Short communication

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Diamond Chisel Utilization and Effect of Feeding on Surface Roughness of AISI 1045 Steel

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ABSTRACT

Shape and surface roughness of a product, when it is produced by a lathe, plays an important role because of its friction, wear, lubrication systems, and others. In each workpiece, the result of the machining process has a certain shape and surface roughness such as shiny, smooth, and rough surfaces. The machining process determines the surface roughness at a certain level, where the surface roughness is used as a reference for product evaluation. Machining the surface roughness of a product does not have a small value, but sometimes a product requires a large surface roughness value according to its function.

***Keywords**:* Feeding, surface roughness, AISI 1045, diamond chisel

INTRODUCTION

"Regarding the quantification of the machining quality, the average surface roughness criterion has been widely used to characterize damage resulting from machining process. Surface roughness crucially affects the mechanical properties and working ability during services. Cutting speed, feed speed, depth of cut, radius of cutting edge, machined materials, cutting tools, coolant parameters, and machining vibrations have strong influences on the surface roughness."[1] "… the required surface roughness is not satisfied as expectation due to the unpredictable issue happening during machining, or the tabular data is not regularly updated."[1] C45 EN 10083-2:2006 carbon steel (AISI 1045 carbon steel) was tested. This steel is recommended as standard by ISO 3685:1993.[2]

LITERATURE REVIEW

Factors that affect the quality of the surface roughness of a workpiece in the machining process might depend on cutting knives in the manufacturing process, cutting speed, improper flashlight position, machine vibration, poor heat treatment, and so on. Cooling also cannot be separated from the machining process, apart from being a cooler and stabilizing the temperature of the workpiece and tool, this cooler also affects the quality of the surface roughness of the workpiece.[3], [4]

The value of the surface roughness of the smooth shaft from the lathe process can be done by selecting the chisel to determine the feeding and depth of cut according to the needs.[5],[6] The sharpness and strength of the chisel are very influential on the resulting product.[7] This project is focused on the use of diamond chisel material and AISI 1045 Steel workpiece to determine the effect of the type of chisel and workpiece on the resulting surface roughness. The best effect of spindle speed and feed depth on workpiece roughness is the combination of the highest cutting speed and the lowest feed rate.[8] So, in addition to the high cutting speed, the depth of feed also affects the roughness of the workpiece. The lower the feeding depth is, the lower the surface roughness of the workpiece will be.[9]

Steel is one of the metals that is widely used in various fields, especially in the machinery and construction industry. Of the many types of steel, AISI 1045 steel which is classified as a carbon alloy is being used as the main material for gears, piston connecting rods and shafts in motor vehicles and industry. Steel characteristics can be changed by heat treatment, one of which is the quenching method. The results of the hardness test on AISI 1045 steel show that this steel has a hardness value of 91.73 HRB with salt water medium, 88.33 HRB with water medium and 77.73 HRB with oil medium.[10]

The term AISI 1045 steel can be divided into two parts, namely AISI and 1045. AISI stands for American iron and steel institute (AISI) while the number 1045 means that the number 1 represents carbon steel, the number 10 represents carbon steel while the number 45 represents the percentage carbon content (0,45 %). The writing or classification of AISI 1045 steel according to other standards is DIN C 45, JIS S 45 C, and UNS G 10450. As a steel that includes machined construction steel, from its micro structure, AISI 1045 includes hypoeutectoid steel (carbon content < 0.8 % C). As the carbon content increases, the tensile strength and hardness increase while the tensile strength, ductility, toughness and weldability decrease. Its strength will be reduced when working at a rather high temperature. At low temperatures the toughness decreases drastically. The elemental content in AISI 1045 according to the ASTM A 827-85 standard is as follows: in terms of elements, percentages and other mechanical properties, AISI 1045 steel has elements of carbon (0.42-0.50) with tensile strength properties, manganese (0, 60–0.90) with yield strength, phosphorus (maximum 0.035) with elongation, sulfur (maximum 0.040) with reduction in area, and silicon (0.15-0.40) with hardness properties.[11]

AISI 1045 is a low carbon steel (0.43-0.50% C by weight). This steel has the following characteristics: good machinability, good wear resistance, and moderate mechanical properties. This specification steel is widely used as an automotive component, for example for gear components in motor vehicles.[12] AISI 1045 steel is referred to as carbon steel because it conforms to the international coding, i.e. 10xx series based on issued nomenclature by AISI and SAE (Society of Automotive engineers).[13]

The research aims to determine the effect of feeding and feeding depth on the surface roughness of AISI 1045 steel on the CNC lathe process, to find out the ratio of the feeding variable and feeding depth for best results, and to determine the value of Ra or surface roughness on the workpiece.

