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www.elsevier.com/locate/ijmecsci

PII: S0020-7403(16)30001-7
DOI: http://dx.doi.org/10.1016/j.ijmecsci.2016.03.014
Reference: MS3254

To appear in: *International Journal of Mechanical Sciences*

Received date: 5 August 2015
Revised date: 7 March 2016
Accepted date: 16 March 2016

Cite this article as: Hamad ul Hassan, Heinrich Traphöner, Alper Güner and A Erman. Tekkaya, Accurate springback prediction in deep drawing using pre strain based multiple cyclic stress-strain curves in finite element simulation *International Journal of Mechanical Sciences* http://dx.doi.org/10.1016/j.ijmecsci.2016.03.014

Accurate springback prediction in deep drawing using pre-strain based multiple cyclic stress-strain curves in finite element simulation

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Abstract

The focus of this work is the accurate prediction of springback in deep drawing for DP600 material. A novel method is used for the characterization of material which leads to simultaneous generation of multiple cyclic stress-strain curves with different magnitude of plastic strains in a single experiment. An enhanced finite element simulation model is also presented which is capable of application of these multiple pre-strain based cyclic stress-strain curves in a single simulation. After each increment, the elements are grouped based on their pre-strain levels independent of the element location and assigned the relevant stress-strain curve. Simulations are performed with the Yoshida Uemori (YU) model, Chaboche-Roussilier (CR) model and an isotropic hardening model for the prediction of springback for hat geometry and tunnel geometry. The maximum deviation between the geometries of experiment and the springback simulation for hat and tunnel geometry for model with multiple cyclic stress-strain curves is 0.8 mm and 1.6 mm respectively in contrast to the deviation of 1.8 mm and 4.2 mm for the simulation model with single cyclic stress-strain curve respectively. It is shown that the simulation model with multiple cyclic stress-strain curves predicts the springback more accurately than the other models with single stress-strain curve.

Keywords: Springback, deep drawing, kinematic hardening, FE simulation