International Journal of Engineering Applied Sciences and Technology, 2016
Vol. 1, Issue 10, ISSN No. 2455-2143, Pages 72-75
Published Online August - September 2016 in IJEAST (http://www.ijeast.com)

DETERMINING THE PROCESS PARAMETER FOR FILTER CAP

Mr.P.M.Chopade
Department of Mechanical Engineering
JNEC Aurangabad, Maharashtra, India

Prof.S.B.Ubale
Department of Mechanical Engineering
JNEC Aurangabad, Maharashtra, India

***Abstract*— Sheet metal forming problems are typical in nature since they involve geometry. Drawing part involves many parameters like punch and dies radius, clearance, lubrication, blank holding force, etc. So, designing the tools for part drawing involves a lot of trial and error procedure. To reduce the number of costly trial error steps, the process can be simulated by using finite element packages. Effect of thinning, wrinkling and tearing with respect to various blank thicknesses is studied in this work. Design of Punch and Die and simulation of the Deep drawing process is carried out using CAE software. Experimentation is also carried out to validate the simulation results. The finite element method is a powerful tool to predict material thinning deformations before prototypes are made. The proposed innovative methodology combines two techniques for prediction and optimization of thinning in Filter Cap. Taguchi design of experiments has been applied to analyze the influencing process parameters on Thinning. Optimization problem has been formulated for thinning and Experimental validation of results proves the applicability of newly proposed approach. The optimized component when manufactured is observed to be safe, no thinning or fracture is observed.**

Keywords— Tearing, Thinning, Wrinkling, Springback

I. INTRODUCTION

Metal stamping refers to the process of shaping and cutting metals into particular forms, and is generally used in producing components for structures or large pieces of machinery. It may also be used to mold metal sheets into specific shapes for use in common everyday items, including cans and cookware. Zinc, steel, titanium and aluminum are among the most common metals used for this purpose. Metal stamping is well known as a cost effective way to produce lots of different items on a large scale. The metal stamping process works by placing sheets of metal in a press tool or die with a specially designed cavity that gives the sheet its preferred shape. The upper part of the die is attached to the press slide and the lower part is attached to the press bed. The punch pushes the sheet of metal through the die and does the actual shaping. Metal may be plated with various others after stamping to prevent corrosion or improve appearance, as well as to improve soldering ability and wear. Sheets may be pre plated before stamping, then cleaned. After stamping, most items are heat treated for strength, and then deburred to remove sharp corners, with abrasives or chemical means. There are two different kinds of presses for metal stamping - hydraulic and mechanical. They come in a wide range of capacities, stroke lengths, operating speeds and sizes. They're growing more popular as metal stamping begins to replace other processes, including machining, fabrication, forging and die casting, due to its much lower cost and ability to handle harder metals. Metal stamping also has less expensive secondary processes, and is the only way to produce some kinds of products. Deep drawing is also a process of forming sheet metal through a forming die with a punch. 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 contact with the punch - the punch radius and thinnest in the areas where stresses are greatest. Deep drawing is often used to produce metal objects that are more than half their diameters in height.

II. RELEVANCE

Items often made by deep drawing include cup baking pans, like muffin pans, and aluminum can cylinders. However, irregular items, like fire extinguishers and enclosure covers for oil filters in trucks are also made this way - as is your kitchen sink! Products made by deep drawing are deep and seamless. The finished shape produced by a drawing press depends on the position in which the blanks are pushed down. Only malleable metals that are very resistant to damage by tension and to stress can be used in this process. Industries where deep drawing is often used include the dairy industry, pharmaceuticals, plastic manufacture, and the auto industry, aerospace and lighting. Companies making parts by deep drawing need expensive presses and operations put together by trained engineers, as well as plates, molds, and other accessories. Unlike metal stamping, deep drawing uses a single piece blank, not a continuous stream of blanks. The productivity of the stamping process in the industry yields

International Journal of Engineering Applied Sciences and Technology, 2016
Vol. 1, Issue 10, ISSN No. 2455-2143, Pages 72-75
Published Online August - September 2016 in IJEAST (http://www.ijeast.com)

better quality product at a economic price. The dissertation work is relevant in the context of developing a cost effective die with a lower lead time through the phase of Design, Development, Trials and Testing, Pilot lot production & Regular supply. The Deep draw process being critical to evaluate offers higher scope for study and research while addressing the most suitable design for the Draw Die.

