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Influencing parameters and temperature impact on the fatigue crack growth behaviour of rubbers

Bernd Schrittesser
Polymer Competence Center Leoben GmbH, Austria

The unique mechanical properties of rubbers make them suitable for applications in which cyclic loadings are involved. In this loading condition, failure is mainly related to fatigue and therefore the understanding of the phenomena connected to it results fundamental for a reliable lifetime prediction of rubber products. In the field of elastomeric materials, one of the main approaches followed for fatigue life prediction is the crack growth approach. This is based on the study of the growth of pre-existing cracks up to end of service life using tearing energy as fracture mechanical parameter. The fatigue behaviour of rubbers is influenced by a large number of parameters, which can be related to the mechanical history, environmental conditions and rubber formulation. In order to investigate more into details how the fatigue crack growth behaviour is influenced by the different involved parameters, pure shear specimens were loaded cyclically at different loading conditions and mechanical histories. A camera system was implemented for crack growth detection and the surface temperature was recorded using an IR sensor. A detailed investigation of the influence of different parameters was hence carried out. In particular, the influence of waveform, load and displacement control, mechanical history, frequency and temperature were studied in detail. Moreover, the heat build-up during cyclic loading was further investigated, by monitoring the surface temperature through an IR camera. The aim of this research is to provide a further description of fatigue crack growth in rubbers by defining the influence of different parameters involved during cyclic loading. From a deeper understanding of these influences, models that can supply more accurate lifetime predictions could be developed.

e: Bernd.Schrittesser@pccl.at

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