Chapter 1
Natural Fibers for the Production of Green Composites

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ABSTRACT

Development of green composite from natural fibers has gained increasing interests due to the environmental and sustainable benefits when compared with petroleum based non-degradable materials. However, a big challenge of green composites is the diversity of fiber sources, because of the large variation in the properties and characteristics of the lignocellulosic renewable resource. The lignocellulosic fibers/natural fibers used to reinforce green composites are reviewed in this chapter. A classification of fiber types and sources, the properties of various natural fibers, including structure, composition, physical and chemical properties are focused; followed by the impacts of natural fibers on composite properties, with identification of the main pathways from the natural fibers to the green composite. Furthermore, the main challenges and future trend of natural fibers are highlighted.

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INTRODUCTION

Remarkable achievements of green technology in material science have been made in past few decades, mainly by using natural resources to develop high performance engineering products. Utilization of natural fibers, or lignocellulosic fibers, extracted from biodegradable materials to reinforce composites have attracted increasing interest (Satyanarayana, Arizaga, & Wypych, 2009). The design of novel, green, value-added products focuses on sustainable ecology and "green chemistry" with the holistic approach of life cycle assessment (Faruk, Bledzki, Fink, & Sain, 2014; Satyanarayana et al., 2009). Moreover, other driving forces for increased global attention on natural fiber reinforced composites, are strong worldwide demands for:

1. Creating a resource circulating society, and
2. Addressing the environmental challenge of using petroleum-based products (Satyanarayana et al., 2009).

Lignocellulosic materials had been used earlier around a century ago to produce composites. The first polymer composite based on natural fiber was recorded as early as in 1908. This composite was produced from cotton or paper reinforced on phenol or melamine form aldehyde resins (Bledzki & Gassan, 1999). In the 1940s, the development of reinforcement using glass fibers with lower cost and superior properties took over the competition with lignocellulosic materials (Satyanarayana et al., 2009). However, utilization of glass fibers suffers the problems of high density of glass leading to high dead-weight of the material, and disposal problem at their end life.

The development of lignocellulosic fibers restarted during the period of oil crisis. Required by the laws on reduction of environmentally unfriendly materials, great efforts had been paid by the EU to manufacture eco-friendly products based on natural resources. In 1990s, cellulosic fibers were explored extensively to replace traditional glass fibers for reinforcement composites. In 21st century, polymers reinforced with natural fibers (NFCs), commonly known as bio-composites, have been developed and successfully applied in automotive and building sectors, as well as other consumer goods.

Natural fibers are playing an important role in a number of applications due to their inherent eco-friendly advantages, which are explored to substitute traditional synthetic fibers, particularly, emphasizing green reinforcement. Consequently, natural fibers reinforced composites are emerging very rapidly as the potential substitute of the traditional synthetic fibers in automotive, aerospace, marine, sporting goods and electronic industries (Vijay Kumar Thakur & Thakur, 2014) for the following major advantages:

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