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KAPOK FIBRE AS A SOUND INSULATION FOR SOUND PROOFING WALL PANEL

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ABSTRACT

Noise pollution has impact on the quality of life and it is a serious health and social problem. The aims of this innovation project were to create Kapok Fibre as a sound insulation for soundproofing wall panel design ideas. Next, to assemble the prototype of Kapok Fibre as a sound insulation for soundproofing walls in building. Other than that, to demonstrate the performance of the Kapok Fibre as a sound insulation for soundproofing walls in building and to demonstrate the entrepreneurship skills in Kapok Fibre as a sound insulation for sound proofing wall that can be marketable. Sound Level Meter was used to determine the noise level. The value of the concrete wall panel that had been used in this innovation project were 500cm x 150cm x 200cm. Results shows that sound of normal concrete wall panel has a higher reading which is 66.33dB higher than Kapok fibre wall panel which only 49.2 dB. The highest reading of concrete wall panel was 67.9 dB while the highest reading of Kapok fibre wall panel was 54.4 dB. However, the innovation project concludes that the sound experimental need to be done in a standard room.

Keywords: *sound insulation, wall panel, kapok fibre, pollution, noise*

INTRODUCTION

Nearly half of people aged 12 to 35 may be exposed to dangerous levels of sound from personal audio devices (World Health Organization). Around 40% of that age group may be exposed to potentially harmful levels of sound at entertainment venues. Noise pollution can come from a variety of sources, include but are not limited to vehicles, neighbourhoods, electrical appliances, TV and music systems, public address systems, trains, aeroplanes, and power plants (Singh & Davar, 2004). The problem of noise pollution tends to be less significant in suburban areas and rural communities. On the other hand, residents of small towns and villages located next to major roads or railways are subjected to a great deal of background noise. Many respond differently to noise. It causes problems communicating with others, sleeplessness, and inefficiency in the workplace. Although common psychosomatic reactions include annoyance and melancholy, more severe reactions including deafness and mental collapse cannot be ruled out. An overwhelming majority of noise complaints involve people asking for the noise to be reduced.

The main background factors of noise issues are overcrowding, growing urbanisation, sprawling development, construction of apartments and houses with inadequate sound absorption, increased use of electric equipment at home, an increase in the number of recreation facilities, and a lack of communication among neighbours. Furthermore, disturbances from the outside can disrupt the peace and quiet of a neighbourhood. Loudspeaker noise, noise from businesses operating late at night, and ambient noise from daily activities were the three main sources of disturbance identified by these studies as contributing significantly to the overall volume of ambient noise in residential areas (Lee., 2020).

PROBLEM STATEMENT

Small towns and villages typically have a lower incidence of problems related to noise pollution. Those who live in villages or towns along national or state highways or in close proximity to railroad tracks are subjected to the most severe levels of noise pollution. It results in difficulty in communicating, sleeplessness, and a reduction in productivity. It is not possible to rule out the possibility of more severe effects like mental instability and loss of hearing.

The construction of apartments and houses with inadequate sound insulation, an increase in the use of electrical equipment in the home, and a lack of communication between neighbors are the primary background factors that contribute to noise problems. The noise made by loudspeakers, the noise made by the nighttime operation of business facilities, and the noise made just by living one's life are some of the primary sources of noise in residential areas.

AIM AND OBJECTIVE

This research will look into the factors that contribute to noise pollution in the building and construction industry, with the end goal of developing an innovative product that will help protect the environment from the harmful effects of noise pollution by installing cotton fibre as a sound insulation for soundproofing wall. In order to accomplish this purpose, there are a few objectives as follows:

- To create Kapok Fibre as a sound insulation for sound proofing walldesign ideas.
- To assemble the prototype of Kapok Fibre as a sound insulation forsound proofing walls in building.
- To demonstrate the performance of the Kapok Fibre as a soundinsulation for sound proofing walls in building.
- To demonstrate the entrepreneurship skills in Kapok Fibre as a sound insulation for sound proofing wall that can be marketable.

Overview of Existing Product

It is important to keep in mind that a person's level of acoustic comfort is dependent not only on the person's role as a sound receiver but also on the person's role as a sound producer. A lack of adequate sound insulation betweenresidences can be the root cause of activity restrictions as well as social tensions and disagreements. This can lead to frustration and conflicts, and sometimes the only answer is to move to another property, especially one withgreater sound absorption. Troubles with sound insulation occur when there isa difficulty with the way in which sound travels from one location to another.Poor quality materials, environmental noise all play a role in these problems.

