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PHOTODEGRADATION OF ALIPHATIC POLYESTERS AND THEIR COMPOSITES WITH TiO_2

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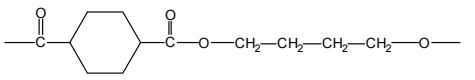
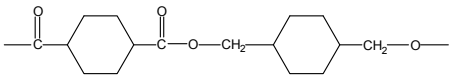
Abstract

Degradability or, on the contrary, durability of polymers are very important features affecting the performances of the materials in their shelf-life and their impact on the environment. The degradation can be due to different environmental factors, including light exposure, very important for polymers used in outdoor applications.
The knowledge of the photodegradation mechanisms and the possibility to modify them is a very important topic, especially for the novel biopolymers, as their durability with respect to the petro-plastics is yet an open question.
Among the biopolymers, aliphatic polyesters are an emerging class of materials, thanks to the possibility of preparing them from renewable resources and their potential environmental degradability. In this study two aliphatic molecular structures, containing 1,4-cyclohexylene units, have been analysed and used as matrixes for composites. The two repeating units are shown below.



PBCHD



PCCD

PBCHD and PCCD were exposed to UV irradiation in an accelerated photo-ageing device and the modifications in their chemical structures were analysed by UV and IR spectroscopies. It results that the photodurability of PBCHD, containing only one cycle per repeating unit, is higher than that of PCCD.
Moreover, in order to increase the durability, substances can be incorporated into the polymer. Among all the particles and nanoparticles which can be used, titanium dioxide (TiO_2) is known for its capability of absorbing UV radiation. This photocatalytic effect is strictly connected to its crystalline phases.
Therefore, composites containing different amount of TiO_2, in the anatase and rutile crystalline phases separately, have been prepared by using a Brabender mixer. The well dispersion of the particles and the good adhesion between TiO_2 and polymer have been checked by SEM observations.
The composites result to have a photostability higher than those of the homopolymers. The protection of TiO_2 against the photooxidation increases with the particle content and results higher for the anatase crystalline phase.
As a conclusion, a good increment of the photodurability of the studied aliphatic polyesters has been obtained by preparing composites with titanium oxide. This result could be particularly significant for outdoor applications of these polymers.