

Evaluation of Polymer Nanocomposite Degradation During Melt Processing

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The use of polymer materials to produce consumer goods or to replace other types of materials in various industrial processes has grown considerably in the past decade.

The continuous growth in the use of polymer materials to make products that are disposable or have short lifetimes has been attracting attention from researchers and authorities throughout the world because of the generation of solid wastes and the consequent environmental pollution. Recycling is one of the main ways to control the environmental impact caused by these wastes. However, during recycling, polymers can undergo degradation of the polymeric. Hence, one of the greatest challenges of this process is to keep the performance of these materials at a good enough level that they can be reused in the same application or other economically attractive applications defined according to the new characteristics [1,2,3].

Additivation of polymers is a procedure commonly employed in industry, to rectify or minimize the negative impacts of recycling on polymers. This technique can be applied to obtain polymer or while using it to make the final product. Two factors particularly influence the quality of the additive load and must be taken into consideration: particle size and distribution. The smaller and better distributed the particles are, the more effective their action and aspect ratio will be, and the higher this last property is, the better the reinforcement properties will be. Nanoparticle have all these characteristics, making their use an innovative way to significantly improve the properties of materials, due to the nanometric scale of the particles (0.1-100 nm). Polymeric nanocomposites based on lamellar silicates have attracted a good deal of interest because of their potential industrial uses. The addition of up to 10% clay can alter the properties of these materials due to the large surface contact area between the clay and polymer. These modifications include improvements in flame resistance and the gas barrier and mechanical properties. However, the dispersion of clay in polymers poses some challenges, because there is a preferential interaction between them that favors the formation of agglomerates. In many cases the clay needs to be organically modified to make it compatible with the polymer and allow good dispersion [4,5,6,7].

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In this work the high impact polystyrene nanocomposites with organoclay were prepared. Clay of the smectite group, the montmorillonite, with two types of intercalating was used. The nanocomposites were prepared by melt intercalation, applying two shear intensities. Different cycles of extrusion were used to simulate the recycling process. The characterization techniques chosen were effective, corroborating the information obtained and complementing it in the evaluation and comparison of the nanocomposites. The use of low-field NMR, to measure the spin-lattice relaxation time of hydrogen (T_1H), provided more precise information on the mobility of the materials, to complement the results obtained by other techniques

To obtain information on the molecular dynamics of the HIPS samples and the nanocomposites, the spin-lattice relaxation times (T_1H) were determined using inversion-recovery pulse sequence in a low-field NMR, in the solid state, using a Resonance Instruments Maran Ultra 23 spectrometer, operating at 23.4 MHz (for protons) and equipped with an 18 mm variable temperature probe.

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