AGEING OF PVC FOR OUTDOOR APPLICATIONS: ROLE OF WATER AND INORGANIC FILLERS

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Abstract

In most of polymer ageing studies conducted at laboratory, there is a trend to subestimate some of the parameters involved in natural exposure, leading to a poor simulation results and low reliability of the real world phenomena. Moreover the nature of polymer and its formulation should be taken into account due to possible synergies and antagonisms between environment and polymer additives. Among the subestimated parameters, we can stress the role of ambient humidity and inorganic fillers. These last additives are usually considered to be inert regarding the degradation induced by radiation. In this work we used X-ray photoelectron spectroscopy (XPS) and infrared spectroscopy (FTIRS) to evaluate the influence of the different photo-oxidation conditions. Different PVC formulations, designed for outdoor applications, in the form of calendered films, were submitted to artificial accelerated ageing under different radiation sources, with and without water spray, and also to natural exposure in Lisbon. Usually, PVC degradation is evaluated by dosing evolved chlorine under the form of HCl or Cl_2. XPS results show that, in technical PVC formulations, the fraction of chloride ions trapped in the inorganic filler is a better parameter to measure the PVC degradation (measured by the yellowing index variation) than the total lost (or remaining) chlorine in the surface. FTIRS measurements were used to follow the formation of oxidation products of the carbonyl type, which are due to radical attack on the double bonds in the molecular structure of PVC. Results show that relative rates of PVC degradation reactions are different under different photo-oxidative conditions. Combination of XPS and FTIRS analyses have shown that the best simulations of the

natural weathering of such PVC materials under laboratory conditions needs to consider, besides the light, the intervention of water jets and/or humidity as well as the existence of light and dark periods.

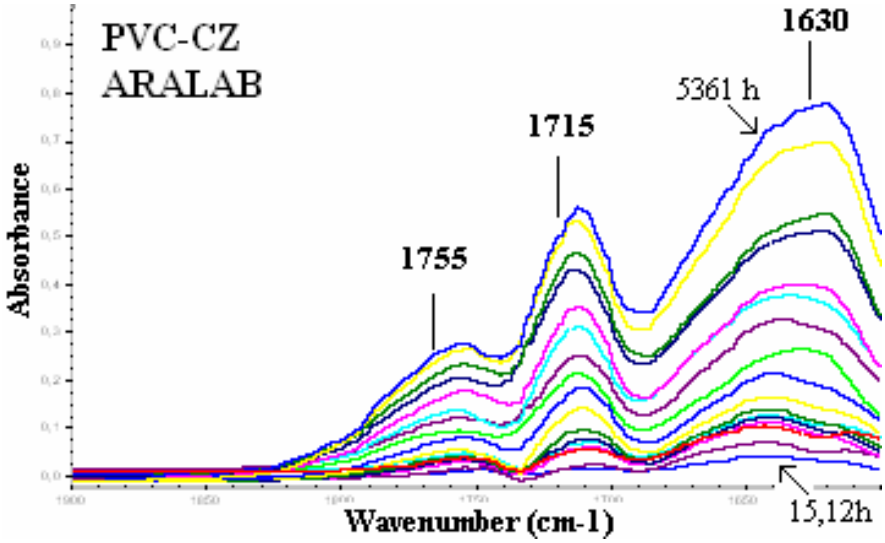

Figure 1 - FTIR spectra, in the region of (a)C=O and C=C streching, of PVC CZ under artificial weathering

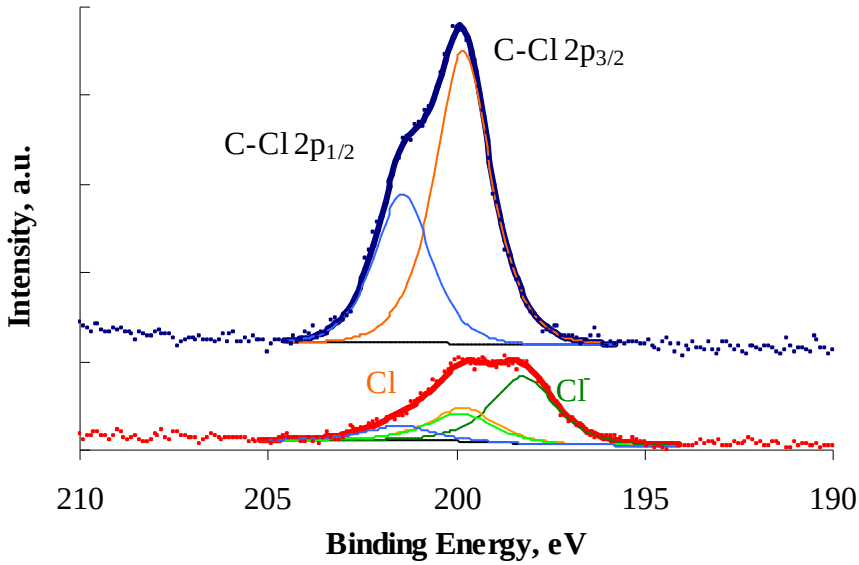

Figure 2- XPS Cl 2p region for films to two different artificial weathering procedures