International Journal of Integrated Science and Technology (IJIST)
Vol.2, No.12, 2024: 1103-1114

Manufacturing of Coconut Coir Peeling Machine

Anhar Khalid
Politeknik Negeri Banjarmasin

Corresponding Author: Anhar Khalid; anhar.khalid@poliban.ac.id

A R T I C L E I N F O

Keywords: Peeling Machine, Coconut, Manufacturing

Received : 20, October
Revised : 25, November
Accepted: 20, December

A B S T R A C T

An automatic coconut coir peeling machine is a tool designed to make the process of peeling coconut coir easier. In the context of trade, especially in the sale of coconuts, this tool is very helpful for sellers who previously relied on traditional methods, such as cutting coconuts with crowbars, which required considerable time and effort. With the automatic coconut coir peeling machine, this process becomes more efficient and faster.

The process of manufacturing this machine involves several important steps, including material selection, component procurement, and manufacturing the components themselves. The material chosen is ST 37 steel with profile steel specification 1. Machine components are manufactured using lathes and grinding machines.

The test results show that this coconut coir peeling machine makes the stripping process easier and more efficient. This machine has specifications that are quite large and heavy, so it requires sufficient space for operation and placement so as not to interfere with other activities. In addition, moving the machine from one place to another requires additional energy. The time it takes to peel coconut coir with this machine is about eight minutes.

INTRODUCTION

The development of technology, especially in the field of machinery, is very rapid, especially in the manufacturing industry. In the era of globalization like now with the development of technology that has existed today, humans are always trying to make the latest innovations to make human work more efficient and can be used by many people (Cahyaningtyas et al., 2023; Rabbani & Najicha, 2023). In today's life, many coconut peeling or cutting aids are made to facilitate human activities in carrying out peeling or cutting, for example knives, machetes and others. But in the era of globalization like now, there are not many tools to cut old coconut shells.

In this plan, the author designed the drive system on the old coconut coir peeling machine (Riyadi et al., 2021; Riyan et al., 2022). This old coconut coir peeling machine is used to peel or cut old coconut shells. This tool is made with the aim of shortening the peeling time and making it easier to peel old coconut coir so that the process is faster and can produce more and neater production of old coconuts, the main driver is dynamo 1HP because this machine is easy to start, efficient electrical performance, durable, and low noise level, Its low-vibration, much smaller emissions without sacrificing power/power or performance The dynamo 1HP provides enough power for the toughest conditions.

THEORETICAL FRAMEWORK

A. Definition of Coconut

Coconut is a plant native to the tropics, namely areas located along the equator. In these tropical areas, many coconut plants grow and are cultivated by most of Patani (Fauzana et al., 2021). In Indonesia, it is found in almost all provinces, from flat coastal areas to rather high mountainous areas. In densely populated areas, for example in Java and Bali, coconut plants are more planted in moorland or yard land, while in sparsely populated areas, for example in transmigration areas, coconut plants are mostly planted on large areas of land with a monoculture pattern of coconut plantations. The coconut plant is also a versatile plant. Almost all parts of plants that can be used for human life. From coconut trees, food and beverages, industrial materials, building materials, household appliances, and so on can be obtained (Pomalingo et al., 2022). One of the results of the coconut part is that coconut shells can be used as shell charcoal. The composition of coconuts is that old coconut fruits contain high calories, amounting to 359 cal per 100 grams, half-aged coconut meat contains a number of calories of 180 cal per 100 grams and young coconut meat contains 68 cal per 100 grams. Meanwhile, the average calorie value contained in coconut water is around 17 cal per 100 grams. Green coconut water compared to other types of coconut water contains the highest tannins or anti-dotum (anti-toxin). The content of other dominant chemical substances is in the form of enzymes that are able to decompose the properties of toxins, the composition of chemical substances contained in coconut water includes vitamin C, protein, fat, charcoal hydrate, calcium or potassium. The minerals contained in coconut water are iron,

phosphorus, and sugars consisting of glucose, fructose, and sucrose. The water content found in coconuts is 95.5 grams per 100 grams.

