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"A RESEARCH PAPER ON OPTIMIZATION OF DRILLING PROCESS PARAMETERS USING TAGUCHI METHOD"

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ABSTRACT

Now a day's the application of optimization techniques are very useful for maintaining and improving both the quality and productivity. In this paper the overview on, the optimization of different parameters in drilling process is given through literature review. Analysis of variance (ANOVA) was used to determine the most significant control factors affecting the surface roughness. The response surface methodology (RSM) and design of experiments (DOE) techniques are largely used in the various research works on drilling process. The quality of drilling processes depends on different parameters like cutting speed, feed rate, drill diameter, depth of cut, material type, etc. during operation. The researchers in the following literature review have worked on drilling process by taking into consideration the above mentioned factors. In this present paper the parametric optimization of the drilling machining process for Surface roughness (Ra) has been performed using Taguchi method.

Keyword: *Drilling process; Machining parameters; Surface roughness; Response surface method, Design of experiments, Analysis of variance (ANOVA), Optimization.*

I. INTRODUCTION

Drilling is a process of producing round holes in a solid material or enlarging existing holes with the use of multi-point cutting tools called drills or drill bits. Drilling is a continuous machining process. Various cutting tools are available for drilling, but the most common is the twist drill. Wide variety of drill processes are available to serve different purposes (core drilling, step drilling, counter boring, counter sinking, reaming, center drilling, gun drilling etc.).With the rapidly growing technologies quality and productivity are the major concern. Productivity is concerned with the material removal rate (MRR) during machining operation and quality refers to the product characteristics. So the quality and productivity can be improved through parameters optimization.There are number of research works related to various drilling parameters optimization for achieving the performance responses. Among them surface roughness, material removal rate (MRR) and thrust forces on drill bit are the major performance responses. Material removal rate (MRR) is the primary response variable while considering productivity. The material removal rate depends on input parameters and the machine during drilling operation. So the primary objective of optimization analysis during drilling operation is to optimize the input parameters. Also material removal rate (MRR) play a major role in surface roughness. The primary objective in all the research works relating to drilling parameter optimization is to optimize the input parameters such as spindle speed, fees rate, drill bit diameter etc. Simply the optimization means improving the material removal rate and reducing the surface roughness value. The other aspect governing the drilling parameter optimization is quality of the product. Quality relating to the product characteristics like surface roughness, wear resistance, cost etc. Design of experiment and analysis of experimental data play a significant role in parameters

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optimization and cost of optimization. Among all the design of experiment techniques Taguchi method is the simplest one. Analysis of variance (ANOVA) is used for analysing the data obtained during experiment. The grey relational analysis is the most accurate and effective analysis tool for the data obtained during CNC drilling. Many of the researches in parameter optimization uses wide variety of design experiments and analysis focused on different performance parameters and different materials. So this paper concentred on drilling parameters optimization in different material using Taguchi method.

II. Need For Optimization

In industry having large production rate, the cost of process is depends on drilling time and finishing time. So for economical production deep study of machining process is required. In traditional machining the selection of cutting parameters for machining is left to the machine operator. In this case the experience of the machine operator plays important role, but every time it is not possible to achieve the required quality of output. So industries are going to optimize various machining parameters to improve process quality, reduce cost of production, & for obtaining high efficiency. To obtain this quality, various optimization techniques are used.

III. Literature Review

Sumesh A S. et. al. [1] -has conducted experiment using Taguchi technique to obtain minimum surface roughness (Ra).for validation ANOVA Software is used. Experiments were performed on cast iron using HSS twist drills. A number of drilling experiments were conducted using the L9 orthogonal array on a radial drilling machine , it is observed that the variation in drilling parameters are optimized with respect to multiple performances in order to achieve a good quality of holes in drilling. Finally variation in parameter it was identified that a spindle speed of 80 rpm, drill diameter of 4mm and a feed rate of 0.1 mm/rev is the optimal combination of drilling parameters that produced a high value of S/N ratios of hole roughness.

Yogendra Tyagi et.al [2] - has studied on drilling of mild steel with the help of CNC drilling machine, with tool high speed steel, to optimize various process parameters using Taguchi method and L9 array, taguchi method and analysis of variance (ANOVA) are used. Finally it is found that, the Spindle Speed of drilling machine Tool mainly affects the surface roughness and the Feed Rate largely affects the MRR.

Nisha Tamta et.al. [3] - has conducted experiment to optimize the drilling machining process for Surface roughness (Ra). The drilling parameters were chosen as Spindle speed, Feed rate and Drilling Depth. L9 orthogonal array used to conduct the experiments. Signal to noise (S/N) ratio and analysis of variance (ANOVA) is used to analyze the effect of the drilling parameters on material. Optimization of parameters is done by Taguchi method using statistical software MINITAB-15. Finally it is conclude that optimum parameter combination for the minimum Surface roughness (Ra) are, Spindle speed 3000 (rpm), Feed rate 15(mm/min.) and Drilling Depth 9 (mm) ,the ANOVA and S/N ratio showed that Drilling Depth is obtained as the most significant factor for Ra followed by Spindle speed.

