E-ISSN 2503 - 1430
ISSN 2541 - 3090

Journal Of Industrial Engineering Management
(JIEM Volume 8. No 1 Tahun 2023)

COMPOSITE VOICE-ABSORBING MATERIALS MADE OF POLYESTER-REINFORCED PARTICLES WASTE GLASS PLASTIC AD BIOCOMPOSITE FIBER

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Article history:
Submitted 23 July 2022
Revised 17 December 2022
Accepted 5 April 2023
Available online 20 April 2023

ABSTRACT
Natural fiber as a sound-absorbing biocompisite material is believed to not only reduce noise pollution but also to absorb heat. There are many underutilized coconut husks, which so far the use of coconut husks is only conventional. The focus of this research is to find the right solution in the use of coconut fiber as well as composite material engineering for technological purposes. The research method will use pure experiments using controlled specimens in the mechanical Engineering laboratory of ITB, including mechanicals tests, soundproofing. The results of he tensile test are the tensile strength of the largest coconut fiber composite fiber is found in the fiber volume fraction of 25% with a value of 59.072 Mpa, followed by 20% fiber fraction with a value of 59.025 Mpa, 15% fiber fraction with a value of 56.736 Mpa, fiber fraction 10% with a value of 56.807 Mpa, 5% fiber fraction with a value 53.736. and for he results of the soundproof test with frequency of 250 Hz – 2000 Hz at 5% fiber fraction, it has an absorption coefficient value of 0,03, 10% fiber fraction, has an absorption coefficient value of 0.18, 15% fiber fraction has an absorption coefficient value of 0.18. 0.18, the fiber fraction of 20 has an absorption coefficient of 0.22, the fiber fraction of 25% has an absorption coefficient of 0.28.

Keywords: Biocomposite, Coconut Fiber Test, Soundproof Test

Published By:
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DOI : http://dx.doi.org/10.33536/jiem.v8i1.1214

1. Introduction

A composite is a material that is formed from a combination of two or more of its constituent materials through an inhomogeneous mixture, where the mechanical properties of each forming material are different (Matthews, 1993).

The uniqueness of this composite can be made to utilize natural fibers as biocomposites (coconut fiber) and plastic waste as new materials that are useful for solving environmental problems. Production of coconuts from Gorontalo Province in 2011 was estimated at 125.5 million coconuts (average production of 40 coconuts/tree/year). The potential for coir produced is 62,000 tons per year.

The use of plastic and plastic-based goods is increasing along with the development of technology, industry, and population. In Indonesia, the need for plastics continues to increase to an average increase of 200 tons per year. As a result of this increase in plastic use, plastic waste also increases. Based on the assumptions of the Ministry of Environment (KLH), every day the Indonesian population generates 0.8 kg of waste/person, or a total of 189 thousand tons of waste/day. Of this amount, 15% is in the form of plastic waste, or a total of 28.4 thousand tons of plastic waste/day (Fahlevi, 2012).

Polyester is a thermosetting material that is widely circulated in the market because the price is relatively cheap and can be applied to various uses. Term*polyester* originates from the reaction of organic acids with alcohols to form a polyester.

This study aims to identify the mechanical properties of the tensile strength of coco fiber composites and the sound absorption value of coco fiber composites.

2. Research Methods

2.1 Tools and Materials

There are several tools and materials used in the composite manufacturing process, which are as follows:

1. Tool

The tools used in the manufacture of composite specimens are a plate and Magnetic stirrer, analytical balance, Pycnometer 50 ml, Beaker, 25 ml burette, Erlenmeyer, Condenser, Tensile specimen mold

2. Material

a. Coconut Fiber

Coconut coir is a material that contains lignocellulosic which can be used as an alternative raw material for coconut coir, coconut skin which consists of fibers found between the hard inner skin (shell), which comprises approximately 35% of the total weight of a mature coconut. For different coconut variations, of course the percentage above will be different too.

b. *Unsaturated Polyester*

Polyester a liquid resin with relatively low viscosity hardens at room temperature with the addition of a catalyst.

c. Used Aqua Glass

d. Aquades

e. Ethanol

2.2 Research Design

1. Composeition od Fiber Variation

The composition of fiber variations in the composite consists of 3 variations; Variation I: 5% coconut coir fiber, II variation: 10% coconut fiber, III variation: 15% coconut fiber, IV variation: 20% coconut fiber, and V variation: 25% coconut fiber

2. Research Stages

In this study there were several stages, namely the first stage (treating coconut coir fiber), the second stage (plastic waste treatment), the third stage (making test objects), and the fourth stage (testing test objects).

