Investigation and Analysis of Fibre Reinforced Matrix Through Natural Technology

Mr. K. Ramadurai
Assistant Professor, Department of Mechanical Engineering, Parisutham Institute of Technology and Science, Thanjavur, India

Mr. K. Sanjay raj
UG Student, Department of Mechanical Engineering, Parisutham Institute of Technology and Science, Thanjavur, India

Mr. S. Jayasurya
UG Student, Department of Mechanical Engineering, Parisutham Institute of Technology and Science, Thanjavur, India

ABSTRACT

Natural fiber reinforced composites (NFRC) represent a promising class of materials that intertwines environmental sustainability with engineering excellence.This study exploresthe integration of natural fibers, sourced from plants and animals, into polymer matrices to develop composites with enhanced mechanical properties and reduced environmental impact. The key focus lies in understanding the potential applications, processing techniques, and the challenges associated with the adoption of NFRC.Natural fibers, such as jute, flax, hemp, and sisal, offer renewable and lightweight alternatives to traditional reinforcing materials. Their incorporation into polymer matrices, including thermoplastics and thermosetting resins, results in composites that exhibit good specific strength and stiffness. Moreover, the biodegradability of natural fibers contributes to the overall eco-friendly profile of these composites.While NFRC presents notable advantages, challenges such as moisture absorption and inherent variability in fiber properties require careful consideration. Researchers are actively engaged in developing surface treatments and processing methods to overcome these challenges and further improve the overall performance and reliability of NFRC.The applications of NFRC span across industries, including automotive, construction, packaging, and consumer goods. Components such as interior panels, automotive parts, and packaging materials benefit from the lightweight and sustainable characteristics of these composites.

Keywords : Fibre, NFRC, Hardness and Tensile

1. INTRODUCTION

In recent years, the pursuit of sustainable materials and technologies has gained significant momentum across various industries. Among these, the development and utilization of fiber-reinforced matrices through natural technology have emerged as promising avenues. This innovative approach integrates the inherent strength and eco-friendly properties of natural fibers with advanced matrix materials, offering a sustainable alternative to conventional composite materials. The investigation and analysis of fiber-reinforced matrices through natural technology entail a multidisciplinary approach encompassing materials science, engineering, chemistry, and environmental studies. Researchers and industry experts are delving into various aspects, including fiber extraction techniques, matrix formulation, composite fabrication methods, mechanical properties characterization, durability assessment, and life cycle analysis.Key challenges in this domain revolve around optimizing the compatibility between natural fibers and matrices, enhancing the mechanical performance, mitigating environmental degradation, and ensuring scalability and cost-effectiveness. Additionally, understanding the fundamental mechanisms governing the interaction between fibers and matrices is crucial for tailoring composite properties to specific applications.This paper aims to provide an in-depth exploration of the investigation and analysis of fiber-reinforced matrices through natural technology. Through comprehensive literature review, case studies, and experimental findings, we seek to elucidate the current state-of-the-art, identify research gaps, and propose future directions in this rapidly evolving field. Ultimately, the integration of natural technology in fiber-reinforced matrices promises to revolutionize the landscape of composite materials, offering greener, more resilient, and economically viable solutions for diverse applications in the 21st century and beyond.

2. LITERATURE SURVEY

Investigation of mechanical behaviour of reinforced sisal epoxy hybrid composite: Several studies have highlighted the it has high moisture absorption and limited temperature resistance which cause damage to fibre and reduce strength of composite material(Yuvaraj.,2021).These studies emphasize the hybridization of natural fibre.

Investigating the Mechanical and Physical Enhancements of Silk-sisal Hybrid Composites : Silk fibre is majorly used in this composite material and it will not easily non biodegradable and it will also increase the production cost of silk(Sripriyan.,2019).So we will go relplacement of silk fibre by banana fibre.

The use of coir/coconut fibers in composites: The coconut fibre only used in the composite material and will have low adhesion and it reduced mechanical properties of material(Deepak varma.,2022).The problem can be solved by adding glass fibre with coconut fibre.

Mechanical Properties of Epoxy Reinforced Glassfiber and CoconutFiber: Differential moisture absorption rates Causing dimensional change (Ravi kumar .,2019). By adding moisture resistan additives.

