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# The Sharpening effect on Chisel for turning the surface of casted Piston Waste

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***Abstract***

*This research begins with the casting process of motorcycle piston waste and then continues with the turning process on conventional lathes. The purpose of this machining process is to identify the quality of the surface roughness of the turned casting product. The surface roughness quality of the turning product to be applied must show high precision and not experience significant surface defects. To get the surface quality, there are many machining variables that need to be considered, one of which is the use of lathe chisels. The turning tool becomes an important component during the turning process to form various forms of products produced through the mediation of rotary motion and tool motion resulting in large and small friction. This friction that occurs will depend on the sharpness of the chisel itself. The problem studied is the use of sharpened and non-sharpened chisels in terms of product surface roughness during the turning process. In addition, this study will vary the variable thickness of the feed which varies 0.2 mm, 0.4 mm, 0.6 mm, 0.8 mm to be a factor in finding out the quality of turning products. While the spindle rotation of the lathe used is 240 rpm, 350 rpm, 430 rpm. From the experiments on turning the casting product, it was found that the lowest surface roughness quality was obtained with the N6 sharpened chisel of 1.13 $\mu$m while the N6 unsharpened chisel was 1.19 $\mu$m.*
***Keywords*****:** *lathe chisel, casting, piston waste, turning, surface roughness value*.

## 1. Introduction

Piston waste is one of the motorcycle component wastes that continues to increase along with the increase in production of spare parts. This fact is proven by data from the Central Statistics Agency regarding the use of motorcycles in Indonesia reaching 112,771,136 units [1]. Not only motorcycles that produce piston waste, but several other means of transportation also contribute to this waste. When viewed from the production side of spare parts, there will be problems in reducing the supply of raw materials. Most of the raw materials for making pistons come from pure aluminum.

Aluminum is obtained from bauxite ore which is chemically the hydrous oxide of aluminum in large quantities on the earth's surface. This ore is treated with caustic soda to produce aluminum oxide which is then mixed with melted cryolite and reduced electrolytically to produce aluminum metal. To overcome the low mechanical properties, aluminum is usually combined with other elements such as silicon, copper, iron, zinc, manganese either singly or in combination in a certain percentage to go through the casting process. [2]. Therefore, aluminum has a low tensile strength when compared to other metals but is lightweight and has high corrosion resistance.

One of the best alternatives that is necessary and must be done to overcome the scarcity of aluminum raw materials in the future is to recycle existing waste. The process of recycling piston waste is not easy but requires adequate knowledge and experience. The quality of casting results is very dependent on several variables related to the casting process because many phenomena occur which impact on mechanical properties.

Apart from the casting process, there are also other manufacturing processes as follow-up processes that need to be carried out as a form of product processing to be ready for market. The advanced process is the turning process using conventional machine tools. As with casting, turning work also has various variables as a factor in determining the value

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of surface roughness. There are several turning variables that affect the surface roughness value depending on the cutting conditions such as the tool, spindle rotation, feed thickness, feeding and cooling.

Iswanto et al 2020, examined the effect of coolant and spindle speed on the surface roughness of AISI 4140 steel. The variables in this study were coolant and spindle speed. The coolant used is dromus, used SAE 40 oil and used cooking oil. Spindle rotation used 370 rpm, 665 rpm, and 1040 rpm. The results obtained for the greatest value of surface roughness using dromus coolant with a spindle rotation of 665 rpm. While the smallest surface hardness value of the workpiece when using dromus coolant with spindle rotation of 1040 rpm. The final conclusion is that the coolant dromus and spindle rotation have a significant effect on surface hardness in the AISI 4140 steel turning process. [3].

