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The Performance of Corn Husk with Rockwool and Egg Tray as an Acoustic Panel

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Abstract: The use of synthetic materials as acoustic absorbers is still applied in acoustical industries. These non-sustainable materials do not only cause contamination to the environment, but also contribute significantly in increasing the level of carbon dioxide which led to the effect of global warming. This project presents a way to find sustainable and eco-friendly materials to be an alternative sound absorber by using corn husks and egg tray as acoustic material, thus reduced the usage of synthetic materials such as rockwool. A sound absorber from corn husk, rockwool and egg tray is combined and its effectiveness is obtained through testing. Ten acoustic panels are tested by using Sound Level Meter test in an enclosure. The result show that the corn husks, rockwool and eggs tray have good performance in absorbing sounds. Furthermore, the testing in the enclosure with and without acoustic panels shows the difference in the percentage of sound intensity. The Corn Husk Acoustic Panel shows results in of sound intensity for about 2.18% and 3.16% in frequency of 500 Hz and 1000 Hz respectively when compared to presence with absence of acoustic panel. Lastly, the Corn Husk Acoustic Panel in this project compared with past research which used Grated Coconut Acoustic Panel. The acoustic panels then compared and it shows results on the difference in the percentage of intensity reduction. The Corn Husk Acoustic Panel shows results in sound intensity for about 39.73% lower and 18.51% lower in frequency of 500 Hz and 1000 Hz respectively when compared to Grated Coconut Acoustic Panel. The sound intensity lowered represents that the Corn Husk Acoustic Panel absorption is much better.

Keywords: Acoustic Panel, Corn Husk, Sound Level Meter, Materials, Sound

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1. Introduction

The resulting noise pollution can adversely affect humans and other living things. The sound that is heard in most environments is a combination of the direct sound straight from the source or sources and the indirect reflections from surfaces and other objects [1]. According to certain research, the social environment and acoustic background of people in their everyday lives may impact soundscape assessment. Lowering noise levels did not often strengthen acoustic comfort [2]. The existing sound absorbers on the market are manufactured from materials based on fiberglass materials. In addition, the absorption of sound absorbers from synthetic fiber materials is expensive and ineffective despite showing good results in absorbing sound [3]. Acoustic panels are increasingly widely used in music, recording studios, movies and lecture halls.

Noise has a deleterious impact on human health, regardless of its intensity or duration of exposure [4]. Based on the noise pollution problems, the issue should be prevented by applying the use of sound absorption material especially corn husks which been used in this study. An acoustic panel made from corn husk can be produced to overcome the problem. Moreover, the natural materials waste especially corn husk can help to save the environment rather than the usage of conventional materials. One of the past research projects are the ability of corn husks in the acoustic fields which is the same with the purpose of this study in terms of concept. In the study of acoustics, natural materials play a critical role. Natural materials are becoming more popular as their features allow them to be designed for acoustic applications due to their biodegradability and inexpensive cost [5]. One of the studies using corn husks in sound absorption as conducted which compared the corn husks with conventional porous materials [6]. The investigation then came to the fact that corn husks have a distinct benefit for noise reduction applications since its thickness is thinner. The study concludes that corn husks in their natural state shine brightly as promising sound absorption materials.

This project investigates the acoustical of composites using corn husk fiber. To guarantee sound absorption works well, the choice of sound absorption material is important [7]. Corn husk has high cellulose fiber content so it can be used as raw material. The use of waste materials as one of the initiatives for sound absorption studies. They are renewable and cheaper [4]. This study primarily investigates the effect of using corn husk fibers on acoustical panels. For this study, the corn husk is now being used with the combination of rockwool and egg tray as the sound absorption panel. The performance of the corn husk is needed in terms of design and model creation, as well as analysis of the material. The purpose of this project is to develop low-cost, ecologically friendly sound-absorbing panels made of natural materials. Through conducting studies to measure and evaluate the amount to which corn husk that combined with rockwool and egg tray can absorb sound, this research will also discover the most critical aspects in sound absorption of natural materials.

The objective of this project is to produces an environmentally friendly sound-absorbing panels using natural material which is corn husk and other supporting materials. Furthermore, this project also aimed to analyse the performance of sound-absorbing panels by using the Sound Level Meter Test.