B. Definition of Semi-Automatic Coconut Coir Peeling Machine.

This type of machine in the production process uses rotation and power from a drive in the form of an electric motor and an engine as a coconut peeler and assisted by human labor to insert the coconut, and push the coconut shell that has been peeled from coconut coir (Rabbani & Najicha, 2023).

C. Components of Coconut Coir Peeling Machine

- **Chain**
  Chains (Roller Chains) are usually made of high-strength steel so that they are more capable of transmitting torque with high values (Efrizal & Sabar, 2020). The chain can transmit power and spin up to 6000 rpm.

- **Gear Box WPA**
  WPA Gear Box Speed Reducer is a device that can increase the strength of the load/torque by changing the speed/speed of the motorcycle dynamo (Yericsen, 2023) . A Gear Box or Reducer is a combination of mechanical and electrical devices where the function of the Gear Box is to reduce the speed of the motor's dynamo to get a greater load/torque.

- **Gears**
  Gear is a term for Gears that work on a machine whose function is to transmit power (Wibowo & Pramono, 2018) . A gear is a simple part of the engine with rotating teeth and is usually connected to other gears. Two or more gears working together will generate mechanical power through their rotation is a simple definition of a machine.

- **Stainless Pipe**
  Stainless steel is the preferred metal alloy for making kitchen utensils, as it does not affect the taste of food (Dearest, 2020). Easy-to-clean stainless steel equipment surface. The minimal maintenance and total recycling of stainless steel equipment also contributes to their popularity. Stainless steel is the universal name for metal alloys, which are made up of Chromium and Iron. It is often also called stainless steel because it is very resistant to stains (rust).

- **Shaft**
  The shaft is one of the most important parts of every engine (Danuri, 2015). Almost all engines pass on energy along with rotation. The main revolution in such a transmission is held by the shaft.

- **Bearing**
  The bearing is the engine element that concentrates the loaded shaft, so that the rotation or reciprocating motion can work safely, smoothly and with a

long service life (Cost & Quality, 2016) . The bearings must be sturdy to allow the shaft or other engine elements to work properly.

- **Generator**
  A generator (dynamo) is a device whose working principle is based on electromagnetic induction. Electromagnetic induction is widely used to convert kinetic energy into electrical energy such as in bicycle dynamos (McLean, 2005). Dynamos are distinguished in alternating current dynamos and direct current dynamos.

METHODS

This research is an experimental research, which is a type of research in which researchers actively manipulate or intervene on certain variables to observe the effects or results of the intervention. In this study, we have adopted experimental methods to explore and understand how various design and operational factors affect the performance and results of coconut coir peeling machines.

As part of this experimental approach, we systematically changed various parameters such as operating speed, mechanical stress, and the type of material used in the design of the machine. The goal is to assess the impact of each of these changes on stripping efficiency, finish quality, and machine durability. By controlling and manipulating these variables, we can isolate the factors that influence the outcome and identify the causal relationship between the changes made and the effects observed.

This experimental method provides great advantages in terms of accuracy and validity of the data obtained. By implementing a well-structured and well-planned experimental design, we can collect robust and objective data on how each intervention affects the peeling process. This approach also allows us to conduct in-depth, evidence-based analyses of machine performance, as well as identify potential areas for improvement or innovation.

In addition, this experimental research helps us understand the complex dynamics involved in machine operation and provides valuable insights into how various factors interact with each other. Thus, we can not only optimize the machine design based on empirical results but also ensure that any changes implemented are based on in-depth data analysis and not just on speculation or assumptions.

This approach also allows us to conduct a comprehensive evaluation of the effectiveness of the design and process, and provides a solid basis for continuous improvement. By utilizing experimental methods, we were able to draw more accurate and reliable conclusions about how each aspect of the design affected the final result, which in turn improved the quality and efficiency of the developed coconut coir peeling machine.

RESULTS

The manufacture of the Coconut Coir Peeling Machine is an innovation designed to improve the efficiency of coconut processing by peeling the coir attached to the shell. This machine overcomes the manual stripping process which takes a lot of time and effort. With the use of machines, stripping coir becomes much faster and more practical.

In terms of design, a coconut floss peeling machine typically consists of key components such as the frame, drive motor, and paring blades or teeth. The drive motor serves as a power source that rotates the blade or teeth, which then peels the coir from the coconut shell. This design allows stripping to take place continuously without much manual intervention.

