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Preparation and Properties of Unmodified Ramie Fiber Reinforced Polypropylene Composites

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Abstract: Ramie fiber (RF) was used to reinforce the polypropylene (PP). The composites were prepared with a melting hybrid technology. Tests had been performed on PP and composites with different RF contents (10 wt%, 20 wt%, and 30 wt%). By using SEM, DSC, TGA, electronic universal testing machine, HDT-VICAT tester and coefficient of linear expansion tester, the effects of the RF loading were assessed on the basis of morphologies, mechanical and thermal properties as well as vicat softening temperature and CTE of the resulting composites. The results show that the thermal degradation temperature of the PP/RF composites becomes lower with higher fiber content. The crystallization rate of the PP matrix is accelerated by the unmodified RF. Because of the inferior interfacial bonding strength between RF and PP, the tensile strength of composites decreases by the presence of RF. And the RF used is relatively long compared with the diameter, the impact strength of the composites is improved by the unmodified RF. The vicat softening temperature of composites can be increased by about 5 ℃ in the presence of RF compared with PP. The CTE is reduced significantly in the presence of RF. Generally speaking, impact strength, crystallization rate, vicat softening temperature and CTE of PP/RF composites could be improved in the presence of RF. The tensile strength is decreased and thermal degradation temperature of composites becomes lower, but these should not affect most subsequent normal uses of the composites. As the unmodified RF is used directly, no hazardous waste is produced during the fabrication process, combined with the low price, so, a facile and economic preparation pathway is given by using unmodified natural fiber to reinforce polymer and composites with good performance obtained.

Key words: ramie fiber; polypropylene; composites; characteristics; properties

1 Introduction

As a result of the desire to reduce the cost of conventional fibers (*i e*, glass and carbon) reinforced petroleum-based composites, and the increasing demands for sustainability and also reconsideration of renewable resources, natural fibers (NFs) used as reinforcements in composites have been found in an increasing number of applications in recent years[1-4]. Most of the NFs are hydrophilic in nature as they are mainly composed of lignocellulose, which contains strongly polarized hydroxyl groups. Sometimes, the hydrophilic nature of natural fibers affects negatively interfacial adhesion with hydrophobic polymeric matrices and finally influences the mechanical properties of composites, especially for the tensile strength. Currently, in order to improve the fiber-matrix adhesion, various treatments were used to decrease the polarity of the natural fibers' surface. Current available modification methods like plasma, mercerization, acetylation, coupling agents, polymer grafting, can be mainly grouped into physical and chemical treatments[5-8]. The results showed that the treated NFs reinforced composite offered superior mechanical properties compared to that of untreated NFs. However, potential problems are that most of the modification methods have the disadvantages of using polluting organic solvents, producing hazardous waste and posing a risk to the environment. It would

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