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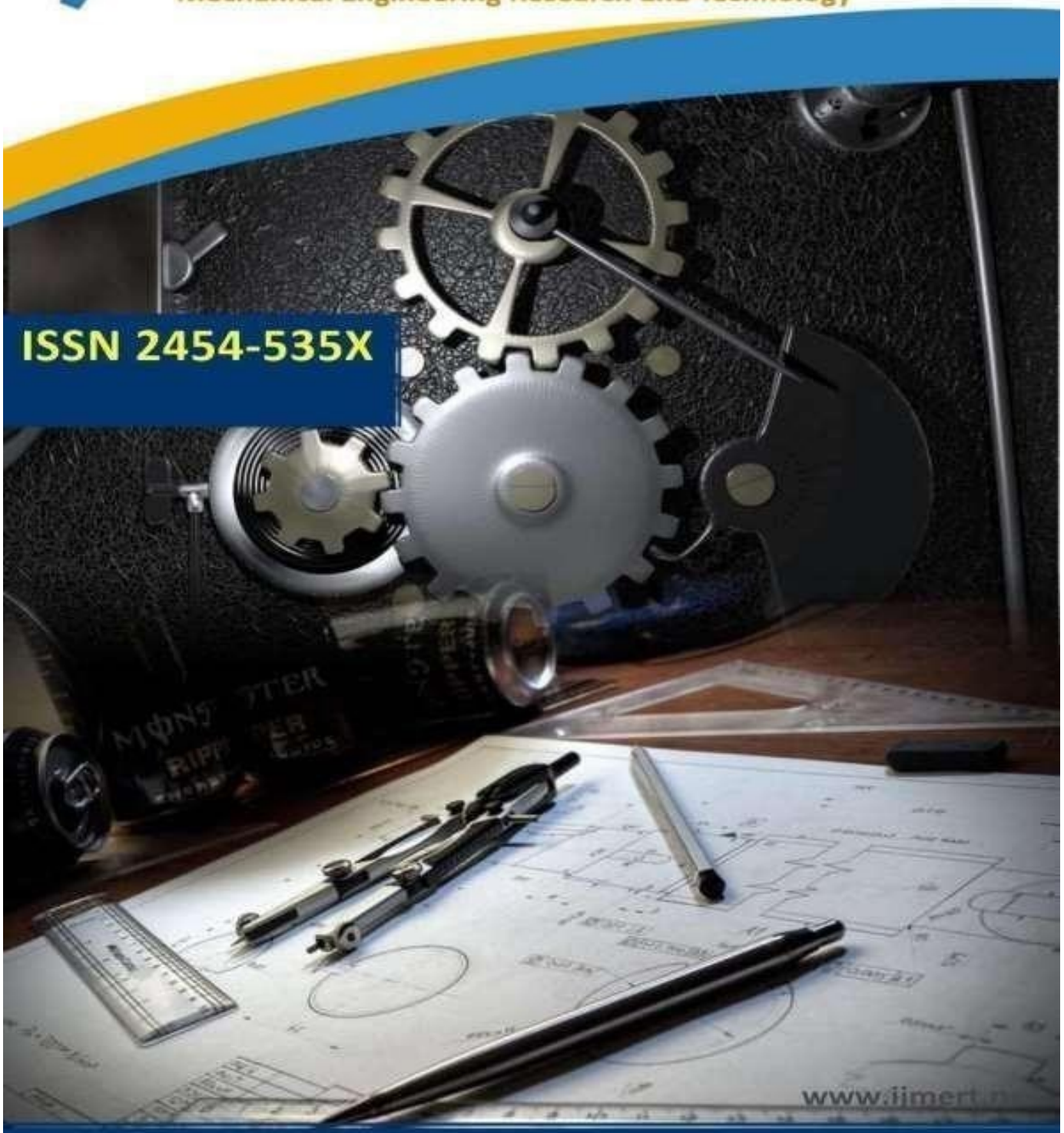

