Abstract

Taguchi methodology has been used to optimize the processing parameters for the EOC: PDMS blends. It was found that the rotor speed and the blending temperature of the mixer play significant roles in controlling the strength properties of the blends. While, the time of mixing has less effect on the ultimate properties of the 70:30 EOC: PDMS blends as compared to the other parameters. The optimum processing conditions such as temperature, rotor speed and blending time in the mixer were found to be 140 °C, 80 rpm, and 8 minutes respectively. Further, three structurally different peroxides, namely dicumyl peroxide (DCP), tert-butyl cumyl peroxide (TBCP) and Di (tert-butylperoxyisopropyl) benzene (DTBPIB) were taken for the preparation of TPVs. It is found from curing study that, among the three peroxides, DCP is the best peroxide for the EOC: PDMS blend system to get higher technical properties. Co-crosslinking of EOC and PDMS without reduction in the overall crystallinity is favorable to the overall increment in the mechanical properties. As the amount of EOC increases eg. for 90:10 EOC: PDMS TPVs, more EOC gets crosslinked which causes a reduction in the crystallinity as well as overall mechanical properties. Reprocessing of all the DCP cured TPVs are carried out and the property retention is found to be excellent even after two times reprocessing. After the optimization of the peroxide type and amount, this optimized peroxide at the optimized amount was used for the preparation of TPVs of various EOCs with PDMS rubber. From the ODR study, it is found that for the same amount of peroxide, PDMS rubber gets crosslinked more than that for the other EOCs. Also, it is found that, as the octene content increases from 16 weight % to 38 weight %, the crosslinking efficiency of the peroxide to crosslink the EOC decreases. Further, the effect of electron beam irradiation on the blends over a composition range varying from 70:30 to 90:10 were studied on exposure to radiation doses from 25 to 150 kGy. The gel content steadily increases for the neat EOC, neat PDMS and their blends under increased irradiation dose. It is found that electron beam irradiated blends cause tremendous improvement in the physico-mechanical properties of EOC: PDMS blends. This has been supported by the phase morphology of the blends before and after irradiation using scanning electron microscopy (SEM) and atomic force microscopy (AFM). Thermal studies show that, through the blending of EOC with PDMS rubber and subsequent radiation crosslinking, the maximum degradation temperature of the EOC was increased from 488.6 °C to 512.8 °C, i.e. 5% increase as compared to neat EOC. Whereas, the effect of radiation crosslinking is more prominent in the EOC: PDMS blend system where the co-monomer content is high as compared to the EOC with low co-monomer content. The better radiation crosslinkability of high co-monomer contained EOCs were supported with the help of gel content study and rheology analysis. Finally, the effects of different crosslinking methods on the crosslinkability of the EOCs and various EOC: PDMS blends were tested. All the crosslinked blends exhibit lower dielectric constant, lower dielectric loss, and higher electrical resistivity as compared to the virgin blends, which makes it suitable insulating material for high voltage cable applications.

Key words: Silicone rubber, Ethylene octene copolymer, Thermoplastic vulcanizate, Peroxide, Radiation crosslinking.