PLA-PHB POLYMER BLENDS: STUDY ON PROCESSING CONDITIONS AND INFLUENCE OF COMPATIBILIZERS

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Introduction

In the recent years, the concerns related to the environmental issues stimulated an increasing interest towards the application of biodegradable polymers. However, the use of these renewable resources, in alternative to the conventional petrochemical derived products, has some disadvantages such as limited thermo-mechanical properties. A possible and effective method to overcome some biopolymers limitations is the development of bio-based polymer blends.

Material and Methods

PLA was supplied in pellets by IngeoTM Natural Natureworks (Minnetonka, MN, USA) under the trade name PLA 3251D. PHB was manufactured by Aonilex, KANEKA Biopolymer (Osaka, Japan) under the trade name PHBX151A. Span TM 80-LQ-(RB) is a sorbitan ester, and Tween TM 80-LQ-(CQ) is an ethoxylated sorbitan ester. Synperonic (Syn) is a polyalkylene oxide block copolymer in the form of flakes (at 25 °C). All the compatibilizers are commercialized by CRODA. Cloisite 5 bentonite organomodified with bis(hydrogenated tallow alkyl)dimethyl salt (CL) was supplied by BYK Additives & Instruments, ALTANA.

Results and Discussion

Blends based on PLA and PHB polymers were prepared by melt blending using a twin screw extruder and different amounts of natural compatibilizers and nanoclay were added. The morphology of the blends and their thermal, mechanical, and rheological behavior were evaluated, aiming at assessing the influence of the selected compatibilizers, the role of nanoclay and the different process parameters on the microstructure and final properties of the systems. Morphological analyses of the compatibilized blends indicated that Span-Tween surfactant is effective in inducing morphology refinement, as also suggested by results coming from rheological measurements. Furthermore, thermal analyses demonstrated that the presence of both kinds of compatibilizers induced an enhancement of the crystallinity content of blends. Finally, a remarkable increase of the elastic modulus values was obtained for the compatibilized blends as compared to the pure counterparts, with a consequent significant enhancement of the HDT values. The nanofilled blend was processed considering three different screw profiles and particularly the presence of backflow and distribution elements in the screw profile, high shear stresses are induced during the processing able to allow a better interaction between polymers and clay. This finding also occurs in the thermo-mechanical properties of material, as an improvement of storage modulus up to 20% in filled blend processed with a specific screw profile. Rheological studies were able to explain the different blend morphologies and the role of chemical and processing variables.