3.PROBLEM DEFINITION

1. **Moisture Sensitivity:**
   - Many natural fibers, such as jute, hemp, and flax, have a tendency to absorb moisture. This can lead to dimensional changes, reduced mechanical properties, and potential degradation of the composite material.
2. **Variability in Fiber Properties:**
   - Natural fibers can exhibit variations in properties such as length, diameter, and surface characteristics. This variability poses challenges in obtaining consistent material properties in the composite, impacting reproducibility and reliability.
3. **Adhesion and Compatibility:**
   - Achieving strong adhesion between natural fibers and the matrix material (polymer or resin) can be challenging. The compatibility between the fibers and the matrix is crucial for optimizing mechanical properties.
4. **Limited Temperature Resistance:**
   - Natural fibers may have limitations in terms of temperature resistance. This can restrict their use in applications where exposure to high temperatures is a concern.
5. **Biodegradability vs. Durability:**
   - While the biodegradability of natural fibers is an eco-friendly feature, it may pose a challenge in applications that require long-term durability and resistance to environmental factor
6. **Lack of Standardization:**
   - There is a lack of standardized testing methods and industry standards for natural composites. This makes it challenging to compare and evaluate materials consistently across different studies and applications.
7. **Cost and Economic Viability:**
   - In some cases, the cost of natural fibers or the processing methods for natural composites may be higher compared to traditional materials. This can impact the economic viability of using natural composites in certain applications.

4. EXISTING METHOD

1. **Raw Material Selection:**
   - Choose natural fibers based on the specific application and requirements. Common natural fibers include jute, flax, hemp, sisal, bamboo, and kenaf.
2. **Fiber Processing:**
   - Clean and treat the natural fibers to remove impurities, waxes, and other contaminants.
   - Optionally, perform surface treatments on the fibers to enhance adhesion with the polymer matrix. Alkali treatment or silane coupling agents are commonly used.
3. **Matrix Material Selection:**
   - Select a suitable polymer matrix, typically a thermoplastic (e.g., polypropylene, polyethylene) or a thermosetting resin (e.g., epoxy, polyester), based on the desired properties of the composite.
4. **Fiber Impregnation:**
   - Mix the natural fibers with the polymer matrix material. This can be done using various methods, such as melt blending for thermoplastics or liquid resin impregnation for thermosetting resins.
5. **Molding and Shaping:**
   - Arrange the impregnated fibers in the desired orientation or layup to achieve the desired mechanical properties in the final composite.
   - Mold the composite material into the desired shape using methods such as compression molding, injection molding, or extrusion.
6. **Curing (for Thermosetting Matrices):**
   - Subject the composite material to a curing process, typically involving heat and sometimes pressure. This allows the polymer matrix to solidify and create a strong bond with the natural fibers.
7. **Cooling and Solidification:**
   - Allow the composite to cool and solidify in the molded shape. This step is crucial for the final formation of the composite structure.
8. **Cutting and Finishing:**
   - After solidification, the composite material can be cut, machined, or finished according to the specific requirements of the application.

5. PROPOSED METHOD

1. **Advanced Fiber Treatment:**
   - Explore novel surface treatments or modifications for natural fibers to improve their compatibility with the polymer matrix, enhance adhesion, and reduce moisture sensitivity.
2. **Hybridization with Nanomaterials:**
   - Investigate the incorporation of nanomaterials, such as nanoparticles or nanoclays, to reinforce both the natural fibers and the polymer matrix. This can improve overall mechanical properties and enhance the structural integrity of the composite.
3. **Smart Coatings or Functional Additives:**
   - Introduce smart coatings or functional additives that can impart additional properties to the composite material, such as self-healing capabilities, enhanced flame resistance, or improved UV stability.
4. **Bio-Based and Sustainable Matrices:**
   - Explore the use of bio-based or sustainable polymer matrices derived from renewable resources. This can contribute to the overall sustainability of the composite material.
5. **Innovative Molding Techniques:**
   - Investigate advanced molding techniques, such as 3D printing or continuous fiber reinforcement, to achieve complex shapes and optimize fiber alignment within the composite structure.

