Simulation and Numerical Implementation of Chemo-Thermomechanical Aging of Rubber

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Abstract

This work shows the finite element implementation of a constitutive model which can represent the chemo-thermomechanical aging behavior of rubber. This approach considers the nonlinear thermo-viscoelastic behavior of rubber, is formulated for finite deformations in the continuum mechanical framework, takes thermo-oxidative aging effects, which are caused by the diffusion of oxygen into the bulk material, into account and describes its reaction with the polymer network. The resulting set of partial differential equations and evolution equations corresponds to a multiphase continuum mechanical model. It is necessary to solve these equations numerically using the finite element method. With help of the software COMSOL Multiphysics®, especially its Weak Form PDE interface, the coupled multifield problem was implemented. In order to discuss the properties of the model and its implementation, an illustrative boundary value problem was numerically solved with respect to different types of chemical and mechanical boundary conditions. Mechanical loadings and aging processes of an industrial elastomer component are simulated under finite dimensions.

Reference

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