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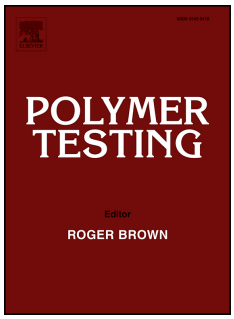

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Development of a New Combined Numerical/Experimental Approach for the Modeling of the Nonlinear Hyper-Viscoelastic Behavior of Highly Carbon Black Filled Rubber Compound

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ABSTRACT

In this work, a new approach was developed for the determination of the parameters of a complex constitutive model for a highly filled rubber compound. A SSBR sulfur-vulcanized rubber sheet reinforced by carbon black was prepared. Three test specimens in the form of two rubber strips and dumbbell were cut from it. The Arruda-Boyce equation was selected to describe the hyperelastic behavior of the rubber. A parallel rheological framework (PRF) model and a new equation using a sigmoid function were selected to describe the nonlinear viscoelastic and stress softening effects. The model parameters were determined via a novel methodology based on the solution of the inverse problem comprising of the finite element models of the tests. Two multi-objective optimization loops based on the Nelder–Mead simplex method were designed. The accuracy of the predicted parameters was checked via the comparison of the model predictions with their corresponding data obtained from uniaxial and stress relaxation tests. A thorough analysis was made on the predicted results.

Key words: Rubber, Optimization, Nonlinear viscoelasticity, Mullins effect, Finite element method,

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