Effect of Surface Treatment on the Physicomechanical and Thermal Properties of High-Density Polyethylene/Olive Husk Flour Composites

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ABSTRACT: In this study, a particular interest was focused on the recovery of lignocellulosic waste of olive husk flour (OHF) by its incorporation as filler in manufacturing composite materials based on high-density polyethylene (HDPE) matrix with various filler contents (10, 20, and 30 wt %). The problem of incompatibility between the hydrophilic filler and the hydrophobic matrix was treated with two methods: the first method consists of using maleic anhydride-grafted polyethylene (MAPE) as compatibilizer in HDPE/OHF composites. The second method, was focused on the chemical modification of OHF by vinyl-triacetoxy-silane (VTAS). Fourier transform infrared spectroscopy is used to analyze both grafting and silanization reactions involved. Scanning electron microscopy was used to show the morphology of the flour surface. Furthermore, the physicomechanical and thermal characteristics of the various composite samples were investigated as a function of filler contents and treatment types. The results showed that the properties of the composite materials are positively affected by the silanization treatment of OHF and also by MAPE addition. However, better mechanical and thermal properties with less moisture absorption were obtained for the composite materials compatibilized with MAPE. © 2011 Wiley Periodicals, Inc. J Appl Polym Sci 123: 1310–1319, 2012

Key words: composites; fibers; polyethylene; compatibilization; modification

INTRODUCTION

Natural fiber-reinforcing composites have attracted the attention of scientists and industrialists community because they are turning out to be an alternative solution to the ever-depleting petroleum sources. As a result of the increasing demand for environmentally friendly materials, many natural fiber composites have been developed and tend to integrate an ecological character.[1] Natural fibers like banana, cotton, sisal, jute, and olive husk flour (OHF) exhibit a number of attractive features, including low density, abundance, and certainly biodegradability, and efficient production technologies, including extrusion and injection molding.[2,3] These composites are being used in a large number of applications, including automotive, interiors, building industry, and many other furniture.[4]

Commodity thermoplastics are mostly used in the manufacture of plastic/wood filler composites. Among these thermoplastics, high-density polyethylene (HDPE) is one of the most important thermoplastics because of its good properties, i.e., fluidity, flexibility, and electrical insulation.[5] The olive husk, one of the several lignocellulosic materials, is an agricultural industrial residue produced as by-products during the olive milling process in the olive-producing countries such as Algeria. Every year, thousands of tons of this product are incinerated or rejected in the wild, causing major inconvenience to the environment.

Despite the advantages, the use of natural fiber has been restricted because of its inherent high moisture absorption capacity, thermal instability during processing, poor wettability, and poor adhesion toward polyolefins.[6,7] The surface characteristics of the natural fibers, such as wetting, adhesion, surface tension, or porosity of fibers, can be improved through chemical modification. In the literature, several strategies have been suggested describing the way to improve the compatibly of lignocellulosic fibers with thermoplastic polymers,[8] such as esterification, silane treatment, graft copolymerization, use of compatibilizers, plasma treatment, and treatment with other chemicals. The chemical treatment of wood filler or the functionalization of the polymer usually requires the use of reagents, which contain functional groups

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