An investigation of modelling approaches for material instability of aluminum sheet metal using the GISSMO-model

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ABSTRACT

The use of aluminum sheet for stamped parts in the automotive industry is a continuous trend driven by the pressing need of weight reduction. At the same time the role played by numerical methods for the design of forming processes and components is constantly increasing. Suppliers of aluminium sheet are facing the challenge to (i) optimize the formability of their material and (ii) demonstrate the feasibility of complex geometries to their customers in (iii) as little time as possible. For those three tasks, the standardized, experimentally determined mechanical properties like *n*- and *r*-values or the forming limit curve, however, do not always guarantee a reliable assessment. Therefore, in the framework of a joint research project supported by AMAG rolling GmbH, an effort has been made to investigate the suitability of novel alternative methods for the assessment of sheet metal formability.

The present contribution shows results from laboratory-scale experiments like tensile tests, Nakajima and Cross-die tests and corresponding FEM simulations for an AA6063-T4 alloy at room temperature. A material model, including the GISSMO damage model, has been calibrated. Specifically the question of the material instability is addressed. It will be shown, that for small to intermediate mesh sizes the criterion according to Hill and for higher mesh-sizes (> 2 mm) the criterion according to Swift, respectively, are resulting in a good correlation to the experimental results. Furthermore, detailed simulations with small solid elements have been performed. The relationship between local physical fracture strains and phenomenological fracture curves used in industrial applications with large shell elements will be discussed.