

Treated Olive Husk flour in a PVC-Based Composite Material: Recycling Effect on Physico-Mechanical and Rheological Properties

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Abstract

The work is directed to study the recycling effects on the olive husk flour reinforced polyvinylchloride composites with and without maleic anhydride-grafted polyvinyl chloride used as compatibilizer. To improve the fiber-matrix adhesion, olive husk flour was chemically treated by benzoylation treatment. The material was characterized after each extrusion using tensile tests, Rheological measurements, scanning electron microscopy (SEM), and Size Exclusion Chromatography (SEC). Results indicated that generally after four cycles, the recycled composites had considerably higher modulus as compared with the original composites which were attributed to changes in physical and chemical properties of the composites induced by the recycling process. This effect was enhanced for the compatibilized samples. Increase of the modulus strength of the poly (vinyl chloride) (PVC) matrix is detected due to the molecular chain cross-linking resulting from degradation.

Keywords: Poly (vinyl chloride), Benzoylation treatment, Olive Husk flour, Recycling, Physico-Mechanical properties.

I. Introduction

In recent decades, the increase in world population and the need to adopt better living conditions have led to a dramatic increase in the consumption of polymers, mainly plastics, resulting in the generation of waste in large quantities. To reduce the environmental problems caused by the accumulation of this waste, it is in our interest to recycle it [1].

Several research works have focused on the effect of recycling on composites based on polypropylene, polyethylene and vegetable fibres [2]

Petchwattam et al [3] carried out a study on the recycling of composites based on polyvinyl chloride and wood flour (WF), their work is composed of two parts, the first focuses on the recycling of the mixture of industrial waste from PVC/WF composites and PVC pellets reinforced with WF. The second part consists in recycling the PVC/WF composites (seven extrusion cycles), according to their results they found that the recycling reduced the molecular weight of the PVC matrix, they explained this reduction by the scission of chains molecule by shear stress during the recycling process. On the other hand, the results of

the mechanical tests have shown that PVC/WF composites can be recycled again as composites without critically affecting their mechanical performance.

Hammiche et al [4] studied the effect of mechanical recycling on the properties of PVC/Alfa composites. They prepared three formulations, Virgin PVC, Composite loaded with 20% of alfa in the presence and in the absence of 5% of PVC-g-MA.

The composites produced underwent four extrusion cycles. According to their results, they found that the mechanical properties of composites increase with the number of recycling cycles. Indeed, the tensile strength and the Young's modulus in the studied formulations increased considerably. These are clearly revealed by scanning electron microscopy (SEM). After recycling, the morphology of the composite materials indicates that the alfa fiber particles are uniformly dispersed and embedded in the polymer matrix. They also observed that the maximum degradation rate is shifted to a slightly higher region in the case of composites compared to virgin PVC, due to the higher thermal stability of composites.