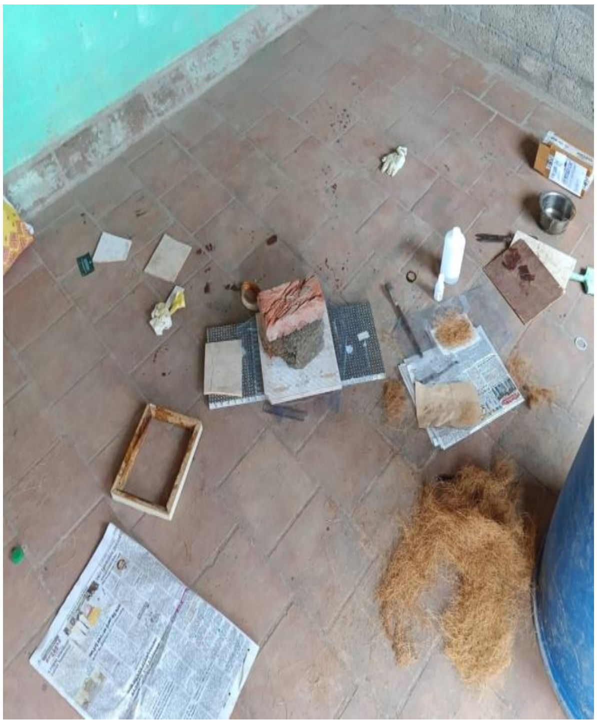
6. MATERIALS USED

- Coconut fibre
- Banana fibre
- Fibre glass
- Epoxy resin
- Polyester hardner

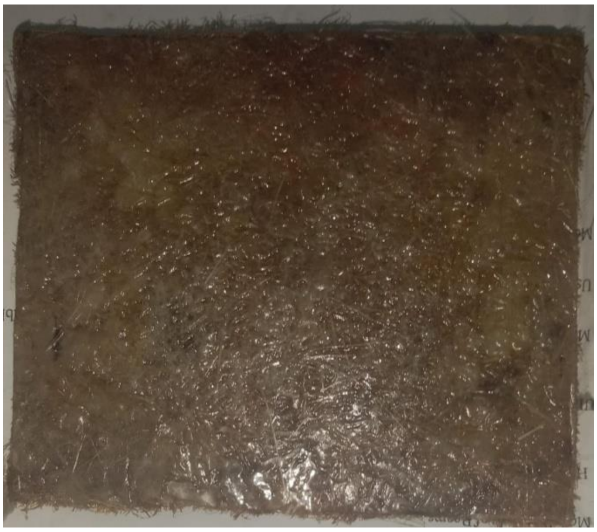
7. METHODOLOGY

Selection and purchasing of material
↓
Natural fibre mat preparation
↓
Preparation of mould
↓
Epoxy resin preparation with mixing ratio
↓
Layer arrangement of fibre mats
↓
Fabrication of composite material