2.3 Data Processing

1. Tensile Test

The output of the tensile test in the form of load data and elongation is processed into tensile strength (stress), strain, and modulus elasticity.

Tensile stress can be calculated by the equation (Gibson, 1994):

$$\sigma = \frac{F}{A_0}$$

Information:

σ : *Engineering Stess* (Tegangan) (Mpa),

F : Beban yang diberikan dalam arah tegak lurus terhadap spesimen (N),

A_0 : Luas penampang awal sebelum spesimen diberikan pembebanan (mm^2).

Composite strain can be calculated by the equation (Gibson, 1994):

$$e = \frac{\Delta L}{L_0} \times 100\%$$

Keterangan :

E : Engineerring Stain (Regangan) (%)

L_0 : Panjang mula-mula specimen sebelum diberikan pembebanan (mm),

ΔL : Pertambahan panjang (mm).

After getting the stress and strain values, the elastic modulus values can be obtained, with the formula (Gibson, 1994):

$E = \sigma / \varepsilon$

Keterangan :

E : Modulus elastisitas (GPa),

σ : *Engineering Stress* (Tegangan), (MPa)

e : *Engineerring Strain* (Regangan) (%)

2. Soundproof Test

The sound absorption coefficient is usually denoted by α and has a decimal value between 0 and 1. The sound absorption coefficient depends dynamically on the sound frequency and the angle formed by the incident sound wave and the surface normal of the medium (Bell 1994). Material can be categorized as a sound absorber if the material has a minimum sound absorption coefficient value of 0.15 (ISO 11654 1997).

The coefficient value absorption sound (α) is calculated using the following equation:

$I = I0\ e{-}\alpha t$

$\text{Ln } I = \ln I0\ (-\alpha\ .t\ )$

$-\alpha = \ln I - \ln I0\ /\ t$

3. Results and Discussion

3.1 Tensile Test

Water hyacinth and plastic waste composite specimens were tested using a tensile tester NTC-13.04.2. By using the JIS 2201 standard. The test results are in the form of tables and graphs which are then processed and calculated.

Table 1. Tensile Test Mechinical Properties

Coconu Coir Volume Fraction	Average Tensile Strength (Mpa)	Average Strain (%)	Average Modulus Of Elasticity (Mpa)
0%	57,767	1,8	32,195
5%	53,756	1,4	37,692
10%	56,807	1,2	46,149
15%	56,857	1,2	48,994
20%	59,025	1,4	43,594
25%	59,072	1,5	40,212

Figure 1. Tensile Strength test Diagram

Figure 2. Strain Test Diagram

Figure 3. Modulus od Elasticity test Diagram

Based on the tensile tests that have been carried out on the coco fiber and plastic waste composites, the results obtained at the fiber fraction of 5%, 10% and 15% the tensile strength is below the resin composite, while the fiber fraction is 20% and 25% the tensile strength is higher than resin composite.

The difference in tensile strength composite fiber is affected by the voids contained in the composite considering that in the process of making specimens using the method of hand lay-up. Voids are physical defects in the specimen where there are empty spaces that can affect the mechanical properties of the composite. With the presence of voids in the composite, the tensile strength transmitted from the fiber is not spread thoroughly over all parts of the composite thereby reducing the strength of the composite.

3.2 Soundproof Test

Soundproof testing with a frequency of 250 Hz – 2000 Hz on 4 specimen variations; 5% fiber fraction, 10% fiber fraction, 15% fiber fraction, 20% fiber fraction, and 25% fiber fraction.

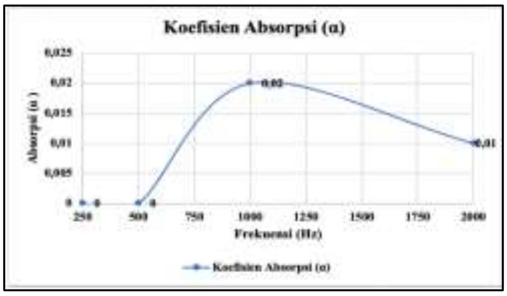

Figure 4. 5% Composite Absorption Coefficient Diagram

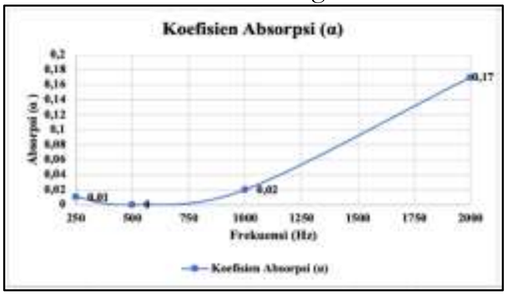

Figure 5. Diagram of The 10% Composite Absorption Coefficient.

