# A physically motiviated thermoviscoelastic model for filled elastomers

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The Dynamic Flocculation Model (DFM) is a micro-structure based model of rubber reinforcement which is developed on a physical framework to describe the non-linear and inelastic mechanical behaviour of filled elastomers. This one-dimensional material law has been implemented into the finite element code using the concept of representative directions, which allows the generalization of one-dimensional models to compute three dimensional stress-strain states. The model shows very good agreement with the standard quasi-static multi-hysteresis tests on CB-filled elastomers like NR, SBR or EPDM. An extension of this model to include time dependent effects allows to consider the filler induced dynamic response such as strain rate dependency, amplitude dependency and stress relaxation. The physical hypothesis of characterizing the filler clusters as time-dependent parameters is described recently. This contribution presents the extension of the quasi-static DFM model to include the time-dependent effects using first-order differential relaxation equation which evolves as a function of time. Subsequently, the corresponding parameters were identified through curve fitting and the model was further validated against associated experiments. The influence of each parameter on the course of change in material behaviour has been investigated. The major advantage of the model is its physically meaningful parameters and the ability to reproduce the material response at different loading rates under arbitrary deformation using the single parameter set for each rubber compound. A further extension of DFM was considered to include temperature effects on the mechanical behaviour. Model prediction was substantiated by temperature controlled experiments. The potential to couple thermo-mechanical quantities of DFM is presented.