Rotary Model Corn Sheller Design to Reduce Workload and Increase Productivitys

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Abstract: The current working process of corn kernels is removed by crushing manually by hand so it is very tiring and low productivity. To speed up the shelling process, it is necessary to design a model of the corn sheller which is expected to be able to remove the corn kernels from the cob. The method used in this rotary method of removing corn kernels uses a prime mover in the form of an electric motor which is connected to the drive shaft through pulleys and belts that will process the release of corn kernels. Thus, this study is aimed to investigate the ability of shelling process to reduce the workload and increase work productivity. Corn sheller machine with rotary method with dimensions of 950 mm high, 755 mm wide and 750 mm long using a 0.25 HP electric motor as the main driver. This machine has 2 functions, namely as a corn kernel thresher and corn kernel size separator. In the corn kernel threshing section there is a sheller knife with a diameter of 76.2 mm and a length of 600 mm. The corn kernel separator is slightly conical in shape with a diameter of 250 mm on one side and 200 mm on the other. This is so that the corn can move from the side that is 200 mm in diameter to the side that is 250 mm in diameter. The corn kernel sheller and separator uses a 1" diameter shaft. This tool is also equipped with a blower that functions to clean corn kernels from the corn cob skin that comes off during shelling. Based on test results, the time for shelling corn seeds using this corn sheller machine takes an average of 8.30 minutes for 50 kg of corn cobs. While the time required for the manual shelling process for 50 kg of corn cobs is an average of 56.73 minutes. Work productivity by using shelling machine increased by 588% from 0.0084 manual shelling process and work productivity increased to 0.051 using corn sheller machine.

1 INTRODUCTION

Shelling is the process of separating the cob from the corn kernels. The corn shelling process is almost the same as the rice shelling process, which is to separate the seeds from the attachment site. Corn is attached to the cob, so the seeds and cobs must be separated. According to Aqil, M. (2009), Hadijah (2010) and Bunyamin et al (2015) an increase in corn production that is not followed by good post-harvest handling causes the opportunity for seed damage due to mishandling to reach 12-15% of the total production. Furthermore, among all post-harvest stages, the shell segment has the highest probability of losing its yield which reaches 8% so that this process is considered a critical process in post-harvest handling. The process of shelling corn manually causes fatigue to occur quickly in farmers. According to Tarwaka (2004) and Tarwaka (2014) fatigue is a body's protective mechanism so that the body avoids further damage so that recovery occurs after rest. To avoid the level of fatigue, it is necessary to avoid a static work attitude and strive for a more dynamic work attitude. This can be done by changing a static work attitude into a more varied or dynamic work attitude, so that blood and oxygen circulation can run normally throughout the body.

The peeling process is carried out by farmers manually using hands, so it takes a long time. Manual shelling of corn produces small amounts of shelled corn, namely 0.1 kg per minute. The use of hands for the shelling process causes corn farmers to easily experience fatigue and complaints of sore hands.

In an effort to overcome this, a rotary model corn sheller machine was designed and built to speed up the shelling process and reduce fatigue so that work productivity increases.

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2 METHODOLOGY

2.1 Research Design

T This research is a one-short case study with a pre and post test design which was carried out by observation of the corn shelling work process (Corlett, 2005) and (Wilson, 2015). Chart can be described as follows:

R → P0 → PI

Figure 1: Research design.

Information:
R = Random sample.
P0= the result of the pre-test experimental unit.
PI = the result of the post-test experimental unit.

2.2 Research Variable

The variables to be measured in this study include: (1). workload as measured by pulse of rice before and after work; (2) complaints of fatigue and skeletal muscles before and after work; (3) work productivity after work by comparing work pulse (beats per minute) with the number of products produced (kg) during working time (minutes). The measurement of variables number (1) to number (3) is the information data of the initial condition and the final condition which is then compared to determine the comparison before using the corn sheller machine and after using the corn sheller machine.

2.3 Data Analysis

The design data for the corn sheller machine with the rotary method is calculated based on the capacity requirement of 50 kg of corn, then the shelling system, the ergonomic construction of the machine seat. The test data before the use of the sheller machine and after the use of the sheller machine includes data on working time/length of work, workload and work productivity which will then be analyzed descriptively to obtain conclusions.

3 RESULTS AND OUTCOMES

3.1 Machine Design Results

The corn sheller machine is designed with an electric motor drive, the basic concept is to utilize the rotary motion or rotation of an electric motor to rotate a modified shaft for threshing corn kernels. The rotation of the electric motor is transmitted by the pulley and the V-belt. Furthermore, the corn will be inserted through the funnel attached to the frame, the corn will automatically be crushed and run along the track, until the end of the corn kernels is flat apart from the cob.

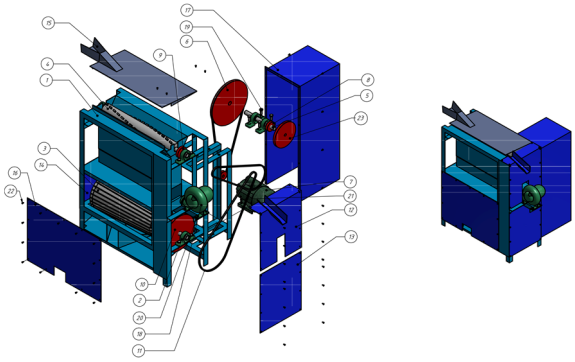

Figure 2: Machine design results.

