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THE INFLUENCE OF THE TYPE OF BLADE MATERIAL IN THE BANANA STICK WASTE SHREDDING MACHINE ON THE QUALITY OF THE CHIPPED PRODUCTS

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ABSTRACT

The banana gedebog waste chopper machine moves mechanically so that it cuts with a blade, the mechanical analysis of the machine consists of a chopper mechanism. For the analysis of choppers that use the main components, namely blades and shafts, while the driving mechanism is a supporting component such as electric motors, pulleys, and bearings. In analyzing the chopping machine aims to analyze the mechanical work of power and analyze the steps of each component work, analyze the results of the type of material usage of the blade. The driving engine power used is 94.57363 (watts) and the chopping force is 4.51375 x 10-6 (kg.m). The variation of rotation on the drive motor produces a variation of rotation on the chopping knife which has an average of good quality with the largest amount if using used blade material per car.

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1. INTRODUCTION

The need for inexpensive equipment in order to increase production yields from processing agricultural products is needed by our community. The problem with banana stem waste (gedebok) in villages is that it is only used for rope, and only a small portion is used for other materials. The utilization of banana stems for caterpillar breeding media if banana stem waste is chopped and mixed with soil and other organic waste will be able to become a caterpillar breeding media. Therefore, this banana stem waste chopping machine is necessary for caterpillar breeders. Some studies that show the processing of banana plants include banana slicing machines with various diameters [Edi, 2019] and banana stem waste cutting machines for briquettes [Faktur, 2018]. There is also a banana stem waste cutting machine for animal feed [Abdul, 2019]. The research idea for this banana gedebog cutting machine was also inspired by the cassava slicing machine [Husman, 2018]. Advances in science and technology play a role in realizing a better community life. Various practical and flexible processing tools have been created so that they help make it easier for humans to meet their needs. Therefore, the author tries to analyze the banana stem waste chopping machine as a form of advancement in appropriate technology. banana stem waste as a form of appropriate technological progress for the community.

In general, it can be defined that appropriate technology is technology designed for a particular community that is adapted to the elements of the environment, ethnicity, culture, and culture. elements of the environment, ethnicity, culture, social, political, and economy of the community concerned. From the required objectives, appropriate technology must be able to help the community in increasing production and income.

The shaft is one of the most important parts of any engine. Almost all machines transmit power together with rotation. The main role in such transmission is held by the shaft. While the peg is a component of machine elements used to set machine parts such as gears, sprockets, pulleys, couplings, and so on on the shaft.

Functions similar to pegs are also performed by splines and serrations that have outer teeth on the shaft and inner teeth with the same number of teeth on the naf and interrelated with one another. The teeth on the spline are large, while those on the serrations are small with a small dividing distance. Both can be shifted axially when transmitting power.

Bearings are machine elements that support the loaded shaft, so that rotation or alternating motion can take place smoothly, safely, and longevity. Bearings must be sturdy enough to allow the shaft and other machine elements to work properly. If the bearing does not function properly, the performance of the entire system will decrease or not work properly.

In the manufacture of this banana stem cutter, the bearings used are rolling bearings. In these bearings there is rolling friction between the rotating parts and the stationary ones through rolling elements such as balls (bullets), rollers or needle rollers and spherical rollers.

a. On the Basis of Load Direction Against the Shaft:
   1. Radial bearings, the direction of the load that this bearing supports is perpendicular to the axis of the shaft.
   2. Axial bearings, the direction of the load that this bearing supports is parallel to the axis of the shaft.
   3. Combination bearings, these bearings can support loads whose directions are parallel and perpendicular to the shaft axis.
b. On the basis of rolling elements

Rolling bearings have the advantage of very small rolling friction compared to glide bearings. Rolling elements such as balls or rollers, are mounted between the outer ring and the inner ring. By rotating one of the rings, the ball or roller will make a rolling motion so that the friction between them will be much smaller.

