Deformation Behaviour of Sheet Metals in Laser-Assisted Hydroforming Processes

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Keywords: hydroforming, laser, forming limit curves

Abstract. Cupping small form elements in hydroforming processes requires high work pressures and clamping forces and thus high capital investments for presses. Localised laser heating used during sheet metal hydroforming processes should reduce the necessary work pressure. By reducing the yield strength and the strain hardening using local heating, small form elements can be formed at very low pressures of 2 MPa, whereas cold forming requires pressures which are 20-50 times higher. Besides the proportion of forming temperature and work pressure, temperature distribution is very important and can be adjusted using a special laser beam forming optic or a scanning processing head. Line network analysises were carried out showing great improvements in the resulting plastic deformation distribution. In order to characterise the general improvement of the material's formability, forming limit curves (FLC) were generated using the bulge-test. The results approve the extended forming limit of the laser assisted warm cupping process.

Moreover, the mechanical properties and the grain structure of the form elements generated were determined. All investigations were carried out for a deep drawing steel, a 5182 aluminium alloy and an AZ31 magnesium alloy.