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Analysis Comparative Feeding Variation to Quality Surface Processes Blocking Equipment of Ems Steel 45on Cnc Latheing Machine

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Abstract: This research aims to analysis comparative feeding variation to quality surface processes blocking equipment of ems steel 45on cnc latheing machine. Quality products are obtained from good cutting conditions. One of the most important variable cutting conditions to obtain surface roughness quality is feeding. The purpose of this study was to see the comparison of feeding variations of G94 and G95. The multilevel cutting process is carried out with a cutting depth of 0.5 mm and a length of 40 mm with a carbide cutter with feeding variations (G94 / G95) of 0.3048 mm / min and 0.3281 mm / min respectively and at the price of the round / cutting speed speed (G97 / G96) is controlled. Surface roughness testing using Surface Tester Mitutoyo SJ-201P. The result of this research can be concluded that the higher the surface roughness obtained is lower compared to the average price of roughness of the lathe result that uses low feed.

Keywords: feeding variation, steel EMS45, surface roughness

1. Introduction

In the industrial world, machine tools are very instrumental in supporting the success of a production process because each construction machinery workshop and metal workshops, in general these machines are widely used in the manufacture or repair of certain components in a machine. Of the several machine tools available, one of them is a lathe. Lathe Machine is a machine tool used to cut rotated objects. Lathe itself is a process of feeding work pieces whose incisions are carried out by rotating the work piece then worn on the tool that is moved in translation parallel to the rotating axis of the work piece. The swivel movement of the work piece is called relative cutting motion and the translational motion of the tool is called the bait motion.

One of the ideal geometric characteristics of a component is a smooth surface [5]. In practice it is indeed impossible to get a component with a really smooth surface. This is caused by several factors, such as human factors (operators) and the factors of the machines used to make them. However, with advances in technology, it continues to strive to make equipment capable of forming component surfaces with a fairly high degree of fineness according to the applicable standard standards in metrology proposed by experts in geometric measurement of objects through research experience.

The level of fineness of a surface is indeed a very important role in the planning of an engine component, especially concerning the problem of lubrication friction, wear, resistance to fatigue and so on. Therefore, in planning and making it must be considered in advance about which machine tools should be used to make it and how much it should cost. In order for the manufacturing process not to occur, the meaning of the surface characteristics must be understood by the planner even more so by



the operator. Communication of surface characteristics is usually done in technical drawings. But to explain perfectly the characteristics of a surface seems difficult.

High quality turning results can be seen in terms of size, precision, and surface characteristics in the form of roughness from the surface of the object that has been turned into. Basically, each machining has different surface quality requirements (surface roughness), depending on its function. The characteristics of the surface must be able to be used as needed, so that the surface efficiency will be more in line with the surface. The surface roughness of an engine component is always related to friction, lubrication, fatigue resistance, wear, and the assembly of engine components and is always related to compatibility.

The surface roughness of the object resulting from turning into a demand must be considered by each lathe operator, because the surface roughness of the engine components has an influence in a series of machines such as wear problems, resistance to fatigue and so on. The level of surface roughness of high engine components can cause rapid wear, so that the engine components break down quickly and ultimately work efficiency decreases and is not time efficient.

The surface roughness of the product as a result of the turning process has a very important function, so each working image has the designation of conditions regarding surface roughness that must be met. To get the surface roughness that is expected so that the production process is able to produce a quality product and it is necessary to regulate the factors that affect the level of surface roughness of the product. Factors that influence the level of surface roughness of metal objects in lathe machines include: spindle speed, feeding motion, feeding depth, engine condition, work piece material, cutting tool angle, cutting tool material, cooling, cutting speed (cutting speed), and operators.