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# MECHANICAL PROPERTIES & APPLICATIONS OF NATURAL FIBRE-BASED COMPOSITE MATERIALS

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**ABSTRACT**

The majority of the research focuses on characterizing natural fibers and comparing their mechanical behavior and application performance to that of traditional composites. A wide variety of natural fibres exist, each with its own set of characteristics that determine which commercial uses for each are most appropriate. Because these materials are naturally occurring, their characteristics may vary greatly depending on the harvesting site and other factors; this makes it challenging to choose the best fiber for a given task. This study presents a thorough evaluation of the characteristics of natural fibers used to reinforcing composite materials in an effort to chart the relative positions of the various fiber types with respect to a number of attributes. Also included is the most recent research on emerging fiber kinds. Here we provide the results of a bibliometric analysis of papers on the use of composites made of natural fibers. There is also a discussion and presentation of a prospective analysis of the tendencies in the future of natural fiber applications and the necessary advances to expand their uses.

Green composites made of natural fibers have many potential uses in the automotive and industrial sectors.

## 1. Introduction

### 1.1 Composite Materials:

A composite material can be defined as a combination of two or more materials that results in better properties than those of the individual components used alone. The two constituents of a composite are a reinforcement and a matrix.

### 1.2 Matrix:

The continuous phase is the matrix, made of polymer, metal, or ceramic.

### 1.3 Reinforcement:

A strong, inert, woven and nonwoven fibrous material is incorporated into the matrix to improve its mechanical and physical properties. For example, fibres, whiskers, particulate etc.

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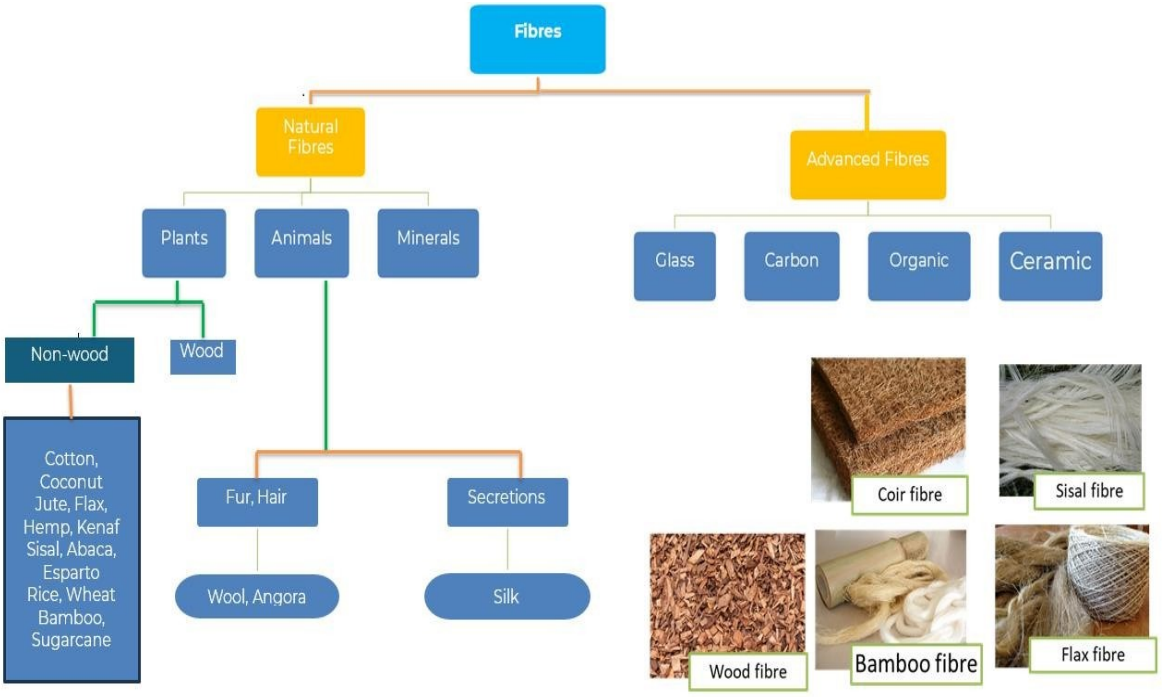


