DEVELOPMENT OF HYBRID COMPOSITE BY USING COIR, KENAF AND GLASS FOR THERMAL INSULATION

P. Chandrasekaran[1], C. Gokularajan[2], P. Adarsh[3], S. Pratheep[4]

Assistant Professor - II, Department of Textile Technology, Kumaraguru College of Technology, Tamil Nadu, India[1]

Final Year B. Tech Textile Technology, Kumaraguru College of Technology, Tamil Nadu, India[2]

Final Year B. Tech Textile Technology, Kumaraguru College of Technology, Tamil Nadu, India[3]

Final Year B. Tech Textile Technology, Kumaraguru College of Technology, Tamil Nadu, India[4]

ABSTRACT

This study focuses on the development of a hybrid composite using coir, kenaf, and glass fibre for thermal insulation applications. Natural fibres like coir and kenaf are increasingly gaining attention due to their sustainability, low cost, and eco-friendly properties, while glass fibre adds strength and durability. The hybrid composite developed in this research aims to combine the thermal insulating properties of coir and kenaf with the mechanical robustness of glass fibre. Various proportions of these fibres were tested to optimize the balance between thermal insulation efficiency, mechanical strength, and cost-effectiveness. The thermal conductivity and mechanical performance of the hybrid composites were measured and compared with traditional insulation materials. Preliminary results indicate that the hybrid composite shows promise as an alternative material for insulation in building construction, particularly as a sustainable option for roofing. The findings of this research could contribute to the development of greener and more efficient construction materials.

Keywords: *Hybrid Composite, Thermal Insulation, Coir Fiber, Kenaf Fiber, Glass Fiber Mat.*

1.INTRODUCTION

The demand for sustainable and eco-friendly materials in construction has led to increased interest in natural fibres for thermal insulation. Traditional insulation materials, while effective, often have significant environmental drawbacks. In contrast, natural fibres like coir, derived from coconut husk, and kenaf, a fast-growing plant fibre, are renewable, biodegradable, and offer excellent thermal insulation properties. However, their mechanical strength is limited for structural applications. To overcome this, the use of glass fibre, known for its high strength and durability, in combination with these natural fibres, can create a hybrid composite that provides both effective insulation and the necessary structural integrity for construction. This study focuses on developing and characterizing a hybrid composite made from coir, kenaf, and glass fibre, specifically for roofing material with enhanced thermal insulation and mechanical properties, offering a sustainable alternative to conventional materials.

1.1 Advantages of composite

1. Sustainable: Made from renewable, biodegradable natural fibres (coir and kenaf).

2. Good Thermal Insulation: Coir and kenaf offer excellent natural insulation properties.
3. Enhanced Strength: Glass fibre improves mechanical strength and durability.
4. Cost-Effective: Natural fibres are low-cost and locally available.
5. Moisture Resistant: Coir provides resistance to moisture, improving performance.
6. Energy-Efficient: Producing natural fibre composites consumes less energy than synthetic alternatives.

