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Review Report

Date: **27-November-2018**

Title: **ANALYSIS OF TOOL VIBRATION WITH COMPOSITE DAMPER OF CEMENT - SUGAR CANE FIBER ON TURNING PROCESS WITHOUT TAILSTOCK**

Authors: **Santoso Mulyadi, Triwahju Hardianto, Yuni Hermawan, Dwi Djumhariyanto and Robertus Sidartawan**

Evaluation	**Poor**	**Fair**	**Good**	**Very Good**	**Outstanding**
Originality					√
Innovation				√	
Technical merit				√	
Applicability					√
Presentation and English					√
Match to Journal Topic					√
<u>Recommendation to Chief Editors</u>					
	Strongly Reject	**Reject**	**Marginally Accept**	**Accept**	**Strongly Accept**
Recommendation					√

Review Comments: In these papers, machining process, surface roughness is one of the indicators. Surface roughness is strongly influenced by vibration factors from machine tools. When the lathe is turned on, before the machining process occurs there will be vibration in the machine tool, this vibration will increase when there is a slicing of the workpiece by the tool. To reduce vibration on this tool, particle composites are made as vibration dampening elements that are installed on the lathe body. **Analytical Study.** **Paper Accepted for publication in IJMET.**

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INTERNATIONAL JOURNAL OF MECHANICAL ENGINEERING & TECHNOLOGY (IJMET)

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Paper ID: IJMET_09_11_176 **Date: 03-Dec-2018**

Certificate of Publication

This is to certify that the research paper entitled " ANALYSIS OF TOOL VIBRATION WITH COMPOSITE DAMPER OF CEMENT - SUGAR CANE FIBER ON TURNING PROCESS WITHOUT TAILSTOCK" authored by "SANTOSO MULYADI, YUNI HERMAWAN, DWI DJUMHARIYANTO, ROBERTUS SIDARTAWAN and TRIWAHJU HARDIANTO" had been reviewed by the Editorial Board and published in "International Journal of Mechanical Engineering & Technology (IJMET), Volume 9, Issue 11, November 2018, pp. 1681–1689; ISSN Print: 0976-6340 and ISSN Online: 0976-6359; Journal Impact Factor (2016): 9.2286 Calculated by GISI (www.jifactor.com); InfoBase Index IBI Factor for the year 2015–16 is 3.46; Thomson Reuters' Researcher ID: B-7384-2016".

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ANALYSIS OF TOOL VIBRATION WITH COMPOSITE DAMPER OF CEMENT - SUGAR CANE FIBER ON TURNING PROCESS WITHOUT TAILSTOCK

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ABSTRACT

In making the machining process, surface roughness is one of the indicators. Surface roughness is strongly influenced by vibration factors from machine tools. When the lathe is turned on, before the machining process occurs there will be vibration in the machine tool, this vibration will increase when there is a slicing of the workpiece by the tool. To reduce vibration on this tool, particle composites are made as vibration dampening elements that are installed on the lathe body. This particle composite consists of sugarcane fiber particles, portland cement and steel powder which is made with high pressure as a vibration damper which will become a new body of the tool

In this study, the use of composite vibration dampers effectively reduces vibrations that occur due to variations in machining processes. The vibrations that occur are smaller with the spindle speed rising. The biggest vibration at 77 RPM in the direction of the Fc cutting force is 8.2 m/s^2, while the smallest vibration occurs at 350 RPM spindle speed in the direction of the axial force / back force of 0.4 m/s^2. The biggest roughness occurs at 77 RPM spindle speed conditions without vibration dampening with a surface roughness value of 43.8 µm and the smallest roughness occurs at 350 RPM spindle speed conditions using vibration dampers with a surface roughness value of 8.2 µm.

Keywords: Composite, Vibration and Surface Roughness.

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http://www.iaeme.com/IJMET/issues.asp?JType=IJMET&VType=9&IType=11

1. INTRODUCTION

With the advancement of technology like today, conventional machinery is needed for the work of materials. One of the conventional machining processes is the lathe process, the lathe process is one of the many ways used to carry out a production and has the aim of producing a cylindrical product. In the world of manufacturing industry, the turning process plays an important role, the turning process has very many applications, several machine parts, even almost all cylindrical workpiecescan be done using a lathe. With the production process using a fast lathe it will improve work efficiency so that ultimately the production costs will be more effective, but not all of these processes are easy to do because to make a desired product special skills are needed. If these skills are not owned, the products cannot be marketed because the market demand must meet good quality standards and prices can compete [1].