Vinh Do and Quoc Manh Nguyen, 2021., optimizing machining parameters to minimize surface roughness in SKD61 steel turning using the taguchi method. Surface roughness is an important indicator and can be reduced during machining of SKD61 steel. The selected research parameters include cutting speed, depth of cut and feedrate. In addition, the cooling conditions were also investigated with three different conditions including dry cutting, MQL and wet machining. The selected machining condition parameters are able to optimize to produce the smallest roughness. [4] Peniel I. Gultom and Kiswandono, 2020 determines the cutting speed, feed speed, and main cutting angles in the lathe process of medium carbon steel workpieces. The workpiece used was ST 60 steel with dimensions Ø 30 mm x 200 mm with a chuck-tailstock spindle clamping system. The results of the research determined that for the ST-60 steel lathe process without follower rest, the main machining size was the main cutting angle Kr = 45°, the cutting rate was 60.5 m/min, the feed speed was 44.66 mm/min and the depth of cut was 0. 2 mm obtained a surface roughness value of 3.72 µm or N8 level of roughness. Meanwhile, for the main machining size, the cutting angle Kr = 90°, the cutting speed is 60.5 m/min, the feed speed is 22.33 mm/min and at a cutting depth of 0.2 mm, a surface roughness value of 3.69 µm or N8 level is obtained. [5] 6061 aluminum machining on Hurco TM 20 CNC machine using ISCAR DNMG IC907 insert cutting tool with parameters spindle speed 2092 rpm, infeed speed 0.07 mm/ref and depth of cut 0.5 mm resulting in optimal surface roughness in the range of 0.28 ± 0.13 [6]. Factors that affect surface roughness in the turning process are the treatment of the chisel, depth of cut, cutting speed, feeding motion, machine vibration during cutting. [7]. The product quality of the machining process is always associated with the accuracy of the dimensions-tolerances and roughness values surface, therefore surface roughness is one of the standards for accuracy and surface quality [8]. Cutting speed of 125 m/min and depth of cut of 0.2 gave effect to the best surface roughness value for the cylinder block of the aluminum casting lawn mower.. [9]. The surface quality of the workpiece is caused by machining parameter factors, the factor is the spindle speed and feed speed. Roughness problems due to machining parameters need to be investigated and studied so that know how much influence it has [10]. Factors that affect the surface quality of a workpiece on machining processes including cutting knives in the manufacturing process,cutting speed, improper flashlight position, machine vibration, heat treatment the less good and some [11]. The benchmark for product surface roughness results is very dependent on machining variables such as cutting speed and feed depth. From the results of turning ST 41 material using HSS chisels, the best surface smoothness was obtained at 1.189 µm at a variable cutting speed of 24 m/minute and cutting depth of 0.5 mm. The dry machining process using a lathe is an alternative for turning work that is oriented towards the production process. To improve the quality and efficiency of turning results, it is necessary to pay attention to machining variables such as cutting speed, cooling used [12]. The cutting process is an essential step that substantially affects the quality of the surface of the generated component. Therefore, it is essential to choose optimal cutting settings to manage the desired surface quality. Operators usually utilise "trial and error" methods in industry in order to set up machine cutting settings to obtain desired surface roughness. Obviously, the 'trial and error' approach is not completely efficient or effective and obtaining the intended result is a time consuming repeated and empirical procedure [13]. Turning operation under dry environment is considered with cutting speed, feed rate, and depth of cut as the input parameters, as well as material removal rate, average surface roughness, and cutting force as the responses [14]. on 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 [15].

## 2. Research Methods

The research method applied is a real experiment where the turning process is carried out on a T100 Horizontal lathe using an HSS chisel. This study focused on the use of chisels which were treated by sharpening. There are 2 research designs applied, namely the first way the chisel is sharpened after finishing turning the specimen in the same rotation with variations in infeed depth. Whereas the second type, namely the chisel is sharpened for each different depth of infeed but at the same rotation. After the machining process is complete, the surface roughness of the test object (Ra) is measured. Procedures for obtaining research data include : The process of preparing motorcycle piston waste (Figure 1).

Figure 1. Motorcycle waste piston

Preparation of specimen molds made of galvanized pipe with a diameter of 25.4 mm (Figure 2),

Figure 2. Permanent mould

Preparation of a conventional furnace, with its accessories (figure 3),

Figure 3. Conventional foundry furnace

The casting process can be carried out after reaching the melting point of the aluminum alloy ±700°C then being removed from the furnace and at a temperature of ± 600 °C, it is poured into the mould (Figure 4).

Figure 4. Specimen printing process

The specimen machining process can be carried out after the printed specimens are ingots. The machining variables that are varied are spindle rotation 240 rpm, 350 rpm, 430 rpm and depth of cut 0.2 mm, 0.4 mm, 0.6 mm and 0.6 mm. 8 mm. Chisels used in the lathe machining process are HSS chisels with kerosene cooling (figure 5).

Figure 5. Test specimen

Testing the surface roughness of the specimen using a surface roughness tester (figure 6).

Figure 6. Surface roughness test

## 3. Result and Discussion

After going through the research method procedures mentioned above, the test data obtained in the form of surface roughness values can be seen in table 1,2 and 3. The three tables below show the results of surface roughness (Ra) due to spindle rotation to variations in depth of cut with the condition of the tool given the sharpening treatment.

Table 1. Surface roughness data from the test results due to spindle rotation, depth of cut by sharpening lathe chisel

| Spindle rotation (rpm) | Depth of Cut (mm) | Surface Roughness Ra (µm) |
|---|---|---|
| 240 | 0,2 | 1,22 |
| 240 | 0,4 | 1,57 |
| 240 | 0,6 | 2,26 |
| 240 | 0,8 | 3,08 |

Table 2. Surface roughness data from the test results due to spindle rotation, depth of cut by sharpening lathe chisel

| Spindle rotation (rpm) | Depth of Cut (mm) | Surface Roughness Ra (µm) |
|---|---|---|
| 350 | 0,2 | 1,18 |
| 350 | 0,4 | 1,30 |
| 350 | 0,6 | 2,05 |
| 350 | 0,8 | 2,76 |

Tab 3. Surface roughness data from the test results due to spindle rotation, depth of cut by sharpening lathe chisel

| Spindle rotation (rpm) | Depth of Cut (mm) | Surface Roughness Ra (µm) |
|---|---|---|
| 430 | 0,2 | 1,13 |
| 430 | 0,4 | 1,26 |
| 430 | 0,6 | 1,50 |
| 430 | 0,8 | 2,20 |

In accordance with the data from the surface roughness test results shown in Tables 1, 2 and 3, then data analysis is carried out. The data from the test results will be plotted into microsoft excel to make a graph. From the existing graph, it will show the effect that occurs due to differences in the depth of cut with the same spindle rotation.

