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Machinability Study of Aa 6082 Alloy By Turning Operation

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Abstract: In this study, the Machinability of AA 6082 alloy was investigated in turning operation using CNC Lathe. Machining and surface finish plays an important role in the component manufacturing. The experiments were carried out using Taguchi L27 orthogonal array. The input parameters are taken as Spindle speed, depth of cut and feed rate and the output response as Surface roughness.
Keywords: AA6082, Taguchi method, Surface Roughness, CNC Lathe

1. INTRODUCTION

Development of new materials and manufacturing technologies has an effect on manufactures to adopt new condition in production and production strategies. Manufactures are faced with advantages and disadvantages of these new processes, but there is no simplicity in adoption of technological parameters and its machinability rating. It is necessary to select the optimum parameters for each specific machinability criteria and machining application. Machinability is a critical property controlling the product economy in the manufacture of engineering components. Machinability of a material is generally defined in terms of three factors: forces and power consumption, tool wear and surface finish and integrity. Thus, a material with good machinability is the one requiring low power consumption, with low tool wear and producing a good surface finish with no surface damage. In actual production, tool life and surface integrity are generally considered to be the most important considerations in machinability. Modern science and technology constantly require new materials with special properties to achieve breath taking innovations. Since machining is basically a finishing process with specified dimensions, tolerances and surface finish, the type of surface that a machining operation generates and its characteristics are of great importance in manufacturing. In turning operations, it is possible to obtain the desired surface quality by selecting the appropriate cutting parameters. Kaladhar et al. studied the optimization of process parameter in turning operation of AISI202 austenitic stainless steel. The experiment was carried out using full factorial design of experiments. The analysis of variance was used to analysis the interaction between the process parameters. Rashad and El-Hossainy studied the machinability of 7116 aluminum alloy in hot conditions. The specimen was undergone different heat treatment condition and then turning at different parameters like speed, feed and depth of cut using a HSS tool. From the observed result, the artificially aged specimen has better machinability than other specimens do. Al–Mg–Si alloys are widely used in automotive and aerospace industries as a result of their good physical and chemical properties such as corrosion, formability, Weldability and because they are age hardening to develop adequate strength [Williams and Starke (2003), Hosseinifar and Malakhov (2008)].

2. EXPERIMENTAL PROCEDURES

The chemical composition of AA 6082 alloy is listed in the Table 1. The Machining trials were performed using CNC lathe by CVD tool with a nose radius of 0.4mm (coated insert). The experiments were carried out using three factor three level (L27) orthogonal array[Sandhya Rani Rana et al. (2018)]. The process parameters are cutting speed, feed rate and depth of cut are listed in table 2. The Surface roughness tester is used to measure the roughness "Ra" of the material. It is a portable and self-contained instrument for measuring the surface texture which is suitable for both the workshop and laboratory. It helps to measures the surface irregularities due to roughness and is made unresponsive to the more widely spaced irregularities caused by waviness or curvature.

Table 1: Chemical Composition of AA 6082

Alloying Element	Mg	Si	Mn	Cu	Cr	Zn	Ti	Fe	Al
Wt. (%)	0.63	1.02	0.54	0.030	0.013	0.008	0.015	0.18	97.56

Table 2: Full Factorial Design of Experiments

Process parameters	**Process parameters**	**Level 1**	**Level 2**	**Level** 3
A	Spindle speed (m/min)	1200	1800	2400
B	Depth of cut (mm)	0.25	0.30	0.35
C	Feed (mm/rev.)	0.08	0.1	0.12

3. RESULTS AND DISCUSSIONS

3.1Chip Morphology

In the machinability study, all the 27 experiments were carried out from the CNC lathe, the chips are continuous forms. The continuous chips which describes, the work-piece material is more ductile as compared with other hardened material. The chips are long and continuous spiral in nature. The Spindle speed, feed rate and depth of cut does not influence the work-piece. Fig. 1 shows the chip morphology of the work-piece. Collected chips were taken for further surface morphological study using Scanning Electron Microscope (SEM). The SEM image is shown in Fig. 2. SEM result shows that the material is in ductile in nature.