For balls or rollers, high precision in shape and size is a must. Because the contact area between the ball or roller and the ring is very small, the amount of load per unit area or pressure becomes very high. Thus the material used must have high resistance and hardness.

Bearings are machine elements that function to support the shaft, so that rotation / movement can take place smoothly, safely and longevity. Bearings must be sturdy enough to allow the shaft and other machine elements to work properly. If the bearing does not work properly, the performance of the entire system will decrease or cannot work properly.

Bolts and nuts are very important fastening devices. To prevent accidents or damage to the machine the selection of bolts and nuts as a fastening device must be done carefully to get the appropriate size. To determine the size of bolts and nuts, various factors must be considered such as the nature of the force acting on the bolt, working conditions, strength of materials and accuracy class. On this machine, nuts and bolts are used to fasten several components, including:

1. Fastener on the bearing
2. Fastener on the electric motor mount
3. Fastener on the pulley

To determine the type and size of nuts and bolts, various factors must be considered such as the nature of the force acting on the bolt, the way the machine works, the strength of the material, and so on. The forces acting on the bolts can be:

1. Pure axial static load
2. Axial load with punter load
3. Shear load.

Belts are usually used to transfer motor rotation to shafts whose distance is not possible to use gear transmission. There are two belts used as transmission, a long distance between two shafts used as transmission using gears (Sularso, 2008; 163). Types of belts (belts) are grouped into three, namely:

1. Open belts, there are several that consist of:
   a. Open belt without pulley holder
   b. Open belt with pulley holder
   c. An open belt that drives multiple shafts

2. Cross belts, there are several consisting of:
   a. Ordinary cross belt
   b. Perpendicular cross belt without introduction pulley
   c. Perpendicular cross belt with introduction pulley

3. Drive belt

The drive belt is a piece of equipment from machines that work based on sliding. This force transfer depends on the pressure of the drive belt to the pulley surface. Therefore, the tension of the drive belt is very important if there is a slip, the strength of the movement is reduced, as for the following types.

1. Flat drive belt
   a. Ordinary flat drive belt
   b. Sequential flat drive belt
   c. Positive flat drive belt
2. Drive belt - V

V drive belts can be found in a variety of standards and types for transferring power. Usually this drive belt is best at 1500 rpm to 1600 rpm. The ideal belt is approximately 4500 rpm.

In belt planning there are several steps that must be followed by considering the power to be transmitted, as for the transmitted power depends on: tension, rotational speed, contact angle between belt and pulley, and the conditions under which the belt is used.

Defining motor power must be done first before calculating the motor power. The drive motor used is an ac electric motor. The electric motor is one of the main sources of power to supply power to the shaft with a pair of pulleys through the belt as an intermediary used in this jerupuk material cutting machine. To determine the power of the drive motor is done as follows:

1. Determine the drive motor power required to drive the entire moving device.
2. Determine the drive motor power required to perform the cutting process.
3. Determine the total power, which is the sum of the power to drive the machine tool with the power to perform the cutting process.
4. Determine the plan power of the drive motor used for the cutting machine.

To drive all components of the machine device, it is necessary to know the drive motor power required to be able to drive all components of the machine. It can also be determined that the torque (T) acting on an object with a moment of inertia (I) will cause an angular acceleration of (rad/s2).

3. RESEARCH METHOD

The place of machine analysis and trial activities is planned or carried out in the workshop of Ilmu Desa Hamparan Perak. The time of research and trial activities is planned, carried out from the date of approval of the proposal by the manager of the Mechanical Engineering Study Program until it is declared complete, estimated for 7 weeks with the details of the table below.

This Final Project is planned to be completed from preparation to completion in 7 weeks.

There are several stages carried out in this test:

1. Preparing banana stems/gedebogs with the size that has been determined with the needs needed when conducting experiments/tests.
2. Prepare machine tools and equipment for the banana stem/gedebog cutting machine Provide Stopwacth to measure the working time of the acid cutting machine.
3. Prepare scales
4. Carry out tests with variations in rotation.
5. Recording the test results of each test
6. Conducting tests for iron blades ST 37 and SS 304 (Stainless steel).