The lathe tool and machining process are one of the important factors that determine the success of the machining process. Chisel geometry, especially the angles, must be chosen correctly according to the type of workpiece material, tool material, and cutting conditions, so that the cutting temperature will be reduced, and results will be obtained that have high accuracy and smoothness. A machining process that uses a tool as a cutting tool must pay attention to the tool geometry because the tool geometry is one of the most important factors that determine the success of the machining process [6], besides the cutting speed determined by the workpiece factor the workpiece material and sculpture material determine the price cutting speed [10]. In depth of cut is the distance from the cutting base to the surface that is not cut from the workpiece measured perpendicularly "[12]. For a single cut-edged lathe tool, the most basic tool angle is the angular angle (rake angle), free angle (clearance angle), and cutting edge angle. The cutting angle is the cutting edge of the tool that touches the surface of the object and cuts the surface of the workpiece. As a result of imperfections in measuring instruments, the method of measurement and the way of evaluating the results of measuring the actual surface of a workpiece (real, surface) cannot be graphed or duplicated, but only approaches the actual form [6].

The mechanics of metal cutting processes require parameters involving cutting conditions and geometry and the ability of cutting tools. The greater the cutting speed the greater the engine power consumption. The cross section in the process of cutting is largely dependent on feeding (mm / put) or in the thickness of the cut (mm). In the machining process, to achieve optimal and stable cutting conditions it is important to note that there is a combination of cutting rate, feed motion and cutting depth which is closely related to tool life and surface quality of machined materials [6]. The tool that moves relative to the workpiece will produce fury and while the surface of the workpiece will gradually form into the desired component. Chisel can be classified into two types, namely single-edged and multi-edged chisel. The relative motion of the tool to the workpiece can be separated into two components of movement, namely cutting motion and feeding motion. According to the type of combination of cutting motion and feeding motion, the machining process is grouped into seven different types of processes, namely: lathe process, drilling process, frais process, flat grinding process, cylindrical grinding process, scrap process, sawing process or grate.

The development of today's computers has been applied to machine tool tools such as Lathe Machines, Frais Machines, Scrap Machines and Drill Machines. The result of this combination of mechanical technology is called CNC (Computer Numerically Controlled) [9].

The development of lathes as a metal-forming production device is very rapidly demonstrated by the discovery of non-conventional lathes, namely in the form of Computer Numerically Controlled (CNC). The CNC operating system uses a program that is directly controlled by a computer The

process of cutting using machine tools is also called the machining process, the level of roughness is also part of the value of the quality level of the components produced. Smooth surface quality will contribute to the load evenly across the surface of the component. On the rough surface, the stress concentration will focus on that part, so that if you experience continuous loading, the rough part will be the starting point of fatigue / failure of the component (material) [1].

EMS 45 steel is medium carbon steel which is cheap and easy to obtain and easy to form with good quality causing its use to increase as tools or tools in human life such as tooling tools, bolts, crankshafts, gears, vise, spring, agricultural equipment and household appliances. EMS 45 steel is steel containing 0.48% carbon to be able to produce a quality product with CNC machines, but on the other hand still prioritizing efficiency in carrying out the production process, in such conditions the selection of appropriate machining parameters is needed in machining with metal lathe, among others, spindle speed (spindle speed), feed depth (depth of cut), feed speed (feeding), cutting speed (cutting speed) engine condition, work piece material, sharpness and strength of the chisel eye. To obtain a surface roughness value from a smooth shaft from the turning process, it is necessary to adjust the feeding speed of the CNC lathe.

Feeding is the cutting edge of the cutting edge cutting the work piece moving longitudinally along the bed of each engine rotation. Thus the engine speed increases, the feed speed also increases. In practice feeding measurements expressed in $\mu\text{m}/\text{put}$ on CNC machines are G95 and mm/minute on CNC machines. G94 determines the speed of feeding in the turning process affects the level of surface quality of the work piece. From the background of the problem, the writer will conduct research that will observe Comparison of Variation of Feeding Analysis to Surface Quality of EMS45 Steel Flat Turning Process on CNC Lathes.

1.1. CNC Lathe

CNC lathes are machine tools that operate the workpiece cutting process by tools assisted by computer numerical control or CNC (Computer Numerical Control). the program is "a number of sequences of logical command codes consisting of combinations (connections) of symbols, letters, and numbers, which are arranged in a specific language format that is understood by the MCU (technical control unit) to make a product or component" [12].

