Review Paper Optimization of Machining Parameters by using of Taguchi's Robust Design for AA-6063 Alloy Steel Metal

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Abstract - This Experimental study mainly focuses on the Optimization of the cutting parameters on MRR of AA6063 alloy steel with carbide tool. The input parameters like cutting speed, Depth of Cut (DOC), Feed rate are influencing in Material Removal Rate (MRR), Machining Time using Taguchi method. The contribution and important parameter square measure determined by using the Taguchi design of Experiments (DOE) methodology. A number of turning experiments were conducted mistreatment the L9 orthogonal array on a CNC machine. In this paper analysis is based on Taguchi method of optimization and experimental design and further analysis is carried out with the help of statistical software MINITAB-18

Keywords– *Keywords: Taguchi Design of experiment, Carbide Tool, Turning Experiments, Depth of Cut, Material Removal Rate, MINITAB*

1. INTRODUCTION

Metals are formed into completely different usable forms through numerous processes during which no chip formation takes place. In these processes, the metal is formed under the action of heat, pressure or each. This class includes operations like shaping, drawing, spinning, rolling, extruding etc. A few of the important machining processes falling in this category are turning, milling, drilling, shaping, planning, broaching etc. Turning is that the most generally used among all the cutting processes. The demands for turning operations are attaining new dimensions at the present, in which the growing competition needs all the efforts to be directed towards the economical manufacture of machined parts. This can be made possible by the use of lathe machines. Material Removal Rate can be very helpful to predict the importance of different set-up variables. Hence by optimizing these desired results are considered to be important in the present industrial applications.

Turning produces 3 cutting force parts,(the main cutting force i.e. thrust force, (FZ), which produces within the cutting speed direction, feed force, (FX), that produces within the feed rate direction and also the radial force, (FY), that produces in radial direction and that is traditional to the cutting speed). inorganic compound cutting tools area unit very hip in metal cutting business for the cutting of varied onerous materials like, alloy steels, die steels, high speed steels, bearing steels, white forged iron and C forged iron. Within the past few decades there had been nice advancements within the development of those cutting tools. Coating is additionally used on cutting tools to produce improved lubrication at the tool/chip and tool/work piece interfaces and to scale back friction, and to scale back the temperatures at the innovative. Throughout machining, coated inorganic compound tools guarantee higher wear resistance, lower heat generation and lower cutting forces.

The surface machining properties will be increased by carburizing so heat treating the carbon-rich surface. Therefore the current work is targeted on finding the optimum parameters combination of cutting speed, feed and depth of cut for increasing the speed of material removal throughout machining.

Taguchi methods developed by Genichi Taguchi improve the quality of manufacturing roots are recently applied to the field of engineering, biotechnology, marketing and advertising. The Taguchi method is a very powerful carrying of experimental design, the main aim of the Taguchi methods is to produce an optimum result of analyzing the statistical data which have been given as input function. This technique permits restricted no of experimental runs by utilizing a well-balanced experimental style known as orthogonal array style and signal to noise magnitude relation

II. 1.3 Mechanism of Orthogonal Cutting in Turning Process

During machining, many roughing cuts area unit typically taken on the work piece material, followed by one or 2 finishing cuts. The roughing cut typically removes massive amounts of material from the beginning work half. It creates a form nearer to desired pure mathematics of the work half, however going some material for any end cutting operation. In roughing cut, high feed rates and depth of cuts, low cutting speeds area unit ideally adopted. Whereas the finishing cut completes half pure mathematics and achieves final dimensions, tolerances, and therefore the surface end.

III. Need for Optimization of Machining Parameters Using Various Tools and Techniques

Machining processes are inherently complex, nonlinear, multivariate and often subjected to unknown external disturbances. The operation is generally performed by a skilled operator, who uses his decision-making capabilities and rules of thumb gained from experience. A fully automated system requires the ability for automatic control, monitoring and diagnostics of the machining processes. Such a system is similar to a human operator. An automated system is equipped with a computer for processing the feedback information from sensors in real time for taking appropriate decision to ensure optimal operating conditions. The decision making in an automated system requires a model of the machining process. A model co-relating input control parameters with the machining output responses can be developed based on sufficient amount of data describing the behavior of the process, Roy et al. (2008).

III. METHODOLOGY

Specification of Work Material

For performing turning operations EN 31 alloy steel iron materials have been used. They were within the type of cylindrical bar of diameter 30mm and cutting length 67mm. In this study nine specimen of EN 31 alloy steel were used as work material for experimentation on centre lathe machine as shown in figure 2. The chemical composition and mechanical properties of the selected work piece is shown as in table 1 and table 2 respectively. Cemented carbide coated insert having 0.08 mm nose radius was used as cutting tool as shown in figure 1, which gives high wear resistance and crater resistance required in steel machining.

Fig 3.1: CNC Milling Machine

Fig. 3.2: Some of the machined samples AA6063

Based on the properties and their application in the manufacturing industry the AA6063 Alloy steel materials of 20mm diameter and 150mm length rolled rod is used for this research work and the machining has been carried out with experimentation on centre lathe machine as shown in figure 1. For this study L9 OA experiments were used. The material removal8rate is calculated by using the Equation (1)[9]. MRR=$Wtb-Wtat*\rho$ (1) Where Wtb, Wta - Weight of workpiece before and after machining in mg t- Machining Time in mm.

