Chapter 9

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ABSTRACT
Nowadays, the research and engineering attention stimulated towards development of environmentally gentle materials to satisfy the energy needs of the society through renewable resources. The growing cognizance in the production and consumption of renewable energy for civilization necessities has directed towards the growth in the wind energy utilization. The wind energy is a leading renewable and sustainable energy resource and key answer to the global energy problem. The rotor blades of wind turbines are its integral parts and traditional materials used for blade manufacturing are carbon or glass fibre reinforced polymer composites owing to their low density and high strength to stiffness ratio. But the non renewability and adverse environmental effect during their processing and disposal forced the researchers to look out for some biodegradable and light weight natural plant fibres for reinforcement in polymeric resin to produce required polymer composites. In the present work, application of bio filler based epoxy composite is proposed to be used as wind turbine rotor blades.

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INTRODUCTION

For the last few decades, the composite materials based on natural cellulosic fibers and polymer resins are increasingly being developed for various applications as replacements for synthetic materials derived from different kinds of petroleum resources. Interest in natural fibers has increased worldwide owing to their excellent price performance ratio, high strength to weight ratio, abundant availability and recyclability, good thermal and mechanical resistivity and to their environmental friendliness [Thakur et al., 2012; and Bhowmick et al., 2012]. The environmental problems associated with the production and use of synthetic fibers has changed the scenario. Natural fibers are now considered as favourable alternative to their manmade counterparts for use in various fields. Natural fibres reinforced polymer composites enjoyed a cult status in this ecological-economical balance owing to the biodegradable and sustainable origin of natural fibres. The natural fibres are obtained either directly from cultivated agricultural plants and crops or in form of secondary by-products after processing of primary crops [Kumar et al., 2014; and Courtenay et al., 2017]. Examples of different natural fibres utilized in polymer composites are wood, sisal, hemp, bamboo, coir, flax, pineapple leaf, kenaf, jute and so forth. The natural polymer based materials are found abundantly in nature and also renewable and biodegradable in nature [Nopparut and Amornsakchai, 2016; and Prabhakaran & Thirumalai, 2014]. The biodegradability of the natural fibers contributes towards formation of a healthy ecosystem, while their lower expense favours the economic aspect of industries. Fibre reinforced polymer composites have been acquainted with the wind industries since a long ago for the manufacturing of wind turbine blades. These fibre reinforced polymer composites are principally utilized for the production of small to large size wind turbine blades. Fibre reinforced plastics are the obvious material selection for wind turbine rotor blades due to their large strength and stiffness to weight ratio compared with conventional structural materials [Shah et al., 2013; and Park, 2015]. During the recent decade, much effort has been put on the improvement of the mechanical properties of these composite materials in order to reduce the blade weight by materials savings.

The some basic properties of materials to be used as wind turbine blade material, is like greater specific stiffness and tensile strength, lower mass per unit volume and ample endurance limit. The rotor blade should have adequate value of strength and resistance to deflection to endure under severe environmental condition without breaking and bending [Nielsen & Landel, 1994]. Also, the time varying cyclic loading has crucial life defining impact on projected life cycle of produced rotor blades, therefore blades must have sufficient fatigue strength to sustain. These basic material criteria in addition to eco-friendly nature for rotor blades can be met by natural fibre reinforced polymer composites. The discussed literature background suggests the potential application of natural fibre/filler reinforced polymer composites as rotor blade material and the determination of optimal value of fibre and matrix content to satisfy such strength requirement is need of the hour. Therefore, the correlation between the required mechanical properties and the characteristic parameters, e.g., the composition of the composite and the working environments is of major importance for designing proper composites in order to satisfy various practical necessities. The optimization of such characteristic parameters is very much important.

Therefore in the present chapter, application of bio filler based epoxy composite was proposed to be used as wind turbine rotor blades. In Section. 2, brief introduction of composite materials and along with natural fibre and their properties is given. In Section. 3, wind turbine, its components followed by exhaustive reviews on parts manufactured with synthetic fibre polymer composites by the previous researchers is discussed. In Section. 4, detailed fundamental scientific aspects of wind turbine and its blade preparation including their working principle, manufacturing methods, parts assembly, advantages,