Effect of rake angle and feed rate on wear and roughness in machining carbon steel 1045

Mohd Fawzi Zamri*, Norlida Jamil, Ahmad Razlan Yusoff

Kolej Kejuruteraan, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300, Gambang, Kuantan, Pahang, Malaysia.

*Corresponding e-mail: fawzizamri@gmail.com

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ABSTRACT – In metal industry, the optimum usage of insert in turning process is a common practice to reduce the machining cost. Hence, the endurance limit for the insert will be low and will affect the quality of the surface finish. Several studies have discovered the tool wear and surface roughness when machining parameter of the process is properly considered. This study present analysis of tool wear of carbide inserts in finish turning of carbon steel 1045. This paper contribution concerns the experimental occurrence of tool wear and roughness for a continuous cutting condition of tool holder that has a variable rake angle and variable of feed rate. So, these parameters become critical to minimize the tool life and roughness of the work part.

1. INTRODUCTION

An excellent machining performance of workpiece materials can produce finished goods with high quality product. The quality of the product's surface finish as well as the productivity of the manufacturing processes are usually affected by the cutting tool wear [1]. Tool wear such flank wear and crater ware were often occurs during machining processes due to its effect on surface integrity and dimensional accuracy. Thus, it is important to predict the tool wear to avoid tool failure which will affects the machining performances and the quality of the final part of product [2]. Besides that, Wang et al. [3] selected within a range of more than 0.10 mm to less than 0.25 mm of tool wear to prevent unnecessary failure. Chen & Pan [4] make different changes to the rake angle of the milling cutter and do real cutting tests to discuss the impact that rake angle change has on its processing characteristics. Moris Devotta et at. [5] study the transition from continuous to segmented chip for varying rake angle and feed at constant cutting velocity is predicted while using the ductile damage modeling approach with two different fracture initiation strain models (Autenrieth fracture initiation strain model and Karp fracture initiation strain model). As for this study, the optimum parameter of rake angle and feed rate is used to obtain the low tool wear and surface roughness of finish part.

2. METHODOLOGY

A chip breaker CNMG 120412 PM 4325 (Figure 1a) and tool holder of DCLNL 2525M 12 (Figure 1b) commercially available turning tool was used in the present study. This was used to facing a carbon steel 1045 solid round bar. The axial length and the diameter of the work part are 125 mm and 90 mm, respectively. Figure 2 shows an additional support for the tool holder for decreasing the rake angle -6° initially to -9°.

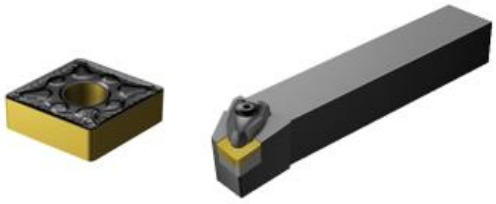

Figure 1 Insert and tool holder.

Figure 2 Difference angle of shim support.

The cutting process was conducted at a constant cutting speed of 275 m/mm with a depth of cut 1mm. There cutting length choose for this study are 15.00, 18.75, 22.20, 26.25 and 30.00 m respectively. The feed rate used were 0.2 mm/rev and 0.4 mm/rev. Figure 3 shows the experiment setup for this study which is face cutting.

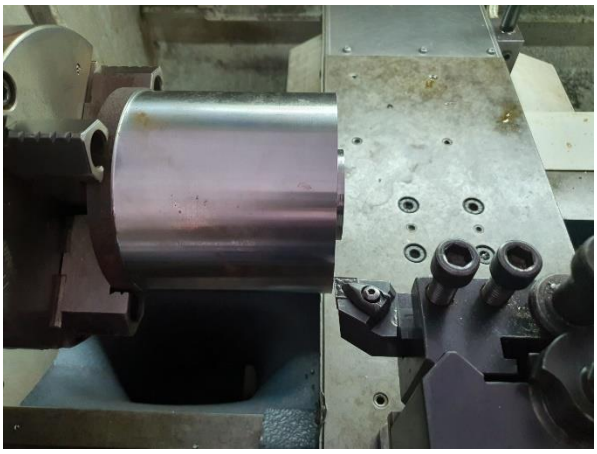

Figure 3 Schematic of experiment setup.

3. RESULTS AND DISCUSSION

Figure 4 illustrates the predicted tool wear for both rake angle. Wear was measured with measurements outside insert (using a microscope, etc.). A standard measure of tool life is the time to develop a flank wear length V_{BB} of 0.3 mm or V_{BBmax} of 0.6 mm. While Figure 5 shows the predicted surface roughness also for both

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rake angle. Roughness was measured on the cutting surface by using laser scanning microscope at MPLFLN5X magnificent. The results obtained from the study indicates that lowest tool wear and better surface finish could be obtained at a feed rate of 0.4 mm/rev and a rake angle of -9°. Therefore, it could be concluded that the rake angle and feed rate can play a significant role in the tool life and surface finish to enhance the productivity and quality in the machining process.

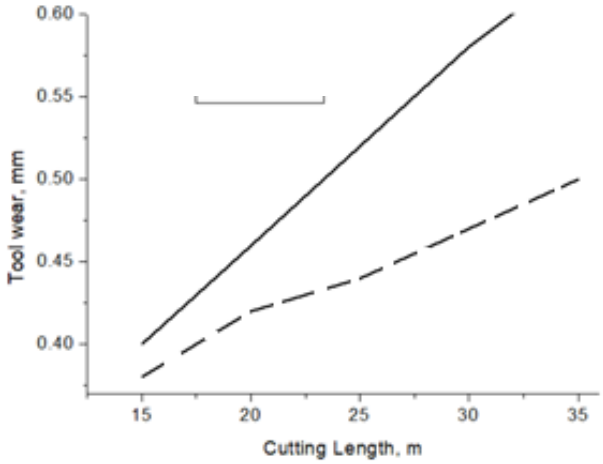

Figure 4 Tool wear value.

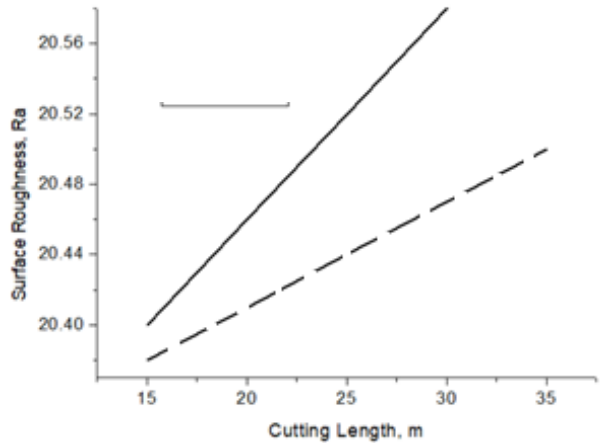

Figure 5 Surface roughness value.

4. CONCLUSION

As conclusion feed rate of 0.4 mm/rev and a rake angle of -9° indicates that lowest tool wear and better surface finish.

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