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Review on Manufacturing Process step up in Fasteners with Rib Lock Washer by Cold Forging

Harsh Badhal[1], Yati Parjesh[2]

M.Tech. Scholar, ME (Manufucturing and Automation), SBMNEC, Rohtak
Lt. Assistant Prof. (ME) , SBMNEC, Rohtak

Abstract: This study is an approach to investigate the viable impacts of Head Broken in M5 X 40 Socket Head Low and Screw with Rib Lock Washer and to choose the suitable material Boron steel 10B21 for selected manufacturing process of screw by putting environmental aspects as important as economic aspect. The parameters involved were types of material and manufacturing process of screw that using the available data of environmental. The different manufacturing approaches being evaluated were tools &dies (Cold Forging M/C). Cold forging process with Statistical Process control (SPC). The types of material concerned for forging process encompassed wire size form raw material boron steel. In the result socket depth maintained in 2.58/2.75 mm in cold forging. Head Height maintained in 3.35/3.50 mm in cold forging. Hardness maintained in 28 to 31HRC. With this model accurately dimensioned threads and significantly improved surfaces have been obtained.

Keywords: Cold Forging, Heat Treatment, Thread Rolling, Forged part, SPC.

INTRODUCTION

The main aim of this work was to investigate the Head Broken in M5 X 40 socket head low screw with rib lock washer (Customer Problem) with a commercial machine and Improvement in Process by help of cold Forging. Much work has been performed on the development of Process for the Cold Heading Materials. Hexagonal forging screw machine screw is selected for this study for a Low Head Socket Screw, the manufacturing stages are arranged in the following Order / Sequence: Wire Rod (Raw material) Inspection, Incoming of Spring Washer, Cold Forging, Heat Treatment, Thread Rolling (flat rolling m/c) and Finish (Plating). The head to shape, forming the screw end and finally on machines. Cold forming the screw thread by means of a flat dies.

The forging is a process in which the work piece is shaped by compressive forces applied through various die and tools. The fasteners are produced in multi operation cycles and design of the best manufacturing technology is a challenge. The major product form supplied to the fastener industry is wire rod high grade boron steel. More than 70% of the product used in the fastener industry is derived from wire rod bar mills in the India LPS Plant 1 and 4 has got 35 Multi-station progressive primary forging machines forging from Ø3 mm to Ø30 mm and up to 300 mm by cold forging process . Included in these thesis specialist are boltmakers m/c. A basic boltmaking machine can provide a cold forging parts former with a relatively high level of versatility (with respect to the component shapes it can produce) for a lower cost.

There are many types of forging used in various industries today, among which bolted joints plays an important role and is among widely used joints because of various advantages such as ease of assembling or disassembling, lower costs and the ability of M5X40 to withstand longitudinal and transverse loads. Areas of research have been very broad from the control of one parameter like the amount of deformation or temperature to establishing a rule-based system for forming sequence design for multi-stage forging. The transfer mechanisms included in the machine must be capable of accepting rod Grade 8.8 (AISI 10 B 21), once the machine is set, material can be fed into the machine, cut to length, cold forged and ejected as semi- finished components. Different authors made an attempt to optimize to achieve the quality of forged part, for that they have used different techniques, like cold forging.

LITERATURE REVIEW

M. Vasundara and T. Rama chandran [2014] In this research they presents the manufacturing modification is made to minimize the manufacturing and raw material cost. This has been done by changing the die design and eliminating the additional burr removal operation. This enhances the strength and hardness of the material and also the raw material yield improvement of the manufacturing method in the bolt manufacturing system.

Khaleed Hussain and Samad. Z [2009] In this research they presents optimization of cold forging die design is required to reduce the production cost of die as well as the forged part and also to increase the accuracy of the die and the forged part. Since the past few years computer aided engineering (CAE) techniques have been widely used for research in metal forming. Amongst them finite element analyses (FEA) have been greatly successful to provide the understanding of metal flow and die stresses for different forming processes. The present work is a review of the existing die design techniques which are used in forging process to enhance the die design and to optimize die design process which will improve the performance of die. In cold forging the die will under go high loads. Hence it is essential to know Fatigue behavior and Fatigue Failure of the die when it has been under go cyclic loading. The study end up with future challenges of the die design and its processes, the approaches adopted to develop an optimum system that can fulfill the customer demand.

Umut Incea and Mustafa Gudenb [2010] In this paper, the use of finite element method increasingly as tool in metal forming industry result in cost reduction, time saving and improvement in product quality. The simulation software in the cold forging industry show material flow, capture the defects and allow to determine the process parameters such as press forces, die stresses, predict the tool life and fracture and calculate residual stresses. The present study reports two case studies of the cold forging simulation in fastener production.

