Chapter 12
Coir Fiber-Reinforced Composites

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ABSTRACT

Nowadays, fiber-reinforced polymer composites have played a significant role in many different fields of applications, regarding their high specific strength and high modulus. The fiber which serves as reinforcement mechanism in polymer composites may be either synthetic or natural. Natural fibers are not only strong and lightweight but also very economical and environmental friendly. Natural fibers as reinforcement are stated to be a major step taken in promoting environmental protection and sustainability. There are many types of natural cellulose fibers but the thickest and most resistant of all commercial natural fibers, coir/coconut fiber is a coarse, short fiber extracted from the outer shell of coconuts. Coir/coconut fibers have the highest concentrations of lignin, making it most suitable for applications where slow biodegradability is required. This chapter has been written with an aim to explore the potential of the coconut/coir fiber reinforced polymer composites in terms of their performance, surface treatments/modifications and areas of application.

INTRODUCTION

The advantage of composite materials over conventional materials are mainly due to their higher specific strength, stiffness and fatigue characteristics, which enables structural design to be more versatile. By definition, composite materials consist of

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two or more constituents with physically separable phases (Lilholt and Lawther, 2000) (Mueller and Krobjilowski 2003), having notably different and enhanced properties.

Processing of composites using natural fibers as reinforcement has increased dramatically in recent years. (Li, 2008) Fiber-reinforced composites consist of fiber as reinforcement and a polymer as matrix. Studies about the utilization of natural fibers as reinforcement in polymeric composites are increasing due to the improvements that fibers can provide to the product, regarding the increasing environmental consciousness and awareness of the need for sustainable development.

Natural fiber composite materials have gained importance and popularity due to their lightweight, high strength, stiffness, corrosion resistance, and lower impact on the environment (Satyanarayan et al. 1981). Because of their quality, durability and other advantages, they are used to make a wide variety of floor mats, yarn, rope, etc. (Mohanty et al 2000). In some cases, natural fibers can be obtained as a by-product of the coconut fruit, for example. The traditional products consume only a small percentage of the total world production of coconut husks that is generated by the food industry and coastal touristic regions. Thus, research and development efforts have been carried out to find new uses for coir, including its utilization as reinforcement in polymer composites in automotive parts, household and electrical applications. However, a high level of moisture absorption and insufficient adhesion between untreated fibers and the polymer matrix may lead to bio-composites presenting high water absorption and poor mechanical properties that reduce their use in electrical devices.

Several fiber surface treatment methods have been studied to improve the adhesion between coconut fibers and the surrounding matrix, as well as, to reduce water absorption and increase mechanical properties. Nowadays, effective methods based on chemical treatment (Samadi et al 1986) (Murali et al. 2007) such as dewaxing and grafting are used to increase the surface area available for contact with the matrix, but these methods are expensive (like silane agents) and they may cause serious damage to the environment (acids or alkalis agents). Alkalization is the main technique used on natural fiber to remove hemicelluloses (Joseph et al 2002) of fiber surfaces and it has been employed as a less harmful treatment to the environment and cheaper than other methods proposed. However, its use is still controversial, some are favorable (Bledzki and Gassan, 1999) others suggest controlled application (Luo and Netravali,1999) mainly due to chemical wastes generated. Physical treatments (cold plasma treatment, corona treatment) (Ràcz and Hargitai, 2000) have been proposed as eco-friendly processes for superficial modification of the fibers, but these are usually complex and very expensive methodologies. Research on an effective low cost treatment of natural fibers is necessary since the cost of the raw material, i.e. the natural fiber, is very attractive to the market.

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