INFLUENCE OF NANOCLAYS ON THE THERMAL AND MECHANICAL PROPERTIES OF POLYLACTIC ACID

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Introduction

Polylactid acid (PLA) is a versatile thermoplastic biopolymer produced from lactic acid monomer coming mainly from the fermentation of corn, potato, sugar bee, and sugar cane.[1] Currently it is the most used biopolymer owing to its high mechanical strength and easy processability.[2] In the other hand PLA has some disadvantages such as brittleness, sensitivity to high temperature and humidity, low impact strength and high cost. However, it has been reported that these properties can be improved by adding low amounts of nanoclays.[3] Nano-reinforcements are mainly used in polymer nanocomposites to enhance properties of neat polymer, including their mechanical strength and thermal stability.[4] In this study, the effect of three different nanoclays over the mechanical and thermal properties or PLA was evaluated.

Experimental Part

PLA 3251D from Nature Works LLC was used as polymeric matrix. The nanoclays used were 1.44P and 1.34MN from Sigma Aldrich and 15A from Cloisite. Pellets of PLA-clay nanocomposites were prepared in a twin-screw extruder with a clay content of 1, 3 and 5 wt% in order to evaluate the effect of clay amount as well as nanoclay type. Afterwards the nanocomposites pellets were processed by injection molding to obtained samples for the evaluation of their mechanical properties (flexural, tensile and impact) as well as thermal properties by DSC and TGA.

Results and Discussions

The results obtained from the mechanical tests showed that PLA flexural strength (Fig. 1) increased around 11 and 23 % by the addition of nanoclay 1.44P and 1.34MN respectively. The flexural modulus was increased by nanoclays content in a similar way for the three nanoclays used. The maximum values achieved were with 5% of 1.44P and 1.34MN content. It was observed that tensile modulus increases 20% with 5% of nanoclay for all the nanoclays used while tensile strength increased less than 10%. In the case of impact strength, it remained similar with nanoclay addition. It has been reported that nanoclays influence the thermal stability of PLA[4], nevertheless in this study it was observed from TGA results that the nanoclays used did not affect PLA thermal stability. By DSC experiments, the values obtained of T_g, T_m and ΔH were also very similar for neat PLA and the nanocomposites.

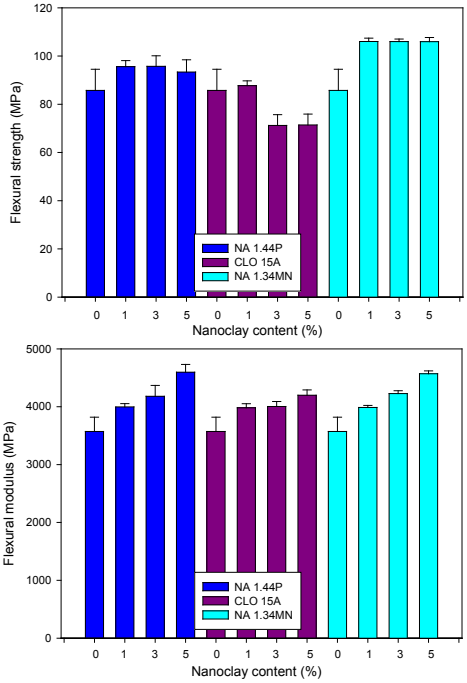

Figure 1. Flexural properties of PLA-nanoclays composites

Conclusions

In this study it was observed that nanoclay addition improved some mechanical properties, i.e. flexural and tensile; on the opposite, the nanoclays did not modify the thermal behavior of composites.

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