ABSTRACT

Various aspects of deformation and fracture of rubber to rubber two-component joints have been investigated. Firstly, a test procedure for the study of stress induced fatigue of dissimilar rubber joints and the effect of joint angle on fatigue life has been reported. For this purpose, two types of joints -- type I and type II -- are prepared. In type I joint, the angle tip is embedded in softer matrix at an angle and type II having the reverse configuration. The complex deformation behaviour of this simple rubber-to-rubber two-component joints under tensile mode of fracture has been examined and the nature of failure has been predicted by calculating the stress, stress distribution and strain energy density across the bondline of rubber-rubber joint by using FEA based on linear classical elasticity theory. Since rubber is a highly deformable material, it no longer follows the linear stress-strain relationship at higher strain level. Therefore, for accurate analysis, an algorithm based on Rivlin-Saunders's equation and Green-Lagrange tensor analysis has been developed for the establishment of non-linear stress-strain relationship of rubber. A computer program is also written based on this algorithm which is then extended and applied to the rubber-rubber two-component joints for failure analysis and stress distribution. For further verification of the theoretical analysis, experimental photoelastic method is applied both in monochromatic dark field and in white light (dark field) to observe the stress distribution in birefringent natural rubber (NR) to filled NR joints subjected to

uniaxial tension. Experimental study on the effect of interlinking density, relative proportion of one component in the two-component joints, filler loading in the filled part of the joint, strain level and type of two-component joints has also been performed on radial type and transverse type joints. A term 'DPEL' is also introduced to measure the elongation loss in each cycle of stress response. The fracture of a joint depends very much on the adhesion between the components. In the initial stage of formation of joint, tack is the most important property in the uncured state. A new test method has been developed to measure the autohesive tack between the uncured rubber to uncured rubber. This method gives quite reproducible results. The effect of contact time, contact temperature,contact area, filler loading, oil loading etc. on tack strength has also been studied by this method. In order to understand the diffusion phenomenon at the interface during tack bond formation,depth of penetration of one rubber component into another between EPDM onto Silicone rubber or vice-versa has been studied by EDX and XPS techniques. The effect of joining on dynamic mechanical properties of rubber is finally reported.

KEY WORDS : Joint ; Fatigue ; Fracture ; Deformation ; Angle; FEM ; Photoelasticity ; Adhesion ; Tack ; Rubber ; Composite ; Diffusion ; Radial ; Transverse ; NR ; SBR ; EPDM.