

BLOCK CO-POLYMERS BASED ON NATURAL RUBBER AND POLYURETHANE OLIGOMERS OF ETHYLENE GLYCOL-TOLUENE DIISOCYANATE

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A series of segmented block co-polymers based on hydroxyl-terminated liquid natural rubber of number average molecular weight 3000 were synthesized by one-shot and two-shot processes in solution. The hard segment consisted of polyurethane formed from toluene diisocyanate and ethylene glycol. The materials were characterized by infrared spectroscopy, thermal analysis, mechanical testing and SEM studies. Block co-polymers synthesized by the two-shot process were found to possess superior mechanical properties to those produced by the one-shot process. With increasing hard segment content, the properties compared varied from soft to rigid elastomers and then to rubber toughened plastics. This variation in behaviour was consistent with the sample morphology, which, in fact, depended upon the relative fractions of the soft and hard segments. All of these short-segment block co-polymers showed nearly complete phase separation.

Key words : Liquid natural rubber, Block co-polymer, polyurethane, phase segregation, thermoplastic elastomer.

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INTRODUCTION

Segmented block co-polymers are generally multiphase compositions of glassy or hard segments and rubbery or soft segments. The former has a glass transition temperature above and the latter below, the service temperature. The two block segments are thermodynamically incompatible and hence phase segregated into domains (Chen *et al.*, 1983; Xu *et al.*, 1983) with dimensions related to the block length of each component. The hard segment domains, held together by intermolecular secondary bonding, function as physical crosslinks for the soft segments. The block

co-polymer can, therefore, act as a thermoplastic elastomer. Segmented block co-polymers of the polyurethane type are a class of (AB)_n alternating block polymers in which the hard segment is urethane oligomers of diisocyanates and diols (Fu *et al.*, 1985; Serrano *et al.*, 1987).

Recently a macroglycol based on natural rubber, viz., hydroxyl-terminated liquid natural rubber (HTNR), has been employed as soft segment in the synthesis of segmented block co-polymers (Ravindran *et al.*, 1991). The present work deals with the synthesis of similar products based on HTNR in which polyurethane made from

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