International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Jounal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-10, Issue-4; Apr, 2023
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.104.8

Design and Building of Servo Motor Portable Coconut Peller Machine

Damianus Manesi*, Imanuel A. Tnunay, Elkana B Lopo, Jemssy R. Rohi, Boy Bistolen

Department of Military Logistics, Indonesian Defense University, Indonesia
*Corresponding Author

Received: 01 Mar 2023,

Receive in revised form: 02 Apr 2023,

Accepted: 09 Apr 2023,

Available online: 23 Apr 2023

***Keywords*—Post Harvest Technology, Coconut, Coconut Peeler Machine**

Abstract*—*Threats to food security for the Indonesian nation as an agricultural country are still occurring where the government is still opening import faucets, especially for food products. For this reason, Indonesia needs to build food self-sufficiency by optimizing its potential and resources, one of which is through the use of post-harvest technology. Utilization of post-harvest technology can be carried out on all types of commodities, one of which is coconut. Coconut as a leading commodity in the agricultural sector is a multifunctional plant and can grow in all regions of Indonesia. Even though there are a lot of coconut products in all regions of Indonesia, especially in the regions, the availability of technology to improve the quality of post-harvest production is still low. Therefore this study aims to design a coconut peeler machine. The results of the research are in the form of a portable coconut peeler with a servo motor that can be applied in rural areas to be used by farmers to increase the productivity of post-harvest coconut management. The development of this research has several updates, namely a type of portable tool that is easy to carry anywhere

I. INTRODUCTION

Indonesia is located on the equator so it has a tropical climate and is a place to grow a variety of plants including coconut. Coconut is easy to find in all regions of Indonesia, from from the coast to the highlands. The coconut plant is a multipurpose plant where all parts of the plant, starting from the roots, stems, leaves and fruit, can be used to meet human needs and have high economic value.

One part of the coconut, namely Coir, has recently become a trend and is being exported on a large scale to various parts of the world because it has durability whose quality is not inferior to raw materials. commercial material when it is produced into an item.

Products made from coconut coir are not inferior in quality to synthetic materials [3]. Indonesian production of coconuts averages 2.8 million tonnes in 2021 [1],[2]. This amount has a higher percentage value of 1.47% of the total coconut production in 2020 of 2.81 million tonnes.

Meanwhile, coconut derivative products also experienced an increase such as national copra by 3.02 million tons, 0.75 million tons of shell charcoal, 1.8 million tons of coir fiber, and 3.3 million tons of coir dust.

The coconut processing industry is generally still focused on processing fruit flesh as the main product [8], while industries that process coconut by-products (by-products) such as: coconut water, coconut coir, and coconut shells are still traditional and the raw materials for building a processing industry are still very large. Not only in terms of quantity, in terms of downstream product types, the processing of coconut products also still has quite a big opportunity [5].

East Nusa Tenggara Province is one of the regions in Indonesia, has a large area and abundant natural resources. With regard to coconut products, Belu as one districts in East Nusa Tenggara which are on the border have a land area for coconut plantations of 1303 Ha [2]. Existence of plantations coconuts that were scattered in various areas of Belu district, then attracted many partners, so that the process of buying coconuts from the plantations of the surrounding community was carried out, both in peeled and unpeeled conditions. countries such as China, Thailand and Singapore.

In general, coconut-based industries consist of 3 (three) types of industries, namely: upstream industry, intermediate industry, and downstream industry [6]. The coconut-based upstream industry produces products in the form of fresh coconuts and copra. The intermediate industry produces products such as copra flour, while the downstream industry produces carbon, coconut oil, nata de coco, and coconut syrup. Distribution of coconut coir as a result farmers to consumers are as follows, coconut coir from farmers is collected by collectors, then distributed to industries to be processed into derivative products or even directly exported[4].

Business potential that can be developed is inversely proportional to resources that can be managed. The demand for coconut coir for high export needs is not supported by the existence of technology which can streamline the production process. So far, coconut coir orders tend to be late and result in difficult order quotas being met, this is due to the large part of the process Coconut coir processing still uses the old method or what is commonly called the manual (traditional) method, namely by peeling the coconut coir from the coconut shell using traditional tools and semi-mechanical equipment.

Peeling coconuts with traditional tools has several drawbacks, namely the small work capacity where peeling one coconut takes ± 1–5 minutes. Wages for a stripping coconut around Rp. 300, - up to Rp. 400,-. When coconut production is high enough, the costs, time and effort for stripping it are also high.

