DEVELOPMENT OF NOISE ABSORBING MATERIALS USING AGRO WASTE PRODUCTS

Submitted in partial fulfillment of the requirements for the award of the degree of

B.TECH

by

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CERTIFICATE

This is to certify that the thesis entitled "**DEVELOPMENT OF NOISE ABSORBING COMPOSITE USING AGRO WASTE PRODUCTS**" submitted by **RAJULAPATI NAVEEN (208W1A03F7), GUDURU VENKATA MARUTHI ABHIRAM (208W1A03C9), MUTHYALA SAI KIRAN (208W1A032E8), MOHAMMAD ABDUL HAADEE IRSHAD (208W1A03E5) and THUMU BHARATH KUMAR (198W1A03B7)** to V. R. Siddhartha Engineering College, Vijayawada under the jurisdiction of JNTU Kakinada in partial fulfillment of the requirements for the award of the degree of **Bachelors of Technology** is a record of bonafide research work carried out by us under our supervision and guidance. This work has not been submitted elsewhere for the award of any degree.

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CONTENTS

ABSTRACT

The project focuses on the development of effective noise-absorbing materials utilizing agricultural waste as a sustainable and cost-efficient resource. Noise pollution has become a pressing concern in urban and industrial environments, necessitating innovative solutions that can mitigate its adverse effects on human health and well-being. Agricultural waste, which is abundantly available and often underutilized, presents an opportunity to create environmentally friendly noise-absorbing materials. Noise created by different machines can be controlled either by suppressing the noise-generating factors or by using noise-proofing materials which help to reduce the acoustic wave's energy by blocking or absorption. Traditionally, noise is controlled by using expensive and non-biodegradable sound-absorbing materials such as glass wool, polymer foams, fabric filler, and polymer fibers, posing additional harm to the environment. The health risk factors associated with glass-and mineral-fiber materials, also provide an opportunity to develop the soundproofing material made of naturally available materials. At present the focus is to develop a cheap, renewable, and biodegradable soundproofing material with maximum utilization of agro-waste material Such as Rice husk to develop Noise absorbing material and study of acoustical and flexural properties of Composites.

Keywords: Sound Reduction Technology, Natural Fibre, Sound level, Agro-waste materials, sound absorption coefficient, noise, Recovery of rice husk composite, Mechanical properties.

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Chapter 1
INTRODUCTION

1.1 INTRODUCTION:

Noise is generally unwanted sound caused in the outside world due to various reasons, involving machines, transportation systems, engines, aircraft, etc. Noise pollution has become the third pollution resource that has great adverse influences on the environment, human health, and economy [Fig 1.1]. How to reduce the damage of noise has become an important issue. Generally, the means of controlling noise include active control and passive control Noise absorption constitutes one of the major requirements for human comfort today. The former is accomplished by reducing the production of noise at the locations of noise sources, but it can only control the noises of a narrow frequency range. Passive control is normally achieved by utilizing high sound absorption materials, which can be used to absorb noises of a wide frequency range by effectively dissipating sound energy on the process of propagation of the sound wave.

Fig 1.1: Noise Pollution

Noise insulation requirements in automobiles, manufacturing environments, and equipment, generating higher sound pressure drive the need to develop more efficient and economical ways of producing sound absorption materials. Industrial applications of sound insulation generally include the use of materials such as glass wool, foam, mineral fibers [Fig 1.2], and their composites. A porous laminated composite material manufactured by lamination, preheating, and molding of premix, exhibits a very high sound absorption property in the frequency range of 500–2000 Hz.

Fig 1.2: Glass Wool and Foam Insulation

The use of synthetic porous and fibrous acoustic materials is still frequently found especially in building acoustics as well as in noise control applications. The products such as foam, rock wool, and glass wool made from minerals are known for their toxicity and polluting effects which are harmful to human health as well as to the environment [Fig 1.2]. It has been presented that their production can release more carbon dioxide into the atmosphere compared to those made from natural materials. In order to support the "Green" environment campaign, Acoustic absorbers from natural materials are therefore of interest due to their biodegradability and sustainability. As an alternative, natural fibers like jute, cotton, flax, ramie, sisal, and hemp obtained from renewable resources can be used as cheap, biodegradable, and recyclable sound-absorbing materials. Although composites made of jute fiber/felt with other fibers are being used for various applications in the automotive industry, construction, building sectors, furniture, etc.