In terms of efficiency, this machine is able to peel a large amount of coconut coir in a shorter time than the manual method. Some medium-capacity machines are even capable of peeling between 100 and 200 coconuts per hour, depending on the specifications of the machine. This not only speeds up the process, but also reduces the amount of labor required, making it more cost-effective and increasing productivity.

Coconut coir peeling machines also produce cleaner and higher quality coir, which can be used for various derivative products, such as raw materials for the mattress industry, mats, or even for biomass fuels. The use of this machine helps optimize the use of coconut without much wasted material.

Another advantage is the relatively efficient use of energy, especially in modern machines designed to save electricity without compromising the quality of the results. The safety aspect is also considered, with safety features such as knife covers and emergency buttons. In addition, the ergonomic design of the machine makes it easy to operate, making it safer and more convenient to use.

In the industrial sector, coconut coir peeling machines have been widely used, especially in coconut-producing areas such as Indonesia and the Philippines. The development of machine technology continues to be carried out to be more efficient, with several innovations such as automation and sensors to improve performance. However, like any other machine, regular maintenance is necessary to keep the machine's performance optimal. These machines also have constraints in terms of price, as the relatively high price makes them less affordable for farmers or small entrepreneurs. However, there are attempts to develop cheaper and affordable versions.

DISCUSSION

A. Design of Coconut Coir Peeling Machine

The Coconut Coir Peeling Machine is designed to separate the coconut shells from the coir, resulting in clean coconut shells. This engine works by using an Electric Dynamo drive, where power from the dynamo is transferred to the gear box, gears, chain, and both blade elements. The stripping process is carried out by placing the coconut between the two blade elements that move in opposite directions while pressing the safety handle, so that the coconut separates from the coir. The coconut coir then falls into the drain section next to the machine.

The blade is designed with a straight type to speed up the stripping process, while the gear ratio is made different to improve time efficiency. The gear teeth at load 1 are 60 z 24, while at load 2 they are 60 z 20, which aims to speed up the stripping of coconut fibers.

The use of the Electric Dynamo as the main drive was chosen because it is easy to operate, has a low noise level, and provides sufficient power for severe stripping conditions. Meanwhile, the gear box is used to increase torque by reducing the speed of the dynamo, so that the engine can handle larger loads and work more efficiently.

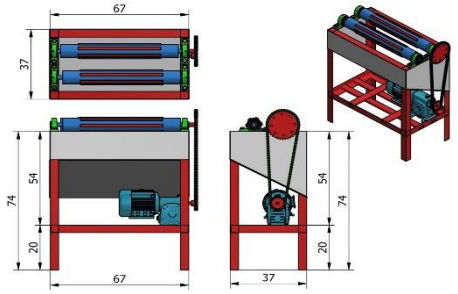

Figure 1: Design of coconut coir peeling machine

B. Working Process of Coconut Coir Peeling Machine

Here are the steps that need to be followed to operate a coconut floss peeling machine safely and efficiently. The first step is to make sure all test tools and materials have been carefully prepared. This preparation includes checking the condition of the machine, ensuring that the coconut to be processed is in a ready state, and checking that all machine components, such as the peeling blade and drive system, are functioning properly. This preparation is essential to prevent technical errors during the stripping process and ensure optimal results.

Once the tools and materials are ready, turn on the dynamo engine that is the main source of power. This dynamo will drive the blade shaft and other elements of the engine. When the machine has reached a steady rotation, carefully place the coconut on the blade shaft. The position of the coconut must be right so that the peeling process runs smoothly and the shell is not damaged. At this stage, caution is needed because the engine is operating at high speed.

Press the coconut gently but steadily with your hands, making sure to always be careful not to get your hands too close to the knife. The pressure applied should be enough to ensure that the coir is peeled off, but not too strong so that the coconut shell does not suffer damage. Hold the coconut in that position until all the coir is completely peeled off from the coconut shell. This process will take a few seconds, depending on the size and thickness of the coconut coir.

