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Analysis Of Feed And Tool Nose Radius On Surface Roughness Cast Iron Material And Tool Life

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Abstract. *Optimization of cutting parameters is intended for the cutting process to find the ability of the cutting tool to do cutting the specimen, we need optimization value of surface roughness and tool life for varied cutting parameters. This experiment us ing gray cast iron as material, SNMG 120408 and SNMG 120412 as cutting tool. Cutting speed (Vc) 100 $^{m}/_{min}$, 125 $^{m}/_{min}$ and 150 $^{m}/_{min}$. Feed (f) .20 $^{mm}/_{rev}$, 0.23 $^{mm}/_{rev}$, 0.27 $^{mm}/_{rev}$. Final results of the present work determine the appropriate parameter for increasing the tool life and surface finish for two different nose radius tools. The optimal value of the process parameters for the desired performance characteristics is obtained by linier regression method. After obtaining the data from the machining results with the experimental design, data processing using minitab 19 software. In terms of surface roughness and tool life, the most influencing factors are feed, cutting speed, and size of the nose radius. The surface roughness will be better if the cutting speed is accelerated, the feed is reduced, and the nose radius is increased. The tool life will be longer if the cutting speed is slowed down, the feed is reduced and the nose radius is increased.*

Keyword: *Surface Roughness, Tool Life, Linear Regression, Nose Radius, Parameter of Cutting Process*

INTRODUCTION

In the metal forming process, cutting speed is an important thing to consider to increase production, which is high, and processing time is relatively low. The use of high cutting speeds, of course, results in a decrease in machining time and an increase in the number of products produced. But another effect is the wear of the cutting tool blade becomes faster. The use of cutting chisels which have higher temperature resistance so they can last longer.

Cast iron workpiece material (Grey Cast Iron) is a metal material that has high hardness, but also has brittle properties. Cast iron is one of the oldest types of metal, which humans have found among the many metals that exist. This metal is widely applied, about 80% for vehicle engines made of cast iron. Cast iron is basically an alloy of iron and carbon eutectic. In the metal machining process, tool life is affected by tool wear, tool wear is caused by friction between the tool blade and the workpiece. The wear of this tool will increase to a certain extent, so that the tool can no longer be used. The length of time to reach this wear limit is defined as tool life, so research is needed to get the wear value that occurs does not exceed the specified standard.

Several things that affect the surface roughness of the turning result, give rise to the idea that the nose radius of the tool and the cutting parameters can affect the surface roughness of the turning result. Based on this assumption, it is necessary to conduct research on "Analysis of Feed and Tool Nose Radius On Surface Roughness Cast Iron Material and Tool Life".

METHODOLOGY

The research method used in this research is the experimental method. Then through the data that has been obtained will be processed using the linear regression method. The processed data will be made into a graph to see changes in the surface roughness of the material and tool life on the tool blade. Making analysis based on data and graphs that have been obtained to be used as conclusions.

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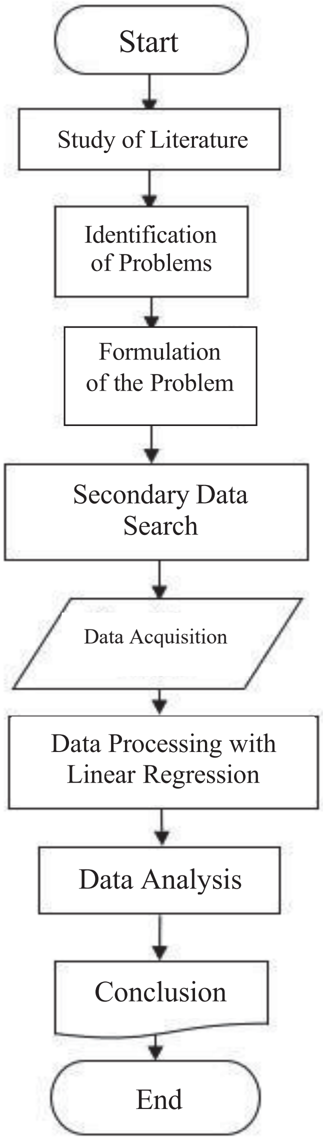

