DURABILITY OF POLYLACTIDE-BASED NANOCOMPOSITES IN DIFFERENT ENVIRONMENTS

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Polylactide (PLA)-based nanocomposites have been successfully prepared by a melt intercalation method using Cloisite 30B (C30B) as organoclay. The material morphology obtained from this protocol indicates that the dispersion of mineral platelets within the PLA matrix is relatively homogeneous, as revealed by wide angle X-ray scattering, transmission electron microscopy, rheology and nanoindentation[1].

Thus, the aim of the present communication is to develop the influence of different kinds of environments (natural ageing, gamma-irradiation and biodegradation in compost) on the structure, the morphology and the thermo-mechanical properties of PLA/C30B nanocomposites. The results obtained are discussed on the basis of neat polymer. The degradation of the aged samples is evaluated as a function of clay contents (1, 3 and 5 wt.%) using several techniques as infrared spectroscopy, steric exclusion chromatography, nanoindentation measurements, differential scanning calorimetry, thermogravimetric analysis, scanning electron microscopy and transmission electron microscopy[2].

The natural weather effect on PLA/C30B nanocomposites with respect to neat PLA has been studied up to 130 days. The FTIR results showed that the photo-oxydation mechanism of PLA was not modified in the presence of C30B, but only the degradation rates were accelerated. The decrease of molecular weights associated with an enhanced polydispersity of the nanocomposite samples indicated that chain scission was the most prominent phenomenon in natural weathering. Under natural weathering exposure, the PLA nanocomposites undergo photo-oxidative degradation by free radical process which can lead to a breakdown of the polymer backbone and to the formation of lower molecular weight species. These

structural modifications are responsible for the deterioration of the physico-mechanical properties of the samples.

Then, the effect of the gamma-irradiation at low doses (up to 100 kGy) on the structure and properties of neat PLA and PLA nanocomposites containing 5 wt.% of C30B has been also investigated[3]. Results show the gamma-irradiation leads to a severe decrease in the molecular weight of PLA and nanocomposites as a function of radiation dose, suggesting PLA degradation due to chain scission mechanism. Nevertheless, thermal and mechanical properties are less affected in the case of nanocomposites than in the case of neat PLA. This behavior may be explained by the homogeneous dispersion of C30B platelets in the PLA matrix, leading to a relative inhibition of gamma radiation effect.

Finally, some results concerning the biodegradation rate of these materials, i.e. neat PLA and PLA-C30B nanocomposites filled up to 5 wt.%, have been obtained in compost at 58°C and the nanoclay role on the PLA biodegradation kinetic has been discuss[3]. The biodegradation curves clearly show improved biodegradability for PLA nanocomposites compared to pure PLA. The improved biodegradability of PLA after nanocomposites preparation may be due to a catalytic role of the nanofiller in the biodegradation mechanism as usually explained in the literature. The presence of residual hydroxylated groups at the C30B surface may be one of the factors responsible of this behavior.

References

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