

Avraam I. Isayev  
Sergei P. Yushanov  
Seok-Ho Kim  
Victor Yu. Levin

## Ultrasonic devulcanization of waste rubbers: Experimentation and modeling

Received: 29 July 1996  
Accepted: 2 October 1996

**Abstract** Continuous ultrasonic devulcanization of ground tire rubber (GRT) and styrene-butadiene rubber (SBR) is considered. Experiments are performed under various processing conditions. Two recipes of SBR with different amounts of polysulfidic linkages are utilized. Gel fraction and crosslink density of devulcanized rubbers are measured and a unique relationship between them is established. Die characteristics with and without imposition of ultrasonic waves are determined. Devulcanized samples are revulcanized and mechanical properties are measured. In some cases, properties of revulcanized SBR samples exceeded those of virgin vulcanizates. This is explained based on the presence of a double network in the revulcanized rubber. A modification of acoustic cavitation and flow modeling of ultrasonic

devulcanization of SBR and GRT is proposed using a concept of effective viscosity characterizing the flow of vulcanized particles before devulcanization combined with a shear rate, temperature and gel fraction-dependent viscosity of devulcanized rubber. Velocity, shear rate, pressure, and temperature field along with gel fraction, crosslink density and number of bonds broken are simulated. Predicted data on gel fraction, crosslink density, and pressure using the present modification of the model are found to be closer to experimental data than previously reported.

**Key words** Rubber – devulcanization – revulcanization – ultrasound – cavitation – viscosity – model – experiment – mechanical properties – gel fraction – crosslink density – pressure drop – converging flow

Dedicated to the memory  
of Professor Tasos C. Papanastasiou

Prof. A. I. Isayev (✉) · S. P. Yushanov  
S.-H. Kim · V. Y. Levin  
Institute of Polymer Engineering  
The University of Akron  
Akron, Ohio 44325-0301, USA