FIGURE 1. Research Process Flowchart

TOOLS AND MATERIALS

1. CNC machine as the machine that will be used in this research to perform the turning process.
2. Toolholder special type boring bar as the holder of the tool to be used, so there must be adjustments to the tool
3. Digital Microscope to observe the wear and tear that occurs on the tool blade during the turning process
4. Surface test to measure the surface roughness that occurs after turning
5. The caliper serves to measure the diameter of the workpiece before and after the machining process
6. The rake angle serves to get an angle to the cutting process by placing it on the tool holder
7. Gray cast iron serves as a research specimen
8. Coated carbide chisels (SNMG 120408 and SNMG 120412) for cutting workpieces

EXPERIMENTAL DATA

The experimental data that have been carried out are then entered into the table. Journal data sources: [4]

SURFACE ROUGHT DATA

The following is the surface roughness data obtained during the experiment.

TABLE 1. Surface Roughness Experiment Result Data when f = 0.27

doc 2.5 mm			
No	Vc (mm/min)	Surface Roughness	
		Nose Radius 0.8 mm	Nose Radius 1.2 mm
1	100	3.8	3.1
2	125	3.1	2.69
3	150	2.63	2.5

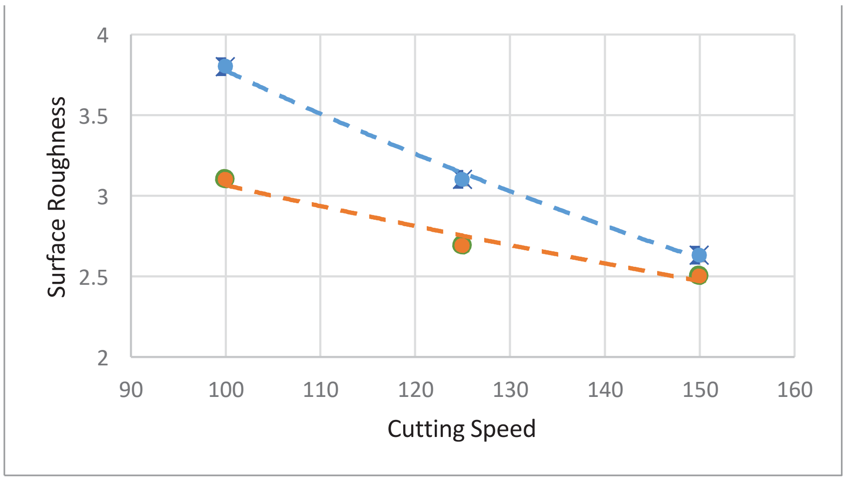

FIGURE 2. Vc and nose radius Against Surface Roughness when f = 0.27

TABLE 2. Surface Roughness Experiment Result Data when f = 0.23

doc 2.5 mm			
No	Vc (mm/min)	Surface Roughness	
		Nose Radius 0.8 mm	Nose Radius 1.2 mm
1	100	3.2	2.8
2	125	2.8	2.5
3	150	2.5	2.3

