sawdust increases the mechanical properties of the composite material. (Romels et al., 2011), Then in 2018 Andre et al. investigated the effect of adding palm fiber particles to the composite, which, the proportion of weight and size affect the mechanical

properties of the composite. In 2019, Romels, et al. investigated the flexural strength of coconut coir fiber composites where variations in volume fraction affect the flexural strength of composites. Then in 2021 Romels, et al investigated the effect of volume fraction and particle size of palm fiber that affects the mechanical properties and water absorption of polyester composites.

The researcher raised the topic of polyester composites reinforced coconut coir fiber and palm fiber powder based on the amount of coconut fiber waste and the availability of palm fiber as a basic material which is expected to be produced into composite materials.

II. RESEARCH GOALS

The purpose of this study was to obtain the effect of volume fraction on bending strength and sound absorption of hybrid composites of coconut fiber and palm fiber powder

III. LITERATURE REVIEW

- Bending Strength

Bending strength testing is intended to determine the resistance of the composite to loading at the bending point. In addition, this test is also intended to determine the elasticity of a material. In this test the test sample is given a load whose direction is perpendicular to the direction of fiber reinforcement. The loading given is loading with a bending point, with the point as a holding material and the loading point is placed at the mid-length of the sample. The following equation was used to obtain the flexural strength value.

Bending moment
 $Mb=(P.L)/4$ (1)
 Bending stress
 $\sigma=(3P.L)/(2bd^2)$ (2)
 Flexural Modulus of Elasticity
 $E=(PL^3)/(4bd^3.\delta)$ (3)
 Moment of Inertia
 $I=1/12bd^3$ (4)
 Bending stiffness
 $D= E \times I.$ (5)

Where:

- σ = Bending stress (N / [mm] ^3)
- P = pressing force (N)
- L = distance of two supports (mm)
- b = sample width (mm)
- d = test sample thickness (mm)
- δ = deflection (mm)

• Water Absorption

When an impulse sound wave meets a boundary surface that separates two regions with different wave rates, the sound wave will be reflected (R) and absorbed/transmitted (α) and the possibilities that occur are:

1. Reflected all ($R = 1$), meaning that when the sound wave arrives and is reflected back, the efficiency value $R = 1$ or the reflection coefficient (R) is 1.
2. Transmitted / absorbed all ($\alpha = 1$), meaning that if the sound wave arrives and the wave is absorbed all then the efficiency value $\alpha = 1$ or the absorption coefficient (α) is 1.
3. Some waves will be reflected and some will be transmitted/absorbed ($0 < \alpha < 1$).

IV. RESEARCH METHODOLOGY

The research procedure carried out according to the following stages. Stage 1. Sample preparation. Stage 2. Producing Sample testing following ASTM ASTM D 790-02standard Bending Test, and the ASTM E1050 standard sound absorption test. Stage 3. Preparation of test specimens. Stage 4. Specimen testing. Stage 5. Sample testing data analysis

V. DISCUSSION AND RECOMMENDATION

Bending testing was carried out on composites made from fiber and palm fiber powder which were treated with 5% NaOH alkali for the volume fraction of SSK and SI. 5%:5%; 5%:10%; 10%:10%; for each particle size 80 mesh and 180 mesh.

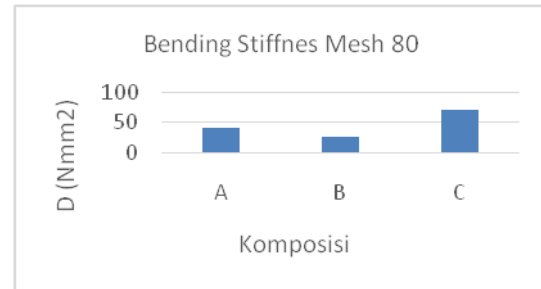


Figure 1 Bending Stiffnes Mesh 80 vs Compositioin

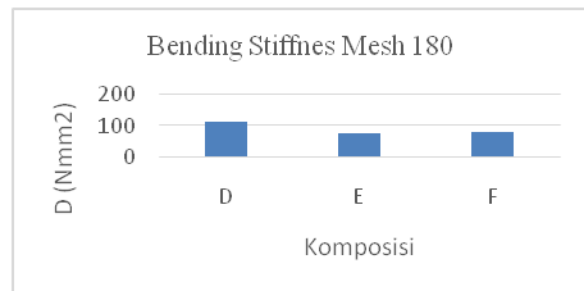


Figure2 Bending Stiffnes Mesh 180 vs Compositioin

In Figure 3 there is an average value of sound absorption coefficient for each composition