After all the fibers are removed, immediately turn off the dynamo engine to stop the operation of the machine and avoid work accidents. Turning off the engine after it is finished using also helps maintain the durability of the engine components so that they do not wear out quickly. Take the coconut that has been peeled off the coir carefully, make sure the coconut produced is in good condition

and ready for further processing. The final step is to clean the machine table of any coir residue or coconut pieces that may have been left behind. This cleaning is important not only to keep the workplace clean, but also to ensure that the machine remains in optimal condition and ready to be used again at the next opportunity.

By following this procedure, the coconut fiber stripping process will take place efficiently and safely. These machines are designed to increase productivity by speeding up peeling, but proper and careful use is essential to maintain safety and quality of results.

C. Advantages of Coconut Coir Peeling Machine

This machine is designed to speed up the process of peeling coconut coir, especially for medium-sized coconuts. With high speed and efficiency, this machine is able to peel up to 7 coconut shells in just one minute, making it very effective in increasing productivity. The straight blade design is deliberately created to speed up the stripping process by minimizing drag when the coconut coir is separated from the shell. In addition, this machine is also optimized to work stably and efficiently, making it suitable for use on an industrial scale or coconut processing businesses that require speed and precision in separating coir.

D. Disadvantages of Coconut Coir Peeling Machine

The weaknesses of the Coconut Coir Peeling Machine can be found in several aspects. First, this machine is not designed to peel large coconut coir. This limits the use of the machine to only medium or small coconuts, which are certainly less ideal for processing on a large scale or in regions that produce coconuts of varying sizes. The inability to accommodate large coconuts can force users to perform manual sorting, which reduces efficiency and increases work time.

In addition, this machine is not equipped with a special shelter for coconuts that have been separated from the coir. Once the coir is peeled off, the coconut must be picked up manually, which can be time-consuming and slow down the workflow. The absence of this efficient shelter can also cause the coconut to fall and risk damage if not handled carefully. In a busy production environment, these shortcomings can be a significant hindrance in terms of productivity.

Furthermore, this machine is also not equipped with vibration dampers. Vibrations from the machine during operation can cause faster wear of components and potentially make operation less comfortable for the user. Uncontrolled vibration can also affect the stability of the machine and increase the risk of errors or work accidents. Without vibration damping, these machines may be noisier and less comfortable to operate for long periods of time.

Another significant drawback is that the machine relies on an electric dynamo as its propulsion, which makes it not ideal for use in coconut plantations or remote areas that do not have stable access to electricity. The use of electricity as a power source limits the flexibility of the machine, especially in locations

where power sources are difficult to access or not available at all. In this situation, engines with combustion motors are preferred because they can operate on fuels such as gasoline or diesel, providing better mobility and flexibility. Reliance on electricity can also add to operational costs if additional generators are needed in areas without electricity.

Overall, while these machines are quite efficient under certain conditions, these drawbacks make them less suitable for field applications or large-scale use without proper adjustments.

E. Shaft Planning

It is known some basic parameters that will be used to calculate and plan the shaft. First, the conversion of 1 HP is equal to 746 Watts, so the power of an electric motor of 0.8 HP can be converted to 596 Watts. The plan revolution (n2) is 23 rpm, and the correction factor (Fc) used is 2. Thus, the planned power (Pd) is 0.596 kW. The shaft material used is ST37 steel with a tensile strength (σB) of 37 kg/mm². The safety factor consists of two components, namely the safety factor according to the material used (sf_1) of 5.5, and the safety factor according to the influence of voltage concentration (sf_2) of 1.3. The correction factor for the torsional moment (Kt) is 1, and the correction factor for the bending load (Cb) is 1.2.

The first step is to calculate the transmitted power:

The transmitted power (P) is 146.75 kW with an initial rotation speed (n1) of 1380 rpm. The power correction factor (fc) is set at 1.0, so the planned power (Pd) is calculated using the formula:

$$Pd = fc \times P \quad \text{.....(1)}$$
$$Pd = 1{,}0 \times 596 = 596 \text{ Watt} = 0{,}596 \text{ kW}$$

Calculating the twist moment of the plan (T):

$$T \text{ (planned twist moment)} = (9.74 \times 10^5 \times Pd) / n_2 \quad \text{.....(2)}$$
$$T = (9.74 \times 10^5 \times 0.596) / 552$$
$$T = 1042.18 \text{ kg.mm}$$

Shaft material used:

The shaft material used is ST37 steel with a tensile strength (σB) of 37 kg/mm². The safety factor (sf_1) for the material is 5.6, and the safety factor (sf_2) for the effect of voltage concentration is 1.3.

