

**DEVELOPMENT OF NOISE-ABSORBING COMPOSITE
MATERIALS USING AGRICULTURAL WASTE
PRODUCTS**

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Degree of Master of Science

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Sri Lanka

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Dissertation submitted in partial fulfillment of the requirements for the degree
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DECLARATION

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The above candidate has carried out research for the Master’s Dissertation under my supervision.

Name of the supervisor: Mr. A M P B Samarasekara

Signature of the supervisor:

Date: 09-08-2024

ABSTRACT

Development of noise-absorbing composite materials using agricultural waste products

Noise is an irritating phenomenon and generally unwanted sound caused by many industrial processes, transport, and entertainment. It is mandatory to regulate and mitigate the noise generated by industries as per National Environmental (Noise Control) Regulations published under the Gazette Notification No. 924/12 dated 23.05.1996 in order to avoid public disturbances especially when the industry is located in a highly residential or mix residential area. As a result, industrialists are advised to control the noise effect but those mitigation mechanisms are expensive and therefore could not be affordable by the small to medium scale industrialists. These worries have prompted a number of experiments on cost-effective and environmentally friendly methods of noise control and sound absorption. Noise managing mechanism shall be instigated when the sound intensity is reduced to a level that is harmless for human ears. One such method is taking the sound energy and turning it into thermal energy. Therefore, it is highly desirable to have natural fiber materials that are thin, light, and inexpensive and that can absorb sound waves across a wider frequency range.

The study was twofold: one was to test the possibility of finding some natural sound absorbing materials while the other was to construct a setup to measure the sound absorption coefficient. In this Investigation, a composite made of rice straw-saw dust agricultural waste materials was studied for their sound absorption coefficients using urea formaldehyde resin (UF) as the binder. The fabrication of the composite sample was carried out using hot compressing. Five (5) composite samples with various percentage weights of composition ratios were obtained. The binder composition was kept the same. The test specimens were assessed for acoustic, mechanical and physical properties. Density and percentage moisture absorption were determined. Flexural strength in terms of bending modulus of rupture was determined performing the 3-point bending test. S5 (80 % Rice straw) had the highest density. When the rice straw compositions increased, the water absorption increased. Commercially available polystyrene and MDF (Medium Density Fibre) board samples with 10 mm thickness were also tested for the noise absorption coefficient. The sound absorption coefficients of samples were determined according to the American Society for Testing Materials (ASTM E1050-19) two-microphone method against both lower and higher frequencies.

The sound absorption coefficient variation was plotted against frequency. The maximum noise absorption coefficients for samples S1 (80 % Rice Straw), S2(50 %Rice Straw), S3(40 % Rice Straw), S4 (30 % Rice straw) & S5(0 % Rice Straw) were 0.53 at 100 Hz, 0.34 at 100 Hz, 0.49 at 200 Hz, 0.49 at 100 Hz and 0.47 at 3295 Hz respectively. Better noise absorption performance was obtained for lower frequencies of the samples when the compositions were varied in the composite material. Maximum alpha 0.25 at 3295 Hz and 0.56 at 100 Hz were obtained for the commercially available MDF and Polystyrene samples respectively. Around 50 % of incident sound was absorbed by 80 % RS samples at frequency of 100 Hz. Thus only had shown average absorbing performance. Various parameters can be caused to reduce the noise-absorbing performance of the rice straw-sawdust composite. The density, porosity, sample thickness, fiber length, tortuosity of the rice straw fibers, flow resistance, compression and pretreatment with sodium hydroxide as well as the age of the rice straw.

However, it's evident that 80 %of rice straw sample had better acoustic property comparatively with other compositions but its mechanical and physical properties needed to be improved further. Due to its averagely good acoustic property, it can be applied in the field of sound proofing materials manufacturing as sheets or panels in the walls, flooring and ceiling for building acoustics.

Keywords: Noise, Composite, Noise absorbing coefficient, modulus of rupture

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LIST OF ABBREVIATIONS

ACF	Activated Carbon Fiber
ASTM	American Society for Test Method
B & K	Brüel & Kjær
CEA	Central Environmental Authority
dB	Decibel
IDB	Industrial Development Board
ISO	International Organization for Standardization
Lzf	Level at zero weighted fast mode
MPSS	Measurement Partner Suite Software
MDF	Medium Density Fibre
MOR	Modulus of Rupture
NFC	Natural Fiber Composite
PVC	Polyvinylchloride
SPL	Sound Pressure Level
UF	Urea Formaldehyde