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Effects of interface modification on composites based on olive husk flour

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ABSTRACT

Every year a considerable amount of olive husk was rejected in nature by different oil mills or incinerated. The valorization of these agricultural wastes by its incorporation as loading in the development of composite materials with polyvinyl chloride (PVC) is the object of this research. To improve the properties of the interface between the polymer matrix and olive husk flour (OHF), two chemical treatment methods were conducted. The first treatment consisted to use PVC-g-MA (maleic anhydride grafted on PVC) as a compatibilizer in composites; the second was a surface modification of olive husk flour by benzoylation. In this context, we prepared various formulations based on polyvinyl chloride/olive husk flour with different loading rates (10, 20, and 30%) using twin-screw extrusion. The Fourier transform infrared was used to study the chemical modification of the fiber. The composites were characterized by mechanical tests, thermogravimetric (ATG/DTG), mechanical dynamic analysis (DMA), and the physical characterization by the water absorption test. The thermogravimetric analysis revealed the improvement of the thermal stability of the composites with and without treatment compared to virgin PVC.

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1. Introduction

Composites reinforced with natural fibers have attracted the attention of several researchers [1], because of their low cost, low density, biodegradability and availability, ease of implementation and high specific properties, etc. [2]. These advantages allow the use of these materials in increasingly varied applications. Moreover, the reinforcement of plastics with natural fibers reduces problems of plastic waste elimination and leads to new materials easily recyclable [3]. The properties of the composite materials depend essentially on the characteristics of the polymer-filler interface [4]. The adhesion between the hydrophilic surface of the fibers and the hydrophobic polymer used as a matrix is low [5], therefore the reinforcement capacity reduced. The treatment of the natural fibers and some additives used in the composite ensure the modification of the tension at the interface and the improvement of the properties of these materials [4]. Several studies had been considered to improve the compatibility between the lignocellulosic load and the thermoplastic matrix, some researchers performed a chemical modification of natural fibers, and the

others used a compatibilizer. Bakar et al [6] noted an improvement in the interfacial adhesion between the matrix and the fiber after the chemical modification by benzoylation. Singh et al [7] examined the effect of alkali treatment, silane treatment, benzoylation, and graft copolymerization on the mechanical, dielectric, and thermal properties of Grewia optiva fiber reinforced polyester composites. They observed that the composite fibers treated with benzoylation have higher mechanical strength. Nair et al [8] investigated the effect of chemical treatment on the mechanical properties of polystyrene composites reinforced by sisal fiber. They used NaOH and benzoyl chloride for the surface treatment of the sisal fiber, and they certified that the thermal stability of the treated composites was higher than the untreated ones. Hammiche et al [9] evaluated the effects of PVC-g-MA as a compatibilizer on the morphological, mechanical, and thermal properties of PVC/Alfa. They reported that the addition of PVC-g-MA improved the thermal stability of the composites.

The main objective of the present work was to study the effect of benzoylation and PVC-g-MA on the mechanical, thermal properties of PVC/OHF composites. In this context, we are interested in developing two types of composites, modified and unmodified, with different rates of olive husk flour namely 10, 20, and 30%. The treated and untreated OHF were characterized by Fourier

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