- Poor insulation material

The choice of insulation materials during design phase can have a big effect on how well soundproofing works. If the materials aren't strong enough or don't have enough density, they may not be able to block or absorb sound well. This can lead to poor acoustic performance. Materials with greater density and sound-absorbing qualities are preferable for soundproofing. Mass-loaded vinyl (MLV), acoustic foam panels, soundproof drapes, mineral wool insulation, double-glazed windows, and solid core doors are all examples of regularly used materials for effective sound absorption.

- Fragile

Noise cancelling products, as an additional layer of the wall panel, require extra care to maintain their performance and ensure your wall is always in good condition. Acoustic foam is one example. Acoustic foam is a type of open-celled foam used to treat acoustics. It attenuates air bone sound waves by lowering their amplitude for noise reduction or noise management. Cleaning acoustic foam should be done on a regular basis, one to two times a year, depending on the amount of dust that accumulates in your room. Because acoustic foam is combustible due to its composition, placing it on the kitchen wall can result in the danger of a fire.

Development of new ideas

Building sound insulation has improved during the last century. New building technologies, powerful sound sources in dwellings, and societal awareness of noise have all contributed to sound insulation design. Theoretical descriptions and solutions to sound insulation issues including the coincidence effect, flanking transmission, floating floors, and window sound insulation angle of incidence are crucial to this progress (Holger, 2015).

Kapok fibre has various advantages including durability and flexibility. The strength of the cotton increased 25% when it wet. cotton is not extensible, though, thus untreated cotton clothing will wrinkle easily. Cotton clothing is cool to wear because it is a good conductor of heat. (Karthik & Ganesan, 2015). The incorporation of Kapok Fibre into the concrete wall as a sound insulation for soundproofing wall helps to solve the problem of a noise pollution in residential area.

Overview of Kapok Fibre

Kapok or known as Jara Cotton or Ceiba is a popular fibre for textile applications because it possesses a variety of desirable fibre qualities. Cotton was first used by humans more than 5000 years ago in India and the Middle East (Dochia et al., 2012). Cotton is the purest type of cellulose found in nature. Kapok is the seed hair of plants in the genus Gossypium. The chemical structure of cotton is shown as Table 1. The multilayered structure of Kapok Fibre has been investigated for almost a century. The coating, which is the outermost covering of the Kapok Fiber's primary cell wall, has a significant impact on the fiber's characteristics, processing, and application (Dochia et al., 2012). The fibrillar structure of Kapok Fibre has three walls: a primary wall, a secondary wall, and a lumen as shown as Figure 1.

However, Kapok Fibre have a flat, twisted, ribbon-like look and are primarily made of cellulose. Its physical attributes are determined by this structure. The strength of kapok fibre is because of its highly fibrillar and crystalline structure. The strength of the Kapok increased 25% when it wet. Kapok is not extensible, though, thus untreated cotton clothing will wrinkle easily. Cotton clothing is cool to wear because it is a good conductor of heat. It absorbs water but dries slowly (typical moisture recapture = 8.5%), is quickly soiled by cotton yarns rough surface, and shrinks when washed, especially when using extremely alkaline washing solutions (Dochia et al., 2012). Figure 2 shows the appearance of Kapok Fibre under the microscope while images of Kapok Fibres in different layers are shows as Figure 3.

Table 1: Chemical composition of Kapok Fibre

Constituents	Percent (dry basis)		
	Typical	Low	High
Cellulose	94.0	88.0	96.0
Protein	1.3	1.1	1.9
Pectic substances	0.9	0.7	1.2
Ash	1.2	0.7	1.6
Wax	0.6	0.4	1.0
Malic, citric and other organic acids	0.8		1.0
Total sugars	0.3		
Pigment	Trace		
Other	0.9		

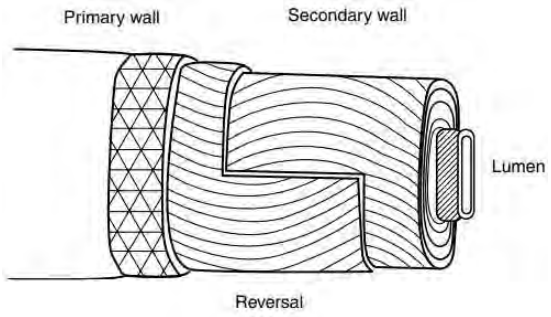

Figure 1: Structure of Kapok Fibre.

