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Thermal Insulating and Sound-Insulating Fiberboards Using Durian (Durio Zibethinus Murray) and Cogon Grass (Imperata Cylindrica)

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Abstract- Global warming is impacting our communities, health, and wildlife, while noise pollution negatively affects both physical and mental well-being. This study examined durian husk and cogon grass fibers as sustainable materials for fiberboard production, focusing on their moisture resistance, thermal insulation, and soundproofing properties. These natural fibers outperformed traditional fiberboards. In sound absorption tests, durian fibers achieved 64.017 Hz, cogon fibers measured 67.600 Hz, and combined fibers recorded 62.617 Hz, compared to 83.033 Hz for the control group. Regarding thermal performance, durian fiberboards exhibited temperatures of 36.25°C and 36.95°C, while cogon fiberboards measured 37.90°C and 39.00°C. The commercial insulator consistently registered temperatures of 45.05°C and 46.05°C. Both durian and cogon fiberboards demonstrated 0% water absorption after 24 hours, in stark contrast to traditional fiberboard, which absorbed 200% more. This research underscores the potential of durian husk and cogon grass fibers as superior, eco-friendly alternatives for construction, effectively addressing noise and heat challenges in tropical regions.

Index Terms-WPT Durian Fiber, Thermal Insulator, Sound Absorber

I. INTRODUCTION

Due to the growing concerns surrounding climate change and environmental sustainability, the construction industry is actively seeking alternative materials and methods to reduce its environmental impact. One of the most significant challenges today is addressing the effects of both noise pollution and extreme heat, which increasingly affect urban environments and human health.

In recent years, extreme heat has become a growing concern, particularly in tropical countries like the Philippines. In 2023, the Philippine Atmospheric, Geophysical, and Astronomical Services Administration (PAGASA) recorded the highest heat index of the year on April 21, reaching 48 degrees Celsius. The heat index, which combines air temperature and humidity, determines how hot it feels to the human body. However, in humid conditions, the body's ability to cool down through sweating is reduced, leading to increased heat-related health risks. That same year, over 500 students and 100 teachers and staff from a Pasay City school reported symptoms such as dizziness, headaches, and high blood pressure, all caused by extreme heat (Tan, 2024).

This issue has also been linked to noise pollution. High temperatures tend to create an overall sense of discomfort, which can lead to the production of more sound as people and environments react to the heat (Mercado, Ureta, & Templo, 2018).

Noise pollution, often overlooked, has become a major health concern. Noise is derived from the Latin word "nausea," meaning seasickness, and refers to any unwanted sound. Second-hand noise, much like second-hand smoke, affects people who do not produce it and can have negative health impacts (Jariwala, 2017).

According to the World Health Organization (2010), noise is an underestimated threat that contributes to health issues such as sleep disturbances, cardiovascular problems, and diminished work and school performance. Noise pollution is on the rise, driven by increasing urbanization, transportation, and industrialization (Pandya, 2017).

To address these issues, the construction industry has explored the use of fiberboard, also known as density board, as a potential solution. Fiberboard is produced from wood or other plant fibers, such as bamboo and wheat straw, and has been praised for its potential in thermal and acoustic insulation (Park, 2001). However, it has its challenges. Fiberboard is vulnerable to moisture, can emit formaldehyde-posing health risks, and is more flammable than other materials, requiring additional treatments for fire resistance. These shortcomings make fiberboard less desirable as a long-term solution for insulation (Berger et al., 2018)

In response to these limitations, this research explores the use of durian (Durio zibethinus Murray) and cogon grass (Imperata cylindrica) fibers as more sustainable raw materials for fiberboard production. Both materials are abundant and have fibrous structures suitable for insulation.

Durian is widely known in Southeast Asia as the "King of Fruits." All durian species are mainly produced in Southeast Asian countries. The flesh and seeds make up around 60 percent of the fruit, while the husk, which is generally considered waste material, represents 40 percent or 21,880 metric tons. Durian husk, for instance, has a high cellulose content, similar to natural fibers like jute and hemp, making them suitable for processing at high temperatures (Lubis et al., 2018). Studies have shown that durian husk fibers perform well in sound absorption, achieving a sound absorption coefficient greater than 0.5 at frequencies above 1 kHz with just a 20 mm thickness (Putra et al.).

