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OBTAINING OF POLYCARBONETE/CLAY NANOCOMPOSITE AND CHARACTERIZATION BY NMR OF LOW-FIELD

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Abstract – Polycarbonate (PC) polymers are an important technological and commercial interest. The study of the addition of low levels of nanoparticles in polymeric materials has received much attention, since the nano promotes greater area of contact between the components of a composite, resulting in desirable properties. In this work, nanocomposites of polycarbonate were prepared by solvent cast method by using quantities of montmorillonite organophilic clay (OMMT). To assess the dynamics of molecular nanocomposites, we used the NMR relaxation time, in particular spin-lattice relaxation times, T1H and characterization by XRD to confirm the results.

In the past few years, polymer nanocomposites have gained increased attention in materials research as they offer immense opportunities to design materials with improved properties. Many of these were found to be controlled by the selection of the polymer as well as the distribution of nanoparticles within the polymer matrix. The study of the addition of low contents of nanoparticles to polymeric materials has attracted considerable attention, especially because the nanometric scale favors closer interaction between composite components, which plays a role in achieving desirable applications [1].

To evaluate the influence of clay content on the modification on the properties of nanocomposites in the polymeric matrix the techniques of X-ray diffraction (XRD), infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and transmission electron microscopy (TEM), among others, have been used. In this work, nanocomposites of polycarbonate were prepared by the solvent cast method by using quantities of montmorillonite organophilic clay (OMMT), 1%, 3%, and 5% in weight of the polymer to evaluate the dynamics of molecular nanocomposites, through low-field nuclear magnetic resonance (NMR), as many properties, including density of connections, aging and mechanical properties, among others, depend on the mobility of the molecular arrangement and can be characterized using NMR relaxation time, in particular spin-lattice relaxation times, T_1H, and characterization by XRD to confirm the results.

The nanocomposite was prepared through solution intercalation: polycarbonate (PC) was solubilised in dichloromethane under agitation for 24 hours; after PC solubilization, the clay was added and the system was stirred for 24 hours at room temperature. The suspension was put into the glasses and the solvent was evaporated slowly, resulting in a nanocomposite film.

These results show that the incorporation of 3 and 5 %wt OMMT changed the molecular mobility of the polycarbonate matrix, due to the formation of a nanostructured material, suggesting the formation of OMMT/PC nanocomposites with a high degree of exfoliation, since the polymer chains are around the clay lamellae and the metals present on it acts as a relaxation agent, diminishing the relaxation time. This effect was not seen for 1% of organoclay, which can indicate the formation of intercalated nanocomposites, because the polymer chains lose their motions when they are constricted among the clay lamellae.

The X-ray diffractogram of clay showed two peaks, one at $2\theta = 3.4°$, for the organophilic material, and the other in $2\theta = 6.80°$, derived from unmodified clay. It was also observed an increase in the basal spacing of the clay platelets due to a shift in the 2θ angle for the samples with lower clay ratios, suggesting an exfoliation and intercalation.

The results observed from XRD showed that nanocomposites of PC/OMMT with different clay ratios were obtained by solution intercalation. The values of T_1H, obtained by low-field NMR, were sensitive to changes in molecular mobility of the samples with different clay ratios, which could not be detected by X-rays because of the observed scale.

Table 1– T_1H measurements for PC film, 1%wt, 3%wt and 5%wt OMMT/PC nanocomposites films

SAMPLES	T_1H (ms)	T_1H (%)
PC	97	3.0
1 %wt OMMT/PC	101	5.0
3 %wt OMMT/PC	92	5.0
5 %wt OMMT/PC	93	6.0

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