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HYPERELASTIC MODELLING AND EXPERIMENTAL CHARACTERISATION OF CELLULAR RUBBER

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Cellular rubbers are elastomeric materials containing pores. Those rubbers can undergo large volumetric deformations. They are widely-used in seals, weather stripping and vibration damping applications.

This paper presents an isotropic, hyperelastic material model using the approach of Danielsson et. al. [1]. The constitutive equations are derived from the kinematics of an idealized pore, represented by an incompressible hollow sphere distorted to an ellipsoid. Homogenising the elastic strain energy of the matrix material leads to an energy potential describing the cellular rubber behaviour. The approach is extended by adding higher order terms, which requires a three-dimensional numerical integration. This is realised by combining a spherical Lebedev-quadrature with a radial Gauß-quadrature. In addition, pore pressure is considered under the assumption of ideal gas behaviour. The model is implemented into the finite element software MSC Marc. Moreover, a feasible procedure of parameter fitting avoiding lateral strain measurement is outlined and tested.

For model validation and parameter fitting, experimental characterisations were carried out on four foamed elastomers and the corresponding pore-free materials. The digital image correlation technique is used to obtain experimental data of the lateral contraction behaviour of the elastomers under uniaxial tension. The FE implementation is demonstrated by simulating a compression test on a car door seal.

REFERENCES

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