A Review on Analysis of Sound Absorbing Panel to control sound pollution by Using Agro Waste Products

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***Abstract*—Now a day's, commercially available sound absorption materials for acoustic treatment used in the building construction industry consists of glass or mineral Fiber materials. Noise control is one of the most important factors in modern life to achieve good acoustic environment and human comfort. Sound absorption materials are specifically engineered and designed to absorb sound and significantly reduce reverberation in a closed space. Rockwool, fiberglass and polyurethane foam are typical sound absorbents which have been used for a wide range of acoustic applications such as industrial and machinery noise control, studio acoustics and automotive acoustics. For this study of noise pollution analysis Katraj is selected as study area. In this project we will collect Rice Straw, Coconut Fiber. Maize agro waste material from different area. All materials will collect from different part of the Pune area between few kms in circumference. After collecting the material prepare sound absorbing panel and perform testing of sound on it.**

***Index Terms*—Noise Pollution, Agro Waste, Rice Straw, Coconut Fiber. Maize.**

I. INTRODUCTION

Now a day's, commercially available sound absorption materials for acoustic treatment used in the building construction industry consists of glass or mineral Fiber materials. However, they are growing concern health and safety issues due to the potential health risks associated to these Fibers when exposed to the human such as the effect from the Fiber shedding from glass or mineral Fiber to human lungs and eyes. These issues provide an opportunity for an alternative material from organic materials. The growing environmental awareness strategies espoused in today's world demands the industries to treat wastes as a resource that should be valorised for developing new products. In 2014, 32 million tons of textile and wood wastes and 68 million tons of paper wastes were generated which accounts around 39% of total municipal solid wastes which is generated every year in the United States.

In India, as per the studies conducted by Central Pollution Control Board (CPCB) New Delhi, this proportion generated varies from 3-10%, 30-45% and 1-5% of paper, wood and textile wastes respectively. However, these wastes generated from the industries have been increasing gradually every year and needs to be recycled or reused. Reusing of these wastes is better than recycling pro porous materials are widely used as sound absorbing substances in noise control engineering. They consist of various synthetic materials like glass wool to minerals and agro-based foams and Fibers. The microscopic modelling of sound propagation in porous materials is extremely complicated.

In recent years, it has been difficult to obtain solid woods, and this causes problems for wood-based industry. To meet the standards required for a high-class residential environment, substitute wood-based materials (plywood, MDF, and particleboard), including natural materials and composites of steel or chemical materials are required as construction materials theoretical explanation of saturated porous materials which is easier to be used. Agricultural lignocellulose Fibers such as rice straw and wheat straw can be easily crushed to chips or particles, which are similar to wood particle or Fiber, and may be used as substitutes for wood-based raw materials.

Noise control is one of the most important factors in modern life to achieve good acoustic environment and human comfort. Sound absorption materials are specifically engineered and designed to absorb sound and significantly reduce reverberation in a closed space. Rockwool, fiberglass and polyurethane foam are typical sound absorbents which have been used for a wide range of acoustic applications such as industrial and machinery noise control, studio acoustics and automotive acoustics. Nevertheless, these materials are still not environmentally friendly enough for sustainability of sound absorbing materials development.

Fig 1 Noise Pollution.

II. STATE OF DEVELOPMENT

Balan A V & Shivasankaran N et. al. (2019) This paper presents a research on the properties of new waste material reinforced composites to absorb sound. The raw materials used to prepare these composite materials are wastes generated from the textile, maize and newspaper wastes. These raw materials were bonded using Poly Vinyl Acetate (PVA) adhesives. The seven samples of different combinations and proportion were prepared with the diameter and thickness of 99.5mm, 100mm respectively. Sound absorbing capacity for these new composites relays on the nature and proportion of the waste used. The sound absorption coefficient for each sample was determined using impedance tube method. The test results indicated that, while the frequency increases then the sound absorption coefficients increases for all the samples. The maximum sound absorption coefficient (0.43) at highest frequency and extreme Noise Reduction Coefficient (0.2875) are found in the sample having 75% maize and 25% textile wastes as reinforcements. This waste material exploitation approach is more cost beneficial and offers an environmental friendly solution to the noise control.

Festus Adda Naphtali et. al. (2022) Acoustical materials play several important roles in acoustic engineering, such as industrial noise control, room noise control, studio and automotive acoustics. This study presents research on the sound attenuation properties of recycled agro-waste composite materials. The raw materials used to prepare these composite panels are wastes generated from rice, sugar cane, groundnut, oil palm, and corn. Starch was the matrix material, thereby making the composite fully green. Five sound absorption composite panels were produced for the five categories of agro waste by compression molding method. The sound attenuation capacity of the produced composite panels relayed a quality sound absorption coefficient α ranging from 0.72 – 0.86. An increase in the thickness of the composite panels resulted in a lowering sound absorption coefficient, which indicates that thickness is an important factor in determining the sound attenuation capacity of agro-waste-based composites. The agro-waste material approach in sound control was effective, cost beneficial and offers an environmentally friendly solution to sound control.

