

DOMESTIC THERMAL INSULATION WITH SUGARCANE COMPOSITE

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ABSTRACT:

This project aims to utilize waste materials to create a composite material suitable for heat insulation applications, such as rooftops. By combining bagasse (the residue from sugarcane extraction) and waste plastic, we aim to harness the specific properties of composite materials, including high strength-to-weight ratio, low cost, and ease of fabrication. The composite material will be tested under various loading conditions to assess its mechanical and thermal properties, crucial for its application as a thermal insulator in diverse settings like buildings, shelters, and hospitals.

INTRODUCTION:

In this paper domestic thermal insulation with sugarcane composite which mixes the sugarcane waste and waste plastic to prepare a composite material and further the prepared composite material can be used as an

thermal insulation after testing the various loading conditions.

The importance of thermal insulation in homes to embark on our journey of understanding the significance of sugarcane composite in domestic thermal insulation, it is crucial to first grasp the fundamentals of thermal insulation itself. We explore the critical role insulation place in maintaining comfortable indoor temperatures, reducing energy consumption, and enhancing overall building performance. By elucidating the principles of heat transfer and the mechanisms of thermal insulation, readers gain a foundation understanding of the topic.

Exploring the properties of sugarcane composite sheds light on its suitability for domestic thermal insulation applications. From thermal conductivity and moisture resistance to

durability and fire performance, sugarcane composite possesses a diverse range of characteristics that make it an attractive choice for insulation. By comparing these properties to those of traditional insulation materials. Readers gain insight into the unique advantages offered by sugarcane composite. Manufacturing process and environmental impact understanding the manufacturing process of sugarcane composite is integral to assessing its environmental footprint and sustainability credentials. Case studies and real-world examples provide tangible illustrations of successful installations and applications of sugarcane composite material. Economic viability and long-term benefits assessing the economic viability of sugarcane composite insulation involves considering both upfront costs and long-term savings. This topic explores the cost-effectiveness of sugarcane composite compared to traditional insulation materials, taking into account factors such as material cost, insulation expenses, energy savings, and maintenance costs. By conducting a comprehensive cost-benefit analysis, readers gain insights into the financial implications of adopting sugarcane

composite insulation in domestic settings.

KEY WORDS:

Bagasse: Bagasse is the residue left after over sugarcane are crushed to extract their juice. This fibrous residue, often considered waste, holds immense importance and potential beyond its conventional disposal. In this comprehensive exploration, we delve into the multifaceted significance of bagasse, elucidating its pivotal role in sustainable practices, environmental conservation, energy generation, and economic development.



Fig (1) Bagasse

Waste Plastic: Plastic, hailed as a marvel of modern convenience, has now become global predicament. Its proliferation in various forms, particularly in the form of plastic bottles, has led to an unprecedented surge in plastic waste generation. This

surge poses significant environmental challenges, from pollution of land and water bodies to endangering wildlife and ecosystems. Moreover, this the disposal of plastic waste exacerbates the already pressing issue of overflowing landfills and incineration, contributing to green houses gas emissions and climate change.



Fig (2) Plastic bottles

Composite Material:

Composite materials play a crucial role in various industries due to their unique combination of properties, offering several advantages over traditional materials like metals, ceramics, or polymers. Composites materials have emerged as a cornerstone of modern engineering, revolutionizing industries ranging from aerospace and automotive to construction and sports equipment. Composed of two or more distinct materials with complementary properties, composites offer a unique combination of strength, durability,

and versatility. In this comprehensive exploration, we delve into the importance of composite materials, providing a clear and accessible explanation of their fundamental principles, diverse applications, manufacturing processes, advantages, challenges, and future prospects.



Fig (3) Composite Material

Reinforcement:

In domestic thermal insulation using sugarcane composite, reinforcement refers to enhancing the structural integrity and thermal insulation properties of the composite material. In this, the reinforcement is provided by the incorporation of bagasse fibers within the composite matrix, typically composed of waste plastic. The bagasse fibers reinforce the composite, increasing its strength, durability, and ability to resist heat transfer, thereby improving its effectiveness as a

thermal insulator for domestic applications such as rooftops.

Matrix: In domestic thermal insulation with sugarcane composite, the matrix refers to the primary material in which the bagasse fibers are embedded. In this, the matrix is typically composed of waste plastic. The matrix material holds the bagasse fibers together, providing cohesion and structural support to the composite. It also plays a crucial role in determining the overall properties of the composite, such as its flexibility, durability, and resistance to heat transfer.

PROJECT IMPLEMENTATION:

Bagasse Collection: Gather bagasse from you're your local areas.

