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Experimental Analysis of Turning Parameters Using Aluminum Alloy (AA6063)

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ABSTRACT

Mechanical engineering without production and manufacturing is meaningless and inseparable. Production and manufacturing process deals with conversation of raw materials inputs to finished products as per required dimensions' specifications and efficiently using recent technology. Our project is "Experimental analysis of turning parameters using aluminium alloy (AA6063)" is used to find the accuracy & improve the quality of machining material by running various parameters Analysis of input parameters for the improvement of quality of the product of turning operation on CNC machine by using aluminium alloy. Speed, feed & depth of cut are taken as the input parameters and the machining time, surface finish & MRR as output parameter.

Keywords: *Taguchi Technique, cutting speed, feed rate, DOC, MRR, Surface finish, Machining time.*

I. INTRODUCTION

Computer Numerical Control (CNC)

Machining is the metal removing process from the work piece to achieve desired geometry by using a single or multi point cutting tool. The three principal machining processes are classified as turning, drilling and milling. Other operations are falling into miscellaneous categories include shaping, planning, boring, broaching and sawing. In turning operation, the tool with a single point cutting edge is used to remove material from a rotating work piece to generate cylindrical shape. The speed motion is provided by the work piece and feed motion is achieved by tool. Computer numerical control (CNC) is the automation of machine tools by means of computers executing pre-programmed sequences of machine control to commands. This is in contrast to machines that are manually controlled by hand wheels or levers, or mechanically automated by cams alone. In modern CNC systems, the design of a mechanical part and its manufacturing program is highly automated. The part's mechanical dimensions are defined using computer-aided design (CAD) software, and then translated into manufacturing directives by computer- aided manufacturing (CAM) software. The resulting directives are transformed (by "post processor" software) into the specific commands necessary for a particular machine to produce the component, and then loaded into the CNC machine.

II. METHODOLOGY

Taguchi Technique

Design of experiments is a powerful analysis tool for modelling and analysing the influence of control factors on performance output. The traditional experimental design is difficult to be used especially when dealing with large number of experiments and when the number of machining parameter is increasing. The most important stage in the design of experiment lies in the selection of the control factors. Therefore, the Taguchi method, which is developed by Dr . Genichi Taguchi, is introduced as an experimental technique which provides the reduction of experimental number by using orthogonal arrays and minimizing the effects out of control factors. Taguchi is a method which includes a plan of experiments with the objective of acquiring data in a controlled way, executing these experiments and analysis data in order to obtain the information about behaviour of the given process. Besides that, it is a set of methodologies that took into account of the inherent variability of materials and manufacturing process during the design stage. It is almost similar to the design of experiment (DOE) but the Taguchi design's balanced(orthogonal) experimental combination offers more effective technique than the fractional factorial design.

This technique has been applied in the manufacturing processes to solve the most confusing problems especially to observe the degree of influence of the control factors and in the determination of optimal set of conditions. In the Taguchi definition, the quality of a product is defined interms of the loss imparted by the product to the society from the time it is shipped to the customer. The losses due to the functional variation are known as losses due to the deviation of the product's functional characteristics from its desired target value. Besides that, the noise factors are the uncontrollable factors which cause the functional characteristics of a product that do not achieve its targeted values. The noise factors can be classified as the external factors (temperature and human errors), manufacturing imperfections and product deterioration. The main purpose of quality engineering is to make sure that the product can be robust with the respect of all possible noise factors. So, the Taguchi method could decrease the experimental or product cycle time, reduce the cost while increasing the profit and determines the significant factors in a shorter time period as it can ensure the quality in the design phase. The procedure of Taguchi's design as shown in figure can be categorized into three stages viz. system design, parameter design and tolerance design. Parameter design, considered as the most important stage, can determine the factors affecting quality characteristics in the manufacturing process. The first step in Taguchi's parameter design is selecting the proper orthogonal array (OA) according to the controllable factors(parameters). Then, experiments are run according to the OA set earlier and the experimental data are analysed to identify the optimum condition. Once the optimum conditions are identified, then confirmation runs are conducted with the identified optimum levels of all the parameters. The use of parameter design in Taguchi's technique is an engineering method of focusing on determining the parameter settings producing the best levels of a quality characteristic with minimum variation for a product or process. The main objective of quality engineering is to make products that are robust in respect of all noise factors.

So, Taguchi created standard orthogonal array to accommodate as many factors as possible into control factor selection stage to identify nonsignificant variables in the earliest opportunity. Taguchi used the signal-to- noise (S/N) ratio as the measurable value of the quality characteristics of thechoice.

Aluminum Alloy (AA6063) Material

AA 6063 is an aluminium alloy, with magnesium and silicon as the alloying elements. The standard controlling its composition is maintained by The Aluminum Association. It has generally good mechanical properties and is heat treatable andweldable.

