Morphology and properties of hybrid polylactide and thermoplastic corn starch composites

Summary

An original method of obtaining thermoplastic corn starch (TPS) was developed. Blends of polylactide (PLA) and TPS made by twin-screw extrusion as well as hybrid composites containing unmodified (SiO_2) and modified nanosilica heaving amine (A-SiO_2) or epoxy (E-SiO_2) functional groups were obtained. In order to increase compatibility between hydrophobic PLA and hydrophilic TPS, maleated polylactide (MPLA) was used as a compatibilizer. Blends were plasticized with non-reactive [poly(dimethylsiloxane)] or reactive [poly(dimethylosiloxanol)] plasticizers. The joint effects of compatibilizer, type and content of plasticizer and nanofiller on the structure, mechanical, rheological and thermal properties of PLA/TPS blends were examined. Several interdisciplinary research methods, *e.g.*: infrared spectroscopy with Fourier transformation (FTIR), scanning electron microscopy (SEM), differential scanning calorimetery (DSC), thermogravimetric analysis (TGA) and dynamic-mechanical thermo analysis (DMTA) were used to evaluate the properties of obtained materials. The addition of MPLA increased PLA/TPS blends compatibility, while plasticizers improved elongation at break and impact strength. Moreover, the reactive plasticizer improved tensile and flexural modulus. The addition of nanosilica resulted in further increase of elongation at break with simultaneous slight decrease in impact strength. DSC and DMTA analyses show that nucleation ability and reinforcing effect of A-SiO_2 on plasticized blends are much better than those of SiO_2. Silica practically had no effect on the thermo-oxidative degradation. However, composites with the reactive plasticizer showed slightly better thermal resistance. The subject taken in the submitted doctoral dissertation is interdisciplinary and fits in with the so-called green chemistry (environmentally friendly technologies).

Key words: polylactide, thermoplastic starch, nanosilica, biodegradable polymers, nanocomposites