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"OPTIMIZATION OF MACHINING PARAMETERS THROUGH TAGUCHI STATISTICAL TECHNIQUE – A REVIEW"

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ABSTRACT

Manufcturing division, not just creating the items with great quality alongside dimensional precision and close resistances is essential yet additionally it needs to deliver financially and in a brief timeframe. Subsequently choice of ideal process parameters turns out to be extremely critical for machining forms. In this paper, a survey is made on streamlining of round and hollow granulating process parameters done by various scientists on various materials. Every one of the specialists examined and chose some crucial procedure parameters which vigorously influence the yield parameters of tube shaped granulating, for example, surface quality, MRR and so forth and done investigations on examples. Taguchi technique is utilized for experimentation and to locate the ideal parameters.

Key Words: *Optimization, Roughness, Taguchi, Design, Array, Grinding*

I. INTRODUCTION

In the manufacturing sector, producing products with good quality surface finish along with dimensional accuracy and close tolerances play an important role. To fulfil these requirements, several finishing processes are used such as burnishing, honing, lapping, and grinding. Cylindrical grinding is one of the important metal cutting processes used extensively for finishing operations of cylindrical objects such as shafts, axles, spindles, studs etc. Grinding process is mostly used in which surface quality and metal removal rate are considered as an output parameters. But these output parameters of grindings are influenced by several operating input parameters such as: (i) wheel parameters type of abrasives, grain size, grade, structure, binder, shape and dimension; (ii) work piece parameters mechanical properties, chemical composition, fracture mode; (iii) process parameters wheel speed, depth of cut, table speed, feed, and dressing condition; (iv) machine parameters static and dynamic characteristics, spindle system, and table system. Hence in grinding operation, it is an important task to select appropriate input parameters for achieving high cutting performance. Usually, the desired cutting parameters are determined based on experience or by use of a handbook. However, this does not ensure that the selected parameters have optimal or near optimal cutting performance for a particular machine and environment.

II. METHODOLOGY

Different procedures have been used by researchers from time to time for the process of optimization. Taguchi method is an experimental method. It is effective methodology to find out the effective performance and machining conditions. Taguchi parameter design offers a simple, systematic approach and can reduce number of experiment to optimize design for performance, quality and manufacturing cost. Signal to noise ratio and orthogonal array are two major tools used in robust design. And collected the data after experiments for each factor/level combination and then analyzed

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using Analysis of Variance (ANOVA).