1.2. CNC ET120 Lathe

CNC ET120 lathe is a CNC PU machine (production unit) used for mass production so that the machine is equipped with more expensive accessories. Like automatic chuck systems, automatic door openers, automatic discharges and others. The machine runs automatically according to the command of the program provided, so that with the same program CNC machines can be ordered to reduce the process of implementing the program continuously [4].

1.3. Working Principle of CNC ET120 Lathe

The CNC lathe machine has the principle of motion with the coordinate system of carthesius (clockwise) with two axes, X axis, and Z axis. X axis is the size of the work piece diameter and the Z axis is the longitudinal direction of the work piece. Coordinate system on CNC lathe.

1.4. Main Parts of CNC ET120 Lathe

In CNC machines there is an electronic set of computers that functions as an input device into the machine. The main parts of the CNC ET120 machine consist of hard ware and shot ware.

1.5. Cutting Parameters

The pomotongan parameters that must be taken into account on the lathe are as follows: a) Cutting Speed (cutting speed), b) Spindle speed, c) Feeding Speed.

1.6. Tools

Harder materials are needed than the work piece, so the cutting process has certain advantages to produce good quality work pieces.

1.7. EMS Steel 45

Baja EMS45 is steel containing 0.48% carbon. For 0.3% silicon content, 70% manganese content. For the temperature of the annealing temperature around 680°C-710°C, for hardness after anelling (Hardness After Analing) process around 910°C, then for hardness temperature (Hardness Temperature) around 800°C-830°C [3]

1.8. CNC Programming

Programming is a sequence of commands that are arranged in detail each block per block to provide input for CNC machines about what to do.

1.9. Turning Process

Turning is a machining process using a single point cutting tool to move material from the surface of a rotating cylindrical work piece. In the turning process we prepare a complete drawing plan with the dimensions of the specimen / material. Henceforth it is clearer that the process will be divided into 2 parts of the processing process, namely the operation process I (OP I) for variations in fixed feeding rpm and operating process II (OP II) variations in rpm feeding [2].

1.10. Surface Hardness

The level of fineness of a surface plays a very important role in the planning of a machine component, especially concerning the problem of friction lubrication, wear, resistance to fatigue and so on. In the roughness measurement tool can be read the arithmetic average price (Ra) or the price of the average square (rms). Average height deviation is a reference line (CD). The surface with the same average roughness can essentially differ due to height, number of peaks and valleys and the width can also be different. The most commonly used method is the use of diamond needles to explore the surface being examined and record the enlarged record [7].

2. Methods

2.1. Types of research

This research is an experimental research. Experimental research methods can be interpreted as research methods used to find out the influence of treatment on others under controlled conditions [8].

This experiment was conducted to determine the difference in surface quality of the work piece with changes in feeding during the CNC ET120 lathe. In the research carried out the turning process both with variations of feeding with fixed rpm and with variations in rpm with changing feeding and then new data collection process by measuring the level of surface roughness results of flat turning on EMS45 steel. In the process of testing the surface roughness of the work piece placed on the V-Blocks as a buffer then adjust the height on both sides of the buffer block to get a straight position on the work piece. After the calibration of the mitutoyo SJ-201P surface tester, then adjust the position of the stylus/ sensor so that it can perform surface roughness testing for all segments of the work piece.

The research method used is experimental research by conducting direct observations to determine the effect of variations in the main cutting angle and feeding on surface roughness resulting from the finishing process of flat turning on the work piece. Before the turning process, the work piece must first be cut according to the planning dimension and sharpening the chisel to form a major cutting angle that will be varied. After cutting and grinding, then setting the work piece and tool on the CNC ET120 lathe.