The health risk factors associated with glass-and mineral-fiber materials, also provide an opportunity to develop soundproofing material made of natural fibers. Sound absorption panels produced from particle composite boards using agricultural wastes, Natural fiber have challenged researchers to develop novel enhanced soundproofing material made up of natural fiber. At present the focus is to develop a cheap, renewable, and biodegradable soundproofing material with the help of jute (natural fiber) fiber/felt which is a non-abrasive, porous, good insulator, hygroscopic and combustible material for automobiles, home appliances, and architecture applications. Synthetic materials widely used in sound attenuation processes are sourced from petrochemical sources, thus producing significant carbon footprints [Fig 1.3]. A high temperature associated with the manufacturing processes of synthetic materials releases hazardous substances into the environment, consumes more energy, and has a higher global warming potential from cradle-to-site installation based on life cycle assessment. Synthetic materials, such as mineral wool, glass wool, rock wool, asbestos, polymer foams, fabric filler, polymer fibers, and glass fiber used as sound attenuation panels, are hazardous as such can affect human health in the short-term period and pollute the environment in the long run [Fig 1.2]. In addition, the financial implication involved in the handling and processing of sound attenuation panels from synthetic materials is high.

Fig 1.3: Polyurethane Foam Acoustic Sheet

Of late, natural materials are becoming alternative quality materials to synthetic materials as they provide good health to a greener environment. Natural fiber materials are directly obtained from animal, mineral, or vegetable sources. Natural fiber materials are bio-degradable, non-harmful and less hazardous to human health and the environment, including low safety risk in their process. Advantages of natural materials in the fabrication process of sound attenuation panels include their renewable nature, non-abrasive, low-cost, abundance, lower carbon footprint, very low toxicity, low density, lightweight, good biodegradability, and of less health and safety concerns.

1.2 ABOUT AGRICULTURAL WASTE:

Agricultural waste, often referred to as agro waste or agricultural residue, encompasses various organic materials generated as byproducts of agricultural activities and food production processes. These materials are typically left unused or discarded after the primary products (such as grains, fruits, and vegetables) have been harvested. Agro-waste includes a wide range of organic materials, each with its own unique properties and potential applications. Some common examples of agro-waste include:

- **Crop Residues:** Stalks, stems, leaves, and husks left behind after crops like rice, wheat, corn, and sugarcane have been harvested.
- **Husk and Shell Waste:** Outer layers of grains, nuts, and seeds, such as rice husks, coconut shells, and peanut shells.
- **Fruit and Vegetable Waste:** Peels, cores, and seeds from fruits and vegetables, which are often discarded during processing.
- **Straw:** Stems of crops like wheat, barley, and oats that are left over after grain harvesting.
- **Wood Residues:** Byproducts of wood processing in the form of sawdust, wood chips, and bark.
- **Bagasse:** Residue obtained from sugarcane after juice extraction, commonly used in the production of paper and biofuels.
- **Stover:** The leaves, stalks, and husks of cereal crops left after grain harvest, often used for animal feed or as biomass fuel.
- **Animal Manure:** Organic waste from livestock farming, which can be converted into biogas or used as fertilizer.
- **Cotton Waste:** Byproducts of cotton processing, including stalks, seeds, and lint.

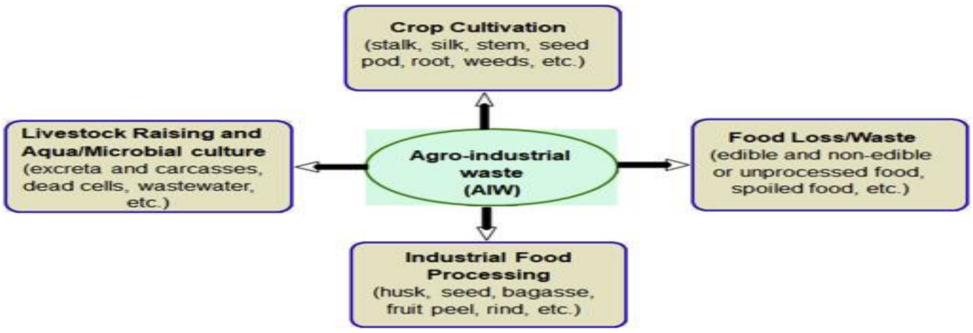

Fig 1.4: Agro-based industrial wastes

Agro waste is typically disposed of through methods like open burning, landfilling, or simply left to decompose, which can have negative environmental consequences such as air pollution and greenhouse gas emissions. However, the use of agro waste in various applications offers significant benefits, including:

- **Resource Utilization:** Repurposing agro waste helps maximize the use of available resources, reducing waste and the need for additional raw materials.
- **Environmental Benefits:** Utilizing agro-waste can lead to reduced air and water pollution, as well as decreased pressure on natural resources.
- **Sustainable Practices:** Integrating agro waste into products and materials aligns with principles of sustainability and circular economy.
- **Economic Opportunities:** Agro-waste utilization can create income streams for farmers and waste producers, contributing to rural economies.
- **Innovation:** Agro-waste can be transformed into a wide range of products, such as biofuels, bioplastics, construction materials, and, as in your project, noise-absorbing materials.

