

ABSTRACT

A novel process of surface modification of precipitated silica and kaolin clay has been performed by coating the fillers with an acrylate monomer, trimethylolpropanetriacrylate or a silane coupling agent, triethoxyvinyl silane followed by electron-beam irradiation at room temperature. Presence of the acrylate and the silane coupling agent on the modified silica and clay fillers is confirmed from the *FTIR*, *ESCA*, *SEM/EDX*, *TEM*, and *TGA* studies. The water contact angle measurement suggests a significant improvement in hydrophobicity of the treated silica fillers. *XRD* studies demonstrate that the modification process does not alter the bulk properties of the fillers. Both unmodified and surface modified fillers have been incorporated in an ethylene-octene copolymer rubber, which is then subjected to cure either by peroxide or electron-beam radiation. Phase images of the above composites, obtained by tapping mode atomic force microscopy studies, elucidate the reduction in aggregate size due to the filler surface modification, which is more pronounced in the case of silane modification. The results obtained from the section analysis, surface roughness, power spectral density and the histogram of the filler distribution further corroborate the above findings. Significant improvements in rheometric, mechanical, volume swelling and aging properties have been noticed in the case of the vulcanizates containing modified filler. The above properties are improved especially in the case of electron-beam irradiated silanized silica filled composites. Modification of the silica filler via silanization process significantly reduces filler-filler networking, as evidenced from the strain sweep tests and thus helps in reducing **Payne effect**. The enhancement in the storage modulus at high temperatures and changes in the loss tangent at T_g suggest definite improvement in the polymer-filler interaction in the case of these modified fillers. The filler-filler and the polymer-filler interactions in the case of silanized silica filled copolymer are quantified with the help of a generalized mathematical model correlating the modulus and the volume fraction of the filler. The efficacy of electron-beam radiation treatment for the surface modification of silica filler

and the influence of the modified filler in the polymer matrix have been investigated with the help of the above model. The reduction in filler-filler networking potential due to the above surface modification is also revealed from the thermorheological studies of the unvulcanized silica filled ethylene-octene copolymer. However, the flow properties of the ethylene-octene copolymer remain unaffected with the addition of clay filler as obtained from the rheological studies.

In another part, clay-polyacrylate (MPA) hybrid material is prepared from montmorillonite (M) clay and polytrimethylolpropanetriacrylate (PA) by the diffusion of trimethylolpropanetriacrylate monomer into the interlayer of modified clay via polymerization of the acrylate monomer. The results obtained from *XRD*, *IR* and *SEM/EDX* studies show the successful intercalation of PA in the M moiety. The MPA hybrid material is then blended with ethylene-octene copolymer. Tensile and dynamic mechanical thermal analyses have been performed on this polymer-filler composite and the results show improved interaction between the treated clay and the base polymer.

Key Words

Precipitated silica, Kaolin clay, Trimethylolpropanetriacrylate, Triethoxyvinylsilane, Filler surface modification, Radiation processing, Silanized silica, Silanized clay, Acrylated silica, Acrylated clay, Ethylene-octene copolymer, Peroxide curing, Electron-beam radiation curing, Atomic force microscopy, Dynamic wicking, Payne effect, Filler-filler interaction, Polymer-filler interaction, Nanocomposite, Polymer-clay hybrid material, Montmorillonite clay, Intercalation