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Sustainable Acoustic Panel in Music Studio for Sound Proofing

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Abstract: ***This study investigates the application of sustainable acoustic panels within interior design and architecture, with particular focus on music studios and more used in offices, classrooms, auditoriums.***
The significance of these panels can be examined from multiple perspectives. Manufactured from natural fibber's, recycled textiles, and biodegradable composites, they present an eco-friendly alternative that maintains and in some cases enhances acoustic performance while reducing environmental impact. Experimental findings indicate that such panels deliver equal or superior results compared to conventional options in noise reduction and sound quality enhancement, while also supporting improved indoor air quality and lowering the overall environmental footprint. panels are applied in music studio interiors for wall and ceiling treatments, offering dual benefits of superior sound absorption and sustainable design. They enhance acoustic quality, reduce textile waste, and add aesthetic value, making them an eco-friendly alternative to conventional materials. This research advocates for the integration of green materials in acoustic design, promoting environments that harmonize functionality (soundproofing), aesthetics, human wellbeing, and ecological responsibility.
Keywords: Acoustic, Interior Desing, Panel, Sustainable, Textile.

I. INTRODUCTION

In a world where every note deserves to breathe freely, sustainable acoustic panels rise woven from echoes of the past, tuned for the harmony of tomorrow. so Here I used Recycled textile acoustic panels which are an innovative and sustainable solution for managing sound in interior spaces while addressing the growing issue of textile waste. These panels are produced using postconsumer fabrics, discarded clothing, and industrial textile scraps, which are processed into fibrous boards or felt-like structures with excellent sound absorption properties. Unlike conventional panels made from fiberglass or synthetic foams, recycled textile panels are eco-friendly, free from harmful chemicals, and safer for human health. Their porous texture naturally reduces echo, reverberation, and noise pollution, making them highly effective for use in music studios, offices, classrooms, hospitals, and other public spaces.

1) Schools & libraries → to improve focus and reduce noise.
2) Hospitals → for a calmer healing environment.
3) Workspaces & co-working hubs → to manage open-office noise.

Primary research site visit at sound plant sound studio on the music studio for sound proofing the requirement:

- Control Room – Clear sound monitoring, no reflections.
- Recording/Live Room – Reduce echo & reverb for clean sound.
- Vocal Booth – Dry, noise-free recordings.
- Corners & Ceilings – Bass traps absorb low frequencies

Textile acoustic panels are strategically placed to achieve balanced sound quality. They are installed on side and back walls to absorb reflections, on the ceiling above the mixing desk and recording area to control overhead noise, and in corners as bass traps to manage low-frequency buildup

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II. LITERATURE REVIEW

Noise pollution has become a major concern worldwide. Many researchers have come forward sharing views and conducting studies on the noise issue. Whilst the majority agrees at some level that the current traditional sound absorption panels using synthetic materials such as glass, mineral wool or polyester fibres are the solution to the noise problems, others on the other hand voice out concerns on the

health and environmental impacts of such synthetic materials. Thus, new research on sustainable sound absorption panels is now trending. Textile recycle waste which can usually be found in textile industries, households, retail stores (fabric scraps) have proven in previous studies to have the capability to absorb sound.

This paper reviews studies of the environmental impact of textile reuse and recycling, to provide a summary of the current knowledge and point out areas for further research. Forty-one studies were reviewed, whereof 85% deal with recycling and 41% with reuse (27% cover both reuse and recycling). Fibre recycling is the most studied recycling type (57%), followed by polymer/oligomer recycling (37%), monomer recycling (29%), and fabric recycling (14%). Cotton (76%) and polyester (63%) are the most studied materials.

Environmental impact of textile reuse and recycling –

A review

- We reviewed 41 studies of the environmental impact of textile reuse and recycling.
- In general, there are environmental benefits with textile reuse and recycling
- Textile reuse leads to greater environmental benefits compared to recycling.
- Most benefits come from avoided production, so the replacement rate is a key factor.
- We list sources of inventory data, reveal knowledge gaps and suggest research needs.

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This study presents an experimental investigation of the heat transfer and acoustic properties of semi-finished panels obtained from post-consumer textile waste. Their different compositions (mostly polyester, mostly cotton, and mixed fabric) and different densities, in a range from 50 to 150 kg/m^3, were considered. The transient “hot disk” method was used for thermal conductivity and diffusivity measurements and a Kundt's tube for sound absorption.

In the EU, according to recent studies undertaken by the Joint Research Centre (Donatello et al., 2021; Huygens et al., 2023), the total textile waste, covering clothing and footwear, home textiles, technical textiles, and post-industrial and pre-consumer waste, in 2019 amounted to 12.6 million tonnes (Mt), 10.9 Mt postconsumer waste and 1.7 Mt post-industrial and pre-consumer waste. Clothing and footwear waste amounted to 5.2 Mt, equivalent to 12 kg per person per year in the EU.