Research on composites from sugarcane fiber materials has been carried out, including: K. Bilba [2], examines: the influence of mass mixtures of cement, water and sugarcane fibers on heat transfer of composite materials. The result is obtained 2.5 grams of sugarcane fiber mixture will produce a stable temperature and resistance to temperatures of 450oC compared with cement composites without mixture. R.S. Teixeira1 [3], examined the effect of the percentage volume of portland cement, sugarcane fiber and silica powder on the rupture modulus of cement composites by direct extrusion process. The result: a higher percentage of volume will result in a higher modulus of rupture than pure cement. The test was carried out after 28 days of experimentation and the fiber will experience degradation at 200 cycles. M. J. Ghazali [4], examined the composite mixture of cement and sugar cane with a styrene butadiene binder, the results showed that a mixture with 6% styrene butadiene produced the highest composite stiffness. Dipan Patel [5], examined the effect of sugarcane, water and cement mixture on the strength of concrete paving blocks. The result is the greater the percentage of sugar cane fiber, the strength of the concrete will increase. The best results in this study are mixed with a percentage of 1.5% sugarcane fiber. Ali Varshoee [6], examined cement composites with sugarcane fiber strength, a mixture of water and calcium chloride with a sugarcane fiber weight fraction of 4% and 10%. The result is the best conditions for flexural strength, elastic modulus, internal bond and minimum thickness are 4% use of sugar cane fiber and 7.5% calcium chloride.

Then the researcher Matheus R [7], studied the effect of boiling cane fiber on the modulus of elasticity of MoE and fragile modulus of MoR composite of sugarcane fiber particles with portland cement matrix, the result is that the sugarcane fiber experienced boiling treatment has a higher MoE and MoR than those without treatment. The MoE value for those experiencing treatment was 2.97 MPa while those who did not experience treatment were 1.61 MPa.

Antonio ludovico stated [8], examined the effect of the size of sugar cane powder on portland cement composites. Sugarcane powder functions to replace the position of the mixture of sand in cement, the result shows that the MoE bending strength decreased by 9% and the compressive strength decreased by 38%. U.S.VijayVikram [9], examining sugarcane fiber mixtures in cement composite concrete, the results of concrete cement will be more economical if partially replaced by sugarcane fiber particles. From the mixture of sugarcane fiber particles for M25 concrete quality can be achieved with a volume fraction of 2%. D. Verma1 [10], reviewing research on sugar cane composite, from this study it was found that sugar cane fiber can be used in various industrial aspects such as: car, furniture, packaging and electronics industries. Sugarcane fiber composites have several advantages over synthetic fibers, namely: biodegradable, lighter and easier to form. Carla Regina Ferreiraa [11], this study discusses the effect of adding organic fibers of bamboo and sugar cane to the mechanical properties of concrete, the test specimens are made with 2% and 5% by weight fraction. The result: concrete composites meet the compressive strength standard, minimum strength of 20 MPa and recommended NBR6118 for structural applications.

Of all the studies above [2-11] only discuss cement composites - sugar cane fiber from the view of tensile strength, impact strength, elasticity strength (MoE) and rupture strength (MoR). The researchers above have not discussed the application of cement composites - sugarcane fiber for vibration dampers, especially in reducing tool vibration in the lathe process without tailstock. So in this study the researcher will discuss the vibration analysis of the tool with a silencer of cement-fiber powder composite on the lathe process without tail stock. The uniqueness of this research is the usecement composites - sugar cane fiber for vibration dampening applications in the machining process. The success of this new finding will contribute to the science of damping which so far only uses elastic materials such as rubber or compounds.

