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WarmAp: Hot forming of aluminium sheets for high-performance components of future mobility concepts

Im Projekt WarmAp wurde die Warmumformung hochfester Aluminiumlegierungen untersucht. Dazu wurden in drei Teilprojekten ein mehrstufiges Umformwerkzeug entwickelt und in Betrieb genommen, der Grundstein für eine Reib- und Verschleißprüfmethode bei erhöhten Temperaturen gelegt, sowie die simulative Abbildung von Umformprozessen bei erhöhten Temperaturen erforscht. Dies ermöglichte die Bestimmung von Prozessgrenzen sowie die Erhöhung der Bauteilkomplexität.

Project description

The use of high-strength aluminium alloys (e.g. EN AW-6082 and -7075) makes it possible to meet the high lightweight construction requirements of the mobility industry compared to conventional materials. A challenge in processing these alloys is the low formability in the high-strength T6-state. For this reason, different process routes for forming are possible, which can be combined with a heat treatment cycle (see figure 1).

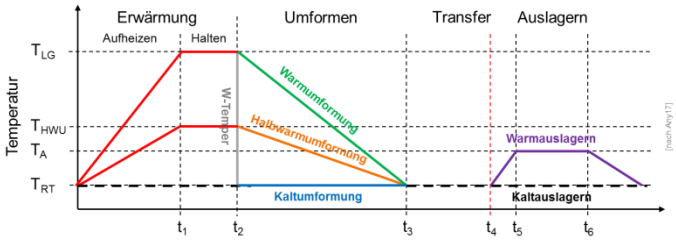

Figure 1: Process routes for the forming of high strength aluminium

WarmAp is a joint SME project of the Hessenagentur in cooperation with Filzek Tribotech (FT), Hörmann Automotive Gustavsburg GmbH (HAG) and Werner Schmid GmbH (WS). The project is affiliated to the LOEWE-focus Allegro, in which the process chain for the forming of high-strength aluminium alloys is being holistically investigated.

Results

Central results of the project are the development of process chains and process infrastructure for the forming of high-strength aluminium sheets.

In the subproject WS a four-stage forming tool (see figure 2) was developed, which allows the specific temperature control of the individual active parts.

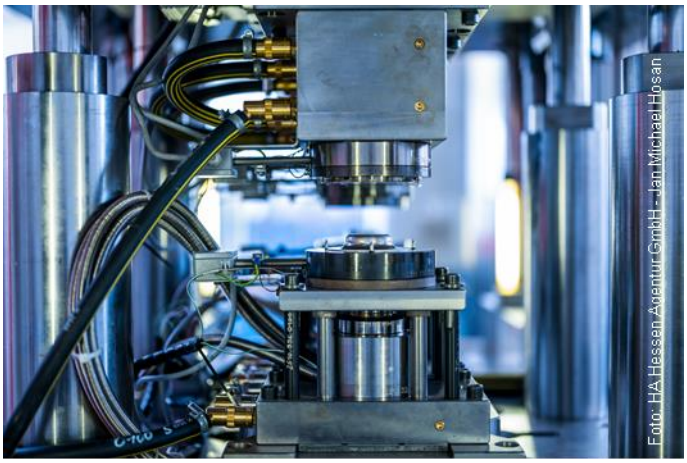

Figure 2: Side view of the four-stage forming tool including the cooling, heating and thermocouple connections

With this tool, all process routes can be investigated experimentally. In addition to the process limits of the individual stages and processes, the feasibility of multi-stage forming of high-strength aluminium could be demonstrated.

In the sub-project carried out by HAG, a process for increasing the formability of high-strength alloys by integrating local blank heating for industrial forming processes was developed and experimentally investigated. The basis for the construction of thermomechanically coupled numerical simulation models was thus created. These models were used to apply the technology to industry-related component geometries in a specially designed tool system.

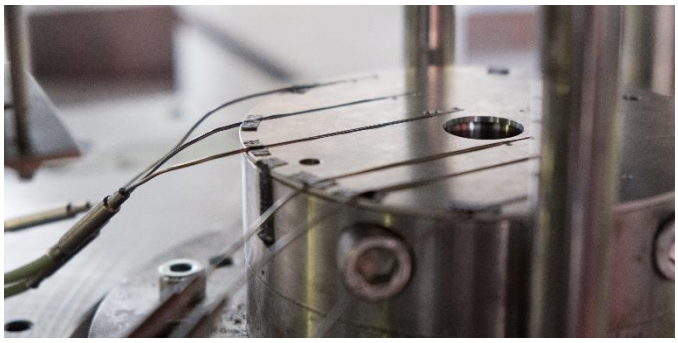

Figure 3: Test setup for the investigation of collar drawing with local contact heating of the sheet

The project also highlighted the need for tribological studies. The friction test facility at the PtU was extended by a high performance sheet heating unit. The friction behaviour of different lubricants was investigated in initial strip pulling tests. The project results serve as a basis for further tribological investigations of temperature-supported forming processes.

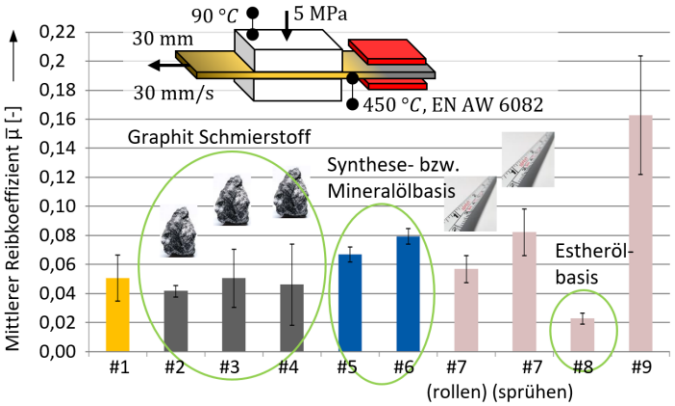

Figure 4: Friction coefficients of different lubricants in the strip pulling test

Acknowledgement

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Project information

Period	Jan. 2018 – Dec. 2019
Editor	M.Sc. Erik Sellner (HAG) M.Sc. Janosch Günzel (WS) M.Sc. Lukas Schell (FT)
Department	Process Chains and Forming Units

Funding Agencies

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