In the last decade, different studies have been carried out with the purpose of exploring solutions and potentialities of recycling waste materials for making thermal and acoustic insulating panels, and some of them have specifically considered textile waste. Zach et al. (Zach et al., 2016) tested insulation panels made from various recycled materials encompassing flax, cotton, and polyester, with different bulk densities and at different temperatures. The results showed thermal insulation performances comparable with mineral/rock wool, although, as both composition and density vary at the same time, their effects on thermal conductivity could not be separated.

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The prototypes of products for building applications, based on recycled textile materials, were developed in collaboration between the university and commercial and industrial partners. The production process of these semi-finished panels included the sorting of the post-consume textile materials, granulation of the fabric, the addition of a binding component, and a thermal mechanical process called the “Airlay” technique for the mixing and cohesion of the granulates. Airlay technology is based on heatbonded fibrous material well mixed with bi-component (binding) fibers that are pressed between the rolls in the heated chamber (furnace). Temperature is dependent on the bi-component fibers’ thermal properties (i.e., melting point) and pressure on the desired bulk density. Indeed, the binding component is a fiber made of two components,

Different fabric materials and percentage of binding component (10 % or 20 %) were used for the productions of the mats, resulting in different density and rigidity. Three families of compositions were considered for the recycled material selection: mainly cotton (>90 %), mainly polyester (>90 %), and a mix (34 % polyester, 30 % wool, 23 % viscose, and 13 % cotton). It must be remarked that the so-called mix was obtained by taking the clothing waste as a whole, without applying any sorting, and thus the corresponding fiber composition was not decided *a priori*, but rather it can be considered a result.

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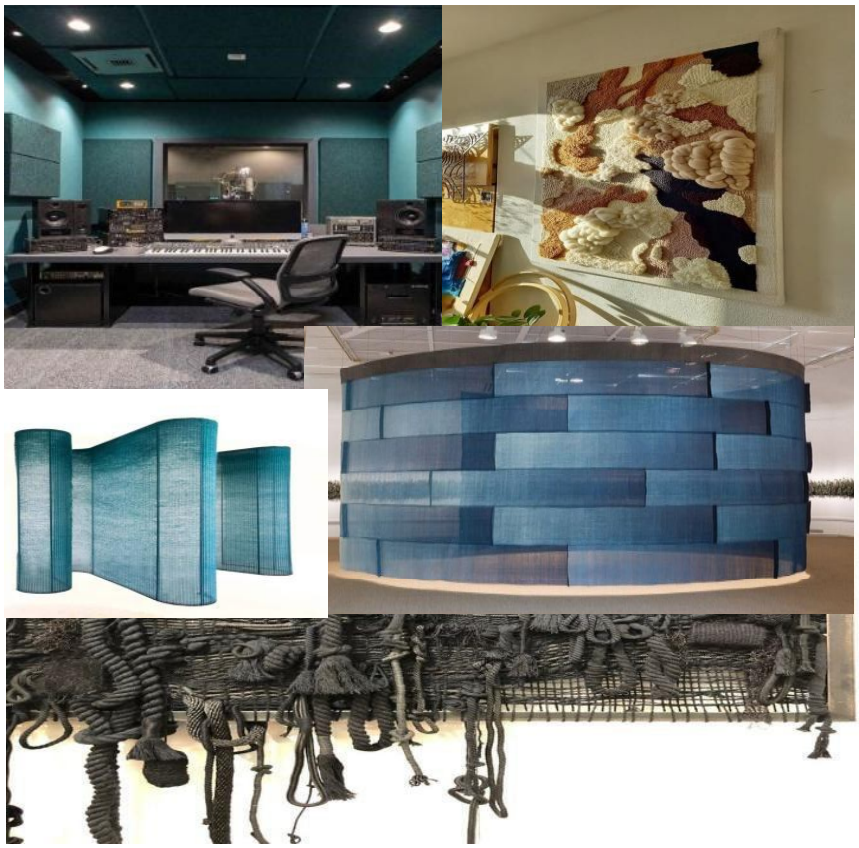

III. RESULT AND DISCUSSION

The review of various research studies on sustainable acoustic panels reveals that the use of eco-friendly and recycled materials such as textile waste, natural fibers (like jute, hemp, coir, and kenaf), agricultural residues, and biodegradable binders provides an effective alternative to conventional synthetic acoustic materials. These sustainable materials demonstrate good sound absorption coefficients, particularly in the mid to high-frequency range, which are critical for applications such as music studios, classrooms, and office spaces.

Studies indicate that panel density, thickness, and fiber composition significantly influence acoustic performance. Panels made from recycled textile composites and natural fiber mats perform comparably to traditional fiberglass and foam panels while reducing carbon footprint, production costs, and health hazards associated with synthetic fibres. Additionally, resin-coated recycled panels enhance durability, surface aesthetics, and moisture resistance without compromising acoustic efficiency.

