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Influence Speed High-Speed Steel Chisel Cut Against Integrity Carbon Steel Surface

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ABSTRACT (9 PT)

This research aims to investigate the Influence of High-Speed Steel Cutting Tool Speed on the Surface Integrity of Low Carbon Steel. Low carbon steel is a commonly used material in the industry due to its strength and corrosion resistance. However, the steel processing processes diminish its quality and service life. In this study, variations in high-speed steel cutting tool speeds were used to examine their influence on the surface integrity of low carbon steel. The research results indicate that the cutting speed of high-speed steel tools has a significant impact on the surface integrity of low carbon steel. It was found that increasing the cutting speed can reduce surface damage and make the surface smoother, thereby improving the quality and service life of low carbon steel. However, excessively high cutting speeds can also lead to overheating and excessive wear. Additionally, other factors such as cutting fineness and tool conditions need to be considered in maintaining the surface integrity of low carbon steel. This research provides a better understanding of the relationship between high-speed steel cutting tool speed and the surface integrity of low carbon steel, which can be used as a guideline in the low carbon steel processing to optimize quality and efficiency.

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1. INTRODUCTION

The more increasing development life man then the times follow develop with fast . Because of development humans are very advanced so field technology has followed suit experience advanced development as well (Asry, 1993) . In an era of dynamics industry continued manufacturing development , innovation and improvement of production processes become key For maintain Power competitive (Mazwan *et al.,* 2024) . According to Rosdiana *et al.,* (2020) , technology Keep going develop along with development industry manufacture If reviewed from side results production required technology that can give optimal and efficient results (Xu *et al.* , 2018) .

Manufacturing Process is something method or process applied For change form something objects ((Trihutomo , 2015) ; Klahn *et al.* , 2015) . Manufacturing is closely related related with manipulation or technique . According to Jannah *et al.,* (2023) manufacturing process objectives is For produce components that use certain materials with consider shape , size and structure . These processes are very interconnected tightly with the world of machinery . Where is the field machining hold role important in progress technology in the world. Increase quality end from the machining process own significant impact to Power competitive product , efficiency production , and costs whole (Mazwan *et al.,* 2022) .

According to Sitorus *et al.,* (2017) , principles base machining is ability chisel toughness to object Work . Many developments in materials chisel To use For the more increase machinability , where geometry and materials chisel is things to consider (Zhou *et al.* , 2013) .

Principle Work machine lathe namely : shaft spindle will twist object Work through plate carrier so that twist wheel teeth on the spindle shaft (Akhmadi & Usman, 2018) . Through wheel tooth connecting , round will be delivered to wheel tooth axis thread . By clamps threaded , round axis thread the changed become motion translation of the carrying part chisel . The effect on things Work will happen incision . More quality tall No only create more products interesting for consumers , but also reduce finishing and repair costs , increase satisfaction customers , and reduce risk security (Main *et al.,* 2022) .

According to Khair *et al.,* (2020) , each surface from A object own a number of various shapes variety according to its structure nor from the results of the production process . *Roughness* or rudeness defined as no subtlety forms that accompany the production process caused by workmanship machine (Yusuf & Carles, 2020) . Roughness value stated in *Roughness Average* (Ra). Ra is the most common roughness parameter used in a way international . Ra is interpreted as arithmetic mean and deviation absolute profile rudeness from the mean centerline (Fecske *et al.,* 2020) .

2. RESEARCH METHOD

Research location in Workshop lathe helmi Jl. CL. Yos Sudarso and the Engineering Laboratory of Medan State University (UNIMED)

2.1 Sampling Technique and Sample Size

The sampling technique and sample size can be presented in tables 1 and 2 as follows:

Table 1. Sampling technique

Speed Cut (Cs) (m/ min)	Depth (mm)	Feeding (mm/ rev)
12.74 minutes	0.5	0.040
6.37 minutes	0.5	0.040
4.25 minutes	0.5	0.040

Table 2. Large sample of objects work and tools it works

Workpieces Used	Workpiece Specimen	Material Measuring Tools	Insert tool used
Low Carbon Steel	The length of the object is 40 cm	Vernier calipers	HSS chisel
Low Carbon Steel	Object diameter 50 mm	Vernier calipers	HSS chisel
Low Carbon Steel	Used length 30 cm	Vernier calipers	HSS chisel

2.2 Design / Research Design

2.2.1 Machining Process

Specification machine lathe used in the research This is as following:

Type / No. Series : OKUMA LS 3134
Made in : Japan
Maximum length workpiece11 : 1200 mm
Maximum width object Working : 300 mm

Round spindle shaft : 35-1800 rpm

Figure 1. Machine lathe okuma LS 3134

2.2.2 Testing Process Rudeness Surface

Steps taken during the testing process rudeness object Work is: Prepare surface roughnesh tester tool; Prepare the materials to be tested his rudeness; Take data every 1200 on the bar material cylinder with three point testing; Print result data rudeness surface

Furthermore measurement rudeness surface can done with the same way for other materials.