## 2. Properties of Natural Fibre-based Composite Materials

### 2.1 Mechanical Properties:

- Mechanical efficiency depends upon the interface provided by the fibre matrix along with the stress transfer function in which stress is transferred to fibre from the matrix. Stiffness and stress transfer in composites increases with an increased or excessive addition of fibre. The fracture behaviour of composites is also affected due to the nonlinear mechanical behaviour of natural fibres. To develop composites with good mechanical properties, chemical modification of fibre is carried out to reduce the hydrophilic behaviour of fibres and the absorption of moisture.

  **Flame Retardant Properties:** Natural fibres and polymers are organic materials and are very sensitive to alter any features if flame is introduced to them. Flame retardancy is a safety aspect to counter this.

- **Biodegradability:** At high temperatures, natural fibres start degrading whereas constituents of fibre may start decomposing at earlier temperatures. The thermal stability can be improved if the concentration levels or the structural constituents are completely removed by chemical treatments. Natural fibres have a short lifetime with minimum environmental damage degradation whereas synthetic ones affect environment dueupon to pollution caused by degradation.

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- **Energy Absorptions:** High strength, energy absorption, and stiffness are obtained by composite materials which are widely used in automotive and motorsport sectors of industry mainly due to the property of mass reduction. Enhanced energy absorption is evident from the increased volume fraction that is only possible in the presence of low speed. On the other hand, at high speeds, similar performance is shown by flax, jute, and hemp.
- **Water Absorbent Properties:** The main weakness of the application of natural fibres is their susceptibility to moisture. The natural fibres are rich of components which are hydrophilic sources and strong polar while the polymers show hydrophobicity. These can cause warping, buckling, bigger possibility of their microbial inhabitation, freeze, and unfreeze caused destruction of mechanical characteristics of composite materials. The effect of coupling agent such as maleic anhydride polyethylene and chemical treatments such as bleaching, acetylation, and alkali treatment reduces moisture absorption of natura fibre-based composites.
- **Thermal Properties:** Enzymatic treatment for many natural fibres such as flax and hemp often can lead to improvement in surface and thermal properties.

## 3. Industrial Applications of Natural Fibre

### 3.1 based Composite Materials:

- AUTOMOTIVE INDUSTRY
- NAUTICAL INDUSTRY
- BIOMEDICAL INDUSTRY
- OTHER APPLICATIONS

## 4. AUTOMOTIVE INDUSTRY:

- The automotive industry has developed various new components based on natural fibre composites. Non-structural or semi-structural components are realized mainly by using polyester resin or thermoplastic polymers and lignocellulosic fibres (i.e., flax, hemp, sisal and jute). Bast fibre composites are predominantly used in automotive interior panels, such as doors, pillars, trim, trunk liners and package or real parcel trays.Flax or

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sisal material can be moulded in complicated 3D shapes, thus making it more suitable for door trim panels than previously used materials.

**Natural Fibre Based Composites in Mercedes C class**

**Natural Fibre-based Composites in Mercedes C Class**

## 5. BIOMEDICAL INDUSTRY

- The most important requirements for use in medical industry are biocompatibility and absence of adverse effect to the host tissues. The traditional structures began to be substituted by bio-engineered composites, consisting of biodegradable polymer as matrix and usually bio-fibres as reinforcing elements which have generally low cost, low density, high toughness, acceptable specific strength properties, good thermal properties, ease of separation, enhanced energy recovery and biodegradability.
- Silk fibre has been used in biomedical applications such as sutures by which the silk fibroin fibre is usually coated with waxes or silicone to enhance material properties and reduce fraying.

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- Chicken feather fibre (CFF) has attracted much attention to different product design and engineering industries.