Washing and Drying: Thoroughly wash the bagasse to remove any residual sugar. Dry it for approximately a day to eliminate the moisture content.

Alkali Treatment: Treat the bagasse with an alkali solution to eliminate the bacteria present in the bagasse.

Fiber Cutting: Cut the alkali treated bagasse into the small fibers using a cutter.

Plastic Melting: Collect waste plastic bottles and melt them in a furnace, maintaining a temperature to keep it in a liquid state.

Layering: Pour a layer of melted plastic into the mold, then add a layer of chopped bagasse fibers on top. Repeat the process, alternating layers of plastic and bagasse fibers to create a sandwich structure.

Compression and Drying: Apply equal pressure throughout the mold to ensure proper mixing of materials. Allow the mixer dry in the mold for several hours until solidified.

Sample Preparation: Create sample specimens for testing the strengths of the composite materials.

Compression and Tensile testing: Compare the results obtained from different specimens to evaluate the composite's performance under various loading conditions.

Thermal Conductivity Testing: Determine the thermal conductivity of a composite material to assess its thermal insulation properties.

TESTS CONDUCTED:

Compressive Test:

A compressive test is a fundamental mechanical test used to determine the

behavior of materials when subjected to compressive loading, where in forces act to squeeze or crush the material. This test is crucial for understanding the compressive strength, stiffness, and deformation characteristics of various materials, including metals, ceramics, concrete, and polymers.



Fig (4) Tested material b/w compression platens



Fig (5) Reading shown in dial gauge

Water Absorption Test:

The water absorption test evaluates how much moisture a material can absorb, providing insights into its durability and moisture resistance for various applications.

Procedure:

Preparation of Sample: Uniform specimens are prepared according to relevant standards, ensuring consistency in size and shape. These specimens are dried to a constant weight before testing to establish a baseline.

Immersion Process: Specimens are immersed in water or subjected to water absorption through methods like spraying or partial immersion. The duration of immersion varies based on material type and applicable standards.

Weighing Before and After: Before immersion, specimens are weighed to determine their initial dry weight. After the specified immersion period, they are removed, briefly drained to eliminate excess surface water, and then weighed again.

Calculation of Absorption: The water absorption percentage is calculated using the formula,

$$\text{Water absorption (\%)} = \left[\frac{(\text{wet weight} - \text{dry weight})}{\text{dry weight}} \right] \times 100.$$

Weight Analysis (After Sunlight Exposure):

Outdoor Setup: The molded composite sample is placed in an area

where they can receive direct sunlight exposure.

Monitoring Period: The composite sample is left exposed to sunlight for a specified duration, depending on the experimental design. During this time the sample is periodically checked to assess any changes in weight or appearance.

Weighing Process: At regular intervals, the composite sample is removed from the outdoor exposure area and weighed using a precision scale. Any changes in weight are recorded and compared to the initial weight of the sample before sunlight exposure.

Data Analysis: The recorded weight measurements are analyzed to determine the extent of weight loss or gain in the composite material due to sunlight exposure.

Thermal Conductivity Testing:

Thermal conductivity testing is a method used to measure the ability of a material to conduct heat. This property is essential in understanding heat transfer characteristics and is crucial in various industries, including construction, electronics, and manufacturing. The test involves subjecting a sample of the material to

controlled heat flow conditions and measuring the resulting temperature difference across the sample. There are several methods for conducting the thermal conductivity tests, including steady-state and transient techniques.

In steady-state methods, a constant heat flux is applied to one side of the material, and the temperature difference between the two sides is measured when the system reaches a stable state. Examples of steady-state methods include the guarded hot plate method and the heat flow method.

FINAL PRODUCTS:



Fig (6) Cube type composite material



Fig (7) Flat type composite material

COMPARISON BETWEEN INSULATING MATERIALS:

| WOOD | COMPOSITE MATERIAL |
|--|--|
| 1. These are dimensionally unstable | 1. These are dimensionally stable |
| 2. Maintenance cost is high | 2. Maintenance cost is initially low |
| 3. Compressive strength = 30-60 MPa | 3. Compressive strength = 2.45 MPa |
| 4. Thermal conductivity = 0.1-0.2W/m-K | 4. Thermal conductivity= 0.002622W/m-K |

| FIBRE GLASS | ASBESTOS |
|-------------------------------------|-------------------------------------|
| 1. Thermal conductivity = 0.36W/m-K | 1. Thermal conductivity = 0.08W/m-K |
| 2. Moisture content = 2.5-3.5 % | 2. Moisture content = < 30 % |
| 3. Compressive strength = 72 MPa | 3. Compressive strength = 59.2 MPa |
| 4. Light in weight | 4. Heavy in weight |

