SEMARAK ILMU PUBLISHING

Journal of Advanced Research in Applied Sciences and Engineering Technology

Journal homepage:
https://semarakilmu.com.my/journals/index.php/applied_sciences_eng_tech/index
ISSN: 2462-1943



Green Organic Partition Board from Waste Materials as Soundproof Material

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ARTICLE INFO

Article history:
Received 23 December 2022
Received in revised form 5 April 2023
Accepted 13 April 2023
Available online 27 April 2023

Keywords:
Industrialised Building System (IBS); partition; recycle material; sound proof

ABSTRACT

Walls are vital in the structure, and give security to the host. Wall as part of structure in industrialised Building System (IBS). Walls can be made a plunge two bearing and non-bearing walls. Non-bearing walls are made of delicate parcel boards. Segment board ought to be, areas of strength for light have great Noise Reduction Coefficient (NRC). This' exploration will likely make another segment board from squandered material to deliver ecologically protected and less expensive board from the current board. The principal material is coconut shell and paper. Each board is made in various extents to pick the board with best NRC. Commotion impact framework chamber is utilized to test the capacity of sound proof of the new sheets. The perusing of the sound level meter was taken in various good ways from the sound source and changing the level of the sound recurrence and sound power. The outcome showed that the new parcel board which produced using 80% coconut shell, 15% concrete, 5% paper can diminish the clamor better compared to the other sheets. This board has NRC is 21%, 21%, 24%, and 12% for the different sound level tests. This can be an option IBS parcel board.

1. Introduction

IBS is a way of speeding the construction process with a prefabricated concept in which each part is first produced in the component manufacturing plant. In order to improve the efficiency of construction projects, it is necessary to use modern technology such as the IBS [1]. The term "industrial building system" (IBS) has been used by Malaysia's construction industry to describe a prefabricated construction process in which practically all structural components are manufactured on-site or off-site and the finished product is installed at the construction site [2]. A slab, beams, wall, and columns are examples of these components. Partition walls are an example of IBS. The IBS consist of five types of construction components which are fabricated steel structures, precast component systems, innovative mould systems, prefabricated timber structures and modular block systems [26].

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https://doi.org/10.37934/araset.30.2.304313

In a home, there are two different kinds of walls: load bearing and non-load bearing. Rooms are separated within by non-bearing walls, which do not support any weight. Load-bearing walls serve as dividers while also supporting the weight of the structure [3]. Since partition walls don't carry any load, they should be soft, thin, and light, hence the name "partition board." Bearing walls aid in the load transfer from the above structure to its lower structure.

High-rise buildings in general minimize achieving the use of construction materials that has a heavy weight to reduce the building load and efficiency [4]. Many contractors utilize partition walls to divide up space while taking into account the soundproofing impact, ease of installation, cost, and other variables. Partition designs are frequently employed in modern construction's interior design. Therefore, public safety factors in the event of a fire, the wall becomes a protective material. The selection of the type of fire-resistant wall material in a certain period is the reason for the selection of the type of wall material [5].

The partition board was accepted as a fire prevention partition and was built after the completion of the main building structure. These safety factors should be given due attention. The need of the partition board is usually based on their price, quality, strength, fire-resistance, heat insulation [6].

There are many methods to improve the durability of partition walls, but the environmental protection characteristics of materials, price, durability, cost and portable and light specifications are factors to consider for selection. The board that can be soundproof, environmentally friendly, and lightweight will be the subject of this research.

1.1 Waste Material

The Roman word "vastus," which means to eliminate, abandon, or stop building, is where the word "waste" first appeared [7]. Wastes may be intended to be unwanted or pointless items. Waste is therefore regarded as unwanted stuff because it is thought that it has no worth. Waste is described as a product that has been abandoned by its owner (this is the subjective definition of waste) [8].

Globally, the traditional supply chain activities have changed to embrace a sustainable agenda due to the increase in environmental consciousness. The objective to achieve sustainable consumption and production that protects the environment, along with Sustainable Development Goals (SDGs) 12 of the 2030 Agenda, exhorts everyone, especially corporate groups, to manufacture environmentally friendly products. For a product to be accepted on the market, it must satisfy the demands and desires of the consumer [9].

The use of sustainable materials in product manufacturing, procedures to reduce the consumption of raw materials, water, and energy, and strategies to use resources in renewable and environmentally friendly ways are all examples of how businesses are beginning to implement sustainable practices. Some businessmen who care about the environment by using technological logistics to achieve a balance between economic profit and protecting the environmental impact. Recycling to produce new products can increase product value and reduce pollution residues. [10].