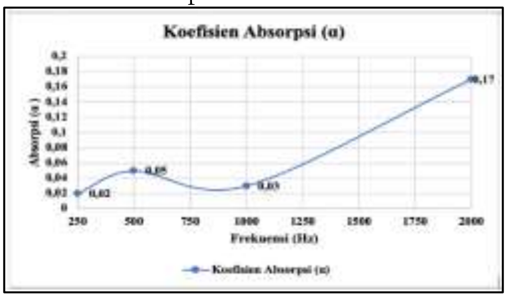

Figure 6. Composite Absorption Coefficient Diagram 15%.

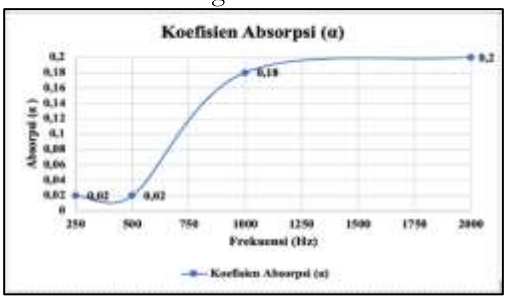

Figure 7. Composite Absorption Coefficient Diagram of 20%.

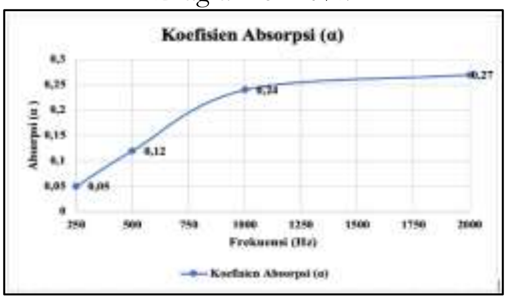

Figure 8. 25% Composite Absorption Coefficient Diagram.

The best sound absorption test results were found in the 20% fiber volume fraction with a value of $\alpha = 0.28$ which can be classified in class D. This value can be categorized as a sound absorber because it has a minimum sound absorption coefficient value of 0.15 (ISO 11654 1997).

4. Conclusion

Based on the results of experimental research conducted in the laboratory and data processing, researchers can draw the following conclusions:

The greatest tensile strength of the coco fiber composite is found in the 25% fiber fraction with a value of 59.072 MPa. While the smallest tensile strength is found in the 5% fiber fraction with a value of 53.736 MPa.

The best sound absorption coefficient is found in the 20% fiber volume fraction with a value of $\alpha = 0.28$ and the lowest sound absorption coefficient is found in the 5% fiber volume fraction with a value of $\alpha = 0.01$.

Bibliography

Arsyad, Muhammad, 2014. “Pengaruh Variasi Arah Susunan Serat Sabut Kelapa Terhadap Sifat Mekanik Komposit Serat Sabut Kelapa”. Ujung Pandang : Jurnal Teknik Mesin Politeknik Negeri Ujung Pandang

Astika, A., Lokantara, P., Karohika, I.M.G., 2013, Sifat Mekanis Komposit Polyester Dengan Penguat Serat Sabut Kelapa, Jurnal Energi dan Manufaktur, Vol.6, No. 2, hal 95-202, (Diakses pada tanggal 20 Juli 2017)

Betha, dkk. 2000. Konduksi Panas Komposit Polimer Polipropilena-Pasir. Banten: Jurnal, Jurusan Fisika, ITS. Vol: Vol.2, No.2 Tahun 2000: 21-26. ISSN 1411 – 1098.

Endrianto, N., Kadir, Alim, 2015, Analisis Sifat Mekanik Komposit Sandwich Serat Pisang denagan Core Kayu Biti, Vol. 6, No. 2, hal 1-6, (Diakses pada tanggal 6 Agustus 2017)

Fahlevi, M.R., 2012, Sampah Plastik. (http://rizafahlevi.blogspot.com/2012/01/twit- sampah-plastik.html) (Diakses pada tanggal 15 0ktober 2017)

Frank A.,1998, Cassis, Polyester and Vinyl Ester Resins, Chapman and Hall.

Hakim, A., 2007, “Forum Sains Indonesia, Teknologi Material Komposit” (Diakses tanggal 12 Agustus 2017)

Kadir, 2012. Kajian Pemanfaatan Sampah Plastik Sebagai Sumber Bahan Bakar Cair.

Universitas Haluoleo, Kendari.

Kang, J., 2007, Urban Sound Environment, Taylor and Francis. London.