MICROSTRUCTURAL, THERMAL AND MECHANICAL PROPERTIES OF GRAFTED POLYPROPYLENE COMPOSITES WITH ACETYLATED WHEAT STRAW FIBERS

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Introduction

The utilization of lignocellulosic fibers as reinforcement fillers in thermoplastics polymers and elastomers composites have been attracting attention recently because the naturals fibers provide to the composites which better properties such as low density, biodegradability in comparison with other fillers as talc, glass fiber, etc. The lignocellulosic fiber have a sustainable value, because they could be obtained from agricultural residues such as stalks of cereal crops, rice husks, coconut fibers (coir), bagasse. [1] The wheat straw fiber is a natural fiber, available, renewable, nontoxic, low density, and his low cost is of industrial and economic interest. These residues, as whole fiber or as cellulose fiber, have been used to obtain composite either with polyolefin or other polymers as matrix. [2]

Experimental Part

The straw wheat fibers were harvested in the region of Ocotlán Jalisco. Isotactic polypropylene (PP) type PP-30 from PEMEX was used as matrix polymer. The fiber acetylation process was performed according to a process reported elsewhere.[3] PP matrix was grafted with 5 wt.% of anhydride maleic (MA) (Polybond 3200) as a coupling agent. The PP and PP-g-MA composites were obtained using a mixing chamber Brabender at 180 ºC and 20 rpm. The content of fibers was of 10, 20, 30 wt.%. Specimens for testing were molded by thermo-compression and were cut according to the ASTM-D638 norm. Mechanical properties were performed in a universal testing machine INSTRON 5500 R. The thermal properties and microstructural characteristics were obtained with a DSC 6 differential scanning calorimeter Perkin Elmer and a JEOL-JSM-5900LV Scanning electron microscope, respectively.

Results and Discussions

Young's modulus of PP-g-MA composites were higher than the pure PP matrix, and increased with the non-acetylated fibers. This result suggests that the fibers act as a nucleation agent, favoring their strengthening. However, when the fibers were acetylated for both, PP and PP-g-MA composites, the Young's modulus was lower than those materials prepared with the non-acetylated fibers. The increase of Young's modulus of grafted composites is related to the improvements of compatibility of the fiber and the matrix, because the PP-g-MA can form covalent linkages and hydrogen bonds between the anhydride maleic and the hydroxyl group of the fiber. On the other hand, the DSC measurements showed an increase of the crystallinity with the fiber content; whereas the SEM micrograph showed a good fiber dispersion for the PP-g-MA composites with non-acetylated fibers.

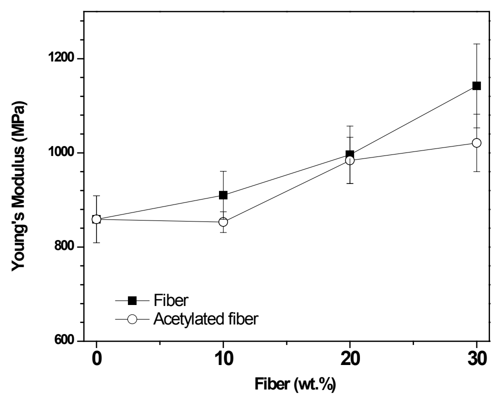

Figure 1. Young's modulus of composites with fibers and PP-g-MA.

Conclusions

In general, the PP-g-MA composites with non-acetylated fibers showed better mechanical properties than those prepared with acetylated fibers, due to the repulsion between the anhydride maleic and the acetate groups of the acetylated fibers.

References

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