ADVANTAGES:

- Renewable material
- Insulation properties
- Environmentally friendly
- Low cost
- Non-toxic
- Light in weight
- Easy to install
- Good thermal performance

- Moisture resistance and durability
- Acoustic insulation
- Versatility and adaptability
- Soundproofing purpose
- House hold purposes
- Industries
- Appliance insulation
- Door and the window insulation

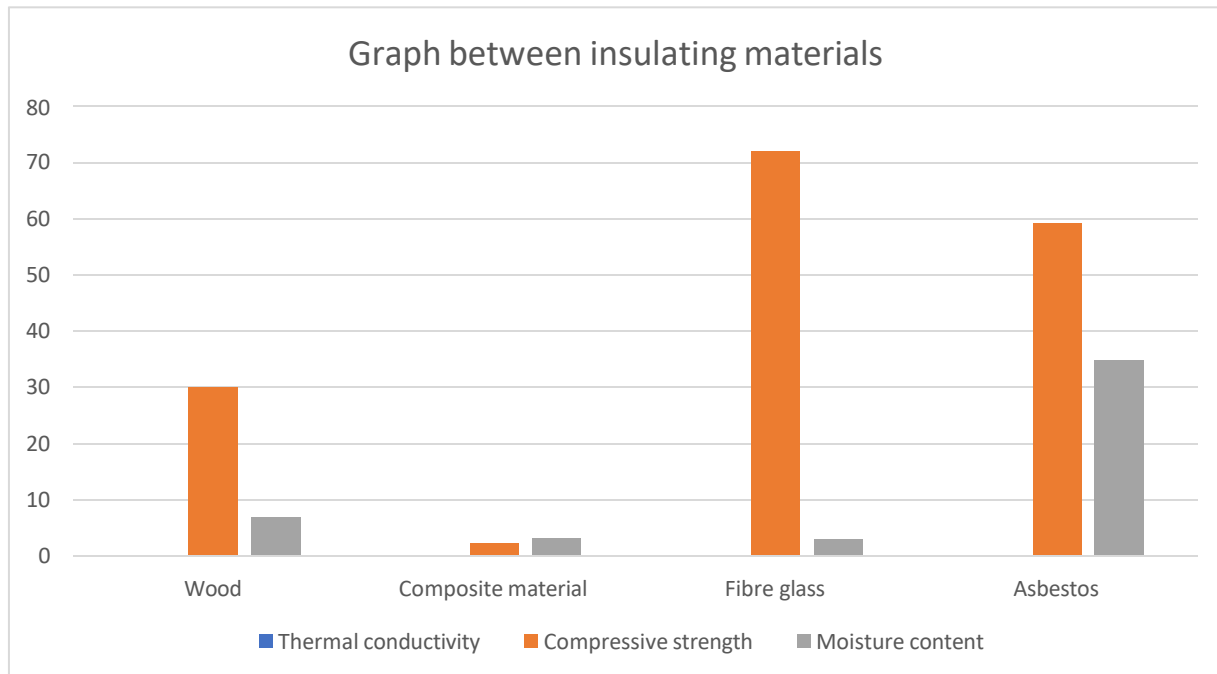
APPLICATIONS:

- Roof insulation
- Wall and floor insulation
- Pipe insulation

RESULTS:

| S.NO | NAME OF THE TEST | RESULT |
|-------------|---|---------------|
| 1. | Compressive strength | 2.45 MPa |
| 2. | Water absorption test | 3.27 % |
| 3. | Weight analysis (After sunlight exposure) | 5 gm |
| 4. | Thermal conductivity | 0.002622W/m-K |

GRAPH:



CONCLUSION:

In conclusion, domestic thermal insulation using sugarcane composite materials offers a sustainable solution to enhance energy efficiency and indoor comfort. By leveraging the natural insulating properties of sugarcane fibers, this approach effectively reduces heat transfer, thereby regulating indoor temperatures and decreasing reliance on heating and cooling systems. The utilization of sugarcane as a renewable resource

aligns with environmental sustainability goals, minimizing carbon emissions and promoting resource conservation. Additionally, the production process of sugarcane composites typically involves low energy consumption and emits fewer pollutants compared to conventional insulation materials, further enhancing its eco-friendliness. Overall, adopting sugarcane-based insulation contributes to creating more energy-efficient homes while mitigating the environmental impact of construction

activities. This innovative approach holds promise for fostering greener, more sustainable communities while simultaneously addressing the pressing challenges of climate change and energy conservation.

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