www.ijiarec.com

ISSN: 2348-2079

MAR-2015

International Journal of Intellectual Advancements and Research in Engineering Computations

INVESTIGATION OF MACHINING ON BRASS ROD WITH ALUMINIUM NITRATE INSERT

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ABSTRACT

This study presents an experimental investigation on surface roughness of a hardened material (brass) machined by using aluminum nitrate coated insert. The process parameters considered for this experimental work are cutting speed (m/min), Feed (mm/rev) and Depth of cut (mm). By varying these parameters, surface roughness is calculated using surface roughness tester. The experimental results are then optimized using Taguchi analysis-L27 array method. The results revealed that surface roughness was greatly influenced by the feed rate rather than the cutting speed and depth of cut for AlN coated insert.

Keywords: Turning, Brass, Surface roughness, Taguchi Analysis

INTRODUCTION

In this paper is concentrate to attain a high quality of work piece and surface finish, high production rate, less wear on the cutting tools, economy of operation in terms of cost saving and increase the performance of the product with reduced environmental impact [1]. The surface quality is an important parameter to evaluate the productivity of machine tools as well as machined components. Hence, achieving the desired surface quality is of great importance for the functional behavior of the mechanical parts [2].In Hard machining, it was quite known that the surface roughness is one of the most important product qualities as it significantly affects the design of the product. In machining process, material removal rate is also important factor because it fixes the economic value of machining process. To optimize the cutting parameters several approaches were studied. One of the most important approaches that are widely used among the researchers is the Taguchi method as it provides small number of experiments, particularly when the process parameters increase.[3,4] Surface roughness ,often shortened to roughness, is a component of surface texture. It is quantified by the deviations in the direction of the normal vector of a real surface from its ideal form. If these deviations are large, the surface is rough; if they are small, the surface is smooth. Roughness is typically considered to be the high-frequency, short-wavelength component of a measured surface (see surface metrology). Rough surfaces usually wear more quickly and have higher friction coefficients than smooth surfaces (see tribology). Roughness is often a good predictor of the performance of a mechanical component, since irregularities in the surface may form nucleation sites for cracks or corrosion. On the other hand, roughness may promote adhesion.

WORK MATERIAL & CUTTING TOOL

The work material selected in this investigation was brass. The composition of the brass shown in table 1. A commercially available single point Aluminium nitrate inserts tool was used as cutting tool material.

Table 1 Nominal composition of brass

NORMINAL COMPOSITION OF BRASS (Mass content in %)	
Cu	Balance
Sn	< 0.05
Zn	30
Ni	<0.2
Fe	<0.05
Al	<0.02
Pb	<0.005
Other	<0.1

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In this process, we are taken the aluminium nitrate insert tool. In This Fig 5.3.1 the insert is a multi point cutting tool**.** The AlN is one of the advance material that have a bright prospect in future since it has features such as lightweight, high strength,

Expt.No	Parameter 1 (cutting speed)	Parameter 2 (feed)	Parameter 3 (depth of cut)
E 1	100	0.15	0.5
E 2	100	0.25	0.5
E 3	100	0.35	0.5
E 4	100	0.15	1
E 5	100	0.25	1
E 6	100	0.35	1
E 7	100	0.15	1.5
E 8	100	0.25	1.5
E 9	100	0.35	1.5
E 10	150	0.15	0.5
E 11	150	0.25	0.5
E 12	150	0.35	0.5
E 13	150	0.15	1
E 14	150	0.25	1
E 15	150	0.35	1
E 16	150	0.15	1.5
E 17	150	0.25	1.5
E 18	150	0.35	1.5
E 19	200	0.15	0.5
E 20	200	0.25	0.5
E 21	200	0.35	0.5
E 22	200	0.15	1
E 23	200	0.25	1
E 24	200	0.35	1
E 25	200	0.15	1.5
E 26	200	0.25	1.5
E 27	200	0.35	1.5

high hardness and stiffness quality.[5] Aluminum alloy reinforced with alumina and silicon carbide, as well as its reinforcement with aluminium nitride (Al/AlN) has been extensively investigated by the scientific community, as their integration shows some excellent mechanical properties and thermal properties [6] .

DESIGN OF EXPERIMENTS:

Experiments were designed using Taguchi
method which uses an OA to study the entire parametric space with a limited number of experiments.

Table 2 parameters for the experiment

In present research three parameter (factors) chosen such as cutting speed, feed and depth of cut. All of them were set at three different levels. (See table 2)

TAGUCHI APPROACH:

Taguchi's orthogonal arrays are highly fractional designs, used to estimate maineffects using only few experimental runs. For example, a four-level full factorial design with five factors requires 1024 runs while theTable 3 L-27 Matrix

CUTTING PARAMETERS	SYMBOL	UNIT	LEVEL 1	LEVEL 2	LEVEL 3
CUTTING SPEED	V	m/min	100	150	200
FEED	F	mm/rev	0.15	0.25	0.35
DEPTH OF CUT	d	mm	0.5	1	1.5

Taguchi orthogonal array reduces the required numberof runs to 16 only. Hence The experiments have been conducted and values of surface roughness for different combination of cutting speed (m/min), feed (mm/rev) and depth of cut (mm) have been shown in table 3. Then the next process is to
checking the surface roughness value by the
surface roughness tester.

Then we arechecking the surface roughness value of thebrass accordingto the parameters (cutting speed, feed, depth of cut) Initially we are testing the surface roughness of brass material corresponding to the combination.The value of surface roughness for the 1 st combination of Cutting speed of 100 m/min with depth of cut of 0.5, 1, 1.5 mm and feed of 0.15, 0.25, 0.35 mm/rev as shown in the table 4.