However, results also highlight certain limitations — including inconsistency in raw material properties, lower fire resistance, and limited large-scale manufacturing processes. To overcome these challenges, future research should focus on hybrid composites, biobased binders, and nanomaterial reinforcements to enhance mechanical and acoustic properties while maintaining sustainability.

In conclusion, the reviewed literature strongly supports that sustainable acoustic panels are a viable and environmentally responsible alternative to conventional materials. With further technological optimization and standardization, these panels can play a crucial role in achieving green building goals and acoustically efficient interiors.

IV. CONCLUSION

The review concludes that sustainable acoustic panels made from natural and recycled materials are an effective and eco-friendly alternative to conventional synthetic panels. They provide good sound absorption, reduce environmental impact, and promote waste recycling. While challenges such as material inconsistency and durability remain, ongoing research and improved manufacturing methods can overcome these limitations. Overall, sustainable acoustic panels represent a promising solution for achieving both acoustic efficiency and environmental sustainability in modern interior design.

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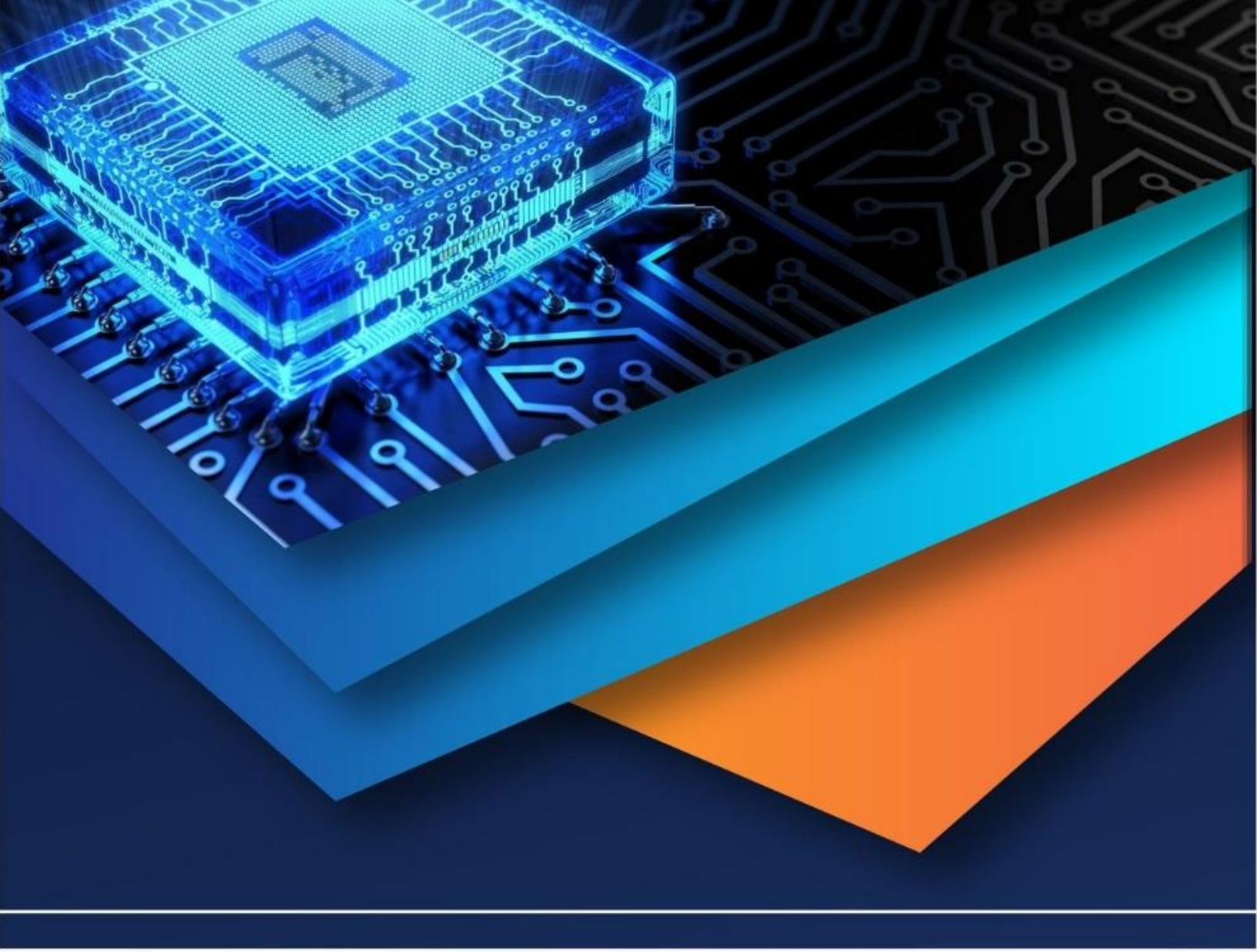

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