

ON THE PHOTO-OXIDATION BEHAVIOUR OF NANO-FILLED POLYPROPYLENE: ROLE OF THE FILLER TYPE AND COMPATIBILIZER

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The increasing interest in polymer nanocomposites over the last years is leading to a greater concern for their resistance to photo-oxidation, in particular for outdoor applications, where the action of direct sunlight, humidity and rain can lead to dramatic worsening of the main aesthetic and technological properties of polymers, due to its structural and morphological modification. The photo-oxidation behaviour of polyolefin based nanocomposites with layered silicate fillers has been investigated in the literature, and it has been found that their mechanical properties worsen at a higher extent, if compared to the neat matrices¹⁻³ while few data are available on those containing nano-calcium carbonate⁴. Literature reports also about the photo-oxidation behaviour of clay-filled nanocomposites in presence of compatibilizers such as maleated polyolefins, finding partially contrasting results, since Mailhot *et al.*⁵ reported that maleic anhydride grafted polypropylene does not significantly modify the rate of photo-oxidation, while Qin *et al.*⁶ found that this compatibilizer can actually introduce some photoresponsive groups, leading to an acceleration of the photo-oxidation of PP when used in combination with organophilic montmorillonite.

In this work, the photo-oxidation behaviour of nanocomposites based on polypropylene and different nanofillers such as organo-modified clay and precipitated calcium carbonate has been investigated. Particular attention has been focused on the effect of a compatibilizer.

The materials used in this work were a general purpose polypropylene (PP) manufactured by Basell under the name Moplen X30G, and several types of nanometric fillers. In particular, these were: an uncoated, precipitated

calcium carbonate, produced by Solvay under the commercial name of Socal 31 (S31; mean particle diameter approximately 70 nm); two layered silicates (montmorillonites) produced and commercialized by Southern Clay Products as Cloisite Na⁺ (NaMMT; without organic modifiers) and Cloisite 15A (OMMT; modified with dimethyldihydrogenated tallow-quaternary ammonium chloride quaternary surfactant). Also a micro-sized calcium carbonate, commercialized by Solvay as MVM, was used for comparison purpose. The neat PP as well as the nanocomposites (5 wt%) and the comparison-purpose microcomposite were prepared by means of a Brabender counter-rotating intermeshing twin-screw extruder with a max. temperature set at 190 °C. The obtained materials were subjected to compression moulding and subsequent mechanical, FTIR and morphological characterization. These were performed on the samples before and after accelerated weathering in a Q-UV environmental testing apparatus. The photo-oxidation behaviour of these samples was directly compared to that of the corresponding composites with different amounts of a compatibilizer, polypropylene grafted with maleic anhydride (PP-g-MA) were used in order to assess its influence on the photodegradation rate.

Tensile test showed that the behaviour of the different nanocomposites is comparable, and there are not many differences with the reference microcomposite. Also the photo-oxidation rates of the various nanocomposites are comparable. Morphological characterization showed the presence of significant changes in the morphology upon increasing the photo-oxidation time. The use of PP-g-MA led to significant variations in the photo-oxidation behaviour, both in terms of photo-oxidation products formation and induction time.

References

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