8. FABRICATION OF COMPOSITE MATERIAL



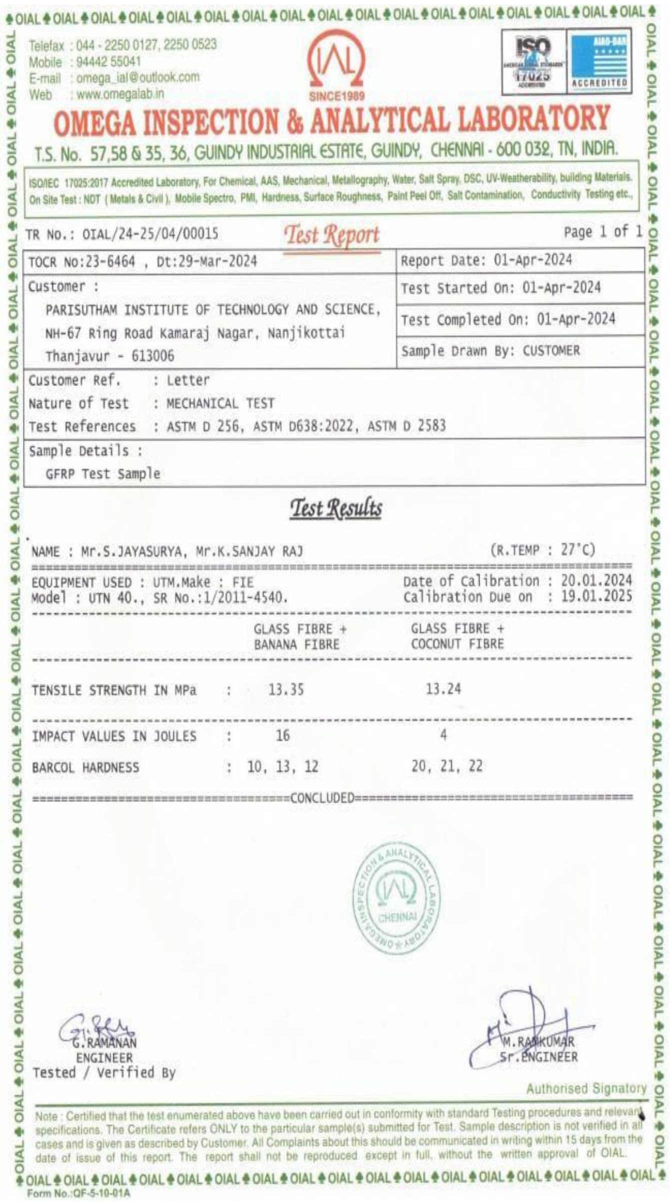
Coir and Glass Fibre



Banana and Glass Fibre

9. REPORT OF TEST

- ❖ Tensile test
- ❖ Impact test
- ❖ Hardnes test



Telefax : 044 - 2250 0127, 2250 0523
Mobile : 94442 55041
E-mail : omega_ial@outlook.com
Web : www.omegalab.in

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TR No.: OIAL/24-25/04/00015 — Test Report — Page 1 of 1

TOCR No:23-6464 , Dt:29-Mar-2024	Report Date: 01-Apr-2024
Customer : PARISUTHAM INSTITUTE OF TECHNOLOGY AND SCIENCE, NH-67 Ring Road Kamaraj Nagar, Nanjikottai Thanjavur - 613006	Test Started On: 01-Apr-2024 Test Completed On: 01-Apr-2024 Sample Drawn By: CUSTOMER

Customer Ref. : Letter
Nature of Test : MECHANICAL TEST
Test References : ASTM D 256, ASTM D638:2022, ASTM D 2583

Sample Details :
GFRP Test Sample

Test Results

NAME : Mr.S.JAYASURYA, Mr.K.SANJAY RAJ (R.TEMP : 27'C)

EQUIPMENT USED : UTM.Make : FIE
Model : UTN 40., SR No.:1/2011-4540.
Date of Calibration : 20.01.2024
Calibration Due on : 19.01.2025

	GLASS FIBRE + BANANA FIBRE	GLASS FIBRE + COCONUT FIBRE
TENSILE STRENGTH IN MPa	13.35	13.24
IMPACT VALUES IN JOULES	16	4
BARCOL HARDNESS	10, 13, 12	20, 21, 22

=====CONCLUDED=====

G.RAMANAN
ENGINEER
Tested / Verified By

M.RAMKUMAR
Sr.ENGINEER
Authorised Signatory

Note : Certified that the test enumerated above have been carried out in conformity with standard Testing procedures and relevant specifications. The Certificate refers ONLY to the particular sample(s) submitted for Test. Sample description is not verified in all cases and is given as described by Customer. All Complaints about this should be communicated in writing within 15 days from the date of issue of this report. The report shall not be reproduced except in full, without the written approval of OIAL.

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10. CONCLUSION

From our research we concluded Glass fibre reinforced with banana fibre will give good impact strength and Tensile Strength. Glass fibre reinforced with Coconut fibre will give good Hardness properties due to good bonding in nature.

11. ACKNOWLEDGEMENT

We would like to express our sincere gratitude to all those who contributed to the investigation and analysis of fiber-reinforced matrix through natural technology. First and foremost, we extend our appreciation to our research team for their dedication, expertise, and collaborative efforts throughout this project. Their commitment to excellence has been instrumental in the successful completion of this endeavor.

12. REFERENCE

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