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The Effect of Cutting Parameter towards Surface Roughness in Conventional Turning

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Abstract
The study was conducted with depth of cut, cutting speed, and cutting length as cutting parameters by referring surface roughness as a standard. In the study, cutting parameter variations which were applied were 0.25 mm, 0.5 mm, 0.75 mm of depth of cut; 50mm/rev, 80 mm/rev, 110 mm/rev of cutting speed; and 50 mm, 100 mm, 150 mm of cutting length by using carbide DCMT 070208-C25 as the tool. The maximum surface roughness value, which was 4,35 µm, was produced at 0.5 mm of depth of cut, 50 mm/rev of cutting speed, and 50 mm of specimen length. Due to the large depth of cut and low cutting speed, the tool could not move along the specimen's diameter and it resulted in threaded finish. Besides, chips which piled on the tool's edge also affected the specimen's surface. The minimum surface roughness value, which was 0.76µm, was produced at each cutting parameter variation of 150 mm of cutting length, 110 mm/revof cutting speed, and 0.25 mm of depth of cut. This was because high cutting speed made the formed chips are passed off along the specimen's rotating movement which thus resulted in minimizing chips piling on the tool's edge. Besides, the high cutting speed could make the tool able to move along the whole specimen's surface diameter and it made the feeding even.
Key words; *Turning, surface roughness, carbide tool(DCMT 070208-C25).*

INTRODUCTION

A machining process is a cutting process or the process of removing unwanted part from a work piece to shape a desired product. Machining processes which are mostly done in manufacture industries are shaping, drilling, milling, sawing, grinding and turning (saini et al, 2012). Machining parameters in turning process cover *cutting speed*, *depth of cut*, and *feedrate* (Settineri et. al, 2005; Narutaki et al 1993). Those three parameters affect surface roughness on the result of the machining process. The set up of feeding rate value and large depth of cut makes the turning process more efficient. However, the product will have high surface roughness value (Chou et al,2002 ; Suhail et al, 2010)

Low feeding rate value and depth of cut will minimize the efficiency of turning process but the product will have low surface roughness value. Besides the main three parameters, length of cut is also one of the factors which may affect the result of turning process (Vigneau et al.,1987; Arunachalam et al, 2004 ; Prasad et al, 2009). Large cutting length lengthens the time of feeding process and makes the work piece's surface rougher which is caused by the chipsthat pileon the tool'sedge during the feeding process. Therefore, a future study about selecting lathe's cutting parameter needs to be conducted. Among some cutting parameters, cutting length, *depth of cut*, *cutting speed*have been selected as free variables to get optimum value from each variable in order to produce lowest surface roughness (Ståhlaa et al, 2011). Surface roughness of a machining product may affect some functions of the product such as its level of preciseness, ability to spread lubricant**,** coating, etc. The softer the surface, the higher its preciseness level.Soft surface may prompt even lubricationand produce good quality of product coating. Therefore, surface roughness can be said as standard of accuracy and quality of a manufactured industry product (Ståhlaa et al,2011).

METHOD

Free variables which were used in this study were *depth of cut, cutting length, and cutting speed* with 0.25 mm of *depth of cut*, 0.5 mm, 0.75mm; 50 mm of cutting length, 100 mm, 150 mm *and* 50 m/min, 80 m/min, 110 m/min *of cutting speed*.

Tools

The method used in this study was *true experimental research* which was directly applied to the researched object. The type of lathe used was the conventional Krisbow KW 15-486. Tool used was *Carbide insert* DCMT 070208-C25 type. Tool holder used in the study was SDJCR 1210 d07. The *feeding speed* was 0.06 mm/rev. Mitutoyo Surftest SJ – 301 was used to measure surface roughness.

Material

Cutting material used in the study was steel S45C. Chemical compound of the work piece was 0.44% C of Bal. Fe, 0.23% of Si, 0.64% of Mn, 0.008% of P, 0.009% of S, 0.06% of Cr, 0.03% of Cuwith 77800 kg/m^3 of density, 200 HB of hardness and 625 Mpa of tensile strength.

RESULT AND DISCUSSION

Data visualization of the study can be seen in graph which relates surface roughness and depth of cut, surface roughness and cutting speed, surface roughness and cutting length (Figure 1).

