ANALYSE THE SOUND ABSORPTION CHARACTERISTICS OF E-GLASS AND KEVLAR FIBER HYBRID COMPOSITE MATERIALS USING IMPEDANCE TUBE

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Abstract

This paper presents the analysis of sound absorption properties of few natural fibers by using impedance tube. The impedance tube plays a vital role to study the sound absorption co- efficient. The specimen of impedance tube is prepared by handlay up process. In sample A, the fiber combination of 20% agave tequilana and 25% Kevlar fiber along with 55% of epoxy resin and sample B, the another combination of 30% of E - Glass and 15% of bamboo fiber along with 55% of epoxy resin was prepared.

In this present work, both the specimens are tested using impedance tube and the results was studied and compared. From those two samples, sample A absorbed the sound absorption coefficient more than the sample B due to the physical properties of agave tequilana and Kevlar fiber.

1.INTRODUCTION

The natural fibers are obtained from stems, leaves, roots, fruits and seeds of plants. However, from commercial and technological points of view, cotton, kenaf, sisal, flax, palm, coir, are Cantu and banana fibers acquire utmost significance, since reinforced plastics, strings, cords, cables, ropes, mats, brushes, hats, baskets and fancy articles such as bags are manufactured with those fibers.

The date palm (Phoenix dactylifera) is one of the most cultivated palms around the world. It geographically covers the deserts from the Atlantic coastline of Mauritania to India and from the Mediterranean Sea to about 15o in Africa. The main date-producing countries of the world are Iraq, Saudi Arabia, Egypt, Iran, Algeria, Pakistan and the Sudan. The date palm in Sudan is common in the Northern Sudan along the Nile. Date palms have a fibrous structure, with four types of fibers: leaf fibers in the peduncle, baste fibers in the stem, wood fibers in the trunk and surface fibers around the trunk .Riahi et al investigated the application of date-palm fibers filters as porous medium for the tertiary domestic wastewater treatment. Al- Sulaiman evaluated the performance of the date palm fiber as wetted pads in evaporative cooling.

Most practical sound absorbing products used in the building construction industry consist of glass or mineral-fiber materials. However, the growing concern about the potential health risks popularly seen as being associated with glass or mineral fiber materials provides an opportunity to develop for sound absorption panels made of natural fibers. Many researches have been conducted in developing particle composite boards using agricultural wastes. Yang et al. reported that the sound absorption coefficient of rice straw-wood particle composite boards are higher than other wood-based materials in the 500-8000 Hz frequency range, which is caused by the low specific gravity of composite boards, which are more porous than other wood-based materials. From the view of environmental protection, natural bamboo fibers were used for sound absorbing purposes. Impedance tube measurement of the bamboo fiber samples, revealed similar properties to that of glass wool. Bamboo material formed into a fiber board yields a superior sound absorption property when compared to plywood material of similar density.

Ersoy and Kucuk experimentally investigated the sound absorption feature of tea leaf fiber as an industrial waste material. The good acoustic absorption aspect of that fiber with respect to other absorbers was noticed. Coconut is one of the most important harvests in Malaysia. Coir fiber from coconut husk is one of the hardest natural fibers having high amount of lignin. The sound absorption attribute of coir fiber was investigated previously in Automotive

Research Group laboratories, UniversitiKebangsaan Malaysia. Those studies covered experimental observations in reverberation room and using impedance tube.

2.LITERATURE SURVEY

The tube had to be isolated from exteriornoise and vibrations; accordingly, the wall needs to be strong and thickenough to prevent the vibrations generated during the emission of the soundsignal and to prevent the resonance at frequencies within the operatingfrequency range (Kin Ming et al. 2005).The tube was designed for the frequency range 125 Hz to 4000 Hz.In order to achieve this range, a tube of 100 mm inside diameter, four soundpressure level meter positions have been used (only two sound pressure levelmeters are used during actual measurements). The tube was constructed usinga circular PVC pipe with the thickness of the pipe close to 5% of the tubediameter (Kin Ming et al. 2005).

The tube also had to be long enoughto ensure the development of plane sound waves between the sound sourceand the sample (Rick et al. 2004 &Suhanek et al. 2005).Therefore, there areseveral methods for mitigating noise problems via reusedsound absorption materials. However, previous methodsusing synthetic materials, such as glass wool, rock wool,asbestos, have disadvantages in that they are health hazards for lungs and eyes (Suter, 2002).

Currently,several researchers have been investigating this issue andfindings have revealed the potential of innovative naturalfibers; for example, (Koizumi *et al*., 2002) used bamboofibers and (Yang *et al*., 2003) studied the absorptioncoefficients of four fiber assemblies," cashmere, goosedown, acrylic fiber and kapok". These materials arenatural and acrylic fibers.Natural fibers have distinctiveinternal structures that influence the sound absorptioncoefficients, which are measured according to thedensity, thickness and sound frequency to check thecontribution of natural fiber against air. Khedari*et al*.(2003) studied new particle board manufactured usingdurian peel and coconut coir fibers to achieve the lowestthermal conductivity to decrease heat transfer into a space.

