ABSTRACT

Epoxy resins are considered as workhorse raw material among the various thermosetting resins due to their outstanding mechanical properties and good handling characteristics. They are now used in a variety of fields such as coatings, military and aerospace. However, because of high cross-link density, these materials have very low resistance to crack initiation and propagation. This necessitates the toughening of the epoxy matrix without impairing its good thermomechanical properties. The thesis deals with the toughening of epoxy resin with low molecular weight liquid rubbers, CTBN and HTPB. The ultimate toughening characteristics depend on the structure-property relationship which, in turn, depends on various morphological parameters such as particle size and distribution. The thesis gives an in depth study on the in-situ cure reaction and simultaneous development of morphology. The study of the mechanical properties of the modified network showed that CTBN-modified matrix is superior to HTPB-modified matrix. The epoxy-CTBN blend system with 10-15 weight % of elastomer showed highest impact and fracture toughness. The epoxy-HTPB system having an elastomer content up to 10 weight % also showed improvement in toughness properties compared to the neat system. The difference in the behavior of these elastomers is explained based on their miscibility in epoxy resin which was evidenced from the shift in the glass transition temperature during viscoelastic measurements. The toughening mechanisms prevailing in epoxy-CTBN system are mainly shear deformation of the matrix and cavitation of particles. On the other hand, in HTPB-modified system, reduction in cross-linking density plays the major role. The poor adhesion between HTPB and the epoxy matrix caused elastomer pull out and failure of the matrix, whereas better energy transference is possible in epoxy-CTBN matrix due to strong interfacial adhesion between the matrix and the elastomer.