In this case the method used for testing is by testing the banana stem/gedebog cutting machine 3 (three) times with variations in rotation. By adjusting the motor to drive the rotation of the blade disk holder (assuming the event of poor cutting because it is too fast).

4. RESULTS AND DISCUSSIONS

Analysis and discussion are more focused on what is written in the general objective, namely the effect of the banana stem waste chopping machine knife on the quality of the chopping results. In order that the discussion does not deviate, the order of the discussion is arranged according to the specific objectives, there is a sequence of discussion as follows:

1. Analyze the engine rotation drive system.
2. Analyze the transmission system on the pulley.
3. Analyze the chopping blade
4. Analyzing power and rotation.

The drive motor power required to drive the machine tool (P1) uses the formula:

$$P1 = I \cdot \alpha \cdot \omega$$

Notes:
P1 = drive motor power required to drive the machine tool (kW)
I = moment of inertia of the moving device (kg.m2)
α = angular acceleration of the moving part (rad/s2)
ω = angular velocity of the moving part (rad/s)

The discussion of this banana waste chopping machine can be done systematically, so it is necessary to know the equipment. This machine is equipped with the following data:

1. Two pulleys, which are estimated to have a total mass of 1 kg.
2. A shaft with a diameter of 25 mm = 0.025 m, with an overall length of 750mm = 0.75m.
3. A disk housing the chopping blade with a diameter of 460 mm = 0.46 m, and a thickness of 8 mm = 0.008 m.

To analyze the variation of rotation on the shaft of the shaft rod waste shredding machine is done by adjusting the rotation of the drive engine. To perform rotation variations, first determine the motor rotation used, namely n1 of 500 (rpm) and 1000 (rpm). Then the drive pulley mounted on the drive motor shaft has a pulley size with a diameter of 2 inches and a knife holder drive shaft diameter of 12 inches.

So as to determine the right rotation variation for chopping, the calculations are carried out below:

To find the variation of rotation on the pully that will be varied on the rotating shaft connected to the drive motor shaft paired with a pully, using the equation:

$$n_1/n_2 = d_2/d_1$$

(d1) with a diameter of = 2 inch = 2 x 2.56/100 = 0.0512 m, (d2) with a diameter of 12 inches = 12 x 2.56/100 = 0.3072 m and motor rotation = 500 rpm, then n2 = 83.333 Rpm.

For motor rotation = 1000 (rpm), the rotation n2 = 166.6667 rpm. For motor speed = 1500 (rpm), the speed n2 = Large than 83.3. From the above calculations, the results of variations in the rotation of the knife holder shaft can be tabulated as below.

No	Pulley diameter of the drive motord1(inch)	Pulley diameter on the knife holder d2 (inch)	Rotation of electric motor n1 (rpm)	Rotation of knife holder shaft n2(rpm)
1	2	14,4	500	83,333
2	2	12	1000	166,667
3	2	9,6	1500	250

Tabel 1. Turning Shaft Variation

No	Round Variation (Rpm)	Knife Holder Diameter (m)	Enumeration Speed (m/s)
1	500	0,46	0,012037
2	1000	0,46	0,024073
3	1500	0,46	0,02512

