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RATE-DEPENDENT PHASE-FIELD FRACTURE MODELING OF RUBBERS

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Evaluating virtual prototypes of rubber components requires adequate numerical simulation tools to describe the mechanical responses. Most currently used tools in the industry are limited in their ability to predict rate-dependent fracture.
A first rate-independent phase-field damage model for rubbers was published by Miehe et al.[2]. Focusing on the thermodynamic consistency, Stumpf et al.[3] introduced the framework for linear thermo-viscoelastic damage models. Basing on these ideas we develop our new rate-dependent phase-field damage model for rubbery polymers.
The problem of a sharp discontinuity caused by a crack is circumvented by smoothing it to a diffuse topology. The main advantage of this continuous representation of fracture is the capability to treat complex branching and coalescence. The size of the damaging zone is controlled by a length scale parameter l_0. This length scale may be interpreted as a material parameter depending on the microstructure and has a high influence on the local solution near the crack tip [1].
We conduct a series of tension test of pre-cracked samples at various strain-rates in order to identify the material parameters. Comparing the measured global force to displacement response to the numerical predicted we see a good agreement. Furthermore, by using the Digital Image Correlation technique, we are able to measure the local strains near the crack tip in order to identify the length scale parameter l_0 .

REFERENCES

[1] Geers, M. G. D., Borst, R., Brekelmans, W. A.M. and Peerlings, R. H. J. Validation and internal length scale determination for a gradient damage model: application to short glass-fibre-reinforced polypropylene *International Journal of Solids and Structures* (1999) **36**, pp. 2557-2583.

[2] Miehe, C. and Schaenzel, L.-M Phase field modeling of fracture in rubbery polymers. Part I: Finite elasticity coupled with brittle failure *Journal of the Mechanics and Physics of Solids* (2014) **65**, pp. 93-113.

[3] Stumpf, H. and Hackl, K. Micromechanical concept for the analysis of damage evolution in thermo-viscoelastic and quasi-brittle materials. *International Journal of Solids and Structures* (2003) **40**, pp. 1567-1584.