Die Surface Structures and Hydrostatic Pressure System for the Material Flow Control in High-Pressure Sheet Metal Forming

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Keywords: tribology, surface, sheet metal hydroforming

Abstract. A promising approach to control the material flow within deep drawing and working-media based forming processes is the structuring of the tool surfaces in the contact zones between workpiece and die. In order to obtain a sufficient and an optimised material flow respectively – especially for non-symmetric or non-uniform workpiece geometries – a locally adapted distribution of surface structures is a practicable solution. The macroscopic, and also the microscopic surface structures can be manufactured sufficiently by means of a high-speed cutting process. The shape of the tool surface structure has a significant influence on the tribological conditions between workpiece and die. To adjust the surface structure distribution to the required material flow distribution, detailed knowledge about the correlation of the material flow from the tribological conditions between sheet and the forming tool is required. A further innovative approach, particularly for decreasing the friction coefficient, is the use of an innovative hydrostatic pressure system using fluid ducts. Its functional principle is based on the reduction of the contact shear stress at the sheet surface in the contact zone with the forming tool by means of locally applying a hydrostatic fluid pressure. To obtain information about the correlation of the material flow from the tool surface structures and from the parameters of the hydrostatic pressure system respectively, fundamental investigations have been carried out. In order to optimise the material flow, these tool-based approaches can be used as stand-alone solution, or in addition to other systems. If the surface structures and a hydrostatic pressure system are used in combination with the multi-point blank holder, which has already been qualified for the high-pressure sheet metal forming (HBU), a powerful system for the material flow control is available.