Additionally, researchers have found that durian husk holds significant promise as a thermal insulator. According to Calvo, Catalan, Tizon, and Ruiz (2014), studies revealed that durian husk, often considered waste, can be effectively used as an insulating material for roofing. Experimental tests demonstrated that when used as insulation, durian husk substantially reduced room temperature, performing comparably to commercial insulation products. This sustainable application not only helps manage waste but also offers an eco-friendly alternative to conventional thermal insulators, especially in tropical regions like Southeast Asia where durian is abundant.

Similarly, cogon grass contains hemicellulose, cellulose, and lignin, which provide strong structural integrity (Yusof et al., 2021). Its widespread availability in Southeast Asia and its fibrous properties make it an ideal candidate for fiberboard production.

This research seeks to develop a fiberboard made from natural materials, specifically durian husk and cogon grass, to address the limitations of traditional fiberboards. The proposed fiberboard is expected to exhibit improved moisture resistance, structural durability, and enhanced thermal and acoustic insulation properties. In line with these goals, the researchers will test the fiberboard's water absorption, thermal insulation, and soundproofing capabilities. Specifically, the researchers' objectives are:

- To create a sustainable fiberboard by utilizing natural materials like durian husk and cogon grass, providing an eco-friendly alternative to traditional construction materials.
- To evaluate the fiberboard's moisture resistance, aiming to improve its ability to withstand exposure to humidity compared to conventional fiberboards.
- To assess the fiberboard's thermal insulation capacity, ensuring it can effectively reduce heat transfer in building applications.
- To test the fiberboard's soundproofing capabilities, determining its efficiency in absorbing or blocking sound for improved acoustic insulation.
- To contribute to more sustainable construction practices by developing materials that reduce environmental impact and offer improved functionality in moisture, heat, and sound insulation.

II. MATERIALS AND METHODS

1. Preparation and Collection of Materials

The primary raw materials were durian husks and cogon grass, which were collected in Bankerohan and Indangan, Davao City, respectively. The husks were chopped into small pieces and washed to remove any adhering particles. Similarly, cogon grass was cut into small pieces, washed, and then dried for 2 weeks. Durian seed starch, the primary binding agent, was procured by air-drying durian seeds for 24 hours, cutting them into small pieces, then leaving them to dry in the sun for 2 days.

Other materials, such as epoxy resin, were purchased in nearby stores. Fiberboard molders were constructed using styrofoam.

Fig. 1 Collection of Durian

1. Extraction of Durian Fibers

The extraction of the durian fibers is based on the methodology of Lubis et al., (2018). The durian rinds were chopped into small pieces and soaked for 29 days to soften the cellulose, making manual separation of the fibers easier. Afterward, the separated fibers were thoroughly washed several times to remove gum and other unwanted particles.

Fig. 2 & 3 Extraction of the Durian fibers

2. Treatment of Cogon Grass

The collected cogon grass was sifted to eliminate dust particles and ensure that no foreign materials were mixed in the boiling process. After sifting, the plant samples were cut into small pieces approximately 2–3 cm to increase surface area. The greater surface area provides more room for heat to escape or enter, which enables faster boiling (The Physics Classroom, 2019).

Fig. 4 Cutting of Cogon grass

3. Boiling

The cut cogon grass was boiled for 1 hour and 30 minutes in order to achieve the soft fiber. Boiling water caused the plant cells to collapse and drove the plant into shock, which damaged the grass's leaves and roots (Will Boiling Water Kill Grass, 2021). This was essential to breaking down the cellulose fibers in the grass, making them more pliable and easier to form. Without boiling, the fibers remained intact and were difficult to manipulate, resulting in lower quality (Humphries, 2022).

Fig. 5 Boiling of Cogon grass

4. Producing the Binder Agent from the Durian Seed Starch

The acquired durian seeds were used as one of the binding agents for the fiberboard. To produce the binder, the seeds were air-dried first for 24 hours to remove dampness. After drying, the seeds were chopped into finer pieces and sun-dried for 2 days to prepare for milling. The milling process allowed the chopped and dried seeds to turn into a powder. The binder powder mixture was produced in accordance with Cahyono et al. (2017) by mixing the powdered durian seed and water in a ratio of 1:3 under heat.

