Ultrasonic Devulcanization of Rubber Vulcanizates. I. Process Model

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SYNOPSIS

Tire and rubber waste recycling is an important issue facing the rubber industry. In addressing this issue, the present article describes the first attempt to formulate a model and to simulate a novel continuous ultrasonic devulcanization process. The proposed model is based upon a mechanism of rubber network breakup caused by cavitation, which is created by high-intensity ultrasonic waves in the presence of pressure and heat. Dynamics of bubble behavior is described by the Notlingk–Neppiras equation with incorporation of an additional term based upon elastic strain-energy potential. Acoustic pressure arising in the ultrasonic field is related to void formation. Their concentration is calculated based upon nucleation and growth of gas bubbles in crosslinked elastomers under negative driving pressure. The breakup of a three-dimensional network in crosslinked rubbers is combined with flow modeling. The viscosity function required for this modeling is based upon a power-law model which includes temperature, shear rate, and gel fraction dependence.