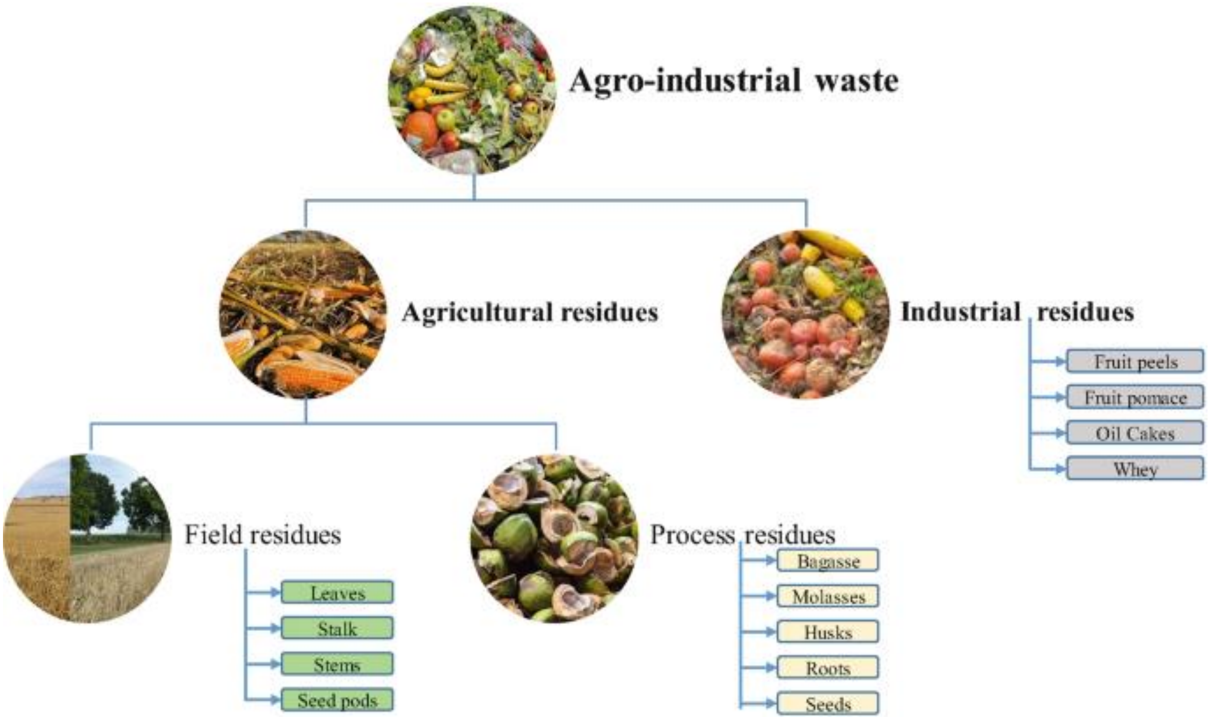

Fig 1.5: Agricultural industrial wastes

1.3 ADVANTAGES AGRO WASTE NOISE ABSORBING MATERIALS:

The project involving the development of noise-absorbing materials using agro waste offers numerous advantages, spanning environmental, economic, and societal aspects. Some of the key benefits of this project include:

1. **Environmental Sustainability:**
    - **Reduction of Waste:** The project repurposes agricultural waste that would otherwise contribute to pollution or be disposed of inefficiently.
    - **Lower Carbon Footprint:** Using agro waste minimizes the need for energy-intensive manufacturing processes typically associated with synthetic noise-absorbing materials.
    - **Conservation of Resources:** By utilizing a readily available resource, the project reduces the demand for virgin materials, promoting responsible resource management.
2. **Waste Reduction and Circular Economy:**
    - **Valuable Utilization:** Agro waste is transformed from a discarded byproduct into a valuable material, exemplifying the principles of the circular economy.
    - **Economic Opportunities:** Farmers and waste producers can benefit economically from selling or supplying agro waste for this purpose, contributing to rural economies.
3. **Innovative and Sustainable Materials:**
    - **Novel Applications:** The project introduces innovative uses for agro waste, demonstrating its versatility beyond conventional applications.
    - **Environmentally Friendly:** Agro waste-based noise-absorbing materials offer a sustainable alternative to synthetic options, aligning with eco-conscious trends.
4. **Noise Pollution Mitigation:**
    - **Enhanced Acoustic Comfort:** Agro waste-based materials effectively absorb and dampen noise, contributing to quieter and more comfortable living and working environments.
    - **Versatile Applications:** These materials can be integrated into various settings, including residential, commercial, and industrial spaces, as well as transportation infrastructure

