

Effects of polymer/filler interactions on the rheological properties of polyolefin elastomer/nanosilica composites

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Nanocomposites were prepared using a silane-grafted polyolefin elastomer (POE) matrix reinforced with hydrophobic silica nanoparticles (oct-SiO₂). The systems were differentiated according to the presence and the extent of polymer/filler interactions, depending on the type of silane agent grafted on the matrix, either monofunctional (VTES) or bifunctional (VTEOS). Polymer/filler interactions consisted primarily of covalent bonds between VTEOS functionalities grafted on the POE matrix and the hydroxyl groups present at the surface of the particles. Weaker interactions occurred when VTES was used, as confirmed by bound polymer measurements. TEM micrographs revealed that the particles were finely dispersed, because of the hydrophobic nature of the nanoparticles. A slight improvement was noticed in POE-g-VTEOS-based composites because of the presence of covalent bonds, which improved stress transfer, thus facilitating the break up of the silica aggregates. Rheological measurements carried out in the melt state revealed significant differences according to the type of matrix used. Time-sweep experiments carried out in the LVE region showed that the storage modulus of POE-g-VTES-based composites increased by 53% after only 500s. On the contrary, properties of POE-g-VTEOS-based composites remained stable. It is believed that the strong interactions occurring between POE-g-VTEOS and oct-SiO₂ prevent the particles to rearrange upon small shear. During stress-sweep experiments, POE-g-VTEOS-based composites were more resistant to deformation as data of the onset of nonlinearity -or critical strain- showed. It is believed that these differences are attributed to the different nature of polymer/filler interactions, depending on whether the monofunctional, or bifunctional silane agent is used.