Experimental and Numerical Analysis of Springback and Bending Behavior of a Composite Sandwich Metal-Polymer Material

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Abstract. Lightweight design, lower fuel consumption and easier recyclability are concerns of the automotive industry as a response to the increasing demands for energy saving and better environmental impact of the transport section. This framework is the opportunity to develop multi-layer materials, in order to replace the high-density homogeneous metal sheets, maintaining the structural properties of the component. The multi-layer materials, known as a composite sandwich or hybrid materials, are composed of outer metal sheets with reduced thickness and a polymeric matrix core (low density), in which high specific strengths are achieved. However, the lack of studies and information about the behavior of these non-homogeneous materials poses new challenges, either with regard to their use in sheet metal forming processes, but also when performing material mechanical characterization. This paper presents the behavior faced with bending test and springback analysis of a sandwich metal polymer sheet. A reference high strength low alloy steel is also used as a basis of comparison for corresponding behavior. Experimental tests and corresponding numerical simulations were performed using the press brake air bending process and a Numisheet benchmark test, unconstrained bending test, at room temperature, using the same experimental conditions for both materials. The numerical simulations were performed using a finite element code. The results show that the sandwich material have a lower formability when using a lower punch radius, namely on the outer surface (tension side). Additionally, the comparison of angles before and after springback show that there is no significant difference between the materials in the study, although the non-homogeneous sandwich material presents a higher springback.