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Optimization of CNC Machining Parameter of Al6061 to Improve Surface Roughness and Material Removal Rate: A Review

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Abstract: ***The purpose of this paper is made to obtain optimization of CNC machining parameter with the help of Taguchi method. By using Taguchi experimental design turning is done on Al6061. Selected input parameter for turning are cutting speed, feed, depth of cut and output responses are surface roughness and material removal rate. The S/N ratio method is used to analyze material removal rate and surface roughness of the effect of operating parameter. After that, statistical technique Analysis of Variance (ANOVA) is used to determine relative effect of each process parameter.From the analysis it is found that feed rate is the most influential process parameter which influences the material removal rate and surface roughness while turning of Al6061 followed by cutting speed and depth of cut. Hardness is also calculated before and after machining operation.***

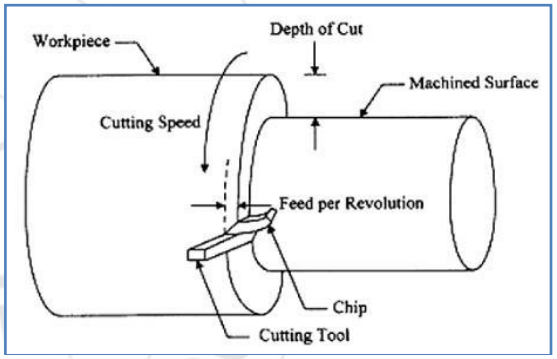
Keywords: CNC Machine, Taguchi method, surface roughness, material removal rate, ANOVA, S/N ratio

1. Introduction

The CNC machine contains minicomputer which is controller unit of the machine. CNC machine is based on control technology. All movement of CNC machine is controlled by English letters and words. The CNC instruction is called part programming command. It interpreted by one by one line called as blocks. We can store all programme in the memory of computer and used when it get needs. We can produce mass production of work piece/job. It works like the robot and we can analyze and control all the movements.

2. CNC Machine

Turning experiment conduct using CNC turning centre which is having maximum turning diameter of 180mm and maximum turning length is 180mm. and there are two axes, travel of X-axis is up to 110mm and Z-axis travel is 250mm and machine dimension are 2200*1850*1900(mm). Turning is usually applied for the cylindrical workpiece, it is used to reduce the diameter of workpiece. We can cut into the workpiece for depth and move the tool parallel to the axis of the workpiece. There is various application of turning into the many industries.



3. Turning Operation

Manufacturers focus on the surface finish and product dimensional accuracy during the manufacturing. They always try to reduce manufacturing time, wear rates (of machine and tool used), and surface roughness to reduce cost of manufacturing and maintenance cost. From the number of machining operations turning is the one of the common machining process and is widely used in variety of manufacturing industries. Surface finish and quality of the surface depends upon the input parameters selected during the fabrication of the part. Generally the surface roughness depends upon the feed, cutting speed and depth of cut input parameters. The use of Aluminium and some of its alloys are now widely used and the components made up of these alloys replaces the components of the steel because it is difficult to fabricate the part from steel rather than aluminium as aluminium is soft, durable, light weight, non-magnetic and ductile in nature. Also the cost of the Steel is higher than the Aluminium. For the machining of aluminium number of inserts are available. Selection of Insert for machining of part depends upon the strength and hardness of material to be machined. In the present study Al 6061 is selected for machining because of sufficient

strength, good toughness and good weld-ability and brazibility.

4. Literature Review

YanmingQuan, Bangyan Ye [1]
In this paper, Sic/Al composite was taken for investing of surface quality of composite. Sic/Al composite contains soft matrix and hard reinforcing particle. The composite did not perform uniformly under the cutting force. In this paper, it was find out the hardness and residual stresses of Sic/Al composites in the surface layer affected by machining. The result indicates that the surface hardness of machine composited may not be lower than of the interior material in the subsurface of machine composites.

Umashankar M. Rawat and Prof. V. V. Potdar [2]
In this paper an attempt is made to study the various literatures on optimization of cutting parameter in machining. Machining parameter are determined by using experimental design and results are analysis by S/N ratio and ANOVA. Result indicates that surface roughness is most significant factor compare to depth of cut and material removal rate.

P. VenkataRamaiah et al. [3]
In this paper an attempt is made to obtain optimization of turning parameters for Al6061 material for minimum cutting forces and cutting temperature. The input parameter is taken as spindle speed, feed, depth of cut cutting temperature and cutting force are measured for different influential parameter combination. Optimal parameter combination is finding out by fuzzy logic technique.

S.A. Syed Azuan [4]
In this paper, the effect of dry machining on tool wear during turning Al6061 is analyzed with the help of different types of PVD and CVD coated carbide inserts. The selected inserts of PVD coated carbide are TN6025, TN6010, HC-K10 and CVD coated carbide are CND-TN712T and CVD-TN7135. These carbide inserts are tested under dry cutting condition under dry cutting condition and tool wear are measured during each machining test using a MOTIC toolmaker microscope. The result indicated that CVD coated carbide tools have shown lower tool wear with compare to PVD coated carbide tool.

Shivraj Singh et al. [5]
In this paper, the effect of cutting parameter on surface finish is analyzed and cutting parameter is optimized. Al6061 material is selected for study. Response surface methodology is used for designing the experiment. Results indicated that as spindle speed increases the surface roughness decreases and as feed rate increases roughness value get increases. For this study input variable value various from 155-250m/min for speed and 0.1-0.2mm/rev for feed and 0.1-1.5mm for depth.

JitendraThakkar, Mitesh I Patel[6]
In this paper an attempt is made to optimize of process parameter for SS410 material for surface roughness and material removal rate. Material removal rate is calculated from Material removal rate equation and it id compared with results of software. Collected data for surface roughness is utilized for optimized and in this study27 specimen are studied.

P. P. Shirpurkar et al. [7]
In this paper an attempt is made to review the literature on optimization of machining parameters in turning parameter by using tool inserts to get optimization of the parameter various conventional techniques employed such as linear programming and nonlinear programming. This paper gives that Tauguchi method has potential to give good results as compare to other methods. This paper gives comparison between conventional and modern techniques to get optimization of machining parameters.

Ranganath M S et al. [8]
In this paper, response surface methodology used to optimization of process parameter in turning operation. In this paper various type of materials and Design of experiment techniques are used. This paper suggests that Response surface methodology gives good results and simple and systematic qualitative optimal design to a relatively low cost.

Dharindom Sonowal et al. [9]
In this paper an attempt is made to review the literature an optimization of cutting parameter for minimum surface roughness in turning. It is observed that feed rate is the highest affecting factor. It is find out the distribution of various methods in optimization of surface roughness. Results gives that Taguchi method is most widely used method.

5. Conclusion

From the literature review it is observed that the surface roughness and material removal rate depends on the various machining parameters like speed, feed, depth of cut. Experiment show that feed rate is most dominating factor that affects surface finish. The higher value of cutting speed decreases the surface roughness. Experiments show that there is least contribution of depth of cut on surface roughness. A Surface roughness value decreases when cutting speed increases. Due to the increase in friction between work piece and tool interface the temperature increases in the cutting zone, whereas the increases in feed rate increases the surface roughness. The higher material Removal Rate depends on the feed rate and cutting. And it is also observed that Tauguchi method has potential to give good results as compare to other methods.

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