REVIEW ON PROCESS PARAMETER OPTIMIZATION FOR FORGING PROCESS

Kishan Katkade¹, R D Shelke²

¹PG Student, Everest Educational Society's Group Of Institutions, Aurangabad, Maharashtra, India.
²Associate Professor, Everest Educational Society's Group Of Institutions, Aurangabad, Maharashtra, India.

ABSTRACT

The world of manufacturing world is broadly classified into two main categories such as cold working and hot working process. The process in the manufacturing world which is conducted above the recrystallization temperature are called as hot working process while the process which is conducted below the recrystallization temperature of the work piece is called cold working process. In the above categorization, the casting and forging process is considered as the hot working process while other processes were kept under cold working process category. The process for our review is forging and in our research paper, we are focusing on the forging process, the types of forging process and the various parameters that are considered as a tool for the process optimization of the forging.

Keywords: Forging, Hot Working, Optimization, RSM.

I. INTRODUCTION

The forging is considered as an important traditional process, which is categorized under both cold working, & hot working process. In forging process, the metal billet is heated to the temperature near or above the recrystallization temperature. The recrystallization temperature is the temperature at which the grain structure of the metal starts to refine or undergoes the distortion or improvement. When the metal is red hot and achieved this stage of recrystallization, the metal is allowed to mold into the desired shape with the help of hammer. The forging is also classified into two sub types as hot forging and cold forging. In cold forging the metal is allowed to be pressed without heating the metal. If we observed the process in microscopic approach, then we will observe that the forging process is further classified into various categories as discussed below.

II. LITERATURE SURVEY

1] In the research paper entitled “Process optimization method for cold orbital forging of component with deep and narrow groove” by Qui Jin et Al. The work was performed on the optimization method for the preform and tool is presented to eliminate the forging defects. The overall conclusion of the research work was the horizontal stress imbalance of the long and thin boss of the rocking tool to be the main reason for its poor stress state. They also concluded that controlling the metal flow to balance the horizontal stress of the long and thin boss of the rocking tool. [1]

2] In the research paper Entitled as “Optimization of Forging Process Parameters for Wheel Hub Using Numerical Simulation” presented by Vasuki Gopal Deshak et.al in the journal Science Direct Materials Today: in their research work, Finite Element Method was used to create the numerical simulation. For the above mentioned research work use of software DEFORM 3D was done. The software gave validations for the modification in the die and mould design with the aid of simulation. They concluded that DEFORM metal forming simulation can give a clear insight of the actual loading conditions, material flow behavior and can clearly depict the actual problems faced at the shop floor level. Modifications in the die design would not only reduce the overall punch load but also increase the die life and reduce material wastage. With the optimized process parameters, experimental validation can be carried out. [2]

3] In the article entitled as “Data-driven oriented optimization of resource allocation in the forging process using Bi-objective Evolutionary Algorithm” presented by Tsung Jung Hseich, Bi-objective Evolutionary Algorithm (BOEA) is proposed for optimization of the resource allocations with the aid of information flow. They concluded that the results received after experimentation proved that the BOEA presents an effective trend for the given analysis for the consideration of fitness value. [3]

4] “Analysis of forces occurring in the process and geometrical correlations for open-die forging with super imposed manipulator displacements” published by Martin Wolfgarten et.al. In their research work, the forging
manipulator was for actively controlling the flow of material towards the final geometry. The investigations is performed for the forging process analysis in respect of bending forces, correlation of process parameters along with resulting geometry. Following an introduction of the process, Semi Empirical model is suggested for the further validation for the determination of the bending forces & geometry of work place. The validation is conducted by the help of numerical simulation. The results obtained from the numerical simulations were incorporated to validate the feasibility of the suggested models and the same model is deployed in the industry. The conclusion of the research work was the force prediction model gave accurate prediction to numerical simulations. [4]

