SL 9.32

Antimicrobial Nanocomposites by Means of Additive Containing Silver-Nanoparticles

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The objective of this work is to study the process of compounding TiO_2 particles decorated with silvernanoparticles into thermoplastic polymers by means of a twin screw extruder to impart the antibacterial properties to the polymer and to characterize it regarding to morphological, mechanical and physical properties. The antibacterial properties are based on the release of silver ions. Silver-nanoparticles show oligodynamic activity, which has a great potential for the prevention of infections caused by different types of microorganisms. Due to the migration of silver ions from inside of the polymer up to the surface, the long time antibacterial effect of silver ions is ensured. For better processing the silver particles are attached to TiO_2 particles.
The silver-nanoparticles were synthesized by the reduction of silver salts with the help of reducing agents. Titanium dioxide having a particle size of 270 nm was used as a carrier substance for the silver-nanoparticles with a size between 10-30 nm, which was dispersed in water or alcohol. This suspension was dried to obtain the powder of titanium dioxide decorated with silver-nanoparticles. The product is further characterized by means of light scattering and transmission electron microscopy (TEM).
Silver-nanoparticles were compounded into low density polyethylene (LDPE) using a fully intermeshing twin screw extruder. The obtained nanocomposite was characterized with respect to the morphological and the physical properties by means of TEM and differential scanning calorimetry (DSC). To optimize the compounding process, parameters like screw configuration, screw speed, throughput and temperature were considered. Subsequently, the nanocomposites were processed to injection molded components and characterized.
The antimicrobial tests were carried out according to American Standards for Testing and Materials (ASTM). The first studies show that even the nanocomposite containing 0.02 wt. % of silver-nanoparticles exhibits very good antibacterial properties.