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Editor's Corner:
Green Materials - The Advancements and Applications of Natural Fibers

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An Overview of Plant Fibers

After the industrial revolution, our world started shifting its focus towards sustainability and eco-friendly green materials to replace their synthetic counterparts. Cellulose fibers have played a significant role in human history, providing clothing and various products for many centuries [1]. However, as technology advanced, the use of natural fibers became limited, minimized by synthetic materials. Growing environmental awareness has compelled industries to rethink their strategies, directing their attention toward sustainable and eco-friendly alternatives. In this context, natural cellulose fibers have gained a significant interest due to their eco-friendliness. These fibers can be derived from various sources, including trees, plants, and grasses. Cellulose fibers obtained from plants possess remarkable properties such as low density, wide availability, considerable mechanical strength, good thermal insulation, affordability, ease of processing, and non-toxicity [2]. As we embark on a journey towards an eco-friendlier future, these properties make cellulose fibers an ideal choice for reinforcement in polymer composites. The publication of these concepts has surged in the past few decades. Furthermore, plant fibers actively contribute to the circular economy by promoting biodegradability and renewability, thereby reducing waste, and minimizing the overall carbon footprint. This, in turn, supports agriculture and provides numerous employment opportunities [3].

The Chemical Fundamentals of Plant Fibers

Plant fibers comprise various chemical constituents, including cellulose, hemicellulose, lignin, pectin, and more. These constituents vary depending on the specific part of the plant or tree from which they are extracted, their geographical origin, and the fiber extraction process. Cellulose, hemicellulose, and pectin are complex carbohydrate polymers, with cellulose forming long glucose chains that contribute to the fiber's strength and stiffness [4]. Hemicellulose provides a less ordered but supportive matrix within the plant cell wall, promoting flexibility in the fiber's structure. Pectin acts as the bonding agent that holds plant cells together. Lignin, on the other hand, is a complex non-carbohydrate polymer that lends rigidity, decay resistance, and toughness to plant fibers. It serves as a binding agent, imparting structural rigidity to the fibers. The ratio of these constituents significantly influences the mechanical and thermal properties of plant fibers. A clear understanding of these components aids in selecting or processing materials for various applications. The retting of plant fibers involves various techniques, including water retting, dew retting, mechanical retting, enzyme retting, and bacterial retting. These processes have a substantial impact on the chemical properties of the fibers. Additionally, processing techniques such as surface and chemical treatments are employed to tailor the chemical properties, enhancing the fibers' performance as reinforcements in composites[5].

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Applications and future scope of Plant Fibers

Plant fibers find application in a diverse array of industries, including textiles, automobiles, aerospace, construction, geotextiles, papers, packaging, furniture, interior design, bioengineering, healthcare, sports goods, and more [6]. The extensive range of applications has led to an increase in natural fiber production, which now stands at 32.9 million tons worldwide. The future scope of global cellulose fibers focuses on sustainability and eco-consciousness. An array of research endeavors is emerging, focusing on improving the thermal and mechanical performance of composites using natural fibers as reinforcement, through hybridization and surface modification techniques. Moreover, the isolation of cellulose has gained recent attention, with applications extending into various medical fields, where nano cellulose finds increasing use. In a world increasingly prioritizing sustainability and green materials, the utilization of natural fibers presents a promising possibility for a more environmentally friendly future. As research and innovation continue to unfold, we can anticipate the ever-expanding role of plant fibers in shaping our eco-conscious world.

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BIOGRAPHY

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