Synthesis of a New Compatibilisant Agent PVC-*g*-MA and Its Use in the PVC/Alfa Composites

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ABSTRACT: The main objective of this research was to synthesize a new compatibilisant agent (PVC-*g*-MA), which was grafted from the maleic anhydride on the PVC chains. The presence of maleic anhydride grafting on PVC was made evident by infrared analysis. PVC-*g*-MA was used like compatibilisant to solve the problem of the incompatibility between the hydrophobic polymeric matrix (PVC) and hydrophilic fiber (alfa). Composites samples were prepared with different alfa fiber loading (10, 20, and 30 wt %) and incorporating PVC-*g*-MA (1, 3, and 5 wt %) or PP-*g*-MA (3 wt %). The tensile properties, the thermal stability and the morphology of the composites were investigated. The result indicated that the PVC-*g*-MA increased the interfacial adhesion between the fibers and the polymer matrix and this effect was better than that obtained for the maleated-polypropylene-coupled composites. Microstructure analysis of the fractured surfaces of MAPP modified composites confirmed improved interfacial bonding. The addition of alfa and PVC-*g*-MA increased the thermal stability of the composites. The temperature of degradation of the polymer matrix increased about 16°C in comparison to the noncoupled composite, indicating that PVC-*g*-MA improved the thermal stability of the polymer. © 2011 Wiley Periodicals, Inc. J Appl Polym Sci 124: 4352–4361, 2012

Key words: composites; compatibilization; polyvinylchloride; mechanical properties; thermal properties

INTRODUCTION

In the recent years, great attention has been dedicated to the exploitation of natural fibers as reinforcement for plastics, replacing glass fibers, and other synthetic materials.[1] This occurs not only due to environmental concerns but also for providing a unique combination of high performance, great versatility, and processing advantages at favourable cost.

Advantages of natural fibers have encouraged their application in polymer composites. Relating to this, many researchers reported the incorporation of various natural fibers in thermoplastics composites.[2] The main problem in natural fibers filled thermoplastics composites is the incompatibility of hydrophilic natural fibers and hydrophobic polymer matrix, which yields composites of poor interfacial adhesion.

Several methods of improving adhesion in natural fiber/polymer composites have been described in the literature. Some methods were based on fiber modification (physical or chemical) and others were based on the addition of a coupling agent for interfacial adhesion improvement.[3]

It reported that small amounts of PP modified with maleic anhydride added to the composites significantly increased the mechanical properties. After this treatment, the surface energy of cellulose fibers were increased to a level much closer to the surface energy of the matrix.[4] The coupling agent more often used was a polypropylene grafted with maleic anhydride.[1] Interactions between the anhydride groups of maleated coupling agents and the hydroxyl groups of natural fibers can overcome the incompatibility problem and increase tensile and fiexural strengths of natural fiber thermoplastic composites.[5] The hydrophilicity of natural fibers generates high moisture absorption and weak adhesion to hydrophobic matrix.[6]

Lu et al.[7] found that maleation significantly influenced thermal and dynamic mechanical properties of resultant wood-PVC composites. Experimental results indicated that storage modulus (E) and complex modulus (E^*) increased with increase of maleated polypropylene (PP-*g*-MA) retention, but leveled off or decreased at high PP-*g*-MA retention. Compared with wood, PVC and untreated composites, maleated wood-PVC composites had significant shifts in most dynamic mechanical analysis, thermogravimetric analysis (TGA), and differential scanning calorimetry spectra due to chemical coupling by PP-*g*-MA at the interface.

Mishra et al.[8] reported that maleic anhydride treatment reduced the water absorption to a great

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