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Effect Of Cutting Speed Variation On Wear And Life Of Lathe Tool Blade In Skd11 Steel Material

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Abstract. The manufacturing process is a process carried out to produce physical or chemical changes in raw materials. The manufacturing process is carried out in several steps starting from raw materials to the machining process. The machining process is a series of workpiece forming processes using cutting tools by cutting layers of material into the desired shape. This study aims to analyze the effect of cutting speed on lathe tool wear on SKD11 steel. This study uses an experimental method, using the transverse turning method. Transverse turning is a turning process when the cutting tool movement is parallel or linear with the spindle axis. The test specimens will be turned starting with determining the turning parameters, namely the feeding motion (f) 0.16 mm / rev, depth of cut (depth of cut) 1.0 mm, with variations in cutting length (Lt) 200 mm, 400 mm and 600 mm. then varying the cutting speed (Vc) starting from 99m/min, 172 m/min and 292 m/min. Based on the results of the test data obtained, it shows that; Cutting speed (Vc) affects the wear of the lathe tool blade on SKD11 material. The higher the cutting speed (Vc), the more the tool blade wear value (VB) increases.This is due to heat and friction between the cutting edge and the test piece. The wear that occurs on the lathe tool blade is edge wear or abrasive wear due to the continuous contact of the two materials so that it rubs between the lathe tool blade and the SKD11 material and is also caused by the thixotropy phenomenon.

Keywords: Cutting Speed, Tool Wear, Machining Parameters.

INTRODUCTION

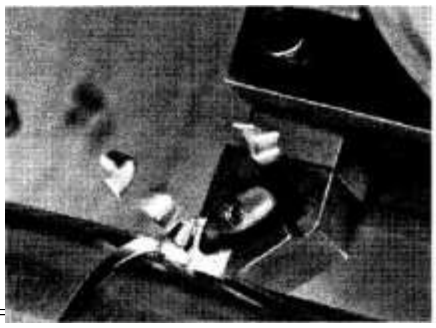
The development of technology today plays an important role in technological and economic progress. Technology is developing very advanced and rapidly along with the progress of the times, especially in the field of manufacturing processes [1]. The manufacturing process is a process carried out to produce physical or chemical changes in raw materials, thereby increasing the value of the material. The manufacturing process is carried out in several steps starting from raw materials to the machining process. The machining process is a series of workpiece forming processes using cutting tools by cutting layers of material into the desired shape [2].

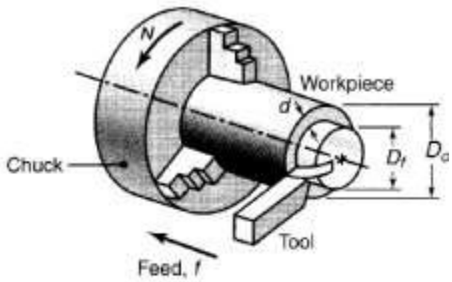
Tool blade wear in the turning process occurs due to friction that occurs between the tool blade and the workpiece during the cutting process. Factors that can cause tool blade wear include the hardness of the workpiece material, too high a feed speed, and non-optimal cutting conditions. To reduce tool blade wear, it is important to select a tool material that is suitable for the workpiece material, adjust the cutting and feeding speed appropriately, and perform regular maintenance such as grinding and lubrication [3].

The slower the cutting speed, higher the tool wear rate, on the other hand, the faster the cutting speed,lower the tool wear rate [8]. The longer we use the chisel, it will experience wear, which is characterised by the surface of the cut workpiece getting rougher, the cutting force that occurs increases [9]. The growth of edge wear (VB) will slow as the cutting time decreases, due to the smaller cutting force that occurs [10].

The difference between the research with the title above and the research that will be examined in this study is the test object that will be examined, namely SKD 11.

The principle of a lathe is a cutting tool that functions to reduce the workpiece material by rotating the workpiece on a fixed shaft (spindle) while the cutting tool moves linearly. The cutting tool on the lathe in the form of a lathe tool mounted on a holder in the tool house (tool post) is then moved manually or automatically with the help of numerical control (CNC).Here below is figure 1. a.b Chuck on a lathe machine.





