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Impact of Succinic Anhydride on the Properties of Jute Fiber/Polypropylene Biocomposites

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Abstract: Chemical treatment is an often-followed route to improve the physical and mechanical properties of natural fiber reinforced polymer matrix composites. In this study, the effect of chemical treatment on physical and mechanical properties of jute fiber reinforced polypropylene (PP) biocomposites with different fiber loading (5, 10, 15, and 20 wt%) were investigated. Before being manufactured jute fiber/PP composite, raw jute fiber was chemically treated with succinic anhydride for the chemical reaction with cellulose hydroxyl group of fiber and to increase adhesion and compatibility to the polymer matrix. Jute fiber/PP composites were fabricated using high voltage hot compression technique. Fourier Transform Infrared spectroscopy (FTIR) and Scanning Electron Microscopy (SEM) tests were employed to evaluate the morphological properties of composite. Succinic anhydride underwent a chemical reaction with raw jute fiber which was confirmed through FTIR results. SEM micrographs of the fractured surface area were taken to study the fiber/matrix interface adhesion and compatibility. Reduced fiber agglomeration and improved interfacial bonding was observed under SEM in the case of treated jute fiber/PP composites. The mechanical properties of jute/PP composite in terms of Tensile strength and Young's modulus was found to be increased with fiber loading up to 15 wt% and decreased at 20 wt%. Conversely, flexural strength and flexural modulus increased with fiber loading up to 10 wt% and start decreasing at 15 wt%. The treated jute/PP composite samples had higher hardness (Rockwell) and lower water absorption value compared to that of the untreated ones.

Keywords: Jute fiber/PP composite, Tensile strength, Young's modulus, FTIR, SEM

Introduction

In the recent years, as the eco-awareness like recycling and reusing have been increased, and the focus on clean environment, green materials and technologies, has resulted researches to come out some new materials such as jute fiber reinforced polypropylene biocomposites [1-3]. Materials that having specified characteristics for specific purposes and at the same time poses characteristics of non-toxic and environmentally friendly are becoming more and more popular due to the factor that lack of resources and increasing environmental pollution [4,5].

Recently the use of natural fibers as reinforcement is increasingly replacing the conventional inorganic fibers in polymer matrix composites. Especially, natural fiber-reinforced thermoplastics have a good potential in the future as a substitute for wood-based material in many applications such as furniture, paper etc [6,7]. The development of environmental friendly 'green materials' has become popular because of the natural fibers is biodegradability, light-weight, low cost, high specific strength compared to glass and carbon, recycling and renewing natural sources of plants, such as bats, seed, leaf, wood and fruits. Nowadays synthetic polymers are combined with various reinforcing natural fillers in order to improve the physicomechanical properties and obtain the characteristics demanded in definite applications [8,9]. A remarkable research is moving towards using lignocellulosic fibers as reinforcing fillers [10-12]. Compared to synthetic fibers (i.e. talc, silica, glass fiber, carbon fiber, etc.), the lignocellulosic fibers (i.e. corn stalk rice husk, rice straw, jute, abaca, sawdust, wheat straw, and grass) are lightweight, biodegradable, easily available, renewable, and inexpensive, which are generally more competence than the others in terms of economically and practically [4,13]. Moreover they are biodegradable and do not leave residues or result in by-products that are toxic [14,15]. Since the natural filler filled polymer composites have many advantages properties, the fabrication of polymer composite using natural filler have gained much attention in the recent years [16].

Thermoplastic polymers could be found from renewable resources, which can be synthesized from petrobased chemicals or microbially synthesized in the laboratory [5]. Among the

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