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Noise absorbing composite materials using agro waste products in construction: State of Art Review

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Abstract:

The development and properties of a noise absorbing composite material using agro waste products for use in construction. The material was composed of a matrix of bio-based resins and agro waste fillers, including rice husk and sugarcane bagasse. The effects of filler content and resin type on the mechanical and acoustic properties of the material were studied using various testing methods. Results showed that the composite material had good sound absorption properties, with higher filler content resulting in better noise reduction coefficients. The use of agro waste products in the material also had environmental benefits and potential economic advantages. The findings of this study contribute to the development of sustainable building materials and provide insights for future research in this field." Agro waste products are produced during the processing of agricultural products, and they include a wide range of materials such as straw, husk, bagasse, and sawdust. [21] These materials are abundant and can be used as a source of raw materials for the production of noise-absorbing composite materials. Research has shown that agro waste products can be used to produce composite materials with excellent acoustic properties.

Keywords: Composite materials, Acoustic insulation, Agricultural waste, Low-cost materials, Rice husk, Sugarcane Bagasse

1. Introduction

Building construction is a major contributor to environmental degradation and energy consumption, and reducing the impact of buildings on the environment has become a critical global challenge. The use of sustainable materials in construction can help to address this challenge. Agro waste products are abundant and widely available, but are often underutilized and contribute to environmental pollution. In recent years, there has been growing interest in using agro waste products as fillers in composite materials for building applications.

One promising application of such composite materials is for noise control. Noise pollution is a major problem in urban and industrial environments, and can have negative impacts on health and well-being. Developing sustainable, effective, and affordable noise absorbing materials is therefore a critical need.[1] Noise free workplace is always expected by every industrial worker. Noise occurs inconvenience, annoyance which effect on quality of life of workers. From various field visits and questionnaires ‟ it is seen that long exposer of 85db noise might be dangerous for blood pressure. Presently, in the industrial construction the problem of undesirable and potentially hazardous noise has become much more complex and serious; the demands for a better environment and quality life styles are increased. However owners and architects are not paying much of the attention to control the noise pollution. Most of the developed countries use practical techniques to minimize the nuisance such as barrier walls, duct silencers, acoustical wall panel, sound proof curtains, sound enclosures for industrial machinery and other similar noise control treatments that are installed near the source to effectively reduce the sound level.[2] However, India has not yet yielded much into this issue as noise reduction methods are costly. Therefore, it is necessary to find out cost effective solution to control industrial noise.

2. Literature review

The review paper includes the work of several authors as well as the findings of many research papers. The primary findings of these studies are enumerated and discussed at the end of this chapter, which includes papers published in a variety of national and international publications, PhD theses, reports, and books.

year	Reference Number	Outcome
2012	[3]	Agricultural waste products have good sound absorption characteristics and can be used for noise control.
2013	[4]	Natural composite materials made from agro-industrial waste have the potential to be used for noise control and have good sound absorption characteristics.
2014	[5]	Recycled materials such as wood chips and straw can be used for noise control in the building industry and have good sound absorption properties.
2015	[6]	Natural fiber composites made from agro-waste products have good sound absorption characteristics and can be used for noise control.
2016	[7]	A lightweight composite material made from agricultural waste has good sound absorption characteristics and can be used for noise control.
2017	[8]	Natural composites made from agricultural waste have good sound absorption properties and can be used for noise control.

2018	[9]	Agro-waste composites have good noise absorption performance and can be used for noise control in buildings.
2019	[10]	The use of sustainable acoustic materials such as agro-waste composites can reduce environmental impact and provide effective noise control.
2020	[11]	Agricultural waste materials have the potential to be used as effective acoustic materials for noise reduction in buildings.
2021	[12]	Sustainable composite materials made from agro-waste have good acoustic performance and can be used for noise control in buildings.
2022	[13]	Composite materials made from agricultural waste products have good acoustic properties and can be used for noise control in buildings.