Table 4 surface roughness value for 1 st combination

The value of surface roughness for the 2 `nd combination of Cutting speed of 200 m/min with depth of cut of 0.5, 1, 1.5 mm and feedof 0.15, 0.25, 0.35mm/rev as shown in the table 5. The value of surface roughness for the 3`rd combination of Cutting speed of 300 m/min with depth of cut of 0.5, 1, 1.5 mm and feed of 0.15,0.25,0.35mm/rev as shown in the table 6.

Cutting speed m/min	Depth of cut (mm)	Feed (mm/rev)	Surface roughness (µm)
150	0.5	0.15	1.18
150	0.5	0.25	2.61
150	0.5	0.35	4.2
150	1	0.15	1.37
150	1	0.25	2.51
150	1	0.35	4.25
150	1.5	0.15	1.3
150	1.5	0.25	2.65
150	1.5	0.35	4.08

Table 5 surface roughness value for 2 `Nd combination

Cutting speed m/min	Depth of cut (mm)	Feed (mm/rev)	Surface roughness (µm)
200	0.5	0.15	1.28
200	0.5	0.25	2.83
200	0.5	0.35	4.25
200	1	0.15	1.33
200	1	0.25	2.7
200	1	0.35	4.17
200	1.5	0.15	1.3
200	1.5	0.25	2.76
200	1.5	0.35	4.12

Table 6 surface roughness value for 3 `rd combination

RESULT AND DISCUSSION: Taguchi method stresses the importance of studying the response variation using the signal–to–noise (S/N) ratio, The surface roughness was considered as the quality characteristic with the concept of "the smaller-the-better”. Beyond that concept we are taking the calculation on the mini tab soft ware. the results are followed in figures.In this fig 1shows the smaller is the best for s/n ratio. So the 100 m/min value of cutting speed is better for surface roughness value. Because while increasing the cutting speed the surface

Cutting speed m/min	Depth of cut (mm)	Feed (mm/rev)	Surface roughness (µm)
100	0.5	0.15	1.16
100	0.5	0.25	2.69
100	0.5	0.35	4.46
100	1	0.15	1.13
100	1	0.25	2.7
100	1	0.35	4.7
100	1.5	0.15	1.13
100	1.5	0.25	2.66
100	1.5	0.35	4.55

roughness value is goes down .both are indirectly proportional to each other.

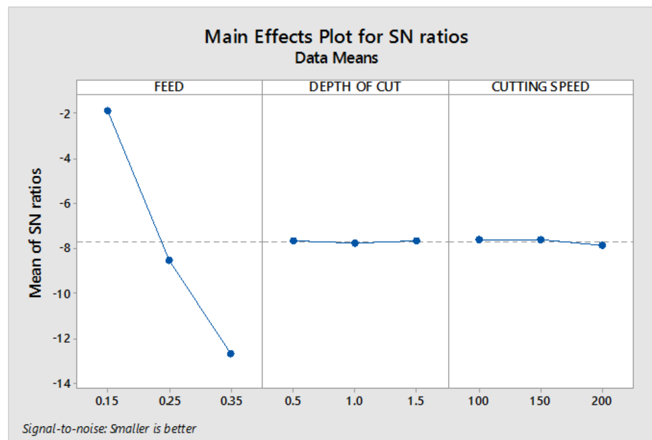

Fig 1 Main effects plot for SN ratio .

Fig 2 shows the main effects for means are plotted .Regardless of the category of the performance characteristics, a smaller S/N value corresponds to a better performance.

The effect of parameters cutting speed on the surface roughness values is shown above graph 1 for S/N ratio.Its effect is increasing with increase in cutting speed up to 200 m/min beyond that it is increasing. So the optimum spindle speed is level 1 i.e.100 m/min.\The effect of parameters feed rate on the surface roughness values is shown above figure S/N ratio. Its effect is increasing with increase in feed rate. So the optimum feed rate is level 3i.e. 0.35 mm/rev.The effect of parameters depth of cut on the Surface roughness values is shown above figure for S/N ratio.

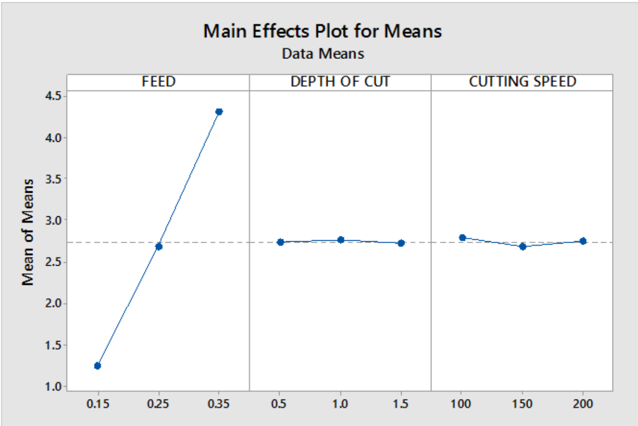

Fig 2 Main effects plot for mean

Fig 3 Main effects plot for st Devs

Its effect is increasing with increase in depth of cut. So the optimum1 i.e.main effect for depthof cut is level 0.5 mm. Fig 3 shows the standard deviations are plotted

In this table the depending on the rank value firstpriority parameteris feed then the next parameter is cutting speed the final priority parameter is depth of cut.

CONCLUSION

The surface roughness parameters arein machining of brass rod by AlN is analyzed in the investigation. The cutting parameters considered for this experiment such as cutting speed, feed rate, and depth of cut. The analysis of the results specify that the increase of cutting speed decreases the surface roughness in machining of brass rod. The gradual increase of feed rate and depth of cut increases the surface roughness in machining of brass rod by aluminium nitrate insert.The results shows that the feed rate is highly control the parameter, which influence the surface roughness of machining brass rod.

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