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"STRENGTHENING FOOD AND FEED SECURITY AND ENERGY SUSTAINABILITY TO ENHANCE COMPETITIVENESS"

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"Strengthening Food and Feed Security and Energy Sustainability to Enhance Competitiveness"

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A.8

DESIGN OF MACHINE FOR SHELL REMOVAL OF OIL PALM SEED

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ABSTRACT

Seed germination is quite difficult, because the seeds have a thick and hard shell and dormancy. To accelerate germination, it is necessary to shell removal for seed germination. The objective of the research is to machine design for the shell removal of palm seed.. Cracking of shell palm seed required a force of 0.8-3.0 kN. The working mechanism of the palm kernel shell crusher applies to the compressive force. The force is produced from two cylinders rotating in opposite directions. The oil palm seeds are divided into 3 parts based on the size of oil palm seed in 3 dimention of large, medium and small. The testing of cracker machine is a loose shell of the kernel, the kernel is not defective and is mechanically defective. The result of this cracker testing is that the shell still attaches to the kernel for small, medium and large seed sizes of 30%, 23% and 20%, no kernel at shells of 52%, 61% and 64% and defective kernels of 18% 14% and 16%. Kernels that can be germinate with small, medium and large seed sizes are 70%, 77% and 80%. The cracker testing for one cylinder are that the shell still attaches to the kernel 10%, damage kernel 4% dan whole kernel 86%.

Keywords : shell, cracking, seed, germination, and kernel

I. INTRODUCTION

The planting of oil palm crops in general still uses seed from plant breeding. Palm oil seeds can not be directly germinate after harvest, because the palm kernel is dormant. According Farhana, et al. (2013) the process of germination of oil palm seed is quite difficult because the seed has a hard shell that is dormant. The existence of this dormancy condition causes the seeds to be treated to break the dormancy. The process of seed germination of high quality oil palm takes about 3 months with dry heating method at 40 °C.

Drying of palm kernels is intended to prevent palm kernels from being attacked by microbes. Due to the drying of palm kernels, there will be a cavity between the kernel and the palm kernel shell. This happens because the kernel shrinks when it is dried. Depreciation of kernel volume is higher than shrinkage of shell volume. This is because the kernel water content is higher than the water content of the shell.

Palm kernel can germinate, then the kernel content of palm kernel seed must reach 25 - 30%. There are two things that inhibit water up to the kernel inside the shell that is, a) hard palm kernel shell, so the water is rather difficult to enter through the shell to get to the kernel. B) there is a cavity between the kernel and the palm kernel shell, this will inhibit water from the shell to the kernel. C) The thickness of palm kernel shell and seed size are also not uniform. This will cause the water time to go through the seed shell and get to the kernel takes a long time. To achieve a 25-30% kernel moisture content for the germinated kernel requirement requires timeout. As a result germinate become not uniform. It is also found that there is a decrease in the germination of seeds that have been stored for 5 months, if it is germinated by konvensional. To solve this problem for quick germination of palm kernels can be done by solving hard shells of palm kernels.

The principle of the palm kernel shell breaker is the seeds are pressured with a certain style. Only the shell is under heavy pressure, while the kernel inside the shell gets a light pressure. This happens because the seed is dry, between the kernel with the shell there is a cavity. This cavity allows the kernel not to experience mechanical stress. Constraints faced is the size of the shell is not uniform. So in practice, before the shell in peel, the shell first separated in 3 levels of size, namely large, medium and small. Peeling is also done with 3 types of distances between rollers that are adjusted to the size of the shell.

A. Seed of Palm Oil

Anonymous (2012) states that good seeds require high quality sprouts (germination and high levels of uniformity) so that oil palm crops planted in the field will be of high quality. This means that the nursery process

can affect the quality and production of oil palm crops in the future. A good seed and legitimate comes from a clear and superior breed.

B. Imbibition

Imbibition is a very important first stage in seed germination, because it causes an increase in the seed water content required to trigger biochemical changes in the seeds so that the seed germinates (Asiedu et al., 2000). If the process is inhibited then germination will also be inhibited. According Widyawati, et al. (2009) inhibition of imbibition cause germination of the seeds of palm sugar long enough and when germination is not simultaneously. In the cultivation of palm trees, it causes inefficient nursery processes both in terms of funding, energy allocation, time and place use and cause viability in seedling growth. To overcome this required various ways done to break the dormancy of seeds, so the seeds can germinate. Seed generally have dormant period before germinating for finish his life. (Soerodikoesomo,1994).