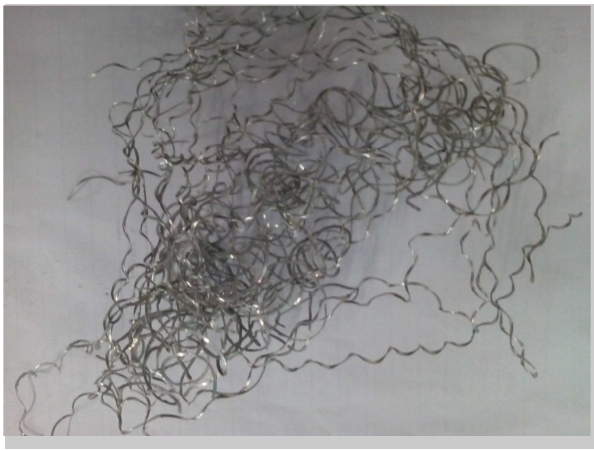

Fig.1: Chip Morphology

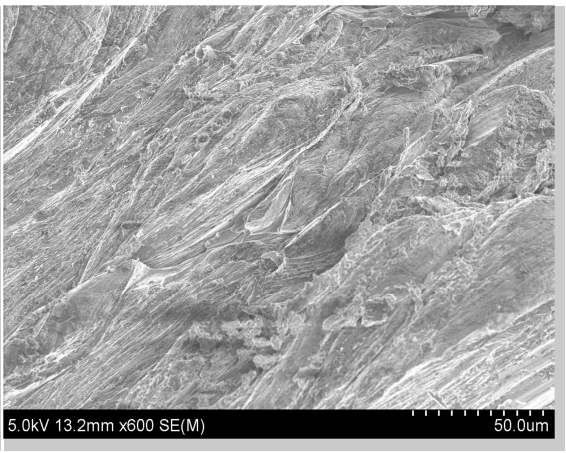

Fig.2: Surface Morphology

3.2 Effect of Material Removal rate (MRR)

From the observed result, it shows that the metal removal rate has been increased as spindle speed, feed and depth of cut increases. This is due to the high stability of tool at high speed and easy removal of metal. If the input values are higher, the MRR is also high. The calculated material removal rate was considered as the response and shows the main effect plot using Taguchi method for all L27 experiments. From the observed main effect plot shows in all the conditions is considered as smaller is better.

3.3 Main Effect Plot for Surface Roughness (Ra)

The main effect plot for feed rate, depth of cut and spindle speed shows that the intermediate levels obtained better surface finish as compared with the other conditions. Fig.3 shows the main effect plot for surface roughness.