(a) (b)

Figure 1. Lathe Machine [4]

The working principle of the lathe as shown in Figure 1.a.b is to rotate the workpiece fastened with a chuck on a fixed shaft (spindle) with the help of an electric motor. The cutting tool then approaches the workpiece slowly and cuts the material in a linear motion. The initial workpiece diameter is expressed as Do while the diameter after cutting is expressed as Df in millimetres (mm). In general, lathes are used to produce a smooth and precise surface on the workpiece by cutting the material in a regular manner. Lathes can also be used to make various types of holes, threads, and other parts of the workpiece. Some lathe processes that are often carried out in the manufacturing industry are; face lathe, cylindrical lathe, groove lathe, eccentric lathe and hole expansion (boring) [2].

Lathe Parameters

Lathe parameters are the main variables that can affect the production of work materials. To get optimal results, lathe parameters need to be matched with the test specimen and the type of cutting tool to be used. There are 3 parameters used in the lathe process, namely cutting speed, depth of cut, and cutting motion speed**.**

Cutting speed

Cutting speed is the twist of the test specimen in the cutting process that is eroded by the tool when the material rotates for one minute and is expressed in metres (m).

Type of tool blade wear

Flank Wear

This wear occurs on the side or face of the tool in contact with the workpiece. The cause is friction between the tool and the workpiece which causes erosion of the tool material. Here is figure 2. a.b edge wear on the lathe tool.

(a) (b)

Figure 2. Side Wear

METHOD

The method of collecting data on lathe tool blade wear is done by measuring the length of tool blade wear before and after use using a microscope and evaluating the geometry and surface quality of the lathe results. In this dissolution, the workpiece used is SKD 11 steel with a carbide lathe tool type CNMG 120408 Coating. This study uses an experimental method by varying 3 different lathe spindle rotations of 450, 710 and 1120 rpm with a depth of cut of 0.5 mm and a feed motion (f) of 0.16 mm/put and variations in the length of the feed (Lt) of 600 mm, 400 mm and 200 mm at each Rpm variation of cutting speed Vc 99 m/min, Vc 172 m/min, Vc 292 m/min Visual observations can also be made to see signs of wear such as cracks, dullness, or discoloration of the tool blade.

The equipment used in this study is as follows:

Lathe Machine

This machine will be operated by varying 3 different lathe spindle rotations of 280 rpm, 450 rpm, and 710 rpm with cutting speeds (Vc) of 99 m/min, 172 m/min and 292 m/min. Feeding 0.16 mm/rev and length of feed (Lt) 200 mm, 400 mm, 600 mm with a depth of cut of 1 mm. The following figure 3. lathe used in data collection

Figure 3. Conventional Lathe

Digital Microscope

This microscope adopts HD resolution of 0.3m pixels, providing a perfect display to observe objects and be able to measure them at the same time. Video Capture Resolution: 640 x 480 Focus Range: Manual Focus from 15~40 mm. The following figure 4. Digital microscope used in data collection

Figure 4. Digital microscope

Lathe Chisel

The selection of carbide inserts refers to the workpiece material, machining variables and type of machining. The tool geometry is determined by the shape of the cutting geometry and the type of tool holder available for the carbide insert tool and has the ability to withstand high cutting speeds ranging from 250 m/min to 400 m/min and in accordance with the recommendations of the catalogue of machining. [5] The carbide tool bits used are CNMG 120408

Figure 5. Carbide CNMG 120408

Steel Material

SKD 11 steel is a type of high-alloy steel known for its superior properties, especially in terms of hardness and wear resistance. It falls under the category of tool steel which is widely used in the manufacture of cutting tools, moulds, and machine components that require high hardness.[6]

Here is a more detailed explanation of steel SKD 11:

Table 1. explanation of steel SKD 11

Chemical	Composition	Mechanical Properties	
Karbon (C)	1,45 - 1,60%	Violence	58 - 62 HRC
Kromium (Cr)	11,0 - 13,0%	Tensile Strength	1.800 - 2.100 MPa
Vanadium (V)	0,80 - 1,20%		
Tungsten (W)	0,50 - 1,10%		
Molibdenum (Mo)	0,20 - 0,50%		

Applications for the manufacture of cutting tools such as knives, saws, chisels. Mould making for the plastics and rubber industries. Machine components that require high hardness, such as gears, bearings, and press tools.[7]

Sampling Method

This research uses the transverse turning method. Transverse turning is a lathe process when the cutting tool movement is parallel or linear with the spindle axis. The test specimens will be turned starting with determining the spindle rotation parameters of 450, 710 and 1120 rpm with a depth of cut of 0.5 mm and a feed motion (f) of 0.16 mm / input and variations in cutting length (Lt) 200 mm, 300 mm and 600 mm at each Rpm and cutting speed variations, namely (Vc) 99 m/min, (Vc) 172 m/min and (Vc) 292 m/min. The following figure 6. at the time of data collection.