In terms of heat reduction, these agriculture wastes are an economical and interesting option that could be utilised to insulate ceilings and walls. After a year, (Khedari*et al*., 2004) developed a particleboard of low thermal conductivity manufactured using a mixture of durian peel and coconut coir at an optimum ratio of 90:10 (coconut coir to durian) by weight. The density was 856 kg/m³, the thickness was 10 mm and the ratio of extracted coconut coir to durian fiber was quite low, with their differences between 0.0728 and 0.1342 W/m K.

Meanwhile, (Ersoy and Kucuk, 2009) investigated thesound absorption of industrial tea leaves waste developed into three different layers with or without a single backing layer of woven textile cloth to test itsexperimental properties of sound absorption. The data indicated that the sound absorption properties increased by increasing the thickness of the layer of single backingcotton cloth. This result means that the natural material and renewable material has positive sound attenuation properties and most importantly, it poses lesser or no harm to human health.

3.COMPOSITE MATERIALS

Composite materials are materials made from two or more constituent materials with significantly different physical orchemical properties, that when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure. The new material may be preferred for many reasons: common examples include materials which are stronger, lighter or less expensive when compared to traditional materials.
Typical engineered composite materials include:

- Composite building materials
- Reinforced Composites
- Metal Composites
- Ceramic Composites

Composite materials are generally used for buildings, bridges and structures such as boat hulls, swimming pool panels, race car bodies, shower stalls, storage tanks, imitation granite and cultured marble sinks and counter tops. The most advanced examples perform routinely on spacecraft in demanding environments.

4.MATERIALS AND METHODS

SELECTION OF MATERIALS

This chapter describes the details of selection of natural composites materials and the experimental setup for the sound absorption coefficient for the selected materials.

The materials used in this work are

- Agave tequilana
- Kevlar fiber
- Bamboo fiber
- E-glass fiber
- Epoxy Resin

5.RESULT AND DISCUSSIONS

SOUND ABSORPTION COEFFICIENT (α) OF SAMPLES

Experiment is conducted for both the samples. The various input frequencies are sent to the impedance tube for testing the sound absorption characteristic of samples in impedance tube setup and the corresponding responses of sample A and sample B are observed and the results are listed in the table.

Input	**Output**	
Frequency (Hz)	**Sample A (α)**	**Sample B (α)**
	0.35	0.27
500	0.33	0.24
750	0.29	0.23
1000	0.27	0.25
1250	0.21	0.21
1500	0.17	0.14
1750	0.28	0.26
2000	0.35	0.29
2250	0.41	0.38
2500	0.47	0.43
2750	0.56	0.46
3000	0.63	0.57
3250	0.72	0.69
3500	0.82	0.80
3750	0.88	0.87
4000	0.94	0.93
4250	0.97	0.91
4500	0.99	0.93

Table: Sound absorption coefficient for sample A and sample B

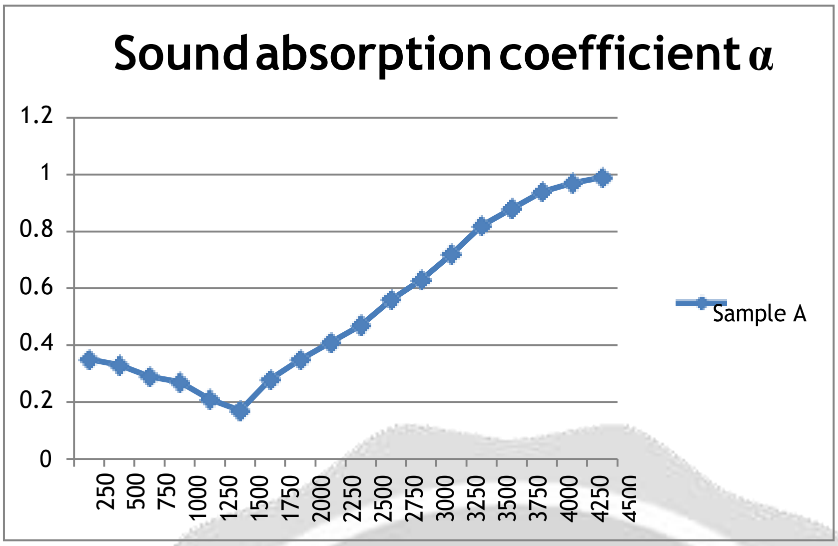

Figure: sound absorption coefficients (α) of sample A with various frequencies

Graph is plotted between the frequency (Hz) and the output voltage to find the response of the system.

In Figure 6.1, shows the amplitude response for sample A. the lower frequency from the amplifier, the corresponding sound absorption characteristic of sample A is also lesser and for the maximum frequency, the sound absorption characteristic of sample A is higher. But in-between the frequency like 1500 Hz, the sound absorption coefficient value is very less when compared to frequency 250Hz.

