Characterization of Evolving Plastic Anisotropy and Asymmetry of a Rare-earth Magnesium Alloy Sheet by Means of a Non-associated Flow Rule

A. Abedini*, C. Butcher and M.J. Worswick

Department of Mechanical and Mechatronics Engineering
University of Waterloo
Waterloo, Ontario, Canada
E-mails: aabedini@uwaterloo.ca, cbutcher@uwaterloo.ca, worswick@lagavulin.uwaterloo.ca
Web page: http://www.formingandimpact.uwaterloo.ca

ABSTRACT

Superior ductility of rare-earth magnesium alloys over conventional magnesium sheets makes them promising candidates for light-weight structural alloys. However, severe evolving anisotropy and tension-compression asymmetry as a result of activation of different deformation mechanisms (slip or twinning) leads to complications involved with modelling the response of the rare-earth magnesium alloy sheet [1].

In the present paper, the constitutive plastic behaviour of a rare-earth magnesium alloy sheet, ZEK100 (O-temper), is considered at room temperature, under quasi-static conditions. The non-associated flow rule is employed by calibrating yield function and plastic potential at different plastic deformation levels using the CPB06 formulation. The model was implemented as a user material subroutine (UMAT) into the commercial finite element package LS-DYNA along with an interpolation technique to consider the evolving anisotropy of the material. Finally, predictions of the model were compared with the experimental results in terms of flow stresses and plastic flow directions under various loading conditions and along different test directions.

REFERENCES

[1] A. Abedini, C. Butcher, M.J. Nemcko, M.J. Worswick, *Constitutive characterization of a rare-earth magnesium alloy sheet (ZEK100-O) in shear loading: studies of anisotropy and rate sensitivity*, submitted to the International Journal of Mechanical Sciences, (2016).