The cracking machine of oil palm shell in patent on behalf of Sun Y. Kim. Drawing of the machine sketch as follows:

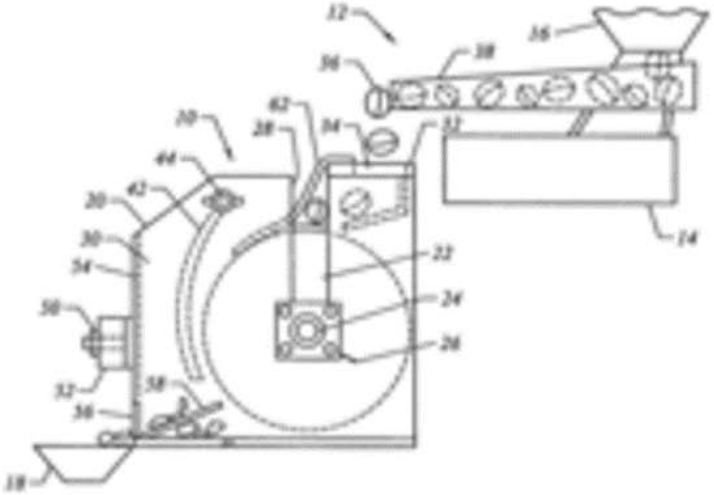

Fig. 1. Sketch of a hard peeler

The working mechanism of this machine in general is a rotating cylinder with the outer surface of the cylinder having a breaker. The machine is equipped with a static plate as contribute to suppress the hard seed. The curvature of the static plate is equal to twice the curvature of the cylinder. Hard seeds that are between the cylinders with the plate will break.

There are many types of palm kernels crusher. One of them is a ripple mill (Fig. 2). The peeling result of this machine is kernel and palm kernel shells. Getting the kernel in one piece is one of the determinants of quality to produce quality palm kernel oil, as more and more of the palm kernel is intact, the palm kernel losses are getting smaller. To know the ripple mill to work to the performance maximumly, it is necessary to check on the output ripple mill is like mixed shell with kernel.

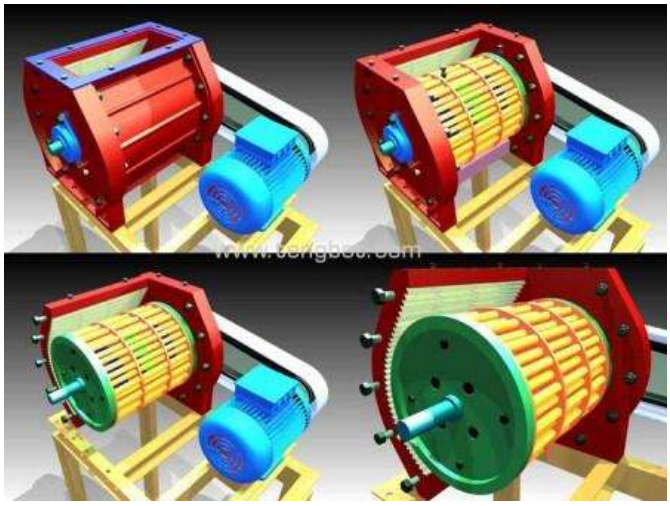

Fig. 2. Riple mill machine (Anonimus, 2013)

II. MATERIALS AND METHODS

The research was conducted from February to June 2017 at Agricultural Engineering Workshop, University of Lampung.

The research threat to compare with two cylinder cracking machine with one cylinder cracking machine. Drawing sketch for cracking machine of oil palm shell two cylinder can be seen at Fig. 3 and 4. This machine test to know the machine performance from cracking machine two cylinder with one cylinder. It is used 50 – 100 seed for testing machine per experiment unit. It is observated for shell crack, but sticky shell with kernel, damage kernel, whole kernel and seed pass. Data is analysed by average, grahp and percentace.

