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Performance of Fabricated Portable Grinder on Traditional Lathe Machine in Manipulating Multi-Tasks Machine

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ABSTRACT

Performing more than one machining process is always a priority to machine manufacturers. Multi-task machining would reduce time for work piece set up and machining process. In this study, the portable grinder has been attached to manual lathe machine with custom made bracket to perform multi-task machining, turning and grinding processes. Surface finish was been analyzed to justified the reliability of this approach. The objective of this study is to investigate the performance of portable grinding on lathe machine based on surface integrity. Two combination spindle revolution per minute (rpm) 200/10000 and 1000/5000 on grinding and turning has been used. It is found that the combination 1000/5000 rpm produce a better surface finish on 20mm diameter mild steel (workpiece) on wet machining condition. The results of this study could provide a useful data for the right combination of spindle speed to be applied in turngrind machining. The result obtained also can be used in related industries as well as other learning about the characteristics of a retrofit multi-task machine.

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INTRODUCTION

Recently the multi-tasking machine has been introduced to the market for the most of manufacturers. The machine that can be performed more than one machining operations has been acknowledged as efficient machining process based on less time consuming in machining set-up and capable to perform multi-tasks machining operations in one set-up. Most of machine shops are eagerly to own this type of machine but the higher cost of investment make them think twice. The available machine such as traditional lathe which still have a tolerable accuracy should be manipulated with multi-tasking machine. Commonly grinding is the final process before assembly. Therefore, it is crucial to grind the work piece on the same set-up to avoid reference offset. The pneumatic hand grinder will be attached on the conventional lathe machine with custom made mounting. This fixture will be design and fabricated to accommodate the rigidity of machining process and the movement of lathe carrier. The effects of grinding parameter on surface quality have been a subject of interest by researcher. The effect of machining parameters on material removal rate and surface roughness on cylindrical grinding has been studied (Mark J. Jackson, J Paulo Davim, 2011), (M.Kiyak, O. Cakir, E. Altan, 2003), has investigated the cylindrical grinding effects on work piece by dry and wet conditions. He stated that the work piece speed and feed should be kept low in order to have good surface finish. Surface roughness is one of the prominent factors in assessment of quality of products. The selection of optimum cutting conditions is absolutely necessary in a machining process. Surface integrity is dominant criteria in assessing the performance of grinding process. The approximate ranges of average roughness are 6.3- 0.025µm (S.Kalpakjian, S.Schmid, 2010). In addition, the fine surface finish is the indicator the successful of this study. The scope of this study is to analyse the surface integrity of combination speed of lathe and air grinder for multi-tasking machining process. As stated by (Marinescu *et al*, 2006), the ability of manufacturing operation is based on many factors. The rotational speed of the wheel, work speed, feed rate, types of work piece being machined, depth of cut, diameter of work piece, types of wheel, and others parameter that can effect to surface finish work piece.

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2. Bracket Design and Fabrication:

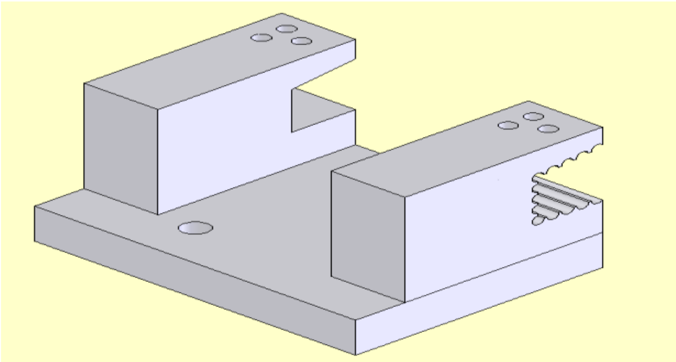

Fig. 1: Isometric View of Bracket Design.

Fixture design process is complex, intuitive, long-term and mostly depends on designer's knowledge and experience (Cecil, J, 2004). In this case, the bracket was design based on availability of lathe machine space, easy adjustment of grinding wheel to synchronize with work piece centre and saddle movement limit. The idea will be translate to conceptual design in Computer Aided Design (CAD) software. A 3D model was generated by using solid modeling software, as shown in Figure 1. The assembly view of the bracket was generated to get the best fitting for product assembly at the lathe machine. At the same time the data is export to Computer Aided Manufacturing (CAM) software to generate tool path for machining process. Concurrently, the raw materials have been cut to require size. The generated Computer Numerical Control (CNC) programmed will then be sent to CNC Milling machine to perform machining activities. The step of machining to fabricate bracket is shown in Figure 2. Next the air grinder was fitted to the bracket as a preparation to run an experimental on grinding performance as per Figure 3.

Fig. 2: Fabrication process of Turngrind bracket, a) Cutting of material, b) Milling of blocks, c) Surface Grinding Process, d) Drilling holes for rear bracket, e) Slots machined on the bracket, f) Turngrind attachment on lathe machine.

Fig. 3: Pneumatic hand grinder fitted on the bracket on lathe machine.

