Strain Path Change Influence on Residual Stresses after Deep Drawing

D. Hérault[1,2 a)] and S. Thuillier[1,b)] and P.Y. Manach[1]

[1]*Univ. Bretagne Sud, UMR CNRS 6027, IRDL, F-56100 Lorient, France*
[2]*ESI Group, 3 bis Saarinen, CP 50 229, 94528 Rungis Cedex, France*

[a)] diane.herault@univ-ubs.fr
[b)] sandrine.thuillier@univ-ubs.fr

Abstract. Automotive manufacturers have shown a growing interest in an integrated design approach, considering the coupling of the different design phases, as it saves time and increases part reliability. In particular, the residual stresses induced by the forming process of metallic sheets affect the service life [1]. Therefore, the accuracy of the service life prediction is closely related to the reliability of the forming process simulation. As complex strain path changes can occur during forming and affect the behavior of the sheets, there is an interest for models that take their influence into account, e.g. the recently developed Homogeneous Anisotropic Hardening (HAH) model [2].

In a first step, this study investigates numerically the influence of the mechanical model on the residual stresses after the direct redrawing of cylindrical cups. A cup is stamped from a circular dual phase steel DP600 sheet of thickness 1.2 mm. Then, the cup is stamped a second time in the same direction to obtain a cup with a smaller diameter. These two stages involve complex strain path changes. To estimate their influence on the residual stress field, the numerical simulation is performed with two models of the material behavior, i.e. isotropic hardening and HAH model; the material parameters are taken from the literature [3]. The residual stress field is then analyzed and correlated with strain path changes, evaluated by the indicator included in the HAH model.

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