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TOOL LIFE ANALYSIS OF THE CAR LEAF SPRING

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ABSTRACT

Car leaf spring NISSAN CK12 included in the class of spring steel. The main properties of the steel spring are the elastic modulus and elastic limit. This study aimed to analyze the age and tool wear made from the leaf spring NISSAN CK12 and the HSS. This study uses a conventional lathe tool and Electronic Microscope to take a micro image of the eyes of the tool. The average value of hardness is highest in lathe tool from the leaf spring NISSAN CK12 which treated by Quenching 800ºC holding time of 60 minutes (heat treatment) hardness value by an average of 638.082 HV and from HSS lathe tool amounted to 623.723 HV. From the results obtained on the lathe Tool HSS during the cutting speed Vc = 66.7 m / min VB = 0.3017 tc = 7.17 min f = 0.3 mm / put, Non Treatment tool during the cutting speed Vc = 66 , 7 m / min, a = 0.7 mm VB = 0.3061 with tc = 6.77 minutes. Heat Treatment tool on cutting speed Vc = 66.7 m / min f = 0.3 m / put a = 0.7 mm VB = 0.3051 tc = 6.77 minutes. From the test results it can be concluded that the cutting speed (Vc) 66.7 m / min with a depth of 0.7 mm eating the entire tool wear results can be seen in cutting speed (Vc) 66.7 m / min with a depth of 0.7 mm that the tool of the leaf spring car given the heat treatment has a longer lifespan tools age compared with the leaf spring car Non Treatment. While the HSS has age and the wear rate which is higher than the second tool of the leaf spring car. As seen in HSS tool, the tool age is 1,41 min, Heat treatment tool 1,45 min, non heat treatment tool 1,46 min.

Keywords: car leaf spring, lathe machine, tool, wear, hardness

1. INTRODUCTION

The machining parameters include spindle rotation speed and cutting depth feeds. Determining the quality of machining one seen from the surface roughness (Rochim, 1993). Cutting tools machine is a machine designed for cutting or slicing the workpiece using a chisel both conventional and non-conventional. Machining process included in the classification process of metal cutting is a process used to change the shape of a product from metal (engine components) by cutting, peeling or splitting with the use of machine tools. According to the type of combination of motion and motion eat then cut machining processes are grouped into seven different processes. In the process of lathes, cylindrical workpiece resulting from the combination of motion chisel and workpiece. Rotating the workpiece and the cutting tools driven into the surface of the workpiece by moving transversely by shifting carriage on the engine cradle. This process is repeated several times until you get the desired diameter (Rochim, 1993). Damage and wear tools will occur and the cause must be known to determine corrective action so that the subsequent machining process tool life is expected to be higher.Figure 1 shown wear on tools.

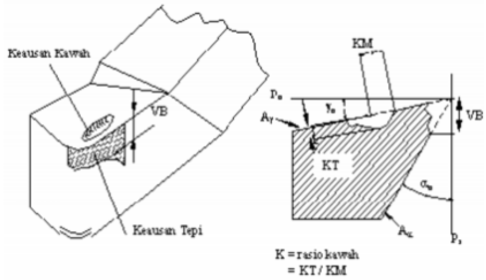

Figure 1. wear Crater (KT) and wear on the edges (VB). (Rochim, 1993)

Based on the results of research on the wear and damage chisel can be concluded that the cause of the wear and damage chisel can be a dominant

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factor or combination of factors particular. The causative factors include: (Rochim, 1993)

Age determination is based chisel tool life equation proposed by F.W. Taylor (1907) is written as follows

(Rochim, 1993)$v\,T^n = C_T$ (2.5)

v: cutting speed (m / min)
Q: tool life (minutes)
n: exponent depends on cutting conditions
C: constant (tool life)

The larger the tool wear, the conditions will be increasingly critical. If the chisel is still used then growth will wear more quickly and at a chisel tip at all damaged. , For example, based on the experience of the permitted wear limit for a particular type of cutting tool used to cut a workpiece types are as follows:

Table 1 Critical wear limit of materials

Pahat	Benda kerja	VB (mm)	K
HSS	Baja & besi tuang	0.3 – 0.8	-
Karbida	Baja	0.2 – 0.6	0.3
Karbida	Besi tuang & non ferrous	0.4 – 0.6	0.3
Keramik	Baja & besi tuang	0.3	-

