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A combined experimental and theoretical approach to quantitative assessment of microstructure in PLA/PP/Organo-Clay nanocomposites; wide-angle x-ray scattering and rheological analysis

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Abstract

A rheological study and morphological investigation using scanning electron microscopy (SEM), transmission electron microscopy (TEM) and wide angle x-ray scattering (WAXS) techniques were performed on the single step melt processed poly(lactic acid) (PLA)/polypropylene (PP)/organoclay counterpart blend nanocomposites prepared via a micro-compounder. Two types of organoclay, Cloisite 30B and 15A were used for the preparation of the nanocomposites. Using a thermodynamic approach and with the aid of experimental techniques, it was indicated that both types of organoclay tend to localize within the PLA phase. Accordingly, in PLA-rich blends, 30B organoclay was localized in the matrix while in the PP-rich system the organoclay (15A) was mainly concentrated within the dispersed phase and also at the interface. In analyzing the WAXS results, two quantities, derived from Bragg and Scherrer's equations, in order to quantify the extent of interaction of organoclay with the different media and also partitioning of clay within the blend components. By that means, it was indicated that WAXS technique owns a great potential to predict organoclay morphology within the blend nanocomposites. Using the weighted relaxation spectrum of blends and implementation of Palierne emulsion model the interfacial tension of PLA/PP counterpart blends was determined. Despite the weak interaction of organoclay with the PP and also the low content of PLA in the PP-rich blend, the 25/75 PLA/PP blend represented substantial enhancement in elasticity as a result of organoclay loading. This behavior was attributed to the