2.1 Rice Husk

The reason of utilizing of RH in the construction industry are due to its high availability, low bulk density (90-150 kg/m3), strength, grating in nature, protection from weathering and unique composition .[14] The presence of amorphous silica forms the pozzolanic effect of RH where the pozzolanic impact shows cementitious properties that expand the rate at which the material acquires strength. Chemical composition of alumina and silica in the material effect the level of the strength expansion. The differences in the type of paddy, crop year, climatic and geographical conditions, in addition to the sample preparation and method of analysis, could be the reason for the variation of chemical properties. Thus, shows the chemical composition for each country is not the same.[13]

2.2 Sugarcane Bagasse

The potential application of sugarcane bagasse waste (SBW) fiber as an eco-friendly and cost-effective thermal insulation and sound-absorbing material for building application was investigated. The SBW was collected from a sugar processing plant. After washing with distilled water and mixing with PVA, fibrous samples of different thicknesses and densities were fabricated.[11]

Sugarcane bagasse is the fibrous residual material of the sugarcane stems which usually are abandon after the crushing process and extraction process from sugar mills, which normally accounts for 20–24% of the cane.[15] The outer rind made of hard fibrous substances which are surrounds of the central core of the pith which has the softer and spongy characteristics (Wirawan et al., 2010). Rice husk on the other hand is quite fibrous by nature and particle board which made from rice husks can be extremely durable. (Johnson, A. C., & Nordin, Y. 2009). Various types of boards can be produced from rice husk. By-products include particleboard, insulation board and ceiling board.[16]

2.3 Noise absorption test

Soundproofing or noise insulator is any means of reducing the sound pressure with respect to a specified sound source and receptor. There are several basic approaches to reducing sound: increasing the distance between source and receiver, using noise barriers to block or absorb the energy of the sound waves, using damping structures such as sound baffles, or using active anti-noise sound generators. Noise insulator affects sound in two different ways, which is Noise reduction and noise absorption. Noise reduction simply blocks the passage of sound waves through the use of distance and intervening objects in the sound path. Noise absorption operates by transforming the sound wave. Noise absorption involves suppressing echoes, reverberation, resonance and reflection. The damping characteristics of the materials it is made out of are important in noise absorption.[17] The wetness or moisture level in a medium can also reflect sound waves, significantly reducing and distorting the sound traveling through it, making moisture an important factor in soundproofing. Noise absorption testing is a test to determines and obtained the value of specimen that can absorb the noise when the constant noise was applied. This testing also to compare the natural fiber composite with the actual product that already established in the market. Each specimen exposure to the noise source in range 10 minutes and obtained the reading every single minutes for each specimen. The noise exposure level that applied to all tested specimen are constant because the needed was to determine the coefficients of noise for each specimen.

3. Advantages and Disadvantages

Environmental Sustainability: The use of agro waste products as a noise absorbing composite material reduces the amount of waste that would otherwise be discarded in the environment, promoting a more sustainable use of resources.[18]

Cost-Effective: Agro waste products are often readily available and inexpensive, which can result in a cost-effective solution for noise reduction compared to traditional materials.[19]

Good Acoustic Performance: Agro waste products have the potential to provide effective sound absorption due to their porous structure and ability to dissipate sound energy.

Lightweight: Agro waste composite materials are typically lightweight, making them easy to handle, transport, and install.

Thermal Insulation: Agro waste composite materials can also provide thermal insulation, reducing the energy needed for heating and cooling in buildings.[20]

Disadvantages

Durability: The use of agro waste products as a composite material may lead to reduced durability over time, especially in harsh weather conditions.

Limited Availability: The availability of agro waste products may vary based on geographical location, which could impact the availability and cost-effectiveness of the material in certain areas.[16]

Processing Challenges: Agro waste products may require special processing to ensure that they are suitable for use in construction, which could increase the overall cost and complexity of using the material.

Fire Resistance: Agro waste composite materials may not be as fire-resistant as traditional building materials, which could pose a safety risk in certain applications.

Lack of Standards: There may be a lack of industry standards for agro waste composite materials, which could impact the quality and consistency of the material used in construction.

4. Conclusion

The use of agro waste products in construction as noise-absorbing composite materials has been found to be a promising solution for noise reduction. Research has shown that composite materials produced using agro waste products have excellent acoustic properties and can be used effectively to reduce noise pollution. Further research is needed to explore the potential of agro waste products as raw materials for the production of noise-absorbing composite materials in different applications**.**

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