



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 6, June 2022

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.118



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6381 907 438



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# To Prove the Sustainable Alternative of Natural Composite Fiber Material to Conventional Synthetic Fiber Material by Comparing Equivalent Noise / Sound Absorbing Capability

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**ABSTRACT:** Automobile, Construction equipment, Process equipment, Production and there are many more fields where in various equipment's leads to production of noise/ sound and vibrations. These various sounds and vibrations produced have ill effect on human and surrounding environment which necessitate the use of acoustic materials. Many of conventional acoustic materials are not found sustainable considering greenhouse gases emission and energy consumptions. By evaluating acoustic properties of natural fiber composite materials will leads us to understand the alternative solution for conventionally used harmful synthetic materials for applications of cabin compartment constructed nearby sound producing machines. Natural fiber exhibits superior acoustic and thermal properties in comparison with synthetic fiber. Natural fibre composite materials have very low impact on humans and environment. Concentration here in is on experimental study of acoustic behaviour of natural fiber composite made from Jute fiber, Coir fiber, Cotton fiber and multilayer composite is also tested for finding better material by comparing sound absorbing coefficient (NRC) with in frequency range of 63Hz to 6300Hz of all samples.

**KEYWORDS:** Sustainable natural fibre composite, Jute fiber, Coir fiber, Cotton fiber, multilayer composite.

## I. INTRODUCTION

Word acoustic comes from Greek language which means hearing and acoustics means the science of sound, which is about the production, dissemination, transmission, and control of sound. Sound and vibration area areas having harmful side effects on many mechanical systems such as home appliances, motor vehicles and buildings. In residential and industrial places sound levels are to be maintained under maximum noise threshold which has been determined and if noise exceeds this limit, it endangers the comfort and health of the residents. According to the definition of sustainability, "Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs". A product can be therefore considered sustainable if its production enables the resources from which it was made to continue to be available for future generations and has the lowest possible impact on human health and on the environment. A sustainable product is generally made from natural or recycled materials and its production requires a small amount of energy makes a limited use of non-renewable resources and has a low environmental impact. Many currently used acoustic materials cannot be considered sustainable, at least as far as energy consumption and greenhouse gases emissions; moreover, some of them can be harmful for human health. The study presents an updated survey of the characteristics and the experimental evaluation of acoustical properties of sustainable materials from extremely wide variety of natural fibres allows finding a suitable material for noise control and in particular sound absorption coefficient of Jute, Cotton, and coir natural fibre composite materials. Many natural materials as kenaf, flax, sisal, hemp, cork, jute, sheep wool, bamboo or coconut fibres show good absorbing performance and therefore can be used as sound absorbers in room acoustics and noise barriers. An increasing attention has been turned to natural fibres as alternatives to artificial ones, in order to combine high acoustic and thermal

performance with a low impact on the environment and human health. Sound-absorbing materials absorb most of the sound energy putting on them, making them terribly helpful for the management of noise.

## II. RELATED WORK

YANG WeiDong & LI Yan, in the paper Sound absorption performance of natural fibers and their composites, compares the sound absorption coefficients of natural fibers (ramie, flax and jute) with synthetic fibers (carbon and glass fibers).

In the same paper it mentioned that jute fiber shows good sound absorption properties over frequency of 1000 Hz. The sound absorption coefficient is basically higher than 0.9. However, glass and carbon fibers have values lower than those of natural fibers. And also stated that,

The mechanism of fibrous materials to absorb sound energy mainly involves three physical processes:

- Firstly, when the sound wave transmits into the fibers, the viscous effect between fiber frame and numerous air cavities will attenuate part of sound energy and convert it into heat.
- Secondly, heat transfer will happen due to temperature distinction between different fibers and this process will further dissipate sound energy.
- Finally, the vibration of air in the bulk materials will also lead to the vibration of fibers.

N H Zunaiddi, W H Tan, M. S. A. Majid and E A Lim, in the paper Effect of physical properties of natural fibre on the sound absorption coefficient. Explained the effect of physical properties of natural fibre to the sound absorption coefficient and the relation of the physical properties of natural fibre to wider the frequency range and increase the sound absorption coefficient.