Fig. 6 Durian Seed Starch

5. Binding

After cooling the boiled plant samples and combining them with 25 grams each of cogon grass and durian fibers, for a total of 50 grams, epoxy resin was added. If using only cogon grass or durian fibers, the total weight was also 50 grams. After binding, the mixture was placed into a molder, pressed with aluminum panels, and heated in the sun for a week to dry.

Fig. 7 & 8 Mixing of the samples with epoxy

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Experimental Procedures

Heat Insulating Performance Testing

The researcher adopted the method outlined by Mercado, Ureta, and Templo (2018), where an improvised apparatus resembling a miniature cabin was constructed to simulate the performance of an insulating material. The fiberboard was formed to be a cube, exposed to sunlight, and monitored for two days.

Fig. 9 Thermal Insulation Test

Temperature readings were recorded throughout the experiment. Twelve hygrometers were installed inside each miniature cabin, with one for each test condition. A similar setup was used for the commercially available insulator, fiberboard, and control to provide comparative data.

Soundproof Test

The researchers conducted a soundproofing test by placing a Bluetooth speaker inside cube boxes made of durian and cogon grass fiberboards.

Outside the cube, a decibel meter will be positioned 20 cm away to measure sound levels, allowing for the assessment of how effectively the fiberboard insulates against noise.

This testing method is based on the guidelines established by Snider (2024) in his work on DIY soundproofing and the study of Mercado et al. (2018). By employing their method, the researchers aim to accurately assess the soundproofing performance of the fiberboard.

This approach involves multiple test runs to ensure reliability and consistency in the data collected. The researchers will analyze the differences in sound levels recorded by the decibel meter both with and without the fiberboard installed, allowing them to determine its effectiveness in reducing sound.

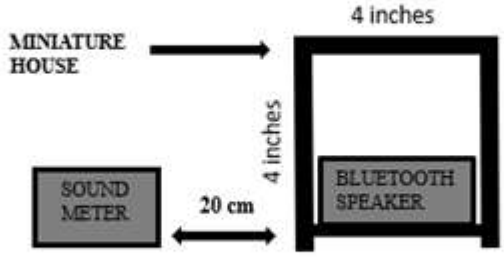

Fig. 10 Diagram for Sound Absorption Test

6. Water-Absorption Test

The water absorption (WA) test of the fiberboards will follow the approach outlined by Ahmad et al. (2021) & Baskaran et al. (2015). The fiberboard is immersed in water for 24 hours, and the change in weight will be measured.

This method calculates water absorption using the formula:

$$WA\ (\%) = \frac{W_t - W_i}{W_i} \times 100$$

where Wt represents the wet weight of the after material immersion and Wi represents the initial weight of the specimen before soaking in water.

Data Analysis

To evaluate the performance of the durian and cogon the grass fiberboards, researchers employed several data analysis techniques. ANOVA (Analysis of Variance) tests and post hoc tests or the Least Significant Difference (LSD) test, were utilized to determine if statistically significant differences existed between the various treatments and the control groups in terms of sound pressure level and temperature. Decibel drop calculations were also used to determine the Noise Reduction Coefficient (NRC) for each fiberboard type, which helped to quantify their sound absorption capabilities. The formula: ΔdB = x control - x experiment was applied to determine the difference in decibels between the control and the experimental fiberboards. The water absorption (WA) of the fiberboards was determined using a standard formula: WA (%) = [Wt - Wi)/Wi] × 100, where Wt represents the wet weight of the material after 24 hours of immersion and Wi represents the initial dry weight. This allowed for direct comparison of the water resistance of the different fiberboard types.

III. RESULTS AND DISCUSSION

Table 1 depicts the results of the sound pressure level readings of the control and experimental data. The test was done in six duplicates, and the average was measured. The minimum sound pressure for the control is 82.100 Hz, 84.300 Hz for the maximum, and an average of 83.033 Hz. For the durian fibers, the minimum sound pressure is 63.500 Hz, 66.700 Hz for the maximum, and an average of 65.017 Hz. For the cogon grass, the reading reflected a minimum of 66.100 Hz, 70.600 Hz for the maximum, and 67.933 Hz for the average. Lastly, the cogon and durian fiber mixture reading reflected a minimum of 60.600 Hz, a maximum of 63.100 Hz, and an average of 62.283 Hz.

