Design Process Parameters on Thread Manufacturing Rolling Process of Collar bolt

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Abstract: *This paper presents* the thread rolling processes are typically used to manufacture threads in mass production. While these processes are well established, the process design is mostly based on individual experience. Thus, due to the lack of process understanding, a systematic design of thread rolling processes is not established. Within this paper, a systematic study of the influence of the process configuration towards the occurrence of defects is performed. In order to enable the investigation of the rolling process, a sensor setup is introduced that allows to measure forming forces in feed and radial direction in direct force flow. An increase of the stroke speed leads to a significant increase of forming force accompanied by the emergence of seams within the root radius for specimens with a zinc-phosphate and polymer coating. Removing this coating prior to the experiments neither allows executing trials without force increase nor seams. Accompanying numerical studies are validated with the help of geometrical as well as force measurements and show that these defects are caused by a shift of the relative sliding velocities within the contact zone.

Keywords: Process Parameters, Thread Manufacturing Rolling Process, Collar bolt etc.

1. INTRODUCTION

Threads may be generated by the thread chasing, thread milling, casting, thread rolling, thread grinding etc. Out of these; the thread rolling process has various advantages. In this work we determine the effect on the dimensions of external threads. Outer diameter and pitch circle diameter. When we generate the threads by external thread rolling process, it uses the different type of carbon steel which has different blank diameter, surface roughness. After that the results obtained by the experiment will be optimized by fuzzy method. This study will help to determine the effect on the dimensions of the threads when the above parameters vary. Thread rolling is a cold forming or chip less machining operation under considerable pressure by the rolling action of the blank diameter between, either rotating cylindrical dies or reciprocating flat dies. The reasons behind the selection of thread rolling process over grinding, machining etc. are lower unit cost, superior mechanical properties, excellent surface finish and surface hardness. The advantages are not only excellent surface finish but also a good surface hardness and increase in thread strength up to 40%.

2. LITERATURE REVIEW

Effect of Surface Roughness indicate that the surface roughness affects significantly the dimensions of thread [1]. Effect of Selected Process Parameters Feng Feng analyzed effect of Seleucid process parameter on material flow of one thread profile in external thread rolling. The results of the study show that blank diameter had little effect. While flow sliders, friction factor had significant impact on the thread root, crest, and the achievable thread height [2]. Effect of Tensile Testing on Threads Saglam and Kus investigated that the thread formed by internal-thread rolling had accurately dimensioned threads and improved surface had been obtained. The tensile load capacity of the rolled thread was found higher than the thread made by cutting method [3–4]. A new idea for online manufacturer selection is based on state of the art, literature and existing industry practices. Fuzzy logic is gaining more and more popularity due to factors such as conceptually easy to understand, flexibility, tolerant of imprecise data, being based on natural language, etc. Fuzzy logic expresses vague and subjective relationships mathematically

3. TAGUCHI PHILOSOPHY

Taguchi addresses design and engineering (off-line) as well as manufacturing on line quality. This fundamentally differentiates Taguchi methods from the Statistical Process Control (SPC) , which is purely an on l;ine quality control method. Taguchi ideas can be distilled into three fundamental concepts:

a) Achieving high system quality levels economically requires quality to be designed into the product. Quality is designed but not manufactured into the product.
b) Quality losses must be defined as deviations from target not conformance to arbitrary specification.
c) Quality is best achieved by minimizing the deviation from a target.

3.1 Signal to noise ratio (S N Ratio)

Taguchi recommends the use of the criterion he calls, Signal to noise ratio as performance statistic. The change in the quality characteristic of a product under investigations in response to factor induced in the experimental design is the signal of the desired effect. The effect of external affairs (uncontrollable factors) on the outcome of the quality characteristic under test is termed the noise.

The Signal to noise ratio measure the sensitivity of the quality characteristic being investigated in controlled manner, to those external influencing factors not under control. The S N ratio is basically a transformed figure of merit, created from the loss function . To use the loss function as figure of merit an appropriate loss function with its constant value must first be established which is not always cost effective and easy. Taguchi recognizes that dilemma early in the development of his methodologies and created the transform of the loss function, which is named as S N ratio. The S N ratio is a concurrent statistic which is able to look at characteristic of distribution and convert these characteristic in a single number or figure of merit . The S N ratio combines both the parameters in a single matrix.