2. MATERIALS AND METHODS

The method used in this study is experimental and modeling methods, namely the method used to test by adding several treatment variations, so that later large vibration data and surface roughness will be obtained after the addition of the tested variables. Material or workpiece used is Aluminum 6061. Workpiece profile can be seen in Figure 1 below:

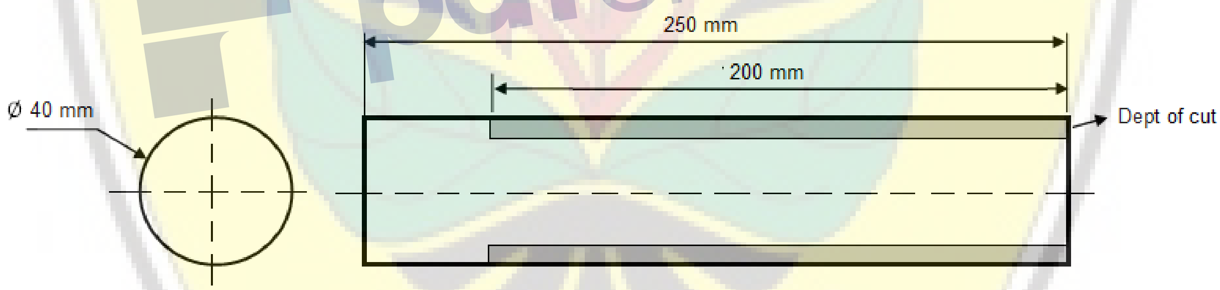

Figure 1 Dimensions of workpiece specimens

3. MACHINE DATA AND TEST EQUIPMENT

The machine used in this study was the Yamazaki lathe made of Japan. The rounds available on the lathe include: 25, 37, 54, 77, 112, 160, 240, 350, 500, 720, 1050, 1500 RPM. Meals available on the lathe include: 0.067, 0.135, 0.27, 0.55, 0.83 and 1.2 mm/rev. The tool used is the HSS tool (High Speed Steel) with a taper angle = 6º - 20º, relief angle = 6º and final cutting angle = 15º. The vibration test equipment used is the Propscope USB Oscilloscope 32220 series and a graph reader using Propscope software

The independent variables in this study are:

1. Spindle speed: 112, 160, 240, 350 and 500 RPM.
2. Feed motion: 0.05, 0.08, 0.1, 0.2 and 0.5 mm/rev.

While the dependent variable expected to be obtained through testing is:

1. Vibration machine tools (mm/s^2)
2. Surface roughness (µm) results of aluminum 6061machining process

4. RETRIEVAL OF VIBRATION DATA

PropScope vibration measuring components consist of: Accelerometer serves an instrument that functions to measure acceleration, detect and measure vibration, or to measure acceleration due to gravity. Accelerator can also be used to measure vibrations that occur in vehicles, buildings and machines. In addition, the accelerometer is also commonly used to measure vibrations that occur inside the earth, engine vibration, dynamic distance, and speed with or without earth gravity affected. Amplifiers are electronic components that are used to strengthen power (or power in general). In the audio field, amplifiers will amplify the sound signal (which has been expressed in the form of an electric current) in the input part into a stronger electric current in the output. In this study Amplifiers are used to amplify vibration signals to be detected on a computer screen, because the signal obtained by the accelerometer is still very small. ADC (Analog to Digital Converter) is a device designed to convert analog signals into digital signals. Many inputs, especially those from transducers, are analog signals that must be encoded into digital information before the input is processed, analyzed or stored in digital circles, a series of vibration test devices as shown in Figure 2.

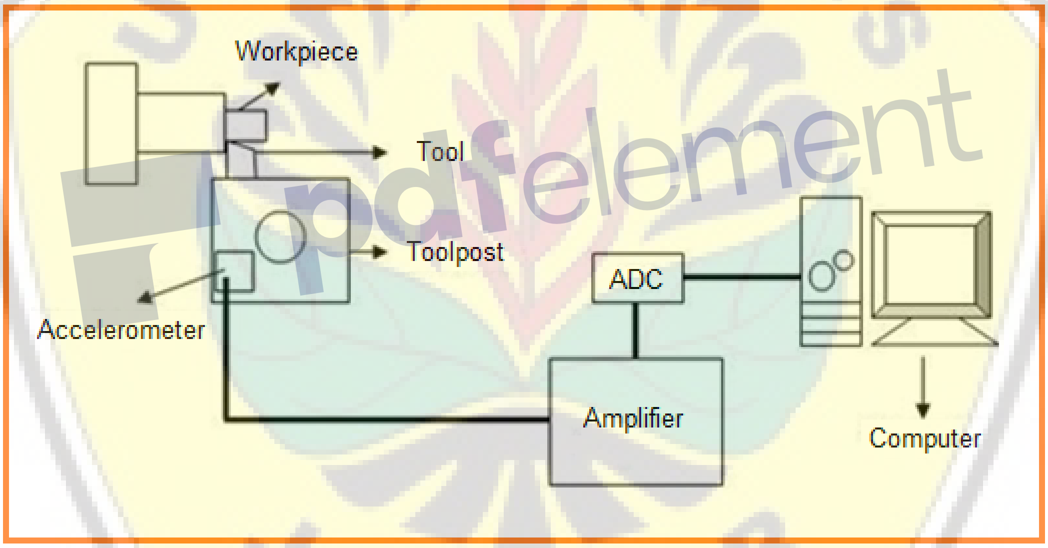

Figure 2 Series of vibration test equipment. (Source: Suhardjono, 2004)