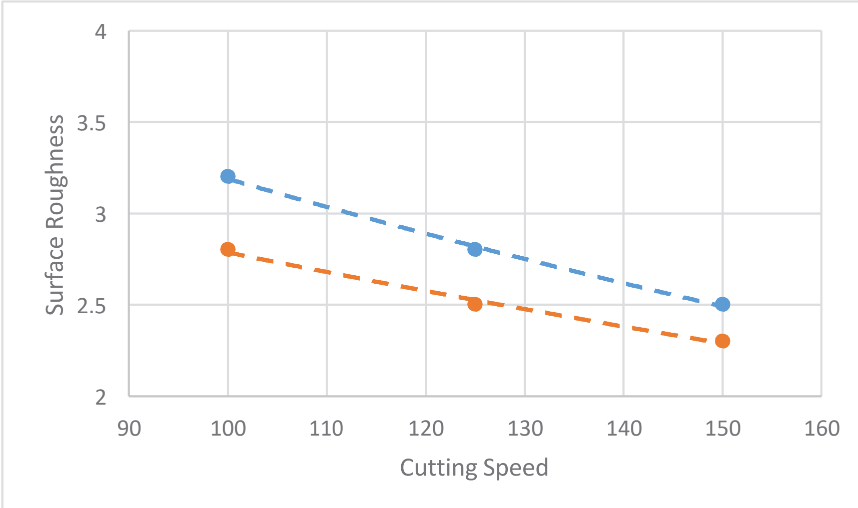

FIGURE 3. Vc and nose radius Against Surface Roughness when f = 0.23

TABLE 3. Surface Roughness Experiment Result Data f = 0.2

doc 2.5 mm			
No	Vc (mm/min)	Surface Roughness	
		Nose Radius 0.8 mm	Nose Radius 1.2 mm
1	100	3	2.55
2	125	2.55	2.3
3	150	2.3	2.1

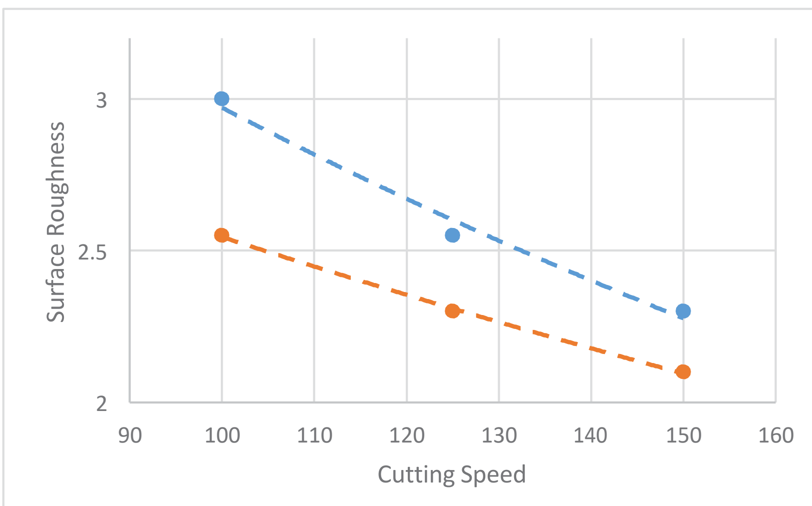

FIGURE 4. Vc and f Against Surface Roughness when f = 0.2

TOOL LIFE DATA

The following is the tool life data obtained during testing.

TABLE 4. Experimental Data of Tool Life when f = 0.27

doc 2.5 mm			
No	Vc (mm/min)	Tool Life	
		Nose Radius 0.8 mm	Nose Radius 1.2 mm
1	100	61	72
2	125	51	60
3	150	47	52

