Indian Journal of Natural Rubber Research, 11(1&2) : 50-57, 1998

STUDIES ON THE DEGRADATION OF NATURAL RUBBER CURED BY ACCELERATED LOW SULPHUR AND URETHANE CROSSLINKING SYSTEMS

Rosamma Alex and Ahamed S. Farid

Alex, R. and Farid, A.S. (1998). Studies on the degradation of natural rubber cured by accelerated low sulphur and urethane crosslinking systems. *Indian Journal of Natural Rubber Research*, 11(1&2) : 50-57.

Changes in molecular level network structure have been investigated for natural rubber (NR) cured by low sulphur (EV) and urethane (Novor®) systems by measurement of continuous and intermittent stress relaxation. NR cured by urethane system, showed more crosslinking and scission reactions at temperatures between 100 and 130°C but lower crosslinking and scission reactions at temperatures between 150 and 160°C compared to NR cured by low sulphur system. At temperatures between 100 and 130°C, NR vulcanized by low sulphur system showed lower permanent set and at temperatures between 150 and 160°C higher permanent set, as compared to NR vulcanized by urethane system. The ageing of urethane cured natural rubber, perhaps results in the occurrence of intermolecular interactions such as hydrogen bonding. A lower value of activation energy of stress relaxation shown by urethane cured NR, indicates that the mechanism of degradation is not identical to that of low sulphur cured NR.

Key words : Ageing, Crosslinking, Natural rubber, Permanent set, Stress relaxation.

Rosamma Alex (for correspondence), Rubber Research Institute of India, Rubber Board, Kottayam - 686 009, Kerala, India; e-mail : rri@vsnl.com and Ahamed S. Farid, School of Polymer Technology, University of North London, 166-220 Holloway Road, London N 7 8DB.

INTRODUCTION

Decay of stress at constant elongation and temperature has been used as a physical index of chemical deterioration of rubber (Tobolsky *et al.*, 1944). When NR is exposed to elevated temperatures simultaneous crosslinking and scission reactions take place due to interaction with molecular oxygen (Stern and Tobolsky 1946; Tobolsky and Andrews 1945). It is known that these crosslinking and scission reactions are responsible for the permanent set which occurs in rubber samples that are deformed. Andrews *et al.* (1946) had proposed a molecular theory of permanent set for rubber during stress relaxation at elevated temperature. Permanent set was also related to the creep phenomena observed in elastomers (Gehman, 1948). The occurrence of permanent set is a serious limitation on service performance of rubber products. The molecular level changes in network structure which account for permanent set, have important implications in the performance of rubber articles, such as gaskets seals *etc.* at high temperatures.

Conventionally the efficient vulcanization (EV) system has been used for samples