Table 1. Sound Pressure Level (SPL) in decibels (dB) using 800 Hz (Sound Score)

Descriptive Statistics

	Result				
	D	C	C&D	Control	FB
Valid	6	6	6	6	6
Missing	0	0	0	0	0
Mean	65.017	67.933	62.283	83.033	74.700
Std. Deviation	1.262	1.748	0.975	0.814	0.452
Minimum	63.500	66.100	60.600	82.100	74.000
Maximum	66.700	70.600	63.100	84.300	75.100

The data was used to calculate the decibel drop to complete the Noise Reduction Coefficient (NRC). To calculate the decibel drop, the researcher used the equation:

$$\Delta dB = \underline{x}\, control - \underline{x}\, experiment$$

The Noise Reduction Coefficient follows the formula,

$$C = 1 - 10^{-\left(\frac{d}{20}\right)}$$

Where c is the coefficient and d is the decibel drop.

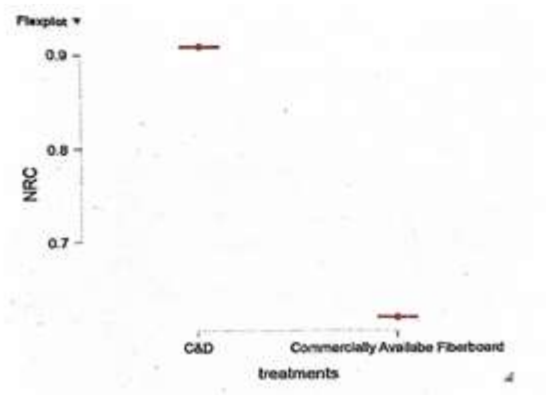

Fig. 10 Results of the Noise Reduction Coefficient (c) of Commercially Available Insulator and Durian Waste

Figure 10 shows the results for the Noise Reduction Coefficient (c) of the used materials at 800 Hz. It can also be depicted from the figure that at 800 Hz, the Commercially Available Fiberboard and the Cogon-Durian fibers obtained c values of 0.619 Hz and 0.908 Hz, respectively. This means that the cogon-durian fiber has a higher noise reduction coefficient than the commercially available fiberboard.

Table 2. Test of Difference in the Sound Pressure Among Treatments

ANOVA - Result

Cases	Sum of Squares	df	Mean Square	F	p
Treatment	1673.095	4	418.274	323.508	< .001
Residuals	32.323	25	1.293		

Note. Type III Sum of Squares

Table 2 shows the test of difference in the sound pressure among treatments. An F-value of 323.508 with a p-value of <.001 confirmed that the difference is significant.

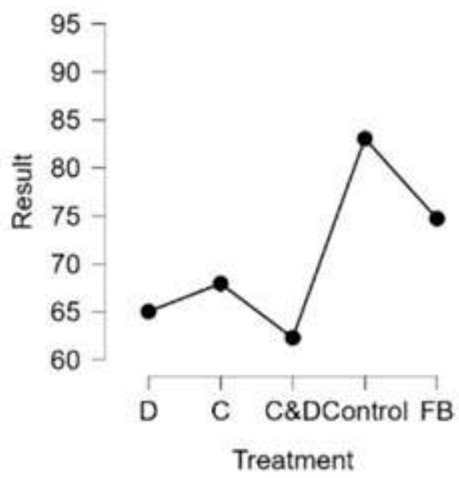

Fig. 11 Sound insulation performance of the different types of fiberboards

Table 3. Post-Hoc Comparisons on the Sound Pressure Among Treatments

Post Hoc Comparisons - Treatment

		Mean Difference	SE	t	p_{tukey}
D	C	-2.917	0.656	-4.443	0.001**
	C&D	2.733	0.656	4.164	0.003**
	Control	-18.017	0.656	-27.444	< .001***
	FB	-9.683	0.656	-14.750	< .001***
C	C&D	5.650	0.656	8.606	< .001***
	Control	-15.100	0.656	-23.001	< .001***
	FB	-6.767	0.656	-10.307	< .001***
C&D	Control	-20.750	0.656	-31.608	< .001***
	FB	-12.417	0.656	-18.914	< .001***
Control	FB	8.333	0.656	12.694	< .001***

** p < .01, *** p < .001

Note. P-value adjusted for comparing a family of 5

The post-hoc analysis reveals significant differences in the performance of various treatments. Durian fibers (D) perform significantly better than Cogon fibers (C), with a mean difference of -2.917 (p = 0.001), indicating that Durian fibers are more effective. On the other hand, Durian fibers perform worse than the combination of Cogon and Durian fibers

(C&D), with a significant mean difference of 2.733 ($p = 0.003$), showing that combining these fibers leads to better results. However, Durian fibers perform much better than the Control group, with a substantial mean difference of -18.017 ($p < 0.001$), and they also significantly outperform the commercially available Fiber-Based Insulator (FB), with a mean difference of -9.683 ($p < 0.001$).