Figure 6. Transverse Turning

RESULT AND DISCUSSION

In this study what was analyzed was edge wear (Flank Wear), edge wear was seen using a Digital Microscope and measured after several turning variables were completed. Based on the turning process that has been carried out, the following data will be analyzed.

Turning Results Table

The following is a table of tool blade wear values with variations in cutting speed between 99 m/min,172 mm/min and 292 m/min, and variations in feed lengths of 200 mm, 400 mm and 600 mm with a constant feed 0,16 mm/rev with 1 mm depth of cut

Table 2. Turning Data

Feeding Motion : 0.16 mm/rev

Depth of Cut : 1.0 mm

No	Rpm	Vc m/min	Cutting Length (Lt) Wear Value (VB) 600 mm	400 mm	200 mm
1	450	99	0.135	0.110	0.085
2	710	172	0.161	0.101	0.067
3	1120	292	0.228	0.152	0.093

From the data collected in the form of table 1 above to facilitate analysis, it can be concluded that the higher the cutting speed, the faster the tool wear occurs. (VB)

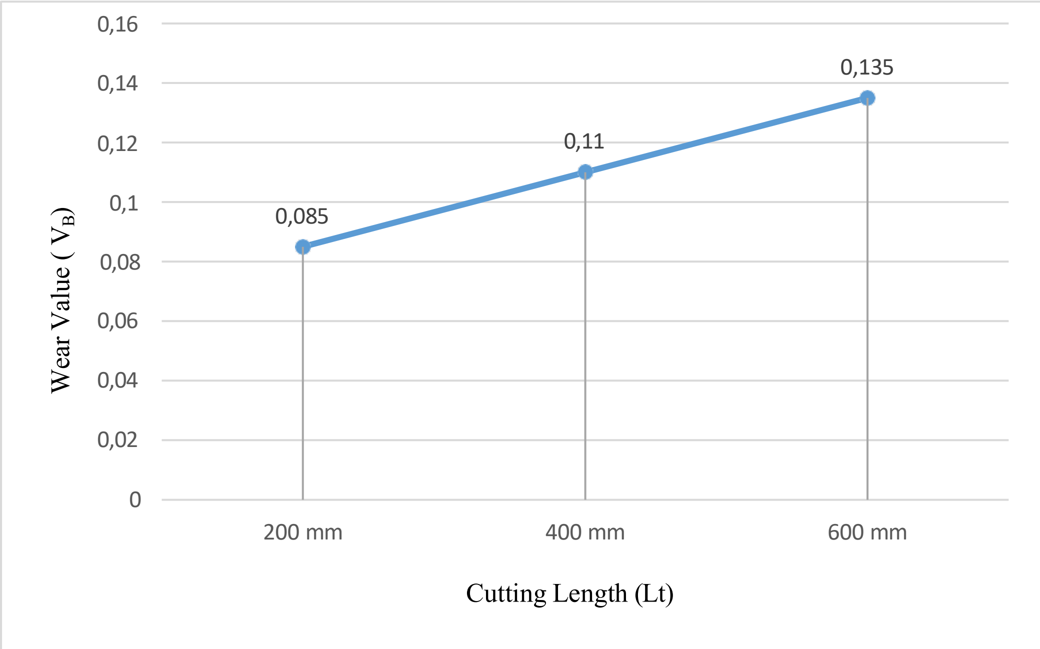


Figure 7. Graph of Tool Blade Wear at Vc 99 m/min

From the Figure 7. On the feeding motion Vc 99 m/min with the addition of cutting length resulting in an increase in the tool edge wear value so that the tool life will decrease. The higher cutting speed of the chisel used, it will experience wear which is characterized by the surface of the workpiece being cut increasing. rough, the cutting force that occurs increases and visually the lathe tool will change color.