2.METHODOLOGY

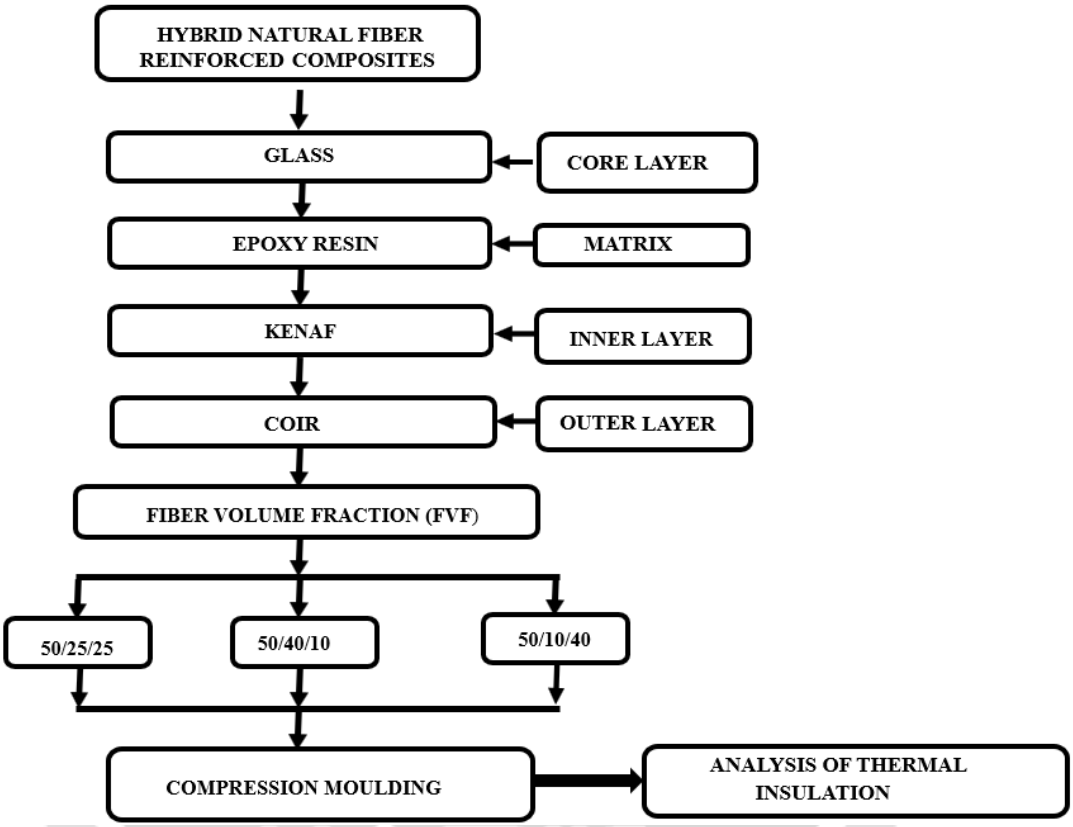

Fig:1 Methodology

3.SAMPLE PREPARATION

Parameters required:

- Temperature –room temp
- Time -5,10 and 15 min
- Pressure -10,20,30 kg/cm²

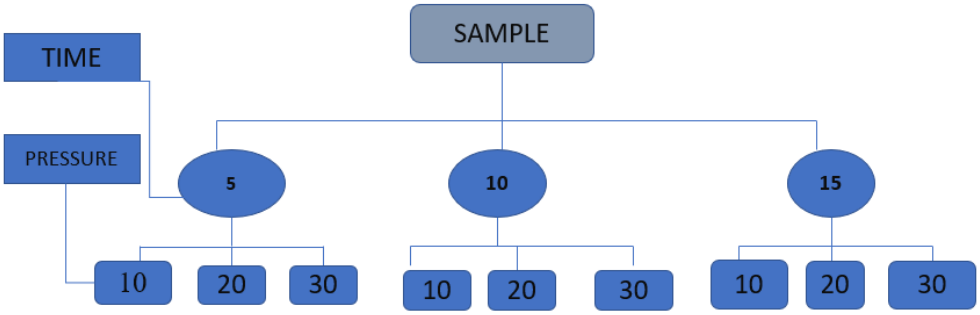

Fig 2: sample Preparation

4.MATERIALS

* Composite 1 : 50% Glass and 25% coir and 25% kenaf
* Composite 2 : 50% Glass and 10% coir and 40% kenaf
* Composite 3 : 50% Glass and 40% coir and 10% kenaf
* Resin : Epoxy resins

5.PURPOSE AND FABRICATION PROCESS OF THE NON-WOVEN MAT

The use of a non-woven structure made from coir and kenaf fibers plays a crucial role in achieving evenness within the composite, enhancing both its thermal insulation and mechanical stability. This non-woven layer ensures a consistent distribution of fibers, which is vital for effective bonding with the glass fiber core, thus supporting the structural integrity required for roofing applications. The non-woven fabrication process employing techniques such as needle punching minimizes gaps and creates a uniform layer, which helps improve heat distribution and insulation. Additionally, this structure offers advantages over woven alternatives by maintaining resilience against environmental stress while providing the lightweight, eco-friendly benefits associated with natural fibers. The non-woven layer, therefore, is integral to the composite's overall performance, aligning with the project's goal of developing a sustainable, effective material for thermal insulation.

6.FABRICATION OF COMPOSITE

The fabrication of the hybrid composite is carried out using a compression molding technique. First, the core layer of glass fibre, the inner layer of kenaf, and the outer layer of coir are prepared by cleaning, drying, and cutting them to the required dimensions. A polymer resin, typically epoxy, is selected to bond these layers. The layers are arranged in a mold with glass fibre as the core, followed by kenaf and coir on the outermost surface. The resin is applied to the layers, ensuring uniform impregnation. The composite is then subjected to compression molding, where heat and pressure are applied to cure and compact the material. After curing, the composite is removed from the mold, trimmed, and finished for use as a thermally insulating and mechanically strong material, particularly suited for roofing applications.

