Investigation of Pre-Process Parameter for Filter Cap using Hyper form Software

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Abstract— Deep drawing can be defined as a metal forming process in which a part is produced from a flat sheet metal blank by the action of a punch force onto the blank. The blank is pulled (drawn) into a die cavity, which causes the flange of the blank to compress in the circumferential direction while material flow is controlled by a restraining force provided by a blank holder. . Metal in the area of the die shoulder undergoes a lot of stress, and will result in wrinkles if a blank holder is not used to control the flow of material into the die. Material is usually thickest in the area where the metal loses con Items often made by deep drawing include cupped baking pans, like muffin pans, and aluminum can cylinders. This dissertation work would focus on eliminating the Design problems arising out of incorrect selection of values for the variables / parameters. The parameters affecting the quality of the component produced could be listed as Blank holding pressure, Radii at Die entry & punch nose, Material of the component, Thickness of sheet, Depth of Form/ Draw, Use of Mechanical or Hydraulic Press, Shape of the blank. Sheet metal forming is one of the most widely used manufacturing processes for the fabrication of a wide range of products in many industries.

Key words: Filter Cap, Hyper form

I. INTRODUCTION

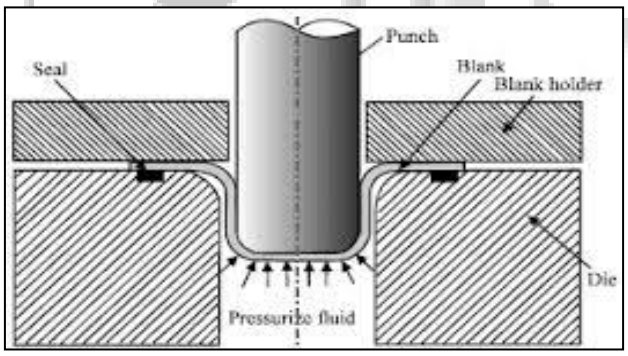

Fig. 1: Representation of a Deep Draw operation

Deep drawing is one of the extensively used sheet metal forming processes in the industries to have mass production of cup shaped components in a very short time. In deep drawing, a flat blank of sheet metal is shaped by the action of a punch forcing the metal into a die cavity Sheet metal forming is one of the most common manufacturing processes to plastically deform a material into a desired shape. Based on the geometry, the volume and the material, sheet metal forming can be divided into various categories such as stamping, deep drawing, stretch forming, rubber forming, and super plastic forming. Among these, Stamping and deep drawing are the most common operations. Deep drawing products in modern industries usually have a complicated shape, so these have to undergo several successive operations to obtain a final desired shape.

II. PROBLEM DEFINITION

The forming operation for deep draw component (undertaken by the sponsoring company) normally has an adverse length to diameter ratio. This poses challenges for processing the component using conventional design practices. The current component under design too has a longer depth with features that are critical to process through the draw die.

The problems faced as a result of poor design are:

- Wrinkling
- Tearing
- Thinning
- Spring Back

A. Scope of the Work/Objectives

- Analyze the part for Draw operation using appropriate CAE software for Forming/
- Draw simulation
- Interpret the results
- Conduct trials for experimentation
- Document the results for validation

III. METHODOLOGY

- Analytical & Physical Experimentation:
- Data collection for Historical data of forming/ draw Dies
- The part design
- Analysis for Component to be drawn

IV. EXPERIMENTATION

Experiments are to be conducted on a hydraulic press of a suitable capacity. The die would be mounted on the bolster plate of the press and the speed of the ram would be set based on the historical data as well as the input received from the analysis data (simulation).

Forming problems can be predicted before tool fabrication through the use of software that can be integrated into production routes which rely increasingly on computer technology. The prediction

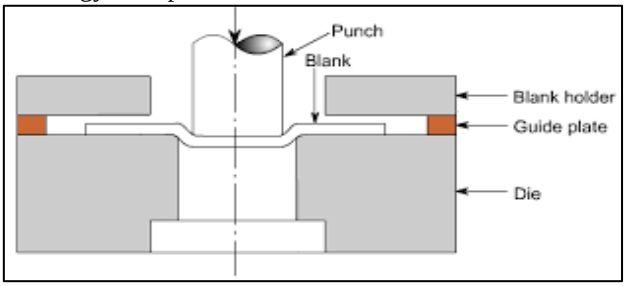

Fig. 2: Schematic Diagram of Forming With Punch and Die

Fig. 3: Experimental Set Up

V. ANALYSIS OF THINNING FOR VALIDATION EXPERIMENTATION

After performing validation experiments, analysis of validation experimental data is done by using MINITAB-17 software. The effect of various input parameters on output responses will be analyzed using analysis of Taguchi Method. The graph shows experimental result.

A. Analysis of Single Parameter Effects on Thickness Difference (Simulation Trail Experimentation)

The following process parameter selected for trails simulation experimentation for deep drawing process as per literature review. The table 4.1 shows process parameter for trails experimentation.

Parameter	Levels				
BHF (kN)	10	12	14	16	18
COF (µ)	0.05	0.1	0.15	0.20	0.25
RD (mm)	5	6	7	8	9
RP (mm)	2	6	10	14	18

Table 1: Process Parameter for Trail Experimentation

B. Effects of Blank Holding Force (BHF-KN)

The Main effect plot for thinning for filter cap is as shown in fig 4.1. As a Blank holding force increase thinning goes on decreasing because of flow of material in the die it's depend on blank holding force.