The aim in any experiment is always to determine the highest possible (S N) ratio for the result irrespective of the type of quality characteristic . A high value of S N ratio implies that the signal is much higher than the random effect of noise factors. Products design or process operation consistent with highest S N always yields the optimum quality with minimum variances. From the quality point of view, there are three possible categories of quality characteristic. They are:

1. Smaller the best
2. Nominal is the best
3. Larger is better

The S N ratio is computed from the mean square deviation (MSD) by the equation:

$$S\,N = -10 \log_{10} (MSD)$$

For the S N ratio to be larger, MSD must have a value that is small.

If smaller is the best quality characteristic;

$$\textbf{MSD} = [(Y_1^2 + Y_2^2 + \ldots\ldots\ldots\ldots\ldots + Y_n^2)]\ \ N$$

Where Y_1 ,Y_2……………. Y_n are the quality characteristic.

If nominal is the best quality characteristic;

$$\textbf{MSD} = [(Y_1 - Y_0)^2 + [(Y_2 - Y_0)^2 + \ldots\ldots\ldots\ldots\ldots[(Y_n - Y_0)^2]\ \ N$$

Where Y_0 = target or nominal value

If larger is the best quality characteristic;

$$\textbf{MSD} = [(1\ Y_1^2 + 1\ \ Y_2^2 + \ldots\ldots\ldots\ldots\ldots + 1\ Y_n^2)]\ \ N$$

The S N ratio analysis is designed to measure quality characteristic. This is Taguch s solution to Robust Product or Process Design.

3.2 Procedure and Steps of Taguchi Parameter Design

Step-1: Selection of the quality characteristic

There are three types of quality characteristics in the Taguchi methodology, such as smaller-the –better, Larger the – better and Nominal-the best. For example, smaller - the –better is considered when measuring fuel consumption of an automobile or shrinkage of a plastic component. The goal of this research was to achieve maximum productivity or zero loss in target.

Step-2: Selection of noise factors and control factors

In this step, the controllable factors are Material (A), Surface roughness (B) and Blank diameter (C), which were selected because they can potentially affect the dimensions of threads. Since these factors are controllable in the production process, they are considered as controllable factors in the study. One of the attributes of taguchi parameter design is it could also consider uncontrollable (Noise) factors in the analysis.

Step-3: Selection of Orthogonal Array

There are 9 basic types of standard Orthogonal Arrays (OA) in the Taguchi parameter design (Genichi Taguchi and Yu-in Wu, 1979). An L_9 orthogonal Array is selected from Appendix B, 2^{nd} edition, 2005 Taguchi Techniques for Quality Engineering, Philip J Ross[20], Tata McGraw-Hill Publishing Company limited, for this study.

Step-4: Conducting the experiments

After the data were collected and recorded in level table , Signal to Noise ratios of each experimental run were calculated based on the following equation, which are listed in Table with the experimental data and is defined as;

$$\textbf{S N} = -10 \log_{10} (\textbf{MSD})$$

Where $$\textbf{MSD} = [(Y_1 - Y_0)^2 + [(Y_2 - Y_0)^2 + \ldots\ldots\ldots\ldots\ldots[(Y_n - Y_0)^2]\ \ N$$

Y_0 = target or nominal value

The change in diameter values were also calculated and recorded in the Table .

Taguchi proposed a standard eight-step procedure for applying his method optimizing any process.

Step-5: Analyzing the results, determine optimum conditions.

After raw data were collected, average change in diameter and S N Response ratio, respectively were calculated. The S\N ratio indicates the degree of the predictable performance of a product process in the presence of noise factors.

Step-6: Predicting the optimum performance

Using the aforementioned data, one could predict the optimum combination of Material, Surface roughness and Blank diameter using the different Material, Surface roughness and Blank diameter combination. With this prediction, one could conclude that which combination will creates the minimum loss in target achievement within the range of specified combinations of the variables. A confirmation of the experimental design was necessary in order to verify the optimum variables combination.

Step-7: Establishing the design by using a confirmation experiment

The confirmation experiment is very important in parameter design, particularly when screening or small fractional factorial experiments are utilized. The purpose of the confirmation experiment in this study was to validate the optimum values of different variables to reduce the rejection.

4. CONCLUSION

The aim of such an approach is to develop the idea an expert system that would fulfill the role of intelligent advisor for the parameter based on composed knowledge base and implement the knowledge of experts in this field. Knowledge and awareness of the importance of such an assessment of the manufacturing process gives companies a competitive edge in attracting and keeping the production of its plan. Since the proposed procedures allow the archiving of data as well, they can be used for long-term decision making, and monitoring compliance with quality manufacturing process.

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