Test Type : Surface Roughness Tester (Roughness)
Tool Type : Tool Type
Model : Surfcorder SE300
Ser.No : ME-52083
Test Length : 2.5 mm
Material : Low Carbon Steel

Figure 2. Measuring tool roughness (surface tester)

2.2.3 Implementation Study

Steps taken during the machining process is: Prepare equipment to be used; Prepare and check size object Work; Do installation the chisel will used; Install object working on the chuck in the machine lathe; Setting cutting parameters on the machine; After the process is complete, then material processing will be done turned can done in accordance specified size Furthermore turning of other materials is possible done with the same way.

Material specifications used in research This is as following:

Type / No. Series : HITACHI NS – 1045
Made in : Japan
Carbon Content (C) : 0.43 – 0.50

Content (Mn) : 0.60 – 0.90
Content Silicon 27 (Si) : 0.15% - 0.35%
Content Phosphorus 30 (P) : 0.040 (max)
Sulfur (S) : 0.050 (max)
Material length : 40 cm
Meterial Diameter : 50 mm

2.2.4 Data analysis technique

Varying Materials and Speed Cut with given code certain.
Cutting First (A)
Cutting Second (B)
Cutting Third (C): first digit after letter are the first material, second digit, and third digit is speed he cut.

For taking the data use random sampling system with draw lots use bottles that have been written the. Do Collecting data on roughness, hardness and visual image of the material based on existing data variables taken. Prepare tool measure (term shove, surface tester, hardness tester, microscope metallography) which will used.

3. RESULTS AND DISCUSSIONS

3.1 Result

3.1.1 Material cutting process

First prepare steel materials carbon low will be cut its surface with three level speed different cuts, namely: Cutting steel carbon first (A) with speed cut low with time cut 12.74 minutes; Cutting steel carbon second (B) with speed cut currently with time cut 6.37 minutes; Cutting steel carbon third (C) with speed cut tall with time cut 4.25 minutes.

Third after finished done cutting surface, then the material is cut Again become three part so it doesn't difficult do testing rudeness surface, then testing process is carried out his rudeness.

3.1.2 Testing process rudeness surface and results

Testing process rudeness started with cleaning surface carefully, that is with taking three point smoothed surface at every 1200 in points shaft, with three steel material carbon the same low and become nine point testing. In addition to process parameters, fluids cutting or *cutting fluid* also gives influence important in increase quality the resulting surface (Mazwan *et al.,* 2024) . Use fluid cutting can lowering the temperature during the cutting process so that Can reduce happen deformation plastic in the material.

Then after done refinement existing surface determined then the material is ready smoothed will done testing rudeness surface with tool *Surface Tester* (Rasyadi & Iswanto, 2024) , where results testing rudeness surface can seen in the table following :

Table 3. Value table rudeness axis (μm).

Speed Engine (RPM)	Roughness Value (Ra)		
	1	2	3
(A) 12.74 minutes	9,489	9,627	9,484
(B) 6.37 minutes	4,485	4,979	5,106
(C) 4.25 minutes	4,136	4,176	3,749