III. PROBLEM DEFINITION

The Sheet metal industry is faced with a host of challenges while developing a Tool (Die) for a forming or a Deep Draw operation. The operation is critical in nature and calls for high competency on the part of Design as well as the material and the process factors. While designing a Formed or Drawn component, the Design Engineer needs to predict its behavior during the processing. The designed components should be feasible for processing while maintaining its design intent. A formed component like Windshield reinforcement shall be considered for this dissertation work as this component poses problems in terms of formability/ thinning/ tearing or springback.

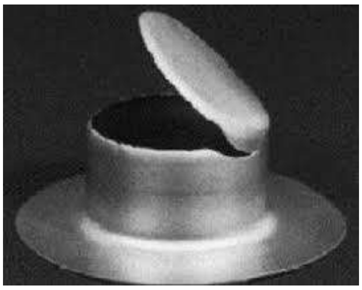

Fig.1Tearing

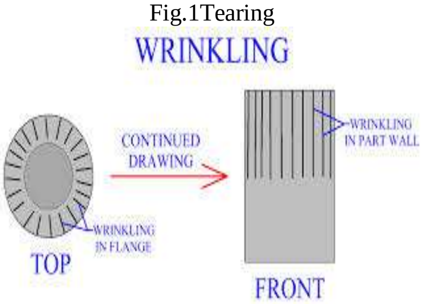

Fig.2.Wrinkling

IV. METHODOLOGY

1. Analysis for the given configuration of the component
2. Document the query report and discuss with the concerned Product designer for his comments
3. Selection of configuration for the process parameters
4. Recommendation for the best options over the choices available through Analysis using HyperForm' – CAE software

this process, after that apply the inverse wavelet transform to the image for find out watermark image.

V. EXPERIMENTATION

A. Analysis of thinning for simulation experimentation

The table 4.1 shows the values of the selected process parameters, four parameters with three levels. All these values are selected on the basis of literature review, machine specification. By using Design of Experiments by Taguchi Method, L_9 orthogonal array is selected for simulation and validation experiments. The columns of L_9 orthogonal array are shown in table 4.2.

Table: 4.1 Process Parameter and their Levels

Parameter	Levels		
	I	II	III
BHF (KN)	12	14	16
COF (μ)	0.05	0.10	0.15
RD (mm)	6	7	8
RP (mm)	2	6	10

Table: 4.2 L_9 Orthogonal Arrays of Filter Cap for Simulation &Experimentation

Expt. No.	BHF (KN)	COF (μ)	RD (mm)	RP (mm)
1	12	0.05	6	2
2	12	0.10	7	6
3	12	0.15	8	10
4	14	0.05	7	10
5	14	0.10	8	2
6	14	0.15	6	6
7	16	0.05	8	6
8	16	0.10	6	10
9	16	0.15	7	2

After performing simulation experiments, analysis of simulation 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 table 4.3 shows S/N ratio for filter cap.

Table: 4.3 S/N Ratios of Average Thickness for Filter Cap Simulation

Expt. No.	Decrease Thickness (mm)			Average Thickness (mm)	Thickness Difference (mm)	S/N Ratio for Thickness Difference
1	0.527	0.570	0.596	0.564	0.036	28.8739
2	0.511	0.562	0.593	0.555	0.045	26.9357
3	0.520	0.510	0.590	0.540	0.060	20.9151
4	0.536	0.582	0.597	0.572	0.028	31.0568
5	0.522	0.559	0.597	0.559	0.041	27.7443
6	0.460	0.590	0.600	0.550	0.050	26.0206

International Journal of Engineering Applied Sciences and Technology, 2016
Vol. 1, Issue 10, ISSN No. 2455-2143, Pages 72-75
Published Online August - September 2016 in IJEAST (http://www.ijeast.com)

7	0.532	0.566	0.591	0.563	0.037	28.6360
8	0.596	0.527	0.564	0.570	0.036	28.8739
9	0.526	0.562	0.598	0.562	0.038	28.4043

(B) Analysis of Variance for Simulation Experimentation (S/N Ratio for Thinning)

Analysis of variance test is performed to identify the process parameters that are statistically significant and which affect the thinning of filter cap. The response tables of signal to noise ratios for thinning of filter cap are given in table 4.7. The rank 1 indicates that most significant parameter it is coefficient of friction.

