

# A novel Composite of Sound Absorber with Coconut Coir and Banana's Midrib

# <sup>1</sup>Laily Ulfiyah <sup>2</sup>Faizatur Rohmah

<sup>1</sup>Department of Teknik Mesin Alat Berat, Politeknik Negeri Madura, Sampang, Indonesia <sup>2</sup>Department of Teknik Mesin Alat Berat, Politeknik Negeri Madura, Sampang, Indonesia

*Abstract*: In this research, natural fibers are used as composite materials as sound absorbers because they can reduce noise. Sound absorbers from natural fibers can reduce noise. It consists of a combination of coconut fiber and banana midrib as a filler and PVAC glue as a matrix. The variations of ratio of the coconut fiber and banana's mid ribs are 1:1, 2:1, 1:2. To bind the material, PVAc glue was implemented, with its thickness ratio= 2 mm, 3 mm, and 4 mm. The sound-absorbing coefficient value refers to the ISO 11654:1997 standard. The final result shows the value of the sound absorption coefficient= 0.15 on a ratio of 1:1 with a thickness variation of 3mm, 4mm. It is categorized in C-grade. At a fiber ratio of 2:1, with a thickness of 2mm, it is categorized as E-grade. In the ratio of 1:2 fiber with a thickness of 2mm is categorized in E-grade, and 4mm is categorized in D-grade.

#### INTRODUCTION

In the era of technological development, , it has a positive impact on scientific progress, especially in the field of technology that can encourage industry, particularly in the Indonesian composite industry. Not only on synthetic composites, but also on natural composites that have recyclable properties. Composites with natural fibers are environmentally friendly because they can be degraded naturally and also it is cheaper than synthetic fiber materials.

Indonesia is one of the countries in the world that has many natural resources such as natural fiber or vegetable fiber which is very abundant and has not been used optimally. This type of fiber can be used as a filler in composite materials. Composite materials generally consist of two elements, namely: fiber which functions as a filler material, and a matrix as a fiber binding material. Composites can also be formed from a combination of two or more materials, both organic and inorganic metals [1].

Noise is sound that is not desired because it is not in accordance with the context of space and time so that it can cause disturbances to human comfort and health [2].

Noise is a classic problem in Indonesia. By using materials that can absorb sound, it will be able to reduce the noise. To reduce noise in a room, usually acoustic panels are installed on the dividing plane (partition) and ceiling [3].

The absorber is the resistance of a structural system while it gets vibration. This resistance occurs as a result of the release of energy that arises when the system gets a vibration, then the system will return to rest. Thus, the absorber is an energy release phenomenon that existed when a vibrating structural system tends to return to rest. The absorber in a structural system is usually very small so in most analyzes, this component is often neglected [4].

Research on polyester composites was carried out using banana stem fiber which was used as a damping material at low frequencies of 200, 400 and 600 Hz. The results of this composite test obtained the highest sound absorption coefficient value of 0.72 at 50% fiber volume fraction with an input frequency of 200 Hz and the lowest value of 0.54 at 30% fiber volume fraction with a fiber input frequency of 400 Hz [5]. Research on sound-absorbing composites conducted in 2006 also used coconut fiber as a filler and starch glue as a matrix. The results of testing the composite sound absorber made from coconut fiber and starch glue have met the requirements of ISO 11654, namely with a sound absorption coefficient above 0.15 [6].

## NEED OF THE STUDY.

Natural fibers have been one of the most researched topic in recent years. This is due to their inherent properties, such as their biodegradability, recency and availability abundant when compared to synthetic fibres. In Indonesia, coconut fruit (Cocos nucifera) is widely cultivated. The use of coir fiber as biocomposites is growing today as the need for sustainable, renewable, biodegradable and recyclable products continues to grow. In general, coconut coir are waste materials, but they can be used as raw materials for making environmentally friendly biocomposites. Banana's midrib has good mechanical properties. Therefore it is used as an alloy of several other natural materials to improve existing mechanical properties.

