AN OPTIMAL STUDY AND ANALYTICAL WORK ON STAMPING TOOL STUDY

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ABSTRACT:

To understand the wear progression, accelerated stamping tests were performed using a semi-industrial stamping setup which can perform clamping, piercing, stamping in a single cycle. The time domain features related to stamping were computed for the acoustic emissions signal of each part. The sidewalls of the stamped parts were scanned using an optical profilometer to obtain profiles of the worn part, and they were qualitatively correlated to that of the acoustic emissions signal. Based on the wear behaviour, the wear data can be divided into three stages: In the first stage, no wear is observed, in the second stage, adhesive wear is likely to occur, and in the third stage severe abrasive plus adhesive wear is likely to occur. Scanning electron microscopy showed the formation of lumps on the stamping tool, which represents galling behavior. Correlation between the time domain features of the acoustic emissions signal and the wear progression identified in this study lays the basis for tool diagnostics in stamping industry.

1.0 INTRODUCTION

The sheet metal stamping process is a mass manufacturing process employed in the automobile and aerospace industries to produce a variety of parts in terms of shape and size. On a mechanical press, sheet metal is clamped into the die and the punch is pressed against the sheet into the die cavity to make the required shape. Shearing, bending and drawing is incorporated in the stamping process to produce the components on the larger scale in the metal forming industry, finite element (FE) simulations are widely used for process analysis and parameter optimisations. As the current FE simulations are mostly performed in single cycles only, this differs from the cycles experienced by industrial metal forming tools, which are normally operated for a large number of cycles. After a certain number of cyclic loadings, the tools can be damaged due to wear. It is of vital importance for engineers to understand the tribological behaviour in metal forming processes to enable tooling wear life prediction after cyclic loadings. Moreover, tools are often coated with hard coatings for the purpose of reducing friction, increasing hardness and the resistance to wear and oxidation Recently, the tribological behaviour of coated surface contacts have been characterised at a range of conditions

2.0 LITERATURE REVIEW

Vishwanath M.C [1] FE simulations for multi-cycle loading are extremely essential to forecast tool life in metal shaping processes. The stable state friction coefficient will last long for a well-designed coating/substratum framework. However, as the layer becomes thin and the wear extreme and the friction of both tools and blanks is increased.

Kumar S [2] Previous experiments in the tribology and models tested based on wear and friction coefficient changes with internal and external variables including contact strength, sliding speed, etc. Most of these models can model the continuous friction coefficient only during the stationary time. These variables may however, have an interactive effect on the friction coefficient and a coating device failure cannot be predicted by the steady state duration.

Pawan R., Mohammad [3] The die was designed and the production was not enough. The explanation is that the majority of the research studies mentioned concentrated on design, process planning or product mechanisation. However, the creation of complex and progressive tools with enormous numbers of steps is not based very much.

Jyothi Bhaskar, G Sathya Prakash [4] Redesigning the cost reduction mechanism. To increase the number of stations to reduce the time needed for formation. The design of tools to ensure a high lifetime of tools is simulated. This research would also concentrate on simulating and dying tools to ensure their longevity. It will save money and time if all of this is streamlined and analysis and performance can be changed before anything takes place.

3.0 RESEARCH METHODOLOGY

As we know, every product consists of various components used for performing the necessary function. The expense of this product encompasses all the components used therein. We also note that large-scale manufacturing industries buy parts from the vendors or suppliers (used inside the product). These pieces are called purchased parts (BOP). As we have previously discussed, benefit optimize depends on cost control, and unnecessary product or process costs are reduced in several ways. The price of imported parts depends on the production cost. If we evaluate the cost savings in purchased products, the net value of that commodity can be increased. The above thought inspired me to pursue a supplier industry survey to find out the potential for cost reductions compared with cost control strategies currently used in the large-scale OEMs. To clarify their roles and concentrate on enhanced cost reduction, the interview sessions are held with various staff to discuss their experience with their respective organisation's cost reduction technology

Tool-life prediction – a feasibility study

Most FE simulations conducted for the sheet metal forming operations as described in literature are single cycled with a constant friction coefficient/factor assigned as the boundary condition. This ignores any evolutions of the interface conditions due to the multi-cycle loadings and probably is an over-simplification of the complex tribological nature at the workpiece/tooling interface. The results shown in figure indicate that the friction coefficient evolves and the system has an interactive response to wear. Therefore, the use of a constant friction coefficient in the FE simulation, e.g. by taking the average value over the entire life time of the coating, will lead to a considerable deviation from the actual contact conditions at the tooling/workpiece interface. The implementation of the interactive friction model as described above, will enable accounting for complex evolutions in friction coefficient and wear during the metal forming processes which enables a more sensible definition of the frictional boundary conditions. Moreover, implementation of the interactive friction model will enable the estimation of the breakdown of the hard coatings and thus the life of the coated tools.

