Formability assessment of a cup drawing under complex nonlinear strain paths

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ABSTRACT

This work presents a study on the numerical prediction of failure of a can after drawing, reverse redrawing and expansion, as proposed under the NUMISHEET 2016 conference [1]. Since this forming operation induces complex nonlinear strain paths on the material, a good description of the plastic anisotropy coupled with an accurate failure model is mandatory. Therefore, in order to assess the accuracy of the orthotropic behaviour of the material, the earing and the thickness profiles, after the reverse redrawing operation are also evaluated.
Two different materials are considered: a TH330 steel and an AA5352 aluminium. The orthotropic behaviour of both materials is modelled considering the Cazacu and Barlat 2001 (CB2001) yield criterion [2], aiming for an accurate description of both yield stresses and *r*-values directionalities. In this context, a sensitivity study is performed, on the material parameter identification, to evaluate the impact of small variations of the experimental *r*-values. Regarding the failure model, the strain based Forming Limit Diagrams (FLD) is analysed as well as a thinning rate approach.
The results show that the CB2001 can accurately predict the earing profile for both materials, as well as the thickness profile, confirming the importance of an accurate prediction of both yield stresses and *r*-values directionalities. Also, the numerical results show that the failure timing and location are dependent on the set of anisotropy parameters used, while also influencing the thinning rate.

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