Table 2.1 Mechanical properties of AA6063-T6 aluminium alloy

Density (kg/m)	Melting point (degree centigrade)	Ultimate tensile strength (kgf/mm^2	Yield strength (kgf/mm^2)	Hardness (HV)
2,600-2,800	660	1.8-2.6	1.4-12	124

The machining experiments were carried out on the CNC Milling machine (Turn 1000 with 2000rpm) in dry condition. Spindle speed, feed rate and depth of cut were selected as the machining parameters to analyze their effect on surface roughness and while performing turning operation. A total of 9 experiments were carried out with different combination of the levels of input parameter.

IV LITERATURE REVIEW

S. A. Rizvi, et al (2015) [1] have analyzed that an effort was made to optimize the cutting parameters to achieve better surface finish and to identify the most effective parameter for cost evolution during turning by using CNC LATHE MACHINE with IS 2062 steel rods (35 mm diameter) as a work material and Chemical Vapour Deposition (CVD) coated carbide inserts as a tool material. In this work, the input parameters are cutting speed, Feed Rate and Depth of cut.

S. Sahu, B.B.Choudhury(2015) [2] have analyzed that the performance of multi-layer TiN coated tool in machining of hardened steel (AISI 4340 steel) as a work material under high speed turning uncoated tool use. In this work, the input parameters are cutting speed, Feed Rate and Depth of cut. Experiment are designed and conducted based on Taguchi's L16 Orthogonal Array design. From the Taguchi analysis it has been found that the feed is playing as a main parameter for reducing surface roughness, where as depth of cut is having significant effect on the surface roughness.

T. Rajasekaran, K. Palanikumar, et al (2013) [3] during this work, the input parameter area unit cutting speed, feed rate and depth of cut in turning by victimisation typical shaper (MakeNAGMATI, INDIA). Experiment are designed and conducted based on Taguchi's L9 Orthogonal Array design. From the Taguchi analysis it has been found that primarily feed rate and secondarily cutting speed has got the greater influence on surface roughness.

Yusuf S., et al (2005) [4] have determined surface roughness model response surface methodology (RSM) with low-carbon steel as a piece material and TiN coated inorganic compound as a tool material. In this work, cutting parameters area unit cutting speed, feed rate and depth of cut. From the experiment it's

Ilhan A., et al (2011) [5] have investigate the effect of cutting speed, feed rate and depth of cut using AISI 4140 (51 HRC) steel as a work material and Al2O3 and TiC coated carbide as a tool material. Experiment are designed and conducted based on Taguchi's L9 Orthogonal Array design. Through the experiment it is found that Feed rate is the most significant factor on surface roughness.

Satyanarayana K., et al (2015) [6] have determined that effect of process parameters on performance characteristics in finish hard turning of MDN350 steel using cemented carbide tool. In thiswork, the input cutting parameters are cutting speed, feed rateand depth of cut. Experiment are designed and conducted based on Taguchi's L9 Orthogonal Array design. From the experiment it is found that Feedand Cutting speed are the most significant factor onsurface roughness and Cutting Force respectively.

Ashvin J. M., et al (2013) [7] have investigated the effect of turning parameters such as cutting speed, feed rate, tool nose radius and depth of cut on surface roughness with AISI 410 steel as a work material and ceramic as a tool material using Response Surface Methodology (RSM).In this study Feed rate is the most significant factor on surface roughness.

Tanveer H. B., Imtiaz A. (2014) [8] have experimented a study of cutting parameters of AISI1040 steel as a work metrial and uncoated carbide as a tool material using Genetic algorithm and Response Surface Methodology. In this work, the input cooling condition, cutting parameters are cutting speed, feed rate and depth of cut. In this experiment it is found that Feed rate is the most significant factor on surface roughness.

Sayak M., et al (2014) [9] have experimented that to develop the combination of optimum cutting parameters SAE 1020 mild steel as a work material and carbide as a cutting tool using Taguchi technique. In this work, the input cutting parameters are cutting speed, feed rate and depth of cut. Experiment are designed and conducted based on Taguchi's L25 Orthogonal array design. From the experiment it is found that Depth of Cut has the most significant effect on MRR followed by Feed.

Ch. MaheswaraRao et al. [10] optimized the surface roughness in CNC turning using Taguchi method and ANOVA. The material AA7075 was turned using tungsten carbide insert. Experiments were designed using Taguchi technique. ANOVA was performed to study the significance of cutting parameters on surface roughness. The results showed that cutting speed and feed influenced the surface roughness the most.

Ashvin J. Makadia et al. [11] optimized the machining parameters for turning operations based on response surface methodology. Here AISI 410 steel was turned using the turning parameters cutting speed, feed rate, depth of cut and tool nose radius. Design of experiment was used to study the effect of these parameters on surface roughness. The effect of these parameters was investigated by using Response Surface Methodology (RSM). The study revealed that the feed rate followed by the tool nose radius were the main influencing factors on surface roughness.

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