5. RESULTS AND DISCUSSION

Making cement composites is done by combining the ingredients: portland cement, sugarcane powder, iron powder and pure water as a solvent. The tool used by the High Speed Steel (HSS) tool. This composite is used to dampen the vibration of machine tools by nudging it to the body of the HSS tool as shown in Figure 3.

Figure 3 Composite cement vibration dampers

The manufacture of cement composites was carried out on a plastic mold with material composition: 1% sugarcane powder, 10% iron powder, 89% portland cement, distilled water and cement additives. The ingredients are mixed in a container and then put into a mold, after 12 hours the composite is cut with a grinding machine. Dimensions of the composite silencer length x width x height = 150 mm x 35 mm x 30 mm.

Vibration Measurement on The Tool

In this study the tools used in vibration measurement consist of: accelerometer, amplifier, ADC, propscope and computer. These tools will be assembled in such a way and used to obtain large amplitude data obtained from each test parameter. A series of vibration test equipment can be seen in Figure 4 below:

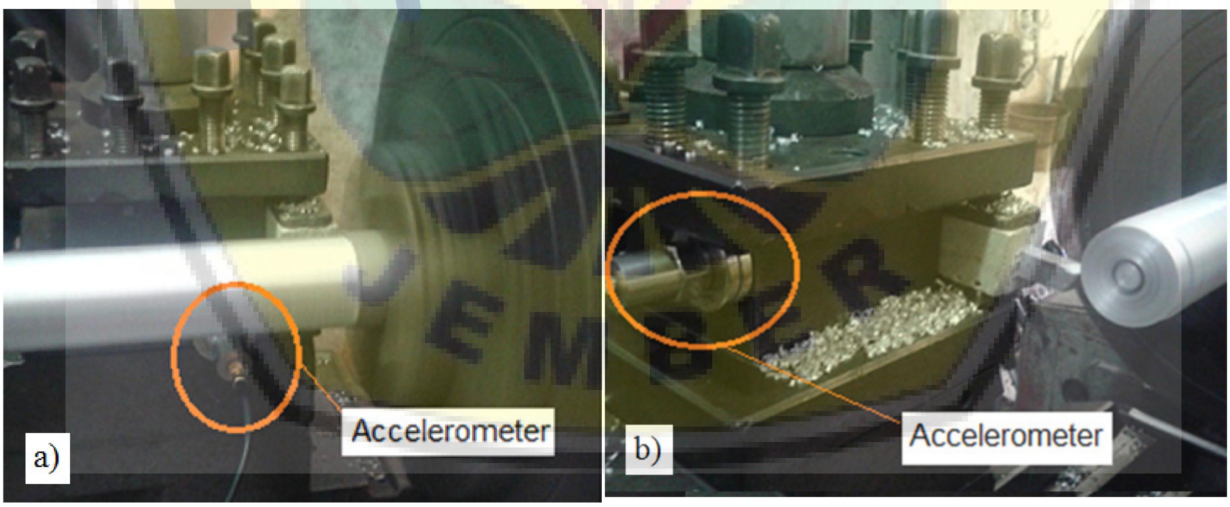

Figure 4 Acccelerometer position for vibration measurement in the direction of: (a) back force (b) feeding force.

Vibration data retrieval is machined to Aluminum 6061 material with spindle speed of 77, 112, 160, 240 and 350. Vibration measuring devices used by Propscope with propscope 2 signal software reader. In this first test, aluminum cutting was done without using vibration dampers. Vibration response is read by the accelerometer, the accelerometer position is determined based on the direction of the force to be measured. For the direction of cutting force the accelerometer is installed above the toolpost, for the direction of feeding force the Ff accelerometer is installed in addition to the toolpost and for the direction of the back force accelerometer on the front of the toolpost. Value vibration data without damper composites is shown as Table 1.