5] In the research paper entitled as “Optimization of Process Parameters for Friction Weld Steel Tube to Forging Joints” by Berna balta et al. in the above mentioned research work the inspection of structurally durability of steel tube/ forging were conducted. The relationship between various parameters were defined by the aid of response surface methodology. During the constant rotational speed, the input parameters were chosen as friction pressure, friction time, Forging pressure & forging time as input variables while the percentage deformation and petal crack length were selected as output variables or simple output parameters. While keeping rotation speed constant, friction pressure, friction time and forging pressure are the parameters that are considered as input parameters while the tensile strength and elongation and the petal crack length are choses as output parameter. Desirability function is used for framing the optimum Elongation (%) is a measure of ductility. Pressure created due to friction, time for the friction and time required for forging has the most significant effect over the elongation (%) values. The grain structure is proportional to the friction pressure and friction time . The lack of time for the forging causes the insufficient plastic flow through the welding lips, therefore more perpendicular grains are left in the WI, as opposed to the longitudinal grains in the base and HAZ region, which leads to a decrease in the elongation (%) values. [5]

6] In the article entitled as “Six Sigma based approach to optimize radial forging operation variables” published by A K Sahoo et al in journal of materials processing technology , In this research, the authors have concentrated on the minimization of the developed residual stresses that are induced due to production in radial forging process. In the investigation mentioned in the above papers there was analysis of critical parameters and their significance with the help of taguchi methodology. they concluded that there was a significant reduction recorded in the development of residual stresses for the improvement of the quality. [6]

7] In the research article entitled as "Multi-objective optimization of process parameters for 7050 aluminum alloy rib-web forgings’ precise forming based on Taguchi method” published by Jing wang et al, combined the finite element method along with taguchi method for the conduction of the optimization design which is designed as per the objective design for the precision forging of the rib web forgings. The conclusion of the research work is that parameters like under filling are selected as the objective function which is being optimized.[7]

8] In the research article “Concurrent design and process optimization of forging” by Murat Ozturk et al , a modern approach such as concurrent design methodology in incorporated for the purpose of minimization of the cost for the part manufactured by the process of cold forging by the use of both product and process design parameters as optimization variables. They concluded that the proposed concurrent design optimization method proved to be effective. [8]

9] In the research article entitled as "Prediction of the folding defect in die forging: A versatile approach for three typical types of folding defects" by P.F. Gao et al., the deciding factor for the experimentation work was the folding index along with the incorporation of response surface methodology. all three types of folding defects can be quickly predicted for different geometrical and processing parameters. The concluding remark of the folding index can also serve as an objective function for the optimization of forging parameters whose target is set for minimizing the risk of folding defects.[9]

10] Research title “Manufacturing Simulation for Determining The Influence of Process Parameters on Quality of Forgings” published by Hemanth Thulasi et al in their research work, Pre-form shape of the billet and die design plays a significant role in bulk forming process for deciding the consumed quantity of the material and energy along with the material flow analysis. [10]
III. METHODOLOGY

On the basis of microanalysis, the forging is classified into following types:

a) Drop forging: this is the basic form of forging process in which the hammer is allowed to fall through the specific height. The drop forging is again sub divided into two types as open die forging & closed die forging. The open die forging is employed for smithy work while closed die forging is employed for the forging of the complex parts.

b) Press forging: press forging is similar to the drop forging but only a little difference is that in case of press forging, the time interval of the pressing is in the order of second which is in millisecond in case of drop forging.

c) Upset forging: upset forging is incorporated in the special high speed machines called crank presses. This type of forging machine can accept the metal blank up to 1000 tonnes.

d) Roll forging: Roll forging is incorporated to reduce the thickness or diameter and to increase the length. Generally the forging billet is subjected to a set of rollers to increase the length and to decrease the diameter. Roll forging is used in steel industry.

e) Precision forging: Precision forging is developed for the minimization of the cost and the waste from the post forging operations.

IV. CONCLUSION

In this review article we become familiar with the facts that there are numerous parameter that affect the performance characteristics of the forging process. and we have studied the various research papers that depicts the various perspectives of the forging process. hence we have studied the latest improvements and development in the region of welding.

V. REFERENCES


[3] “Data-driven oriented optimization of resource allocation in the forging process using Bi-objective Evolutionary Algorithm” presented by Tsung Jung Hseich, Engineering Applications of Artificial Intelligence 89 (2020) 103469