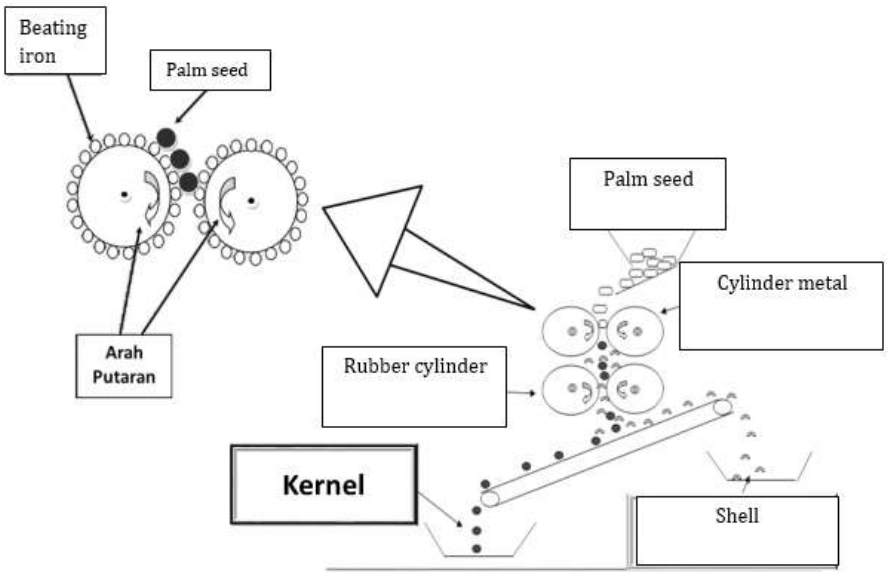

Fig. 3. Drawing sketch for cracking machine of oil palm shell two cylinder

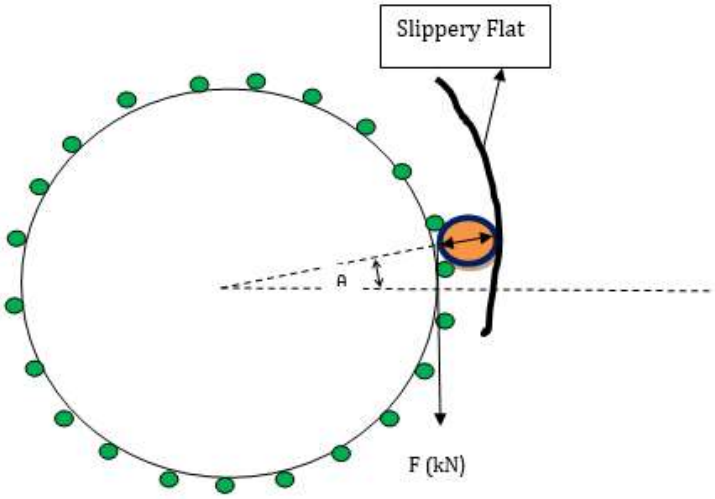

Fig. 4. Drawing sketch for breaking of palm oil seed one cylinder

III. RESULTS AND DISCUSSION

A. Measurement of hardness of palm kernel

Hardness of palm kernel is measured using Compression machine 2000 KN. This tool uses a compressive force with a hydraulic principle working mechanism. The oil-shaped liquid is pumped into the chamber plate of the upper steel plate and the bottom plate is compressed, so the palm kernel is compressed. Press with a certain style, then the palm kernel shell will break.

Fig. 5. Compression machine 2000 kN

The level of hardness of palm kernel ranged from 0.7 to 3.4 kN equivalent to 70.2 - 345.5 kg load, Palm seed hardness level due to varying shapes, the level of seed shell thickness and the size of palm kernel. The results of the measurement of the level of hardness of palm kernel as in Table 1 below :

Table 1. Level of hardness of palm kernels in kN

Number sample of palm kernel	Shortest dimensions of palm kernel		
	14,2 mm (small)	17,4 mm (midium)	20,7 mm (big)
1	1,3	3,5	1,9
2	0,9	1,7	2,3
3	0,8	1,1	0,8
4	0,7	1,3	2,4
5	0,8	1,4	2,7
6	3,0	1,3	2,2
7	0,4	1,9	2,2
8	1,1	0,5	3,2
9	1,2	2,9	0,9
10	0,8	1,7	1,2
average	1,1	1,7	2,0

B. Manual splitting

Manually splitting palm kernels using mechanical press (Ragum). The working principle of similar tools of ragum used to press the palm kernel to shell crushed palm kernel is using a system of leverage. Manually break the shell of palm kernel like in the Fig. 6.

