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Concurrent Enhancement of Multiple Properties in Reactively Processed Nanocomposites of Polylactide/Poly[(butylene succinate)-co-adipate] Blend and Organoclaya

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Abstract

Polylactide (PLA) and poly[(butylene succinate)-co-adipate] (PBSA) were reacted by being blended in a batch mixer in the presence of a chain extender, triphenyl phosphite (TPP), and two different types of organically modified clays—a montmorillonite clay (C20A) and a synthetic mica (MEE)—to enhance the thermal stability, impact toughness, and barrier properties of the PLA. An accelerated increase in the torque during processing indicated catalyzed chain-extension reactions in the clay-based compatibilized blends. The rate and extent of the increase in the chain extension/coupling were dependent on the type of organic surfactant used to modify the pristine clays. Enhanced chain extension/coupling and char formation resulted in dramatic thermal stability increases of 17 and 26 8C for composites with 2 and 6wt% C20A loadings, respectively. Similarly, the oxygen and water-vapor permeabilities were improved with the addition of the clays. At 4wt% MEE loading, the oxygen and water-vapor permeabilities were reduced by 60 and 50%, respectively. Unlike the MEE-based blends, C20A-based compatibilized blends resulted in higher toughness than the neat PLA due to the lesser crystallinity of the PLA component and enhanced chain extensions/coupling in the C20A-based samples. Therefore, this work demonstrates the possibility of enhancing the thermal stability, toughness, and barrier properties of PLA in a one-stage process through reactive blending with PBSA in the presence of clays.