FACTORS AND MATERIAL CONSEQUENCES IN POLYMER WEATHERING

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Abstract

In spite of the amount of data from commercial and academic research dealing with various aspects of polymer weathering, some misunderstandings and open problems remain in this complicated photochemical oxidative process. Mainly complex and reliable assessment of changes and interpretation of the data applicable for service life prediction are of concern. Our aim is a fundamental understanding of inter-relations and links between the sources of aging, its chemical, physical and mechanical consequences on material properties and ways improving weathering impact. The optimized selection of testing methods and interpretation of the data is a challenge for improving the knowledge.

We deal with a proper assessment of tests on stabilized commodity plastics, elastomers, their blends (including recyclates) and coatings. Phototriggered processes involving common atmospheric components, aggressive impurities and photosensitization processes play a decisive role in outdoor weathering, in the initiation processes as well as depletion of stabilizers reflected in the polymer lifetime. A complex evaluation of the development of changes on molecular and supramolecular level, respecting heterogeneity of the processes, development of concentration gradients, changes in morphology and informing on mechanical changes is able to describe the polymer fate contrary to simple chemical or thermal methods providing insufficient information and non-respecting sample geometry and morphology. Experimental results show changes in impact strength, carbonyl index and its distribution into free flowing and crosslinked part of the exposed samples affected by changes on the supramolecular level, and results of inspection of fracture surfaces of tested specimens. A synergism certainly exists between chemical, physical and mechanical changes. The links are explained by contribution of heterogeneity based on

structural and morphological effects, oxygen diffusion and radiation penetration influenced oxidation, morphology changes accounting for chain scission and crosslinking, and transition from ductile to brittle behavior. It is evident that the changes on the supramolecular level are of top relevance for the aging consequences of polymeric materials. This contribution is a part of a complex investigation of aging of polymers, including recyclates.

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