All the physical properties that influence the sound absorption coefficient of natural fibre will be explained. The physical properties of natural fibre that will be studied were

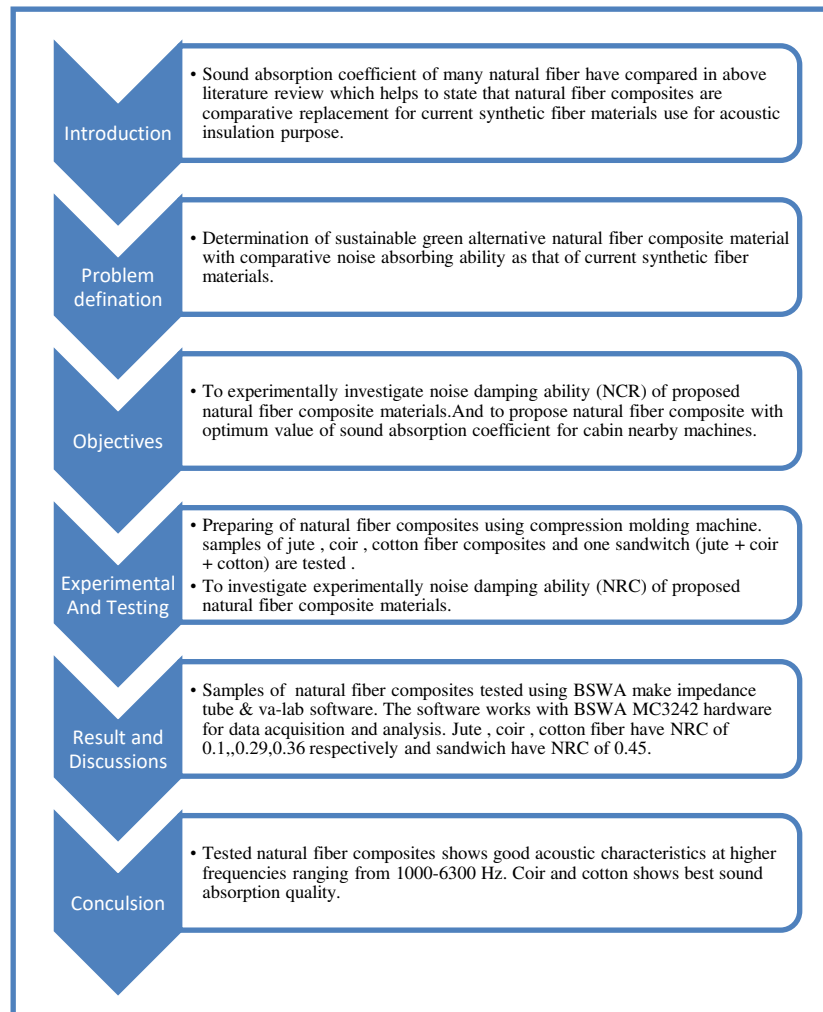
- Fibre thickness,
- Fibre diameter and
- Compressed fibre.

Results have shown that the fibre thickness and diameter have a big effect to sound absorption coefficient. From the results, the utilization of the sound absorption coefficient can be achieved by choosing the suitable natural fibre according to its physical properties for a suitable application.

N. Jiang , J.Y. Chen, D.V. Parikh, In paper Acoustical evaluation of carbonized and activated cotton nonwovens, a carbonized and activated cotton nonwoven was produced and the experimental acoustical nonwovens were designed with a composite structure. The cotton nonwoven composites with three surface layers (glassfiber, cotton and ACF cotton) were evaluated in terms of their acoustic properties for sound absorption and sound insulation. As results in the frequency range from 100 to 6400 Hz, the nonwoven composites with cotton as a surface layer had higher sound absorption coefficients than the glassfiber-surfaced composite.

Xiaodong Zhu, Birm-Junekim, Qingwen wang, Qinglin Wu, in the paper Recent advances in the sound insulation properties of bio-based materials, paper focused on greenhouse effect caused by industrial gases like CO<sub>2</sub>, CH<sub>4</sub> and NO<sub>x</sub> which changed marketing of acoustic materials. The diffusion of these gases directly and indirectly is related to acoustic industries. Therefore, due to negative effect of these contaminants, has seeking attention of producers toward providing environment friendly products, with less polluting processes and in other words green products and also mentioned that bamboo fiber cotton fiber have NCR's 0.68 and 0.62 respectively for thickness of 50 mm in table 1 (in actual paper).and also discussed other important properties of natural fiber materials which affect NCR. Those properties discussed earlier in above papers.