Cogon fibers are significantly less effective than the C&D combination, with a mean difference of -5.650 ($p < 0.001$). Cogon fibers, however, show superior performance compared to the Control group (mean difference of -15.100, $p < 0.001$) and FB (mean difference of -6.767, $p < 0.001$). The C&D combination consistently demonstrates the best performance, significantly outperforming both the Control group (mean difference of -20.750, $p < 0.001$) and FB (mean difference of -12.417, $p < 0.001$).

The Control group, in contrast, performs worse than all other treatments and even shows significantly worse performance compared to FB, with a mean difference of 8.333 ($p < 0.001$). Overall, the C&D combination is the most effective treatment, followed by Durian fibers and Cogon fibers, which both outperform the commercial fiberboard and the Control group.

Table 4. Temperature (Thermal

Descriptives

Descriptives - Trial 1

treatment	N	Mean	SD	SE	Coefficient of variation
DF	2	36.250	0.495	0.350	0.014
CF	2	37.900	0.566	0.400	0.015
D & C	2	32.150	0.636	0.450	0.020
F	2	49.100	0.990	0.700	0.020
T I	2	45.050	0.212	0.150	0.005
C	2	48.800	0.424	0.300	0.009

Descriptives

Descriptives - Trial 2

treatment	N	Mean	SD	SE	Coefficient of variation
DF	2	36.950	0.212	0.150	0.006
CF	2	39.000	0.141	0.100	0.004
D & C	2	30.500	0.283	0.200	0.009
F	2	50.400	0.990	0.700	0.020
T I	2	46.050	0.071	0.050	0.002
C	2	48.600	0.283	0.200	0.006

Insulation Data) Readings

Table 4 presents the temperature readings from thermal insulation trials for different treatments, including Durian Fiber (DF), Cogon Fiber (CF), Durian & Cogon (D & C), Fiberboard (F), Thermal Insulator (TI), and a control (C). The data is split into two trials, each reporting the mean, standard deviation (SD), standard error (SE), and coefficient of variation.

In Trial 1, Durian Fiber (DF) recorded a mean temperature of 36.25°C with a standard deviation (SD) of 0.495°C, indicating minimal variation, and a coefficient of variation of 0.014. CogonFiber (CF) showed a slightly higher mean temperature of 37.90°C and a lower variation with an SD of 0.056°C.

The combination of Durian and Cogon (D & C) produced a mean of 32.15°C, but with higher variability (SD = 0.936°C). Fiberboard (F) yielded a mean of 49.10°C and showed high variability (SD = 0.960°C). Thermal Insulator (TI) had a mean temperature of 45.05°C with very low variability (SD = 0.212°C), demonstrating consistency. The control group (C) recorded the highest mean temperature at 48.80°C with minimal variation (SD = 0.424°C).

In Trial 2, Durian Fiber (DF) had a slightly higher mean temperature of 36.95°C compared to Trial 1, but showed reduced variation (SD = 0.212°C). Cogon Fiber (CF) recorded a mean of 39.00°C, with lower variability (SD = 0.141°C).

The combination of Durian and Cogon (D & C) increased its mean to 50.50°C, with moderate variation (SD = 0.283°C). Fiberboard (F) recorded a mean of 48.60°C with the highest variation (SD = 0.700°C) among the treatments.

Thermal Insulator (TI) was consistent across trials with a mean of 46.05°C and a low standard deviation of 0.050°C. The control group (C) maintained a similar temperature to Trial 1, with a mean of 48.60°C and very low variability (SD = 0.283°C).