Stripping of coir is also done using a tool made of iron in the shape of a crowbar about 80 cm high with the sharp part facing upwards. At the bottom of this tool is given a seat so that iron does not enter the soil. Trained workers are able to peel an average of 500-1000 coconuts every day [7].

A semi-mechanical coconut peeler development of traditional tools. Even though this tool is semi-mechanical, most of it is still operational using human power. Thus this tool cannot be said to be effective because human power has limits and cannot be used for continuous work. Coir peeling machine coconut can help the job of stripping coir faster with a large work capacity when compared to stripping coconut coir traditionally and semi-mechanically.

Currently there are many coco peeling tools that are sold and can assist in the process of stripping coco [4], both conventionally, semi-conventionally, and automatically which can help production process, but the operation of the tool is quite difficult and expensive, so a coco peeler is designed to use an electric-powered engine with a rotation source obtained from the motor servo to be more effective and efficient in overcoming delays in exports for coconut.

II. METHOD

The method used in this study is a design method that clearly describes activities and allows the designer to use and combine the process as a whole, although some of the designs are still conventional.

2.1 FlowChar Methodology

The process and stages in the design of a portable coconut coir peeler are described as follows:

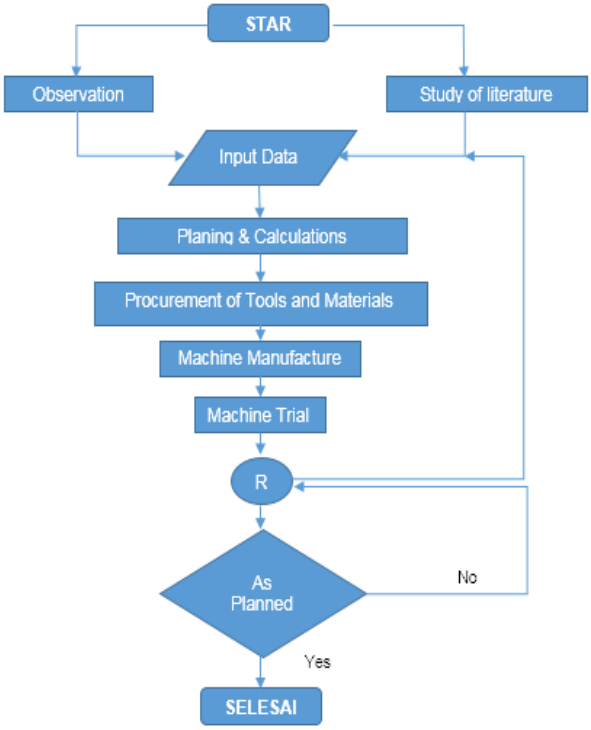

Fig 1. Machine Manufacturing Flowchart

1. Observation

   Observations or field studies were carried out by direct surveys at several locations of small and medium farming communities in Belu district, East Nusa Tenggara. This is done in the context of finding data that can later be used to plan, design and produce coconut coir peelers.

   Study of literature

   The literature study includes searching for and studying library materials relating to all problems regarding the planning of a coco peeling machine obtained from various sources including books, scientific publications and other electronic sources.

2. Data Input

   Data input is the process of collecting data obtained during observation and literature study. From the observation results obtained data on the characteristics of the coconut, the motor power for the stripping process and the operating system and model of the tool applied to the existing coco peeling machine.

3. Planning and Calculations

   This planning and calculation aims to obtain an optimal design and mechanism by taking into account the data that has been obtained from literature studies and direct observation. The machine plan that will be designed is a coconut coir peeler machine

4. Procurement of tools and materials

   From the results of planning and calculations, it can be seen the specifications of the materials and dimensions of the components that will be required for the manufacture of this machine

5. Machine manufacture

   From the components obtained, the assembly is then carried out to make a machine that is in accordance with the design that has been made

6. Equipment Test

   After the tool has been made, testing is carried out by operating the tool. In later testing, the time required will be recorded and the results of the process will be observed

7. Recommendation

   Based on the results of testing the equipment, it is then recommended whether the tool can be made or needs to be modified again.