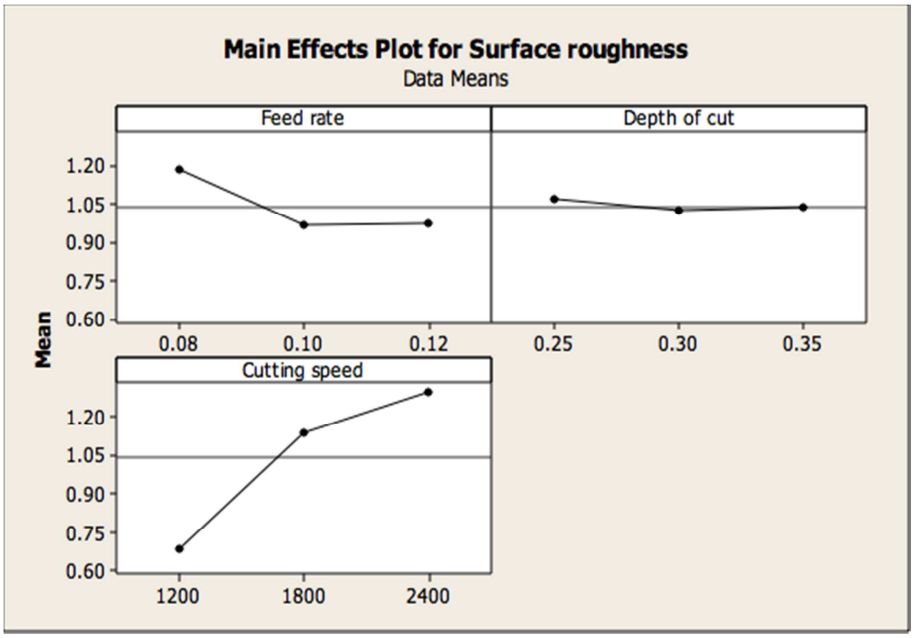

Fig. 3: Main effect plot for Surface Roughness

3.4 Surface Roughness

The measured surface roughness and the input parameters were plotted in the Design of experiments Taguchi method using Minitab 16 software. The work piece material is medium strength and hardness as compared with other materials like steel, titanium and other alloys. Therefore, the work piece required very small amount of force and the generating heat from the work piece is also less. We observed that, the surface finish is depending upon spindle speed, feed and depth of cut. The surface roughness (Ra) results of all the 27 experiments does not show any significant variation. From the Taguchi method, the main effect plot shows mainly influencing the spindle speed and feed rate. The observed surface roughness values were listed in table 3.

Table 3: Full factorial DOE

Sl. No	Feed rate (mm/rev)	DOC (mm)	Spindle Speed (m/min)	Surface Roughness (Ra)
1	0.08	0.25	1200	0.631
2	0.08	0.25	1800	1.131
3	0.08	0.25	2400	1.054
4	0.08	0.30	1200	0.773
5	0.08	0.30	1800	1.371
6	0.08	0.30	2400	1.360
7	0.08	0.35	1200	0.739
8	0.08	0.35	1800	1.192
9	0.08	0.35	2400	1.411

10	0.10	0.25	1200	0.542
11	0.10	0.25	1800	1.375
12	0.10	0.25	2400	1.203
13	0.10	0.30	1200	0.617
14	0.10	0.30	1800	0.848
15	0.10	0.30	2400	1.227
16	0.10	0.35	1200	0.745
17	0.10	0.35	1800	1.104
18	0.10	0.35	2400	1.046
19	0.12	0.25	1200	0.628
20	0.12	0.25	1800	1.014
21	0.12	0.25	2400	1.010
22	0.12	0.30	1200	0.729
23	0.12	0.30	1800	1.102
24	0.12	0.30	2400	1.178
25	0.12	0.35	1200	0.764
26	0.12	0.35	1800	1.120
27	0.12	0.35	2400	1.180

3.5 Interaction plot for Surface Roughness

The interaction plot shows the variation of individual response with the three input parameters, i.e. cutting speed, feed and depth of cut independently. In the plots, the x axis indicates the value of each parameter at three levels and y-axis is the response value (Surface roughness). Interaction plot for feed rate and depth of cut is shown in Fig.4. The interaction plot shows that minimum depth of cut and feed rate achieved better surface finish. Similarly depth of cut has increased, the surface roughness value has increased in the low and medium DOC. Therefore, it is having a good surface finish. The feed and depth of cut, interaction plot show that the higher feed rate is achieved better surface roughness.

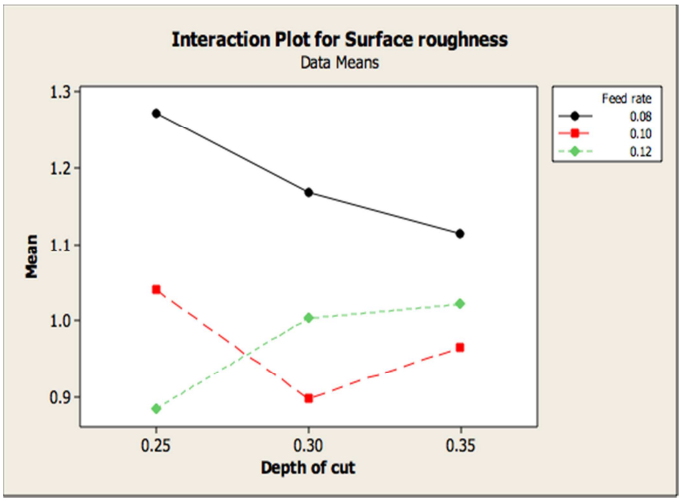

Fig. 4.4: Interaction Plot for Surface Roughness (Feed rate vs Depth of cut)

Fig.5 shows the interaction plot for spindle speed vs feed rate. The lower feed and higher spindle speed achieved good surface roughness than other conditions. The interaction between spindle speed and feed rate shows maximum spindle speed obtained good surface finish. The maximum spindle speed is like a straight horizontal line. It is considered as the mean value of the response. Fig.6 shows the interaction plot for surface roughness of Spindle speed and Depth of cut. The interaction between spindle speed and depth of cut shows medium spindle speed and lower feed obtained better surface roughness.