5. **Cost-Effectiveness:**
    - **Affordable Solutions:** Agro waste is often more cost-effective compared to traditional synthetic noise-absorbing materials, making noise reduction solutions accessible to a broader range of applications.
6. **Customization and Adaptability:**
    - **Tailored Solutions:** Agro waste-based materials can be engineered to address specific noise frequency ranges, optimizing their effectiveness for different environments.
    - **Integration Flexibility:** These materials can be easily incorporated into existing structures, allowing for retrofitting in various settings.
7. **Community Engagement and Education:**
    - **Awareness Building:** The project promotes awareness about sustainable waste management practices and the potential of agricultural waste for positive contributions.
    - **Local Engagement:** Collaboration with local farmers and communities fosters a sense of involvement and ownership.
8. **Academic and Industrial Collaboration:**
    - **Research and Innovation:** The project bridges the gap between academia and industry, fostering collaborative efforts to develop and refine noise-absorbing solutions.
    - **Knowledge Sharing:** Findings and techniques developed through the project can contribute to the broader field of sustainable materials science and engineering.

In summary, the project presents a holistic approach to addressing noise pollution, waste management, and sustainable material development. By leveraging agro waste's potential, it offers a range of advantages that extend beyond noise reduction to encompass environmental responsibility, economic benefits, and innovative solutions for a more harmonious and sustainable future.

Chapter 2

MATERIALS AND METHODOLOGY

2.1 MATERIALS USED IN DEVELOPING PANEL:

The materials used in developing noise absorption boards are as follows:

- Rice husk
- Groundnut husk
- Epoxy Resign
- Hardener
- Mould Release Silicon Spray

Rice Husk

Rice husk is a by-product produced when the harvested paddy is separated from the grains after plants are threshed. They are thrashed either manually, using stationary threshers, or combine harvesters. Each kg of milled rice produced results in roughly 0.7–1.4 kg of rice husk depending on varieties, cutting height of the stubbles, and moisture content during harvest. The average rice husk produced in the world is equal to the annual rice produced. About 45% to 63% of rice husk is used for cattle feeding purposes and the remaining rice straw is dumped or it is burned in the open field.

Fig 2.1: Rice husk

Composition and Characteristics of Rice Husk

The biochemical composition of rice husk and wheat straw is characterized by a typical composition of an agricultural-based lignocellulosic residue: it contains on average 30 – 45% cellulose, 20 – 25% hemicellulose, 15 – 20 % lignin, as well as a number of minor organic compounds. Rice husk is poor in nitrogen, but relatively high in inorganic compounds, often referred to as ash.

Properties of Rice Husk

- Water or moisture does not pass through the surface of the husk due to the presence of wax nature on its outer surface.
- Due to the presence of hollow space, it exhibits lightweight properties.
- It has good thermal resistance nature.

Groundnut Husk

Groundnut husk, also known as peanut husk or peanut shell, is a byproduct of groundnut (peanut) cultivation and processing. It is the outermost layer that surrounds the edible peanut kernel. Groundnut husk is often considered an agricultural waste material and is typically discarded after the extraction of peanuts for food or oil production. However, this husk can be repurposed for various applications due to its physical properties. Groundnut husk is usually dry and fibrous, with a rough and coarse texture.

Fig 2.2: Groundnut Husk

Composition and Characteristics of Groundnut Husk

Composition:

- **Cellulose:** Groundnut husk is rich in cellulose, a complex carbohydrate that forms the structural framework of plant cells. Cellulose contributes to the husk's fibrous nature.
- **Hemicellulose:** Hemicellulose is another type of carbohydrate found in groundnut husk. It is less rigid than cellulose and helps bind plant cell walls together.
- **Lignin:** Lignin is a complex polymer that provides rigidity and strength to plant cell walls. It contributes to the overall structure of the husk.
- **Protein:** Groundnut husk contains some protein content, although it is generally lower compared to the protein content of the groundnut kernel.
- **Fats and Oils:** Groundnut husk contains small amounts of fats and oils, but these are typically present in much lower quantities compared to the groundnut kernel.
- **Minerals:** The husk contains minerals such as potassium, calcium, and magnesium, which are essential for plant growth.