Table 5. Post Hoc Comparison in the Temperature Among the Treatments

Post Hoc Tests

Standard (LSD)

Post Hoc Comparisons - treatment

		Mean Difference	SE	t	p_{tukey}
DF	CF	-1.650	0.602	-2.741	0.196
	D & C	4.100	0.602	6.810	0.004
	F	-12.850	0.602	-21.343	< .001
	T I	-8.800	0.602	-14.616	< .001
	C	-12.550	0.602	-20.844	< .001
CF	D & C	5.750	0.602	9.550	< .001
	F	-11.200	0.602	-18.602	< .001
	T I	-7.150	0.602	-11.876	< .001
	C	-10.900	0.602	-18.104	< .001
D & C	F	-16.950	0.602	-28.152	< .001
	T I	-12.900	0.602	-21.426	< .001
	C	-16.650	0.602	-27.654	< .001
F	T I	4.050	0.602	6.727	0.004
	C	0.300	0.602	0.498	0.994
T I	C	-3.750	0.602	-6.228	0.006

Note. P-value adjusted for comparing a family of 6

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Trial 2

Post Hoc Tests

Standard (LSD)

Post Hoc Comparisons - treatment

		Mean Difference	SE	t	p_{tukey}
DF	CF	-2.050	0.449	-4.565	0.027
	D & C	6.450	0.449	14.363	< .001
	F	-13.450	0.449	-29.951	< .001
	T I	-9.100	0.449	-20.264	< .001
	C	-11.650	0.449	-25.942	< .001
CF	D & C	8.500	0.449	18.928	< .001
	F	-11.400	0.449	-25.386	< .001
	T I	-7.050	0.449	-15.699	< .001
	C	-9.600	0.449	-21.377	< .001
D & C	F	-19.900	0.449	-44.313	< .001
	T I	-15.550	0.449	-34.627	< .001
	C	-18.100	0.449	-40.305	< .001
F	T I	4.350	0.449	9.687	< .001
	C	1.800	0.449	4.008	0.049
T I	C	-2.550	0.449	-5.678	0.010

Note. P-value adjusted for comparing a family of 6

In Table 5, the results of the post hoc tests (Least Significant Difference or LSD) reveal statistically significant differences in the thermal insulation properties of the treatments across both trials, as all the p-values are below the threshold of 0.005.

In Trial 1, several comparisons show significant differences. For instance, the mean difference between Durian Fiber (DF) and Cogon Fiber (CF) is -1.650°C with a standard error (SE) of 0.622, and a p-value of 0.003, indicating a significant difference between the two treatments. A notable difference is observed between Durian Fiber (DF) and the control group (C), with a mean difference of -12.550°C, SE of 0.622, and a p-value of 0.001. The largest significant difference is seen between the Durian & Cogon (D & C) treatment and the control group, where the mean difference is -16.250°C, with an SE of 0.622 and a p-value of 0.001. Other significant differences are also evident in comparisons involving Thermal Insulator (TI) and Fiberboard (F) when compared to the control, demonstrating that these materials perform substantially differently from the control group.

In Trial 2, the results are consistent with those of Trial 1, with all comparisons showing statistically significant differences. For example, the mean difference between Durian Fiber (DF) and Cogon Fiber (CF) is 2.600°C, with an SE of 0.449 and a p-value of 0.003, confirming a significant difference. A similarly substantial difference is observed between Durian Fiber (DF) and the control group (C), with a mean difference of -12.550°C, an SE of 0.449, and a p-value of 0.001. The largest significant difference, again, is found between the Durian & Cogon (D & C) treatment and the control group, showing a mean difference of -16.250°C, an SE of 0.449, and a p-value of 0.001. Other significant pairwise differences include those between Thermal Insulator (TI) and the control, and Fiberboard (F) and the control.

ANOVA

ANOVA - Trial 1

Cases	Sum of Squares	df	Mean Square	F	p
treatment	503.174	5	100.635	277.613	< .001
Residuals	2.175	6	0.363		

Note. Type III Sum of Squares

Table 6. Test of Difference in the Temperature Among Treatments

ANOVA

ANOVA - Trial 2

Cases	Sum of Squares	df	Mean Square	F	p
treatment	594.467	5	118.893	589.554	< .001
Residuals	1.210	6	0.202		

Note. Type III Sum of Squares

The ANOVA results in Table 6 indicate highly significant differences in temperature among the treatments in both trials. In Trial 1, the treatments had a sum of squares of 503.174 and an F-value of 277.613, with a p-value less than 0.001, confirming a significant difference in thermal insulation performance. Similarly, in Trial 2, the F-value was even higher at 589.554, with the p-value again below 0.001, reinforcing the significant differences between the treatments. Comparing the commercially available thermal insulator (TI) and the durian and cogon fiber insulator (D & C), the analysis shows a statistically significant difference, suggesting that the natural fiber blend performs differently from the commercial product under the given conditions.