Ting Ping Chang and Shyh Chour Huang [2014] In this paper, during the cold forging process of hollow fasteners with a thin flange, a folding phenomenon often occurs. This folding defect affects the fasteners strength, especially the inner folding, and it can lead to sudden failures. The defect usually occurs because the mould's geometric parameters are not appropriate. In order to avoid this folding phenomenon, this paper investigates the optimization of mould geometric parameters in the cold forging process of hollow fasteners with a thin flange, using the finite element method (FEM) combined with the Taguchi method. The simulation results are then compared with experimental data, which show that there is good agreement between the theoretical and experimental results.

H. Saglam and R. Kus [2011] In this research they presents thread rolling process is widely used in external thread manufacturing, while limited use in internal thread. In this paper the mechanical properties of thread formed by the internal thread rolling head developed was investigated and their advantages were introduced. Cold forming plastically and permanently displaces the component material instead of cutting away material. With this model accurately dimensioned threads and significantly improved surfaces have been obtained. Therefore, the factors for internal thread rolling head were determined and the rolling head was tested successfully. The thread samples made by cutting and rolling were subjected to tensile test and their results were compared. As a result the tensile load capacity of the rolled thread is found higher than the thread made by cutting method.

E. Cadoni, M.Dotta and D. Forni [2011] In this paper, the preliminary results of the mechanical characterization in a wide range of strain rate of steel, usually adopted for fasteners, are described. In this study the different issues required to implement the dynamic test results in numerical code have been analyzed. Different experimental techniques have been used for different strain rates: universal machine, Hydro-Pneumatic Machine, JRC-Modified Hopkinson Bar and Split Hopkinson Pressure Bar. The failure at high strain rate has been examined by means of fast digital image recording systems. The material shows enhanced mechanical properties increasing the strain rate: this fact can be taken into consideration to improve the product design and the manufacturing process. The experimental research has been developed in the Dyna Mat laboratory of the University of Applied Sciences of Southern Switzerland and in the Laboratory of Dynamic Investigation of Materials in Nizhny Novgorod, in the frame of the Swiss Russian Joint Research Program.

Ming-Chao Sun and Liang-An Zheng [2013] In this research they have presented that stainless automotive battery fastener requires high dimension precision and narrow tolerance. In order to save the developing cost and accumulate more production design experiences, CAD/CAE technology has been used in multi-stage cold forging with five stages to shorten our developing cycle time. In this paper, the CAD drawing is made by Inventor 3D software, then import the STL file to DEFORM-3D software to do the settings of pre-process and simulation analysis. Effective stress, effective strain, velocity field, and forging force have been shown in this study. Finally, the actual manufacture measurement results compares with simulation datum to verify the analysis acceptance. After comparing the FEM simulation results with actual forming measurements, the error rate of washer diameter is increased in fourth stage. Although the measurement results are still in

tolerance, the future work is to decrease the error rate through optimizing the mold design of fourth stage. The verification is performed to reduce the error rate according to the research method proposed in the study.

Cold Forging

In cold forging is important metal processing process, mainly utilizing a die to fix the lower part of a metal rod to the required shape. These shows in Fig.1. The transfer mechanisms included in the machine must be capable of accepting wire rod raw material high grade 8.8 Boron steel 10B21 feed stock so that once the machine is set, material can be fed into the machine, cut to length, cold forged and ejected as finished or part finished components. These machines are designed to produce a single product within a limited size range. The process is done with small reductions and numerous passes until the 5mm radius has been obtained. In forming, cold drawing is the process of forming a flat sheet into a hollow shape by stretching the boron steel. First of all boron steel in the form of wire of diameter 5.32/5.34 mm is fed between two rollers of header machine. The distance is equal to the length of wire piece required for manufacturing of stud. When the wire is stopped by stopper than at every next cutter cuts the wire and along with finger takes the wire piece in between the punch and die. Forward Extrusion is used to reduce the cross section of the wire. Backward Extrusion is used to create a cavity or a bore in M5X40 (see fig.2). These blanks are automatically moved to one or more forming presses by a single pass of the dies, form a round head on the bolt and eject the formed blank into a container. It results in better structure of the metal and hence stronger parts. The machine produces parts to close tolerances and fairly smooth finishes. Squaring is the process of reforming a taper or curved surface to change its angle or make it a flat surface with a sharp. The excess material on the outside of the part is removed through trimming.

Figure 1 Schematic diagram of Cold Forging Machine

Figure 2 M5X40 Low Head Socket Screw

Heat Treatment

It is a operation of heating and cooling of metals in the solid state to induce certain desired properties. Hardening in which is heated to 200°c above the transformation range, soaking at this temp. for a Fastener M5X40. It consist Temperature (1-Zone,840°-880°C), Temperature (2-Zone,870°C ,3-zone,870°C,4-zone,870°C-880°C) travel time, Methanol flow, LPG. The screw is heated to a specific temperature among other things in dependence on its carbon content and kept at this temperature for a long period. Hardness maintained in 28 to 31 HRC in screw. Quenching process consists Oil Temperature, Quenching oil Agitation, Acid value, Water content, Flash Point. Toughness and ductility are improved at the expense of hardness and strength by tempereing.