Tabel 2. Variation of banana stem waste chopping speed using ST 37 blade

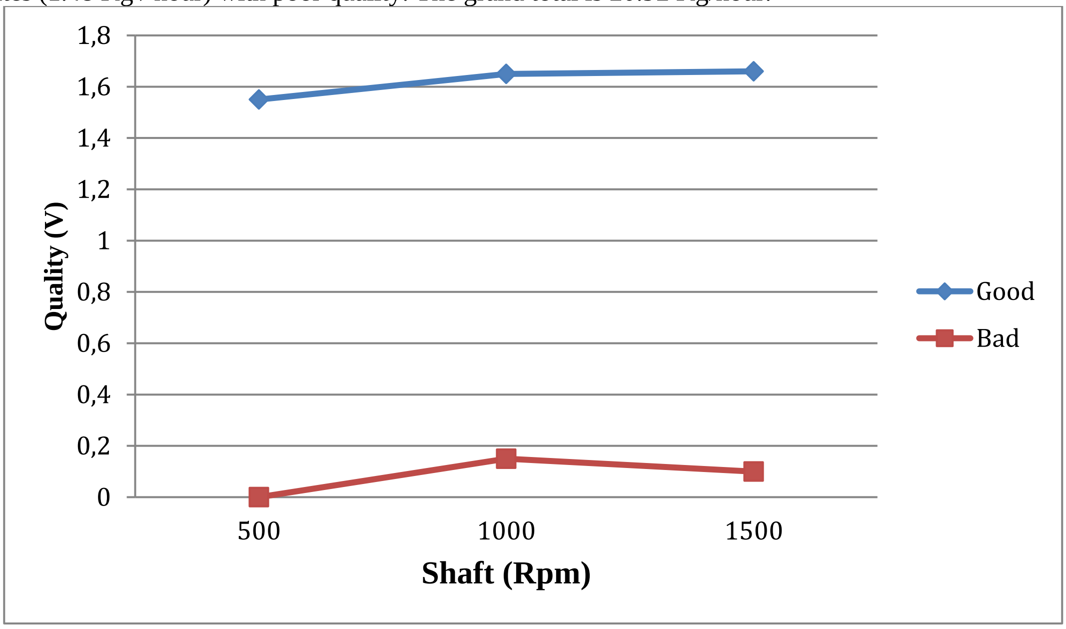
After varying the rotation by adjusting the rotation of the drive motor using an inverter, the chopping speed also varies. So that the chopping speed also varies. As a result of the variation in chopping speed on banana stem waste, of course the resulting capacity also changes as well as the chopping of banana stem waste also affects.

In this experiment, the banana stem waste used has a good condition and is ready to be processed. the results of chopping are determined with two kinds of quality, namely good quality, bad. the results of chopping banana stem waste on the capacity and quality of banana stem waste chopping can be seen in the tables of chopping results.

Round Variation	Enumeration Speed (m/s)	Quantity quality (v)		Enumeration Time (minutes)
Shaft(Rpm)		Good	Bad	
500	0.012037	1.55	0.12	5
1000	0.024073	1.65	0.15	5
1500	0.02512	1.66	0.1	5
Average	0.06123	1.62	0.123333333	

Tabel 3. Average amount of data from all tests using ST 37 (iron) blades

From table 3 the average results of several variations of rotation produce a process of chopping banana stem waste1620 g per 5 minutes (19.44 Kg / hour with good quality or equivalent to and 123.333 Kg per 5 minutes (1.48 Kg / hour) with poor quality. The grand total is 20.92 Kg/hour.



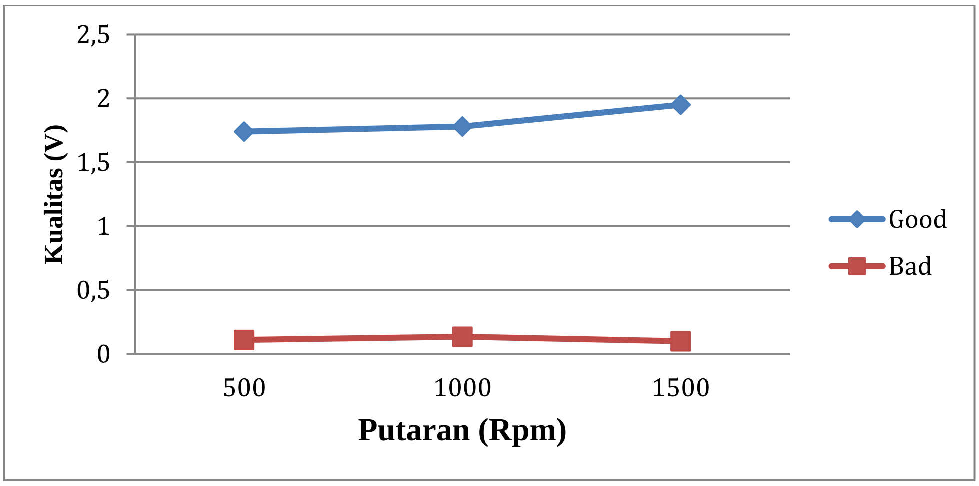
Graphic 1. Enumeration Results With ST 37 Blades

