

Natural fiber reinforced composites for semi-structural applications: A sustainable approach

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Abstract

The Scientific Community is seeking eco-friendly options in synthetic material for future development. Uses of natural fibers within a polymeric matrix as a reinforcing phase makes a significant contribution to the composites. A number of plant-based fibers such as Jute, Bagasse, Bamboo, Banana, Pineapple, wheat straw, and so on, are available quite often and have several advantages over their synthetic counterparts they include lightweight, renewable resources, and are relatively cheaper. Furthermore, India being an agricultural country has plenty of crop waste and if value addition is made to this waste for the development of polymer composites it will help to reduce waste and even give a boost to the rural economy. Modern characterization techniques are well described for the assessment of the properties of these new materials. There is a huge number of uses of these new materials mainly in applications that are semi-structural in nature. This article provides an overview of recent advances in this area of study.

Keyword: Natural fiber, polymer, semi-structural, renewable.

1. INTRODUCTION

When two materials are brought together, known as the reinforcing phase, with another material known as the matrix phase it forms a composite in the form of fibers, sheets, or particles. Common fillers are polymers for the matrix material, and polymers, metals, or ceramics for reinforcements. Generally, the main load-carrying component in composites are the fibers or particles phase of the composite which are often characterized by higher strength and stiffness than the continuous matrix phase. Even in less ideal cases where the matrix is subjected to loads that make the load path more complicated, it may also be expected to transfer loads across the fibers' axis. This is because the matrix gives the composite the toughness it has over the fibers bearing in mind that the matrix is more ductile than the fibers. Also, the matrix protects the fibers from interferences throughout the process of composite production before, in the process, and after. If well-designed, a novel composite material offers improved characteristics as compared to each of the constituent materials. Apart from possessing structural characteristics, composites are being employed in semi-structural, food packaging, sports goods, etc. Material systems with many functions, or composites, have features that are not inherent in specific single materials. These are structures in which two or more materials that are chemically compatible but possess different compositions, properties, and sometimes forms are brought together physically. These composites are even more than joining two materials. From a broader perspective, a merger has its specific features upon which the amalgamation depends. It may be very dissimilar from any of the components separately or

better than the two in mechanical and thermal properties. They offer better performance than synthetic fibers since natural fibers are eco-friendly, recyclable, and economically viable too, and are often used for reinforcement in various polymer systems

1. Classification of Natural Fibers

Naturally occurring fibers which are fibers that have been derived from plant, animal or mineral are classified according to the origin of the fiber.

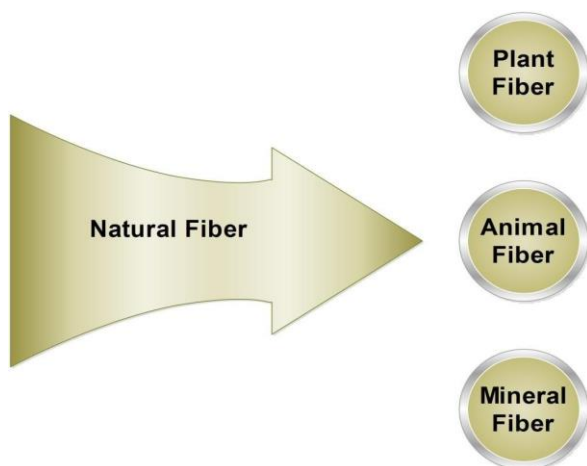


Fig :1 Classification of natural fibers

- **Plant fibers:** Plant fibers: It is noteworthy that almost any stem, leaves, or barks of the plants yield plant fibers. For instance, hemp, flax, cotton, ramie, bamboo, sisal, and jute to mention but a few.
- **Animal fibers:** These fibers are derived from the hair, fleece, or silk of various animals, as the following examples from either the U.S. or other developed countries will illustrate. They include Angora rabbits, alpacas, llamas, wool, and silk fibers among others.
- **Mineral Fibers:** Minerals supply mineral fibers. There are such examples as glass fibers and asbestos.

2. Advantages of Natural fibers

- **Biodegradable:** This means that it is easy to dispose of natural fibers since they can be biodegradable thus reducing the amount of pollutants resulting from disposing of them.
- **Sustainable:** As generation of these kind of energies depends on natural resources, they are also known to be sustainable.

- **Cost Effective:** Natural fibers are recycled from waste material so also available at nearly negligible cost.

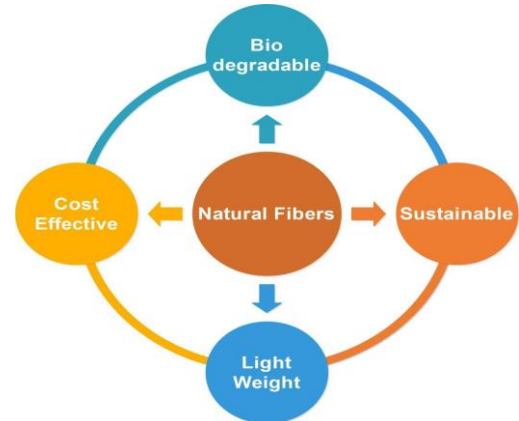


Fig:2 Advantages of Natural fibers

3. Uses of Natural Fibers

Natural fibers are used in many industries some of which are as follows:

- Rope and twine: All these three are very durable and make good material when used in rope and twine.
- Paper: Newspapers, books, boxes, etc are made from wood, bamboo, and hemp.
- Building materials: Fabrics result from flax, hemp, and bamboo fibers that can also be used in the production of roofing, flooring, and insulations.
- Bio composites: Natural fibers can be used as an enhancement in bio composites including the arts such as wood plastic composites, plastics reinforced with natural fibers, and concretes reinforced with natural fiber.
- Agriculture: In horticultural and ornamental use like for tying of plants on trellises and support systems the coir and sisal fibers are used in the manufacture of twine and rope. They also use them to make biodegradable mulch mats.
- Automotive: In the automobile industry bio composite materials used in the body and interior parts of cars are made by natural fibers of hemp and flax.
- Personal Care: Baby wipes, feminine pads and tampons, handkerchiefs, and facial tissues; are some of the products made from cotton, hemp, and bamboo.
- Industrial Products: Some that are manufactured include; geotextiles, abrasive goods, mats, and sisal and coir among many others.
- Home Textile: Some of the examples of usable accessories include, placemats made of bamboo,

seagrass as well as sisal rugs and baskets that are used at home.

- j. Fashion Accessories: Things such as scarves, hats, and gloves are made of silk, wool, and alpaca.
 - k. Sports and Recreation: They include products such as skateboards, snowboards, and surfboards, which are made from hemp and bamboo.
4. Natural fiber reinforces polymer composites and their use in the semi-structural segment Keeping the superior properties in mind natural fibers find wide utility as a reinforcement material in many thermosetting and thermoplastic polymers. Several researchers have employed various natural fibers such as bagasse, wheat straw, pineapple, coconut, and bamboo jute in the reinforcement of different polymer matrices. ASTM characterizations revealed good mechanical and thermal properties on the developed composites. Mechanical properties identified include Tensile, Flexural, Impact, etc. while Thermo-gravimetric analysis (TGA) and Differential Scanning Colorimetry (DSC) are the thermal characterizations used to evaluate the properties of these composite materials. Natural fibers are unique and have great potential.

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