Dr. C. J. Rao et al. (2013) reported the significance of influence of speed, feed and depth of cut on cutting forces and surface roughness while working with tool made of ceramic with an Al2O3+TiC matrix (KY1615) and the work material of AISI 1050 steel (hardness of 484 HV). Experiments were conducted using John ford TC35 Industrial type of CNC lathe. Taguchi method (L27 design with 3 levels and 3 factors) was used for the experiments. Analysis of variance with adjusted approach has been adopted. Krishan kant et al (2012) has investigated in an optimization of turning process by the effects of machining parameters by applying Taguchi methods to improve the quality of manufactured goods, and engineering development of designs for studying variation. EN24 steel was used as the work piece material for carrying out the experimentation to optimize the Material Removal Rate. The bars used were of diameter 44mm and length 60mm. There were three machining parameters i.e. Spindle speed, Feed rate, Depth of cut. Different experiments were done by varying one parameter and keeping other two fixed so that maximum value of each parameter can be obtained. Orthogonal array was designed with three levels of turning parameters with the help of software Minitab 15. In the first run nine experiments were performed and material removal rate (MRR) was calculated. When experiments were repeated in second run again MRR was calculated. Ajay Mishra et al. (2012) used Taguchi techniques to find out the optimum tool flank wear width in turning operation of AISI 1045 Steel. L9 orthogonal array, S/N ratios and ANOVA were used to study the performance characteristics of cutting speed, feed rate and depth of cut as turning parameters with tool flank wear width as response variable. The result of the analysis indicated that the selected machining parameters affect significantly the tool flank wear width of Tungsten Carbide cutting tool while machining AISI 1045 steel and also indicate that the cutting speed was the most influencing parameter out of the three parameters under study. Upinder Kumar Yadav et al. (2012) have optimized the machining parameters for surface roughness in CNC Turning by Taguchi method. Medium Carbon Steel (AISI 1045) of Ø: 28 mm, length 17 mm were used for the turning experiments in the present study. AISI 1045 has a variety of applications in vehicle component parts & machine building industry. Surface roughness was the main quality function in high speed turning of medium carbon steel in dry conditions. In this study, the effect and optimization of machining parameters (cutting speed, feed rate and depth of cut) on surface roughness was investigated. L‟27 orthogonal array, analysis of variance (ANOVA) and the signal-to-noise (S/N) ratio were used in this study. Three levels of machining parameters were used and experiments were done on STALLION-100 HS CNC lathe. Kamal Hassan et al. (2012) investigated the effects of process parameters on Material Removal Rate (MRR) in turning of C34000.The effect of parameters i.e. Cutting speed, feed rate and depth of cut and some of their interactions were evaluated using L‟27 orthogonal array of Taguchi method ANOVA analysis with the help of MINITAB 16 software. It has been concluded that the material removal rate was mainly affected by cutting speed and feed rate. Raju Shrihari Pawade et al. (2011) performed experiment for Multi-objective optimization of surface roughness and cutting forces in high-speed turning of Inconel 718 using Taguchi grey relational analysis (TGRA). A TGRA was proposed to study the optimization of high speed turning process parameters. Cutting force components and the surface roughness of the machined components were selected as quality targets. Twenty-seven experimental runs based on orthogonal arrays were performed. Ahmet et al. (2008) studied the effect and optimization of machining parameters on surface roughness and tool life in a turning operation by using the Taguchi method. The experimental studies were conducted under varying cutting speeds, feed rates, and depths of cut. An orthogonal array, the signal-to-noise (S/N) ratio, and the analysis of variance (ANOVA) were employed to the study the performance characteristics in the turning of commercial Ti-6Al-4V alloy using CNMG 120408-883 insert cutting tools. The conclusions revealed that the feed rate and cutting speed were the most influential factors on the surface roughness and tool life, respectively. The surface roughness was primarily related to the cutting speed, whereas axial depth of cut had the greatest effect on tool life. Tian Syung Lan et al. (2008) has selected the L9 (34) orthogonal array of a Taguchi experiment for four parameters i.e. cutting depth, feed rate, speed, and tool nose runoff with three levels low, medium, and high in optimizing the finish turning parameters on an ECOCA 3807 CNC lathe. The surface roughness (Ra) and tool wear ratio (mm-2) were primarily observed as independent objectives for developing two combinations of optimum single-objective cutting parameters. Additionally, the levels of competitive orthogonal array were then proposed between the two parameter sets. The surface roughness of each work piece was measured four times at three different sections of 40 mm, 80 mm, and 120 mm from the face. The mean effects for S/N ratios were drawn by MINITAB 14. S. Thamizhmanii et al. (2007) the purpose of this research paper was focused on the analysis of optimum cutting conditions to get lowest surface roughness in turning SCM 440 alloy steel by Taguchi method. Experiment was designed using Taguchi method and 18 experiments were designed by this process and

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conducted. The results were analyzed using analysis of variance (ANOVA) method.

