

Continuous Ultrasonic Devulcanization of Unfilled NR Vulcanizates

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ABSTRACT: Sulfur-cured unfilled natural rubber (NR) is successfully devulcanized in a continuous extrusion process under the application of high-power ultrasonic energy. The die characteristics and ultrasonic power consumption are measured. A unique correlation is found between the crosslink density and gel fraction of the devulcanized NR. This correlation is independent of the processing parameters, such as barrel temperature, die gap, flow rate, and amplitude of ultrasound. However, these parameters do influence the degree of devulcanization. In most cases, the degree of devulcanization is found to pass through a maximum at an intermediate level of ultrasonic energy. It is hypothesized that simultaneous breakup and reformation of crosslinks occur during the devulcanization of NR, with the relative contribution of each being determined by the process parameters. The cure curves and mechanical properties of the revulcanized NR are studied. The mechanical properties are found to depend on the revulcanization recipe. On optimizing it, tensile strength as high as 14.2 MPa is achieved, which is about 70% of that of the virgin NR vulcanizate. Ultimate elongation as high as 670% is obtained, which is the same as that of the virgin NR vulcanizate. Such stress-strain behavior is an indication that the devulcanized NR maintains the strain-induced crystallization characteristics inherent to the virgin NR vulcanizates. © 1998 John Wiley & Sons, Inc. *J Appl Polym Sci* 70: 2007–2019, 1998

Key words: natural rubber; recycling; reclaim rubber; devulcanization; revulcanization; ultrasound; crosslink density; gel fraction; mechanical properties; optimization