2.2 Concept Design

Before the design process was carried out, based on the results of observations and literature studies, a scale of importance was drawn up in the design of this servo motor driven portable coco peeler as follows:

1. Producing a machine that can peel coconut coir to the fullest.
2. Only 1 person as operator.
3. Materials and spare parts are widely available and easy to obtain.
4. Simple design and easy to assemble (can be disassembled)
5. Relatively inexpensive manufacturing costs.
6. Easy fabrication process.
7. The fabrication process is sufficient with a conventional machine, no need for a special machine.
8. Safe and easy to operate.
9. No need for special skills in operation.
10. Easy to move (portable)
11. Safe and comfortable.
12. Easy to maintain and can be disassembled.
13. Environmentally friendly.
14. Does not require a large area
15. Tool dimensions 800 x 185 x 1250 mm
16. The stripping capacity reaches 3-4 grains per minute

Based on this concept of importance, a machine concept was designed to be used as a coco peeler for the needs of farmers with the following model:

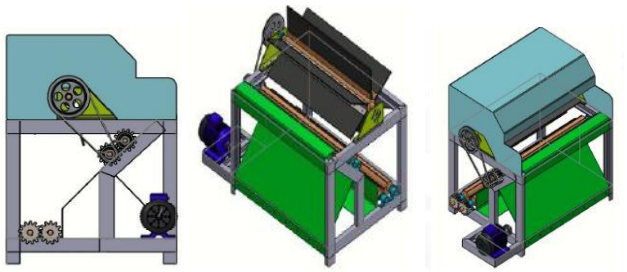

Fig 2. The design concept of a coconut peeler machine

III. RESULTS AND DISCUSSION

3.1 Manufacture and Operation of Portable coconut peeler machine

The production process of the coconut coir peeling machine is carried out by the welding method to build the frame, while for the connection it uses a bolt and nut connection type. The placement of the electric motor, servo and reduced is placed in a position that is safe from

the operator's reach and the ergonomic factor has been calculated. All instruments are operated using a panel and the operator's position when inserting coconut for the stripping process is placed in a safe position.

Fig 3. Coconut coir peeler machine

3.2 Operate the Machine

The workings of this designed machine are as follows:

1. Preparation of Machines and Coconuts to be peeled (Coir)
2. Prepare old or dry coconut husk and coconut fruit peeler machine
3. Stripping Process
4. Turn on the AC Servo motor and let the machine adapt for at least 1 minute.
5. When the AC servo motor receives power from the PLN electricity or through a DC power source which is converted to AC, the main shaft will rotate and then the rotation of the servo motor will be reduced using a speed reduction ratio of 1:40. The rotation reduced by the Speed reduction will then be forwarded to the cylinder shaft where the blade is attached using a v belt and pulley.
6. Place the dried coconuts on the rotating shaft and you can press them using the pressure cover on the lip of the tool.
7. Coconuts are peeled with a knife located on the shaft of the coconut husk peeler
8. Clean coconuts can be taken manually, and
9. After the coconuts have been peeled, the coconut coir peeler is turned off with the ON/OFF switch

3.3 Engine Work Indicator

1. The power of a knife to peel coconuts

Electric motor RPM = 3000 rpm

Speed Reducer ratio 1 : 1 : 40

Speed Reducer ratio 2 : 1 : 30

Ratio of pullyspeed reducer 1 rotation with pullyspeed reducer 2 = 7 : 4

$$Rpm\ Output\ Sped\ Reducer\ 1 = \frac{Rpm\ Motor\ Servo}{Rasio\ Sped\ Rasio\ 1} = \frac{3000}{40} = 75\ RPm$$

$$In\ RPm\ Sped\ reducer\ 2 = \frac{Rpm\ Sped\ Red\ 1}{Ratio\ Pulley} = \frac{75}{7/4} = 42{,}86\ rpm$$

Based on the design and calculation results, it is known that the output speed of the Speed reducer received by the cylinder where the coconut coir knife is attached has been reduced to 42.86 Rpm, causing slower blade rotation and a better feeding effect on coconut coir.