Fig. 6. cracking of oil palm seed manually

By using ragum can break the 100 seeds for 55 minutes. For a more careful solution, the breakdown capacity is lower for 100 palm kernels for 70 minutes. Seed were damaged 1-2% when it breaks by manual. Damage to this seed can be reduced by doing the breaking carefully.

C. Break machine of palm seed

Palm seed shell crusher using 2 rollers rotating opposite direction. But both rolls of this tool are static or can not shift when breaking the palm kernel. This tool uses 8 hp. mechanical breaker machine can be seen in Fig. 3. The results of mechanical testing of two rollers in breaking the shell of palm kernel can be seen in the following table:

Table 2. Test result to cracking performance of oil palm shell (%)

Breaking criteria	dimension								
	small			Medium			Big		
	1	2	3	1	2	3	1	2	3
Breaking shell> 50%	10	8	12	8	6	2	12	12	10
Breaking shell < 50%	24	16	20	6	6	4	16	20	12
Whole kernel	44	64	48	72	72	76	60	62	68
cracking kernel	4	6	12	4	6	0	6	2	2
Breaking Kernel	18	6	8	8	10	14	6	6	4
Passing seed	0	0	0	2	4	4	0	0	4
Time(minute)	3.1	3.7	3.0	1.5	1.5	1.5	2.0	1.3	1.5

Testing masin in breaking palm kernel shells using three sizes, namely small, medium and large. The shortest dimensions of palm kernel with small, medium and large that is 14.2, 17.4 and 20.8 mm. The shortest dimension of palm kernel is used as a guide in determining the distance between cracking rolls of palm shell (clearance). If the clearence rollers exceeds the length of the diameter of the palm kernel, the palm kernel will pass, or the palm shell is not broken. Conversely, if the size of the diameter of palm kernels is too large from the clearence size, the shell of palm kernel is difficult to break. Clearence of palm kernel crusher with small, medium, and large size of 12.14 and 16 mm respectively.

The results of the breaking of palm kernel seeds as in Table 2. Palm oil seed shells are still stickyto the kernel is high enough, it is because some shells are still sticky with the kernel, so the kernel is not separated from the shell. Another reason is the shape or structure of unbroken palm kernel, because partly irregular, so when pressed, then there is only partial breaked of palm kernel.

Breaked seeds and cracked seeds are also encountered during the breaking of the oil palm shells. Breaked and cracked seeds are also the impact of sticky kernels with shells. Because the kernel is sticky with the shell, some kernels are carried by the shell. breaked and cracked seeds are also caused by improperly mounting the beater on the cylinder, so that the position of the beater presses the palm kernel like in Fig. 7, but shifts a few mm, so that the kernel can be compressed by a beating iron.

