

## CURE KINETICS AND COAGENT SELECTION IN PEROXIDE VULCANIZATION OF NATURAL RUBBER

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The kinetics of peroxide vulcanization of natural rubber was followed at different temperatures say, 150, 155, 160 and 165 °C. Being a first order kinetic reaction, cure time should be recorded from a fully decomposed cure graph so as to decompose the entire peroxide in the vulcanizate. The role of different coagents like zinc diacrylate (ZDA), trimethylolpropane trimethacrylate (TMPTMA) and triallyl cyanurate (TAC) has been studied. ZDA offers ionic bridges which behave like polysulphidic crosslinks, hence it can be used for applications where good mechanical properties are required and TMPTMA is suitable for high modulus applications.

**Keywords:** Coagent, Kinetics, Natural rubber, Organic peroxide, Vulcanization

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### INTRODUCTION

Vulcanization of polymers with organic peroxides is known since 1915, but serious interest in this area began with the introduction of synthetic rubbers. Besides synthetic rubbers, peroxide can cure a large number of unsaturated rubbers like natural rubber, butadiene rubber, EPDM, chloroprene rubber, silicones *etc*. Peroxide vulcanization has got less importance in unsaturated rubbers due to inferior mechanical properties and poor scorch time in contrast to the inherent advantages like low compression set, rapid vulcanization without reversion, good heat ageing resistance, high resilience *etc*. Earlier, much work has been done on the peroxide vulcanization of natural rubber (Thomas, 1962; Bristow, 1963; 1965; 1970; 1976; Bell *et*

*al.*, 1967; Loan, 1967; Gonzalez *et al.*, 1998; Ogunniyi, 1999; Gonzalez *et al.*, 2000; 2005). Peroxide crosslinking reaction usually involves three steps, homolytic cleavage of peroxide, hydrogen abstraction/ radical addition and radical coupling resulting in the formation of C-C crosslinks between polymer chains (Endstra, 1985). The peroxide decomposition is a first order reaction and the extent of this depends on both cure time and temperature (Bristow, 1976). The competing chemical reactions involved in peroxide vulcanization, polymer selection, cure temperature and effect of other compounding additives has been studied extensively (Dluzneski, 2001). The properties of peroxide vulcanizates largely depend on the nature of C-C crosslinks (Kok *et al.*, 1986; Gonzalez *et al.*, 2005; Valentin,