Leaf spring included in the class spring steel. Steel springs fact did not have a high hardness as its main properties. The main properties of the steel spring is the elastic modulus and elastic limit, but for low alloy steel elastic modulus is said to remain, therefore problem in the industry is how to use the elastic limit in order to gain the power that allowed higher

Specimens used in this study is a leaf spring NISSAN CK12. The test specimens was performed in LAB NDT PT PUSRI PALEMBANG using a Thermo ARL. The result of the chemical composition of the specimen leaf spring NISSAN CK12 can be seen in Table 3.1 below:

Table 2. Chemical Composition

No.	Chemical elements	Symbol	percentage of Elements (%)
1.	Iron	Fe	97,309
2.	Carbon	C	0,5264
3.	Silicon	Si	0,1724
4.	Manganese	Mn	0,8957
5.	Chromium	Cr	0,9114
6.	Molibdenum	Mo	0,0289
7.	Nickel	Ni	0,0454
8.	Aluminium	Al	0,0125
9.	Cobalt	Co	0,0044
10.	Cuprum	Cu	0,0666
11.	Titanium	Ti	0,0028
12.	Wolfram	W	0,0086

In this work specimen to be tested as many as three specimens consisting of one specimen HSS lathe chisel, lathe chisel one specimen of the leaf spring NISSAN CK12 non heat treatment, and a lathe chisel specimen of the leaf spring NISSAN CK12 is in heat treatment. At this hardness testing used a pyramid-shaped diamond indenter with an angle 1360. Each specimen is given the test load (P) 50 kgf for (t) 10 seconds.

2. RESULTS AND DISCUSSION

In Tests conducted to determine the wear HSS, Heat Treatment and Non Sculpting Treatment is limited to a maximum edge wear VB max = 0.3 mm. In this test using the test material of low carbon steel with a length of 250 mm, with mevariasikan spindle rotation (rpm) and the depth of the meal. Here are the results of testing tool wear as written in Table 3.

Table 3. Wear test data

Pahat Heat Treatment

rpm (n)	a (mm)	Vc (m/min)	Vf (mm/min)	f (mm/put)	lt (mm)	Tc (menit)	VB
300	0.5	23.5	91	0.3	1000	10.98	0.0736
					1500	16.48	0.1466
					1700	18.68	0.1526
580	0.6	45.1	175	0.3	1000	5.71	0.0804
					1500	8.57	0.1889
					1700	9.71	0.1988
850	0.7	66.7	251	0.3	1000	3.98	0.1056
					1500	5.97	0.2044
					1700	6.77	0.3051

Pahat Non Heat Treatment

rpm (n)	a (mm)	Vc (m/min)	Vf (mm/min)	f (mm/put)	lt (mm)	Tc (menit)	VB
300	0.5	23.5	91	0.3	1700	18.68	0.1068
580	0.6	45.1	175	0.3	1700	9.71	0.2134
850	0.7	66.7	251	0.3	1700	6.77	0.3061

Pahat HSS

rpm (n)	a (mm)	Vc (m/min)	Vf (mm/min)	f (mm/put)	lt (mm)	Tc (menit)	VB
300	0.5	23.5	91	0.3	1000	10.98	0.0345
					1200	13.18	0.1306
					1500	16.48	0.1720
					1700	18.68	0.2010
580	0.6	45.1	175	0.3	1000	5.71	0.1109
					1200	6.85	0.1773
					1500	8.57	0.2076
					1700	9.71	0.2280
850	0.7	66.7	251	0.3	1000	3.98	0.1281
					1200	4.78	0.1841
					1500	5.97	0.2007
					1700	6.77	0.2534
					1800	7.17	0.3017

In this study conducted by varying the cutting speed (Vc) and cut into (a). Each increase in value Vc, the depth of intersection is also increased in accordance with the conditions of its machinery itself.

From the testing that has been done, the data obtained are listed in Table 3, we can make a graph of the effect of tool wear on the cutting speed and depth of the following meal.

