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Anomalous Impact Strength for Layered Double Hydroxide-Palmitate/Poly(e-caprolactone) Nanocomposites

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Abstract

Inherent physical properties and commercial availability makes poly(e-caprolactone) (PCL) very attractive as a potential substitute material for nondegradable polymers for commodity applications. However, a balance of toughness and stiffness is needed in order to transfer this potential into reality, particularly for short-term packaging applications. In this context, layered double hydroxide modified with palmitic acid (LDH-palmitate), was used as a nanoadditive to enhance the mechanical properties of PCL. Composites from PCL were prepared by melt-blending with LDH-palmitate loadings in the 1210 wt % range. Scanning electron microscopy, transmission electron microscopy, and X-ray diffraction were used to study the structure and morphology of the composites. The results showed homogeneous dispersion of clay particles in composites, but the degree of stacking of clay platelets was related to the LDH-palmitate loadings. Charpy impact test measurements revealed an anomalous toughness improvement in the case of composite containing 5 wt % LDH-palmitate, attributed to a combination of microcavitation and changes in crystallite sizes in the composite. The addition of LDH-palmitate improved the water vapor barrier permeation of neat PCL film. In summary, LDH-palmitate was shown to have potential as a nanoadditive to obtain tougher LDH-PCL composite with improved barrier property.

KEYWORDS: clay; composites; crystallization; mechanical properties; plasticizer