2.2. Research Objects

Data that has been obtained from the results of roughness testing on specimens / specimens were analyzed to determine the level of quality of the roughness of the test object. The data analysis techniques that are used are as follows:

$$\sum Ra = \frac{T1 + T2 + T3 \dots + Tn}{n}$$

Description: ΣRa : Perspectivity roughness (μm)

F: Feeding

Q: Testing Point

n: Many testing points
 Ra: Average Roughness
 Rz: Average Total Roughness

3. Results

3.1. Research Data

Based on the data of surface roughness measurement using Surface Tester Mitutoyo SJ-201P measuring instruments on EMS steel specimens 45 from the results of working the flat lathe process using a CNC lathe with variations of feeding obtained the measurement data as follows:

3.1.1. Surface Roughness Test Results Using Variation of Feeding with Constan Cut Speed (G96)

Table 1. Results data roughness testing

Feeding	Nilai Feeding	Nilai Cutting speed	Benda Uji	Tingkat Kekasaran (μm)				Nilai Kekasaran	
				T1	T2	T3	ΣRa		
G94 mm/mnt	0.3048	G96 18 m/mnt	1	4,60	5,04	4,72	4,79	N8	
			2	3,11	2,53	2,69	2,78		
			3	4,25	4,59	4,20	4,35		
	ΣRa				3,97				
	0.3821		1	4,18	4,03	4,21	4,14		N8
			2	3,92	3,46	2,72	3,37		
3		2,14	2,39	2,29	2,27				
ΣRa				3,26					
G95 mm/put	0.3048	G96 18 m/mnt	1	4,98	3,94	4,37	4,43	N8	
			2	3,83	5,06	3,79	4,23		
			3	4,26	3,34	3,33	3,64		
	ΣRa				4,41				
	0.3821		1	3,69	2,74	2,22	2,88		N8
			2	2,69	4,77	4,59	4,02		
3		3,70	3,35	2,89	3,31				
ΣRa				3,20					

Turning process with variation of G94 feeding at feeding value 0.3048 mm/min, using spindle rotation speed (G96) = 18 m/min, obtained the average surface roughness (ΣRa) = 3.97 μm , while the variation of G95 feeding with the value of feeding 0.3048 mm/put was obtained by the average surface roughness (ΣRa) = 4.41 μm , with the same class of surface roughness as N8.

G94 feeding variations with feeding values of 0.3821 mm / min with spindle rotation speed (G96) = 18 m/min, obtained average surface roughness (ΣRa) = 3.26 μm , while for variations of G95 feeding with feeding values 38 mm/put, the price of surface roughness (ΣRa) = 3.20 μm , with the same surface roughness class, N8. The roughness level achieved is N8 (ISO roughness number). From the table above the average roughness value is calculated based on variations in feeding each specimen, then graphs the surface roughness values of each feeding as follows:

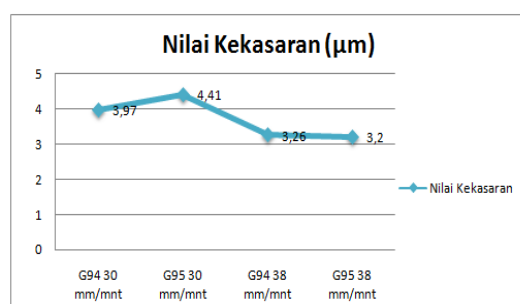


Figure 1. Roughness graph of feeding variation with cutting speed G96

From Figure 1 it can be seen that the higher feeding variation of the surface roughness value is (ΣRa_p) = 4.41 μm , this is due to variations in feeding at the G95 / 0.3048 mm/min value. While the lowest roughness value is (ΣRa_p) = 3.2 μm at the value of G95/0.3821 mm / min, in this case the value of the N8 roughness is obtained.

The graph above can also be seen that the distance between the surface roughness values that are not far between the G95 and G94 feeding variations, this is because there are among the specimens that are hard when turning because the composition of the mixture is uneven and also in poor engine conditions.

