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INM COLLOQUIUM

"VISCO-HYPERELASTIC MODELLING OF POLYMERIC FOAMS & VISCO-ELASTIC/VISCOPLASTIC CHARACTERIZATION OF THERMOPLASTICS"

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Host: Prof. Dr. Eduard Arzt

Part 1: Polymer foams can exhibit large elastic strains and displacements in case of volumetric compression. In addition, they often show significant rate-dependent properties. This material behaviour can be accurately modelled using the visco-hyperelastic approach, in which the large strain viscoelastic description is combined with the rate-independent hyperelastic material model. In case of polymer foams, the most widely used compressible hyperelastic material model, the so-called Ogden–Hill's model, was applied, which is implemented in the commercial finite element (FE) software ABAQUS. The visco-hyperelastic model is defined in hereditary integral form, therefore, obtaining a closed-form solution for the stress is not a trivial task. However, the parameter-fitting procedure could be much faster and accurate if closed-form solution exists. In this contribution, exact stress solutions are derived in case of uniaxial, biaxial and volumetric compression loading cases using ramp-loading history. The analytical stress solutions are compared with the stress results in ABAQUS using FE analysis. In order to highlight the benefits of the analytical closed-form solution during the parameter-fitting process experimental work has been carried out on a particular open-cell memory foam material. The results of the material identification process shows significant accuracy improvement in the fitting procedure by applying the derived analytical solutions compared to the so-called separated approach applied in the engineering practice.

Part2: This article presents the mechanical characterization of a particular thermoplastic foam material applied in thermoforming processes. During the thermoforming process such materials undergo large deformations, which shows elastic, viscous and yielding properties as well. Additionally, the material behavior is strongly temperature-dependent. The only available material model implemented in the commercial finite element software ABAQUS, which can describe such material behavior properly, is the so-called "two-layer viscoplastic model". This model is comprised of an elastic-plastic network in parallel with a Maxwell-type viscoelastic branch characterized by a nonlinear dashpot. In our investigations mechanical tests have been performed on several temperatures and based on the experimental results, the material parameters have been fitted using the external optimization software ISIGHT, since the analytical stress-solution for the two-layer viscoplastic model is not available.

You are invited to a get together with the speaker 15 minutes before the talk.

CONTACT

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