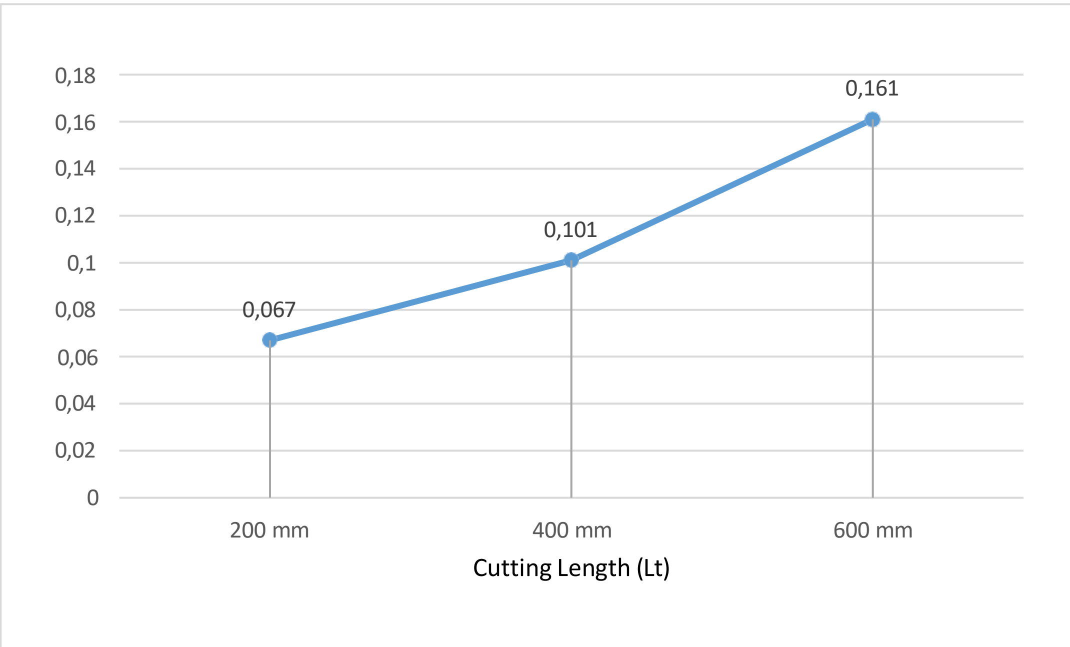


Figure 8. Graph Of Tool Blade Wear At Vc 172 M/Min

From the Figure 8. On the feeding motion Vc 172 m/min with an increase in cutting length results in an increase in the tool edge wear value so that the tool life will decrease.The higher cutting speed of the tool used, it will experience wear which is indicated by the surface of the cut workpiece getting rougher, the cutting force that occurs increases and visually the lathe tool will change color.

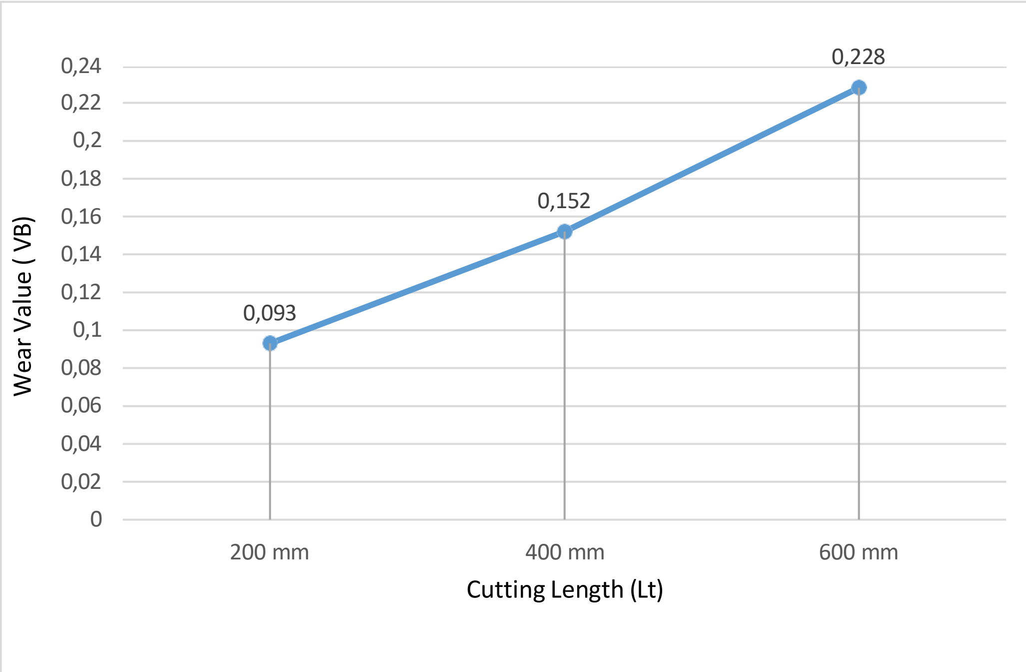


Figure 9. Graph of Tool Blade Wear at Vc 292 m/min

From the Figure 9. On the feeding motion Vc 292 m/min with an increase in cutting length results in an increase in the tool edge wear value so that the tool life will decrease. The higher cutting speed of the tool used, it will experience wear which is indicated by the surface of the cut workpiece getting rougher, the cutting force that occurs increases and visually the lathe tool will change color.

