REVIEW ON THE PARAMETER OPTIMISATION USING GRA & FEA IN PUNCH & DIE DURING BLANKING PROCESS FOR FINDING OUT STRESS DISTRIBUTION & DEFORMATION

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ABSTRACT

Metal blanking is a widely used process in high volume production of sheet metal components. Blanking consists of a metal forming operation characterized by complete material separation. Low carbon steel is a very common material used in fabrication of sheet metal components.The experimental studies were conducted under varying sheet thickness, clearance and wear radius and shear angle. The main objectives are to present the development of a model to predict the shape of the cut side. The model investigates the effect of potential parameters influencing the blanking process their interactions. This helped in choosing the process leading parameters for two identical product manufactures from two different materials blanked with reasonable quality on the same Tool/Die.

Optimization is one of the techniques used in manufacturing sector to arrive for the best manufacturing condition. This is an essential need of industries towards manufacturing of quality product at lower cost. The main objective of this study is to treasure optimal parameters such as sheet thickness, clearance and wear radius in blanking to find out the variations in three performance characteristic such as burr height, accuracy and circularity value for blanking of medium carbon steel. Analysis has been carried on by using Grey Relational Analysis, a Taguchi method. Response tables and graphs were used to find optimal level of parameters in blanking process.The obtained results show that the Taguchi Grey Relational Analysis is being effective technique to optimize the parameters for blanking process. In this work involved some computational issues on modeling blanking processes and investigates the effect of clearance between punch and die in the stress distribution during the penetration phase of cutting process and deformation during blanking process using FEA.

Keywords:- ***Punch & die Assembly, FEA analysis, Catia, Ansys Software***

INTRODUCTION

Die design is a large division of tool engineering, is complex, fascinating subject. It is one of the most existing of all the area of tool design. Stamping presses and stamping dies are tools used to produce high volume sheet metal parts. These parts achieve their shapes through the effect of the die. Sheet metal stampings have now replaced many components, which were cast or machined. material economy and the resultant reduction in weight and cost, high productivity, use of unskilled labor, and a high degree of possible precision have rendered press work indispensable for many mass produced goods. The most common types of dies perform cutting and forming. Cutting dies are used to share sheet material into what is called a blank. These blanks are then exposed to blanking dies, which cut the entire perimeter of the part, or to forming dies where the blank is stamped into a part.Punching is the cutting of a slug from the sheet metal stock to produce hole or slot. Cutting dies are also used to trim excess metal around a format part. It is possible to control dimensional of pressed components within the eighth grades without much difficulty. Even finer tolerance can be achieved through finishing process such as sizing, burnishing and ironing. For the manufacturing of the die, the selection of appropriate material selection of manufacturing process and highly precise mating of the upper and lower half of the die is significant. The proper heat treatment of die blocks, and prevents warping. Also, manufacturing within the tolerances limits provided is important for proper functioning of the die and obtaining dimensional accuracy in the product. Also while designing and manufacturing of die the factor of economy is also kept in mind. Press working may be defined as a chip less manufacturing process by which various components are made from sheet metal.The machine used for press working is called a press. The main features of a press are: a frame which supports a ram or a slide and a bed, a source of mechanism for operating the ram in line with and normal to the bed. The ram is equipped with a suitable punch and a die block is attached to the bed.A stamping is produced by downward stroke of ram when the punch moves towards and into the die block.

OBJECTIVES OF THE PROJECT

The main aim of this study is to evaluate the influence of tool clearance, friction, sheet thickness, punch /die size and blanking layout on the sheet deformation. Hence for optimizing various blanking process parameters following objectives are decided.

To design the die for selected blanking operation
To optimize selected blanking process parameters
Study actual stress concentration on sheet during
Blanking
Study of deformation on punch and die using Ansys

Die Design and Manufacturing

The following factors influence the design of the die.

