A Review on Optimization of Cutting Parameters for Improvement of Surface Roughness and Tool Life on Low Carbon Steel Using Taguchi Method

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Abstract - The test of current machining businesses is principally centered around the accomplishment of high caliber, regarding work piece dimensional precision, surface complete, high generation rate, less wear on the cutting apparatuses, economy of machining in terms of cost sparing and increment the execution of the item. Consequently cutting parameters must be picked and streamlined in such a route, to the point that the surface quality and flank wear can be controlled. Dark taguchi technique is connected to advanced multi -reaction. In this study L27 orthogonal array used to optimized turning parameters i.e. cutting speed, feed, depth of cut and corner radius. The coefficient and grades according to Grey relational analysis are evaluated using normalized experimental results of the performance characteristics. The Analyses Of Variance (ANOVA) are conducted to identify the most significant factor affecting the turning performance. The obtained results indicate that cutting speed is most effective parameter that affect on surface roughness and flank wear subsequently followed by depth of cut, feed rate and corner radius.

Key Words: ASTM A36, cutting parameters, coated carbide tool, corner radius, flank wear, grey taguchi method, surface roughness.

1. INTRODUCTION

This are two fundamental handy issues that specialists confront in an assembling procedure. The first is to decide the estimations of the procedure parameters that will yield the coveted item quality and the second is to boost fabricating framework execution utilizing the accessible assets. Also,another primary issue is to limiting item cost. The choices made by assembling specialists are based not just on their experience and ability additionally on traditions concerning marvels that happen amid handling. In the machining field, a significant number of these marvels are very complex and connect with a substantial number of variables, in this manner keeping high process execution from being accomplished. To conquer these issues, the scientists propose models that attempt to recreate the conditions amid machining and set up circumstances and end results connections between different components and fancied item attributes. Moreover, the mechanical propels in the field, for example the continually developing utilization of PC controlled machine devices, have raised new issues to manage, which additionally underline the requirement for additional exact prescient models [9].

Surface roughness is a widely used index of product quality and in most cases a technical requirement for mechanical products. For improvement of tool life the flank wear is very important response to minimize. Researcher minimizing flank wear and achieving the desired surface quality is of great importance for the functional behaviour of a part. The most common strategy involves the selection of conservative process parameters, which neither guarantees the achievement of the desired surface finish nor attains high wear.

2. LITERATURE SURVEY

Nalbant et al. (2006) used the Taguchi method to find the optimal cutting parameters for surface roughness in turning. The orthogonal exhibit, the flag to-commotion proportion, and investigation of fluctuation are utilized to concentrate the execution qualities in turning operations of AISI 1030 steel bars utilizing TiN covered instruments. Three cutting parameters to be specific, embed sweep, bolster rate, and profundity of cut, are enhanced with contemplations of surface unpleasantness. Test results are given to show the viability of this approach.

Aslan et al. (2006) carried out an experimental study to Optimal cutting parameters by employing Taguchi techniques. They likewise consolidated impacts of three cutting parameters, to be specific cutting velocity, sustain rate and profundity of cut on two execution measures, flank wear (VB) and surface harshness (Ra), were explored utilizing an orthogonal exhibit and the investigation of fluctuation (ANOVA). Ideal cutting parameters for every execution measure were gotten; likewise the connection between the parameters and the execution measures were resolved utilizing numerous straight relapse. Al2O3-based earthenware production material are utilized on the grounds that it is a standout amongst the most appropriate cutting instrument materials for machining solidified steels. Be that as it may, their high level of fragility for the most part prompts to conflicting outcomes and sudden calamitous disappointments.

Motorcu (2010) investigated the surface roughness in the turning of AISI 8660 hardened alloy steels by ceramic based cutting tools in terms of main cutting parameters such as cutting speed, feed rate, depth of cut in addition to tool's nose radius, using a statistical approach. This scientist got comes about demonstrate that the nourish rate was observed to be the prevailing element among controllable elements at first glance unpleasantness, trailed by profundity of cut and device's nose span. In any case, the cutting pace demonstrated an inconsequential impact. Moreover, the communication of nourish rate/profundity of slice was observed to be critical at first glance complete because of surface solidifying of steel. Ideal testing parameters for surface harshness could be ascertained. In addition, the second request relapse display likewise demonstrates that the anticipated qualities were near the trial one for surface unpleasantness.