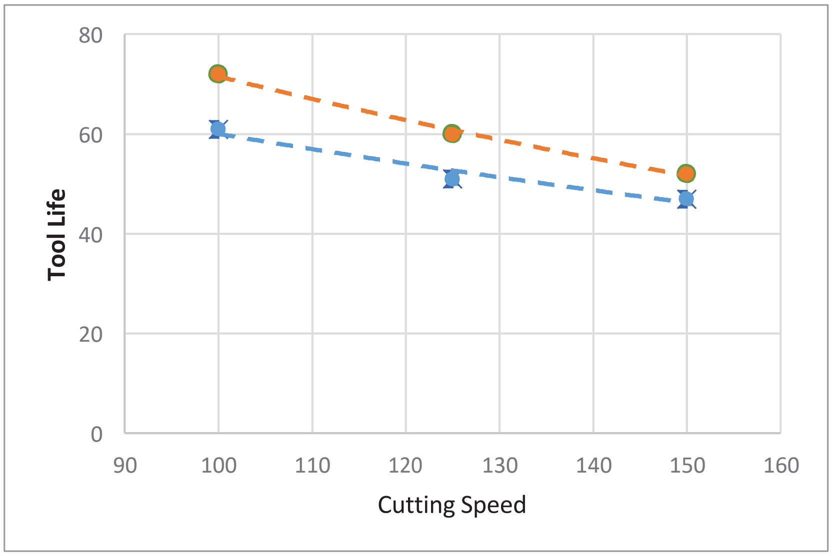

FIGURE 5. Vc and nose radius against tool life when f = 0.27

TABLE 5. Experimental Data of Tool Life when f = 0.23

doc 2.5 mm			
No	Vc (mm/min)	Tool Life	
		Nose Radius 0.8 mm	Nose Radius 1.2 mm
1	100	73	81
2	125	62	66
3	150	57	60

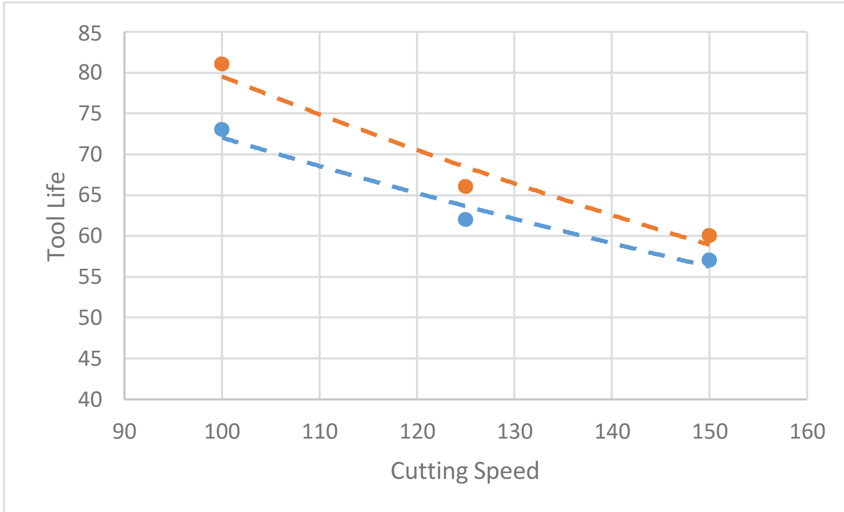

FIGURE 6. Vc and nose radius against tool life when f = 0.23

TABLE 6. Experimental Data of Tool Life when f = 0.2

doc 2.5 mm			
No	Vc (mm/min)	Tool Life	
		Nose Radius 0.8 mm	Nose Radius 1.2 mm
1	100	89	102
2	125	71	85
3	150	65	77