The following are examples of products and services that are more environmentally friendly: products made from recycled materials that can be reused or recycled; products powered by renewable energy sources like biobased fuels, solar, and wind energy; alternate fuel vehicles; and products using alternatives to potentially harmful chemicals, radioactive materials, and biologically hazardous agents [11].

Environmental awareness encompasses not just one's environmental knowledge but also the willpower, morals, and technical know-how required to address environmental problems [12]. There is still a lack of environmental awareness in emerging nations like Malaysia [13].

To address the environmental crisis, energy conservation is a key objective, several studies and practical adjustments are being made to identify the core reasons [14,15]. Find, look and proceed (FLP) is crucial for identifying inefficiencies in big room layouts, such as those in library buildings, because these structures' layouts have a significant impact on air distribution and human comfort. It is to compensate for any inefficiency in energy use. [16].

2. Methodology

In order to give building occupants privacy from sound and sight, partition walls split a building's space into a number of rooms. To prevent disturbing those outside the room, the partition should be able to muffle internal voices [17].

From the leftovers of the used material, a partition board will be made for this research project. Partition board will be made by combining cement, ground newspaper, and ground coconut shell. Coconut shell fiber reinforced polymer composites [18]. The study's goal is to create effective noise- and environment-friendly partitioning materials.

A variety of health effects, particularly hearing-related ones including hearing loss, can be brought on by noise. Numerous causes and locations contribute to indoor noise pollution [19]. The effect of noise in building materials is the subject of this study's experiment. Indoor noise pollution come from many sources and places. For example, a smooth surface and a rigid wall can bounce more than 99% sound [20]. Using a sound level meter and a noise effect chamber, the level of noise reduction in each board is assessed [21].

Composites now meet many designers' material requirements at their best in recent years. Significant advancements have been made in the design and manufacture of light-weight, high-strength materials over the past 50 years, principally as a result of the rise of polymer composite materials [22].

Newspaper and coconut shell will be the materials used in this study. These materials are gathered from the primary retailers and users of the product. Due to its high strength and modulus qualities, coconut shell fiber is a possible candidate for the enhancement of novel composites [23]. Composite fiber can be used in, the board range of application such as, building material, furniture and fishnets. Coconut fiber is important reinforcement material in fabrication of various types of polymer-based composites, due to cost effectiveness, high strength, etc. [24]. Improved mechanical characteristics of coconut shell include tensile strength, flexural strength, flexural modulus, and hardness and impact power [25]. The material underwent some sort of processing after collecting. While the newspaper was being ground, the coconut was being fried in an oven before being ground.

The powder is combined with cement to produce the boards once the coconut and newspaper have been prepared. By altering the ratio of the material and upping the ratio of the coconut in the majority of the boards, four distinct boards may be made.

The first board is made with 20% newspaper, 40% cement, and 40% coconut shell powder. The second board is composed of 15% newspaper, 35% cement, and 50% coconut shell powder. The third board is composed of 5% newspaper, 15% cement, and 80% coconut shell powder. The fourth and final board is constructed using 20% newspaper and 80% cement.

Following board creation, a noise effect chamber is used to assess each board's ability to reduce noise. This 220 cm long, rectangular box with a speaker inside for sound has a long wood piece in the middle that separates it into two halves. The wood has a tiny cut in it where the board will fit. The device contains an external sound level meter that will be used to record the sound level and a monitor that allows to adjust the speaker's volume.

Each board is put through its paces at six interval distances from the speaker during the test: 0, 50, 100, 120, 170, and 220 cm. Each board is subjected to sound testing at four different levels: low frequency, low intensity (level 1), low frequency, high intensity (level 2), high frequency, high intensity (level 3), and high frequency, low intensity (level 4). The following formula can be used to determine the percentage of noise reduction.