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## **RESEARCH METHODOLOGY**

## 3.1 Tools

Some of tools that was used to build an prototype were Composite mold, Hand Gloves, Ruler, Sound Level Meter, Frequency Generator Application, Blender, 500 ml and 250 ml beakers, Caliper, Digital scale, And Prototype room for soundproofing trials. **3.2 Materials** 

The materials that was used during the final project were coir, Banana Stem, And PVAc glue.

#### 3.3 The Prototype of The Soundproofing Test Room

This test uses a prototype room which is a replica of two rooms with one room as a sound source and the other side as a sound receiver with a barrier in the form of a bulkhead using composite test objects. The dimensions of the prototype are 60cm long, 30cm wide and 30cm high and use a pipe with a length of 26 cm and an outer diameter of 3 inches = 7.62cm to forward the sound source from the speaker to the sound level meter to reduce losses during sound measurement. The inner wall is given a layer of glasswool so that sound from outside does not enter the box, as well as sound from inside the box so it does not leak so that the test can be more accurate.

This prototype test system uses a transmission method in which the sound source comes from the speaker and a sound level meter is used to measure the decibel value (dB) of the sound-dampening composite with the use of without dampers and with silencers as shown in Figure 4 and Figure 5.



Figure 1: The Top View of The Sound Attenuation Test Prototype Box

Note:

- a. Frequency generator
- b. Speaker
- c. Pipe
- d. Specimen
- e. Sound level meter



Figure 2: 3D Silencer Test Box

#### **IV. RESULTS AND DISCUSSION**

The effect of fiber alloy composition on the sound absorption coefficient is obtained from the results of processing the data obtained. The data below is the result of the effect of the composition of the fiber alloy on the sound coefficient with the composition

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of the coconut fiber: banana midrib fiber, namely 1:1, 2:1, and 1:2 as shown in Table 2 for the calculation of the sound absorption coefficient can be seen in the appendix.

Variation of Fiber Ratio	t (mm)	$I_0 (dB)$	Experimental Result (dB)	α
1:1	2	75	74.13	0.05
	3		61.26	0.66
	4		58.46	0.62
2:1	2	75	72.16	0.2
	3		73.03	0.06
	4		73.26	0.05
1:2	2	75	71.43	0.25
	3		66.13	0.4
	4		74.06	0.025

#### Table 1 Soundproofing Test Result

In Table 1 there is an effect of the composition of the fiber blend on the resulting sound absorption coefficient. Based on the ISO 11654:1997 standard, it can be seen in Table 2.1 where the higher the sound absorption coefficient ( $\alpha$ ), the better for variations in composition and thickness. From Table 2, a graph of the relationship between the sound absorption coefficient and the composition of the fiber alloy can be drawn, as shown in Figure 6.





In a 1:1 composition with a mass of coconut coir:banana midrib of 10gr:10gr. From three specimens with different thicknesses, the value of the sound absorption coefficient ( $\alpha$ ) increased. When viewed from the shape of the fiber, coconut coir fiber has a rough, stiff and larger shape than banana midrib, while banana midrib fiber has a thin, long and easily broken fiber shape so that in the process of making the fiber it is easy to form. At a 1:1 composition with a thickness of 2mm, the lowest sound absorption value was obtained with with = 0.05. This is due to the use of a matrix that is less than 3mm and 4mm thick so that the composite used has rigid material properties and no absorber can occur, because the addition of the matrix can also affect the material.

At a composition of 2:1 with a mass of coconut fiber: banana midrib of 20gr:10gr which is more dominant in coconut fiber which has rigid properties and is difficult to form. From the three specimens with different thicknesses, the sound absorption value ( $\alpha$ ) decreased at a thickness of 4mm, the value = 0.05 with the smallest sound absorption coefficient value of the three specimens. At a 1:2 composition with a mass of 10gr:20gr coconut coir:banana midrib, which is more dominant in banana midrib fiber which has a smaller fiber shape than coconut fiber and is easy to shape. Of the three specimens with different thicknesses, the sound absorption value ( $\alpha$ ) decreased at a thickness of 4mm, the value of = 0.025 with the smallest sound absorption value of the three specimens, then the composition of 1:1 with a thickness of 3mm as material.

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