Figure 3. Value results rudeness First

Figure 4. Value results rudeness second

Figure 5. Value results rudeness third

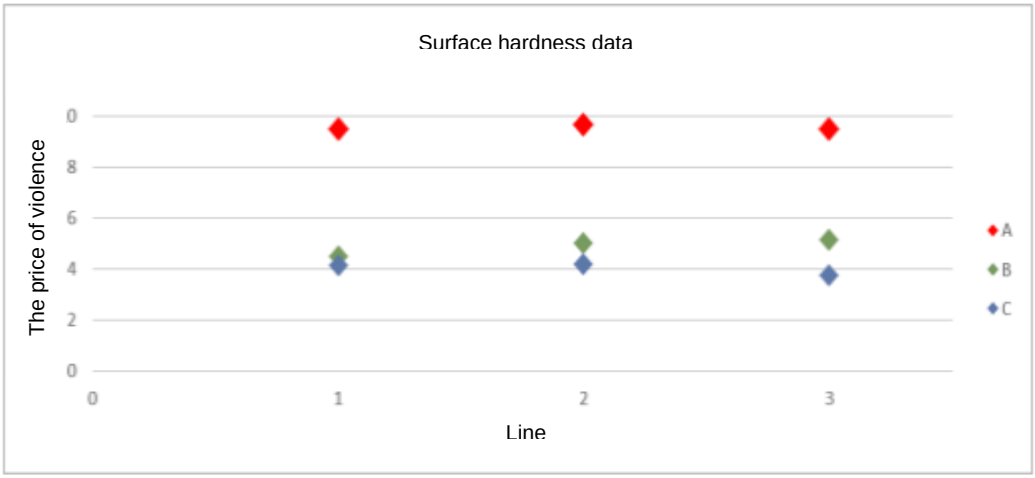

Figure 6. Results diagram rudeness

From the results testing that rudeness has done , done there is influence speed cut HSS chisel Harahap MR & Suriyanto A, (2018) , on steel carbon low with three level speed different cuts, namely at first speed cut low with time cut 12.74 minutes , second speed cut currently with time cut 6.37 minutes , third speed cut high with time cut 4.25 minutes . Where is it possible? tall speed cutting used on steel materials carbon low , then will the more smoother and more small mark his rudeness (Ibrahim *et al.,* 2020) .

3.1.3 Retrieval Process picture With Microscope Metallography and results

Retrieval process picture with microscope metallography with take A little cuts in three steel materials carbon low (Cempaka Kusuma *et al.,* 2024) . Then smoothed surface piece surface steel carbon low.

Therefore that is, wear and tear more chisel big can cause piracy in the cutting process , p This will produce formation Burryang more big (Khanghah *et al.,* 2015) . After That made resin as receptacle seat for steel materials carbon low earlier , so that it doesn't shake things up and focus on the moment see picture with microscope metallography , following results the picture .

Sample A

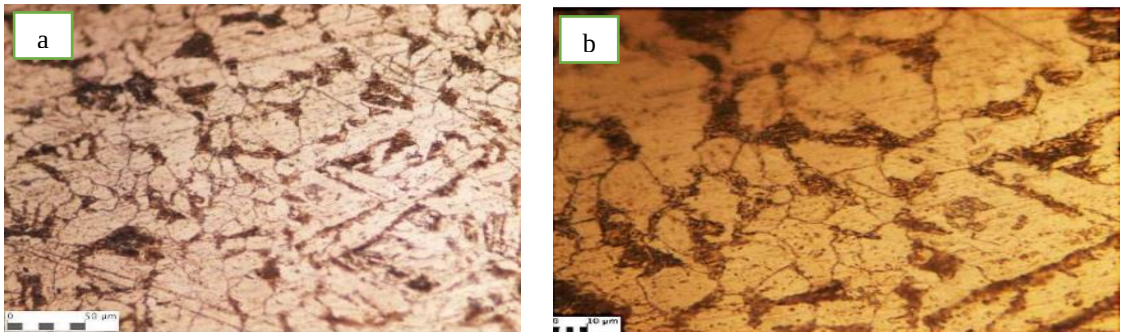

Figure 7. (a) Sample A with 100x magnification and (b) Sample A with 200x magnification