$$\text{Noise Reduction Coefficient (NRC)} = \frac{(sound\ lavel\ without\ \ panel - sound\ level\ with\ the\ panel)}{sound\ lavel\ without\ panel} \quad (1)$$

$$NRC = \frac{a-b}{a} \quad (2)$$

a = sound level after the partition
b = sound level before the partition



Fig. 1. Grinder machine on process of grinding

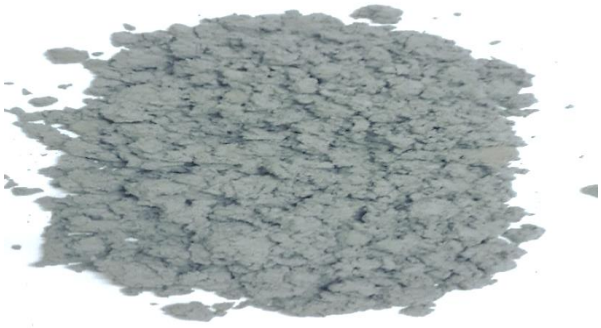


Fig. 2. Grinded newspaper



Fig. 3. Grinded coconut shell



Fig. 4. Mixing the material with water

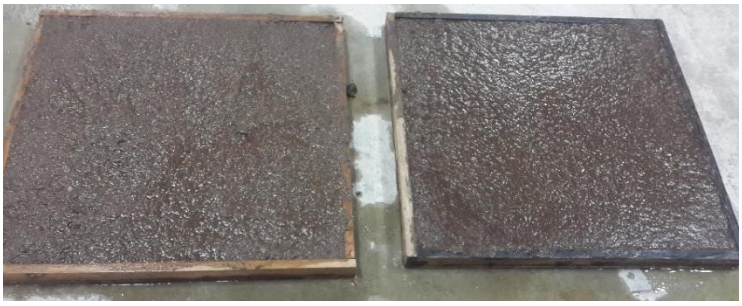


Fig. 5. New casted partition boards



Fig. 6. Noise effect system chamber

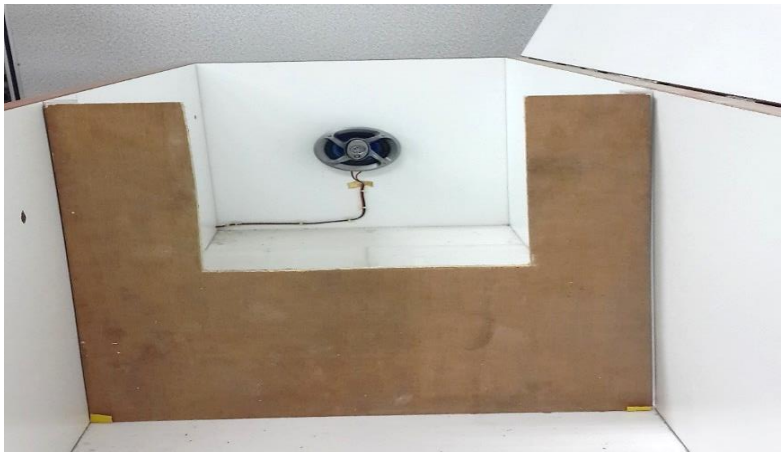


Fig. 7. Inside of noise effect system chamber with no partition

3. Results

The results of the partition boards' noise reduction percentage are displayed in the graph below. This result was obtained by testing each board at six different positions away from the speaker and at various sound levels, then determining each board's noise reduction coefficient and average NRC.

The four new boards and the current gypsum board used as partitions are tested in this research experiment on the effects of noise on buildings. Each board has undergone testing at six different speaker distances with four distinct sound levels, varying the frequency and strength of the sound. Comparing the outcomes of each board or panel, the results of those various four levels had been determined in a different way. During this conversation, the typical outcome will be examined.

Referring to Figure 8, the result of low frequency low intensity test found that sample C new board with 80% coconut shell, 15% cement and 5% newspaper recorded the highest result compared to the other four samples.

