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MODELLING VISCOELASTIC PROPERTIES OF RUBBER-TPE BLENDS

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Blends of natural rubber (NR) and 1,2 polybutadiene (1,2 PBD) were evaluated for dynamic mechanical properties such as storage modulus (E') and damping factor (tan δ). Computations have been made based on mean field theories of Kerner to predict properties of the blends. The discrete particle model predictions are found to be moderately close to experimental results in the case of 70/30 1,2 PBD/NR blend assuming 1,2 PBD as matrix. In the case of 50/50 blend having a co-continuous morphology as revealed by SEM evaluation, predictions based on polyaggregate model are found to be in agreement with experiment, with deviations in the range of -40°C to 0°C which lies between the Tgs of the components.

Key words : Natural rubber, 1,2 Polybutadiene, Storage modulus, Thermoplastic elastomer, Blends, Viscoelastic properties, Kerner models.

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INTRODUCTION

The importance of viscoelastic properties for characterising modulus and damping behaviour of rubbers is well known (Murayama, 1978; Dickie, 1978 ; Ferry, 1980). These time/temperature dependent properties of elastomers subjected to cyclic deformation are expressed in terms of

$$E^* = E' + i\,E'' \quad (1)$$

and $\tan\delta = E'' / E'$ (2)

where E^*, E' and E'' are complex, storage and loss moduli respectively. The terminology and methods of measurement have been discussed elsewhere (Murayama, 1978).

The crucial role of dynamic mechanical analysis in understanding the behaviour of rubber blends is widely accepted. Dynamic mechanical properties are ideally suited for analysis of multicomponent composites/blends by comparing experimental results with predictions based on various models (such as the Kerner model). Multicomponent theories generated for ideal elastic systems can be adapted for viscoelastic materials through elastic/viscoelastic correspondence principle. Here the time-dependent elastic constants are replaced with the corresponding complex viscoelastic constants obtained from dynamic experiments. Earlier, the models have been used for predicting compositional changes (Dickie, 1973; 1978). With the advent of sophisticated test machines for measuring properties over a wide range of temperature and frequency, the models are also used for predicting dynamic properties at different temperatures (Dickie, 1978; Mazich *et al.*, 1989b; Nielsen and Landel, 1994; Shick and Ishida 1994; Ya Goldman, 1994).