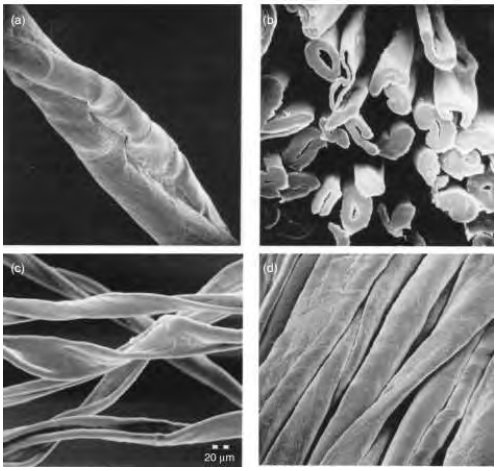

Figure 2: Appearance of Kapok Fibre under the microscope

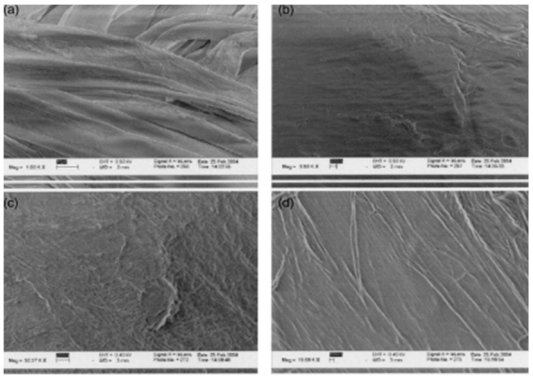

Figure 3: Images of Kapok Fibre in different layers

METHODOLOGY

This chapter describe and elaborate more on the methods, materials, data and collection method of the innovation project. All of these topics will be covered in this section. However, there are a few research methods that have been done in order to achieve the aims and objectives. There are a two type of research method which is qualitative and quantitative methods. One of the research methods that been choose in this innovation project is quantitative methods. The quantitative findings are likely to be generalized to the entire population or a subpopulation since a bigger, randomly chosen sample is involved. Since there are experiment required in this innovation project, so this innovation project has been proven using quantitative data (Rahman, 2016).

- Design Framework

The Design Framework divides the overall Design Flow into a number of Design Steps (DS), each of which represents the stage of design that is currently being worked on, and a number of Design Decisions (DD). The model-based design approach that is being used here follows the top-down approach that has been established in industrial practise. Despite the fact that the Design Flow idea of the DF is generic and may be adapted to any arbitrary design processes, the model-based design approach that is being used here follows it (Hüfner & Engell, 2012). By utilising the framework as a guide to ideation, more ideas can be generated within each area of concentration rather than a large number of ideas that must be sorted and organised among categories after they have been generated. Figure 4 shows the design framework idea of innovation product.

Figure 4: Framework idea of innovation product

- Secondary Research

The term "secondary research" refers to the practise of acquiring information and data from existing sources that have previously been collected and published by other people in the past. It entails analysing and synthesising previous research in the form of studies, papers, articles, books, internet databases, government publications, and any other sources of information that are pertinent to a certain topic or research issue. When it comes to a particular topic, secondary research is an excellent way to get a head start on understanding the current information and findings by providing a starting point from which to get new insights. It is frequently carried out in order to bolster the findings of primary research or to amass background knowledge prior to the commencement of new research activities (Bouchrika, 2023).
Most of the data that use in this innovation project are from the internet. All of the articles are purchased from the internet, articles journals and book such as ScienceDirect, Google Scholar and ect. Based on this data, it has been proposed that cotton fibre be used as a noise insulation material. According to the data that had been compiled, most soundproofing systems are attached to the outside of a building, making up the wall's visible surface. This new approach will make the product more useful and less expensive to use because it requires only one installation.

- Experimental Research

An experiment, also known as experimental research or a randomised controlled trial (RCT), is a technique of research that is used in the scientific field to investigate the links between different variables and their causes and effects. It involves changing one or more variables under controlled settings in order to observe and evaluate the effects on another variable. Controlling for potential confounding factors is also part of the process. Experimentation is a common method of gathering data in many branches of the scientific community, such as psychology, medicine, the social sciences, and the natural sciences. It enables researchers to determine causal linkages, put ideas to the test, and draw conclusions based on data regarding the influence that particular factors have on specific outcomes (Knight, 2010).

In a concrete laboratory, the experiment for this proposition innovation project will be conducted. Experiments must be conducted to obtain accurate results. Instead of relying on internet sources, the information obtained will be reliable Moreover, by conducting experiments for project innovation, it is possible to learn whether or not to obtain a logical value through the acquired data. It is probable that one test will be included in the experiment that will be conducted later. The evaluations involve soundproofing. In addition, the Sound Proofing

Test evaluates the amount of sound a product can absorb. This test determines whether the cotton fibre are the best material for sound insulation. Figure 5 shows the example of sound level meter.

