Experimental simulation of the contact conditions between a tool and a sheet metal during a fine blanking operation.

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The contact conditions between a cutting tool and the sheet to be cut have a great influence on the service life of the tool during a fine blanking operation. In order to optimize lubrication, surface finish, clearances, cutting cycle...we have instrumented an industrial press in order to reproduce the contact conditions in terms of tool/sheet relative speed and contact pressure on a suitable tribometer in the laboratory. The performance of a green lubricant, not derived from petrochemicals, as well as surface texturing were examined in the laboratory before being tested in production.
Keywords: tribology, fine blanking, surface texturing, blanking press instrumentation

1. Introduction

During a fine blanking operation, a blank holder is used which allows a very small clearance between tool and sheet metal (around 10µm), thus leading to a cutting surface of excellent quality [1]. In order to study the influence of the operating parameters on this quality, an industrial press was instrumented with force, displacement and temperature measurements. This study aims to use the kinematic and force data collected with this instrumentation to study in the laboratory on an appropriate tribometer the combined contribution of a specific lubrication on a textured tool.

2. Methods

2.1. Cut parts

The workpieces are blanked from thick sheet metal (4.7 mm thick) in grade 16MnCr5. Tools are made of high alloyed vanadium steel, with PVD multilayer TiN coating. Part and tool geometries are shown in Figure 1.

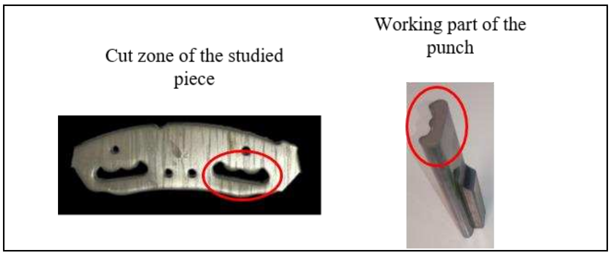

Figure 1: Geometries of the blanked parts and the corresponding punch.

2.2. Methodology

In order to know perfectly the force/displacement cycle, the press has been equipped with force and displacement sensors as close as possible to the cutting punch. The cycle can thus be divided into several characteristic areas shown in figure 2.

2.3. Results

During step 8, the workpiece is already cut, the chip is already ejected and the punch passes again through the cut area in the opposite direction with a friction component due to the shrinkage of the material around it after cutting (because of internal compressive stress).

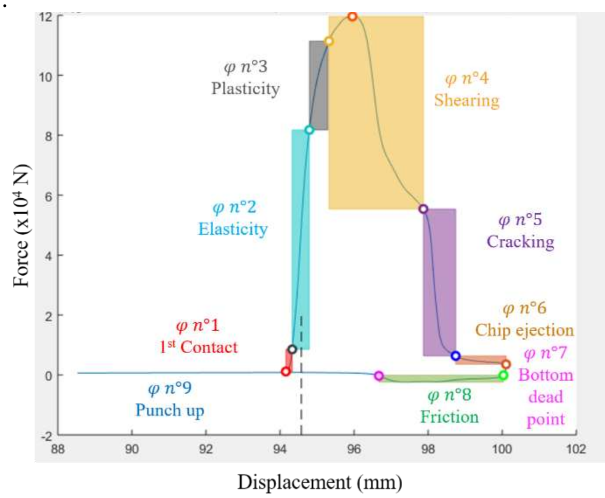

Figure 2: Identifying the force/displacement cycle of the punch during a fine blanking operation

3. Discussion

The punch/sheet friction during this phase 8 can therefore lead to the wear of the punch that we try to minimize. By comparing the geometry of the cut part with that of the punch, we can determine the material shrinkage and therefore the contact pressure applied by the material on the tool during this phase.

Laboratory tests were therefore carried out respecting the contact pressures and sliding speeds encountered in this process. Thus, the study presents the results concerning lubrication (type and quantity) as well as the contribution of a particular surface texture produced by femto-second laser on friction and wear (which is especially important [2]) by respecting the stress conditions measured *in situ* during a real cutting operation.

4. References

[1] Fuchiwaki, K. et al., "Prediction od die-roll in fine blanking by use of profile parameters" Procedia Engineering, 207, 2017, 1564-1569.

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