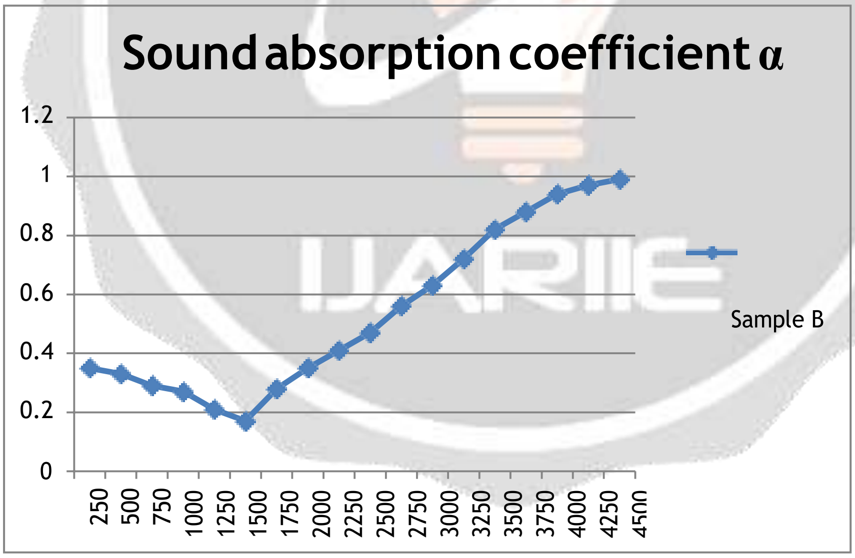

Figure: sound absorption coefficients (α) of sample B with various frequencies

Graph is plotted between the frequency (Hz) and the output voltage to find the response of the system.

In Figure 6.2, shows the amplitude response for sample A. the lower frequency from the amplifier, the corresponding sound absorption characteristic of sample A is also lesser and for the maximum frequency, the sound absorption characteristic of sample A is higher. But in-between the frequency like 1500 Hz, the sound absorption coefficient value is very less when compared to frequency 250Hz.

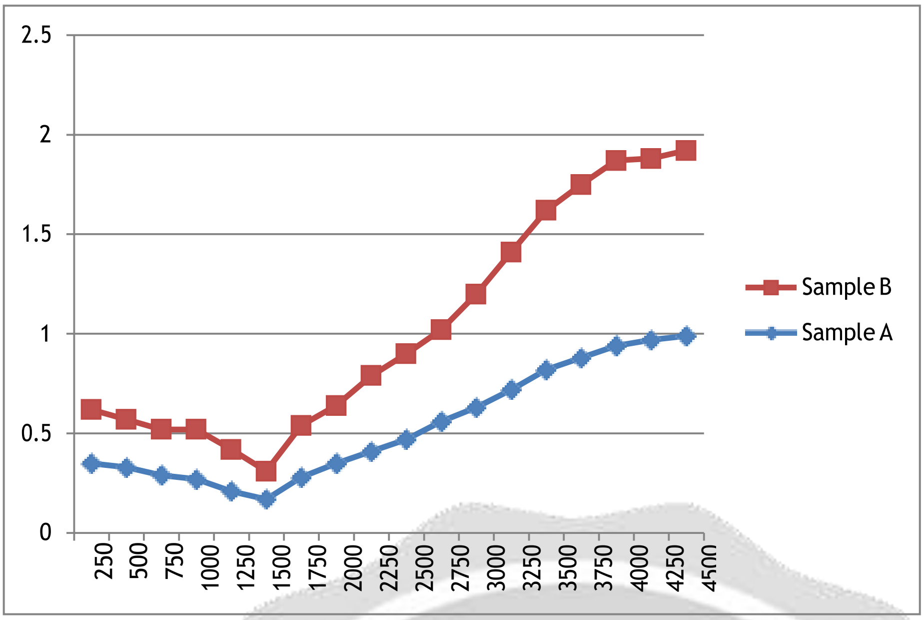

Figure: comparisons of sound absorption coefficients (α) of sample A and sample B with various frequencies

Graph is plotted between the frequency (Hz) and the output voltage to find the response of the system.

In Figure 6.3, In sample A sound absorp little more value when compared with sample B for the lower frequency 250 Hz. Likewise, In sample A sound absorp little more value when compared with sample B for the higher frequency 4500 Hz. At frequency 1500Hz also sample A absorps more coefficient value.

6.CONCLUSION

This study shows that by using the impedance tube test method to determine sound absorption coefficients of selected natural fibers have been successfully carried out. Samples A and samples B of sound absorber have been made from Agave Tequilana fiber, Kevlar fiber, Bamboo fiber and Epoxy resin front which went through a Sound absorber treatment.

From the results of impedance tube, sample A gives the better performance of sound absorping coefficient value. It will use as a alternate materials for sound absorption. This work can be improved by increasing the mixing ratio of fibers and binder.

7.REFERENCES

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