### III. METHODOLOGY



### IV. MATERIAL PREPARATION

#### (A) Jute natural fiber composite:

Initial sheet of jute (300X300) is cut and polyester (linkGP) resin is used. 7 sheets used for the preparation of sample and 1kg polyester resin with cobalt and hardener (1.5 % of resin quantity) as additive. Sample is kept under compression for 24 hours using compression molding machine. Prepared sample then cut ( $\varnothing$  100 and  $\varnothing$  30) using laser cutting and sample having thickness of 5 mm.



Figure 1. Jute fiber composite.

#### (B) Cotton natural fiber composite:

Initially 300 mm long group of fiber of cotton is cut and and placed equally at sheet of plastic and polyester (linkGP)



resin is used. 2 layers used for the preparation of sample and 1kg polyester resin with cobalt and hardener (1.5 % of resin quantity) as additive. Sample is kept under compression for 24 hours using compression molding machine. Prepared sample then cut ( $\varnothing$  100 and  $\varnothing$  30) using laser cutting and sample having thickness of 5 mm.



Figure 2. Cotton fiber composite.

(C) Coir natural fiber composite:

Randomly placed fiber of coir used for preparation of even thickness sample. 2 layers used for the preparation of sample and 1kg polyester resin with cobalt and hardener (1.5 % of resin quantity) as additive. Sample is kept under compression for 24 hours using compression molding machine. Prepared sample then cut ( $\varnothing$  100 and  $\varnothing$  30) using laser



cutting and sample having thickness of 5 mm.

Figure 3. Coir fiber composite.

Above all samples made using compression molding machine at VIIT ,Kondhwa, Pune, Maharashtra 411048.

## V. EXPERIMENTATION AND TESTING

Prepared samples tested with help of Welan technologies. Samples tested to calculate NRC for FREQUENCY RANGE OF 63-6300Hz.

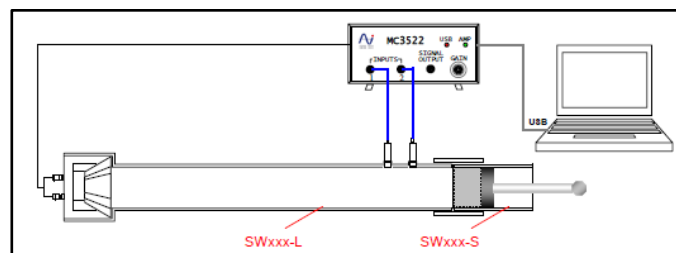


Figure 4. Test Setup for Absorption

Sound transmission loss (TL) represents the loss in sound power during sound transmission through a specimen. The higher the transmission loss, the less the sound waves pass through the specimen. The TL tests are divided into two parts. In the first stage no sample is placed between the impedance tubes. In this case, the results should be 100% transmission and 0% reflection. In the second stage the sample is put between the noise source tube and receiving tube. The incident noise waves hit the sample and are divided into three parts: reflected waves, absorbed waves, and transmitted waves. For measurement of absorption & transmission loss we used BSWA make impedance tube & va-lab software. The software works with BSWA MC3242 hardware for data acquisition and analysis. The instrumental set up includes four microphones and two tubes discussed above (large tube for measuring sound frequencies within 63–1600 Hz; small tube for measuring sound frequencies within 1600–6300 Hz).

## **VI. EXPERIMENTAL RESULTS**

Jute, coir, cotton fiber has NRC of 0.1, 0.29, 0.36 respectively and sandwich have NRC of 0.45.

## **VII. CONCLUSION**

All tested natural fiber composites shows good acoustic properties at higher frequencies, ranging from 1000-6300 Hz. Coir and cotton show best sound absorption quality at higher frequencies having NRC in the range of 0.43-0.84. Sandwich made also have good sound absorption properties with NRC of 0.45.

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SJIF Scientific Journal Impact Factor  
**Impact Factor: 8.118**



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