

Optimum machining parameters in cnc milling operation on AA6041 using Taguchi method

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ABSTRACT – The manufacturing industry in carrying out the production process has the target of achieving high productivity and quality products. In the machining process application, correct and best process selection must be made of the right machine with optimum selection of parameters. This paper presents results of screening studies performed on a milling process involving milling parameters such as the speed of cut, feeding speed, depth of cut, cutting width and flute. The screening results aim at deciding the optimal milling parameters for the process.

1. INTRODUCTION

There are various machining processes in the manufacturing industry with the aim to generate a good finishing process for the production of high-quality products. Surface finish measurement is most commonly used as an indicator for determining the physical quality of the product produced.

The degree of quality of the product will dictate whether the product is accepted or rejected [1]. Surface finishes of machined components have a primary impact on their performance and functionally [2]. The cutting tool for removal of the chip over these materials affects the overall efficiency of the machining process [3]. The aluminum alloy cutting process is a manufacturing process that is predominantly used in the automotive industry as well as for manufacturing mold and dies components in the die casting process [4]. The Taguchi method [5] is widely used as the main apparatus to optimize the process parameters in which concentration at cutting speed, feeding speed, depth and width of cut, also amount of tooth.

2. SYSTEM FRAMEWORK

This section introduces the test setup and methodology that consist of the Taguchi and experiment method.

The screening operation utilizing the HAAS CNC 3-axis milling machine The x, y and z axes. Through the Taguchi method using Minitab 19.0, the optimum parameters can be determined by looking at the analysis table of variants. The experiments utilize shorter time response in the surface process of swirling tool on aluminum alloy. Therefore, S/N ratio “Smaller is the better” (minimize) [6], [7], [8] was selected.

$$\eta = \frac{S}{N} = -10 \log \left(\frac{1}{n} \sum_{i=1}^n Y_i^2 \right) \quad (1)$$

Where Y_i is the experiment results of the data observed and n is the observation number of the experiment ([5], [7], [9]).

3. RESULTS AND DISCUSSION

The cutting tools of the types HPMT 303 1000 070 and HPMT S42 1000 072, cutting speed (V_c), feeding speed (V_f), cutting depth (D_{oc}), cutting width (W_{oc}) and flute (Z) were chosen as machining parameters and their levels were defined. The roughness tester of WAS Foundry Master with ASTM E 1251 standard measured the roughness value from the experimental results. Table 1 lists the surface roughness values obtained for each run. The sixth experiment produced the best surface roughness value.

Table 1 Surface roughness value (R_a)

Run	V_c	V_f	D_{oc}	W_{oc}	Z	R_a
1	100	150	0.1	4	3	0.117143
2	100	150	0.1	6	4	0.116667
3	100	1681	0.5	4	3	0.753043
4	100	1681	0.5	6	4	0.922286
5	220	150	0.5	4	4	0.126286
6	220	150	0.5	6	3	0.108857
7	220	1681	0.1	4	4	0.272571
8	220	1681	0.1	6	3	0.292857

This value was obtained for the cutting speed of 220 m/min, feeding speed at 150 mm/min, cutting width at 0.5 mm, cutting width at 6 mm and flute at 3. Meanwhile, the fourth experiment produced the highest roughness value obtained at speed of cut of 100 m/min, feeding speed at 1681 mm/min, cutting width at 0.5 mm, cutting width at 6 mm and flute at 4.

Table 2 Analysis of Varian

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	5	0.707505	0.141501	37.45	0.026
V_c	1	0.153615	0.153615	40.66	0.024
V_f	1	0.392412	0.392412	103.86	0.009

Doc	1	0.154355	0.154355	40.85	0.024
Woc	1	0.003682	0.003682	0.97	0.428
Z	1	0.003441	0.003441	0.91	0.441
Error	2	0.007557	0.003778		

The bar chart of fig. 1 shows the Pareto chart. It reveals that in this screening test, the denoted feeding speed was the best parameter element followed by cutting speed, cutting depth, cutting width and the amount of flute respectively. Response for Ra with variance was constant describes at fig. 2.

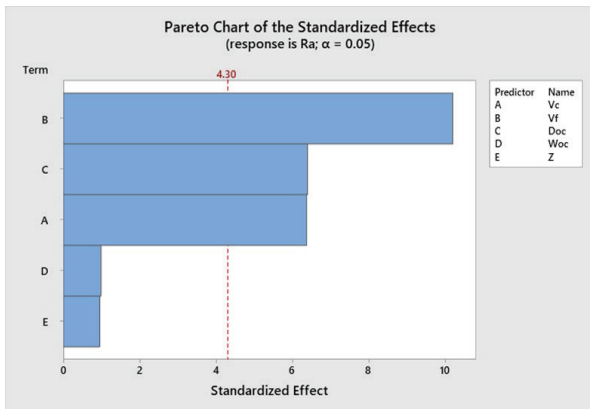


Figure 1 Pareto chart for sequence of best machining parameters

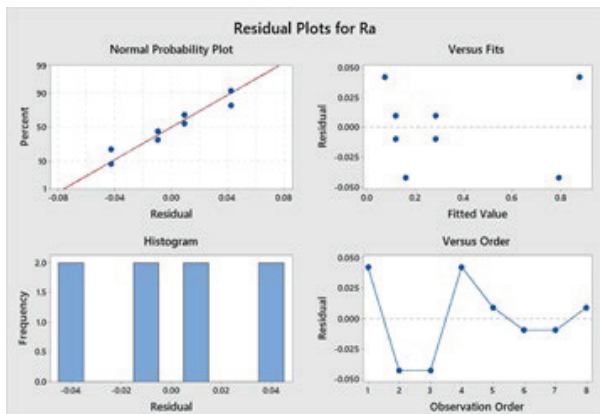


Figure 2 Different residual plots for Ra

4. CONCLUSIONS

The screening test is the right way to define the optimum machining parameters. HAAS CNC Milling by involving level parameters such as the speed of cut, feeding speed, depth of cut, the width of cut and flute and measurement of surface roughness can produce the roughness value as listed in table 1 with the best roughness value was obtained by the sixth experiment through the speed of cut at 220 m/min, feeding speed of 150 mm/min, depth of cut at 0.5 mm, the width of cut at 6 mm and flute of 3. The best value of roughness is 0.1088 μm which was analyzed through ANOVA using Taguchi with the help of Minitab 19.0 gets a detailed explanation on the F-Value and P-Value as set out in tables 2. The best of three achievement sequences of machining parameters are feeding speed, cutting speed and cutting depth respectively. The author defines

conducting the experiment research using optimal machining parameters with levels such as speed of cut at 100 - 220 m / min, feeding speed at 150 - 1681 mm / min and depth of cut at 0.1 - 0.5 mm.. The tool will use HPMT S42 1000 072 of AL SE STD \varnothing 10 with the dry condition.

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