It is similar to the British aluminium alloy HE9. 6063 is the most common alloy used for aluminium extrusion. It allows complex shapes to be formed with very smooth surfaces fit for anodizing and so is popular for visible architectural applications such as window frames, door frames, roofs, and sign frames. Applications requiring higher strength typically use 6061 or 6082 instead.

Application of Aluminum Alloy (AA6063)

Pure aluminium is soft, ductile, corrosion resistant and has a high electrical conductivity. It is widely used for foil and conductor cables, but alloying with other elements is necessary to provide the higher strengths needed for other applications. Aluminium is one of the lightest engineering metals, having astrength to weight ratio superior to steel. By utilising various combinations of its advantageous properties such as strength, lightness, corrosion resistance, recyclability and formability, aluminium is being employed in an ever- increasing number of applications. This array of products ranges from structural materials through to thin packaging foils.

Equations

1. Control factors, (factors that affect theprocess variability as measured by the S/Nratio).
2. Signal factors (factors that do not influence the S/N ratio or processmean).
3. Factors (factors that do not affect the S/N ratio or processmean).

The experimental observations are future transformed into signal-to-noise (S/N) ratios. Signal-to-noise (S/N) ratio was used by Taguchi as the quality characteristics of choice and here are several S/N ratios available depending on the type of performance characteristics. The S/N ratio can be characterized into three categories when the characteristics arecontinuous

Nominal is the best characteristic:

$$S/N = 10\ log\frac{\bar{y}}{S_y}$$

Smaller the better characteristics:

$$S/= 10log\ \frac{1}{n}\ (\Sigma y^2)$$

Larger the better characteristics:

$$S/N = 10\ log\ \frac{1}{n}(\Sigma\ \frac{1}{y^2})$$

III. Experimental Work

Input Parameters

Cutting Speed

Cutting speed is defined as the speed at which the work moves with respect to the tool (usually measured in feet per minute). Feed rate is defined as the distance the tool travels during one revolution of the part.

Feed

When milling or drilling, or creating a tool path for a CNC machine the feed rate must be determined. Materials have rated surface speeds for a given type of cutter. The harder the material the slower the speed. Given the diameter of the tool and the surface speed, the rpm of the spindle can be calculated.

Depth of Cut

Feed, Speed, and Depth of Cut. Cutting speed is defined as the speed at which the work moves with respect to the tool (usually measured in feet per minute). Feed rate is defined as the distance the tool travels during one revolution of thepart.

Output Parameters

Machining Time

Machining time is the time when a machine is actually processing something. Generally, machining time is the term used when there is a reduction in material or removing some undesirable parts of a material.

Material Removal Rate

The material removal rate, MRR, can be defined as the volume of material removed divided by the machining time. Another way to define MRR is to imagine an "instantaneous" material removal rate as the rate at which the cross-section area of material being removed moves through the workpiece

Surface Finish

Surface finish, also known as surface texture or surface topography, is the nature of a surface as defined by the three characteristics of lay, surface roughness, and waviness. It comprises the small local deviations of a surface from the perfectly flat ideal (a true plane).

Response Table for Signal to Noise Ratios, Smaller is better

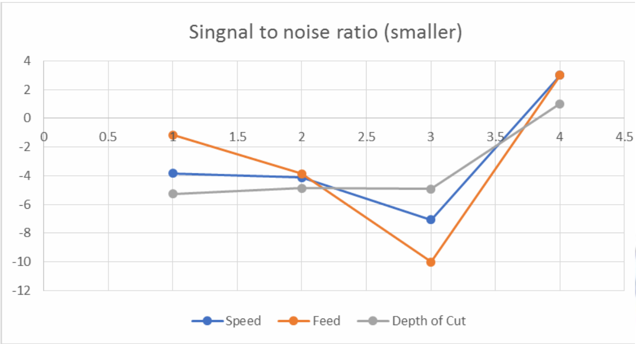
Factor	Level 1	Level 2	Level 3	Rank
Speed	-3.840	-4.140	-7.067	3
Feed	-1.170	-3.870	-10.006	3
Depth of Cut	-5.263	-4.866	-4.929	1

Response Table for Signal to Noise Ratios, Larger is better

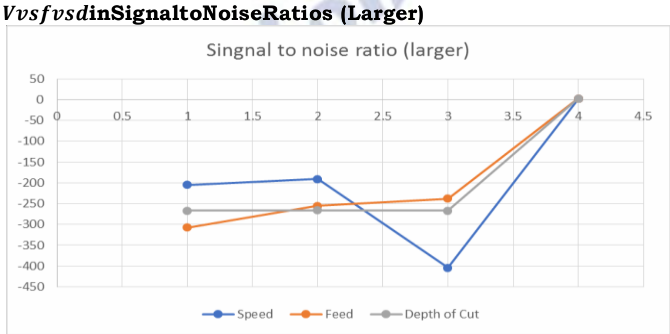
Factor	Level 1	Level 2	Level 3	Rank
Speed	-204.991	-190.718	-404.448	2
Feed	-307.692	-254.910	-237.553	3
Depth of Cut	-266.908	-266.158	-267.090	3

