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DYNAMIC MECHANICAL PROPERTIES OF ALUMINIUM POWDER FILLED NATURAL RUBBER COMPOSITES

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The dynamic mechanical properties of natural rubber vulcanizates containing aluminium powder have been compared with those containing conventional fillers. Storage modulus, loss modulus and loss factor increased continuously with increase in aluminium powder loading. The effect of various bonding agents like hexamethylene tetramine-resorcinol system, bis [3-(triethoxy silyl) propyl] tetrasulphide, cobalt naphthenate and toluene diisocyanate have been investigated. Presence of bonding agents increased the dynamic modulus and mechanical loss due to improved adhesion. With increase in temperature mechanical loss decreased. Variation in testing frequency affects dynamic properties, which decreased as the frequency decreased. Various theoretical models have been used to fit the experimental viscoelastic data.

Key words: Aluminium powder, Composites, Natural rubber, Viscoelasticity.

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INTRODUCTION

Measurement of dynamic mechanical properties helps in understanding the behaviour of elastomers under cyclic loading and temperature. The modulus information obtained from dynamic mechanical testing is of importance to manufacturers and users of polymers in structural applications. Of greater importance is the information on damping, since such end-use properties as vibration dissipation, heat build-up, impact resistance and noise abatement are related to mechanical damping. Rubber products generally undergo dynamic stress during service. Therefore, their behaviour under dynamic loading is highly important. The dynamic mechanical properties of elastomers are strongly dependent on temperature, frequency, type and concentration of filler and the extent of deformation. Several investigators studied the dependence of dynamic mechanical properties of rubber vulcanizates on the type and concentration of fillers (Ulmer *et al.*, 1973; Ferry and Fitzgerald, 1982) under different test conditions (Mukhopadhyay *et al.* 1993). Studebaker and Beatty (1974) studied the effect of basic compounding on dynamic mechanical properties of rubber. The major compounding variables involved in this study were nature of the rubber, nature and amount of ingredients in the curing system and type and quantity of fillers and plasticizers. Viscoelastic studies on sisal fibre reinforced natural rubber composites were reported by Varghese *et al.* (1992). Dynamic mechanical properties of a variety of carbon black–loaded compounds over a wide range of frequency and temperature have been reported (Gandhi and Salovery, 1988; Nagata *et al*, 1987). Manna *et al.* (1998) studied the effect of strain on the dynamic mechanical properties of ENR-carbon black mixture with special reference to the role of oxidation of the filler surface in the formation of rubber-filler bonds. Blaine *et al.* (1998) reported on dynamic mechanical analysis for the characterization of physical proper-