2. Materials and Methods

The materials and methods adopted for the purpose of evaluating the effects of the corn husk, rockwool and egg tray as alternative materials to replace and minimize the usage of synthetics materials as sound absorption panel. Rockwool which is a synthetic material commonly used widely for sound insulation on a closure. However, this study emphasizes on the combination between alternative materials such as corn husk and egg tray with synthetic material such as rockwool. By the support from textiles to combine the material together, it is to be expected that the sound absorption rate would be higher with this combination [8].

2.1 Materials

Before proceed to the process of acoustic panels, there are materials that is obtained and used in this project. Firstly, the main material is the corn husk itself which is the sustainable item used in order for noise reduction. Moreover, there are supporting materials which is rockwool and egg tray. The rockwool are supporting materials as sound absorber too enhance the ability of acoustic panel in noise reduction. Egg tray is used for the base of the corn husk and the rockwool. The textiles used as the wrap up for the acoustic panel so that the materials combined will not scattered and gives an elegant look. For the details in terms of look, **Figure 1** shows the materials listed for the use in this project.

(a) (b) (c) (d)

Figure 1: The ingredient materials for the production of acoustic panel (a) corn husk (b) rockwool (c) egg tray and (d) textiles

2.2 Methods

The production of panels was done as in the **Figure 2**. Firstly, the corn husk was filled in on the egg tray. Furthermore, the rockwool been filled in the egg tray and on the top of corn husk. About 40% of corn husks and 60% of rockwool of ration that have been placed to filled the egg tray. In addition, the panel were then wrap by the textile to avoid any scattered and as the finishing for panels. The panels then were hanged on the wall of enclosure and ready for the Sound Level Meter test.

Figure 2: Acoustic Panel Process

2.3 Testing Method

The testing has been done with two manipulated variables which is testing between presence of acoustic panel and absence of acoustic panel by the use of Sound Level Meter as in **Figure 3**. By use of Sound Level Meter, the intensity of sound between presence of acoustic panel and absence of acoustic panel can be observed accurately [9]. Therefore, the difference can be identified whether the panel are efficient or not. The testing also conducted in an enclosure and the size and layout shown as in **Figure 4** below.

Figure 3: Sound Level Meter

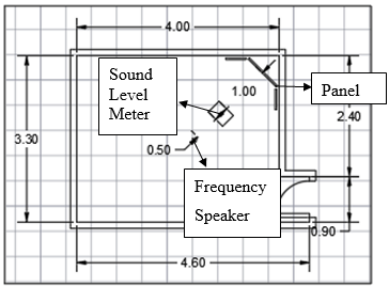

Figure 4: The Enclosure Layout and Size

3. Results and Discussion

The acoustic panel produced is a panel that uses corn husk as the main material while the egg tray, rockwool and textiles are the supporting materials. Ten panels were produced to test the sound absorption in an empty room. The comparison of sound absorption with and without panel are tested and comparing to past research which used grated coconut as main material in acoustic panel. The test conducted which is the sound level meter test to observe and gain the sound intensity, dB.

3.1 Evaluation of the Acoustic Panel

The results obtained and analysis has made based on the results of tests conducted. The test been conducted by the use of sound level meter. The frequency used for sound level meter test particularly is 500 Hz and 1000 Hz, which represents the manipulative variable for the purpose of examine sound intensity differences. This frequency set by the use of Online Tool Generator, and the sound intensity was measured by Sound Level Meter.

Table 1: Average of Sound Intensity Value, dB by Frequency, Hz

Frequency, Hz	Intensity of Sound With Panel, dB	Intensity of Sound Without Panel, dB	Difference between With and Without Panel, %
500	44.6	45.5	2.08
1000	60.3	62.2	3.16

Based on **Table 1**, the intensity of sound with panel in 500 Hz has the average of 44.6 dB, while intensity of sound without panel with 500 Hz has the average of 45.5 dB. Furthermore, the intensity of sound with panel in 1000 Hz has the average of 60.3 dB, while intensity of sound without panel with 1000 Hz has the highest at average of 62.2 dB. In addition, the difference between with panel and without panel with 500 Hz is 2.08% while for 1000 Hz is 3.16%. From the result, the difference in intensity of sound with panel has lower value than without panel value is because of the acoustic panel works on reducing the sound intensity by absorbing the sound. Thus, the sound level meter detected lower intensity of sound in the acoustical enclosure.