Elangbam Athoiba Singh et. al. (2024) This research article deals with one of the major forms of pollution that is invisible but is a threat to living beings. Controlling noise pollution is important so to deal with this, a test was performed using a method known as the impedance tube method. To tackle this noise pollution a sustainable material would be good to use, so waste coming from food industries such as orange peel, sugarcane husk, and eggshells are used with newspaper sludge as a binding material. Disks were prepared of 90mm with different constituents of waste material and paper sludge. The test result showed that these panels were able to reduce sound coming from the source to the receiver side. Sound absorption capacity is different for every material depending upon their structural features. The test was done with 120 decibels of sound and at 120 decibels the SAC (sound absorption coefficient) was 0.35 which is better than other commercially available chemical-infused materials such as glass wool, mineral wool etc. As they are not better for the environment as well as living around. They cause

lung disease if inhaled and skin problems come in contact with them. Materials in use for soundproofing have polyurethane which releases a high amount of smoke if brunt hence we cannot rely on this in case of fire. Hence environmentally friendly as well as materials that do not catch fire or realise high amounts of smoke and are also cost-effective should be used to reduce noise pollution in the environment we are living in.

Olga M. Smirnova et. al. (2021) Traditional sound-absorbing materials have a number of disadvantages: low water resistance, low compressive and tensile strengths, low weather resistance, etc. Therefore, new sound absorbing materials need to be developed with improved properties including the involvement of industrial byproducts. The influence of the grain-size composition of the rubber crumb from used car tires on the sound insulation of cement and gypsum composites was studied in the paper. The results of the study contribute to the creation of a structural material for the manufacture of sound absorbing as well as load-bearing structures. The field of application of the developed materials is very extensive.

Iuliana Iaşnicu et. al. (2015) For sustainable development of the textile industry must find solutions to reduce waste and decrease noise at work. Of textile waste are obtained boards of different thicknesses, which aim to be wide field of use. For it is to achieve some experimental results about the soundproofing of plate types: is studying recoverable boards made of short textile fiber and cork boards. Textiles have a thickness of 3 mm and 10 mm and cork boards with a thickness of 3 mm and 10 mm. For determining is used the impedance tube reading Brüel&Kjaer, type 4206. By analyzing the absorption coefficient results that materials have absorbing characteristics that increase with material thickness. From these boards aims to obtain laminated composite materials used to encapsulate industrial noise sources.

José-Antonio Balmori et. al. (2023) The current European standards demand more energy-efficient, comfortable, and sustainable buildings and encourage the incorporation of recycled materials in building construction. Timber buildings are successfully competing with traditional building materials in addressing these challenges; however, one of the weaknesses of timber systems is their limited sound insulation capacity. One material that can fit into the sustainability aims of timber construction and improve its acoustic performance is recycled ground tyre rubber (GTR), which, on top of this, is a serious environmental problem. This paper presents research on the use of GTR materials combined with timber systems in order to improve their acoustic performance. Three different types of GTR products (granulate, rolls, and sheets) of different thicknesses and densities are selected and are combined with different sound-absorbing materials (mineral wool, cellulose, and wood fibre) inside a lightweight timber sandwich system. In this study, the first qualitative approach, the acoustic performance of the different resulting systems is compared based on the sound pressure level difference measured in a custom-made reduced-size transmission chamber. Secondly, the sound reduction index of four selected specimens is measured in an accredited sound transmission laboratory. The results show that, for all the lightweight timber systems included in this research, introducing a GTR layer improves the acoustic performance of the system.

S V Georgescu et. al. (2018) The paper investigates the thermal and acoustic properties of composites made from wood fibres (WF) and recycled rubber (R) crumbs and acrylonitrile butadiene styrene (ABS) shavings resulted in the particleboards' edge banding. Panels with a target density of 300 kg/m3 were manufactured for testing the thermal conductivity coefficient and sound absorption coefficient. Mixed panels WF:ABS, R:ABS with participation rates (in %) of 10:90, 20:80, 30:70; 40:60; 50:50 and WF:R:ABS with participation rates (in %) of 5:5:90, 10:10:80, 15:15:70; 20:20:60; 25:25:50 were investigated in this paper. The experiment simulated the indoor and outdoor temperature conditions for the winter and summer seasons, namely 20 ºC for indoor and -10 ºC to 35 ºC for the outdoor temperatures. The results show that, with the increase of ABS share, the thermal performance of the panel increases. The presence of WF in the composition has a good influence on the thermal performance of the panels, whilst the presence of rubber brings a better acoustic performance of the composites. The analysis of the results show that the thermal conductivity coefficient (λ) experimentally determined depends on the outdoor temperature and recorded the best value for the composite WF-ABS (0.0434 Wm-1K-1) followed

by WF-R-ABS (0.0460 Wm-1K-1) and R-ABS (0.0477 Wm-1K-1). Maximum values were recorded for R-ABS structure at a temperature of 35 ºC (0.0573 Wm- 1K-1), but this structure recorded the best sound absorption coefficient (0.87).