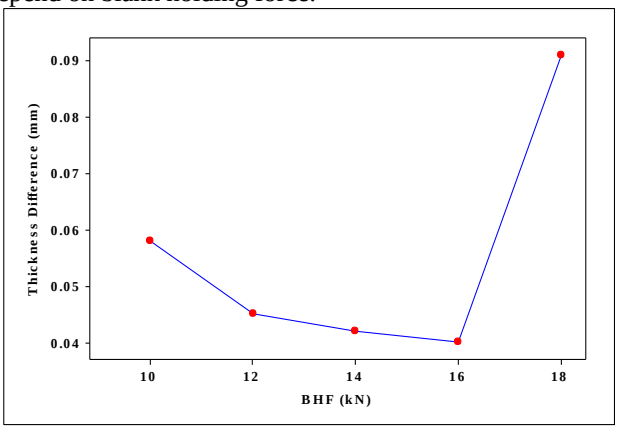

Fig. 4: Main Effect Plots for Thickness Difference (BHF-mm)

C. Effects of Coefficient of Friction (COF-µ)

The main effects plot for average thickness for filter cap for single parameter as shown in fig. 4.2.The coefficient of friction goes on increasing thinning also goes on increase because of deep drawing all surface areas where sheet and tool slide are relative to each other due to the friction increase plastic deformation occur. While coefficient of friction to high stretch of sheet and due to crack formation because the slow movement of sheet can result into tearing and cracking.

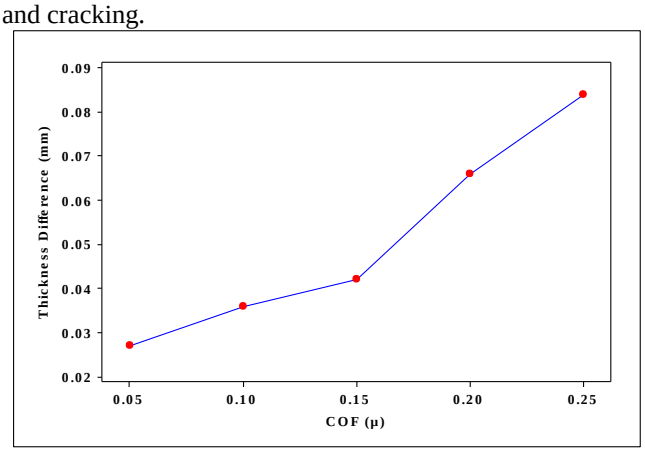

Fig. 5: Main Effect Plots for Thickness Difference (COF-µ)

D. Effects of Radius of Die (mm)

The main effects plot for average thickness for filter cap for single parameter as shown in fig. 4.3. The die radius of start too small so thinning occur and die radius too high thinning may occur so optimum die radius is middle level. Because of the radius of die is too small thinning increase because of high restraining forces caused bending and unbending of the sheet metal over a tight radius. The deep drawing high die radius also produces heat between sheet and tool due to the friction between them and die radius high contact between sheet surface and tool more that is the sheet may occur stretch or thinning the sheet. So die radius is not too small or not a too big.

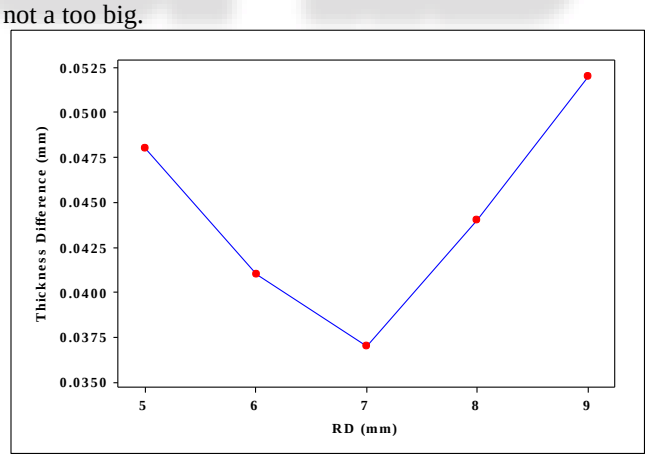

Fig. 6: Main Effect Plots for Thickness Difference (RD-mm)

E. Effects of Radius of Punch (mm)

The main effects plot for average thickness for filter cap for single parameter as shown in fig. 4.4. The radius of punch goes on increasing thinning also goes on increasing.

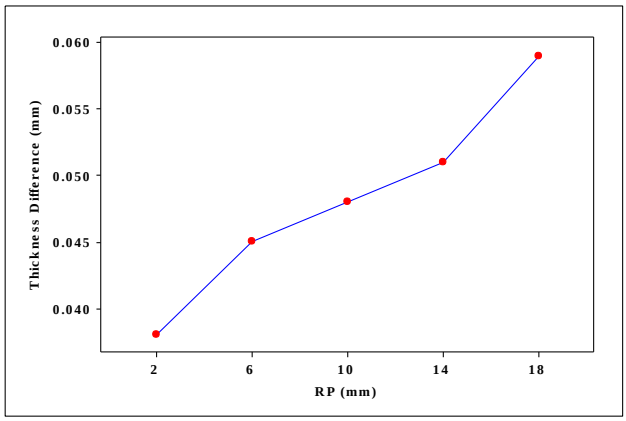

Fig. 7: Main Effect Plots for Thickness Difference (RP-mm)

VI. CONCLUSION

Metal forming, product design, Die design industry can be largely benefited to carry the virtual forming simulation and thus reduce the manual tryouts which involves time and money. Simulation technique can be used effectively to optimize the die design and process parameters. Using Hyper Form and available CAE Technology any modification required to modify the die or the component can be carried out in the software and multiple iterations can be performed and accordingly the design can be finalized. Simulation results obtained by the use of software agree reasonably well with the experimental results. These results also establish generic guidelines for forming die design for Deep Draw materials. In order to expand the range of application of the developed method, parts with more complex geometries can be considered as future scope of work.

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