

Galling mechanism in deep drawing processes



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Introduction

Sheet metal forming of aluminium and zinc-coated steel is done extensively in automotive and aerospace applications using processes like deep drawing. Galling is defined as the mechanism in which material transfer takes place from the sheet to the tool, which is followed by scratching of the work hardened lumps attached to the tool into the sheet. This results in a severely scratched product, see for example figure 1.

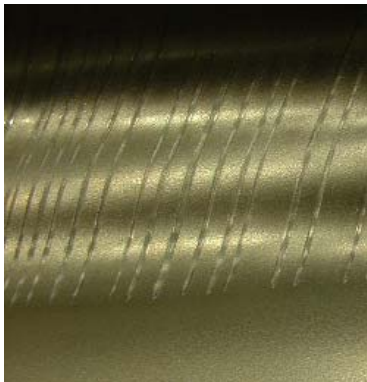


Figure 1: An example of a severely scratched product.

Galling

From the definition of galling two stages can be distinguished:

- 1) Material transfer from sheet to tool.
- 2) Scratching of the tool into the sheet.

Material transfer To enable material transfer a first requirement is direct contact. Deep drawing processes are mostly lubricated, so first of all, the lubricant has to fail. The lubricant fails due to too high flash temperatures on asperity level, see figure 2a and 2b [1].

When material transfer occurs the lump growth (figure 2c) depends on [2]:

- Locale pressure
- Temperature
- Sheet deformation
- Surface roughness
- Etc.

Scratching After lumps have grown to a critical shape and size, severe scratching will take place, see figure 1 and 2d.

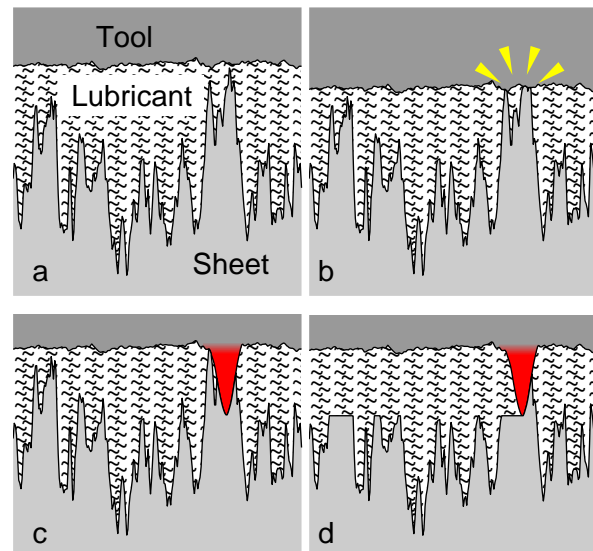


Figure 2: a) Lubricated contact. b) Direct contact - Lubricant failure. c) Material transfer – Lump growth. d) Scratching.

Objective

The objective of this research is to develop a Galling Performance Indicator (GPI) from which the galling tendency of a (coated) tool in contact with a sheet in forming operations can be predicted. The development focuses on in aluminium sheet en zinc coated sheet. The GPI will be coupled to FEM simulations of forming processes.

References

- [1] E. van der Heide, Lubricant failure in sheet metal forming processes, PhD-thesis, University of Twente, 2002.
- [2] M.B. de Rooij, Tribological aspects of unlubricated deep drawing processes, PhD-thesis, University of Twente, 1998.