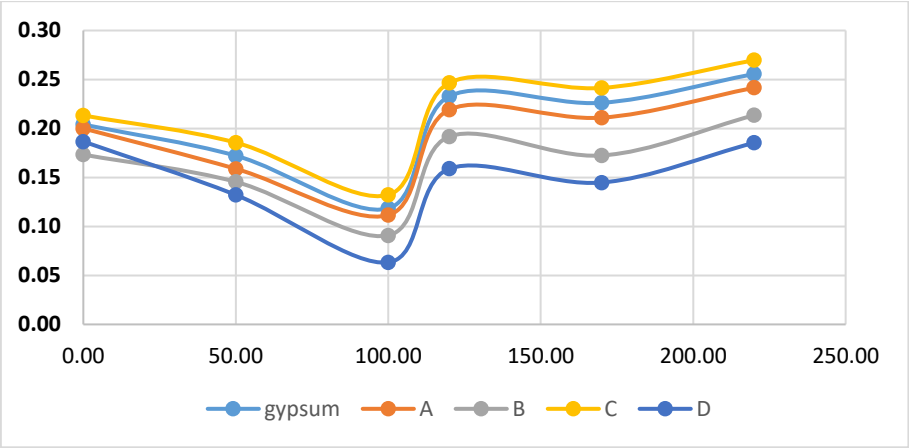


Fig. 8. Result of low frequency low intensity test

There are five boards which was being tested

i. Gypsum board (existing partition)
ii. A = new board with 40% coconut shell, 40% cement and 20% newspaper
iii. B = new board with 50% coconut shell, 35% cement and 15% newspaper
iv. C = new board with 80% coconut shell, 15% cement and 5% newspaper
v. D = new board with 0% coconut shell, 80% cement and 20% newspaper

Referring to Figure 9, Result of low frequency high intensity test it was found that sample C new board with 80% coconut shell, 15% cement and 5% newspaper still recorded the highest results compared to the other four samples which are sample 1, A, B and D.

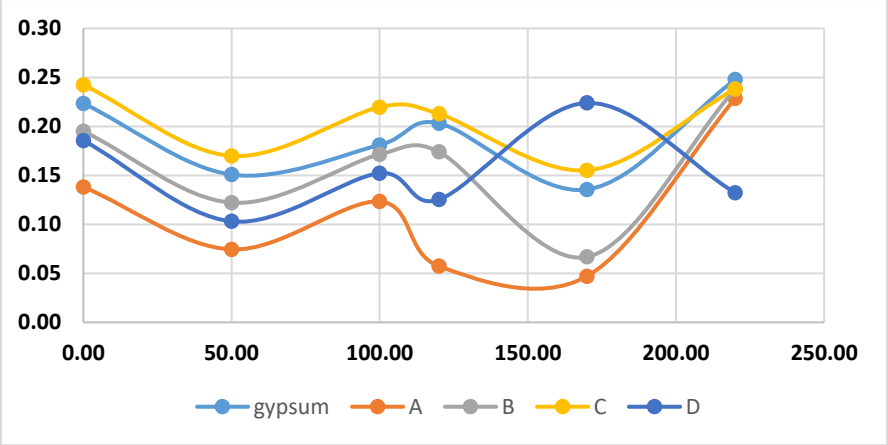


Fig. 9. Result of low frequency high intensity test

Referring to Figure 10, result of high frequency high intensity test it was found that sample C new board with 80% coconut shell, 15% cement and 5% newspaper still recorded the highest results compared to the other four samples which are sample 1 gypsum board existing partition, sample A, sample B and sample D.

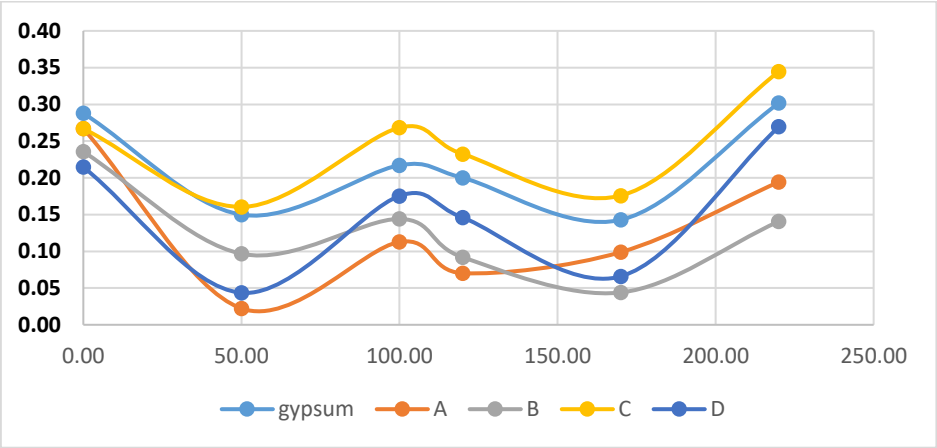


Fig. 10. Result of high frequency high intensity test

While Figure 11 below shows the average results for each board from 0 cm to 220 cm away from the sound source, all blended into one sound level. The vertical line has the numbers of the percentage of the noise reduction coefficient, while the horizontal line shows the levels of the sound, e.g. Point 1 stands for the low frequency and low intensity test. Point 2 stands for low frequency and high intensity test and so on. The horizontal line displays the sound levels, while the vertical line displays the percentages of the noise reduction coefficient, for example. Point 1 denotes the test with low frequency and low intensity. Point 2 denotes tests with low frequency and high intensity, among other things.