Sneha D. Nikalje et. al. (2022) Increasing use of electrical and mechanical appliances at home and industries has created a concern for noise pollution created by them. Urbanization and heavy growth of construction work in every neighbourhood further emphasize the need of new technologies for noise reduction. Noise created by different machines can be controlled either by suppressing the noise generating factors or by using the noise proofing agro materials which help to reduce the acoustic wave's energy by blocking or absorption. Maize, rice straw, and coconut fiber these agro products help to reduce the noise pollution. Newspaper waste also used as noise absorbing materials.

Sruthi, Dr. Kumar A. et. al. (2020) Sound pollution, is the propagation of noise with ranging impacts on the activity of human or animal life, most of them harmful to a degree. The source of outdoor noise worldwide is mainly caused by machines, transport, and propagation systems. poor urban planning may give rise to noise disintegration or pollution, side-by-side industrial and residential buildings can result in noise pollution in the residential areas. Some of the main sources of noise in residential areas include loud music, transportation (traffic, rail, airplanes, etc.), lawn care maintenance, construction, electrical generators, explosions, and people. As an alternative in our research project we are concerned with maximum utilization of agro-waste Material Such as Rice straw to develop Noise absorbing Composite with bamboo as reinforcing material and study of acoustical and flammability properties of Composites.

Abhishek Bangale et. al. (2024) Excessive noise levels in indoor environments, originating from various sources such as construction activities, mechanical systems, and domestic appliances, can lead to a range of physical and psycho- logical health problems. As the world becomes more urbanized and densely populated, finding sustainable and effective solutions to com- bat indoor sound pollution is of utmost importance. This project aims to address the problem of indoor sound pollution by developing noise absorbing sheets using biodegradable agro-waste materials. This study has been undertaken to develop low cost noise absorbing sheet using waste product. This research has investigated the acoustic behavior of composite materials developed from recycled wastes which are considered to be cost beneficial and also a green building initiative. The waste materials have shown better acoustical performance especially at mixed levels than the pure levels due to improvement in the porosity. The maize and textile fiber waste combinations show a better sound absorbing property than the newspaper and textile fiber wastes due to reduction in voids which reduces the porosity.

Mohammad Hosseini Fouladi et. al. (2011) Coir fiber from coconut husk is an important agricultural waste in Malaysia. Acoustic absorption coefficient of the fiber as a porous material is studied in this paper. Two types of fiber are investigated, fresh from wet market and industrial prepared mixed with binder. Moreover two analytical models, namely; Delany–Bazley and Biot–Allard are used for analysis. Experimental measurements in impedance tube are conducted to validate the analytical outcomes. Results show that fresh coir fiber has an average absorption coefficient of 0.8 at f > 1360 Hz and 20 mm thickness. Increasing the thickness is improved the sound absorption in lower frequencies, having the same average at f > 578 Hz and 45 mm thickness. Delany–Bazley technique can be used for both types of fiber while Biot–Allard method is compensated for the industrial prepared fiber considering the binder additive. This form generally shows poor acoustical absorption in low frequencies. Inevitably, fiber has to be mixed with additives in commercial use to enhance its characteristics such as stiffness, unti-fungus and flammability. Hence other approaches such as adding air gap or perforated plate should be used to improve the acoustical properties of industrial treated coir fiber.

Sezgin Ersoy et. al. (2009) The sound absorption of an industrial waste, developed during the processing of tea leaves has been investigated. Three different layers of tea-leaf-fibre waste materials with and without backing provided by a single layer of woven textile cloth were tested for their sound absorption properties. The experimental data indicate that a 1 cm thick tea-leaf-fibre waste material with backing, provides sound absorption which is almost equivalent to that provided by six layers of woven textile cloth.

Twenty millimeters thick layers of rigidly backed tea-leaf-fibres and non-woven fibre materials exhibit almost equivalent sound absorption in the frequency range between 500 and 3200 Hz.

III. CONCLUSION

The use of agro-waste products in sound-absorbing panels to control sound pollution is an innovative approach to both environmental sustainability and noise pollution control. Agro-waste materials are abundant, biodegradable, and often underutilized, making them a promising resource for producing cost-effective and eco-friendly soundproofing solutions. Agro-waste products represent a promising and sustainable solution for sound pollution control. By utilizing materials like rice husk, sugarcane bagasse, and cotton stalks, it is possible to produce effective, eco-friendly sound-absorbing panels that help reduce environmental noise. An increase in the thickness of the composite panels resulted in a lowering sound absorption coefficient, which indicates that thickness is an important factor in determining the sound attenuation capacity of agro-waste-based composites. The agro-waste material approach in sound control was effective, cost beneficial and offers an environmentally friendly solution to sound controlThe approach aligns well with sustainability goals while addressing the growing concern of noise pollution in both urban and industrial areas. However, further research is needed to improve the performance, durability, and cost-effectiveness of these materials, especially in comparison to traditional soundproofing materials.

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