



Artificial simulated and natural weathering of poly(vinyl chloride) for outdoor applications: the influence of water in the changes of properties

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Abstract

Four different PVC formulations, designed for outdoor applications, were submitted to artificial accelerated ageing in xenon light, without and with spray of water, and to natural exposure in Lisbon. The influence of the combined action of water, temperature and radiation in the oxidative ageing was evaluated by means of molecular analysis, using infrared spectroscopy, and in terms of evolution of the aesthetic properties, using scanning spectroscopy and colourimetry.

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1. Introduction

Some artificial accelerated methods are currently used and accepted in the prediction of polymer lifetimes. However, in order to evaluate the durability of these materials, it is indispensable to reproduce the natural weathering phenomena as closely as possible. To attain this target, it is fundamental to understand the role of the atmospheric agents in the photo-degradation. The importance of radiation and temperature in the degradation of polymers is universally recognised. However, there is a trend to underestimate other environmental agents, such as humidity and rain, which play an important part in the evolution of degradation in certain compounded polymers.

The objective of this paper is to show the fundamental role of water in the mechanism of degradation of TiO₂ pigmented PVC formulations, and compare the results from different exposure methods, considering the influence of this degradation agent.

2. Experimental

2.1. Samples: compounding and processing

In this study, we used four different types of TiO₂ (rutile, surface-coated) pigmented PVC formulations, containing CaCO₃ and various additives, which are designed for outdoor applications. Particular care was taken to select thermal stabilisers with acceptable ecotoxicological characteristics.

The PVC formulations are referred to as PVC CZ and PVC S, according to the type of thermal stabiliser present (respectively, based on calcium/zinc or dibutyltin-maleate). Formulations additionally including a

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