ABSTRACT

Studies of an ionic elastomer based on carboxylated nitrile rubber with special reference to the dynamic mechanical analyses form the basis of the present investigation. The carboxylated nitrile rubber(XNBR) neutralised by zinc oxide shows two transitions in the temperature dependent dynamic mechanical spectra. The low temperature transition around -7°C is due to the glass-rubber transition (T_g) of XNBR and the high temperature transition (T_i) around +50°C is due to the formation of ionic clusters. The transition temperature (T_i) and peak value of loss tangent (tanδ) depend on the type and loading of metal oxide. The presence of the ionic cluster, a hard phase, dispersed throughout an amorphous rubber matrix which serve as a reinforcing filler and quasi crosslinks in XNBR-ZnO system, is the cause for profound change in the physical properties. Incorporation of reinforcing fillers like carbon black and silica makes the high temperature transition more prominent and the high filler loading causes shift of the transition temperature to higher side. Formation of ionic clusters in XNBR-ZnO system is believed to cause high rubber-filler interaction and striking changes in storage modulus, loss modulus and loss tangent at different dynamic strain amplitudes, as compared to the XNBR crosslinked by sulfur-accelerator system. The incorporation of the non-reinforcing fillers like calcium carbonate and clay also affects the dynamic mechanical properties, particularly the transition in the high temperature region. The two phase morphology of the XNBR-ZnO system offered two separate approaches for modifying the viscoelastic behaviour: (i) plasticization of the hydrocarbon rich phase or (ii) plasticization of the ionic domains. Results of dynamic mechanical analyses, rheological studies and measurements of physical properties of the ionic polymer based on XNBR-ZnO system reveal that dioctylphthalate (DOP) plasticizes the backbone chain of the polymer, while dimethylsulfoxide (DMSO) and ammonia plasticize the hard phase arising out of the ionic aggregates. The effect of zinc stearate on the viscoelastic properties of the ionomer have been studied by Monsanto rheometry, melt viscometry, differential scanning calorimetry and dynamic mechanical analyses. At temperature below its melting point, zinc stearate functions as a reinforcing agent for ionomer formation and above its melting point, it acts as a plasticizer for the ionic domains, thereby facilitating easy processing of the ionomer.

(Key words : ionomer, ionic elastomer, carboxylated nitrile rubber, dynamic mechanical properties, rheology, filler, plasticizer, zinc stearate)