

The influence of direction-modulated loading conditions on the lifetime of filled elastomers

Daniel Juhre ^{1,2}, Maria Krause ²

¹ Institute of Mechanics, Otto-von-Guericke University, Magdeburg, Germany,
daniel.juhre@ovgu.de

² German Institute of Rubber Technology (DIK), Hannover, Germany,
daniel.juhre@dikautschuk.de, maria.krause@dikautschuk.de

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The increased use of rubber in industrial parts like tires, dampers, seals and medical devices has lead to a considerable increase in the study of the durability in service conditions. It is hence important to predict the fatigue life of the rubber parts during their design phase.

There are many approaches for the assessment of the lifetime for technical rubber components [1,2]. Nevertheless of the existing different approaches to predict the lifetime, all the approaches have one aspect in common: the lifetime estimates are based on the data from the fatigue tests conducted using equidirectional loading where predominantly uniaxial tensile tests were performed [3]. However using these approaches only approximate predictions can be made, provided the experienced load within the components do not change with respect to the change in direction of its application or when the material is considered to be elastic and isotropic. But typical rubber components in most of the cases are not equidirectionally loaded and the rubber material itself is not purely elastic or isotropic. Additionally, the rubber components are loaded in such a way that during loading the principle stress directions migrate through the material. Missing to take these aspects into consideration for the fatigue life prediction of technical rubber components result in inaccurate estimation of lifetime [4].

In this contribution we will present a new method for investigating the influence of the direction-dependent loading conditions on the lifetime for filled elastomers. To achieve this the traditional lifetime prediction experiments, which are based on measuring lifetime under varying load at constant loading direction will be extended to measure lifetime under constant load and continuous change of loading direction. For the realization of the technical measurement involving direction modulated deformation a test rig for simple shear with rotating axes has been constructed.

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