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# Analysis of Machining Parameters of Endilling Cutter on Surface Roughness for Aa 6061-T6

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## ABSTRACT

End milling is the most commonly used milling operation. This experiment consist of numerous end milling operation on a work piece with varying different parameters like speed, feed and depth of cut. After that Analysis of Variance (ANOVA) was done on the design expert software using response surface method of design of experiment (DOE) to find out which of the parameters amongst speed, feed and depth of cut have a greater impact on surface roughness. We observed speed have a greater impact on surface roughness.

**Key words**: end milling, ANOVA, speed, feed, depth of cut, surface roughness.

## I. INTRODUCTION

End milling cutter are used in milling machines to perform milling operations. Milling cutters remove material by their movement within machine. The dynamic behaviour of the milling operation can lead to unstable cutting conditions. The present work focuses on effect of machining parameters on surface roughness. The good the surface quality the better the machining so it is important to study the parameters which has a greater effect on surface finish. There are many parameters which affect the quality of surface obtained. End milling is one of the important material cutting process in a production industry. We can do multiple types of cutting like peripheral cutting, face milling end milling. A good surface leads to better performance of milling cutter and it is also resistive to corrosion. The machining parameters have a greater effect on the quality of the surface obtained.

## II. METHODS AND MATERIAL

The material used in the experiment is AA6061-T6.one plate of dimensions (220*120*25) mm and Aluminium 6061 is a widely used grade of Aluminium in the applications where good surface finish is must such as in the aircraft industries. It has good properties like good strength, good toughness, better surface finish, good corrosion resistance and good corrosion resistance.

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Fig: [1] work piece

The tool used in the experiment was made up of solid carbide. Cutter because this tool material combines increased stiffness with the ability to operate at higher RPM. Carbide tools are best suited for shops operating newer milling machines or machines with minimal spindle wear. Rigidity is critical when using carbide tools. these material also provides good surface finish on the work piece. These tool material can cut harder surface and have a good tool life.

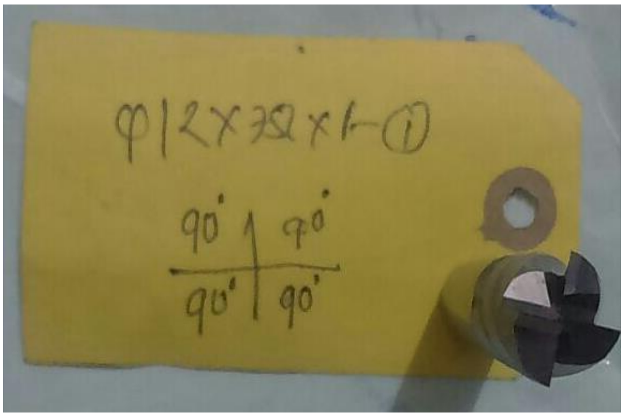

Figure: [2] endmill cutter.

The experiment was carried out with different machining conditions to analyze the effect of speed, feed and depth of cut by taking 27 different conditions including 3 speed*3feed*3 depth of cut. The experiment was performed on VMC 640i manufactured by Jyoti laboratories. Three speeds selected in RPM were250,500 and 750 and feeds in mm/min were 100,200 and 300. The depth of cuts in mm were 0.5,1 and 1.5. Response Surface Method was used for assignment of the factors and surface roughness in micron was response variable. The roughness test was performed on portable surface roughness tester, Model: SJ-201P, Make: mitutoyo, Sr.No.:310397


**Fig: [3] machined work piece**

## III. RESULTS AND DISCUSSION

We got the values of surface roughness test for different machining conditions after the surface roughness test which are as shown in table 1. The values are in the range of 0.86 micron to 2.57 micron. After this ANOVA analysis was carried out on Design Expert Software 11.

Table no. 2 shows the results of Anova. Here, The Model F-value of 20.77 implies the model is significant. There is only a 0.01% chance that an F-value this large could occur due to noise and P-values less than 0.0500 indicate model terms are significant. In this case A, B, C are significant model terms. Values greater than 0.1000 indicate the model terms are not significant. If there are many insignificant model terms (not counting those required to support hierarchy), model reduction may improve your model. The Lack of Fit F-value of 3.22 implies the Lack of Fit is significant. There is only a 4.98% chance that a Lack of Fit F-value this large could occur due to noise. Significant lack of fit is bad -- we want the model to fit.

Table 3 shows the fit statistics in that the Predicted $R^2$ of 0.6353 is in reasonable agreement with the Adjusted $R^2$ of 0.6953; i.e. the difference is less than 0.2. Adequate Precision measures the signal to noise ratio. A ratio greater than 4 is desirable. Your ratio of 14.334 indicates an adequate signal. This model can be used to navigate the design space.