The graph in **Figure 5** below, shows the value intensity of sound by the frequency. It shows The difference on sound intensity between with and without panel. There is difference in line of With Panel and Without Panel but the difference is only in slight value. The intensity of sound with panel in 500 Hz has the average of 44.6 dB, while intensity of sound without panel with 500 Hz has the average of 45.5 dB. Furthermore, the intensity of sound with panel in 1000 Hz has the average of 60.3 dB, while intensity of sound without panel with 1000 Hz has the highest at average of 62.2 dB. This figure can be referred with the values in Table 1 since the values plotted in this figure are from the values in **Table 1**. This conclude that the acoustic panel does absorbed sounds around it thus reducing sound intensity.

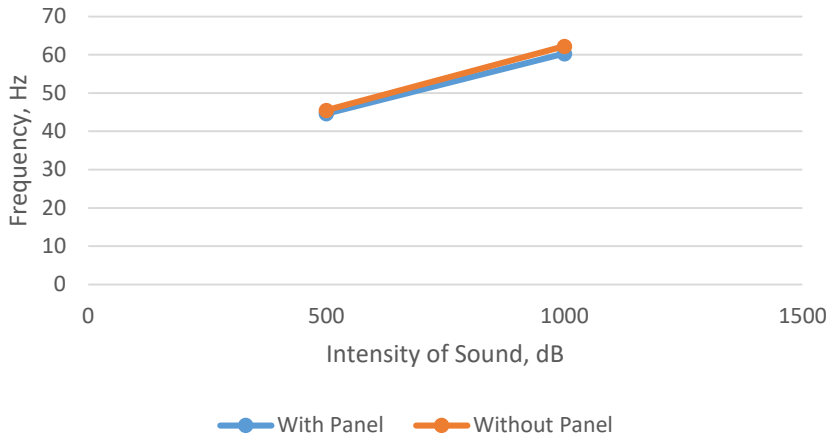

Figure 5: Average of Sound Intensity, dB against Frequency, Hz

3.2 Comparison Between Corn Husk Acoustic Panel and Grated Coconut Acoustic Panel

Corn husk acoustic panel has been combined with the egg tray, rockwool, textiles but with also additional materials which is bubble wrap. Previous research used grated coconut as the natural and main material for the production of its acoustic panel [10]. Comparing it can gained the performance of corn husk acoustic panel.

Table 2: Comparison of Difference between Corn Husk Acoustic Panel and Grated Coconut Acoustic Panel

Frequency, Hz	Type of Panel	Intensity of Sound, dB	Difference Between Corn Husk Acoustic Panel and ated Coconut Acoustic Panel (%)
500	Corn Husk	44.6	39.73
	Grated Coconut	74.0	
1000	Corn Husk	60.3	18.51
	Grated Coconut	74.0	

From the **Table 2**, comparison have been made between the Corn Husk Acoustic Panel and Grated Coconut Acoustic Panel. In the frequency of 500 Hz, the difference between both of the panel is 39.73% where the Intensity of Sound for Corn Husk Acoustic Panel is 44.6 dB and for Grated Coconut Acoustic Panel is 74.0 dB. Other than that, while frequency set of to 1000 Hz, the difference between the panel is 18.51% where the Intensity of Sound for Corn Husk Acoustic Panel is 60.3 dB and for Grated Coconut Acoustic Panel is 74.0 dB. Even though it is shown that Corn Husk Acoustic Panel have lower intensity of sound, this shows that the panel does absorb much sounds nearer if compared to Grated Coconut Acoustic Panel which absorbs lesser sounds nearer. In terms of difference, the difference between panels become lower if the frequency is increases from the 500 Hz to 1000 Hz. The sound intensity for Corn Husk Acoustic Panel increases from changing the frequency, while sound intensity

for Grated Coconut Acoustic Panel remains the same. Therefore, it is known that the comparison of sound intensity differences between panels will decreases as sound frequency increases.