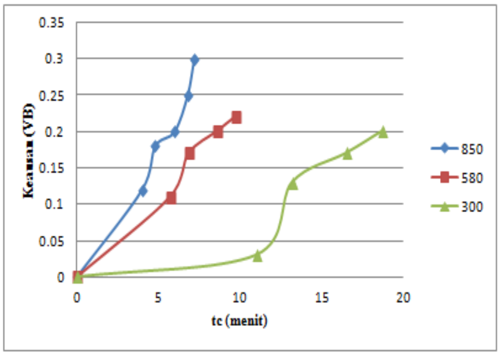

Figure 2 HSS turning Results

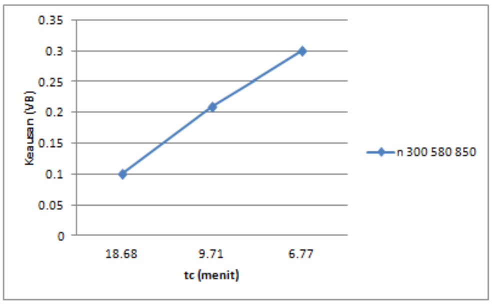

Figure 3 The resulting graph lathe non-treatment tool

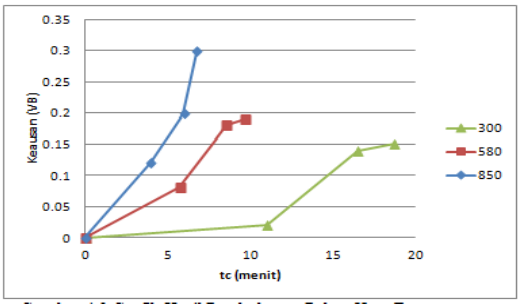

Figure 4 Graph Results turning Heat Treatment tools

From the chart above we can see figure 2 on HSS tool during the cutting speed Vc = 66.7 m / min, f = 0.3 mm / put and a = 0.7 mm generated by the VB = 0.3017 tc = 7, 17 minutes. Then we see Figure 4.2 on non sculpting treatment during the cutting speed of 66.7 m / min, f = 0.3 mm / put and a = 0.7 mm generated by the VB = 0.3061 tc = 6.77 minutes. Then we see figure 4.3 on Tool Heat Treatment on cutting speed Vc = 66.7 m / min, f = 0.3 mm / put and a = 0.7 mm generated by the VB = 0.3051 tc = 6.77 minutes.

From the test results can be concluded that cutting speed (Vc) 66.7 m / min with a depth of 0.7 mm eating the entire chisel wear results can be seen in cutting speed (Vc) 66.7 m / min with a depth of 0.7 mm

At low speed the wear and tear that happens has not reached its limit as the depth of cut varies along its increased cutting speed. Damage to the eye caused chisel abrasive processes arising from the friction between the cutting tool to the workpiece. With its increased cutting speed and depth of the meal, chisel eye damage caused adhesion process pressure and temperature are relatively high. Adhesion process occurs around the eyes cut in the field of chip and main areas of the eye that causes wear chisel edge (Vb).

