

## IN SITU EPOXIDATION OF NATURAL RUBBER LATEX BY PERFORMIC ACID AND THE KINETICS OF THE REACTION

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Epoxidation of natural rubber latex stabilised with a nonionic surfactant was carried out with performic acid generated *in situ*. The reaction was performed at 30, 40, 50 and 60°C at a dry rubber content (DRC) of 20 and concentration of formic acid and hydrogen peroxide 0.955 and 3.75 moles dm<sup>-3</sup> respectively in the aqueous phase of the latex. Product characterization by <sup>1</sup>H NMR and IR spectroscopic methods indicated significant influence of temperature on the extent of epoxidation as well as ring opening reactions. Epoxidation to the extent of 25-35 mole per cent could be reached without ring opening. The concentration of ring opened products at higher levels of epoxidation was found to be low. The reaction followed pseudo-first order kinetics with the formation of performic acid as the rate determining step. This was further confirmed by carrying out the reaction at 10 and 15 per cent DRC keeping the formic acid and hydrogen peroxide concentrations in the aqueous phase the same.

**Key words :** Natural rubber latex, Epoxidation, Performic acid, Epoxidation kinetics, Ring opening reactions.

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### INTRODUCTION

Epoxidation of natural rubber (NR) and other polydienes by peracids, both preformed and formed *in situ*, has been studied by many authors (Colclough, 1963; Udupi, 1979; Ng and Gan, 1981). However, reports on properties of the epoxidised polydienes were conflicting and non reproducible due to secondary ring opening reactions. Recent interest in epoxidation has been due to the finding that NR latex could be epoxidised to any desired level and that when performed under carefully controlled conditions the primarily formed

epoxide ring can be preserved (Gelling, 1985). This was confirmed by sequence distribution studies using <sup>13</sup>C NMR (Bradbury and Perera, 1985). Epoxidised natural rubber (ENR) shows better oil resistance and lower gas permeability compared to NR, and the degree of improvement in these properties depends on the extent of epoxidation (Baker *et al.*, 1985). In addition, it can form miscible blends with polychloroprene (Nagode and Roland, 1991), poly vinylchloride (Margaritis and Kalfoglou, 1987) and other chlorinated polymers (Kallitsis and Kalfoglou, 1987;