Characteristics:

- **Fibrous Texture:** Groundnut husk has a fibrous and rough texture due to its high cellulose and lignin content. This texture contributes to its durability and strength.
- **Porosity:** The husk is naturally porous, allowing for air circulation and moisture absorption.
- **Color:** Groundnut husks can range in color from light tan to darker shades of brown, depending on factors like the groundnut variety and processing conditions.
- **Low Density:** Groundnut husk is generally less dense than the kernel, making it suitable for various applications that require lightweight materials.
- **Biodegradability:** Due to its organic composition, groundnut husk is biodegradable, breaking down naturally over time.
- **Resistance to Decomposition:** While groundnut husk is biodegradable, its high lignin content can make it relatively resistant to rapid decomposition under certain conditions.

- **Absorption Capacity:** The fibrous nature of groundnut husk allows it to absorb and hold moisture, which can be useful in applications like mulching and soil improvement.
- **Abrasive Qualities:** The rough texture of groundnut husk can give it abrasive qualities, making it suitable for applications such as cleaning or polishing.

Epoxy Resign

Thermosetting polymers known as epoxy resins have exceptional mechanical and resistant qualities. As the polymerization technique used to create their results in variable chain length, they are polymeric or semi-polymeric compounds and as such are seldom found as pure substances. Usually, stoichiometric or nearly stoichiometric amounts are used to heal them. Catalytic homo-polymerization of the epoxy resins or cross-linking with a hardener are two methods for achieving the exothermic reaction required for curing. Epoxy thermoset polymers with distinctive adhesion, durability, resistance, and adaptability are the end product of the curing process. Uncured epoxy resins often only have weak mechanical, chemical, and heat-resistant qualities. Paints, adhesives, and composite materials with fiberglass and carbon fiber reinforcement are just a few applications for epoxy-based products. Epoxies are generally regarded as having good electrical insulating qualities, excellent adhesion, and chemical and heat resistance. The hardener component, not the epoxy resin itself, is frequently the one that poses the biggest risk when using epoxy. Most liquid epoxy resins are classified as skin and eye irritants when they are uncured. Epoxy resins in solid form are often safer than epoxy resins in liquid form, and many of them are considered non-hazardous compounds. Long-term exposure to epoxy resins causes an allergic response. We utilized Epoxy Ly556, a high-quality and durable epoxy resin, in our job. It has a very low amount of viscosity. Due to its low viscosity, it may enter extremely small fractures.

Hardener

Hardener is used for curing the epoxy at room temperature. In our project we used Hardener Hy951 which has low viscosity. Epoxy resins with either Hardener HY 951 or Hardener HY 956 produce medium-viscosity adhesives that are ideal for bonding metals, ceramics, glass, rubber and plastics. The solvent-free epoxy adhesives produce chemical-resistant, electrically insulating joints with good mechanical strength. Curing takes place due to heat generated by the exothermic reaction.

Mould Release Silicon Spray

It is an ultra-dry Silicone Mould Release that is formulated for use as a release Agent for the Injection Moulding & Thermo-Plastic Industries. Its spray pattern is super-atomized to coat the entire mould area, allowing for easy release of all thermoplastic materials from the mould and fewer wasted parts due to deformity. It improves moulding efficiency in many processes including injection, compression, transfer, vacuum form, pour cast, die-cast, and extrusion moulding.

