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Influence of organic Montmorillonite in photooxidative degradation of PMMA/clay nanocomposites

Valandro, Silvano R.[1]; Poli, Alessandra, L.[1]; Neumann, Miguel G[1]; Schmitt, Carla, C.[1]

[1]Instituto de Química de São Carlos, Universidade de São Paulo, São Carlos, Brazil silvano@iqsc.usp.br

The aim of this work was to study the photooxidative degradation of PMMA/organic Montmorillonite nanocomposites using gel permeation chromatography. A typical 2^2 factorial design was used to study the effect of the different organic-clays and the concentration these clay on the photooxidative degradation of the PMMA/clay nanocomposites. These factors and their studied levels are identified in Table 1 and the statistical analysis of the results was carried out using the software Statistica®. The PMMA and nanocomposites were prepared by photopolymerization *in situ*. The films were exposed to UV light in an irradiation chamber containing 16 UV lamps (total power 96 W) at 40 °C. The lamps emitted predominantly 254 nm wavelength. For the pure polymer (PMMA), as well as for the nanocomposites (SWy-1-C8/PMMA and SWy-1-C16/PMMA), the changes caused by irradiation of the samples are characterized by a decrease of molecular weights (Table 2).The model for polymer degradation described by *Vinu* and *Madras*[1] leads to a correlation between the change of the number –average molecular weight *Mn* with time and the degradation rate constant k_d. This relationship is plotted in Figure 1. It can be seen that the ratio Mn_0/Mn_t shows an assymptotic behaviour, reaching its maximum faster for the pure polymer than for the clay-containing films. The degradation rate coefficients, k_d, for PMMA and the nanocomposites films were calculated from the initial slopes of these curves (shown in Figure 1b), using the initial *Mn* for each system. The values are shown in Table 2, from where it can be seen that k_d decreases with increasing concentration of the organic-clay. The results of the statistical analysis are reported in Table 3. It was found that the B factor has more significant effect than A (for a significance level of 95%), this can be interpreted since the SWy-1 organic clays can be considered an stabilizer against UV irradiation. The stabilization mode of the clays may be explained on the ability of SWy-1 not only to scatter the incident light but also to absorb part of the UV light thus minimizing the absorption by PMMA and the degradation of the polymer in the nanocomposites, this happens independently of the organic-cation presence in the Montmorillonite. The photooxidative degradation occurs more slowly (6 times) for the nanocomposite prepared with 5.0 wt% and SWy-C16.

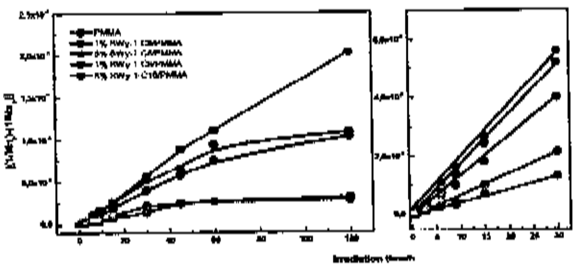

Figure 1: (a) Variation of $[(1/M_{nt})/(1/M_{n0})]$ vs. irradiation time for the degradation of PMMA and nanocomposites; (b) blow-up of the initial time.

Table 2: Photooxidative degradation coefficient of PMMA and nanocomposites films

	$k_d(10^{-8}mol\ g^{-1}h^{-1})$
PMMA	2.59
1%SWy-C8/PMMA	1.21
5%SWy-C8/PMMA	0.71
1%SWy-C16/PMMA	1.72
5%SWy-C16/PMMA	0.43

Table 1: Factors and levels of the 2^2 factorial design

Factors	Inferior level (-)	Superior level (+)
(A) Organic-clay	SWy-C8	SWy-C16
(B) Concentration	1.0 wt %	5.0 wt %

Table 3: Estimated effects of (A) Organic-clay and (B) Concentration

Effects	
Media	3,329
A	0,871
B	3,013
AB	1,505

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References

[1]VINU, R.; MADRAS G., Polymer Degradation and Stability, 2008, 93, 1440