Round Variation	Enumeration Speed (m/s)	Quantity quality (v)		Enumeration Time (minutes)
Shaft(Rpm)		Good	Bad	
500	0.012037	1.74	0.11	5
1000	0.024073	1.78	0.135	5

1500	0.03611	1.95	0.1	5
Average	0.024073333	1.8233	0.115	

Tabel 4. Total Average Data of Overall Test Results Using SS 304 (Stainless Steel) Blades

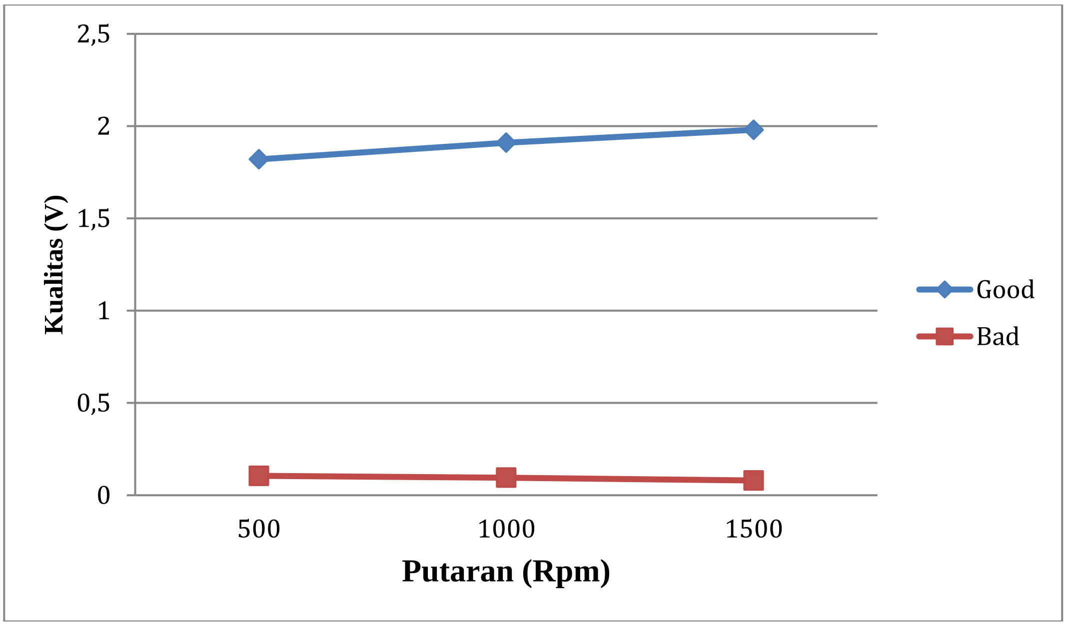
The best results when using a blade made from SS 304 iron are seen at a rotation of 1500 Rpm, because the blade rotation is faster. Then the results that are not good also look smaller if the blade is at a high rotation.