Fig 2.3: Epoxy Resign, hardener and Silicon spray

2.2 METHODOLOGY:

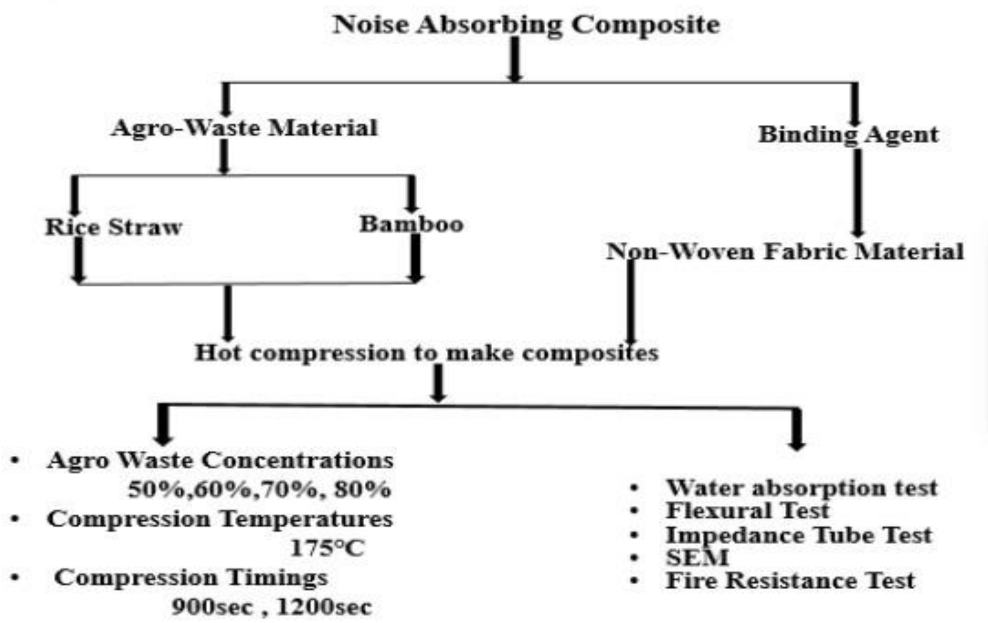

Fig 2.4: Methodology

Steps involved in the preparation of acoustic boards:

Materials sourcing: The agro-waste materials were sourced at their disposed point (dumpsites and waste bins), where they have been dumped as waste.

Sun drying: The materials were sundried for one week. Sun drying is a traditional drying method for reducing the moisture content of agro-waste by spreading the material under the sun.

Cleaning: Each of the agro-waste materials was winnowed to remove dirt, sand and other foreign materials in the agro-waste.

Grinding: This involves breaking large particles of raw materials into small pieces by mechanical means.

Sieving: This process involves separating fine particles from larger particles using a sieve of 2.00 mm manually. Sieving gave the same pore size distribution for the materials selected.

Batching: This is the process of weighing the materials and preparing them for mixing. This involves weighing different agro-waste materials and starch to make up the batch composition for the different sound attenuation panels.

Molding: This involves the slurry preparation and casting process. The different batches for each of the materials composition of the slurry are agro-waste, starch, and water. Water is added to the batches gradually to avoid over-softening of the contents. The sound attenuation panels were fabricated using compression molding methods.

Drying: The produced sound attenuation panels were dried for some days and later sintered at a temperature of 80℃ in an oven. The difference in the weight of the sound attenuation panels before and after drying has to be tabulated.

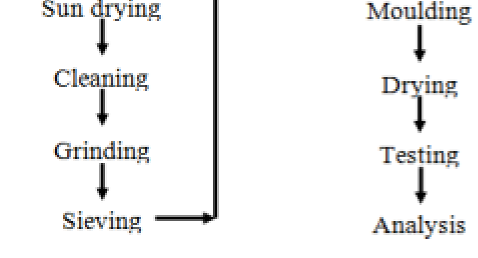

Fig 2.5: The acoustic panel production process

Chapter 3

LITERATURE SURVEY

Zulkifli R, et al. [1] In this study, a semi-active panel design for the sound absorber is developed to ensure operation at a required absorption level for a particular environment and to allow manual control. This study focused on producing an optimum design from several blueprints by using the simulation program, WinFlag. Simulation results are validated by using the impedance tube method. The samples used are perforated plates with open areas of 5%, 7.5%, 10%, 12.5%, and 15%. The second layer is a 35-mm thick coconut coir fiber as the main absorbing material. The third layer is air cavity. Simulation results indicate that the panel with perforation plates with 15% open areas gained the highest peak of sound absorption coefficient (0.851) at 5000 Hz. By using 30 mm thick air cavities, the highest peak is 0.963 at 3129 Hz.

Ersoy s, et al. [2] The sound absorption of an industrial waste, developed during the processing of tea leaves has been investigated. Three different layers of tea-leaf-fiber 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-fibers and non-woven fiber materials exhibit almost equivalent sound absorption in the frequency range between 500 and 3200 Hz.