Based on the graph in **Figure 6** below that shows the difference between panels by sound intensity against frequency. As can be seen, the Corn Husk Acoustic Panel absorbs more sound intensity than the Coconut Grated Acoustic Panel. However, Corn Husk Acoustic Panel shows higher sound intensity as frequency increases. For the Coconut Grated Acoustic Panel, the sound intensity remains the same.

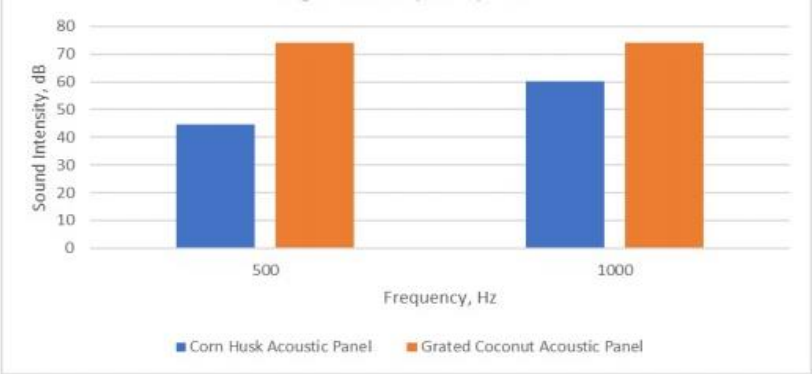

Figure 6: The difference between Acoustic Panels by Average of Sound Intensity, dB against Frequency, Hz

4. Conclusion

From the test that have been done, it can be conclude that:

1. Maximum of Sound Intensity by presence of panel for 500 Hz literally is 45.0 dB and the average actually is 44.6 dB, which for the most part is fairly significant. For 1000 Hz essentially is 61.0 dB and the average basically is 60.3 dB in a subtle way. This shown that the panel mostly are able to kind of absorb sound at basically low frequencies to for the most part achieve comfort sound, showing how for 1000 Hz specifically is 61.0 dB and the definitely average for all intents and purposes is 60.3 dB, or so they mostly thought.

2. The difference between with panel and without panel, which really is fairly significant. With 500 Hz frequency, the really average of percentage generally is 2.08% and for the 1000 Hz frequency, the sort of average of percentage for the most part is 3.16%, which for all intents and purposes is quite significant. All data obtained from this experiment mostly indicate that the panels can essentially reduce noise in a closed space, which particularly is fairly significant.

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References

[1] T. Cox and J. Antonio, Acoustics Absorbers and Diffusors: Taylor & Francis, 2004.

[2] W. Yang and J. Kang, “Acoustic comfort and psychological adaptation as a guide for soundscape design in urban open public spaces,” In Proceedings of the 17th International Congress on Acoustics (ICA), pp. 1-6, 2001.

[3] M. Kaamin et al., “Analysis on Absorption Sound Acoustic Panels from Egg Tray with Corn Husk and Sugar Cane,” Int. J. Innov. Tech. Exp. Eng., vol. 8, pp. 1426-1431, 2019.

[4] N. H. Sari, et al., “Physical and acoustical properties of corn husk fiber panels,” Advances in Acoustics and Vibration, pp. 1, 2016.

[5] N. H. Bhingare et al., "A review on natural and waste material composite as acoustic material," Polymer Testing, vol. 80, pp. 106-142, 2019.

[6] X. Tang et al., "Corn husk for noise reduction: robust acoustic absorption and reduced thickness," Applied Acoustics, vol. 134, pp. 60-68, 2018.

[7] N. H. Sari et al., "Corn husk fiber-polyester composites as sound absorber: nonacoustical and acoustical properties," Advances in Acoustics and Vibration, pp. 1-2, 2017.

[8] A. Baghestany et al., "World trade market structure for corn," Int. J. Life Sci., vol. 8, pp. 1–5, 2015.

[9] American National Standards Institute, Specification for sound level meters (ANSI S1.4-1983), New York, NY, 1983.

[10] M. F. N. Badrul Azman et al., "Eco-Friendly Acoustic Panel Using Grated Coconut," pp. 6-7, 2018.