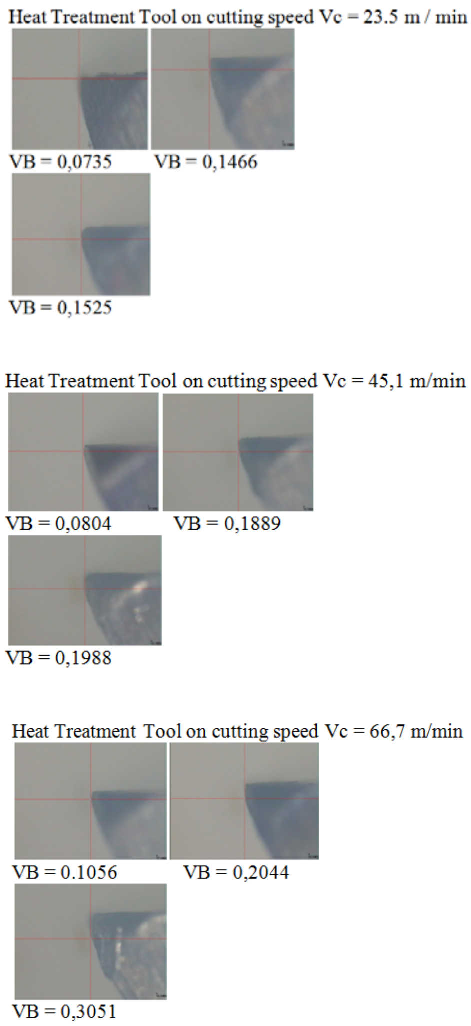

Figure 5 The wear phenomenon Sculpture Heat Treatment

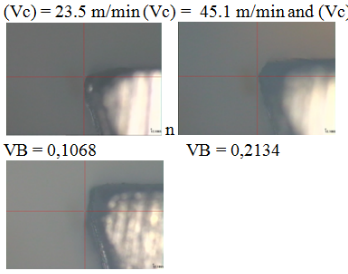

Figure 6 The phenomenon of wear of Non Treatment tool

At the same cutting speed with a chisel before her. The phenomenon of wear and tear incurred in non chisel treatment experienced a high degree of wear. Due to the process of cracking and fatigue. It is extremely short tool life due to broken corner chisel as the cutting speed (Vc) = 23.5 m / min. When the cutting speed is increased, the process resulting in fracture of the eye chisel cracks as in figure 6 with the value Vb = 0.3061.

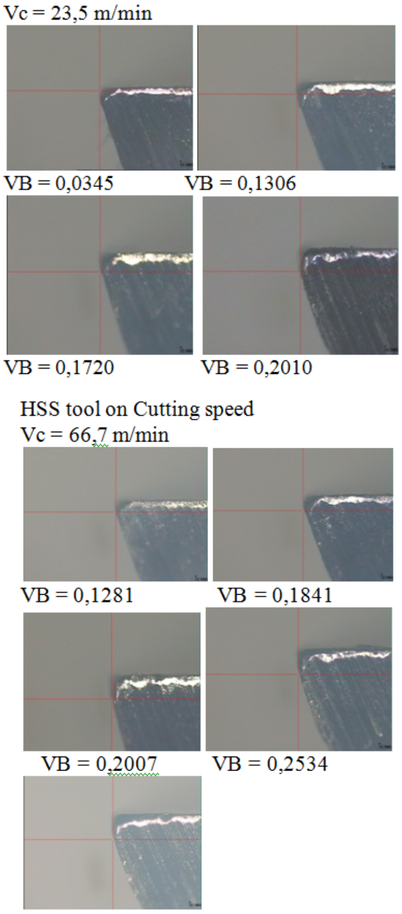

Figure 7. The wear phenomenon HSS tool

On the use of the HSS also vary the cutting speed and depth of the cut to determine wear and tool life. At high speeds (Vc = 66.7 m / min) undergo plastic deformation due to chisel withstand high voltages that are influenced by temperature (Rochim, 1993). It was on testing in HSS do a lot of long-eaters (lt) for 5 times in order to limit the wear obtained so that the power chisel also decreased with increasing depth of cut.

To determine the theoretical tool life can be calculated using the formula, known as the Taylor tool life equation ditelah as described previously (2.7). Price exponent n in Taylor's formula determined by the price exponent m of the correlation of two dimensionless quantities at reasonable prices for a type of cutting tool based on the results obtained in practice.

$$V.T^n = C_{TB} \qquad (2.5)$$

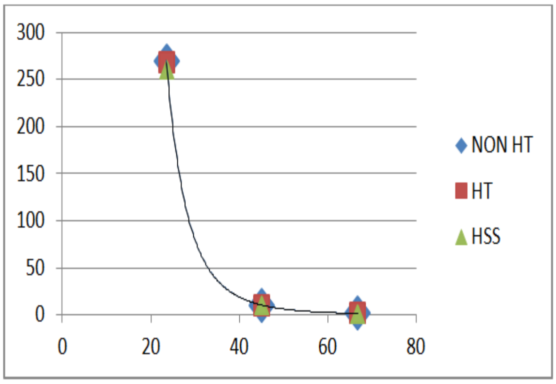

Figure 8. Tool life diagram

Tool life constitutes the entire cutting time (T) that is achieved bataskeausan who have ditetapka (VB max = 0.3 mm). Tool life can be determined by using the empirical analysis tool life persanaan Taylor graph tool life is shown, it appears that with increasing cutting speed (Vc), the tool wear will increase as well and tool life will decrease. Seen in its HSS tool life of 1.41 minutes, Heat Treatment 1,45min Non Treatment 1.46 min.