P. Ricciardi, et al. [3] The purpose of this work is to propose coffee chaff as sound insulation and absorption material for the building industry. The experimental evaluation of the acoustic absorption properties of new samples made of coffee chaff was carried out. Different sample thicknesses were produced and tested by means of an impedance tube, according to ISO 10534-2, showing good behavior at middle-high frequencies. Porosity and flow resistance were also experimentally investigated. In order to highlight the environmental benefits, Life Cycle Assessment was carried out in terms of primary embodied energy and greenhouse gas emissions, considering a “cradle-to-gate” approach.

H. Keskin, et al. [4] In this study, moment capacities of L-type corner joints fabricated from poppy husk-based particleboards, which are expected to be an alternative material for case furniture, were investigated. For this purpose, particleboards with five different ratios of poppy husk (P1, P2, P3, P4, P5) were produced, and then L-type corner joints were prepared. Corner joints were connected to each other with two different joint techniques (screwed, minifixed). Specimens were tested under static tension and compression loads, which are the loads commonly experienced by joints during service.

D.W. Yarbrough, et al. [5] Rice hulls and crushed pecan shells are two solid waste materials with potential for use as thermal insulation. The apparent thermal conductivity, ka, of parboiled rice hulls and crushed pecan shells has been measured in two laboratories over the temperature range of 4 to 41 ºC using heat-flow meter apparatuses. Thermal data were obtained for dried material and as-received material in order to provide information about the variation of k a with water content. In the case of rice hulls, results have been obtained for properties such as resistance to smoldering combustion, critical radiant flux, flame spread index, smoke development index, water sorption, corrosion, odor emission, and resistance to fungal growth in order to determine the suitability of this material for use as a building insulation. The measured k a of rice hulls and crushed pecan shells are compared with data for other solid waste materials such as coconut fiber, sugarcane fiber, and cellulose insulation made from newsprint.

N.-W. Choi, et al. [6] In this paper, a new effective recycling method for rice husks and waste expanded polystyrene is developed by using a combination of both wastes. A styrene solution of waste expanded polystyrene is used as a binder for rice husks-plastics composites. The composites are prepared with various mix proportions by a hot press molding method, and tested for apparent density, water absorption, expansion in thickness, and dry and wet flexural strengths. From the test results, the apparent density of the composites is increased with increasing binder content and filler-binder ratio. Their flexural strength and wet flexural strengths reach maximums at a binder content of 30.0% and a filler-binder ratio of 1.0.

F. Asdrubali, et al. [7] The goal of the paper is to analyze and optimize the manufacturing process of impact sound insulating materials made of recycled tyre granules mixed with binders. Several prototypes were manufactured in laboratory by means of the developed process and tested in order to evaluate their dynamic stiffness. The influence of grain size, binder concentration and density of the sample was investigated. Thanks to the measured values of the viscoelastic properties, it was possible to model the new materials and to estimate the indexes of impact sound reduction ! Finally, the prototypes showing the best properties were produced in bigger size and tested in two overlapping reverberating rooms according to the standard ISO 140-8. Results confirm that the materials manufactured through the developed process have satisfactory acoustic properties, comparable to the ones of commercially available materials.

Khedari J, et al. [8] The development of new particleboards from tropical fruit peels with low thermal conductivity as a component of construction panels for energy conservation of building is the main purpose of this study. Durian (Durio zibethinus) peels and coconut (Cocos nucifera) coir fibers were used as the raw material to manufacture particleboards. Two main parameters were investigated namely binder types, (UF 12%, PF 6% and IC 3%) and board density. In general, the effect of adhesive type on the properties of boards was not obvious whereas that of the density was more significant on most properties of boards.Experimental investigation indicated that the mechanical strength of all boards such as modulus of rupture and modulus of elasticity increased with increasing board density, but it is still rather low. However, this decreased the dimensional stability, measured in term of thickness swelling, and thermal conductivity as well.Finally, as the raw materials are agriculture waste, manufacturing particleboards is therefore an economic and interesting option. Such natural particleboards with a low thermal conductivity could be utilized for specific applications as in insulating ceiling and walls.

Yang hs, et al. [9] In this study, rice straw–wood particle composite boards were manufactured as insulation boards using the method used in the wood-based panel industry. The raw material, rice straw, was chosen because of its availability. The manufacturing parameters were: a specific gravity of 0.4, 0.6, and 0.8, and a rice straw content (10/90, 20/80, and 30/70 weight of rice straw/wood particle) of 10, 20, and 30 wt.%. A commercial urea–formaldehyde adhesive was used as the composite binder, to achieve 140–290 psi of bending modulus of rupture (MOR) with 0.4 specific gravity, 700–900 psi of bending MOR with 0.6 specific gravity, and 1400–2900 psi of bending MOR with a 0.8 specific gravity. All of the composite boards were superior to insulation board in strength. Width and length of the rice straw particle did not affect the bending MOR. The composite boards made from a random cutting of rice straw and wood particles were the best and recommended for manufacturing processes. Sound absorption coefficients of the 0.4 and 0.6 specific gravity boards were higher than the other wood-based materials.