Kunal Sharma et. al. [4] -has conducted experiment to study the performance characteristics of AISI 304 stainless steel using CNC drilling process, with input parameters spindle speed, feed rate and point angle ,to get minimum surface roughness and minimum ovality. Experiments are Conducted based on Taguchi L16 orthogonal array by taking point angle, drill diameter, feed rate and spindle speed at two levels. The Taguchi based signal-to-noise ratio analysis is used to obtain the relation between the machining parameters and performance characteristics. The feed is the most effective parameter and that the small variation in feed will show large increase in surface roughness.

S.V. Alagarsamy et. al. [5]- used Taguchi method to study the effects of drilling parameters such as cutting speed, feed and depth of cut on surface roughness and material removal rate in drilling of Aluminum alloy 7075 using HSS spiral drill. Orthogonal arrays, the signal- to- noise ratio, the analysis of variance are used to analyze the effect of drilling parameters on the quality of drilled holes and experiment results are collected and analyzed using statistical

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software Minitab16. ANOVA software is used to study the most significant control factorsaffecting the surface roughness and material removal rate and it is concluded that the depth of cut has significant role to play in producing higher material removal rate and cutting speed has significant role to play for producing lower surface roughness.

Arshad Noor Siddiqueea et.al.[6] - has conducted experiment on CNC lathe machine using solid carbide cutting tool on material AISI 321 austenitic stainless steel, to optimize deep drilling parameters with the help of Taguchi method for minimizing surface roughness. The cutting parameters such as cutting fluid, speed, feed and hole-depth considered. Taguchi L18 orthogonal array used as design of experiment. To determine which machining parameter significantly affects the surface roughness the signal-to-noise (S/N) ratio and the analysis of variance (ANOVA) is used. Results revealed that the machining done using cutting fluid, at a speed of 500 r.p.m. with a feed of 0.04 mm/s and hole-depth of 25 mm is the optimum condition. The results of ANOVA indicated that all four cutting parameters significantly affected the surface roughness with maximum contribution from speed (27.02%), followed by cutting fluid (25.10%), feed (22.99%), and hole-depth (14.29%).

Yogendra Tyagi et. al. [7]- has conducted experiment to study the optimization of drilling of mild steel with the help of CNC drilling machining operation with tool use high speed steel by using taguchi method and signal-to-noise ratio applied to find optimum process parameter for CNC drilling machining. L9 orthogonal array and analysis of variance(ANOVA) are used to study the performance characteristics of machining parameter (spindle speed ,feed, depth) to achieve good surface finish and high material removal rate (MRR). Results obtained by taguchi method and signal-to-noise ratio match closely with (ANOVA) and the feed is most effective factor for MRR. And spindle speed is the most effective factor for surface roughness.

A.Navanth et.al.[8] -has conducted experiment to optimization of drilling parameters using Taguchi technique to obtain minimum surface roughness (Ra) and hole diameter on conventional drilling machine, and number of drilling experiments were conducted using the L18 orthogonal array. The material used is AI 2014 alloy block using HSS twist drills under dry cutting conditions and measured results are analyzed with the help of MINITAB16 and Analysis of variance (ANOVA).To determine the most significant control factors affecting the surface roughness and hole diameter. It concludes that a spindle speed of 300 rpm, point angle & Helix angle of 1300/200 and a feed rate of 0.15 mm/rev is the optimal combination of drilling parameters that produced a high value of s/n ratios of Hole roughness. And also find that a spindle speed of 200 rpm, point angle & Helix angle of 900/150 and a feed rate of 0.36 mm/rev is the optimal combination of drilling parameters that produced a high value of s/n ratios of Hole Diameter.

M.A. Amran et. al .[9] -has conducted experiment on effects of drilling parameter such as spindle speed, feed rate and drill diameter on the surface roughness and surface texture of drilled hole using response surface method (RSM),and concluded that the appropriate combination of spindle speed, feed rate and drill diameter is very important for drilling process. And also found that the parameters that affects surface roughness is spindle speed, followed by drill diameter and feed rate. the minimum and maximum surface roughness is 1.06 µm and 2.59 µm respectively.

Arya Yashvardhan et. al.[10] -has studied Signal to Noise Ratio to determine the main effects, significant factors and optimum machining condition to the performance of finishing operation in mild steel. And it is conclude that, the Spindle Speed of finishing machine Tool mainly affects the surface roughness and the Feed Rate largely affects the MRR.

IV. CONCLUSION

In this paper investigation is done on Optimization of drilling process parameters with various work piece materials. The study of relationship between the input parameters and the output parameters is done in order to optimize the process parameters to make the drilling process with improved quality and cost effective. So from this study finally come to know that, using proper optimization techniques and efficient software like (Minitab, ANOVA), it is possible to achieve optimum output response parameters like surface roughness, metal removal rate. The Spindle Speed is mainly affects the surface roughness and the Feed Rate largely affects the MRR.

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V. FUTURE SCOPE

The above mentioned researchers had successfully conducted the experiment and obtained the desired results. The outputs of experiment were obtained by various optimization techniques and analysis software. Many researchers had conducted experiments on a cast iron material and the results obtained without rimming process. Thus there is scope, to study the optimization of drilling parameters such as spindle speed, feed rate and drill diameter on grey cast iron material, which is not explored fully.

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