Table 4 shows the model comparison statistics

Table 5 show Coefficients in Terms of Coded Factors. The coefficient estimate represents the expected change in response per unit change in factor value when all remaining factors are held constant. The intercept in an orthogonal design is the overall average response of all the runs. The coefficients are adjustments around that average based on the factor settings. When the factors are orthogonal the VIFs are 1; VIFs greater than 1 indicate multi-colinearity, the higher the VIF the more severe the correlation of factors. As a rough rule, VIFs less than 10 are tolerable.

TABLE 1

| EXPERIMENT NO | SPEED | FEED | DEPTH OF CUT | Ra |
|---|---|---|---|---|
| A111 | 250 | 100 | 0.5 | 1.11 |
| A112 | 250 | 100 | 1 | 1.87 |
| A113 | 250 | 100 | 1.5 | 2.08 |
| A121 | 250 | 200 | 0.5 | 1.39 |
| A122 | 250 | 200 | 1 | 1.99 |
| A123 | 250 | 200 | 1.5 | 1.87 |
| A131 | 250 | 300 | 0.5 | 1.47 |
| A132 | 250 | 300 | 1 | 2.41 |
| A133 | 250 | 300 | 1.5 | 2.57 |
| A211 | 500 | 100 | 0.5 | 0.94 |
| A212 | 500 | 100 | 1 | 1.10 |
| A213 | 500 | 100 | 1.5 | 1.34 |
| A221 | 500 | 200 | 0.5 | 1.68 |
| A222 | 500 | 200 | 1 | 1.56 |
| A223 | 500 | 200 | 1.5 | 1.93 |
| A231 | 500 | 300 | 0.5 | 1.74 |
| A232 | 500 | 300 | 1 | 2.34 |
| A233 | 500 | 300 | 1.5 | 2.04 |

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| | | | | |
|---|---|---|---|---|
| A311 | 750 | 100 | 0.5 | 0.86 |
| A312 | 750 | 100 | 1 | 1.11 |
| A313 | 750 | 100 | 1.5 | 1.O2 |
| A321 | 750 | 200 | 0.5 | 1.39 |
| A322 | 750 | 200 | 1 | 1.74 |
| A323 | 750 | 200 | 1.5 | 1.88 |
| A331 | 750 | 300 | 0.5 | 0.96 |
| A332 | 750 | 300 | 1 | 1.12 |
| A333 | 750 | 300 | 1.5 | 1.25 |

TABLE 2

| **Source** | **Sum of Squares** | **Df** | **Mean Square** | **F-value** | **p-value** | |
|---|---|---|---|---|---|---|
| **Model** | 5.51 | 3 | 1.84 | 20.77 | < 0.0001 | significant |
| A-speed | 2.92 | 1 | 2.92 | 32.99 | < 0.0001 | |
| B-feed | 0.7488 | 1 | 0.7488 | 8.47 | 0.0079 | |
| C-doc | 1.12 | 1 | 1.12 | 12.70 | 0.0017 | |
| **Residual** | 2.03 | 23 | 0.0885 | | | |
| Lack of Fit | 1.75 | 15 | 0.1164 | 3.22 | 0.0498 | significant |
| Pure Error | 0.2888 | 8 | 0.0361 | | | |
| **Cor Total** | 7.55 | 26 | | | | |

TABLE 3

| | | | | |
|---|---|---|---|---|
| **Std. Dev.** | 0.2974 | | **$R^2$** | 0.7304 |
| **Mean** | 1.58 | | **Adjusted $R^2$** | 0.6953 |
| C.V. % | 18.88 | | **Predicted $R^2$** | 0.6353 |
| | | | **Adeq Precision** | 14.3341 |

TABLE 4

| | |
|---|---|
| **PRESS** | 2.75 |
| **-2 Log Likelihood** | 6.81 |
| **BIC** | 19.99 |
| **AICc** | 16.63 |

TABLE 5

| **Factor** | **Coefficient Estimate** | **df** | **Standard Error** | **95% CI Low** | **95% CI High** | **VIF** |
|---|---|---|---|---|---|---|
| Intercept | 1.63 | 1 | 0.0589 | 1.51 | 1.75 | |
| A-speed | -0.3772 | 1 | 0.0657 | -0.5131 | -0.2414 | 1.02 |
| B-feed | 0.1923 | 1 | 0.0661 | 0.0556 | 0.3290 | 1.04 |
| | | | | | | |

Figure 4 shows the normal plot. It is expected that data from experiments form a normal distribution. It reveals that the residuals fall on a straight line,

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they are spread in a normal distribution.