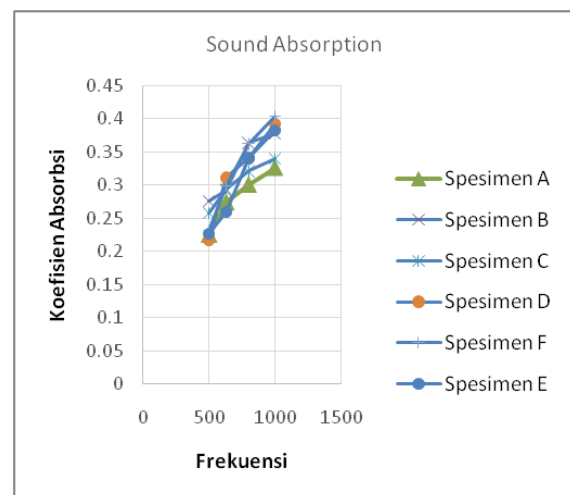


Figure 3 Absorption Coefficient Vs Frekuensi.

DISCUSSION

Based on the results of the analysis of the bending and water absorption test, the relationship between the volume fraction variation and the tensile strength and impact strength is obtained. The maximum value for bending strength values is in the volume fraction of 5% SSK and 5% SI, mesh 180.

The results of each data processing are used to obtain the effect of volume fraction on water absorption. The composition of coconut fiber and palm fiber powder greatly affects the sound absorption of the composite. The test results obtained the larger the grain size given the greater the sound absorption of the specimen.

CONCLUSION

- The maximum value for bending strength values is in the volume fraction of 5% SSK and 5% SI mesh 180.
- The composition of coconut fiber and palm fiber powder greatly affects the sound absorption of the composite. The test results obtained the larger the grain size given the greater the sound absorption of the specimen. The minimum water absorption is found in specimen F with a sound absorption of 0.3933.

REFERENCES

- [1] Lumintang, R., Soenoko, R., Wahyudi, S., Komposit Hibrid Polyester Berpenguat Serbuk Batang dan Serat Sabut Kelapa, *Jurnal Rekayasa Mesin* Volume 2 Nomor 2 Tahun 2011.
- [2] Rauf, F., Lumintang, R., Pojoh, C., 2012, Pengaruh Variasi Ukuran Butiran Filler Serbuk Gergaji Batang Kelapa Terhadap Sifat Mekanik Komposit, *ejournal Poros Online*, Jurusan Teknik Mesin Unsrat, Manado.
- [3] Lumintang, R., Rondonuwu, I., Pratisis, P., Anga, R., 2021, *Impact of Grain Size and Volume Fraction to the Mechanical Properties and Water Absorption of the Polyester-Palm Powder-Based Composite*, IJLERA, Volume 6 Issue 11 November 2021, PP 01-05
- [4] Gibson, R., 2016 *Principles Of Composite Material Mechanics, fourth Edition*, CRC Press Taylor & Francis Group
- [5] Sunanto, Hatta., Aren Budidaya dan multigunanya, Kanisius Yogyakarta, 1993
- [6] Callister, W. D., Rethwisch, D., G., 2017, *Material Science and Engineering, An Introduction 10th Edition*, Department of Metallurgical Engineering The University of Utah, John Willey and Sons, Inc.
- [7] Surdia, T., Saito Shinroku, 2005, *Pengetahuan Bahan Teknik*, cetakan 6 Pradya Paramita, Jakarta.
- [8] Thakur, V. K., Manju Kumari Thakur, M.K., Kessler, M.R., 2017, *Handbook of Composites from Renewable Materials, Volume 2: Design and Manufacturing*, John Wiley & Sons, Inc
- [9] Thakur, V. K., Manju Kumari Thakur, M.K., Kessler, M.R., 2017, *Handbook of Composites from Renewable Materials, Volume 5 Biodegradable Materials*, John Wiley & Sons, Inc
- [10] Doelle, Leslie *LAKustiklingkungan = environmental acoustics / Leslie L. Doelle; diterjemahkan oleh Lea Prasetio, .;* (Erlangga , 1993)
- [11] Auliya Rahman, Mohammad Farid, Hosta, Ardhyanta, *Analisa Sifat Akustik Komposit Serat Ampas Tebu Dan Bambu Betung Dengan Matriks Polypropilen*, *Jurnal Teknik ITS* Volume 5 No 2 tahun 2016.