GRAPHS:

***V vs f vs d*in Signal to Noise Ratios (Smaller)**



***VvsfvsdinSignaltoNoiseRatios* (Larger)**



IV. Conclusion

This paper presented an experimentation approach to study the effect of input parameters on the surface roughness and MRR. The following conclusions are drawn on the experimental investigations carried out: From response Table 1. rankings, it can be concluded that feed rate has the most influencing effect on the quality characteristics of surface roughness followed by spindle speed and DOC. Optimum parameter setting for surface roughness in turning AA6063. From response Table for Signal to Noise ratios based on the ranking, it can be concluded that depth of cut has a maximum influence on the MRR followed by spindle speed and feed rate. Optimum parameter setting for MRR in turning AA6063 is obtained. As shown in this study of AA6063 turning with Taguchi's easy-to-use approach for process optimization may be extended to other aluminium alloys considering the growing importance of such alloys. Present work may pave the way for further research with process variables like tool vibration, power consumption, and temperature effects etc. on the samealloy.

References

[1] Kumar, G., (2013), "Multi Objective Optimization of Cutting and Geometric parameters in turning operation to Reduce Cutting forces and Surface Roughness," B.Tech. thesis, Department of Mechanical Engineering, National Institute of Technology,Rourkela.

[2] Yang W.H. and Tarng Y.S., (1998), "Design optimization of cutting parameters for turning operations based on Taguchi method," Journal of Materials Processing Technology, 84(1)pp.112–129.

[3] Makadia A.J. and Nanavati J.I., (2013), "Optimisation of machining parameters for turning operations based on response surface methodology," Measurement, 46(4) pp.1521-1529.

[4] Neseli S., Yaldiz S. and Turkes E., (2011), "Optimization of tool geometry parameters for turning operations based on the response surface methodology," Measurement, 44(3), pp.80-587.

[5] Bouacha K., Yallese M.A., Mabrouki T. and Rigal J.F., (2010), "Statistical analysis of surface roughness and cutting forces using response surface methodology in hard turning of AISI 52100 bearing steel with CBN tool," International Journal of Refractory Metals and Hard Materials, 28(3), pp.349-361.

[6] M.S. Lou, J.C. Chen and C.M. Li, (1999), "Surface roughness prediction technique for CNC end-milling," Journal of Industrial Technology,15(1).

[7] M.S. Lou and J.C. Chen, (1999), "In process surface roughness recognition system in end-milling operations," International Journal of Advanced Manufacturing Technology, 15(1) pp.200–209.

[8] Faisal, M.F.B.M., (2008), "Tool Wear Characterization of Carbide Cutting Tool Inserts coated with Titanium Nitride (TiN) in a Single Point Turning Operation of AISI D2 Steel," B.Tech. thesis, Department of Manufacturing Engineering, university Technical MalaysiaMekala.

[9] Sharma V.K., Murtaza Q. and Garg S.K., (2010), "Response Surface Methodology and Taguchi Techniques to Optimization of C.N.C Turning Process," International Journal of Production Technology, 1(1), pp.13-31.

[10] Montgomery D.C., Design and Analysis of Experiments, 4th ed., Wiley, New York,1997.

[11] Noordin M.Y., Venkatesh V.C., Chan C.L. and Abdullah A., (2001), "Performance evaluation of cemented carbide tools in turning AISI 1010 steel," Journal of Materials Processing Technology, 116(1) pp. 16–21.

[12] Trent, E. and Wright, P. Metal Cutting, 4th ed., Butterworth-Heinemann, Woborn, MA, Chap2.

[13] Dash, S.K., (2012), "Multi Objective Optimization of Cutting Parameters in Turning Operation to Reduce Surface Roughness and Tool Vibration," B.Tech. thesis, Department of Mechanical Engineering, National Institute of Technology,Rourkela.

[14] Halim, M.S.B., (2008), "Tool Wear Characterization of Carbide Cutting Tool Insert in a Single Point Turning Operation of AISI D2 Steel," B.Tech. thesis, Department of Manufacturing Engineering, University Technical MalaysiaMekala.

[15] Khandey, U., (2009), "Optimization of Surface Roughness, Material Removal Rate and cutting Tool Flank Wear in Turning Using Extended Taguchi Approach," MTech thesis, National Institute of Technology,Rourkela.