ABSTRACT

Effect of conductive carbon black (CCB) and multiwalled carbon nanotube (MWNT) on ethylene acrylic elastomer (AEM) has been studied with respect to physico-mechanical, dynamic mechanical, electrical and dynamic rheological behavior using both dicumyl peroxide (DCP) and electron beam (EB) curing systems. Dispersion of CCB particles and MWNT in the rubber matrix has been studied with the help of field emission scanning electron microscopy (FESEM) and high resolution transmission electron microscopy (HRTEM). FESEM and HRTEM photomicrographs for all compositions reveal homogeneous dispersion of carbon black particles at low filler loading and the effect of ionic liquids on the dispersion of MWNT in the rubber matrix has also been analyzed from the FESEM and HRTEM photomicrographs. Tensile strength is found to increase with increase in filler loading up to 20 phr (parts per hundred rubber) filler loading beyond which it decreases. However, in case of EB curing system the tensile strength increases with increase in EB dose as well as with CCB loading. The polymer-filler interaction for carbon black filled AEM rubber composites have been evaluated by bound rubber content (*BdR*), which increases with increase in reinforcing filler loading. Dynamic mechanical analysis shows that the effect of carbon black loading has marginal effect on glass transition temperature (T_g). The thermal stability of the vulcanizates has been evaluated by thermogravimetric analysis (TGA). A slight increment in thermal stability is observed with increase in CCB content. The dielectric relaxation characteristics of the CCB and MWNT filled AEM composites have been studied as a function of frequency (10^1–10^6 Hz) at different filler loading. The effect of filler loadings on the dielectric permittivity (ε'), loss tangent (tan δ), impedance (Z^*), and electrical conductivity (σ_{ac}) has also been studied. The variation of the ε' with the filler loading has been explained based on the interfacial polarization of the fillers within a heterogeneous system. The effect of filler loading on the imaginary (Z'') and real (Z') part of Z^* are distinctly visible, which may be due to the relaxation dynamics of polymer chains at the polymer-filler interface. The frequency dependency of σ_{ac} has been investigated using percolation theory. The phenomenon of percolation in the composites has been discussed in terms of σ_{ac}. The electromagnetic interference shielding effectiveness (EMISE) has been studied in the *X*-band frequency region (8–12 GHz), which increases with increasing the CCB and MWNT loading. The effect of CCB and MWNT concentration on the dynamic viscoelastic properties of AEM matrix is determined using a Rubber Process Analyzer (RPA 2000) in terms of strain and frequency sweeps of AEM/CCB and AEM/MWNT systems. The storage modulus (G') increases with increase in filler loading. In case of strain sweep, the G' values decrease with strain amplitude for both the systems. The strain dependency of G' for CCB filled AEM systems can be explained on basis of Payne effect. The complex viscosity (η^*) of these systems increases with filler loading and decreases with strain amplitude which is due to the shear thinning effect. The G' increases with angular frequency for both the systems. Correlation study between electrical and rheological percolation reveals that the rheological percolation threshold detected from dynamic rheological measurement almost coincides with the electrical percolation threshold.

Keywords: *Ethylene acrylic elstomer, Conductive carbon black, Multiwalled carbon nanotube, Physico-mechanical properties, Dielectric relaxation, Dynamic viscoelastic properties.*