PREPARATION AND CHARACTERIZATION OF VINLYSILANE CROSSLINKED THERMOPLASTIC COMPOSITES FILLED WITH NANOCLAYS

MA Sibeko and AS Luyt

Department of Chemistry, University of the Free State (Qwaqwa Campus), South Africa
(E-mails: SibekoMA@qwa.ufs.ac.za, LuytAS@qwa.ufs.ac.za)

ABSTRACT

The effects of vinyltriethoxysilane (VTES) grafting, nanoclay content and the nature of the nanoclay were investigated for LDPE-clay and HDPE-clay nanocomposites. LDPE and HDPE were first grafted with VTES (1phr and 3phr) in the presence of dicumyl peroxide and then filled with different contents (1,3, and 5 wt %) of modified (Cloisite 15A – C15A) and unmodified (calcium montmorillonite - Ca^{2+} MMT) clays. The polymer-clay nanocomposites were prepared through melt mixing in a Brabender Plastograph internal mixer. The nanocomposites were characterized for their morphology (including extent of grafting, thermal properties, mechanical properties, and thermomechanical properties. The properties were determined using X-ray diffractometry (XRD), transmission electron microscopy (TEM), Fourier-transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC), thermogravimetric analysis (TGA), tensile testing, dynamic mechanical analysis (DMA), and gel content determination. The dispersion of nanoclay in the polymer matrix is important as morphology has a significant effect on the nanocomposite properties. The grafting of VTES onto polymer chains was confirmed by FTIR. XRD and TEM results show total exfoliation of clay layers for the silane treated Ca^{2+} MMT, while the silane treated C15A and the untreated nanocomposites show intercalated structures. DSC results show a slight decrease in melting temperature for the grafted polymer, while the grafted nanocomposites and the nanocomposites without silane show no effect. The melting enthalpy shows a decrease for the grafted nanocomposites. Furthermore, the crystallization temperature of the grafted nanocomposites shows no effect while nanocomposites without silane show a nucleating effect. The TGA results show an improvement in thermal stability for all the nanocomposites, and the silane treated C15A nanocomposites show the highest degradation rate at high clay contents. The mechanical properties show improvement with the addition of clay, but at high clay loadings it decreases.