Caption:

1	Engine frame	13	Bottom side cover
2	Bearing	14	Left side cover
3	Filter	15	Up Cover
4	Shell knife	16	Bottom cover
5	Axis	17	Motor cover
6	Pulley 12”	18	Blower
7	Electric motor	19	M12 x 30 mm
8	Pulley 2.5”	20	M8 x 35 mm
9	Pulley 3”	21	M6 x 12 mm
10	Pulley 10”	22	M4 x 8 mm
11	V-Belt	23	Pulley 7”
12	Side Up Cover		

3.2 Work Principle

Corn sheller machine with electric motor drive, the basic concept is to utilize the rotary motion or rotation of the electric motor to rotate the modified shaft for threshing corn kernels. The rotation of the electric motor is transmitted by the pulley and the V-belt. Next, the corn will be inserted through the funnel attached to the frame, the corn will automatically be crushed and run along the track, until the end of the corn kernel is flat regardless of the cob.

Corn kernels will fall down to the size separator, when they fall, the corn seeds will be blown by the wind from the blower that has been installed in the frame, which causes the cob flakes to fly and separate from the corn kernels. So later that goes into the size separator only the corn kernels. The size separator

rotation also utilizes the rotation of the same electric motor that is connected to the pulley and V-belt.

3.3 Machine Specification

This corn sheller machine is a machine that uses an electric motor as its borer and electricity as its energy source. With this machine, the corn shelling job becomes more effective and efficient compared to the manual method. Advances in technology are increasingly rapidly creating a lot of shelling machines in the market that are very useful for farmers.

Figure 3: Corn Sheller Machine.

The sheller cylinder is equipped with a plate that functions as a pitcher thrower. This machine is also equipped with a sieve assembly to separate shelled corn from corn cobs and cobs. The sifter can be adjusted so that it can press the corn and husks. Its main components include a cylindrical which has a tooth that is not the same height. This makes shelling easier and separating the shelled corn from the cobs.

The Machine Specifications include:

- Capacity: 360 kg/Hour.
- Size: Height 950 mm, Width 755 mm and Length 750 mm
- Machine Material: Steel Plate.
- Mover: Electric motor.
- Sheller knife: Diameter 76.2 mm and Length 600 mm
- Power (Power):0.25 HP.
- Machine Dimension Frame: Iron elbow

3.4 Machine Testing

The test was carried out 5 times to find out the time needed to complete 1 shelling of 1 corn. The large seeds weigh about 1000 grains ranging from 283.87 to 298.83 g while the small seeds are 219.20 to 239.17 g. In one cob, the average weight of the seeds reaches 223 grams. While the cob weight itself is an average of 242 grams.

1. In the test of sample A, the corn was tested 5 times with an average corn diameter of 33 mm, a minimum corn length of 125 mm and a maximum of 130 mm with a total corn weight of 50 Kg.
2. In the test of sample B, the corn was tested 5 times with an average corn diameter of 36 mm and a minimum corn length of 130 mm and a maximum of 135 mm with a total corn of 50 Kg.
3. In the test of sample C, the corn was tested 5 times with an average corn diameter of 38 mm and a minimum corn length of 135 mm and a maximum of 140 mm with a total corn of 50 Kg.

The results of sample testing on the manual peeling process and the shelling process with the help of a shelling machine include:

1. In the process of shelling corn manually by hand by farmers, the average shelled corn is 23.97 kg of the total weight of corn with an average of 50 kg on the cob, and the length of the picking process is an average of 56.73 minutes.
2. In the process of shelling corn manually with a sheller machine by farmers, the average shelled corn is 24.13 kg of the total weight of corn with an average of 50 kg on the cob, and the length of the picking process is an average of 8.30 minutes.

3.5 Corn Seed Shelling Work Productivity

Productivity testing of corn kernel shelling can be calculated by the formula:

$$Productivity = \frac{Output}{input\ x\ time}$$

- Output is weight of shelled corn produced (kg)
- Input is weight of corn to be shelled (kg)
- Times is times shelling process (minutes)

After the calculation process is obtained, Manual shelling work productivity is 0.0084 and work productivity in the machined shelling process is 0.0580. Based on the acquisition of work productivity manually with a corn sheller machine, it

was found that there was an increase in work productivity of 588% or a ratio of 1:6 due to the use of a corn sheller machine.

4 CONCLUSIONS

Based on the discussion that has been carried out, the following conclusions can be drawn:

1. Corn kernel sheller machine with rotary method with dimensions of 950 mm high, 755 mm wide and 750 mm long uses a 0.25 Hp electric motor as the main driver. This machine has 2 functions, namely as a corn kernel thresher and corn kernel size separator. In the corn kernel threshing section there is a sheller knife with a diameter of 76.2 mm and a length of 600 mm. The corn kernel separator is slightly conical in shape with a diameter of 250 mm on one side and 200 mm on the other. This is so that the corn can move from the side that is 200 mm in diameter to the side that is 250 mm in diameter. The corn kernel sheller and separator uses a 1" diameter shaft. This tool is also equipped with a blower that functions to clean the corn kernels from the corn cob skin that comes loose during shelling.
2. Based on the test results, the time for shelling corn seeds using this sheller machine takes an average of 8.30 minutes for 50 kg of corn cobs. While the time required for the manual shelling process for 50 kg of corn cobs is an average of 56.73 minutes.
3. Work productivity by using a shelling machine increased by 588% from 0.0084 by hand shelling process and work productivity increased to 0.058 by using a corn sheller machine.

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