EFFECT OF AGAVE FIBER SURFACE TREATMENT ON THE TENSILE PROPERTIES OF POLYETHYLENE COMPOSITES PRODUCED BY COMPRESSION MOLDING

Erick Omar Cisneros-López[1], Martíz Estaban Gonzalez-López[3], Aida Alejandra Pérez-Fonseca[1], Rubén González-Núñez[1], Denis Rodrigue[2], Jorge Ramón Robledo-Ortíz[3]

1. *Departamento de Ingeniería Química, Universidad de Guadalajara, Blvd. Gral. Marcelino García Barragán No. 1451, 44430, Guadalajara, México.*
2. *Department of Chemical Engineering and CERMA, Université Laval, Quebec City, G1V 0A6, Quebec, Canada.*
3. *Departamento de Madera, Celulosa y Papel, Universidad de Guadalajara, Carretera Guadalajara-Nogales km 15.5, Las Agujas, 45510, Zapopan, México.* jorge.robledo@cucei.udg.mx

Introduction

For several years now, natural fiber composites (NFC) have gained high interest.[1] However, NFC have some drawbacks, the most important one being low compatibility between natural fibers and most polymers (especially polyolefins).[2] To solve this problem, several methods like chemical, physical and thermal treatments have been proposed to improve adhesion between both phases.[3] In this work, the effect of natural fiber surface treatment with maleated polyethylene (MAPE) is presented to improve the mechanical properties of natural fiber composites (NFC). In particular, a simple dry-blending technique was used to disperse natural fibers (agave) in a polymer matrix (linear low density polyethylene) and composite samples were produced via compression molding.

Experimental Part

The polymer matrix was linear low density polyethylene (LLDPE). Agave fibers (*Agave tequilana* Weber var. Azul) were obtained from residues of a local tequila company. Sodium hydroxide, MAPE and 1,2,4- trichlorobenzene (TCB) were used. For surface treatment, the agave fibers were placed for 15 min in 2% NaOH at 25°C. After washing with water and drying, MAPE treatment was performed in 1% wt. MAPE in TCB at 90°C during 30 min under high intensity mixing. After recuperation by filtration, the treated fibers were dried. Fiber contents between 0 and 40% wt. were prepared by Dry-blending for 2 min at 18000 rpm. Finally, the blends were compression molded in a Carver laboratory press during 6 min at 200ºC and 3,000 kg. Micrographs of cryogenically fractured samples were taken using a scanning electron microscope HITACHI TM-1000. Tensile properties were measured on an Instron model 5565 universal testing machine using Type V samples according to ASTM D638.

Results and Discussions

Micrographs in Fig. 1 clearly show changes at the fiber-matrix interface of untreated composites (UFC) and treated ones (TFC). Some gaps between untreated fibers and LLDPE can be seen, which is not the case for treated fibers. According to literature, MAPE is deposited (mechanical anchoring) as well as chemically grafted (chemical anchoring) on fiber surface.[3]

The tensile strength (Fig. 2) of TFC increased with fiber content: the 40% TFC presented an increase of 120% over UFC and LLDPE. Once again, these results indicate that good fiber-matrix interaction was achieved.[3]

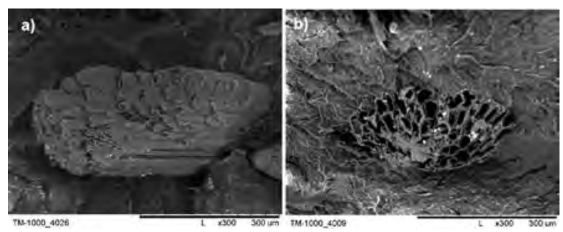

Figure 1. LLDPE-agave fiber interface for: (a) UFC and (b) TFC.

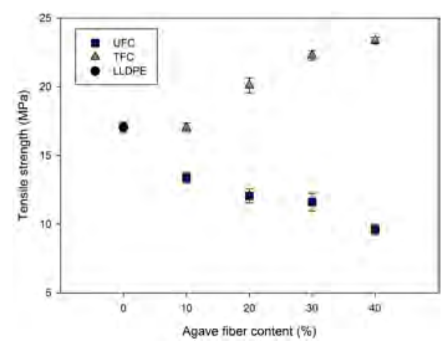

Figure 2. Tensile strength for LLDPE, UFC and TFC.

Conclusions

From the results obtained, it is clear that the simple dry-blending technique combined with a solution surface treatment of the fibers is a simple an efficient way to develop composite materials with enhanced properties.

Acknowledgment: CONACyT; cucei.udg.mx

References

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