Table 4 Hardness (Vickers) In Lathe HSS tools

No.	P (kN)	d_1 (mm)	d_2(mm)	$\left(\bar{d} = \frac{d_1 + d_2}{2}\right)^2$	*HV*
1.	50 kgf	0,374	0,378	0,141	6257,446
2.	50 kgf	0,383	0,383	0,146	565,243
3.	50 kgf	0,388	0,375	0,145	713,077
4.	50 kgf	0,390	0,398	0,155	590,466
5.	50 kgf	0,396	0,398	0,157	586,708
6.	50 kgf	0,384	0,389	0,149	686,666

Table 5. Hardness Test Results Tool Of Spring Leaves tool Car NISSAN CK12 Non Heat treatment

No.	P (kN)	d_1 (mm)	d_2(mm)	$\left(\bar{d} = \frac{d_1+d_2}{2}\right)^2$	HV
1.	50 kgf	0,488	0,489	0,238	389,495
2.	50 kgf	0,493	0,491	0,242	383,057
3.	50 kgf	0,487	0,489	0,238	389,495
4.	50 kgf	0,488	0,489	0,238	389,495
5.	50 kgf	0,499	0,501	0,25	370,8
6.	50 kgf	0,489	0,489	0,239	387,866

Table 6 Hardness test results tool of spring leaves sculpture car nissan ck12 experiencing treatment quenching 8000c holding time 60 minutes with water media

No.	P (kN)	d_1 (mm)	d_2(mm)	$\left(\bar{d} = \frac{d_1+d_2}{2}\right)^2$	HV
1.	50 kgf	0,382	0,382	0,148	626,351
2.	50 kgf	0,406	0,406	0,164	565,243
3.	50 kgf	0,357	0,365	0,130	713,077
4.	50 kgf	0,402	0,393	0,157	590,445
5.	50 kgf	0,398	0,398	0,158	586,708
6.	50 kgf	0,360	0,375	0,135	686,666

Figure 7. Graph of the average value of Vickers Hardness Test

From all the test results hardness on the tooll lathe above obtained hardness value of the average highest in the tool lathe of the leaf spring NISSAN CK12 the treated Quenching 8000C holding time of 60 minutes (heat treatment) hardness value by an average of 638.082 HV, and successive -turut towards the lows that HSS lathe chisel at 623.723 HV then the smallest value of the average hardness in the treatment of non chisel 385.035. On the value level of hardness experienced by the leaf spring NISSAN CK12, hardness value significantly to chisel lathe of the leaf spring NISSAN CK12 the treated Quenching 8000C holding time of 60 minutes is likely to occur because of the influence of alloying elements contained in the leaf spring NISSAN CK12 the so that the level of hardness is almost equal to the number at HSS tools.

3. CONCLUSION

Based on research data and analysis can be concluded as follows: HSS tool during the cutting speed Vc = 66.7 m / min, f = 0.3 mm / put and a = 0.7 mm produced VB = 0.3 to tc = 7.17 minutes. Non treatment chisel when cutting speed of 66.7 m / min, f = 0.3 mm / put and a = 0.7 mm generated by the VB = 0.3061 tc = 6.77 minutes on a chisel Heat Treatment on cutting speed Vc = 66.7 m / min, f = 0.3 mm / put and a = 0.7 mm generated by the VB = 0.3051 tc = 6.77 minutes. From the test results can be concluded that cutting speed (Vc) 66.7 m / min with a depth of 0.7 mm eating the entire chisel wear results can be seen in cutting speed (Vc) 66.7 m / min with a depth of 0.7 mm.

The sharp graph the results of testing the tool life will become shorter. Seen in its Chisel HSS tool life of 1.41 minutes, Heat Treatment 1,45min chisel, chisel Non Treatment 1.46 min. all of the test results obtained lathe hardness on the average value of hardness is highest in lathe chisel from the leaf spring NISSAN CK12 the treated Quenching 8000C holding time of 60 minutes with medium water hardness value by an average of 628.082 HV, and successive -turut towards the lows that HSS lathe chisel at 623.723 HV, and lowest in the lathe chisel from the leaf spring NISSAN CK12 non heat treatment at 385.035 HV. Significant increase in violence on the lathe tool from the leaf spring NISSAN CK12 the treated Quenching 8000C holding time of 60 minutes is likely to occur because of the influence of alloying elements contained in the leaf spring NISSAN CK12 it.

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