1. Piece part size.
2. Stock thickness.
3. Profile of piece part contour.
4. Type of tool.
5. Machinery available for manufacturing of tool.

Design of Press Tool involves the following steps.

Drawing strip layout and comparing material utilization.
Determination of forces (Press Tonnage) required for the operation.
Design of die block.
Determination of die opening size and punch size.
Design of punch assembly and calculate maximum allowable length of punch.
Design of stripper plate.
Design of back up plate.
Selection of die set.
The die block size essentially depends on the work piece size and stock thickness.

LITERATURE REVIEW

R. Hambli, In this paper, an experimental investigation into the blanking process was carried out using tools with four different wear states (wear radius 0.01, 0.06, 0.012, 0.2 mm) and four different clearances (5%, 10%, 15%, 20%). The aim was to study the effects of the interaction between the clearance, the wear state of the tool and the sheet metal thickness on the evolution of the blanking force and the geometry of the sheared profile. He used designed of experiment method for model and analysis the relationships that describe process variations. The interactions between controllable factors (clearance) and noise factors (wear and thickness) are useful in reducing the influence of the noise factors and thereby making the process more robust against variations in tool wear and sheet thickness. The process signatures indicate that the maximum shearing force, the fracture angle and the fractured surface depth are influenced by the material condition as well as the geometric characteristics of the tools and their configurations. The analysis of the tool wear influence allows for the monitoring of the blanking operation and so the parts quality variations during the forming process may be predicted. This investigation shows that, in order to minimize the blanking force, the clearance should be set at 10%, however, to minimize the fracture angle and the fracture depth, it is preferable to set the clearance at 5%. When the clearance is set at 10%, the process is slightly more robust to tool wear, as far as the blanking force response is concerned. Whether clearance should be set at 5% or 10% ultimately depends on the priorities of the practitioners

F. Faura, A. Garcia, M. Estrems,In this paper, they propose a methodology to obtain optimum punch-die clearance values for a given sheet material and thickness to be blanked, using the finite-element technique. In the present investigation, the shearing mechanism was studied by simulating the blanking operation of an AISI 304 sheet. Simulation used the FEM program ANSYS and also the

Cockcroft and Latham fracture criterion. In his investigation it is assumed that clearance is optimum when the direction of crack propagation coincides with the line joining the points of crack initiation in the punch and die (diagonal line), giving cleanly blanked surfaces. To determine the optimum clearance, the diagonal angle and the angle of the direction of crack propagation for different clearances were calculated. The influence of clearance on diagonal angle and angle of the direction of crack propagation, from which it is seen that as the clearance increases, diagonal angle increases proportionally while angle of the direction of crack propagation remains nearly constant. At the point of intersection, the direction of crack propagation coincides with the diagonal line, and so the cracks emanating from the punch and die meet, resulting in a cleanly blanked surface. Hence, this value of clearance is taken as the optimum clearance. The optimum clearance for the values of the parameters used in this work is between 11 and 12%. It is observed that punch penetration increases as the *c/t* ratio increases.

R. Hambli, S. Richir, P. Crubleau, B. Taravel,In this article blanking process and structure of the blanked surface are influenced by both the tooling (clearance and tool geometry) and properties of the work piece material (blank thickness, mechanical properties, microstructure, etc.). Therefore, for a given material, the clearance and tool geometry are the most important parameters. They use simulation of an axis symmetric blanking operation with ABAQUS - explicit software for a given sheet material. A damage model of the Lemaitre type is used in order to describe crack initiation and propagation into the sheet. They use four materials for testing with four different elongation (30%, 47%, 58%, 65%).They show that the optimum clearance decreases as the material elongation increases.

