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STRUCTURAL MODIFICATIONS OF ACRYLONITRILE-BUTADIENE-STYRENE (ABS) DURING PHOTO-OXIDATIVE DEGRADATIO

R.M. Santos [a,b], G.L. Botelho [c], C. Cramez [a,b], A.V. Machado [a]

a Departamento de Engenharia de Polímeros, Universidade do Minho, Campus de Azurém, 4800-058 Guimarães, Portugal

b Poliversal, Plásticos e Tecnologia, S.A. Estrada Nacional, 366, Km 21.5, 2050-145 Aveiras de Cima, Portugal

c Departamento de Química, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal

raquelysantos@gmail.com

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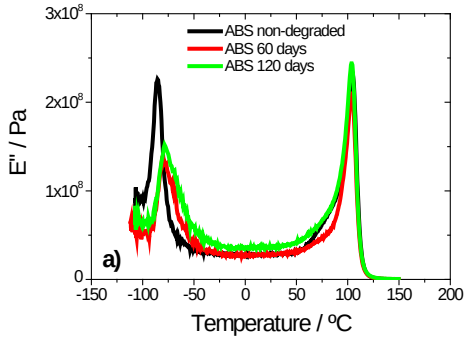
ABSTRACT

This work describes the effect of weathering into physical properties of acrylonitrile-butadiene-styrene (ABS). Mechanical performance of ABS is drastically affected under both type of weathering due to cracks formation on surface and its propagation within the copolymer matrix. Rheological measurements showed that complex viscosity of samples exposed to natural conditions decrease significantly suggesting that chain scission took place while no significant modifications occurs in samples submitted to accelerated conditions. In accordance with rheological measurements, dynamical mechanical analysis evidence that glass transition temperature of all samples increases during exposed to natural conditions, as a consequence of the formation of molecular chains of small dimensions.Thus, these results point out that mechanism under both type of weathering is different. Atmospheric conditions, such as, ultraviolet radiation, oxygen, temperature, humidity, rain and pollutants have a fundamental influence in polymers durability, leading to degradation and restricting the long-term application of these materials [1].

Acrylonitrile-butadiene-styrene (ABS) is an impact-modified styrenic polymer used in important technological applications, which is due to their excellent properties (mechanical, electrical and chemical) and low cost, taking into account that it is an engineering polymer. ABS copolymers exhibit a fundamental particularity; the properties depend essentially on the relative amount of each monomer and on the polymerization method used. Although it is possible to use ABS in a range of applications, for outdoor use this polymer needs protection during life cycle because of its high susceptibility to atmospheric conditions.

Natural weathering tests are not acceptable for many polymers that exhibit UV radiation resistance because long experimental time period is required. Since ABS is very susceptible to UV radiation, natural weathering experiments can be performed in a reasonable time period [2].

Thus, in this work extend initial studies the influence of weathering into physical properties of ABS tapes. Samples were exposed to natural and accelerated weathering conditions, to accordance standard methods, removed periodically and characterized by several techniques, such as infrared spectroscopy, rheological measurements, stress-strain experiments, dynamical-mechanical analysis and chemical treatments.



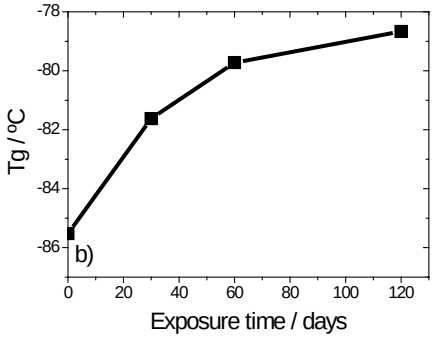
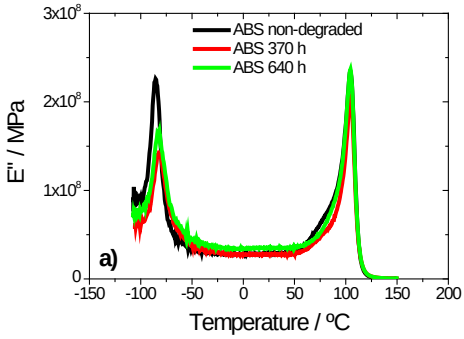


Figure 1 – Loss modulus a) and Tg b) of ABS samples submitted to natural conditions.



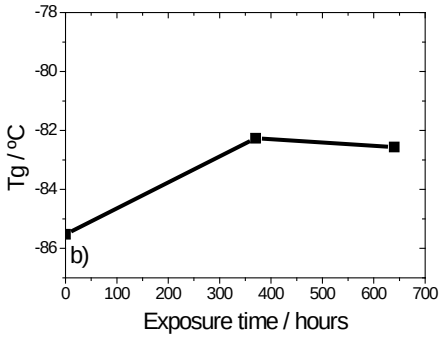


Figure 2 - Loss modulus a) and Tg b) of ABS samples submitted to accelerated conditions.

The loss modulus of all samples exhibit two main relaxations. The first at ca. -85 ºC, assigned to the segmental motions of the amorphous chains of the PB and corresponds to the cooperative relaxation assigned to the glass transition (Tg) dynamics and usually is labelled by β or α_a [3]. The second at 104 ºC corresponding to the relaxation process related to the Tg dynamics of acrylonitrile (SAN) phase.

The glass transition temperatures of all samples along degradation time were determined by the onset of E'' peak. An increase on Tg corresponding to butadiene component was observed for all samples. However, it can be observed that modifications are more pronounced in samples submitted to natural conditions (an increase of 8 ºC) while no significant changes occurs in samples exposed to accelerated weathering conditions.

This study might suggest that mechanism under both type of weathering is different. Thus, further work is necessary to find out if photo-oxidative degradation mechanism are really dissimilar

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AUTHOR BIOGRAFIES

Raquel Santos have a degree in Chemistry at University of Minho, in 2005. She worked for 8 months as research for the Cires – Companhia Industrial de Resinas Sintéticas. In 2007, she received a PhD grant financially supported by FCT and Poliversal – Plásticos e Tecnologia, S.A.