Morphology and properties of spherical nanosilica filled poliolefin nanocomposites

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Summary

Nanocomposites based on low density polyethylene and isotactic polypropylene with the addition of unmodified or modified spherical nanosilica heaving amine functional groups, and compatibilizer (glicydyl methacrylate grafted ethylene-n-octene copolymer) were obtained. The effects of silica loading, size and its functionality as well as the amount of introduced compatibilizer and the type of polymer matrix on the morphology and properties of polyolefin nanocomposites obtained by twin-screw extrusion were investigated. The process conditions were selected experimentally. Several interdisciplinary research methods such as: Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), differential scanning calorimetry (DSC), thermogravimetric analysis (TGA) dynamic-mechanical thermal analysis (DMTA) were used to evaluate the morphology, physicochemical, mechanical and thermal properties. The synergistic effect of the compatibilizer, nanofiller and polymer matrix on the tested properties was noted. The introduction of a compatibilizer promotes the formation of chemical and/or physical bonding between the nanofiller, compatibilizer and polymer, which facilitates the dispersion of the filler particles, resulting in improved mechanical and thermal properties of polyolefin. The obtained composites are characterized by a relatively even dispersion degree of the nanofiller. However, the nanosilica has a tendency to form agglomerates. The modification of the nanosilica and the introduction of the compatibilizer reduce the tendency of the filler to agglomerate. The nucleating and reinforcing effects of the nanofiller were observed. Addition of nanosilica and a compatibilizer significantly improves the thermal resistance of polyolefin nanocomposites, as evidenced by the significantly higher temperature of the beginning and the maximum rate of thermooxidative decomposition. Nanosilica increases the elongation at break. A significant influence of both, the polymer matrix and the size, type and filler content on the impact strength of the composites was also demonstrated. The properties of nanocomposites can be designed depending on their application. The subject matter taken up in the doctoral dissertation submitted is interdisciplinary.

Key words: nanocomposites, polyethylene, polypropylene, nanosilica, compatibilizer