A Literature Review on Optimization of Stamping Tool

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Abstract: In today modern world automotive manufacturers are struggling with a huge challenge of producing dimensionally acceptable stamping parts with minimum material and processing cost. Due to thin nature of sheet metal the stamping process has always been complicated. The dimensional quality has always been difficult to achieve due to the thin nature of sheet metal used in stamping process. The final quality of the part is being affected by various factors such as spring back, thinning and many other. These quality issues or we could say process drawbacks can be avoided by means of optimization with various innovative methods. The main purpose of this paper is to achieve the best possible ways taking into consideration the prioritized criteria (constrain) which could result in maximizing various factors such as strength, productivity, efficiency, utilization, reliability, etc. In this paper various ways of optimization in the field of sheet metal stamping are discussed and as a result of this study it has been observed that the optimization in stamping tool leads to various benefits- improved efficiency, better quality results, better rate of production, saving in terms of cost as well as time.

Keywords: Sheet metal stamping, optimization

I. INTRODUCTION

The manufacturing process which is used to convert flat sheets of metal into specific shapes can be termed as sheet metal stamping. The thin nature of the metal sheet makes the process complex and it involves a number of techniques such as forming, blanking, drawing, piercing, trimming, re-strike, wipe-up, part-off, etc. Sheet metal stamping can be very effective for large quantity manufacturing needs as it is a fast and cost effective process. Low cost and high quality are expected from stamping process.

Optimization is the only solution for reducing the cost as well as the time taken for production. Time and money are two of the most important factors that are taken into consideration in the manufacturing sector. The production rates have a huge role in the profit margins for the final products if the consumption of that product is on a large scale as it is in the automobile field. Since the same part is used in all the assemblies of a particular vehicle with the exact dimensional similarities, optimization can play a huge role.

Optimization in sheet metal processes can be carried out in various ways- optimizing the forming parameters, use of compound dies, use of progressive die, optimizing process parameters, etc. For a specific criterion and given constraint, finding the best alternative is optimization. But care needs to be taken during the optimization process that the various defects like thinning, scoring, wrinkle, crack, spring back, etc do not have any effect on the parts produced.

II. LITERATURE REVIEW

Bhagyashri.R.Billade and Prof Sachin.K.Dahakef analyzed the forming process of REINF-RR END UPR-LH/RH, blank holding force, draw bead height and binder stoke are observed to have most influence on the percentage thinning error and hence contributed in improving the process reliability. This study shows the application of Simulation as well as Taguchi method in the optimization of forming process parameters in order to eliminate the thinning error. This simulation experiment has been successful in achieving the objective of experiment. So by using the simulation tool and optimization of forming process parameters the optimal values for the influential factors of thinning percentage is less than 20% which is obtained from Taguchi's prediction. Using Taguchi prediction method, the error in thinning in REINF- RR END UPR-LH/RH has been eliminated.

Gaurav.C.Rathod,Dr.D.N.Raut and Samadhan Adlinge explained the analysis of press tool. In this paper, real time design of a piercing press tool(simple die) and a prototype is made with static analysis of punch in which the output is pierce hole as well as notch hole. The press machine is mechanical type of 200 ton. In this paper the problem statement is to combine two piercing and notching operation which is now manufacturing separately. Two piercing is done by one punch and also two notching operation is carried out with another punch. Hence a single compound die is manufactured in order to carry out the two operations which are pierce and notching in a single die. This results in saving terms of money as well as time.

Guoying Ma and Binbing Huang analyze the influence of different process parameters on the quality of forming operation for automobile panels with the purpose of optimization are considered. The part used for analysis in this paper is an automotive lower floor board. Friction coefficient to study maximum thinning rate and maximum thickening rate, blank holder force, die clearance and die corner radius are the various factors that were considered for optimization. Simulation analysis is done for the above parameters using orthogonal experiment method for optimization purpose. According to the analysis in this paper the maximum thickening rate as well as the maximum thinning rate can be controlled by means of orthogonal experiment optimization method which as a result helps in producing better quality forming parts without any obvious defects.

Himanshu.V.Patil,Anita.K.Varade and Prof. A.A.Karad', analyzed the design process of design of blanking tool where press tools are used in order to produce a component in large quantity by means of sheet metals where component attained depends on the press tool

construction as well as its configuration. Different types of press tools are used for different operations such as blanking, piercing, bending, forming, drawing, parting off, embossing, cutting off, shaving, dinking, perforating, trimming, lancing, curling etc. The metals having less than 6mm thickness are known as strip. In blanking operation flat components of required shape are produced. In blanking process the required shape periphery is cut and cut-out piece is termed as blank. The press tool used for the purpose of blanking operation is called as blanking tool; in piercing operation it is termed as piercing tool and so on based upon operation that is been performed. Press operations are used in many different types of industries such as automobile, packing, defense, food processing, textile, aircraft and many apart from manufacturing industry. In this paper, an attempt is been made to learn the press tool design, its manufacturing used for press tool, along with the calculations involved in it as well as materials. This paper consists of design of a simple blanking press tool and manufacturing of its prototype. The output is a circular piece on a sheared sheet having diameter of 40mm and 60mm respectively. The press machine used for the analysis is of mechanical type

Liu Wei and Yang Yuying in this paper have explained that there are always conflicting relations between objective functions of sheet metal forming, the solutions that usually minimize each objective is almost impossible. Fortunately, MOGA can find all the Pareto optimal solutions by means of only one-time global search procedure that too without combining all the objectives in a single objective by weight coefficients, along with which designer can find the optimal solutions from the Pareto solutions with respect to their preferences. It has also verified by the analysis that the optimization methodology by means of FEA coupled along with the LHD, RSM along with Pareto-based MOGA can be used as a powerful tool and is super effective for the parameters optimization in stamping process design. The methodology shown in this research paper provides the designer with more short analysis cycle time along with more accurate design results than the traditional optimization methods.

