Bachelor or master thesis

Springback Control by Heating in a Bending Operation

You will join Grundfos Advanced Manufacturing Engineering in cooperation with the IUL, where you will investigate how to control the springback of different stainless-steel grades through use of heating. Depending on individual competences, desires and needs the collaboration can include:

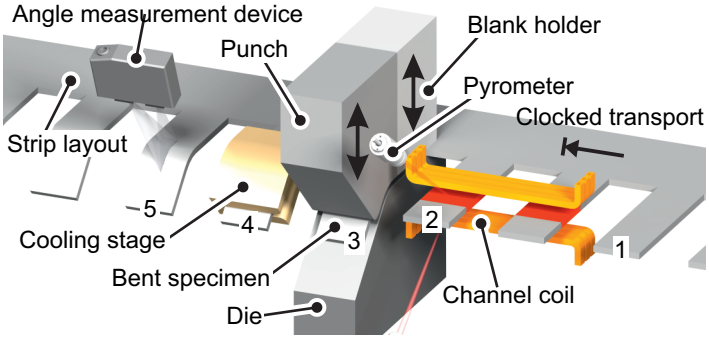
- Analysis of Springback properties of selected metals in varying temperatures at the IUL
- Considerations for Process and tool design
- Studying the impact of heating to corrosion resistance of stainless steel during a stay at Grundfos in Denmark
- Design of control system for implementing springback control in a progressive die

Purpose

Currently, multiple tools are needed to compensate for springback if different part configurations with identical geometry need to be stamped from different material grades. Moreover, batch to batch variations contribute to deviations in final geometry. The efficiency of Grundfos products is closely linked to the precision of the stamped parts. The goal of the project is to investigate the feasibility of controlling springback of various stainless steel grades using temperature and thereby make it possible to form identical parts in the same tool.

Description

Compensating for springback is becoming more challenging as sheet metal grades with higher strength are introduced to production, because springback is a function of the material's yield strength. Furthermore, higher strength reduces material formability, limiting the geometries that can be formed. Yield strength of metals is known to decrease when temperature is increased, and it has been shown by Löbbe et al. [1] that this relationship can be used to considerably reduce the variation of bending angle in progressive die bending.



1: Precut specimen
2: Heating station
3: Bending station
4: Cooling station
5: Measuring station

Despite the technology being demonstrated in literature, there are a few unanswered questions that need to be answered before Grundfos can implement the technology in high-volume production and eliminate redundant tool geometries to produce the same part from different material grades. Thus, the goal of the project is to experimentally verify that a similar springback angle can be achieved for different stainless-steel grades, such as EN 1.4401 and EN 1.4539, used by Grundfos by control of the temperature. Another crucial unanswered question is the influence of elevated temperatures to the corrosion resistance of the material, which could be tested with the help of specialists at Grundfos. Depending on the student's interests and skills, tool design and control design could be included in the project.

Your profile:

- **Knowledge of the fundamentals in the field of forming technology**
- **The ability to work on your own and in a structured manner**

Start of thesis: 01.04.2023

References

[1] Löbbe, C., Hoppe, C., Becker, C. et al. Closed loop springback control in progressive die bending by induction heating. Int. J. Precis. Eng. Manuf. 16, 2441–2449, 2015.
https://doi.org/10.1007/s12541-015-0314-8

Institut für Umformtechnik und Leichtbau

TU Dortmund
Fakultät Maschinenbau
Institut für Umformtechnik und Leichtbau

Prof. Dr.-Ing. A. Erman Tekkaya

D-44227 Dortmund
Baroper Straße 303
Campus Süd / Einfahrt 41
www.iul.eu

technische universität dortmund

Contact IUL:

Juri Martschin
MB 3, Raum 4.012, *Campus-Süd*
juri.martschin
@iul.tu-dortmund.de
Tel.: (0231) 755 - 8437

Contact Grundfos:

Kasper Mygind Madsen
kmygindmadsen
@grundfos.com