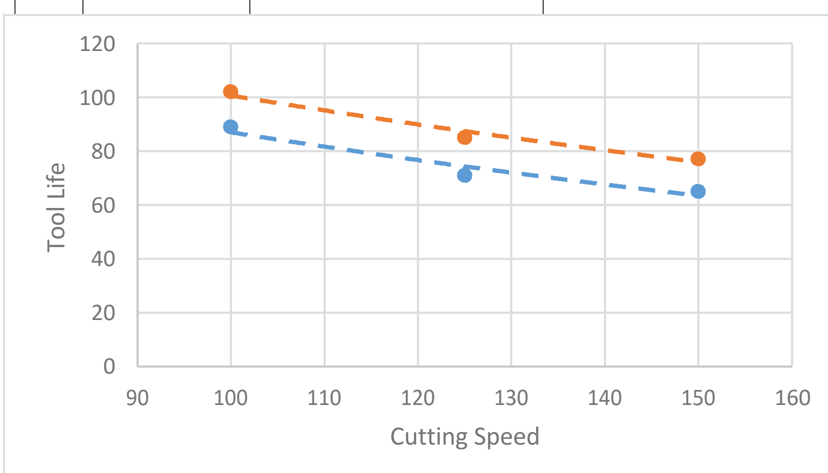

FIGURE 7. Vc and f Against Tool Life when f = 0.2

LINEAR REGRESSION ON DATA

The data obtained were processed using the linear regression method. Linear regression method was used to obtain the correlation between the independent variables (Vc, feed, and nose radius) to the dependent variables (surface roughness and tool life). To find linear regression, Minitab 19 software was used. After the data was processed, the regression equation, regression coefficient table, and normal plot graphs were obtained.

REGRESSION ON SURFACE ROUGHNESS

The following is the surface roughness data obtained when testing the linear method.

Regression Equation

Kekasaran Permukaan = 2.512 - 0.01007 Vc + 9.845 Feed - 0.844 Nose Radius

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	2.512	0.314	8.00	0.000	
Vc	-0.01007	0.00135	-7.46	0.000	1.00
Feed	9.845	0.961	10.24	0.000	1.00
Nose Radius	-0.844	0.138	-6.13	0.000	1.00

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.116921	93.40%	91.98%	87.69%

FIGURE 8. Surface Roughness Linear Regression Equation

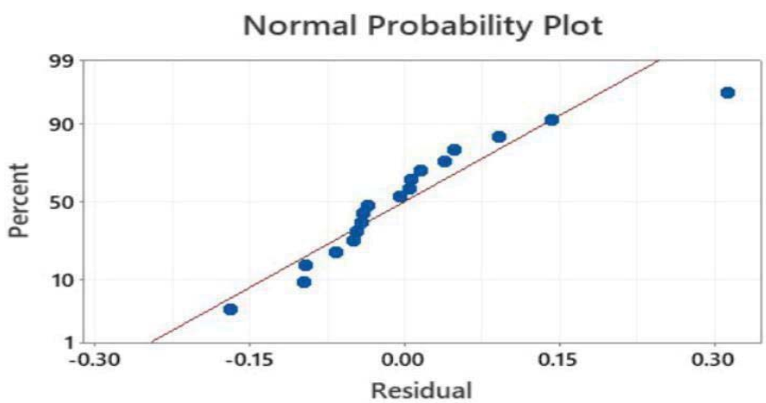

FIGURE 9. Normal Probality Plot Surface Roughness

REGRESSION IN TOOL LIFE

The following is the tool life data obtained when testing the linear method.

Regression Equation

Tool life = -81.81 + 0.4867 Vc + 289.0 Feed + 21.94 Nose Radius

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	-81.81	9.00	-9.09	0.000	
Vc	0.4867	0.0387	12.57	0.000	1.00
Feed	289.0	27.6	10.48	0.000	1.00
Nose Radius	21.94	3.95	5.55	0.000	1.00

