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Optimization Analysis of Turning Process Parameters for Shaft Characteristics

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Abstract: ***In the research that I did with the research team, using conventional machines that are widely used in a university. The machine we use is a conventional lathe with type Kinwa CH-530 × 1100. This study, we use several variables as a test of the material we use. The process of making a round shaft is very helpful in the machining process, because the spindle is very well rounded and the friction is small. Roundness values are obtained by using values from other geometric errors, namely alignment, perpendicularity, and geometric tolerance. From the results tested using this conventional lathe, it is still able to make precise components in terms of geometry. The geometric error value is still below the tolerance value of 50 µm***

Keywords: Cutting Angle, Deflection, S45c, Cylindrical Workpieces

1. Introduction

CNC machining is a machining process the production process of making a manufacturing product in the world almost entirely requires a machining process. The machining process is a manufacturing process where the main process is to remove or remove some material from a basic material that can be a solid block or cylinder so that it meets the desired shape and quality. In addition, this machining process is one of the complex manufacturing processes because it has to consider many factors so that the products produced are in accordance with the specified quality specifications.

Lathe is one of the machines that is very reliable by the manufacturing industry in making a product. This machine can fulfill production needs as a product with a complex form. Such as producing important tools, namely Shafts, Gears, Bolts, etc. that have high quality guidance both geometrically and the level of cylindrical on the surface. The manufacturing system for manufacturing quality products certainly needs to be supported by good machinery. Each machining process has an effect on cylindrical on the surface of the workpiece as a result of feeding. Cylindrical basically is a surface configuration irregularity that can be a deviation and incision resulting from cutting the tool on the surface of the workpiece. irregularities and results of incisions resulting from cutting the chisel on the surface of the workpiece which will be a place of concentration of problems or production defects that cause a decrease in the quality of a product, so that if the material results in deviation of the size it results in economic and material losses. In addition to the cutting angle of the tool and the prime condition of the engine, it also influences the yield of the measurement results in the size of the cylinder.

To get more perfect results as well as influencing or other variables such as tool cutting angle, spindle speed, and cutting depth. These variables greatly affect quality or minimize deviation of deflection and cylindrical. To carry out this research process, components such as conventional lathes, chisels, S45C steel material, indicator dial etc. are needed. The purpose of this research is to find out the spindle rotation and depth of cut and tool angle to the cylindrical deflection.

2. Method

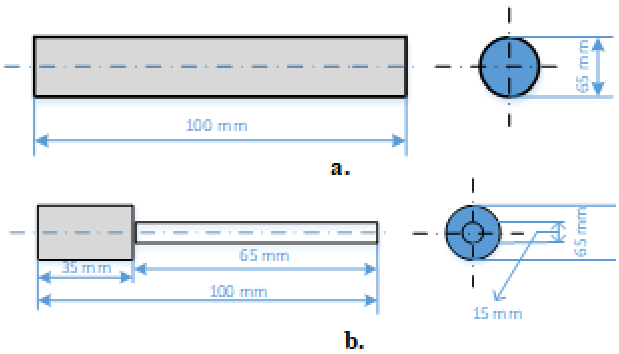
Research carried out using direct research methods (experimental research) involving several variables, namely: Independent variables are variables whose magnitude can be determined based on certain considerations and the objectives of the research itself. In this study the independent variables are:

a) Spindle rotation (n) : 100 rpm, 300 rpm, 600 rpm
b) Cut Angle : 12^O, 13^O, 14^O
c) Depth of cut : 1 mm, 2 mm and 3 mm

Dependent variables are variables whose magnitude cannot be determined, but the value is the result of the effect of the treatment given. So the value of the dependent variable is taken and known after the study takes place. In this study, the dependent variable is deflection and cylindricality on the work piece after the turning process is carried out with variations in cutting angles, feeding depth, and different spindle speeds, deflection and cylindrical measurement are measured by testing using a measuring instrument.

Material used

a) Type: S45C Steel
b) Diameter: 65 mm
c) Length: 100 mm



(a) before turning, (b) after turning

3. Result

Average Test Results

Rpm	Cut Angle	Depth Of Cut	1	2	3	Rata2
100rpm	12	1mm	0,03	0,1	0,16	0,097
100rpm	12	1mm	0,03	0,12	0,13	0,093
100rpm	12	1mm	0,02	0,08	0,15	0,083
100rpm	13	2mm	0,06	0,1	0,1	0,087
100rpm	13	2mm	0,03	0,08	0,11	0,073
100rpm	13	2mm	0	0,1	0,1	0,067
100rpm	14	3mm	0,03	0,01	0,11	0,050
100rpm	14	3mm	0,02	0,05	0,04	0,037
100rpm	14	3mm	0,03	0,04	0,04	0,037
300rpm	12	2mm	0,02	0,06	0,07	0,050
300rpm	12	2mm	0,01	0,07	0,05	0,043
300rpm	12	2mm	0	0,05	0,04	0,030
300rpm	13	3mm	0,02	0,07	0,06	0,050
300rpm	13	3mm	0,01	0,05	0,02	0,027
300rpm	13	3mm	0,01	0,03	0,02	0,020
300rpm	14	1mm	0,02	0,05	0,05	0,040
300rpm	14	1mm	0	0,01	0,04	0,017
300rpm	14	1mm	0,08	0,15	0,23	0,153
600rpm	12	3mm	0,08	0,15	0,23	0,153
600rpm	12	3mm	0,08	0,13	0,12	0,110
600rpm	12	3mm	0,08	0,11	0,28	0,157
600rpm	13	1mm	0,1	0,15	0,28	0,177
600rpm	13	1mm	0,07	0,12	0,2	0,130
600rpm	13	1mm	0,03	0,13	0,18	0,113
600rpm	14	2mm	0,08	0,16	0,2	0,147
600rpm	14	2mm	0,04	0,11	0,18	0,110
600rpm	14	2mm	0,06	0,11	0,16	0,110