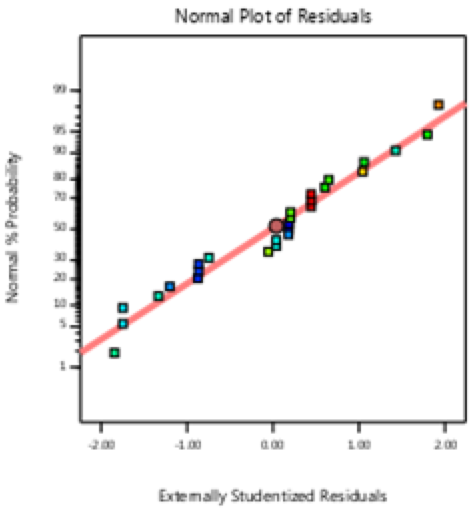


Fig: [4] Normal plot of residuals

Figure 5 shows the residual vs predicted plot there is no specific pattern . Analysis of the residual plots, it can be established that there is no uncertain changes between the residuals and predicted values we can see that the residuals have a constant variance and hence the developed model is highly significant and can be used for the prediction.

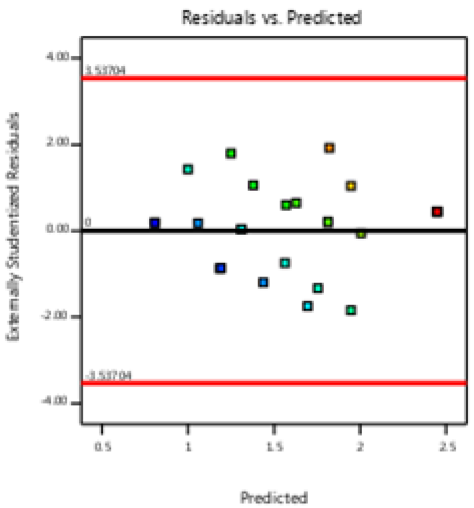


Fig: [5] Residual vs Predicted

Figure 4 is the plot of the residuals versus run, we can see that there is not any pattern above or below 0.

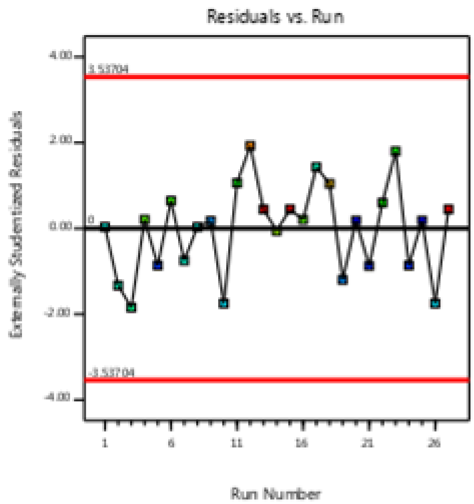


**Fig : [6] Residual vs Run**

Figure 7 shows the predicted versus the actual graph.

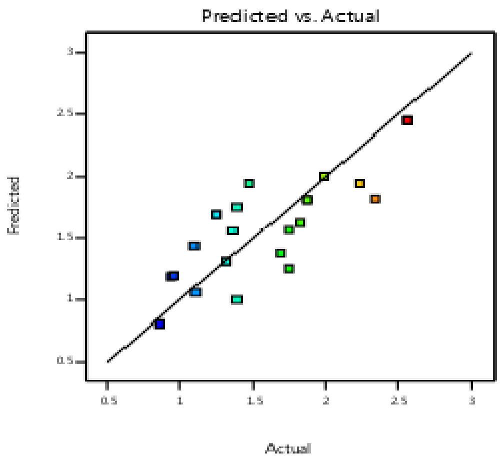


**Fig :[7] Predicted vs Actual**

## IV. CONCLUSION

The least value of surface rouhness obtained was 0.86 micron which was at speed of 750 rpm, at the feed of 100 mm/min and depth of cut of 0.5 mm. It was noticed from ANOVA that speed and feed are significant when target is to get good surface finish. Speed has the maximum effect on the surface roughness amongst the three parameters.

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## V. REFRENCES

1. G Boothroyd and W. Knight: Fundamentals of Machining and Machine Tools. Second Edition, Marcel Dekker Inc., New York. 1989.
2. P Balakrishnan and M. F. De Vries: Analysis of Mathematical Model building Techniques Adaptable to Machinability Data Base System, Proceeding
3. E M. Trent: Metal Cutting, Butterworth-Heinemann Ltd., Oxford. England, 1991.
4. V P. Astakhov and M. O Osman: Journal of Materials Processing Technology, vol. 62, No 3, 1996, 175-179.
5. Giunta et al., 1996; van Campen et al., 1990, Toropov et al., 1996.
6. N Tabenkin: Carbide and Tool, vol. 21, 1985. 12-15 .g of NAMRC-XI, 1983.
7. Parth shah: Investigation on Surface Roughness of AA 6061-T6 for End Milling,IJSTE, Volume 2 | Issue 10 | April 2016 ISSN (online): 2349-78 pg 687-690
8. Parth Shah;Investigation on surface roughness for End Milling on Aluminium Alloy 6061-T6 for different parameters, Volume 4, Issue 01, 2016 ISSN(online):2321-0613 pg 889-893