Physical and Mechanical Properties of Polymer Composite Materials Based on Olive Husk Flour

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Received July 16, 2014; Accepted November 2, 2014

ABSTRACT: The lack of compatibility between cellulose fibers and some polymers, such as thermoplastics, is due on one hand to the hydrophilic nature of the vegetable fibers and on the other hand to the hydrophobic character of the matrix. This incompatibility induces bad dispersion of the fibers and the formation of a heterogeneous material with mechanical properties which are not very satisfactory. The scope of this article is to describe the possibility of using Olive Husk Flour (OHF) as reinforcement in the elaboration of a composite material based on polyvinyl chloride (PVC). In this context, we used the PVC-g-MA as compatibilizer and investigated the effect of the loading and the effect of treatment on the mechanical properties and thermal behavior of these composites; the structures have also been characterized by scanning electron microscopy (SEM) and X-ray diffraction analysis (XRD).

KEYWORDS: Composites, polyvinyl chloride, mechanical characterization, compatibilizer

1 INTRODUCTION

Advanced technology in petrochemical-based polymers has brought many benefits to mankind. However, it has become evident that the ecosystem is being disturbed because of non-biodegradable plastic materials [1]. Currently, there is considerable interest in natural fiber, which can be used as filler in traditional plastics, thus reducing the pollution caused by plastic wastes [2].

Polymer composites based on natural fibers (vegetal fibers, cellulosic and derivatives) are attracting great attention as alternative materials to glass or synthetic fiber-reinforced plastics. Fiber-reinforced polymers offer additional options over other conventional materials when specific properties are required and find applications in diverse fields [2]. The development of vegetal fiber-reinforced composites is a growing sector for many applications, mostly for automotive, appliance and packaging products [2–4].

Natural fiber exhibits a number of attractive advantages including low density, low cost, low requirements on processing equipment, less abrasion during processing, abundance, renewability and certainly biodegradability [2,5,6].

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DOI: 10.7569/JRM.2014.634119

The matrix filler interface plays a critical role in ensuring that the properties of each component contribute optimally to the bulk properties of the final product [7], so the first question is how to apply standard testing methods developed for homogeneous materials to composites, which are naturally heterogeneous [8]. However, certain drawbacks, such as poor compatibility with the hydrophobic polymer matrix, the tendency to form aggregates during processing and their low resistance to moisture, greatly reduce the potential of natural fibers to be used as reinforcement for polymers.

In order to improve the interfacial interactions between polymer and fibers, surface modification of the fibers and/or polymer functionalization, as well as addition of compatibilizers, are required [2,5,9]. Polymer modification with reactive molecules (such as anhydrides, epoxides, amines, etc.) is a largely explored way to enhance interfacial adhesion [10–12].

Many recent studies have investigated the incorporation of vegetal fiber into thermoplastic matrix. Hammiche *et al.* [13] investigated a composite based on hydrophobic polymeric matrix (PVC) and hydrophilic alfa fiber and have shown the interesting synthesis and the addition of a new compatibilizer PVC-g-MA on this composite; they confirmed that the choice of the compatibilizer must be made according to the matrix and to the application aim of the composite material.