Material models for highly dynamic metal forming processes

F. Katzmayr[§], C. Reisinger[§], T. Gross[†], S. Sieberer[X] and C. Zehetner[§*]

[§]University of Applied Sciences Upper Austria
Stelzhammerstraße 23, 4600 Wels, Austria
e-mail: christian.zehetner@fh-wels.at, web page: http://www.fh-ooe.at/

[†] Linz Center of Mechatronics GmbH
Altenbergerstraße 69, 4040 Linz, Austria
e-mail: thomas.gross@lcm.at - Web page: http://www.lcm.at

[X] Institute of Structural Lightweight Design, Johannes Kepler University Linz
Altenbergerstraße 69, 4040 Linz, Austria
e-mail: stefan.sieberer@jku.at - Web page: http:// www.jku.at/ikl

ABSTRACT

In industry, the metal forming process represents a very important and wide-spread manufacturing method. To meet the demand for a reduction in production development time with simultaneous increase in the number of variants, simulative approaches are widely used in industries. Forming processes can be efficiently analysed by Finite Element simulations. To obtain reliable results, a suitable material model that includes all important physical effects is essential, [1]. Especially the flow curve model for the description of the plastic material behaviour is crucial for realistic results. In this work, we mainly focus on highly dynamic forming processes like bending and blanking.

First, a dynamic flow curve model for mild steel has been selected according to the literature. To use the model for forming processes with high strain rates, the temperature is considered in addition to the strain rate for modelling the adiabatic heating effect. The selected dynamic flow curve model was then implemented as a user subroutine in the finite element software ABAQUS. The subroutine was tested with basic finite element simulation. For characterization and calibration of the material model for DC01, static and dynamic tensile tests as well as torsion tests have been performed. The parameters of the material model have been identified according to [2]. Outcome of this work is a calibrated material ready to use for simulation of industrial metal forming applications.

REFERENCES

[1] C. Zehetner, C. Reisinger, W. Kunze, F. Hammelmüller, R. Eder, H. Holl and H. Irschik, ”High-quality sheet metal production using a model-based adaptive approach”, *Procedia Computer Science*, **180**, 249–258 (2021).

[2] M. Murugesan and D.W. Jung, “Johnson Cook Material and Failure Model Parameters Estimation of AISI-1045 Medium Carbon Steel for Metal Forming Applications”, *Materials*, 12 (2019).