ECCOMAS Thematic Conference:
Computational Modeling of Complex Materials across the Scales
CMCS 2017

ANISOTROPIC ELASTOPLASTIC MODEL FOR FIBER REINFORCED LAMINATES

SWAROOP NAGARAJA*, CLARA SCHUECKER* AND MARTIN PLETZ*

* Chair of Designing Plastics and Composite Materials
Department of Polymer Engineering, Montanuniversitaet Leoben
Otto Gloeckel Strasse-2a, 8700, Leoben, Austria
e-mail: {Swaroop.Gaddikere-Nagaraja, Clara.Schuecker, Martin.Pletz} @unileoben.ac.at

Key words: Composites, Anisotropy, Elasto-plasticity

Abstract. The material response of fiber reinforced composite materials to shear and transverse compression is non-linear and inelastic. These non-linearities are strongly influenced by the matrix(polymer), which is plasticized at relatively small deformations, in contrast to fibers(carbon) that remain essentially elastic up to failure. Experimental investigations pertaining to the non-linear behavior of unidirectional carbon fiber/PEEK in shear, transverse compression and their interaction is documented in [1]. The elasto-plastic behavior of composite materials can be described by unit field approach, mean field approach and homogeneous macromechanical approach. In the present work, a macromechanical model is presented for simulating the non-linearities exhibited by composite materials. The material is assumed to be linear elastic in the fiber direction. Following [2], a pressure independent anisotropic yield function is specified wherein yielding is independent of stress in the fiber direction. The yield function can be extended to include hydrostatic pressure and can be reduced to the von-Mises yield criterion by applying suitable conditions. The model is evaluated qualitatively and quantitatively for load cases given in [1] by comparison to simulations with periodic unit cells, a mean field model and other macro models from literature as well as experimental data [1].

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