Eight-Chain and Full-Network Models and Their Modified Versions for Rubber Hyperelasticity: A Comparative Study

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ABSTRACT
The eight-chain model, also known as Arruda-Boyce model, is widely used to capture the rate-independent hyperelastic response of rubber-like materials. The parameters of this model are physically based and explained from micromechanics of chain molecules. Despite its excellent performance with only two material parameters to capture bench measurements in uniaxial and pure shear regime, the model is known to be significantly deficient in predicting the equibiaxial data. To ameliorate such drawback, over the years, several modified versions of this successful model have been proposed in the literature. The so-called full-network model is another micromechanically motivated chain model, which has also few modified versions in the literature. For this study, two modified versions of the full-network model have been selected. In this contribution, five modified versions of the Arruda-Boyce model and two modified versions of full-network model are critically compared with the classical eight-chain model for their adequacy in representing equibiaxial data. To do a comparison of all selected models in reproducing the well-known Treloar data, the analytical expressions for the three homogeneous deformation modes, that is, uniaxial tension, equibiaxial tension, and pure shear have been derived and the performances of the selected models are analysed. The comparative study demonstrates that modified Flory-Erman model, Gornet-Desmorat (GD) model, Meissner-Matějka model, and bootstrapped eight-chain model predict well the three deformation modes compare to the classical eight-chain model.

KEYWORDS: eight-chain model; full-network model; micromechanical model; phenomenological model; rubber-like material

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