THERMAL, MECHANICAL AND MORPHOLOGICAL CHARACTERIZATION OF POLYETHYLENE/CARBON FIBER COMPOSITES PREPARED BY THERMOCOMPRESSION

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Introduction

Carbon fibers (CF) have been used for a wide of applications including reinforcement in composites due to the high elongation resistance. The aim of this study is the modification and interaction of CFs measuring thermal and mechanical properties and morphology of CF/linear medium density polyethylene (LMDPE) composites using maleic anhydride-grafted-polyethylene (MAPE) as compatibilizer.

Experimental Part

The CF was incorporated with and without previous treatment at 0%, 5%, 10% and 15% wt. in LMDPE. The composites were prepared by thermo-compression using a hydraulic press at 160°C and 200 bars during compression for 10 minutes. After 24 hour of cooling, specimens were obtained for mechanical (Impact, flexure and tension) and thermal analysis (TGA and DSC). The functionalization of the CF and compatibilization with MAPE was analyzed by FT-ATR, while the morphology of the composites was obtained by SEM.

The carbon fiber functionalized with –OH and –COOH (CFF) groups was obtained by the immersion of the CF in a 3:1 HNO_3 and H_2SO_4 solution at 60°C during 30 minutes using magnetic stirring[1], whereas the functionalized and treated with MAPE was obtained by the addition of the CFF into a solution of 3% MAPE/Xylene at room temperature and constant stirring for 2 hours.

Results and discussion

From Figure 1 we observe a linear decay trend of the impact resistance and the fiber content without treatment in the polymeric matrix, and a lower stiffness, which results in a brittle material. In the tensile Young modulus, we see a linear increase with the amount of fiber remarking that 15% wt. CF composites has outstanding tensile modulus (330%), this behavior is due to the matrix reinforcement. The presence and orientation of longer fibers as the good dispersion, and fiber-polymer matrix adhesion was corroborated by SEM[2] (Figure 2). The flexure modulus had an increment (30%) due to the addition of fiber, in contrast with the impact resistance, suggests that decrease the toughness of the polymeric matrix. The composites with greater flexion module and impact resistance is which contains 10% wt. of CF suggesting with a greater quantity, can occur an agglomeration leading to a bad interfacial bonding between the untreated filler and the matrix.[3] We expect that the proposed treatment of the CF will improve the bonding interaction that results in better mechanical and thermal properties.

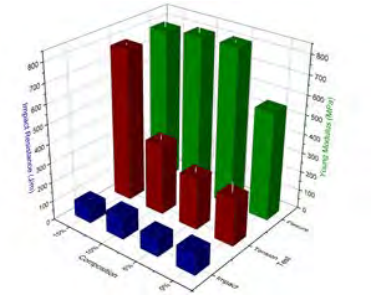

Figure 1. Mechanical properties of LMDPE/CF composites.

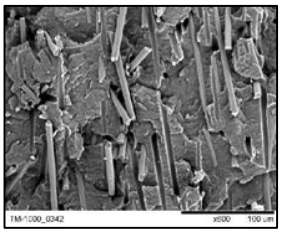

Figure 2. Micrograph of 10% wt. CF in LMDPE without MAPE.

Conclusions

The addition of CF induced modifications in the mechanical properties, and morphology of LMDPE. Such modification is given by the length and dispersion of the fibers in the polymeric matrix, all this, corroborated by SEM and thermical analysis.

Acknowledgements: To the National Council of Science and Technology (CONACYT).

References

1. Zhang G, Sun S, Yang D, Dodelet J-P, Sacher E. Carbon 46(2) 196-205 (2008).
2. Savas LA, Tayfun U, Dogan M. Composites Part B Eng. 99, 188-195 (2016).
3. Chunzheng P. Surface Interface Analysis. 47(3), 357-361 (2015).