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.35325	95.52%	94.56%	92.52%

FIGURE 10. Tool Life Linear Regression Equation

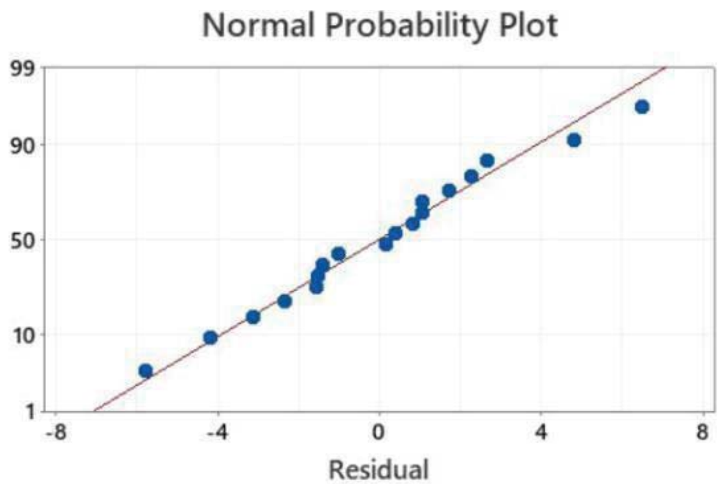

FIGURE 11. Normal Probability Plot Tool Life

ANALYSIS OF LINEAR REGRESSION METHODS

The results of linear regression, it can be seen that the independent variable has the highest influence on the results obtained when conducting experiments, it can be seen from the T value (the parameter estimation value of the hypothesized value). The greater the value, the greater the influence of the variable.

The two graphs above compare the results of the regression method with the results of the experimental method. It can be seen that if the point on the graph is getting closer to the line, the calculation on the regression method is running normally, if the point on the graph is too far from the line then the experimental data need to be repeated.

DISCUSSION

In this section, the data that has been obtained using the linear regression analysis method is studied further with the aim of obtaining good and correct results.

DISCUSSION OF SURFACE ROUGHNESS

On the surface roughness the most influencing variable is the cutting speed, the greater the cutting speed, the smoother the surface roughness. It can be seen the cutting speed in the first experiment, second experiment, and third experiment on a nose radius of 0.8 mm in table 1. The first experiment had the largest value (3.8 m), while the third experiment had the smallest value (2.63 m).

In feeding, the larger the feed, the rougher the surface roughness. It can be seen that the feeding in the first experiment at a nose radius of 0.8 mm in table 1, table 2. and table 3. The first experiment in table 1 had the largest value (3.8 m), while the first experiment in table 3 had the highest value. small (3 m).

On the nose radius, the larger the nose radius, the smoother the surface roughness. It can be seen that the feeding in the first experiment on the nose in table 1. The first experiment in table 1 nose radius 0.8 mm had a larger value (3.8 m), while the first experiment on the nose radius 1.2 mm had a smaller value (3.1 m).

On surface roughness, the most influencing variable is feed, the second variable that has the most influence on surface roughness is cutting speed, and the last variable that has the most influence on surface roughness is the size of the nose radius on the tool blade.

DISCUSSION OF TOOL LIFE

The higher the cutting speed, the shorter the tool life. It can be seen the cutting speed in the first experiment, second experiment, and third experiment on a nose radius of 0.8 mm in table 1. The first experiment had the largest value (61 minutes), while the third experiment had the shortest value (28 minutes).

At the feed speed, the greater the feed speed, the shorter the tool life. This can be seen in the feeding speed in the first experiment at a nose radius of 0.8 mm in table 1, table 2, and table 3. The first experiment in table 1 has the smallest value (61 minutes), while the first experiment in table 3 has the highest value. large (89 minutes).

On the nose radius, the larger the nose radius, the higher the tool life. This can be seen in the first experiment on a nose radius of 0.8 mm in table 4 (61 minutes). The first experiment in table 4 nose radius 1.2 mm has a greater value (72 minutes).

Tool life is the time obtained from the wear of the tool blade that occurs to the specified limit, the unit of tool life is minutes. In tool life, the most influencing variable is cutting speed, the second variable that most affects tool life is the size of the nose radius on the tool blade, and the last variable that most affects tool life is feed.

CONCLUSION

On surface roughness, the most influencing variable is feed (10.24 mm/min), the second variable that most influences surface roughness is cutting speed (7.46 mm/min), and the last variable that most influences surface roughness is the size of the nose radius of the tool blade (6.13 mm).

In tool life the most influencing variable is cutting speed (12.57 mm/min), the second variable that most affects tool life is feed (10.48 mm/min), and the last variable that most affects tool life is nose radius size. on the tool bit (5.55 mm).

Surface roughness will be better if the cutting speed is increased, the feed is decreased and the nose radius is getting bigger. Meanwhile, the tool life will be longer if the cutting speed is lowered, the feed is lowered and the nose radius is getting bigger.

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