Optimization of Drilling Parameters by Using Taguchi Method – Research Paper

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ABSTRACT

We have done Optimization of drilling parameters using the Taguchi method to obtain minimum surface roughness (Ra). Number of drilling experiments were conducted using the L9 orthogonal array on a CNC vertical machining center. The drilling experiments were performed on EN-24 steel blocks/plates using uncoated M10 HSS twist drills under dry cutting conditions. Signal to Noise (S/N) ratio was used to optimize control factors which are affecting the surface roughness. The cutting speed and feed rate were selected as control factors. After the trials nine experiments, it was found that the cutting speed was the most significant factor on the surface roughness. The results of the confirmation experiments showed that the Taguchi method was notably successful in the optimization of drilling parameters for better minimum surface roughness.

Keyword: - *Taguchi, Drilling, Optimization.*

1. INTRODUCTION

Taguchi method is developed by Taguchi and Konishi, initially it was developed for improving the manufacturing process development and optimization, later its application was expanded to many other fields in Engineering and Manufacturing sector. Taguchi Method involves identification of proper control factors to obtain the optimum results. Results of these experiments are used to analyze the data and predict the quality of components produced. Here, an attempt has been made to show the application of Taguchi's Method to improve the surface finish characteristics of that were processed on a Drilling machine. Surface finish affects the life of any product and hence it is desirable to obtain higher grades of surface finish at minimum cost. [1]

The basic objective of drilling operations is to generate holes at minimum cost with the required quality levels. The fulfillment of this straightforward objective can present challenges to those responsible for establishing and maintaining efficient production operation. The broad applicability of drilling results in a large variation in customer requirements, tolerances, materials and shop facilities that, in turn, prevent simplified solution. [2]

This method lays great important on responsiveness towards customer's satisfaction. Taguchi realized and appreciated the vitality of producing an outcome on target and concluded that, excessive variation in performance was the root cause of poor quality and was counterproductive to the society at large. He further stated that these variations in performance or deviation from target would clear itself as certain loss to the society through early wear out, difficulty in integrating or interfacing with other parts, servicing, the need to include safety margins etc. which if ignored would lead to customer dissatisfaction and loss of company reputation. In other words, Taguchi highlighted the importance of reducing process variability around a specified target value and then bringing the process mean on target. [3]

2. OBJECTIVE & SCOPE OF THE STUDY

1. To study and understand the Taguchi method in engineering application.
2. To demonstrate use of the Taguchi parameter design in order to identify the optimum surface roughness performance with a particular combination of cutting parameter in a turning operation.

In order to get the best result, this research must be scoped narrower where it consists of;

1. The Taguchi method is used to find the optimal cutting parameters for surface roughness in drilling.
2. The cutting experiment will be carried out on a CNC vertical machining center. The experiments were performed on EN-24 steel blocks using uncoated M10 HSS twist drill under dry condition.
3. The orthogonal array, the signal-to-noise, and analysis of variance are employed to study the performance characteristics in turning operations.
4. Using three-level array L9 as an orthogonal array as reference to setup the experiment.

3. EXPERIMENT

Design of Experiment is a powerful approach to improve product design or improve process performance where it can be used to reduce cycle time required to develop new product or processes. Design experiment is a test or series of test that the input variable (parameter) of a process is change so that observation and identifying corresponding changes in the output response can be verify. The result of the process is analyzed to find the optimum value or parameters that have a most significant effect to the process. The objectives of the experiment may include.

Table-1: Parameters used in Project

Sr.no	Feed (f, mm/rev)	Cutting Speed (V, RPM)	Depth of Hole (t, mm)
1	0.8	550	30
2	1.0	650	30
3	1.2	750	30

The above Experiments has 3 different feed rates and having three different speed ranges on single hole diameter, the single speed is taken for every five feed rates, according to this our method of preposition will be like below, each speed will be used for 3 different speeds the orthogonal array will be of L9

3.1 Cutting Tool & Work Material Details

The cutting tool material is M10 HSS twist drill its composition is W-18%, Cr-4%, V-1%, C-0.7%, Fe-Rest. Work material details are EN-24 steel block/plate of 30mm will be used for drilling purpose, the drilling will be done on block or plate according to method of preposition.
Chemical composition of material is C-0.44%, Si-0.35%, Mn-0.70%, P-0.035%, S-0.04%, Mo-0.35%, Cr-1.40%, Ni-1.70%.

3.2 Experimental Setup

I n the present work, CNC vertical machine is used to drill holes on EN-24 steel blocks using uncoated M32 HSS twist drill under dry condition; the machine setup is shown in figure.

Fig-1: Experimental Setup

4. EXPERIMENTAL DESIGN & ANALYSIS

The Analysis of Variance (Minitab 18) a powerful and common statistical procedure in the social sciences. It is the application to identify the effect of individual factors. In statistics, Minitab 18 is a collection of statistical models, and their associated procedures, in which the observed variance is partitioned into components due to different explanatory variables. In its simplest form Minitab 18 gives a statistical test of whether the means of several groups are all equal, and therefore generalizes.