J.A.S. Almeida, et al. [10] This paper summarizes the sound-absorbing properties of various green materials found in the literature, including coconut fiber, kenaf fiber, rice bran, rice husk, rice straw, Hanji (a traditional Korean paper), tea-leaf fiber, mandarin peel, pineapple-leaf fiber, corn husk, peanut shell, sugar palm trunk, yucca gloriosa fiber, fruit stones, wood barks, flax fiber, and nettle fiber. Natural fibers can be made by compressing the raw material or manufacturing them into fibrous materials or composites. The key variables that determine sound absorption performance are the thickness and density of the green material, as well as the presence of an air back cavity. Generally, thicker materials exhibit better sound absorption performance in the low- and mid-frequency range.

M.V. Madurwar, et al. [11] The present paper explores the potential application of agro-waste as the ingredient for alternate sustainable construction materials. Based on the availability of agro-waste materials, sustainable construction materials are evaluated for their physico-mechanical properties, methods of production and environmental impact. The application of agro-waste for sustainable construction materials provides a solution which offers reduction in natural resource use as well as energy.

2.1 CONCLUSIONS DRAWN FROM LITERATURE SURVEY:

The literature survey highlights certain challenges in utilizing agro-waste for noise-absorbing materials. Researchers have identified the need for further optimization of manufacturing processes to enhance the consistency and effectiveness of these materials. Addressing challenges related to material durability, fire resistance, and long-term performance will be crucial for their successful implementation in various applications.

Effectiveness of Agro Waste-Based Noise Absorbing Materials: The literature survey reveals that noise-absorbing materials made from agricultural waste, such as rice husks, coconut fibers, and corn stalks, have demonstrated promising sound absorption properties. These materials exhibit the ability to effectively attenuate sound waves across various frequencies, making them suitable for applications in noise control and acoustic insulation.

Environmental and Economic Advantages of Agro Waste-Based Solutions: The literature survey underscores the significant environmental and economic benefits associated with utilizing agro waste for noise-absorbing materials. Researchers have pointed out that using agricultural waste as a resource not only reduces waste disposal issues but also minimizes the reliance on non-renewable resources used in the production of conventional sound-absorbing materials. Additionally, agro waste-based solutions can offer economic advantages by providing an alternate income stream for farmers, as well as contributing to the development of rural economies through waste-to-product initiatives.

Chapter 4
PROBLEM STATEMENT

Developing High-Performance and Sustainable Noise-Absorbing Materials Using Agricultural Waste: A Quest for Effective Acoustic Insulation and Environmental Impact Reduction.

This problem statement encapsulates the key aspects of the project:

- **Performance:** The focus is on achieving high-performance sound absorption properties.
- **Sustainability:** The project places an emphasis on utilizing sustainable resources (agricultural waste) for material development.
- **Acoustic Insulation:** The goal is to enhance acoustic insulation, which is vital for noise control.
- **Environmental Impact:** The project seeks to reduce the environmental impact by utilizing agricultural waste, contributing to waste reduction and a greener approach.

3.1 OBJECTIVE:

Noise has determined effects on human lives and it is Nuisance to Environment in the current market which is hazardous. Conventionally, expensive sound absorption materials are employed to control noise disturbances. The use of synthetic materials as acoustic absorbers is still applied extensively in the building industry. These non-biodegradable materials not only cause pollution to the environment, but also contribute significantly to increasing Carbon-di-oxide causing the effect of global warming, and are also quite expensive for small needs. The main objective is to find sustainable and eco-friendly materials to be alternative sound absorbers. Natural materials have been receiving considerable attention as substitutes for Synthetic materials. Hence, it is possible to utilize Agro waste Material as a potential candidate for a sound Absorption Panel. The use of renewable materials from a sustainable source is increasing in a variety of applications raising. So, use of Panels which is a combination of natural cellulose fiber with other recourses such as bio-polymers, resins, or binders based on renewable raw materials. It is proposed to develop a comprehensive Acoustic Panel for the absorption of noise levels. It is also envisaged to design the fixture within the building interior space. This cost-effective method will potentially open the door for a wide variety of Agro waste in development of Acoustic Pane

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