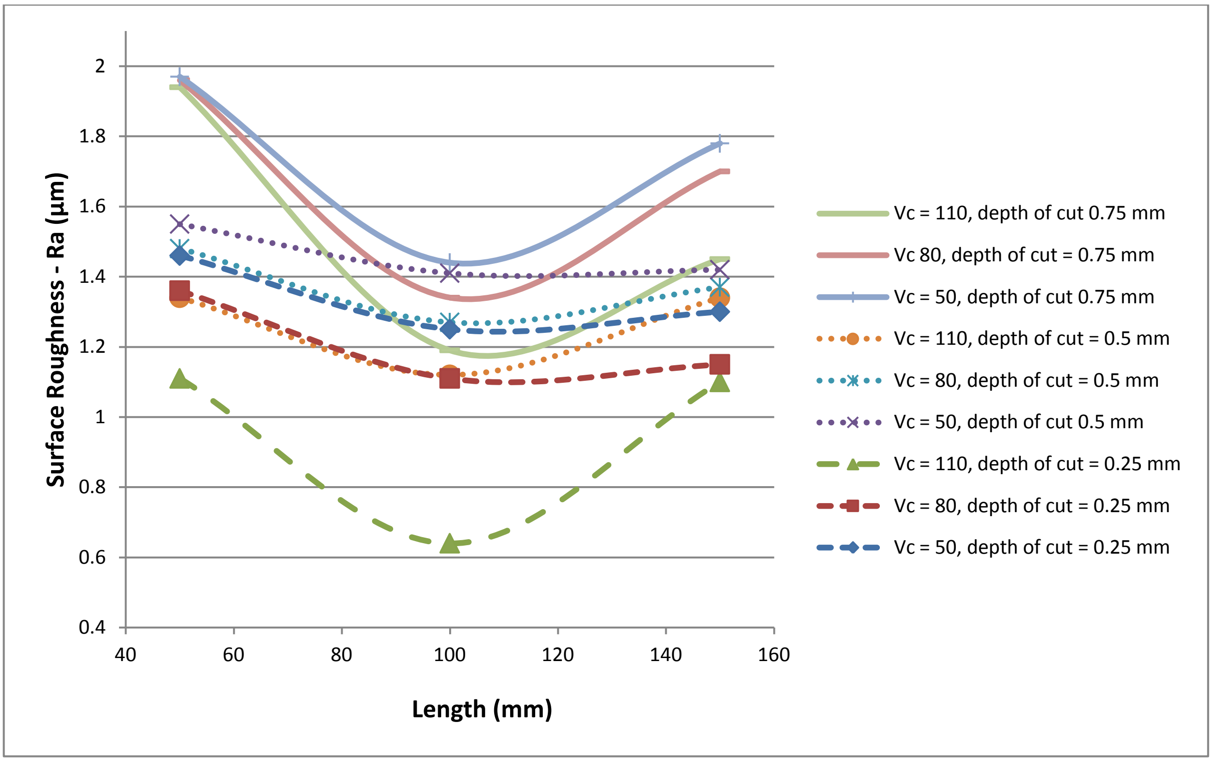

Figure 1. Graph of surface roughness at variation of depth of cut, cutting length and cutting speed

In Figure 1, it can be seen that the minimum surface roughness value, which is 0.76 µm, is produced at cutting parameter variation with 15 cm of specimen length, 110 mm/rev of cutting speed, and 0.25 mm of depth of cut. The maximum surface roughness value, which is 4.35 µm, is produced at cutting parameter variation with 5 cm of specimen length, 50 mm/rev of cutting speed, and 0.5 mm of depth of cut. At cutting parameter variation with 0.5 mm of specimen length, 50 mm/rev of cutting speed, surface roughness value is high. It is because the feeding does not move evenly at high depth of cut and low cutting speed and it causes the cutting tool not able to move along the whole diameter of the specimen's surface.

The length of cut specimen lengthens the feeding process and it makes the product's surface rougher caused bythe chipsthat pileon the tool's edge during the feeding process (Pawade et al, 2007 ; Shaw et al, 1984 ; Trent et al 1984). A machining parameterwith too high cutting style may lead tohigh mechanical stresses and thermal disturbances and it results in the increase of surface roughness (Basim and bashir, 2011). Cutting speed and depth of cut affect surface roughness very much (Basim and bashir, 2011). High cutting speed will produce a specimen with low surface roughness because the tool is able to move on the specimen's surface evenly. Chips which are formed during the turning processare passed off triggered by centrifugal force from the specimen's rotating movement which minimalizes chips piling on the tool's edge.Cutting length may affect specimen's surface roughness value because the specimen's vibrating movement prompted unsymmetrical specimen's rotation. This can be minimalized by using tailstock to hold specimen's end. Large depth of cut may produce high surface roughness value because the tool will need big forcefor the feeding. This can be minimalized by applying high cutting speed and low feed motion which will make the tool's movement lighter and less chipspileon the tool's edge.

CONCLUSION

From the study, it can be concluded that:

1) The highest surface roughness value, which is 4.35 µm, is produced at 0.5 mm of depth of cut, 50 mm/rev of cutting speed, and 50 mm of specimen length. It is because large depth of cut and low cutting speed cannot move along the whole diameter of the specimen's surface which makes the turning result a bit threaded.
2) The lowest surface roughness value, which is 0.76 µm, is producedat each variation of cut parameter at 150 mm of length cut, 110 mm/rev of cutting speed, and 0.25 of depth of cut.
3) Depth of cut, cutting speed and cut length influence are cutting parameters which affect the value of surface roughness.

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