E Al-Momani, Ibrahim Rawabdeh, In this paper authors represent model investigates the effect of potential parameters influencing the blanking process and their interactions. Finite Element Method (FEM) and Design of Experiments (DOE) approach are used in order to achieve the intended model objectives. The combination of both techniques is proposed to result in a reduction of the necessary experimental cost and effort in addition to getting a higher level of verification. It can be stated that the Finite Element Method coupled with Design of Experiments approach provide a good contribution towards the optimization of sheet metal blanking process. They use Design of Experiments (DOE) technique by selecting the experimental levels for each selected factor, i.e. the clearance to be in five levels (5, 10, 15, 20, 25) % of the sheet metal thickness, blank holder force to be in two levels (0,3000N) and sheet metal thickness to be in four levels (0.5, 0.6, 0.7, 0.8)mm. Perform a factorial experimental design in order to take high-level interactions. Develop a Finite Element Model (FEM) that represents the existing process in order to evaluate the quality of the inputs. Compare the two techniques (FEM and DOE) and analyse the results to get the proposed optimal set of parameters. Simulations are conducted on commercial FEM software package ABAQUS/ Explicit in their article , they show that, in order to minimize the burrs height, the clearance should be set at about 5 % with almost no blank holder force.

S. K. Maiti, A. A. Ambekar, U. P. Singh, P.P. Date, K. Narasimhan, Journal of Materials Processing Technology,In this paper they evaluate the influence of tool clearance, friction, sheet thickness, punch/die size and blanking layout on the sheet deformation for thin M. S. sheet. The punch load variation with tool travel and stress distribution in the sheet has been obtained. The results indicate that a reduction in the tool clearance increases the blanking load. The blanking load increases with an increase in the coefficient of friction. These observations are very similar to the case of blanking of component of large size. Further, these effects are very similar in the case of both single and double blanking. Blanking site distance of about twice the sheet thickness is good to reduce the thinning of sheet at the intermediate regions between the two blanking sites. The FEM analysis has been done using ANSYS package. The blanking load increases with a reduction in the tool clearance in the case of both single and double blanking. The blanking load increases with an increase in the coefficient of friction at the tool sheet interfaces

RidhaHambli, in this paper author presents industrial software called BLANKSOFT dedicated to sheet metal blanking processes optimization. The code allows for the prediction of the geometry of the sheared profile, the mechanical state of the sheared zone, the burr height, the force–penetration curve, and the wear evolution of the punch versus the number of the blanking cycles. The approach is based on an original theoretical investigation formulated from plasticity theories. This program is designed by considering several factors, such as material and geometry of product as well as the wear state of the tool. The numerical results obtained by the proposed programs were compared with experimental ones to verify the validity of the proposed software.

RidhaHambli, in this paper author describes a methodology using the finite element method and neural network simulation in order to predict the optimum punch –die clearance during sheet metal blanking processes. A damage model is used in order to describe crack initiation and propagation into the sheet. The proposed approach combines predictive finite element and neural network modeling of the leading blanking para meters . RidhaHa mb li, Fabrice Guerin, in this paper they develop a methodology to obtain the optimu m punch –die clearance for a given s heet materia l by the s imu lation of the blanking process . The blanking process and the s tructure of the blanked s urface are influenced by both the tooling (clea rance and the tool geomet ry) and the properties of the work p iece mate ria l (blan k thic knes s , mechanical properties , mic ros tructure, etc.).They s how that the optimu m value of clearance decreas es with increas ing material ductility.

