World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:12, No:05, 2018

Influence of UV Aging on the Mechanical Properties of Polycarbonate

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Abstract : Polycarbonate (PC) is a promising polymer with high transparency in the range of the visible spectrum and is used in various fields, for example medical, electronic, automotive. Its low weight, chemical inertia, high impact resistance and relatively low cost are of major importance. In recent decades, some materials such as metals and ceramics have been replaced by polymers because of their superior advantages. However, some characteristics of the polymers are highly modified under the effect of ultraviolet (UV) radiation and temperature. The changes induced in the material by such aging depend on the exposure time, the wavelength of the UV radiation and the temperature level. The UV energy is sufficient to break the chemical bonds leading to a cleavage of the molecular chains. This causes changes in the mechanical, thermal, optical and morphological properties of the material. The present work is focused on the study of the effects of aging under ultraviolet (UV) radiation and under different temperature values on the physical-chemical and mechanical properties of a PC. Thus, various investigations, such as FTIR and XRD analyses, SEM and optical microscopy observations, micro-hardness measurements and monotonic and cyclic tensile tests, were carried out on the PC in the initial state and after aging. Results have shown the impact of aging on the properties of the PC studied. In fact, the MEB highlighted changes in the superficial morphology of the material by the presence of cracks and material de-bonding in the form of debris. The FTIR spectra reveal an attenuation of the peaks like the hydroxyl (OH) groups located at 3520 cm-1. The XRD lines shift towards a larger angle, reaching a maximum of 3°. In addition, Vickers micro-hardness measurements show that aging affects the surface and the core of the material, which results in different mechanical behaviours under monotonic and cyclic tensile tests. This study pointed out effects of aging on the macroscopic properties of the PC studied, in relationship with its microstructural changes.

Keywords : mechanical properties, physical-chemical properties, polycarbonate, UV aging, temperature aging
Conference Title : ICPC 2018 : International Conference on Polymers and Composites
Conference Location : Paris, France
Conference Dates : May 17-18, 2018