3.1.2. Surface Roughness Test Results Using Variation of Feeding with Direct Speed of Number of Turns (G97)

Table 2. Results data roughness testing

Feeding	Nilai Feeding	Nilai Cutting speed	Benda Uji	Tingkat Kekasaran (μm)				Nilai Kekasaran	
				T1	T2	T3	ΣRa_p		
G94 mm/mnt	0,3048	300 mm/put	G97	1	6,20	5,38	6,45	6,01	
				2	3,81	5,07	4,22	4,36	
				3	4,44	4,67	5,12	4,74	
					ΣRa_p		5,03	N9	
	0,3821		G97	1	2,45	5,16	3,08	3,56	
				2	2,78	3,47	3,24	3,16	
3		2,46		5,13	3,44	3,67			
				ΣRa_p		3,46	N8		
G95 mm/put	0,3048	300 mm/put	G97	1	5,44	5,29	5,45	5,35	
				2	5,18	4,85	5,14	5,05	
				3	5,08	6,38	5,41	5,63	
					ΣRa_p		5,34	N9	
	0,3821		G97	1	5,80	6,14	7,07	6,33	
				2	8,21	8,57	10,12	8,96	
3		7,81		6,37	8,10	7,42			
				ΣRa_p		7,57	N9		

The test in the table above shows that the average surface roughness in the variation of G94 feeding with a feeding value of 0.3048 mm/min, using G97 cutting speed is (ΣRa_p) = 5.03 μm , in the second specimen on G95 feeding variations with feeding values 30 mm/put, using a G97 cutting speed obtained by the price of surface roughness (ΣRa_p) = 5.34 μm , with a class of surface roughness N9. Whereas in the test specimens with variations of G94 feeding with 38 mm/min feeding value, using the G97 cutting speed, the average surface roughness price is (ΣRa_p) = 3.46 μm , with the N8 surface roughness class. Whereas the roughness number in the parameter variation of G95 feeding with 38 mm/put feeding value, using G97 cutting speed is (ΣRa_p) = 7.57 μm , in the N9 roughness class. From the table above the average roughness value is calculated based on variations in feeding each specimen, and then graphs the surface roughness values of each feeding as follows:

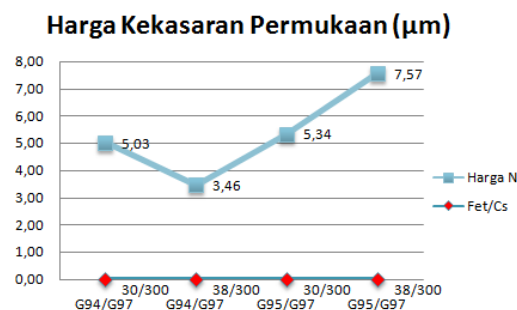


Figure 2. Feeding variation roughness graph with G97 cutting speed

The higher variation of cultivation is the surface roughness value (ΣRa_p) = 7.57 μm , this is because the incompatibility of feeding with the cutting speed used is not strong enough to withstand the load

load resulting in poor surface quality. With the variation of feeding used by the G95 (0.38 mm/min) and the value of cutting speed used by the G97, the incompatibility of the speed used with the hardness of the material used. And the smallest roughness value is (ΣRap) = 3.46 μm , with the value of variation of feeding used G94 (0.38 mm/min) and the value of cutting speed used by the G97, in this case the distance produced is different for the results of the surface quality obtained.

4. Discussion

This research can be concluded as follows:

- Roughness comparison with variations of G94/G95 feeding with G96 cutting speed (constant cutting speed). From the results obtained, the average user roughness value of the G95 feeding variation is lower (better), than the average roughness price with the variation of G94 feeding. With the same level of roughness, namely N8.
- The results of testing the roughness with variations of G94 / G95 feeding with G97 cutting speed (constant cutting speed the number of turns). In this case the G94 feeding variation results in a lower average surface roughness value compared to the roughness value obtained from the turning process using G95 feeding variations. With the level of roughness value that is N8.

5. Conclusion

To produce the lowest level of surface smoothness can be done by selecting the G95 feeding variation and variation of the G96 cating speed obtained by the roughness value of 3.20 rpm with carbide chisel material. As consideration in the production process.

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