Davis et al. (2012) carried out experimental study to optimize the cutting parameters like depth of cut, feed rate, spindle speed in turning EN24 steel. In this study, the turning operation are carried out on EN24 steel by carbide P-30 cutting tool in dry condition and the combination of the optimal levels of the parameters are obtained. Keeping in mind the end goal to concentrate the execution attributes in turning operation the Signal-to-Noise proportion and Analysis of Variance are utilized. Accordingly of the investigation none of the variable are observed to be huge. Taguchi technique has demonstrated that bolster rate took after by Spindle speed and profundity of cut are the blend of the ideal levels of elements while turning EN24 steel via carbide cutting device in dry cutting condition.

Makadia and Nanavati (2012) used Design of experiments to study the effect of the main turning parameters such as feed rate, tool nose radius, cutting speed and depth of cut on the surface roughness of AISI 410 steel. A scientific expectation model of the surface unpleasantness has been created regarding above parameters. The impact of these parameters at first glance unpleasantness has been explored by utilizing Response Surface Methodology (RSM). The created forecast condition demonstrates that the nourish rate is the primary element took after by instrument nose sweep impacts the surface unpleasantness. The surface unpleasantness was found to increment with the expansion in the bolster and it diminished with increment in the instrument nose range. The confirmation analysis is done to check the legitimacy of the created show that anticipated surface harshness inside 6% mistake.

Verma et al. (2012) carried out the analysis of optimum cutting conditions to get lowest surface roughness in turning ASTM A242 Type-1 Alloys Steel by Taguchi method. Taguchi strategy has demonstrated that the slicing speed has critical part to play in delivering lower surface harshness around 57.47% took after by bolster rate around 16.27%. The Depth of Cut has lesser part on surface harshness from the tests. The outcomes got by this technique will be valuable to different examines for comparable kind of study and might be enlightening for further research on device vibrations, cutting powers and so forth..

3. SYSTEM ARCHITECTURE

3.1 Objectives

1. Literature reviews of turning process parameters.
2. Identify the performance characteristics and select process parameters to be evaluated
3. Determine the number of levels for the process parameters and possible interactions between the process parameters.
4. Select the appropriate orthogonal array and assignment of process parameters to the orthogonal array.
5. Conduct the experiments based on the arrangement of the orthogonal array.
6. Optimization of process parameters using Design of Experiments (DOE).
7. Analyze the experimental results using the S/N ratio and ANOVA.
8. Verify the optimal process parameters through the confirmation experiment.

3.2 Method

3.2.1. Taguchi method

The Taguchi method developed by Genichi Taguchi (1990) was the most important statistical tool for the optimization of the single output parameter. It considers a set of different number of input parameters, may it be an L27 orthogonal array or an L9 orthogonal array depending upon the degree of accuracy needed. Taguchi is a set of methodologies by different properties of material and machining process has been taken into account of design shape [9].

Step of Taguchi method follows as:
1. Selection of the factors to be evaluated.
2. Selection of the number of levels.
3. Selection of the appropriate orthogonal array.
4. Assignment of factors to the columns.
5. Conduct the experiment.
6. Analyze the result, predict the optimum level.
7. Perform the verification experiment and plan the future action.

3.2.2 Grey Taguchi Approach

The Grey Taguchi Approach is an advanced form of the Taguchi method, which emphasizes on the optimization of more than one output parameters, rather than optimizing a single output parameter as in case of the Taguchi method. It considers a set of different number of input parameters, depending upon the degree of accuracy needed. The number of experiments chosen in this study is an L27 orthogonal array comprising the input parameters are cutting speed *(Vc),* feed (*F),* Depth of cut (*Dc*) and corner radius (*R*).

Two-output parameters of the surface roughness and flank wear, namely Ra and VB are considered and converted into a single output parameter, called the Grade. The calculation of the grade requires the calculation of the normalized, Δ and Grey relational coefficient (ξ) values for each of the output parameters of the surface roughness and flank wear. The average of the grey relational coefficient (ξ) values for output parameters gives the value of the grade of the entire output parameters. Based on the grade calculated, the corresponding S/N ratio is obtained through the following formula [13].

4. CONCLUSION

The following conclusions can be drawn based on the results of experimental study:

- The machining parameters namely cutting speed, feed rate, depth of cut, corner radius is optimized to meet the objectives. The results reveal that the primary factor affecting the surface roughness and flank wear is speed subsequently followed by depth of cut, feed and corner radius.
- The cutting speed is most significant factor which minimizing surface roughness and improving tool life is 40.72% subsequently followed by depth of cut which contributes 12.13%, feed rate 10.05% and corner radius has least significant factor contributes 6.22%.
- The optimized factor for great surface finish and low flank wear is cutting speed Vc3=325m/min, feed F2= 0.1 mm/rev, depth of cut Dc1=0.25 mm, and corner radius R2=0.8 mm.

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