3. Bracket Configuration:

The bracket consists of three major elements, which are: the front holder, the rear holder and the base. It has to be noted that the bracket should comply the work holding devices. In general, a work holding device serves three primary functions: location, clamping and support (Tien-Chien Chang, et.al, 1991). The base of bracket will serves as location and clamping purpose. The front and rear holder will locate and support the hand grinder. Additionally, the rear holder was machined with arraying slot to increase grip force of holding a grinder as per Figure 4. The grinder was clamped by six bolts for establishing rigidity while machining. All of parts were made from solid mild steel.

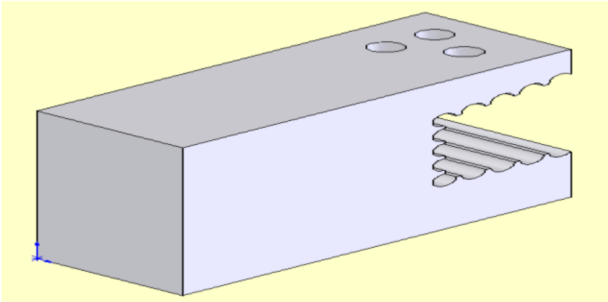

Fig. 4: Rear Holder with arrayed slot.

4. Experimental Set-up:

The objective of this experiment is to evaluate the surface integrity of work materials (mild steel) on portable grinder that attached to traditional lathe machine. It is important to justify the surface quality, in such that grinding usually a finishing process before product or part assembly. The traverse grinding is set up for this experiment. The aluminum oxide abrasive wheel diameter of 120mm is prepared as a cutting tool for this purpose. The cylindrical grinding approach has been adopted as a guided to perform this experiment. Two combination of speed has been choose, the lathe machine speed and the portable grinding speed (rpm) of 200/10000 rpm and 1000/5000 rpm respectively. The grinding speed was controlled by manipulating air pressure. Mild steel rod with diameter 20mm is used as a work piece material. The material is most common materials used in fabrication. Figure 5 shows the experimental set-up for grinding operation.

Fig. 5: Experimental set-up for grinding process of portable grinder.

The experimental study was carried out by issuing the following parameter:

Grinding wheel	:	Al_2O_3 Ø120m X 13mm (Grit size 60)
Wheel speed	:	1000 , 200 rev/min
Work piece	:	Mild steel (Ø20 mm)
Work piece speed	:	5000 , 10 000 rev/min
Feed	:	Manual operate
Grinding depth	:	0.010 mm
Grinding conditions	:	Wet

The surface finish was examined across the work piece with Taylor Hobson Surfcom 130 A surface profiler.

RESULT AND DISCUSSION

The primary purpose of this experiment is to verify that by manipulate the traditional lathe machine to multi- task machine, the quality of surface finish still in the range of grinding operation. Furthermore, to estimate and recommend the right combination speed of lathe machine and portable grinder based on surface integrity. Figure 5 shows that the combination speed (rpm) of 1000/5000 presents the smooth surface finish compare to the combination speed (rpm) of 200/10000. It is very highly that the proper ratio of combine speed is significant factor affecting surface finish. Overall the surface roughness is still in acceptable grinding ranges. Therefore, the custom made multi-tasks machining is considered reliable.

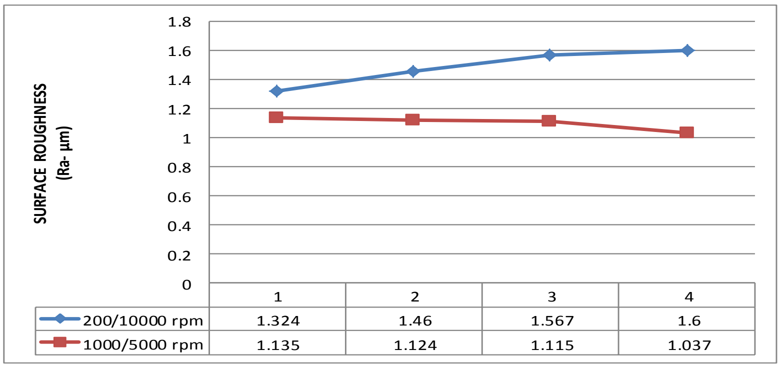

Fig. 6: Surface roughness at combination speed 200/10000 rpm and speed 1000/5000 rpm.

Recommendation:

After gone through post mortem, we have come up with some suggestion and recommendation for future improvement:

i. The bracket should be more flexible especially related to centre adjustment and mounting mechanism. Therefore, we would like to suggest an electromagnetic base.

ii. Safety guard made from transparent acrylic that can cover both operation lathe and grinding shall be introduced.

iii. The future study on additional parameters such as abrasives wheel types, wheel diameter, work piece diameter, cutting condition could be possible areas to look into.

iv. Measurement attachment for grinding operation to assist the operator.

Conclusion:

The result shows there is a good possibility of portable grinding to be conducted on traditional lathe based on the surface finish produced. However, the right combination speed on both machine are important to produce fine surface finish and this could be a good area to explore. It has to be note that harder work piece materials will reflect finer surface finish. The experiment also reveals that multi-tasking machining could be applied on the traditional lathe machine as long as the accuracy and quality are in accepted range. For machine shop owner or workers, this is an advantage to utilize the available machine with combination of experience and innovation.

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