Material for die and punch:

The material cost accounts for 20% of total cost. Sheet metal industries are given due considerations to reduce the manufacturing costs and hence to reduce the cost of production. Thus, selection of proper material for manufacturing of tool components essentially increases the tool life and hence reduces the cost of production. Tool steels find much wide applications in stamping of large volumes of small and medium sized parts are inserts in larger dies. These steels are designed specially to develop high hardness level and abrasion resistance. Both through heat treatment and through existence of hard, stable and complex chromium, tungsten, molybdenum and vanadium carbides, we selected D2 from the AISI table for the modified tool. The old tool had ONHS for punches and dies.

Design of tool components

Land Although long life of all tool components is desirable, special attention is given to dies and punches inserts. The term "die life" specifically refers to dimension length of land in a cutting edge. Generally, the press tools are built to manufacture millions of components and expected to be replaced after being ground and shimmed over a period of time. However, sections should be provided for maximum possible use and generally, 3 to 4 mm land is kept with 1/3 to ¼ degree draft angle depending on shape of die, punch and material of sheet. In our previous tool, there was no provision for land. Hence, once punches and dies wore out, we scraped the whole tool. While in modified tool, the land provided was 3 mm which allowed us to grind the height 0.1mm each time and thus using the tool even after wear.

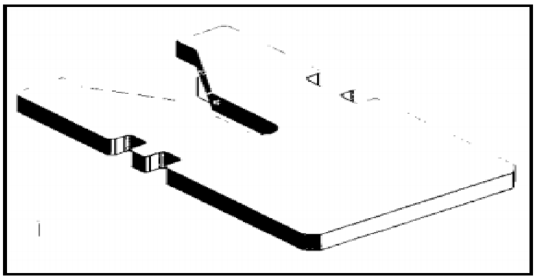

Figure: Arc Chute Plate (3D view)

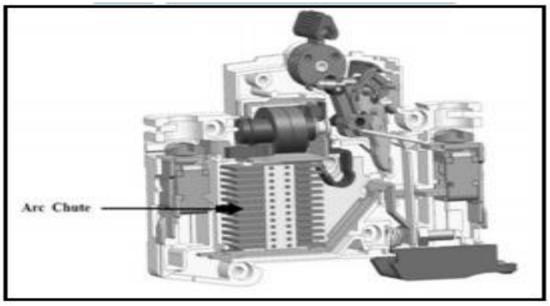

Figure: Location of Arc Chute

Arc chute is the critical component of MCB which is used to cool and extinguish the arc that occurs during short circuit overload condition. The location of Arc Chute in MCB is as shown. Thickness of plate is 0.8 mm and main objective was to design and manufacture of press tool for medium batch long run press tool for Arc-Chute component. In the design of die set, the 1st step is to prepare various configurations of strip layout possible. Strip layout is the position of the component in the metal strip & their orientation with respect to each other. After strip layouts are prepared, we select the most feasible layout for the given application.

Radial Mounting of Punches:

The cutting force is considered when more components per stroke are expected and more tonnage of capacity press is available. This is a new concept in which slight (about) curve is given to the punches. The mechanism works with principle that the curving portion make the side punches hit slightly before the punches in center. Thus, the cutting force is distributed. Data below show the difference in cutting force of initial tool and modified tool: Cutting force of tool 1: Cf = 163.72 kN in one stroke. Cutting force of tool 2: 1st stage = 96.26 kN 2 nd stage = 130.19 kN Thus, the force is distributed and the tool life increases.

Table: Characteristics of the base and top plate

Width (mm)	250
Length (mm)	200
Thickness (mm)	12.5
M10 holes to threaded bars fixture (qty)	4
Ø 8mm holes to linear guides fixture (qty)	4
Base - Oblong hole to tool fixture and material drain (qty)	1
Top - Fixture cylinder hole (qty)	1

4.0 RESULTS AND DISCUSSIONS

The sheet metal industry plays important role in switch gear industry. Sheet metal processes are important and quick means of producing durable, intricate and accurate components on a large scale. Metal cutting includes separating a piece of predetermined strip material. It contains various processes as blanking, trimming, parting off, notching etc. The tool life and accuracy depend on variety of factors as tolerances, selection of material for tools, amount of cutting force, replaceable die inserts etc the forming and shaping of metals and plastics, via processes such as injection molding, stamping, and forging, are essential to modern society. Tools, dies, and molds, collectively referred to here as ‘‘tooling,’’ are required to produce nearly all plastic and metal products in industries such as automotive, medical, aerospace, and consumer electronics. Nevertheless, tooling production is a time consuming, technically difficult, and expensive production process that requires specialized materials, labor, and manufacturing techniques

In order to carry out the simulation, some simplifications were proposed in the model. The system stems and the upper plate were not considered since the load could be applied from the movable plate. Static analysis and an external load of 1100N were used. The results obtained were the displacement and deformation of the parts subjected to the application of the load, besides the safety factor distributed throughout the different regions of each one of the pieces. Displacement and deformation of parts under the load applied were the main outcomes analysed by the comparison to the yield stress of AISI 1020 steel.