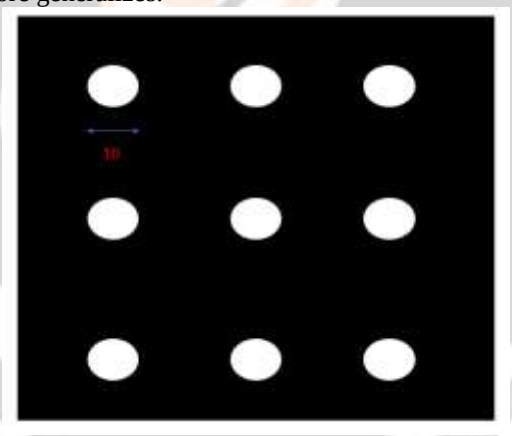

Fig-2: L9 orthogonal array

5. RESULT

Table-2 : Result of Experiments and S/N Ratios

Experiment Level	Speed (RPM)	Feed (mm/rev)	Depth of Hole (mm)	Ra	S/N Ra
1	550	0.8	30	2.38	7.01
2	550	1.0	30	2.15	6.78
3	550	1.2	30	2.45	7.48

4	650	0.8	30	1.68	4.07
5	650	1.0	30	1.78	4.34
6	650	1.2	30	1.88	5.08
7	750	0.8	30	1.56	3.86
8	750	1.0	30	1.45	3.19
9	750	1.2	30	1.68	4.51

Table-3: Response table for S/N ratio for Ra

Level	A	B
1	2.327	1.873
2	1.780	1.793
3	1.537	1.977
Delta	0.790	0.183
Rank	1	2

1. After experimentation the surface roughness is calculated using surface roughness tester.
2. Similarly, the reduction in feed rate and speed given the good surface roughness of work piece.

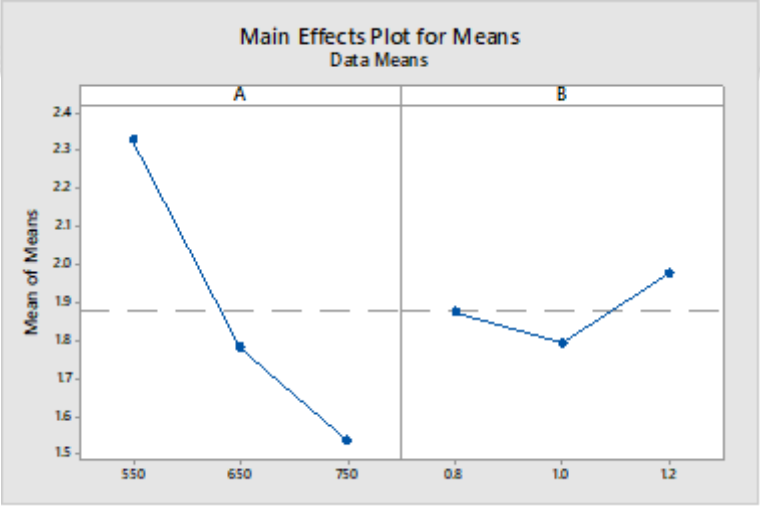

Fig-3: Main Effect plot for Ra

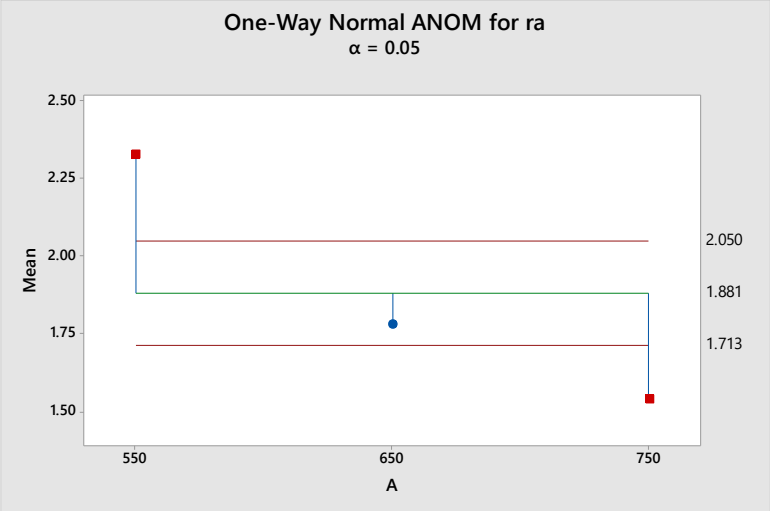

Fig-4: One-way normal Amon for Ra

6. CONCLUSION

This project illustrates the application of the parameter design (Taguchi method) in the optimization of drilling Parameters. The following conclusions can be drawn based on the above experimental results of this study:

1. Taguchi's Method of parameter design can be performed with lesser number of experimentations as compared to that of full factorial analysis and yields similar results.
2. Taguchi's method can be applied for analyzing any other kind of problems as described in this project.
3. It is found that the parameter design of the Taguchi method provides a simple, systematic, and efficient methodology for optimizing the process parameters.

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