III. RESULT ANALYSIS

P. Madhava Reddy et al. (2014) concluded that the optimal process parameters based on grey relational analysis for the turning of EN16 steel include a 200 m/min cutting speed, 0.1 mm/rev feed rate and 0.6mm depth of cut. From ANOVA, it was identified that the interaction parameter between cutting speed and feed rate (60.71%) influences more on turning of EN16 steel followed by depth of cut (20.04%) and feed rate (10.49%). Anand et al. (2014) emphasis on two points (1) for surface roughness optimum combination of speed (4.133 RPM) and depth of cut (6.239mm) was obtained. (2) for tool tip temperature optimum combination of speed (41.55 RPM) and depth of cut (40.66mm) was obtained. Kushal et al. (2014). Results of the study indicated for optimal cutting parameter were wet cutting environment, cutting speed (350rpm), feed (0.6mm/rev), depth of cut (0.9mm), and nose radius (0.8mm) for minimum surface roughness (SR) and dry cutting environment, cutting speed (700rpm), feed (0.6mm), depth of cut (1.2mm), and nose radius (0.4mm) was optimum setting for material removal rate and this developed model can be used to increase the machine utilization at low production cost in manufacturing environment. J.S. Dureja et al. (2014) found that the optimal machining conditions for minimizing tool wear (VB) as per Taguchi analysis cutting speed was 130 m/min, feed 0.10 mm/rev, depth of cut 0.40 mm with an estimated flank wear of 96 µm. The optimized machining conditions for minimizing surface roughness as per Taguchi analysis cutting speed was 155 m/min, feed 0.10 mm/ rev., depth of cut 0.25 mm with an estimated surface roughness of 0.57 µm. Jitendra J. Thakkar et al. (2014) concluded that for surface roughness the percentage contribution of cutting speed was 12.01 %, feed of 78.45 % and depth of cut of 2.04 % on surface roughness for straight turning operation. In multi response optimization the optimum cutting parameter combination was meeting with parameter combination value was 0.200 mm depth of cut, 209.99 m/min cutting speed and 0.14 mm/rev feed rate surface roughness was 0.7429609811393024 µm. For material removal rate the percentage contribution of cutting speed was 14.67 %, feed of 18.14 % and depth of cut of 58.57 % on material removal rate for turning operation. In multi response optimization the optimum cutting parameter combination was meeting with parameter combination value was 1.0 mm depth of cut, 209.99 m/min cutting speed and 0.30 mm/rev feed rate surface roughness was 59271.39999580036 mm3/min. Mahendra Korat et al. (2012). Optimal cutting parameters for, minimum surface roughness (SR) and maximum material removal rate were obtained. optimal cutting parameter were wet cutting environment, cutting speed (260m/min), feed (0.2mm/rev), depth of cut (1.5mm), and nose radius (1.2mm) for minimum surface roughness (SR) and wet cutting environment, cutting speed (260m/min), feed (0.3mm), depth of cut (1.75mm), and nose radius (1.4mm) was optimum setting for material removal. L B abhang et al. (2012) found that surface roughness is better if cooled lubricant is applied. Also feed rate and lubricant temperature are main parameters among the three factors (feed rate, depth of cut, and lubricant temperature) that affect the surface roughness. Raju Shrihari Pawade et al. (2011) conclude that recommended levels of high-speed turning parameters when both the cutting force components and the surface roughness were simultaneously considered were V_c (475 m/min), f (0.10 mm/rev), depth of cut (0.50 mm) with CW2 edge geometry insert. Among the tested parameters, the feed rate showed the strongest correlation to cutting forces and surface roughness. An increase in the value of predicted weighted GRG from 0.1660 to 0.2071 confirmed the improvement in the performance of high-speed turning process using optimal values of process parameters. The machined surfaces show more alterations (micro particle deposits, debris, smeared layer, and micro-chip fragments) at lower cutting speed. However, majority of the alterations wiped out at higher cutting speeds.

IV. CONCLUSION

From the above research paper we found that most of the researchers had taken speed, feed, depth of cut as input parameter and in some cases nose radius, cutting environment (dry or wet) and tool tip temperature whereas material removal rate, surface roughness, and tool wear as output variable. By studying the above literature we concluded that for material removal rate the most significant parameters are depth of cut, feed rate, and speed. Least significant parameter is nose radius. We found that feed rate is most significant factor affecting the surface roughness followed by depth of cut. For tool flank wear speed, depth of cut and feed are significant factors. We also found that Taguchi gives systematic simple approach and efficient method for the optimum operating conditions.

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