MECHANICAL DEVULCANIZATION OF CARBON BLACK FILLED NATURAL RUBBER VULCANIZATES: EFFECT OF CROSSLINK DENSITY

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The present study aims to find the correlation between the crosslink density of the freshly prepared sample to be devulcanised and the efficiency of mechanical devulcanization in a two roll mill. Efficiently vulcanized (EV) carbon black filled natural rubber vulcanizates with varying crosslink densities were mechanically devulcanised on a two-roll mixing mill and the efficiency of devulcanization was determined from the residual crosslink densities of the devulcanized samples and the corresponding revulcanizate properties. With increasing crosslink density of the starting material, the tear and tensile strengths of the sample first increased, reached a maximum and then decreased. The percent devulcanization associated with these samples on mechanical devulcanization ranged between 70-80 per cent irrespective of their difference in original crosslink density. Hence, the absolute value of the residual crosslink density is high when the original crosslink density is high leading to poor revulcanizate properties irrespective of the higher per cent devulcanization attained. Thus, the original crosslink density of the sample to be devulcanized appears to be one of the most important factors that defines the revulcanizate properties of the devulcanized samples.

Key words: Crosslink density, Devulcanization, Natural rubber, Vulcanization

INTRODUCTION

Devulcanization of used rubber products is an extremely significant problem for the rubber industry from the viewpoint of economic and environmental concerns. Vulcanized rubbers have three dimensional crosslinked structures that do not decompose easily. Recycling methods envisage the conversion of used rubber products into any reusable form whereas devulcanization is a recycling strategy which aims at selective scission of crosslinks in the vulcanized network to retrieve the polymer for reuse in the rubber industry itself. The currently employed devulcanization methods (Warner, 1994; Joseph, *et al*., 2016) involve the application of high temperature and or pressure (Gupta and Maridass, 2003; Khait, 1997; Benko *et al*., 2004; Zhang *et al*., 2009; Luis *et al*., 1997; Matsushita *et al*., 2003; Morin *et al*., 2002), microwave (Novotny *et al*.,1978; Hunt and Hall, 1994; Bani *et al*., 2011), ultrasonic energies (Isayev and Chen, 1994; Roberson and Boron, 1998; Dinzburg and Alexander, 2002), biotechnological reactions

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