Figure 5: Sound Level Meter

RESULTS AND FINDING

In the context of this discussion, an experiment has been carried out in which Kapok fiber is utilized as a method of sound insulation. Kapok fiber has been the subject of a number of studies in the past, all of which have concluded that it has the potential to be an effective sound insulation. The Kapok fiber has been incorporated with gypsum board the cement wall panel, and an additional sample of the cement wall panel that does not contain anything has also been fabricated.

Table 2: Specimen of Normal Concrete Wall panel

Specimen	Noise Reading				Picture
	1	2	3	Average	
Normal Concrete Wall Panel	65.0 dB	67.9dB	66.1dB	66.33dB	

Kapok Fibre Wall Panel	46.3 dB	46.9dB	54.4dB	49.2dB	

In tables 2, the outcomes for each sample and the variance between each reading are displayed. The first reading reveals that standard concrete has a noise reading of 65.0dB, whereas the specimen containing Kapok fiber has a noise reading of 46.3dB. In contrast, the second reading reveals a significant distinction between the two. It records a reasonably high reading of 67.9.0 dB for normal concrete, but a much lower reading of 46.9 dB for the Kapok fibre mixture. There is an 21.0 dB difference between the two.
The final measurements for each sample indicate that Kapok fibre-based concrete has 54.4dB while standard concrete has 66.1dB. The conventional concrete has an average measurement of 66.33dB, while the Kapok fibre concrete has an average measurement of 49.2dB. The average distance between the two is 17.13dB. The highest reading for standard concrete is 67.9dB, while the highest measurement for the specimen containing Kapok fibre is 54.4dB. The lowest reading for a standard specimen is 65.0 dB, whereas the lowest measurement for a specimen containing Kapok fibre is
dB.

- Performance of the product

After conducting a noise insulation proofing test, it was determined that Kapok fiber insulated wall panels reduce exterior sound transmission in comparison to conventional wall panels. As is common knowledge, the majority of residential walls are constructed of concrete, and there are no sound insulation on each panel, and it helps on allowing sound to travel to other areas. Aware that the residential environment can be quite noisy at times, preventing some students from revising, creating video assignments, and concentrating in online classes. In such a circumstance, it is impossible to archive the verdant environment. As a noise barrier, Kapok fiber wall panels can help students focus on their studies and create a private, personal space for them. In addition to the primary objective of the innovation, which is to create a soundproofing wall panel, indirectly using Kapok fiber, which is light, fire resistance and heat absorption, it can be a sound insulation and also a good heat absorption. The room will be more comfortable since it reduce noise and reduce heat as well.

- Marketability of product

Due to the increase in noise pollution and the demands of society, wall panels that are made from Kapok fibre are recommended for the marketplace. This is because the demand for private space is higher years by years. In the modern world, where we are continuously disturbed with noise and stimuli, private space is more essential than ever. It is a place where we can escape the commotion of daily life and simply be ourselves. The need for this private space is a consequence of the accelerating rate of technological progress. By minimizing exterior noise, this product are potential to create a personal, private space for the user to concentrate and have their own time without being disturbed by noise pollution hence can give quality time and quality life.

This new innovation product can be used at home and the office. Also it can be used for people who want the private room for itself. Kapok fiber is not actually a lower cost. 1kilogram of Kapok fibre cost RM17, to make as a layer of wall it required a lot of fibre where it can be costly. However, the function of the Kapok fiber as a sound insulation is great. It is worth it to buy since the quality is great as a sound insulation. Other than that, Kapok fiber have a long-life cycle so it will no be easy to break or have a problem. Last but not least, whoever who purchase this Kapok fiber wall panel, it can be guarantee that they will satisfy with the quality.

CONCLUSION

Sound pollution is a significant issue that can negatively affect human health, fauna, and the environment. Construction is one of the main sound pollutions especially when the construction is nearby the residential area. However, there are always a way to reduce noise pollution, including the idea of my innovation project which is made a sound insulation wall using sound insulation material. The insulation material that had been mentioned are Kapok Fiber. Kapok fiber has been demonstrated to be an effective sound insulator. It is a lightweight fiber with a high coefficient of sound absorption. This indicates that it effectively absorbs sound vibrations. Kapok fiber is a renewable resource because it is derived from the kapok tree. Kapok fiber can be utilized in numerous soundproofing applications. Kapok Fibre is a Sustainable Development Goals that suitable with the innovation project goals. However, the innovation project successfully archived the object of the innovation projects and be able to identify the effectiveness of the product. The product has a potential to be market and reduce sound pollution as well.

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SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

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