Sachin.G,Yathish.G and Amar explain the design Analysis along with the review of press tool with the defects occurring in it and its remedies. It gives brief information about design analysis of press tool which serves the purpose of mass production of sheet metal components. Tool production is one of the fields, which requires a very detailed study, structural analysis as well as process planning before proceeding for any practical work. The success of any tool largely depends upon the process analysis along with the design analysis of the tool to be produced. Systematic approach in the field of tool making is therefore very very essential. This project report mainly enlightens various aspects of press tool design and development.

Subramanyam Pavuluri,B.Rajashekar and B. Damodhar explain the process of press tool design along with its manufacturing particularly for blanking operation In this paper an attempt has been made to learn the press tool design, materials used in tooling, manufacturing of blanking tool which is used for press tool and calculations involved in it. In this paper, a real time design of a simple blanking tool and its manufacturing for a proto part is been made along with analysis where the output is a circular pierce with the diameter of 20mm. The press machine is mechanical type with tonnage capacity of 75tons is used.

This paper basically shows the design and analysis of blanking tool.

Sushama.S.Bobade1 and Tushar.Y.Badgujar explain the state of art for a sheet metal forming technology. Here sheet metal forming technology's most important parameters are well explained. The material properties also have major influence on the term called formability of the part. It can be well understood experimentally as well as numerical methods. Simulation also has a major role in successful forming process of any material. Among various defects that occur in a process, wrinkling is one of the defects which is produced by means of a compressive stress field. The prediction of wrinkling issue is very important for the design of forming and deep-drawing processes. Wrinkling is unacceptable in the outer skin of the panels where the final part appearance is very crucial. Wrinkling issue on the mating surface adversely affects the part assembly and also part functions, such as sealing and welding. In addition, severe wrinkles can also damage and even destroy dies. Therefore, the prediction as well as prevention of wrinkling is very important in sheet metal forming process. As a conclusion, it can be said that, though we have a sufficient amount of theoretical data depicts causes of a wrinkling defect; the scope for future study is its practical elimination is definitely high due to parameter variation. Wrinkling issue can immensely affect the final assembly of the part as the excess gap between two mating parts which can be caused due to wrinkles can lead to major failures later on.

Tayani Tedson Kumwenda and Qu Zhoude explained about the research on forming process simulation and optimization for process parameter for the Front Crossbeam of a car roof on the basis of FEM. Here the influence of three process parameters blank holder force, bed depth and coefficient of friction are analyzed and evaluation is done based on the orthogonal experiment design method. The process parameter influencing the quality of stamping forming simulation the most is of the front crossbeam of a car roof obtained by evaluation of the maximum thickening rate along with maximum thinning rate is not always the same. Orthogonal design method in concurrent with FEM numerical simulation which can be used to quickly arrive at optimum results and thereby serving a lot of time and money in manufacturing engineering. Numerical simulation based on Finite element method (FEM) can be used for analyzing complex three-dimension automotive body panels.

Vikrant.J.Jadhav and Mr.B.R.Shah explain the influence of some process parameters on sheet metal blanking. Here investigation of the sheet metal blanking process makes it possible to study the effects of process parameters such as the material type, the punch-die clearance, thickness of the sheet as well as the blank holder force along with their interactions on the geometry of the sheared edge specially the burr height. In general, clearance plays an important role in both product quality and the service life of die. A good clearance design not only improves the quality of product manufactured, but it also reduces products burr. As a result of this the wear of punches and dies can be greatly reduced and the life expectancy of punching dies also increases. More punching time is positively related to bigger wear, while less punching times is related to smaller wear.

III. CONCLUSION

In today's scenario of modern new product development trends, where time to introduce a new product to the modern world is under immense pressure; forming simulation and optimization for each stamping tool has also become very essential. It also helps the tool designer to understand the metal flow in a much better way for more complex shapes, which in turn also increases the product quality and along with it reduces the design cycle time and even cost. Sheet metal simulation can be effectively used for the purpose of optimization of die design in order to improve quality. Process optimization leads to lots of cost saving and time saving.

IV. FUTURE SCOPE

1) Use of new technology called hammer peening to perform the polishing avoiding manual work and increase the accuracy of tool.
2) Use of progressive dies instead of simple die which would lead to increase in production time.
3) Making lighter tool which may reduce the dynamics so that momentum and vibration decrease and precision increases.

V. ACKNOWLEDGMENT

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