## 6. NAUTICAL INDUSTRY:

• Bio-composites are an excellent substitute for thermoset composites reinforced with glass fibers, especially in maritime applications, since they are completely biodegradable. Due to their hydrophilic character, the primary drawback that restricts their usage in this sector is their limited durability in a saltwater environment. • Bamboo, being a natural material, has great promise for composites as a replacement for solid wood in structural applications, including marine ones. Surfboards, rudders, and narrow keels are just a few examples of nautical components that might benefit from flax fiber reinforcement.

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## 7. OTHER APPLICATIONS:

- **Printed Circuit Boards (PCBs):** Due to their total biodegradability, natural fibres represent an optimal alternative to materials currently used in PCBs (fiberglass and brominated flame retardants) as both of them will reduce health risks during manufacturing and at the end of their useful life. Research of bio-epoxy-flax PCB composite design gave acceptable results for thermal, mechanical and electrical properties with the exception of wet conditioning which can be improved by treating the flax fibres with sodium hydroxide and octadecyl trichlorosilane.
- **Packing Industry:** Another possible application of bio-composites regards the packing industry. Most plastic products are discarded after single use. Coconut or coir fibre can be used for packaging applications.

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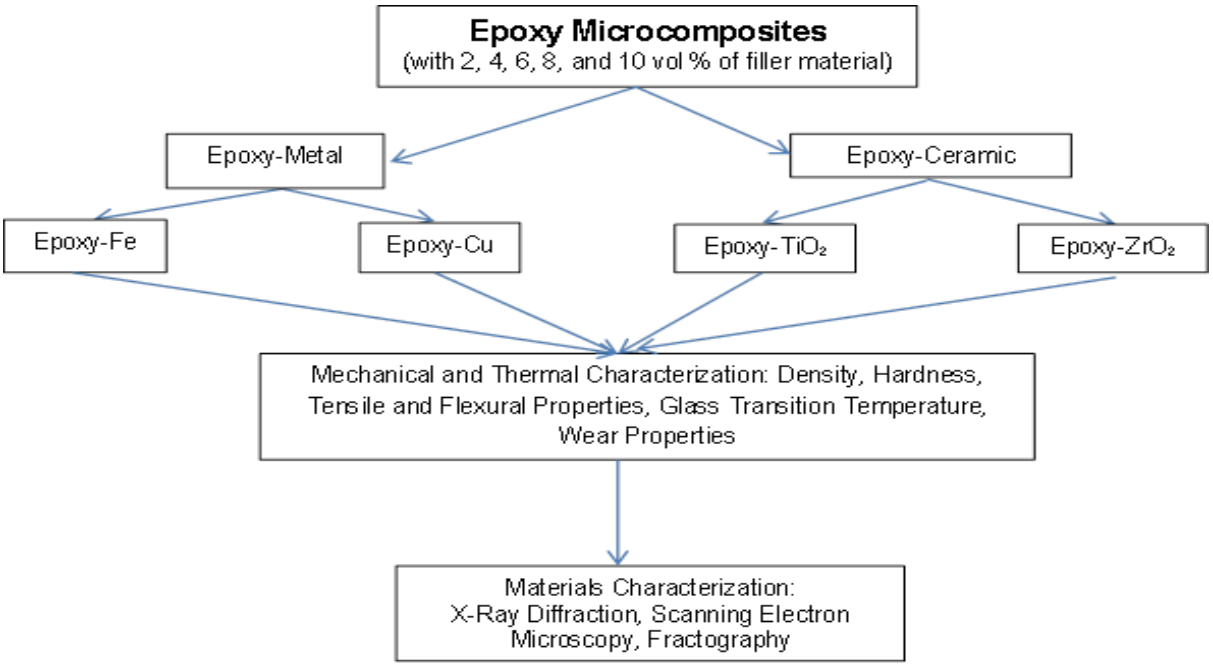
**Plan of work**

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