Table: 4.4 Response Table of Signal to Noise Ratios for Thickness Difference

Level	BHF (KN)	COF (µ)	RD (mm)	RP (mm)
1	25.57	29.52	27.92	28.34
2	28.27	27.85	28.80	27.20
3	28.64	25.11	25.77	26.95
Delta	3.06	4.41	3.03	1.39
Rank	2	1	3	4

The results of Taguchi indicate that the considered process parameters are highly significant factors affecting the thinning of filter cap in the order of coefficient of friction (µ). In S/N ratio value higher is the best results so main effect plot for thinning for filter cap is as shown in fig 4.4. 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. 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. 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. The radius of punch goes on increasing thinning also goes on increasing.

Main effect plots for thinning for filter cap is as shown in fig. 3 In order to see the effect of process parameter on thinning using L_9orthogonal array and experiments are performed and the simulation experimental data are given in table 4.3. It is clear that as blank holding force increasing thinning decreasing. It was observed that as coefficient of friction goes on increasing the thinning also goes on increasing. The effect of radius of die up to 7 mm decrease after that increasing the thinning. The effect of radius of punch goes on increasing thinning also goes on increasing.

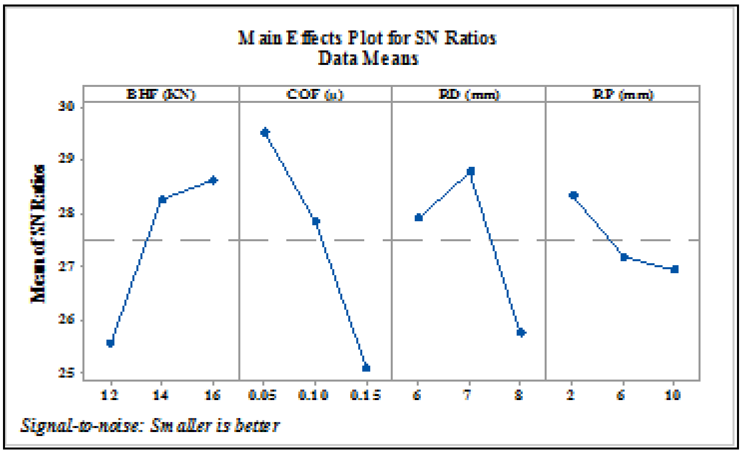

Fig. 3 Main Effect Plot for SN Ratio for Thickness Difference

Our response variable smaller the better but S/N ratio value higher is best, similarly, it can be seen that thinning for S/ N ratio for filter cap is higher 31.0568 mm at 14 (KN) blank holding force,0.05 coefficient of friction, 7 mm radius of die and 10 mm radius of punch. The thinning for filter cap is very low20.9151mm at 12 (KN) blank holding force,0.15 coefficient of friction, 8 mm radius of die and 10 mm radius of punch.

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.

VII. REFERENCES

1. K. Großmann H. Wiemer A. Hardtmann L. Penter S. Kriechenbauer, , Static compensation for elastic tool and press deformations during deep drawing, Prod. Eng. Res. Devel. (2010)

2. H. Zein, M. El-Sherbiny, M. Abd-Rabou, M. El Shazly,Effect of Die Design Parameters on Thinning of Sheet Metal in the Deep Drawing Process, Science and Education Publishing
3. R.Padmanabhana, M.C. Oliveira, J.L. Alves, L.F. Menezesa,Numericalsimulation and analysis on the deep drawing of LPG bottles, journal of materials processing technology 2 0 0 (2008)
4. Michael P. Pereira , Matthias Weiss a, Bernard F. Rolfe , Tim B. Hilditch, The effect of the die radius profile accuracy on wear in sheet metal stamping,International Journal of Machine Tools & Manufacture 66 (2013)
5. R. Narayanasamy, R. Ponalagusamy , S. Raghuraman, The effect of strain rate sensitivity on theoretical prediction of limiting draw ratio for cylindrical cup drawing process, Materials and Design 29 (2008) H. Yang, H. Li, M. Zhan, Friction role in bending behaviors of thin-walled tube in rotary-draw-bending under small bending radii, Journal of Materials Processing Technology 210 (2010)
6. H. Yang, H. Li, M. Zhan, Friction role in bending behaviors of thin-walled tube in rotary-draw-bending small bending under radii School of Materials Science, State Key Laboratory of Solidification Processing, Northwestern University, Xi'an 710072, PR China
7. G.C.R. Moura, M.T.P. Aguilar, A.E.M. Pertence, P.R. Cetlin, The failure analysis of a deep drawing die in the manufacturing of an automotive shock absorber cap, Engineering Failure Analysis 11 (2004)
8. **Cyrill Donaldson,George H. Le Cain,JoyjeetGhose,V.C. Goold,** Tool Design (Fourth Edition) Published by Tata McGraw - Hill