Table 1 Valuetool vibration without dampers composite

No	Spindle speed	Vibration (As) m/s^2		
		Cutting force direction (Fx)	Feeding force direction (Fy)	Back force direction (Fz)
1	77	12.4	8.3	2.6
2	112	9.7	6.8	2.1
3	160	8.5	4.6	1.8
4	240	6.3	3.4	1.3
5	350	4.6	2.8	0.6

From Figure 5 it can be seen that the vibration that occurs is getting smaller with the spindle speed rising. The biggest vibration on the 77 RPM rotation in the direction of the Fc cutting force is 12.4 m/s^2, while the smallest vibration occurs at 350 RPM spindle speed in the axial/back force direction of 0.6 m/s^2.

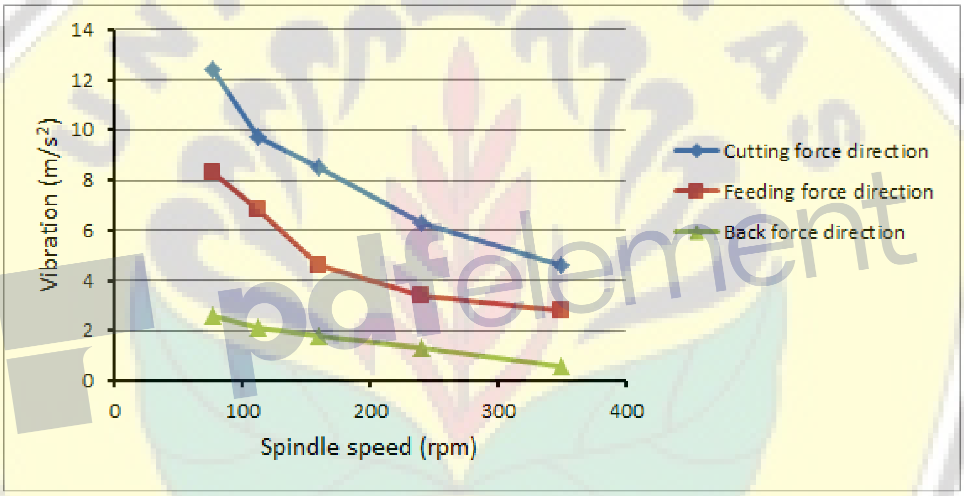

Figure 5 Graph of the relationship between spindle speed and vibration without using damper composite.

In this second test the 6061 Aluminum cutting was carried out using composite vibration. HSS cutting tools are planted on cement composites, this cement composite will be the body structure of the tool so that the vibration that occurs due to the cutting force will be dampened by this cement composite. The placement of the accelerometer vibration sensor is placed in position: for the direction of the cutting force the accelerometer is installed above the toolpost, for the direction of feeding force the Ff accelerometer is installed in addition to the toolpost and for the direction of the back force accelerometer is installed in front of the toolpost. The value vibration data with damper composite is shown as Table 2.

Table 2 Value vibration tool using cement composite vibration damper

No	Spindle speed	Vibration (As) m/s2		
		Cutting force direction (Fx)	Feeding force direction (Fy)	Back force direction (Fz)
1	77	8.2	6.4	2.2
2	112	7.3	5.2	1.8
3	160	6.1	3.3	1.2
4	240	4.5	2.5	0.8
5	350	3.2	1.4	0.4

From Figure 6, it can be seen that the vibration that occurs is getting smaller with the spindle speed rising. The biggest vibration at 77 RPM in the direction of the Fc cutting force is 8.2 m/s^2, while the smallest vibration occurs at 350 RPM spindle speed in the direction of the axial force/back force of 0.4 m/s^2.

Figure 6 Graph of the relationship between spindle speed and vibration using a vibration damper composite.

After analyzing the experimental data using the statistical method shows that independent variablesarespindle speed (n), which affects the response variable, namely vibration (As). The smallest vibration is obtained with the use of 350 RPM spindle speed, with a machining variable depth of cut 1 mm and with feeding 0.27 mm/rev is made constant. And the greatest value is obtained by using 77 RPM spindle speed. Feed motion is made constant, it aims to minimize the occurrence of vibration so that the variation that occurs purely comes from the variable spindle speed only.In this study the spindle speed variable is very influential on the vibration that occurs, at low speed the vibration value that occurs is very large this is due to the vibration has not passed its personal frequency, if the spindle speed is added with a very high rotation past the personal frequency then the vibration will be more stable/small. Previous research states that the higher the spindle speed is very sensitive to the occurrence of vibration [1]. The spindle speed affects the vibration that occurs, at a low rotation, the required cutting force will increase. The existence of a large cutting force when the chisel cuts the workpiece will excite the presence of vibrations in the tool body and the machine tools that cause vibration to increase.

