Sealing concept for flashless forging of aluminum

Auf einen Blick

- ☑ Research objective: Avoidance of thin flash in precision forging of aluminum
- ☑ Problem: Deburring processes are uneconomical
- ☑ Approach 1: Industrially valid prediction model supports tool design
- ☑ Approach 2: Sealing concepts reduce the formation of thin flash

03. 2021

IPH | In cooperation with Otto Fuchs KG, IPH is researching methods to predict and avoid thin flash during flashless forging of aluminum. The development of target-oriented sealing concepts should significantly increase process efficiency in the future.

How can thin flash be avoided in the flashless forging of aluminum under industrial process parameters? This is what the Institut für Integrierte Produktion Hannover (IPH) gGmbH is investigating in the DFG transfer project FliDiAl. Together with Otto Fuchs KG, the IPH scientists are working on the development of sealing concepts for avoiding flash.

Flashless forging of aluminum

Aluminum is the second most commonly used metal in the forging industry and offers high lightweight construction potential due to its low density. Due to this specific property, its use in various industries is steadily increasing. However, the use of aluminum has so far been limited for some industrial processes. One example is flashless forging, which is used in industry.

The potential of flashless forging – namely an increase in resource efficiency and a reduction in post-processing – cannot currently be fully exploited for aluminum. This is because aluminum tends to flow into small die gaps due to its good flow properties. This results in so-called thin flash, which makes the use of flashless forging for aluminum significantly more difficult and reduces economic efficiency.

Formation of thin flash

In the FliDiAl research project, a target-oriented sealing system is to be developed under industrial parameters that prevents thin flash and makes it possible to exploit the potential of flashless forging for aluminum in the future.

To this end, the IPH scientists are first determining critical process windows that influence the formation of thin flash. In the previous research project "Avoidance of thin flash formation for precision forging of aluminum parts (ProGrAl)", IPH scientists had already identified process parameters that potentially influence the formation of thin flash – namely tool temperature, tool gap width (see Fig. 2) and forming speed. For the transfer of these findings to industrial applications, these process parameters are being extended with industry-related, relevant influencing variables – including starting material tolerances and varying die temperature.

Using an FEM analysis, the scientists are investigating the thermal loads, the stress states and the material flow vectors at the mold gap in a test mold. This tool is being developed in the research project in cooperation with Otto Fuchs KG. During the investigations, the scientists vary global process parameters such as tool temperature, speed and starting material tolerances, which have an influence on the local stresses at the tool gap. The approach is expected to provide significant insights with regard to thin flash formation and avoidance, which should support targeted process design in the future.

Development of a sealing concept

While several past research projects have investigated sealing systems for aluminum forging, they have not been implemented in practical industrial processes. Challenges in practical implementation are often deviating parameters such as starting material tolerances and inconstant tool tempering, which are not taken into account in finely calculated scientifically developed sealing concepts.

For this reason, different sealing concepts are to be investigated within the transfer project "FliDiAl" with regard to their feasibility and sealing effect – under variation of industry-related process parameters. A finally selected sealing concept will then be experimentally validated. For validation, the IPH scientists are using two industry-related test component tools under industry-related process influences at Otto Fuchs KG.

The target parameters for the experimental investigation are the lowest possible mass of thin flash and the longest possible service life of the seal in order to exploit the maximum economic potential.

Design and prediction model

In addition to targeted seal development, the scientists are also working on the accurate prediction of the local occurrence of thin flash. Their aim is to avoid or limit the formation of thin flash by preventive adaptation of the process.

To create a generally valid design model, the influences of the process parameters and the thermal and mechanical loads in the mold on the

developed sealing system are evaluated. The basis of the model is formed by the geometry parameters of the seal in combination with a case-specific, target-oriented material selection that promises an optimum sealing effect and long service life while taking process-relevant influences into account. In addition, a prediction model for thin flash formation under near-industrial process conditions is to be developed, based on consideration of the material flow vectors, thermal loads and stress states at the mold gap.

In the future, it should be possible to prevent thin flash to a large extent – by combining the prediction model with case-specific sealing systems.

Looking to the future

The sealing concept developed in this transfer project, like the prediction model, forms the basis for targeted optimization of flashless forging of aluminum. The project results will help companies save time and costs in the future and exploit the economic potential of flashless forging for aluminum within an industrial establishment. In addition, the component quality and material efficiency of the manufacturing process can be sustainably ensured through targeted adaptation of the process parameters.

by Alexander Martini

E-Mail: martini@iph-hannover.de
Tel.: + 49 (0)511 27976-340
Webseite: flidial.iph-hannover.de