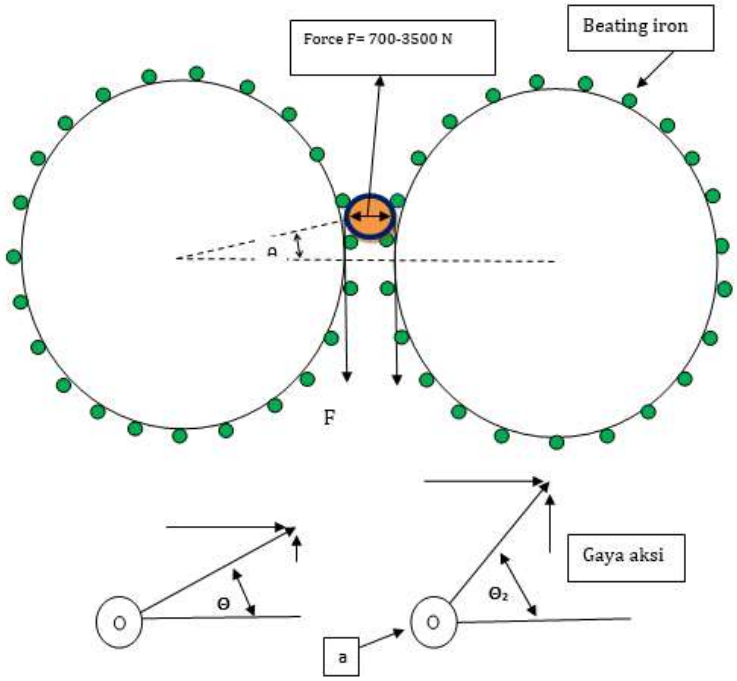

Fig. 7. Seed oil palm position will be crack for two cylinder

The breaked results show a whole peeling above 70% and breakage or crack reaches 6-22%. Damaged or cracked seeds can not be germinated, because the seeds will be attacked by fungus for a few days when they are germinated To improve the seeds are not damaged, it is necessary to modify the peeler with one cylinder accompanied by slippery plate as a pressure barrier from the rotating cylinder. Modification of the machine with the working principle as in the picture will be able to reduce damaged seeds or bruises. Prototype of a two-cylinder coconut shell crusher with opposite direction of rotation as shown in Fig. 8 and Fig. 9 and prototipe of one cylinder to breaked palm oil seed as show in Fig 10.

Fig. 8. Cracking machine used smal pulley

Fig. 9. Craking machine used big pulley

Crushing palm kernel with one cylinder equipped with slippery sloped plate will condition the mechanism of this machine as follows; If the diameter is large, the palm kernel shell will be split at the top, because the clearence is quite large, if the size of the small palm kernel, the palm kernel will be split at the bottom, because the clearence on the bottom is small. Modification of palm kernel breaking machine can be seen in Fig. 10 below:

Fig. 10. Modification of breaking machine of palm seed shell

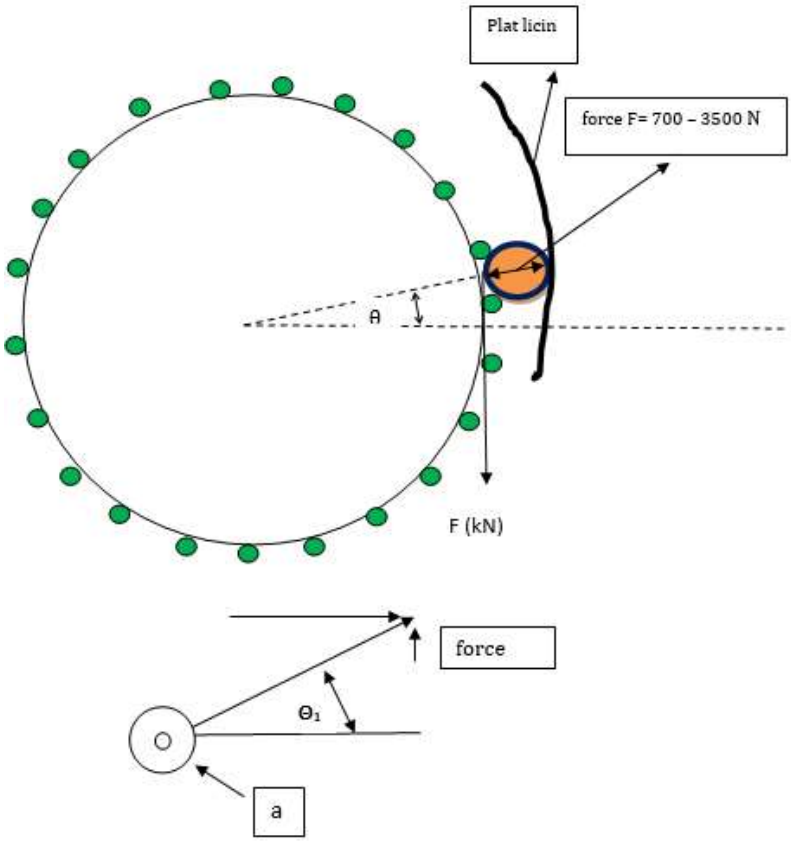

Fig. 11. Cracking machine Skecth for one cylinder

Table 3. Results of machine breaking of palm oil shell with one silinder for 100 seeds at average time 5,2 minute in percent

No	Criteria	replication		
		1	2	3
1	Part cracking shell	8	9	11
2	Damage Kernel	4	3	5
3	Whole kernel	88	88	84

IV. CONCLUSION

1. The result of this cracker for two cylinder testing are that the shell still attaches to the kernel for small, medium and large seed sizes of 30%, 23% and 20% repetively, no kernel at shells of 52%, 61% and 64% and defective kernels of 18% 14% and 16%. Kernels that can be germinate with small, medium and large seed sizes are 70%, 77% and 80%.
2. The cracker testing for one cylinder are that the shell still attaches to the kernel 10%, damage kernel 4% dan whole kernel 86%.

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