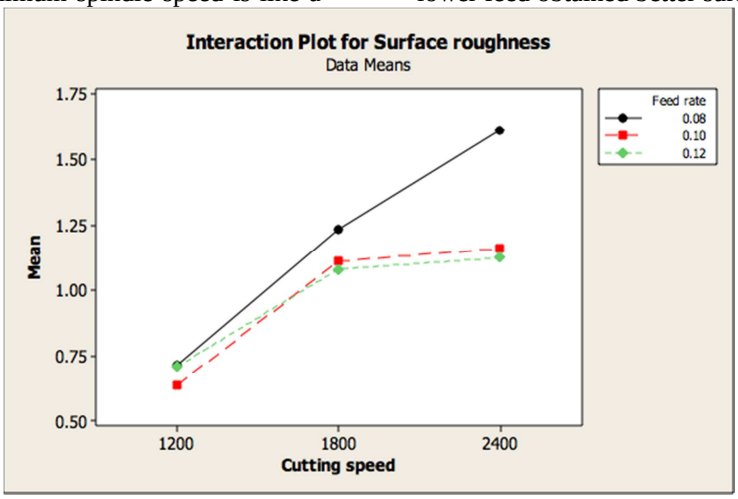

Fig. 4.5: Interaction Plot for Surface Roughness (Feed rate vs Spindle speed)

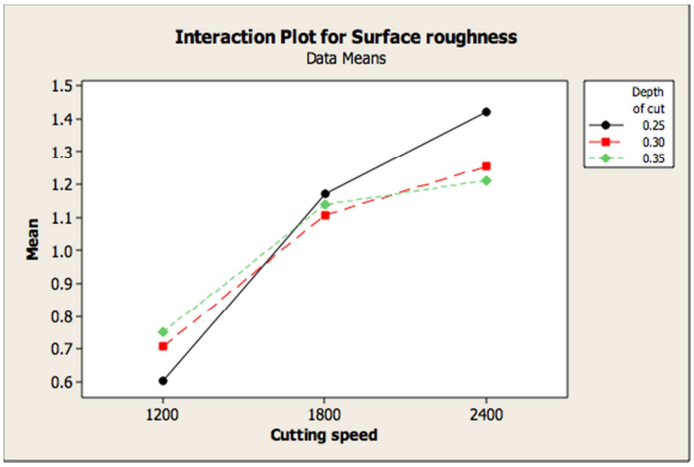

Fig. 4.6: Interaction Plot for Surface Roughness (Depth of cut vs Spindle speed)

4. CONCLUSIONS

The response (Surface roughness) of the as-received 6082 aluminum alloy does not show any significant variation with different Spindle speed, depth of cut and feed rate. The surface finish is not affected in the considerable amount, however there is enhancement of hardness and strength properties as compared with the commercially pure aluminum. Increases of feed rate and cutting depth affect the surface quality negatively. Increase of cutting speed affects the surface quality positively, but this effect appears to be small.

REFERENCES

[1] Williams, J. C and E. A. Starke (2003) Progress in structural materials for aerospace systems. Acta Materialia, 51, 5775-99.

[2] M. Hosseinifar and D. V. Malakhov, (2008) "Effect of Ce and La on microstructure and properties of a 6xxx series type aluminum alloy," Journal of Materials Science, 43(22), pp. 7157–7164.

[3] Kaladhar, M., Venkata Subbaiah, K., Srinivasa Rao, Ch. and Narayana Rao, K. (2010) "Optimization of Process Parameters in Turning of AISI202 Austenitic Stainless steel", ARPN Journal of Engineering and Applied Sciences, 5, pp. 79-87.

[4] Rashad, R.M. and El-Hossainy, T.M. (2006) "Machinability of 7116 Structural Aluminum Alloy", Materials and Manufacturing Processes, 21, pp. 23-27.

[5] Sandhya Rani Rana, A.B. Pattnaik and S.C. Patnaik, (2018) "Comparison of wear behaviour and mechanical properties of as-cast Al6082 and Al6082-T6 using statistical analysis", 338, pp. 1-6.