Allowable shear stress (τ_a):

τ_a (allowable shear stress) is calculated as:

$$\tau_a = \sigma B / (sf_1 \times sf_2) \quad \text{.....(3)}$$
$$\tau_a = 37 / (5.6 \times 1.3)$$
$$\tau_a = 37 / 7{,}28$$
$$\tau_a = 5.08 \text{ kg/mm}^2$$

Torsional moment (Kt) and bending load (Cb) correction factors:

The torsional moment correction factor (Kt) is 1, and the bending load correction factor (Cb) is 1.2.
Calculating shaft diameter (ds):

The shaft diameter is calculated using the following formula:

$ds = ((5,1 \times T) / (\tau_a \times Kt \times Cb))^{(1/3)}$ .....(4)
$ds = ((5,1 \times 1042,18) / (5,08 \times 1 \times 1,2))^{(1/3)}$
$ds = ((25,91 \times 1042,18) / 6,096)^{(1/3)}$
$ds = (32403,46)^{(1/3)} = 31,8 \text{ mm} \approx 32 \text{ mm}$

Occurring shear stress (τ):

$\tau = (5,1 \times T) / d^3$ .....(5)
$\tau = (5,1 \times 1042,18) / 32^3$
$\tau = 0.16 \text{ kg/mm}^2$

Since the allowable shear stress (τ_a) of 5.08 kg/mm² is greater than the resulting shear stress (τ) of 0.16 kg/mm², this design is safe.
Comparison:

$\tau_a \times sf_1 = 5,08 \times 1,3 = 6,60 \text{ kg/mm}^2$ .....(6)
$\tau \times Cb \times Kt = 0,16 \times 1,2 \times 1 = 0,19 \text{ kg/mm}^2$ .....(7)

Since $\tau_a \times sf_1 > \tau \times Cb \times Kt$, this design meets the safety requirements.

Shaft used:
The diameter of the shaft used is 32 mm, made of ST37 material, with a peg size of 6x6.

CONCLUSIONS AND RECOMMENDATIONS

The design of this coconut flake peeling machine is designed to meet the needs of the industry with a processing capacity of up to 120 coconuts per hour. This engine uses a 1 HP electric motor that operates at a rotational speed of 1380 rpm as the main source of driving power. This motor plays a crucial role in driving the engine shaft which is designed to rotate in the opposite direction of the clock. This spinning process allows the cutting blades attached to the machine to work effectively in separating the coir from the coconut shell.

The electric motor is connected to a gearbox that functions to adjust the speed and torque according to the operating needs of the machine. This gearbox ensures that the shaft rotation speed can be precisely adjusted to optimize the performance of the machine in coconut coir stripping. The gearbox also functions

to change and adjust the twisting moment of the motor, thus providing the necessary power to efficiently cut coconut coir.

The cutting blades on this machine are specially designed to work effectively with the help of a 1 HP electric dynamo. This dynamo is connected to a gearbox system, which allows the engine to operate at the appropriate power and speed. With this configuration, the machine can perform coconut fiber stripping quickly and efficiently, maximizing production in a relatively short time.

Overall, the design of this machine aims to increase productivity in the coconut coir stripping process, taking into account efficiency and operational speed. This machine is suitable for use in industrial scale or coconut processing businesses that require fast and reliable peeling solutions. With integrated drive and cutting technology, these machines offer an effective solution to meet the high demands of production, while maintaining optimal quality of peeling results.

FURTHER STUDY

The design of the coconut coir peeling machine must consider various important aspects to achieve efficiency and reliability. Good design can increase productivity and quality of peeling results, reduce time and labor, and minimize waste. The selection of durable materials and the appropriate drive system play an important role in the durability and performance of the machine.

Ergonomic aspects and ease of use should also be considered to ensure operator comfort and reduce the possibility of errors in operation. In addition, the design of the machine must allow easy access for cleaning and maintenance to ensure the longevity of the machine.