Sample B

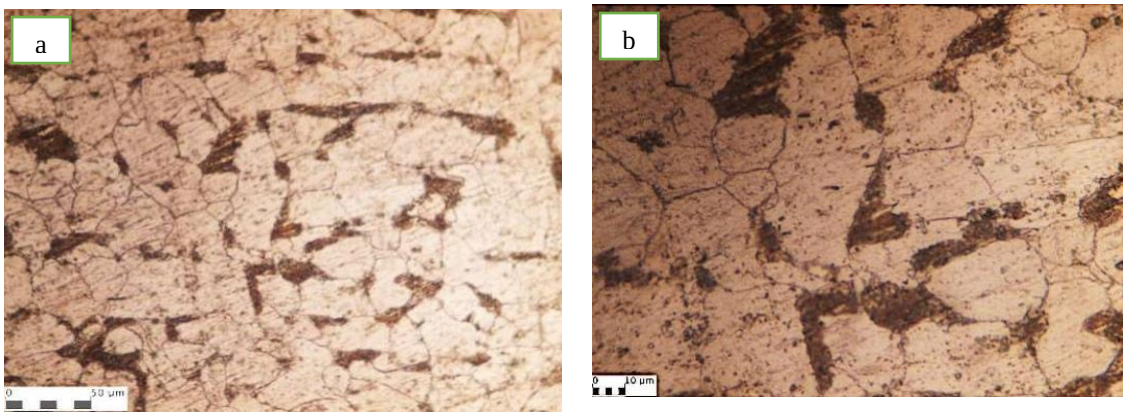

Figure 8. (a) Sample B with 100x magnification and (b) Sample B with 200x magnification

Sample C

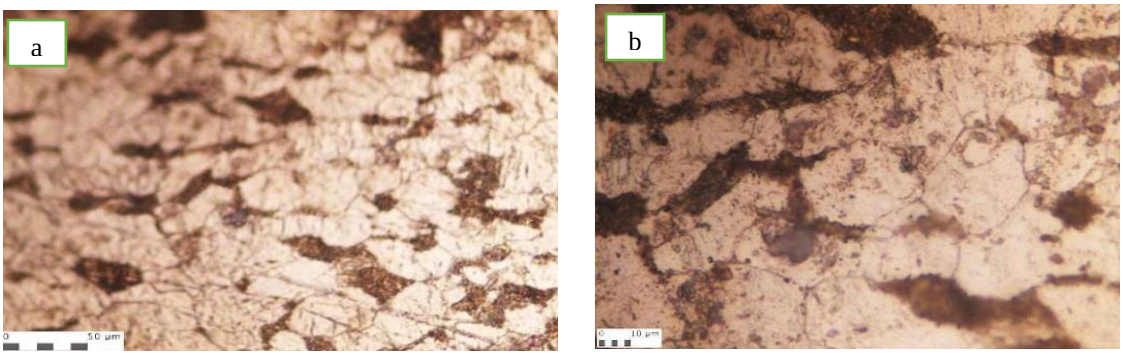

Figure 9. (a) Sample C with 100x magnification and (b) Sample C with 200x magnification

3.2 Discussions

This research systematically explores the effect of cutting speed on the cutting process of low carbon steel using HSS cutting tools. The research results show that there is a positive correlation between increasing cutting speed and increasing surface quality, characterized by a smoother and flatter surface. This indicates that at a certain cutting speed, friction between the cutting tool and the work material can produce a better surface. However, research also found that there is an upper limit for cutting speed. Exceeding this limit will cause excessive heat which can damage the steel surface and accelerate cutting tool wear. In addition to cutting speed, other factors such as smoothness of cut and tool condition also play a role in determining the quality of the final surface. Therefore, to achieve optimal cutting results, it is necessary to balance various cutting variables. These findings have broad implications in the manufacturing industry. By understanding the relationship between cutting speed and surface quality, manufacturers can optimize the cutting process, reduce production costs and improve the quality of the final product. This research also opens up opportunities for further research, such as analyzing the influence of other variables, testing different materials, or developing mathematical models to predict surface quality.

The results of this research provide practical guidance for the manufacturing industry in optimizing low carbon steel cutting processes. By knowing the optimal cutting speed, manufacturers can increase production efficiency and reduce costs associated with cutting tool damage and defective products. In addition, the final product produced will have better surface quality, so it can meet higher quality standards and increase the product's competitiveness in the market. This research also highlights the importance of cutting tool maintenance and selecting appropriate cutting parameters to achieve consistent results.

4. CONCLUSION

Study This has succeed identify influence speed cut HSS chisel against integrity surface steel carbon low. Research result show that speed cut HSS chisels have impact significant to quality surface and age use steel carbon low . Enhancement speed cut can reduce damage to the surface , making it more smooth , and finally increase quality and age use steel carbon low . However , findings this also shows that too tall speed cut can cause problem such as overheating and excessive wear . Therefore the , settings speed cut must noticed in a way be careful and guarded within optimal limits for maximizing the benefits without damage the material.

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Optimization speed cut at the right value For maximizing benefit without damage the material. Consider other factors such as subtlety cut and condition chisel in the processing process . Study more carry on For explore other influencing parameters integrity surface steel carbon low .

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