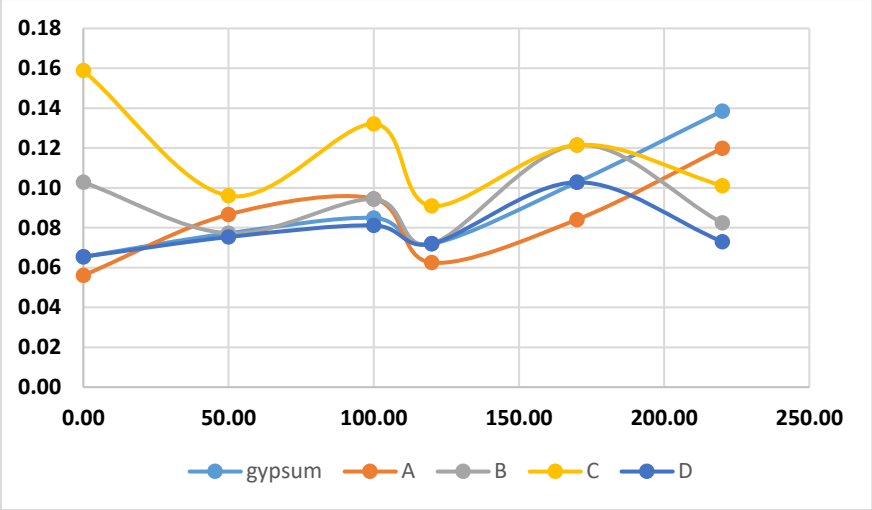


Fig. 11. Result of high frequency low intensity test

The board's typical outcome is displayed in Figure 12. The top line shows the maximum noise reduction coefficient score. The board made of 80% coconut shell, 15% cement, and 5% newspaper, designated Board C, has the highest NRC in the graph, with average noise reduction coefficients of 0.21 in low frequency and low intensity, 0.21 in low frequency and high intensity, 0.24 in high frequency and high intensity, and 0.12 in high frequency low intensity.

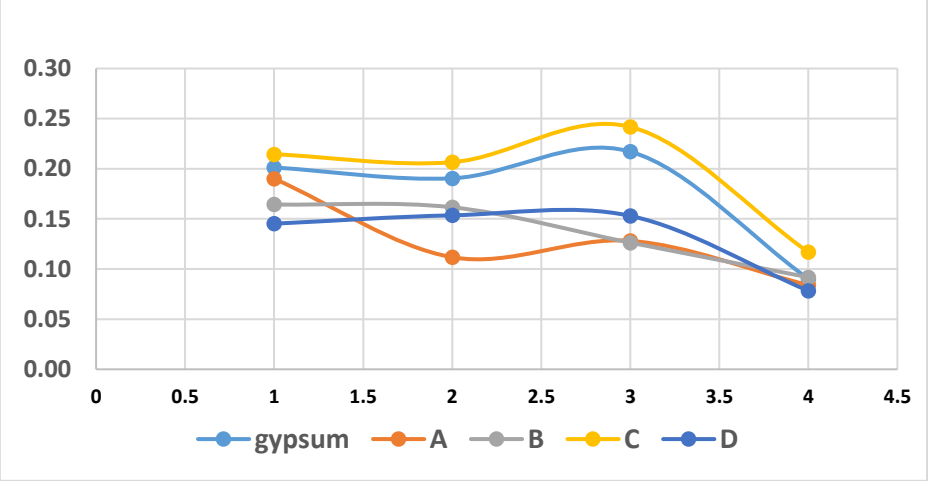


Fig. 12. Average result of the boards

4. Conclusions

The findings of this study demonstrate that the goals of the study to make partition boards out of waste materials that can dampen outside noise and shield it from passing through the board were achieved with the intensity results. The new parcel board which produced using 80% coconut shell, 15% concrete, 5% paper can diminish the clamor better compared to the other sheets. Waste material in Malaysia quite in huge amount. Hence, utilizing leftover materials in construction projects is a great way to cut down on waste. Thus, construction project should have practice more using waste material in construction industry since it can produce a quality material also can save the earth. Indeed, the use of recycled materials can reduce the cost of materials, produce green concept building materials and bring many benefits especially in the preservation of the environment around us.

Acknowledgement

This journal was funded by Centre of Excellence Water Research and Environmental Sustainability Growth (WAREG), and Research Management Centre (RMIC), Universiti Malaysia Perlis (UniMAP).

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