MATERIALS & METHODS

Materials

The workpiece material used was AISI 1045 with mechanical properties: hardness (170-220) BHN, tensile strength (60-80) kg/mm2. and chemical properties: C (0.4-0.45) %; Si (0.1-0.3) %; Mn (0.69 - 0.90) %; P (0.04%); S (0.05 %).

Types of equipment

The lathe equipment used in the small and medium metal industry where the research was conducted was a CNC EmcoTurn-242 lathe. The cutting chisel used was a diamond chisel.

Methods

The first step in this research was the observation of problems regarding the surface roughness of the workpiece (shaft), literature studies that supported the research. Next was the selection of the type of shaft material and the cutting tool used. Then, the workpiece was made using a lathe, then the cutting time and surface roughness, and tool wear were measured. The next step was to compare the surface roughness values obtained for each measurement result.

RESULT AND DISCUSSION

Surface Roughness

The surface roughness test produces data in the form of numbers (values) of average surface roughness (Ra). The data was obtained from measurements using a roughness test tool, namely surface test on AISI 1045 carbon steel. These measurements were carried out after the test object had been turned with five variations of Feeding. namely: 0.11 Mm/r, 0.13 Mm/r, 0.15 Mm/r, 0.17 Mm/r, 0.19 Mm/r, in which a constant cutting speed was 150 mm/min, and a cutting depth of a=0.5 mm.

The results of the surface roughness values on carbon steel specimens were based on the average value of the calculation. The surface roughness values in each test were: the surface roughness value at 0.11 mm/r feeding was 0.892 m, at 0.13 mm/r where feeding was 1.043 m, at 0.15 mm/r in which feeding was 1.129 m, at 0.17 mm/r where feeding was 1,240 m, and at 0.19 Mm/r in which feeding was 1.486 m.

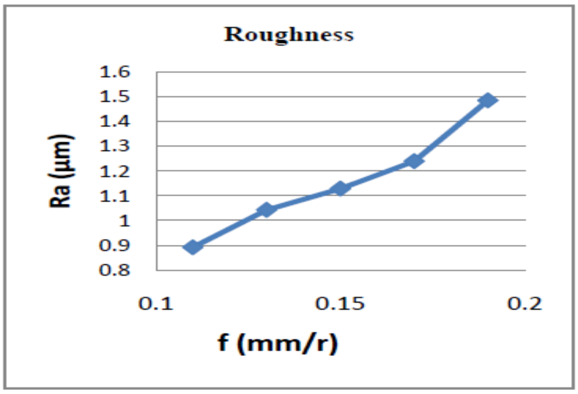

Figure 1: Roughness (Ra) and feeding (f)

Figure 1 shows that the higher the feeding (f) was, the greater the surface roughness value on the test object became, and conversely the lower the feeding (f) was, the smaller the resulting surface roughness value would be and the smoother the surface roughness of the test object could be.

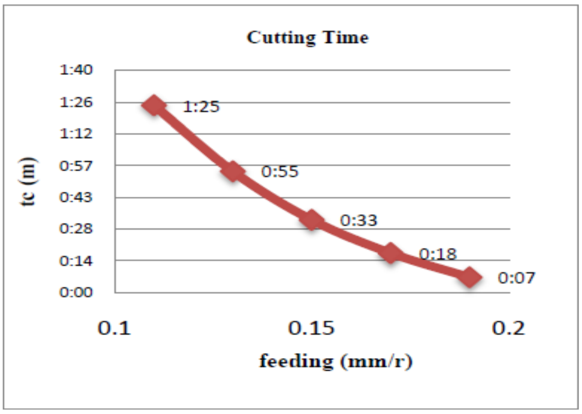

Figure 2: Graphic of roughness (Ra) andfeeding (f)

In the graph above, it can be seen that the feeding speed is very influential on the cutting time. When using 0.11 feeding the results of the cutting time are getting longer due to the distance between the far axis and slow feeding. When feeding is increased, the cutting process will be faster and the time required for cutting will be less. However, the less time it takes, the rougher the surface on the test object.

In this experiment, the higher the feeding speed was, the faster the cutting time was obtained. Table 1 shows the material removal rate (MRR). From the calculation results in Table 1,the material removal rate can be seen Figure 3.

Table 1: Data result of calculation of speed producer fury

No	Feeding (mm/r)	Gram (cm^3/minute)
1	0.11	8.25
2	0.13	9.75
3	0.15	11.25
4	0.17	12.75
5	0.19	14.25

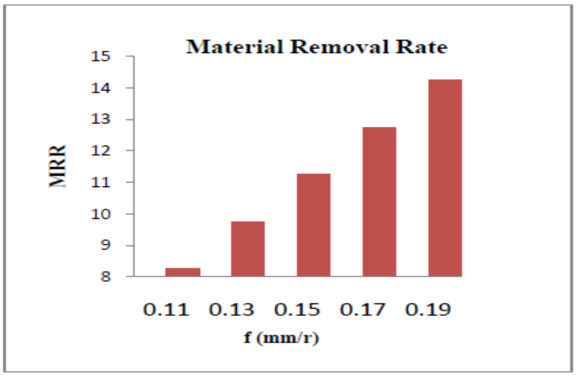

Figure 3: Material removal rate

Figure 3 shows that the fury produced in the experiment is the higher the feeding, the greater the anger produced and when the feeding is low, the anger results will be less. The production of anger depends on the motion of the food, the greater the motion of feeding is gotten, the thickness of the anger produced becomes larger, and vice versa. In addition, due to the motion of feeding, the depth of cut that is too large causes the tool blade to quickly worn-out.