7.DESIGN OF ROOFING COMPOSITE

For designing the composite roofing material, an existing standard roofing panel is used as the mold reference. The dimensions of the composite roofing panel are assumed to be the same as those of conventional roofing materials to ensure compatibility in real-world applications.

8.CONCLUSION

This research successfully demonstrates the development of a hybrid composite using coir, kenaf, and glass fiber mat for thermal insulation, specifically designed for roofing applications. The combination of natural fibers (coir and kenaf) with glass fiber results in a material that not only offers excellent thermal insulation but also possesses enhanced mechanical strength, making it suitable for structural applications in construction. The use of compression molding ensures uniformity, proper bonding, and optimal performance of the composite. This study highlights the potential of natural fiber composites as sustainable alternatives to conventional materials, contributing to greener construction practices. With further optimization, this hybrid composite could play a significant role in energy-efficient and environmentally friendly building solutions.

9.SCOPE OF FUTURE WORK

By modifying the design and dimensions of the composite roofing panel, further analysis can be conducted using simulation tools like ANSYS to enhance thermal insulation efficiency and mechanical strength. Practical testing under various environmental conditions, such as extreme heat, humidity, and wind, can be performed to evaluate the roofing material's real-world performance. Additionally, different combinations of natural fibers and matrix materials can be compared to identify the most effective composite for both thermal and structural applications. Future work could also explore the incorporation of fire-retardant properties and UV protection to improve the material’s safety and durability in construction.

10.REFERENCES

[1]. Mustafa A. Altememy, Mohammed W. Muhieldeen Al-Gailani1, Lih J. Yu1, Cik S. Hassan1, Hussein A. Jaber Development and Characterisation Of Thermal Properties Of Hybrid Composites From Palm Fiber And Glass Wool Reinforced Unsaturated Polyester.

[2]. Somen Biswal, Alok Satapathy.Processing and Characterization of Epoxy Composites Reinforced with Short Palmyra Fibers

[3]. Gurushanth B Vaggar a, S.C. Kamate b, Pramod V. Badyankal a. Characterization of thermal conductivity enhancement of silicon carbide filler glass fiber epoxy resin hybrid composites.

[4]. C. Pavithran, P.S. Mukherjee and M. Brahmakumar Coir-Glass Intermingled Fibre Hybrid Composites

[5]. S. Dubois, F. Lebeau. Design, construction and validation of a guarded hot plate apparatus for thermal conductivity measurement of high thickness crop-based specimens

[6]HamidKaddami, Fatima-ezzahraArrakhiz,OumaimaHafs,ahaELssimi,LamiaBoulafrouh,El-Houssaine Ablouh , Mohamed Mansori,HichamBanouni,SaidBouzit,FouadErchiqui,and Khalid Benmoussa.Implementation and Characterization of Laminate Hybrid Composite Based on Palm Tree and Glass Fibers.

[7]. Rosana Vilarim da Silva, Hiury Voltz, Andre Itman Filho, Mariana Xavier Milagre and Caruline de Souza Carvalho Machado. Hybrid composites with glass fiber and natural fibers of sisal, coir, and luffa sponge.

[8]. Shaofeng Ru, Can Zhao, Songmei Yang and Dong Liang. Effect of Coir Fiber Surface Treatment on Interfacial Properties of Reinforced Epoxy Resin Composites

[9]. Piyush Prajapati, Chaitanya Sharma Rahul shrivastava, R S Rana. Research Of Mechanical Properties of Coir and Glass Fiber Hybrid Composites.

[10]. Tamer Hamouda, Ahmed H. Hassanin, Ali Kilic, Zeki Candan, Mehmet Safa Bodur. Hybrid Composites from Coir Fibers Reinforced with Woven Glass Fabrics: Physical and Mechanical Characters.

[11]. Rahul Shrivastavaa, Amit Telangb, R. S Ranac and Rajesh Purohitd. Study on Mechanical Properties of Coir/ G Lass Fiber Hybrid Composite.
.
[12]. Mohit Mittal, Rajiv Chaudhary.Study of PALF/Glass and COIR/Glass Fiber reinforced Hybrid Composites.