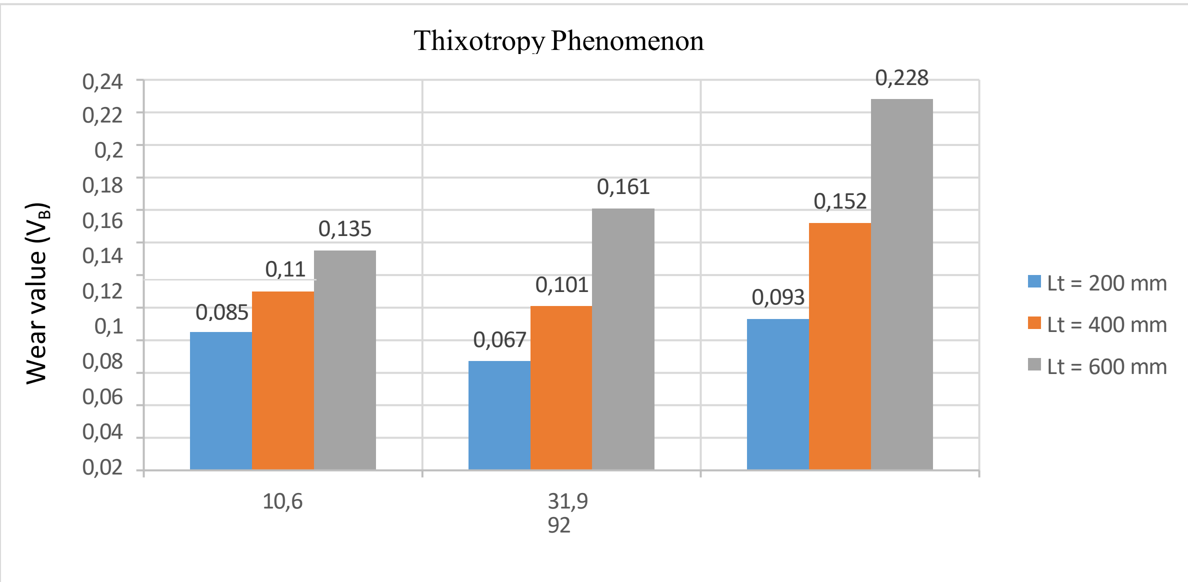


Figure 10. Graph Of Turning Kinetic Energy At Vc 99 M/Min, Vc 172 M/Min, And Vc 292

From the Figure 10. on the feeding motion Vc 99 m/min, Vc 172 m/min and Vc 292 m/min with the addition of cutting length, there is a phenomenon of thixotropy, namely where the material changes viscosity when given penetration or a shift occurs.. Which results in variations in the increase in kinetic energy values is:

1. In turning at Vc 99 m/min the kinetic energy value is 10,6 joule
2. In turning at Vc 172 m/min the kinetic energy value is 31,9 joule
3. In turning at Vc 292 m/min the kinetic energy value is 92 joule.

CONCLUSIONS

Based on the research that has been conducted, it can be concluded as follows that cutting speed (Vc) affects the wear of the lathe tool blade on SKD11 material. The higher cutting speed (Vc), the more the tool blade wear value (VB) increases. (see table 1). This is due to heat and friction between the cutting edge and the test piece.

The highest lathe tool blade wear value (VB) is worth 0.228 mm with a feed length of 600 mm and a cutting speed of 292 m/min, and the lowest lathe tool blade wear value (VB) is 0.067 mm with a feed length of 200 mm at a cutting speed (Vc) of 172 m/min. The wear that occurs on the lathe tool blade is edge wear or also abrasive wear due to the continuous contact of two materials so that it rubs between the lathe tool blade and the SKD11 material. Cutting speed in SKD11 steel is one of the factors that contribute significantly to the occurrence of wear on the lathe tool blade. The tool will experience wear due to friction with a wider range of work materials, which can cause more wear on the lathe tool blade.

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