2. Machine capacity

The working capacity of the tool is calculated by continuously inserting a sample of 1 coconut fruit continuously into the peeler and recording the time required. Testing the performance of the coconut fiber peeler machine can be seen in Table 4.1

Table 4.1 The results of testing the performance of the coconut fiber peeler machine

No	Test	Time (Second)
1	Coconut 1	27,02
2	Coconut 2	25,08
3	Coconut 3	27,11
4	Coconut 4	26,24
5	Coconut 5	26,35
Average		26,36

From the table above it is known that testing the old coconut sample which was carried out continuously as many as 5 coconuts into the bolt peeler obtained an average stripping time of 26.36 seconds. Furthermore, indicators can be determined to calculate engine capacity, among others

The number of results peeled = 5 pieces

Total time= 131.8 seconds = 0.0366 hours ≈ 0.04 hours

Then the capacity of the tool/machine is

$$Machine\ Capasity = \frac{Peeled\ Amount\ (grains)}{Total\ time\ (hours)}\frac{3}{0{,}04} = 125\ grains/hours$$

Based on the results of testing the capacity of the tool, it is known that the production capacity of coconut coir that can be done using this tool is 125 grains/hour.

3. Tool Efficiency

a. Coconut Belt Peeler Machine Efficiency

The coco peeling tool that has been made has the ability to peel 125 coconut husks/hour. Whereas the manual method is 60 coconuts/hour (Silabam,2021). Based on this comparison, it is known that the efficiency of the peeler is 2.08%.

b. Time efficiency

If you reach on an industrial scale with a working duration of 7 hours a day (already outside of breaks), then during these normal working hours workers who work with a coconut belt peeler are able to produce 875 coconuts a day. Meanwhile, if theoretically working normal hours with a production capacity of 1 egg per minute, workers are only able to produce 420 eggs/day.

c. Power Efficiency

Coconut belt peeler machine has a power of 750 watts and lives for 8 hours per day. With the basic PLN electricity tariff for small industrial scale with an installed power capacity of 2200 VA of IDR 1444.70/Kwh. Then the electricity requirement for the coconut belt peeler per day is 750 watts x 8 hours = 6000 Watts (6Kwh). If multiplied by tdl, the electricity used by the coconut belt peeler machine per day is IDR.8,686.- or if multiplied for a month, the cost is IDR.260,586.-

IV. CONCLUSION

Servo Motor Driven Portable Coconut Peeler Machine is operated mechanically with a servo motor drive. This tool does not eliminate the role of humans but only increases the capacity of the tool. The operationalization of the tool is carried out in 3 ways, namely 1. Preparing the machine (ensuring that the machine is ready to work and all components and the power supply are in a ready-to-use condition), 2. Carrying out the stripping process by ensuring the operator uses PPE, and following all the steps according to the SOP listed on the tools and 3. Perform post-use maintenance of tools. The design of a Servo Motor-Powered Portable Coconut Peeler machine is able to provide an efficiency increase in engine capacity of 2.08%, increasing the production capacity of stripping from 420 grains per day to 875 grains/day. As well as in the case of the use of electric power there is cost efficiency where the tool only costs electricity IDR. 260,586 per month

ACKNOWLEDGEMENTS

Sincere thanks to the Chancellor of the Republic of Indonesia Defense University and Chair of the Indonesian Defense University LPPM for funding this activity from the LPPM Funds for the 2022 Fiscal Year.

REFERENCES

[1] Allorerung, D., and A. Lay. "The possibility of developing coconut fruit processing in an integrated manner on a rural scale" Proceedings of the IV National Coconut Conference. Bandar Lampung 21 – 23 April 1998 Pp.327 – 340

[2] Indonesian Central Bureau of Statistics, 2021.

[3] Ecowati, M. Build Farmers Foundation". Tubus Jakarta (1992)

[4] Perdana Putera "Design of Coconut Fiber Separator Machine". Agrotechnics 2 (1): 31-40 (2019). https://doi.org/10.32530/agtk.v2i1.31.PP 31-40

[5] Rumokoi, M.M.M, and R.H. Akuba. "21st century coconut oil: Food or oleochemicals". Proceedings of the Coconut National Conference IV. Bandar Lampung 21 – 23 April 1998. Research and Development Center. Pp.302 – 341.

[6] Stefanus Tri Rezki Perkasa, et.al. "Design of an Environmentally Friendly Young Coconut Peeler for Young Coconut Distribution Micro Businesses. Final Project Report, Akprind Jogjakarta.PP

[7] Suhardiyono, L. "Coconut Plants, Cultivation and Utilization". Yogyakarta : Publisher Canisius. (1988)

[8] Zainal Mahmud, Yulius Ferry. Prospects for Processing Coconut Fruit By-Products, Indonesian Center for Estate Crops and Development for Estate Crops and Development.PP 55-63.