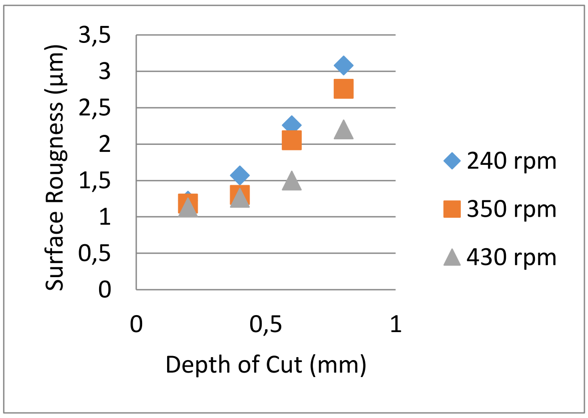


Figure 7 Graph of the relationship between spindle speed and depth of cut

From Figure 7., the graph of the relationship between spindle rotation and depth of cut with the method of grinding lathe chisels, kerosene cooling, the amount of feeding given is 0.5 mm/minute, it can be seen that there is a difference in the value of the roughness of the turning results. The difference in surface roughness values is very clear between the lowest, medium and high rotation.

The higher the spindle rotation and the greater the depth of cut greatly affects the value of surface roughness. When viewed from the rotation compared to the depth of cut, the lowest surface roughness value is at high rotation with a small depth of cut. While the greatest value of roughness occurs at low rotation with a large depth of cut.

The following will display table 4, table 5 and table 6 data related to the surface roughness value of the turning results using lathe chisels that are not sharpened.

Tabel 4. Surface roughness data from the test results due to spindle rotation, depth of cut without lathe chisel sharpening

| Spindle rotation (rpm) | Depth of Cut (mm) | Surface Roughness Ra (µm) |
|---|---|---|
| 240 | 0,2 | 1,45 |
| 240 | 0,4 | 1,70 |
| 240 | 0,6 | 3,07 |
| 240 | 0,8 | 4,51 |

Tabel 5. Surface roughness data from the test results due to spindle rotation, depth of cut without lathe chisel sharpening

| Spindle rotation (rpm) | Depth of Cut (mm) | Surface Roughness Ra (µm) |
|---|---|---|
| 240 | 0,2 | 1,36 |
| 240 | 0,4 | 1,58 |
| 240 | 0,6 | 2,25 |
| 240 | 0,8 | 3,91 |

Tabel 6. Surface roughness data from the test results due to spindle rotation, depth of cut without lathe chisel sharpening

| Spindle rotation (rpm) | Depth of Cut (mm) | Surface Roughness Ra (µm) |
|---|---|---|
| 240 | 0,2 | 1,19 |
| 240 | 0,4 | 1,39 |
| 240 | 0,6 | 1,77 |
| 240 | 0,8 | 2,34 |

The data from the surface roughness testing in table 4, table, 5 and table 6 will be plotted into microsoft excel to create a graphical figure 8. From the existing graph this will show the effect that occurs due to differences in depth of cut with the same spindle rotation

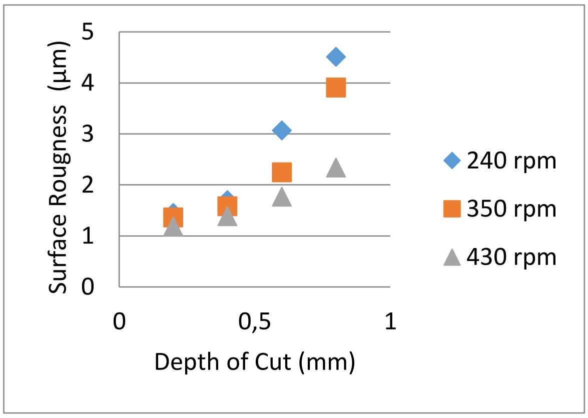


Figure 8 Graph of the relationship between spindle speed and depth of cut

From the graphic figure 8., shows the correlation of depth of cut and spindle rotation as a result of using a lathe without sharpening. The test results have an effect on the surface roughness value. The lowest roughness value (fine) is obtained at a small depth of cut with a large spindle rotation. While high surface roughness values (coarse) occur at large depths of cut with small spindle rotation. If the use of the two chisels is compared, it can be seen that the sharpened chisel has a low roughness value (fine) and the one that is not sharpened has a higher roughness value (coarse). However, the use of both sharpened and unsharpened chisels is still classified at the N6 level of roughness.

## 4. Conclusions

The conclusion from the results of research conducted regarding the recycling of piston waste followed by the turning process is as follows: there is an effect of using sharpened lathe chisels when compared to those that are not sharpened. The results obtained are that the surface roughness for sharpened chisels has a lower (smooth) surface roughness value when compared to the use of coarser non-sharpening chisels. However, the two results of the roughness test have the same level of roughness, namely N6.


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