Thermal characterisation of non-additivated raw Polypropylene/Silicon colloidal composites.

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Oxidation of plastics by ultraviolet (UV) radiation exposure is an important limitation for their use in packaging and other applications where there is direct contact with food or drink. Severe polymer decomposition can occur when free-radical sites are generated along the polymer backbone and react with the rest of the polymer or with oxygen molecules. A strategy to guarantee a successful use of plastic materials is to incorporate additives which can improve the resistance to light and weathering, enhance their physical properties and ultimately respond to environmental health demands of new products. In this framework, novel Silicon-based composites have been recently developed by means of Silicon colloids [1, 2]. This loading consists of Silicon micro and nano particles with a very smooth surface. They are capable to protect polyolefins in a large-span frequency range, covering the visible and far infrared regions.

In this study, polypropylene/Silicon colloidal composites were studied. The composites were prepared by hot melt extrusion. Dispersions manually mixed containing the non-additivated raw polypropylene (PP) matrix, the Silicon colloids (SCs) added at 3% and 5% by weight percentage, and 3% of maleic anhydride as coupling agent were incorporated into the hopper. The resultant needle-shaped composite was then triturated through a Banbury mixer. Then, the film probes, with thicknesses around 200 µm, were obtained by a hot plates press. The influence of Silicon particles on the polypropylene matrix were assessed by means of scanning electron microscopy (SEM) and thermal analysis (TGA, DSC and DMTA). A good dispersion of Silicon particles was found by electron microscopy. Moreover, Polypropylene/Silicon composites improved thermal stability as demonstrated by a retarded onset and higher main degradation temperature in thermal decomposition measurements. Calorimetric studies showed higher melting enthalpy when Silicon was added. In addition, a higher elastic modulus was found by mechanical analysis. In summary, Silicon particles certainly influenced thermal behaviour, showing some differences in comparison with the raw non-additivated polypropylene, probably associated to a nucleating ability of these particles.

References:

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