Arch Appl Mech (2012) 82:1005
DOI 10.1007/s00419-012-0619-3

EDITORIAL

Stefan Hartmann

Experiments and modeling of nonmetallic materials

Received: 4 November 2011 / Accepted: 1 December 2011 / Published online: 29 January 2012

The prediction of nonlinear physical behavior of materials in engineering applications requires the four basic issues of *experimental investigation*, *constitutive modeling*, *simulation* and *material parameter identification*. Beside the more popular investigations of metals, other materials such as polymers, elastomers, or soils are a growing field in Engineering Sciences. Moreover, in an increasing manner, the mechanical behavior during production processes and the lifetime of a product in Mechanical Engineering or mechanical applications in Civil- or Geomechanical Engineering are of important interest. Caused by the increasing amount of research activities in the field of material theory and the capabilities in Computational Sciences due to the increasing computer power, the applications and the physical problems to be addressed become more and more complex. The more the detailed physical phenomena are considered, the more the theoretical considerations and the aspects of numerical reliability have to be investigated. Thus, five collaborating groups work in these areas, that is in both Continuum Mechanics and Theory of Materials as well as Computational Mechanics, and meet annually to contribute to these challenging issues.

The continuum mechanically description of the curing process of resins, the modeling of the compressible behavior of particular rubber materials and the development of constitutive equations for shape-memory polymers are considered and provide a good opportunity to be informed on the current state-of-the-art. Moreover, thin layers of resins are studied, both experimentally and in the framework of constitutive and numerical modeling. Additionally, a concept how to identify material parameters in the case of thin layers using finite elements is discussed.

Since the models become more and more complex, the space and time integration has to be addressed to obtain reliable results. Thus, new numerical schemes using higher-order time-integration procedures for both integrating viscoelastic constitutive equations in long-time applications as well as diffusion processes in heterogeneous materials are proposed. Moreover, basic considerations in the FE^2-context are formulated and conducted to give a contribution to the field of numerically challenging homogenization techniques.

S. Hartmann (✉)
Institute of Applied Mechanics, Clausthal University of Technology, Adolph-Roemer-Str. 2A,
38678 Clausthal-Zellerfeld, Germany
E-mail: stefan.hartmann@tu-clausthal.de