Chapter 16
Techno-Economic and Life Cycle Assessment for the Production of Green Composites

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ABSTRACT

Botanically, green composites belong to an economically important seed plant family that includes maize, wheat, rice, and sorghum known as Saccharum offi cinarum. There are so many natural fibers available in the environment such as rice husk, hemp fibers, flax fibers, bamboo fibers, coconut fiber, coconut coir, grawia optiva and many others also. Life Cycle Assessment (LCA) is a process to estimate the environmental feature and potential impacts related to a product, by organizing a directory of pertinent inputs and outputs of a product system, assessing the potential environmental impacts related with the said inputs and outputs, explaining the results of the inventory analysis and impact evaluation phases in connection to the objectives of the study. Particularly Bagasse, an agricultural residue not only becomes a problem from the environmental point of view, but also affects the profitability of the sugarcane industries. This chapter discusses the properties, processing methods and various other aspects including economic and environmental aspects related to green composites.

INTRODUCTION

Important efforts to protect the environment are focused on finding alternatives to replace synthetic materials, with a growing array of natural materials. The number of research works aiming to develop polymers or composites with natural materials is constantly increasing; one way to accomplish this is by combining the properties of different materials taking advantage of the biopolymer's characteristics.

DOI: 10.4018/978-1-5225-1798-6.ch016

In present scenario green composites have become most versatile and useful materials as compared to the synthetic fiber reinforced composites. The main reason of popularity of green composites resides in their biodegradability, light weight and high strength. The another important thing regarding the green composite is that these materials utilizes the agriculture wastes such as wheat straw, rice husk, banana fibers, coconut fibers etc and used as reinforcements in various matrix materials like thermoplastic polymer, thermoset polymer matrix and also biopolymer matrix materials. Utilization of these wastes results in an ultimate disposal and manufacturing of a new class of materials such as green composites. The another most important point is related to the environmental issue. This environmental issues are also resolved by the green composites. As these composites use the various agricultural wastes as reinforcements in the polymer matrix system as described earlier in this chapter.

Biomass is mainly composed of organic matter derived from plant sources and the very exclusive process such as "photosynthesis" enables trees and plants to store the solar energy into the chemical bonds of their respective structural components. During the photosynthesis process, the carbon dioxide (CO2) from the blanket of air present in the atmosphere vigorously reacts with the universal solvent, water from the earth to produce arbohydrates (mainly sugars in the form of glucose) and this constitutes the building block of biomass.

The essential raw materials of photosynthesis, water and CO2 on entering the cells of dorsal side of leaf produces simple sugar and oxygen. Since the earth's biomass exists in a thin layer called biosphere, where the life is supported and stores enormous energy constantly which is replenished by flowing energy from the sun as a result of photosynthesis. In this chapter we tried to assess the life cycle of green composites. Also the various factors associated or which are useful for the life cycle assessment of the green composites have also reported in the current chapter.

ECONOMIC FACTORS OF WOODY BIOMASS

Biomass generally has two main categories: "virgin biomass" which mainly comprises forestry and energy crops and "waste biomass" leading from the forest thinning, wood residues, recycling, sewage, municipal wastes, food and animal wastes as well as the domestic waste. Despite the advent of modern fossil energy technologies, the biomass still regarded as the vital source of energy for human beings and also for the advancement of raw materials used especially in the present era of the developing world. According to a recent estimation, it has been noted that the biomass production is about eight times higher than the total annual world consumption of energy from all other sources available on earth. According to literature reports in 2003, the world's population uses only a 7% of the estimated annual production of biomass on the basis of new reading of the production rate (Koren and Bisesi 2003; Berndes et al. 2003).

The energy generated from biomass combustion is used as the basic heat source for all the processes and the heat energy is used to vaporize the working fluid in the medium available. The vapour is stretched downward in the turbine to produce mechanical energy which is further converted into electricity through hydroelectricity and geothermal energy as an alternative source of energy. During the process, an electric boiler is utilized for the preliminary investigation of the whole system and the energy liberated by the combustion of biomass lies in the range of 8 MJ/Kg for wet greenwood to 55 MJ/kg for oven dried plant material; while a 55 MJ/kg is generated from methane combustion and 23–30 MJ/kg for coal burning (Twidell 1998).

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