CONCLUSION AND RECOMMENDATION

Conclusion

After conducting testing and analysis, this research can be concluded, that:

1. There is a significant effect of feeding on the level of surface roughness, that can be seen from the measurement values, namely:

a. The lowest roughness or the highest fineness is obtained by the use of the lowest feeding (0.11 Mm/r) with a roughness level (0.892 m).

b. The highest roughness (1,485 m) with feeding refers to (0.19 Mm/r).

2. The larger the feeding variable exists, the greater the value of the surface roughness would be obtained and produced. On the other hand, the lower the feeding (f) is, the smaller the value of the resulting surface roughness and the smoother surface roughness of the test object would be.

3. The surface roughness (Ra) value for each test might be related to the surface roughness value at 0.11 Mm/r in which feeding is 0.892 m, at 0.13 Mm/r in which feeding is 1.043 m, at 0.15 Mm/r whose feeding is 1.129 m, at 0.17 Mm feeding /r might be 1240 m, and at 0.19 Mm/r in which feeding is 1.486 m.

Suggestions

The suggestions given in connection with this research include:

1 In the turning process, care must be taken that the position of the workpiece that is parallel to the tool holders of the tool blade should not exceed.

2 Feeding must match the cutting speed and diameter of the workpiece to obtain the maximum level of smoothness.

3 The tool blade must match the type of tool holder of the lathe used.

4 The length of the workpiece should not exceed the tools holders on the CNC lathe.

5 The variables must be based on the engine capacity.

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REFERENCES

1. Trung D D. Influence of cutting parameters on surface roughness during milling AISI 1045 steel. Tribology in Industry. 2020;42(4):658-665.
2. ISO 3685:1993. Tool-life testing with single-point turning tools. In Eugene Feldshtein, Jerzy Józwik, Stanislaw Legutko. The influence of the conditions of emulsion mist formation on the surface roughness of AISI 1045 steel after finish turning. Advances in Science and Technology Research Journal. 2016; 10(30):144–149.
3. Rosanda F. Pengaruh feeding terhadap kekasaran permukaan baja karbon menggunakan pahat standar [Effect of feeding on the surface roughness of carbon steel using a standard chisel]. Universitas Islam Sumatera Utara.2017.
4. Amini S. 2015. Improvement of near-dry machining and its effect on tool wear in turning of materials and manufacturing processes improvement of near-dry machining and its effect on tool wear in turning of AISI 4142. Education, Technological. 2008: 1-3. http://dx.doi.org/10.1080/10426914.2014.952029.
5. Jain A, and Kansal H. Green machining-machining of the future. 2017.
6. Jerard, R B. On-line optimization of cutting conditions for NC machining. 2001:1-11.
7. Nasution, A H, GintingA, Hamsi A, and Harahap B. Analisa parameter pemotongan terhadap peningkatan produktivitas industri

logam kecil menengah [Analysis of cutting parameters to increase the productivity of the small and medium metal industry].2005; 9(52).
8. Nasution, A H, Harahap M R, Napid S, and Yanhar M R. Machinability study of cast iron in small and medium enterprise machining time VS tool wear. 2018; 7: 445–48.
9. Nasution, A H, Napid S, Poneni I S, and Hasibuan A. Machining process simulation to find NC program and cutting time. 2018;7: 376–80.
10. Pratowo B, and Fernando A. Analisa kekerasan baja karbon AISI 1045 setelah mengalami perlakuan quenching [Analysis of the hardness of AISI 1045 carbon steel after quenching]. Jurnal Teknik Mesin UBL. 2018: 5(2): 9-13. (http://jurnal.ubl.ac.id/index.php/JTM/article/view/1202)
11. (https://adoc.pub/ii-tinjauan-pustaka-komponen-mesin-yang-terbuat-dari-baja-in.html)
12. (https://www.scribd.com/doc/310160656/Baja-AISI-1045-Dan-4140).
13. Pramono A. Karakteristik mekanik proses hardening baja AISI 1045 media quenching untuk aplikasi sprochet rantai [Mechanical characteristics of AISI 1045 steel hardening process quenching media for chain sprocket applications]. Jurnal Ilmiah Teknik Mesin. 2011; 5(1):32-38.

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