Lehrstuhl für Umformtechnik und Gießereiwesen (utg)
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Reduction of adhesion during forming and shearing cutting by external influene of thermoelectric currents

DFG knowledge transfer project (Project number: 501472178)

Motivation

Shear cutting is an indispensable process in industrial sheet metal processing. According to DIN 8588, this is the separation of workpieces between two cutting edges moving past each other (cutting punch and cutting die). Due to current lightweight construction efforts, alloys of copper, aluminum and titanium are gaining in importance.

These materials have a high adhesion tendency. Adhesions are undesirable because they limit the life of the tool and cause high maintenance costs. Currently, lubricants and coatings are used in the process to prevent direct contact between the sheet metal and the tool materials. However, if this separating layer fails, adhesions arise immediately.

In the research project *"Lubricant-free forming by influencing thermoelectric currents*", *utg* was already able to show that an adapted external current (constant current value) reduces adhesions significantly. The applied external current is in the opposite direction to the internal thermoelectric current. The internal thermoelectric current is a consequence of the process-related temperature gradient in the shear zone and the different Seebeck-coefficients of the sheet and tool materials.

Goal and Procedure

In this project, ***utg*** and its project partner, ***Hubert Stüken GmbH & Co KG,*** want to explore the potential of external currents for adhesion reduction in industrial applications. In the first phase, material characterization is the main task. New materials are characterized in order to expand the database of Seebeck-coefficients and to record the associated mechanical properties.

The value of the optimum constant countercurrent is then determined in shear cutting and deep-drawing tests, while the active elements are continuously examined for adhesions. In order to achieve a minimum of adhesions, time-adjusted current profiles are considered in addition to the time-constant current profile. With the optimal compensation strategy determined from these test series, endurance stroke tests on an industrial series production tool are finally planned to evaluate the effectiveness of the external countercurrents for real applications.

In order to be able to apply this process as simply as possible, a theoretical model is being developed during the project, which should enable the estimation of the optimum external current based on known process and material parameters.

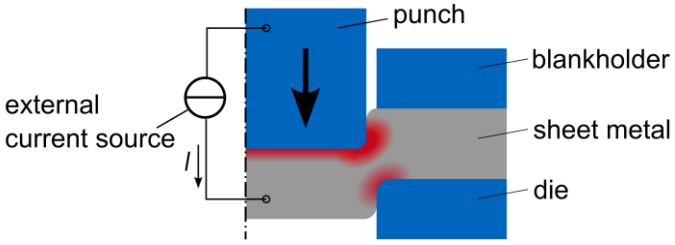

Figure 1: Schematic shear cutting process with external current influence to reduce adhesions

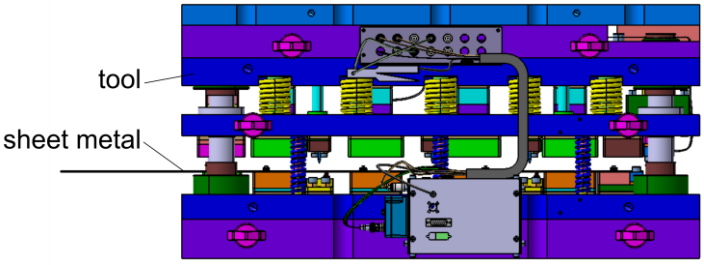

Figure 2: Thermoelectric shear cutting and deep-drawing tool

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