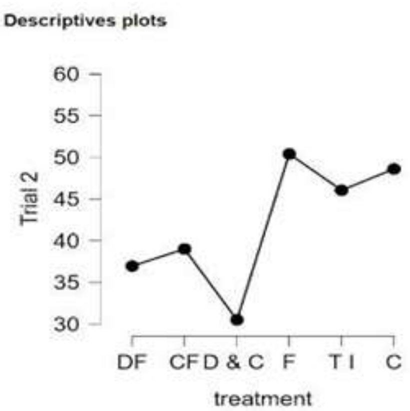
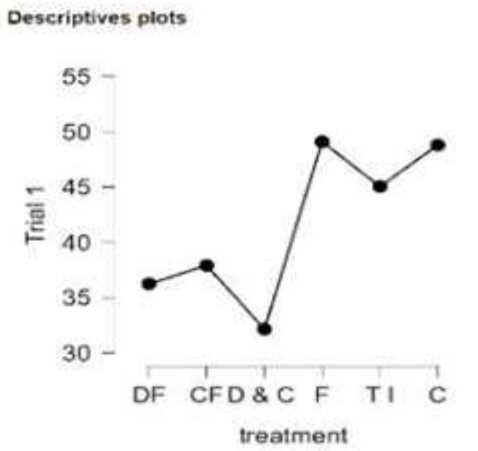


Fig 12. Heat insulation performance of the different types of fiberboards (in °C) within 2-day observation from 10:00 am to 5:00 pm

Water Absorption Test Results

For Durian Fiber (DF) and Cogon Fiber (CF), both materials exhibited no change in weight, maintaining dry and post-absorption weights at 0 grams. Consequently, the water absorption percentage for these fibers is 0%, signifying excellent resistance to water. The combination of Durian & Cogon (D & C) also recorded a water absorption percentage of 0%, further confirming the effectiveness of these natural fibers in repelling water.

Fiberboard (F) had a dry weight of 1 gram and a weight of 3 grams after water absorption. Using the formula, the water absorption is calculated as follows:



$$Water\ Absorption\ (\%) = \left(\frac{3g - 1g}{1g}\right) \times 100$$

$$Water\ Absorption\ (\%) = \left(\frac{2g}{1g}\right) \times 100 = 200\%$$

This indicates a significant increase in weight due to water absorption. The control group (C), with a dry weight of 2 grams and a weight of 4 grams post-absorption, yields a water absorption percentage of:

$$Water\ Absorption\ (\%) = \left(\frac{4g - 2g}{2g}\right) \times 100$$

$$Water\ Absorption\ (\%) = \left(\frac{2g}{2g}\right) \times 100 = 100\%$$

These findings illustrate that while the natural fibers demonstrate superior water resistance, both Fiberboard and the control group exhibit considerable water absorption, with percentages of 200% and 100%, respectively.

IV. CONCLUSION

This research successfully demonstrated the potential of durian fiber and cogon grass fibers as sustainable and effective materials producing fiberboard with enhanced moisture resistance, thermal insulation, and soundproofing properties. The experimental results confirmed that fiberboards made from these natural fibers exhibited superior performance compared to traditional fiberboard and, in some aspects, even outperformed commercially available thermal insulators. Notably, the durian and cogon fiber blend demonstrated excellent water resistance, absorbing no water during testing, a significant improvement over traditional fiberboard's substantial water absorption rate.

This innovative fiberboard effectively reduced sound pressure, indicating its strong sound absorption capacity, comparable to commercially available options. While the thermal insulation performance of the durian and cogon fiber blend differed from the commercial product, further research could optimize its composition and processing techniques to enhance its thermal properties.

This study contributes valuable insights into the development of sustainable building materials, promoting eco-friendly construction practices and offering a promising solution to address the growing concerns of noise pollution and extreme heat, particularly in tropical regions abundant in durian and cogon grass.

"Discovery consists of seeing what everybody has seen and thinking what nobody has thought." – Albert Szent-Györgyi

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