Thread Rolling

Screw threads produced by such removal process both manually using taps and dies as well as in machine tools of different types and degree of automation A pusher push the bolt inside the Booker Plate and Ram Plate and rolling between the Ram Plate and Booker Plate cuts threads on screws. In M5X40 used flat and circular thread rolling.

Finish (Plating)

Surface finish is a coating treatment given to the fasteners for withstanding the wear & tear by atmosphere to resist rusting & damage by atmosphere. Plating consists Process like Receiving part inspection, Acid Pickling, Water Rinse, Anodic

Electrolytic mechanism cleaning, Water - Rinse Cascade Type 1 & 2, Neutralization, Alkaline zinc Yellow plating , Drag out, and Water Rinse Cascade . Zinc Yellow Cr6 Plating coating is provided on the fasteners in dipping products in bath contain Iron Zinc Phosphate solution & heated for some time.

Hardness Testing

Hardness is the measure of a materials resistance to deformation by surface indentation .In this thesis will be maintained Hardness in 28–31 HRC. The hardness measurement is taken from a small indent or a scratch.These Ultimate Tensile Strength Range of hardness shown in Table 1.

Table 1

HARDNESS of the M5X40	
BHN	**HRC**
238/304	22/32

RESULTS

The best design tooling is on a computer with numerical simulation. The analyzes the shape of the current punches and also assess the loads to which the punches are going to be subjected. By testing different screws geometries, a best overall selection can be made based upon the amount of stress on the tooling. The best method to design tooling is on a computer with numerical simulation. The analyzes the shape of the current punches and also assess the loads to which the punches are going to be subjected. By testing different screws geometries, a best overall selection can be made based upon the amount of stress on the tooling. Further analysis made for the produced formed version product, and they are explained below. The results shows that there is an improved Head Height, Socket Depth and strength in the case of formed version of the product. The grain flow of the products are given below in Table 2.

Table 2

M5X40 Head Height &Socket Depth improved By COLD FORGING

M/C CODE – CBF435-I (Cold Forging)

PARAMETER	SPECIFICATIONS		CHECKING INSTRUMENT	OBSERVATION					
	MAX.	MIN.		1	2	3	4	5	6
TOTAL LENGTH	40.25	39.75	VERNIER	39.94	39.96	40.00	40.04	--	
HEAD DIA.	8.48	8.30	MICROMETER	8.39	8.38	8.39	8.40	--	
HEAD CHAMFER	R 0.50 MAX.		PROFILE PROJ.	0.10	0.14	0.14	0.16	--	
HEAD CHAMFER ANGLE	45° MAX.			36°	37°	37°	36°	--	
HEAD HEIGHT	3.50	3.36	MICROMETER	3.37	3.46	3.49	3.49	--	
TRD	4.43	4.40	MICROMETER	4.43	4.42	4.43	4.42	--	
U/H RADIUS	0.50	0.20	PROFILE PROJ.	0.40	0.40	0.40	0.40	--	OK
UNDER BROCH	O.75	0.65	DIAL/SLIP G.	0.70	0.69	0.72	0.70	--	
SOCKET DEPTH	2.75	2.58	DIAL/SLIP G.	2.70	2.74	2.74	2.74	--	
SKT. CHAMFER DEPTH	0.20	----	VERNIER	0.14	0.16	0.10	0.16	--	
POINTING DIA.	3.60	3.40	VERNIER	3.54	3.60	3.59	3.54	--	
POINTING ANGLE	30°	25°	PROFILE PROJ.	27°	28°	27°	28°	--	
A/F	3.09	3.03	GO –NO GO GAUGE	OK	OK	OK	OK	--	

CONCLUSION

The use of cold forging method as tool in metal forming industry results in cost reduction, time saving and improvement in product quality. This paper gives a review of cold forging and screw design process. Cold forging and screw design improvement process optimization has been done by many authors using different techniques excellently. Still it is require getting the higher accuracy in the results. It can be seen that all the components which are designed are completely filled and stresses in the component are less than the ultimate stress of the material. Theoretical and simulated load improvements of the forging processes is calculated. As a future research the adjustable design of Low Head Screws can be transformed into design as compact by engaging with a control mechanism in order to remove the Head Failure. The Recommended trainings given to Machines operators, for men, supervisor, instructors and engineers. Quality alerts should also be display at final inspection areas or stages. To do more tight inspection for next three to four lots of material before dispatch to customers. During this Forging has a chance to likely undergo some changes to suit best the products. Statistical process control (SPC) will be control of all parameters datas of the Fasteners and improved to process M5X40 low head socket screw. Material should be dispatch with all quality respects and also provide the feedback for customers and also compare the differenced. Further Cold Forging technology can be explored to provide the Better surface finish and take a plate form editing parameters of fasteners on the Design of Products.

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