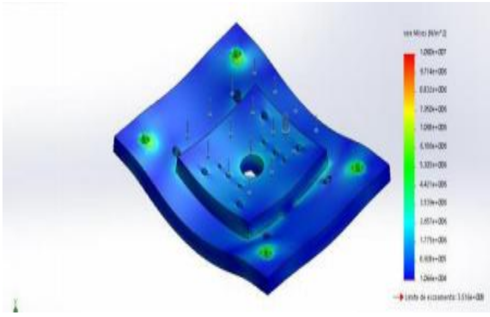

Figure: Bed plate concentration of stress

The following Figure 6 shows the behavior of the part from displacement standpoint.

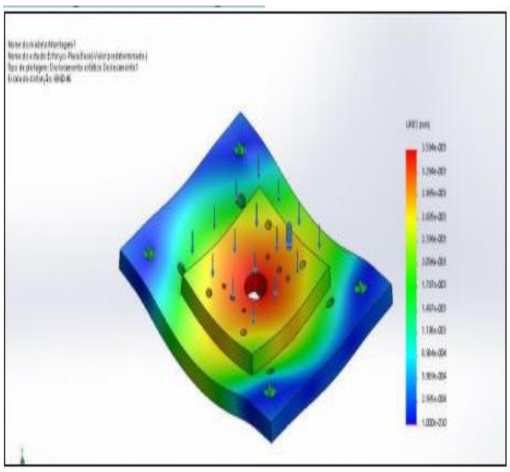

Figure: Bed plate – displacement analysis

The software reproduces the images in a larger proportion in order to allow a better visualization of the displacement. Same happens to the analysis of concentration efforts. The following analysis was performed to verify the safety coefficient of the part the red region is the one that suffers the greatest efforts and tensions.

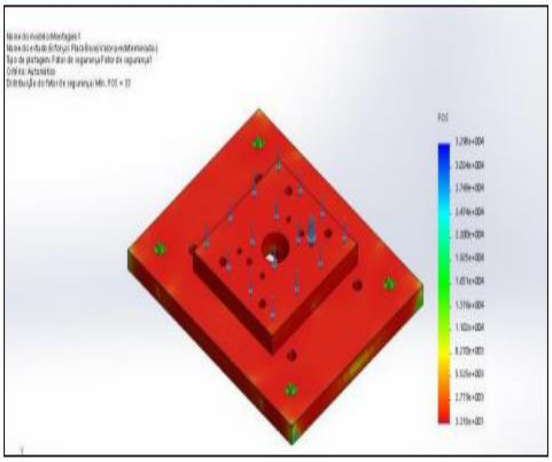

Figure: Bed plate – safety coefficient analysis

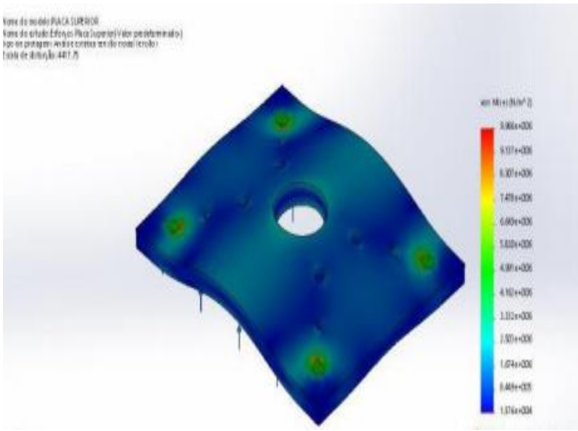

Figure: Upper plate tension distribution

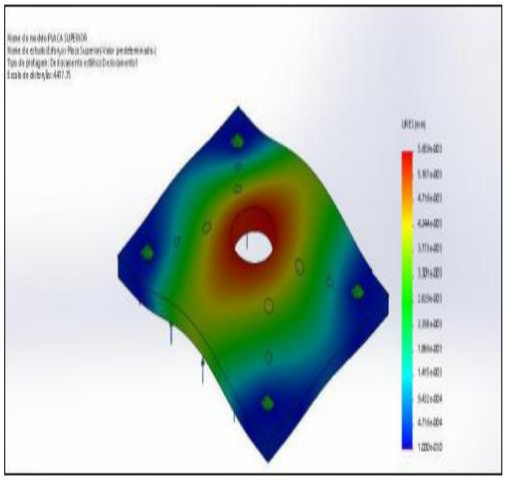

Figure: Upper plate – displacement variation

Related to the analysis to the movable plate Figure shows the regions that suffer the greatest tensions are located in the center of the part, where are the holes for the fixation of the tool of stamping, fixation of the tip of the rod of the cylinder besides the region of the fixing holes of the guide rod

CONCLUSION:

In this case study, the main problem and challenges are design and analysis of progressive die. A huge variety of sheet-metal forming processes is used in modern sheet-metal press-working shop practice. The entire objective is about to reduce the cost; time is taken for production and lifespan of punch. Both cost and time are most important factors that need to be focus before put it in the production section to run the mass production Based on the outcomes from the simulations performed was possible to confirm that the material (AISI 1020 steel) is capable to support the external load applied from material resistance standpoint. The displacements obtained do not represent a significance considering that the highest value founded in the movable plate was around 0,02420mm. CAD design is the base to CAE simulation since the combination of plates from the proposed press interact between it selves distributing the load as soon as it is applied

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