

عنوان مقاله:

Preparation and Characterization of Layered Silicate Polyethylene Terephthalate Nanocomposite by in Situ Polymerization

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خلاصه مقاله:

A series of experiments on the synthesis of poly (ethylene terephthalate) (PET)/organo-montmorillonite (MMT) nanocomposites were carried out in a pressurized reactor using alkyl ammonium exchanged smectite clays, (Cloisite 30B). Given the degradation of organoclay at high temperatures, the in situ polymerization process was carried out at mild temperatures ranging from 210 to 230°C for 40 minutes followed by solid state polymerization (SSP) at 245°C for 30 minutes at a pressure of 5 mbar. The nanocomposites were prepared using different weight percentages (1-5) of organoclay. The reaction completed when the mixing torque ceased to change as recorded by the auto data acquisition system of the pressure reactor. The DSC analysis provided information on the course of the thermal characterization of the PET nanocomposites versus regular PET. As shown by the results of DSC cooling scan, all the PET nanocomposite samples have higher crystallization temperatures (T_c) and faster crystallization rates ($\Delta H_c/t$) compared to regular PET. Furthermore, the opposite behavior is observed for $t/2$. This is due to the fact that the nucleation of organoclay nanoparticles reduces the crystallite size in the PET nanocomposites. The XRD results indicated that the peaks in the 2θ angle from 1° to 7° were disappeared, which is an indication of an exfoliated MMT. In addition, The atomic force microscope (AFM) results showed broken mirror like lamellae, confirming the exfoliated results of the XRD analysis. The peaks are indexed according to the 2θ angle from 10° to 30° known assignments of the triclinic unit cell dimensions for PET. The comparative crystallite size of the PET nanocomposites samples (1-5%wt organoclay) can be deduced from the peak ratio change of 2θ angle from 10° to 30°. Heat distortion (or deflection) temperature (HDT) was enhanced by increasing the amount of organoclay in PET nanocomposites compared to regular PET. The tensile test results of 2%wt organoclay show an increase of 58% in the tensile strength of this sample. As a result of MMT agglomeration, due to the high temperature instability of Cloisite 30B, the relative oxygen pressure drop data shows fluctuations. However, as an overall trend, PET nanocomposite gives about 50% greater reduction in O₂ pressure drop or relative oxygen permeability compared with a homo structure.