Taguchi Method Testing Results

Session

Worksheet 1 ***

↓	C1-T	C2	C3-T	C4	C5	C6	C7	C8
	RPM	cut angle	depth of cut	1	2	3	RATA2	
1	100rpm	12	1mm	0,03	0,10	0,16	0,097	
2	100rpm	12	1mm	0,03	0,12	0,13	0,093	
3	100rpm	12	1mm	0,02	0,08	0,15	0,083	
4	100rpm	13	2mm	0,06	0,10	0,10	0,087	
5	100rpm	13	2mm	0,03	0,08	0,11	0,073	
6	100rpm	13	2mm	0,00	0,10	0,10	0,067	
7	100rpm	14	3mm	0,03	0,01	0,11	0,050	
8	100rpm	14	3mm	0,02	0,05	0,04	0,037	
9	100rpm	14	3mm	0,03	0,04	0,04	0,037	
10	300rpm	12	2mm	0,02	0,06	0,07	0,050	
11	300rpm	12	2mm	0,01	0,07	0,05	0,043	
12	300rpm	12	2mm	0,00	0,05	0,04	0,030	
13	300rpm	13	3mm	0,02	0,07	0,06	0,050	
14	300rpm	13	3mm	0,01	0,05	0,02	0,027	
15	300rpm	13	3mm	0,01	0,03	0,02	0,020	
16	300rpm	14	1mm	0,02	0,05	0,05	0,040	
17	300rpm	14	1mm	0,00	0,01	0,04	0,017	
18	300rpm	14	1mm	0,08	0,15	0,23	0,153	
19	600rpm	12	3mm	0,08	0,15	0,23	0,153	
20	600rpm	12	3mm	0,08	0,13	0,12	0,110	
21	600rpm	12	3mm	0,08	0,11	0,28	0,157	
22	600rpm	13	1mm	0,10	0,15	0,28	0,177	
23	600rpm	13	1mm	0,07	0,12	0,20	0,130	
24	600rpm	13	1mm	0,03	0,13	0,18	0,113	
25	600rpm	14	2mm	0,08	0,16	0,20	0,147	
26	600rpm	14	2mm	0,04	0,11	0,18	0,110	
27	600rpm	14	2mm	0,06	0,11	0,16	0,110	

Proj...

Current Worksheet: Worksheet 1

Taguchi Design

Taguchi Orthogonal Array Design
L27(3**3)

Factors: 3
Runs: 27

Columns of L27(3**13) Array
1 2 3

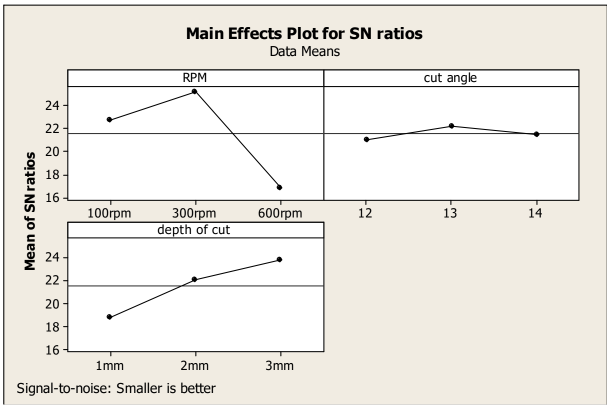
Taguchi Analysis: RATA versus RPM; CUT ANGLE; DEPTH OF CUT

Response Table for Signal to Noise Ratios
Smaller is better

Level	RPM	CUT ANGLE	DEPTH OF CUT
1	23,60	21,77	19,48
2	25,82	22,83	22,70
3	17,36	22,17	24,60
Delta	8,47	1,06	5,12
Rank	1	3	2

Response Table for Means

Level	RPM	CUT ANGLE	DEPTH OF CUT
1	0,06926	0,09074	0,10037
2	0,04778	0,08259	0,07963
3	0,13407	0,07778	0,07111
Delta	0,08630	0,01296	0,02926
Rank	1	3	2



4. Conclusion

Based on the table response for means shows that the three factors namely Depth of Cut, Tool Angle, and Constant Speed can be sorted by ranking value. Deflection and cylindrical test results, where load variations are given in rank 1, Speed 600 rpm, with 1 mm Depth of Cut and Chisel Angle 12^{o}. Based on the Taguchi Experiment design the results of the main effect plot for means graph with the smallest is the better approach, the optimal conditions in the composition are selected S45C mild steel material, namely spindle speed 300 rpm, 14^{o} tool angle, and 3 mm feed depth will give the best results in deflection results on shaft roundness.

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