Measurement of Surface Roughness

The roughness measurement in this study is the process of measuring the roughness of a workpiece surface by comparing it to standard reference or testing with special equipment. The work of this measuring instrument is because there is a detector in the form of a needle to feel the surface to be measured. Detection can be carried out 3 parameters, Ra, Rz, and Rmax in the DIN or ISO/JIS specifications. The roughness of the arithmetic average (mean roughness index/center line average, CLA), Ra (μm) is the arithmetic average price divided by the absolute price of the distance between the measured profile and the middle profile. Measurements of surface roughness were carried out using a TR-220 surface roughness tester measuring instrument made in China. The length of the sample taking test is 8 mm and the roughness used is the type of roughness of the arithmetic Ra.

Table 3 The surface roughness machining of aluminum 6061.

No	Spindle speed (RPM)	Surface Roughness (μm)	
		Without damper	Used damper
1	77	43.8	28.5
2	112	36.6	21.4
3	160	31.7	15.6
4	240	22.9	11.8
5	350	14.4	8.2

From Figure 7 shows that the surface roughness will be smaller with increasing spindle speed, this is because the required cutting force is smaller so that the vibration will be smaller as well. In this study the greatest roughness occurs at 77 RPM spindle speed without vibration dampening conditions with a surface roughness value of 43.8 μm and the smallest roughness occurs at 350 RPM spindle speed conditions using vibration dampers with a 8.2 μm surface roughness value.

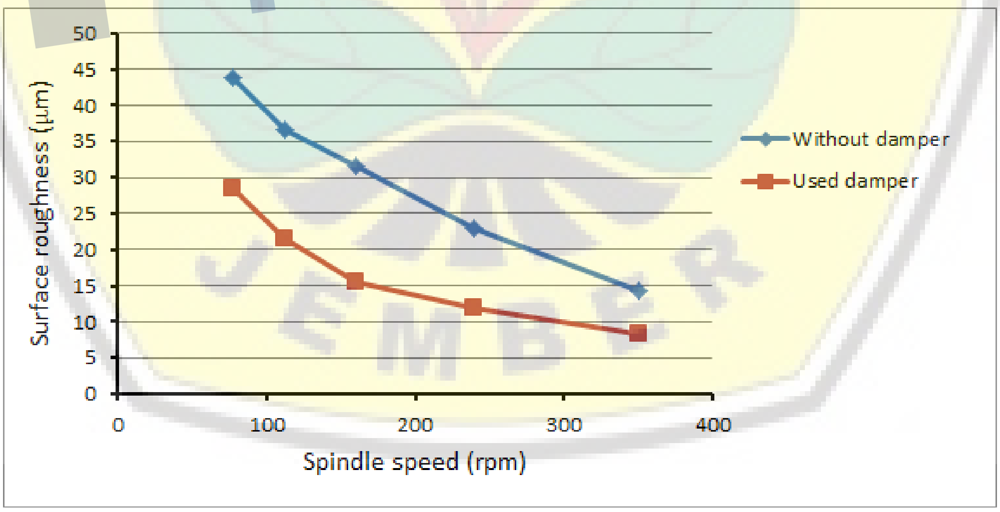

Figure 7 Graph of the relationship between spindle speed and surface roughness machining of aluminum 6061.

6. CONCLUSION

Based on the results of this sugarcane powder biocomposite manufacturing research, the following conclusions are:

- The use of composite vibration dampers effectively reduces vibrations that occur due to variations in machining processes. The vibrations that occur are smaller with the spindle speed rising. The biggest vibration at 77 RPM in the direction of the Fc cutting force is 8.2 m/s^2, while the smallest vibration occurs at 350 RPM spindle speed in the direction of the axial force / back force of 0.4 m/s^2.
- In this study the biggest roughness occurs at 77 RPM spindle speed conditions without vibration dampening with a surface roughness value of 43.8 µm and the smallest roughness occurs at 350 RPM spindle speed conditions using vibration dampening with a surface roughness value of 8.2 µm.

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