Wunhua St., Huwe i, Yunlin ,Ta iwan ,The purpos e of this research paper is focused on the optimal c learance des ign of mic ro - punching die by adductive network and SA method. The punching data (input) and wear s ize (output) were collected for a training databas e. In order to s elect proper clea rance to evaluat e the wea r of die, the adductive network was us ed to es tablis h an efficient relat ions hip between input parameters and output res ult. This can help to predict wear s ize under any degree of clearance and hence to replace worn punches and dies at the right ti me. A s imu lated annealing (SA) optimization a lgorith m with a performance inde x is then applied to the neural network for s earching the optima l c learance para meters , and obtains rather s atis factory res ult as compared with the corres ponding experiment verification. This s tudy aims to identify the re lations hip between clearance and s ervice life of micro punches us ing the Neural Netwo rk, and to find relat ional data involving the s ervi c e life of punches and punching parameters in non -metal blan king p rocess es . Th e res ult can be us ed to es timate optima l clea rance between punch and die for indus trial applications . This s tudy, the practical punching process es with different punching conditions were carried out for a s et of tra ining data. A tra ined model e xh ibited a r elat ions hip between s ervice life and clea rance of micro punch and die through an addictive network s ys tem. The pred icted value of wear by adductive network is very clos e to the actual e xperimental value, with an error of les s than 8%. Th is res ult s atis fies the required s tandard for IC factory production. A good clearance des ign not only increas es the quality of product manufactured, but als o reduces product’s burr. As a res ult, the wear of punches and dies can be greatly reduced and the life expectancy of p unching dies increas ed.

PENG J ia Geng, LIShouben, An analys is model to s implify the s hearing and blanking proces s was developed. Bas ed on the s imp lified model, the s hearing process was s imulated by FEM and analyzed for various clearances . An optimu m c lea rance in the process was determined by new approach bas ed on orientation of the ma ximu m s hearing s tres s on the characteris tic lin e lin king two blades , according to the law of crack propagation and experiments . The optimu m clea rance determined by this method can be us ed to dictate the range of reas onable clearance. By the new approach, the optimu m c learance can be obtaine d conveniently and accurately even if there is s ome diffe rence between the s elected points ,where the in itia l c rac k is as s umed originated, and the actual one, wher1e the initial crack occurs really.

SCOPE OF STUDY:-

The experimental s tudies were conducted under varying sheet thicknes s , clearance and wear radius and s hear angle. The ma in object ives are to pres ent the development of a model to predict the s hape of the cut s ide. The model inves tigates the ef fect of potential para meters influencing the blanking proce ss their interactions. This helped in choos ing the process leading parameters for two identical product manufactures fro m two d ifferent materia ls blanked with reas onable quality on the s ame Tool/Die.

METHODOLOGY OF WORK

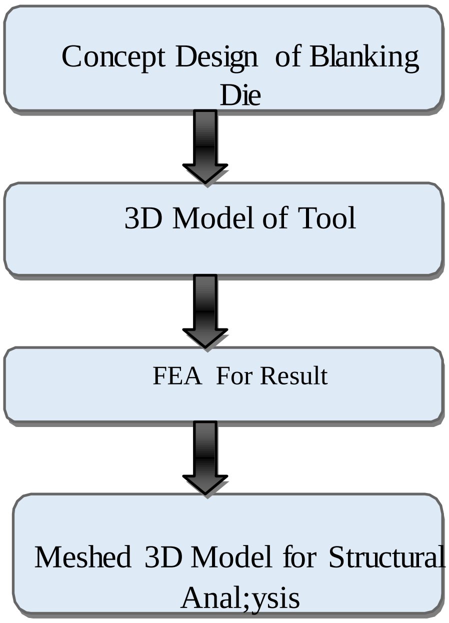

Fig. Methodology of work

Step-I: Received Idea about Stress distribution and punch, die deformation.
Step-II: With the help of Literature survey and Technical Knowledge Preparing CAD Model Blanking tool (Punch and Die)
Step-III: With the help of 3D Model from CAD System Preparing Meshed 3D Model for Analysis
Step-IV: Extracting Results from CAE Software

CONCLUSION:

Taguchi‟s Signal – to – Noise ratio and Grey Relational Analysis will applied in this work to improve the multi-response Characteristics such as MRR (Material Removal Rate), TWR (Tool Wear Rate) and Surface Roughness of mild steel IS 2026 during EDM process. The conclusions of this work are summarized as follows:

The predicted results will check with experimental results and a good agreement will find.

This work demonstrates the method of using Taguchi methods for optimizing the EDM parameters for multiple

Response characteristics

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