Graphic 2. Enumeration Results With SS304 Blades

Round Variation	Enumeration Speed (m/s)	Quantity quality (v)		Enumeration Time (minutes)
Shaft(Rpm)		Good	Bad	
500	0.012037	1.82	0.105	5
1000	0.024073	1.91	0.095	5
1500	0.03611	1.98	0.08	5
Average	0.024073333	1.903333	0.093333333	

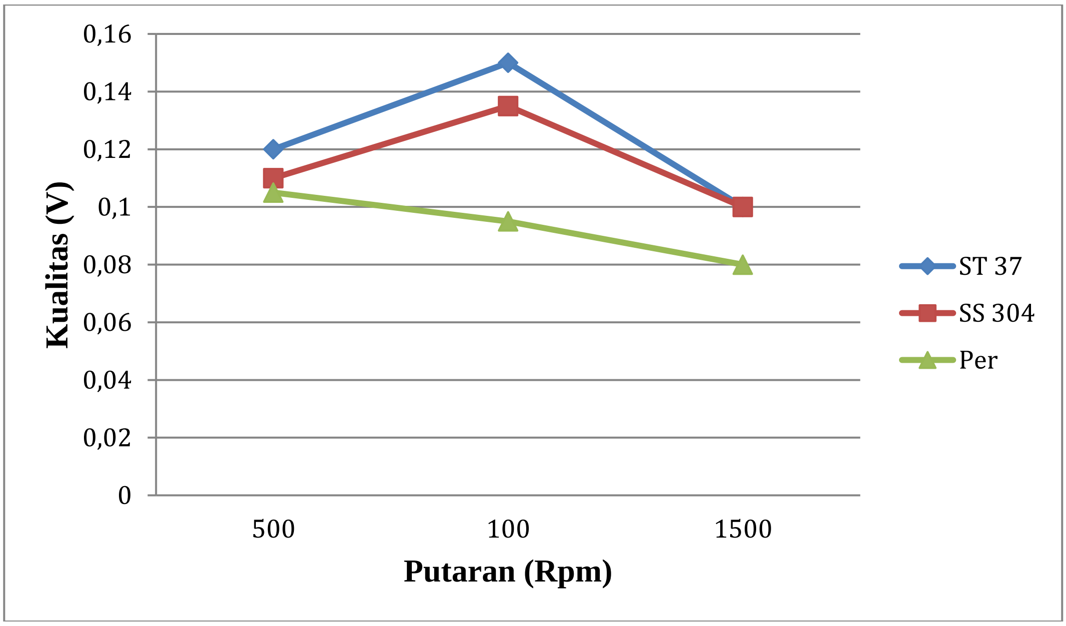
Tabel 5. Average Number of Data of Overall Test Results Using Iron Material Blades Per



Graphic 3. Enumeration Results With Per Material Blades

Shaft (Rpm)	Good Quality (V)/Blade		
	ST 37	SS 304	Per
500	1.55	1.74	1.82
1000	1.65	1.78	1.91
1500	1.66	1.95	1.98

Tabel 6. Recapitulation of Good Quality Results



Graphic 4. Recapitulation of Good Quality Results

Shaft (RPM)	Bad Quality (v)/Blade		
	St 37	Ss 304	Per
500	0.12	0.11	0.105
1000	0.15	0.135	0.095
1500	0.1	0.1	0.08

Tabel 7. Recapitulation of Poor Quality Results.

From Figure 3, it can be seen that in each round the highest good quality results are when using a blade made from waste per car brand Daihatsu Grandmax and also the smallest bad results (Figure 4.5). When comparing the blade material ST 37 with SS 304, good quality results are still higher when using SS 304 blade material.

5. CONCLUSION

The procurement of this banana gedebog waste chopping machine is needed for maggot caterpillar breeding media as a mixture of animal feed. After discussing the effect of the type of blade material on the banana stem waste chopping machine on the quality of the chopped results with the results that can be obtained from the experiment, so based on the objectives of this analysis, the driving electric motor power used is 95 watts (94.57363) and the chopping force is 4.51375 x 10-6 (kg.m). Variations in rotation of the drive motor produce variations in rotation of the chopping knife. The highest average good quality if using a used material blade per Grandmax type Daihatsu car is 1.903 Kg / 5 minutes equivalent to 22.84 Kg / hour (this is due to wet condition waste).

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