Integrating the latest technologies, such as automatic controls and sensors, can improve the efficiency and accuracy of the peeling process. Taking into account the investment costs and potential operational savings is also important to ensure that the machine offers significant added value. Finally, getting feedback from users and considering the environmental impact of the machine's design will help create better and more sustainable solutions.

ACKNOWLEDGMENT

Thank you very much for the help and support that has been provided in this research. The contribution of the team and the Banjarmasin State Polytechnic is very valuable in the process of developing the design of the coconut coir peeling machine. The author greatly appreciates the time, effort, and knowledge that has been poured into helping to perfect this design. The author hopes that the results of this study can provide broad benefits and become an important step in the innovation of the coconut processing industry. Hopefully we can continue to work together on future projects and achieve more achievements together.

REFERENCES

Cost, P., & Quality, D. A. N. (2016). *Digital Digital Repository Repository University of Jember Jember Digital Digital Repository Repository University of Jember Jember*.

Cahyaningtyas, A. S., Aeni, A. N., & Adipura, H. N. (2023). The Influence of Technological Development in the Industrial Revolution Era. *Padjajaran University*, *October*, 1–18.

Danuri, R. (2015). Design of a multi-purpose chopper tool of the blade sliding type using the mechanical Ralph Steiner principle. *Journal of Mechanical Engineering*, *3*(1), 24–30.

Efrizal, E., & Sabar, M. (2020). Analysis of Sprocket and Chain Transmission Design in Gasoline Prototype Vehicles Energy Efficient Car Contest (Kmhe) Minister of Research, Technology and Higher Education Umt. *Burning Motor : Journal of Mechanical Engineering*, *3*(1), 1–7. https://doi.org/10.31000/mbjtm.v3i1.3072

Fauzana, N., Pertiwi, A. A., & Ilmiyah, N. (2021). Ethnobotany of Coconut (Cocos nucifera L.) in Sungai Kupang Village, Kandangan District, South Hulu Sungai Regency. *Al Kawnu : Science and Local Wisdom Journal*, *1*(1), 45–56. https://doi.org/10.18592/ak.v1i1.5073

McLean, G. W. (2005). Generators. *Newnes Electrical Power Engineer's Handbook, Second Edition*, *11*(1), 105–133. https://doi.org/10.1016/B978-075066268-0/50005-6

Pomalingo, N., Rantelinggi, D., & Sirajuddin, Z. (2022). Coconut Economic Potential Through the Utilization of Coconut Derivative Products in Gorontalo Regency. *Poltanesa Bulletin*, *23*(2), 792–798. https://doi.org/10.51967/tanesa.v23i2.1335

Priyotomo, G. (2020). Metal Discharge of Stainless Steel Cookware in Acid and Salt Simulation Solution. *Journal of Halal Agroindustry*, *6*(2), 217–227. https://doi.org/10.30997/jah.v6i2.2680

Rabbani, D. A., & Najicha, F. U. (2023). The Influence of Technological Development on the Life and Social Interaction of Indonesian People. *Researchgate.Net*, *November*, 0–13.

Riyadi, A., Hartono, P., & Lesmanah, U. (2021). Planning of Mechanical System Coconut Coir Peeling Equipment. *Journal of Mechanical Engineering*, *16*(3), 8–15.

Riyan, A., Ibnu, H., Study, P. D., Production and Maintenance Machinery of the

Bengkalis State Polytechnic Jl Bathin Alam, T., Sungai Alam, D., & Riau, B. (2022). *Design of a semi-automatic coconut coir peeling machine with a capacity of 100 pieces/hour*. *1*.

Wibowo, P. P., & Pramono, A. S. (2018). Modeling and Analysis Based on Experimental Studies on the Effect of Tooth Profile Modification on Dynamic Characteristics in Involute Spur Gear. *ITS Engineering Journal*, *6*(2), 752–755. https://doi.org/10.12962/j23373539.v6i2.27202

Yericsen, P. (2023). *Analisa Efisiensi Gearbox Pada Motor Penggerak Listrik Kapal Nelayan= Analysis of Gearbox Efficiency in Fisherman Ship Electric Driving Motors*. *2*, 26–32. https://doi.org/10.25042/jrt2k.062023.04