

## Design and Development of a Coconut Fiber Extracting Machine

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### INTISARI

Perlu perkembangan untuk alat-alat yang dapat mendukung peningkatan produksi pertanian baik sebelum maupun sesudah panen. Salah satu tanaman utamanya adalah kelapa. Sabuk kelapa sebagai bahan pembuatan kasur, karpet, pelapis jok mobil, bantal dan serat karet sangat besar dan prospek ke depannya cerah. Selain itu, batok kelapa yang dihaluskan menjadi bubuk halus juga dikenal dengan istilah *cocopeat*. Sedangkan serabut kelapa diperoleh dari serabut kelapa yang sudah dikupas atau biasa sering kita dengar istilah *cocofiber*. Penelitian ini bertujuan untuk membuat mesin pengurai sabuk kelapa dan menghitung kapasitas dari hasil penguraian. Penelitian ini melakukan pendekatan Studi literatur, Proses perancangan dilakukan dengan membuat sketsa alat serta perhitungan biaya rancang bangunnya. Teori proses pembuatan bisa berupa pemotongan, pengelasan, pengeboran dan yang lainnya. Mesin pengurai sabuk kelapa terdiri dari beberapa komponen yaitu motor penggerak listrik, v belt, pully, penutup, rangka, dan bantalan bearing. Mesin Pengurai Sabuk Kelapa ini menggunakan motor penggerak listrik dengan daya dan kecepatan 1.800 rpm, dengan metode cacahan atau pengurai, dimensi 700 x 600 x 207 x 250 mm menggunakan besi siku (*Calestindo Steel*) 4x4 cm dengan ketebalan 2 mm sebagai rangkanya serta menggunakan besi plat ketebalan 1,5 mm dan sebagai penutup poros mata pisau dan menggunakan baut sebagai penyangga seluruh bagian alat yang akan dirakit. Hasil pengujian yakni dimana hasil cacahan sabuk kelapa menjadi *cocopeat* dan *cocofiber*. Dalam waktu 60 menit dapat mengurai sabuk kelapa sebanyak 8 kg, dan juga menghasilkan cocofiber seberat 6 kg dan cocopeat 1,2 kg.

**Kata Kunci:** Sabut Kelapa, Mesin Pengupas, *Cocopeat and Cocofiber*

## ABSTRACT

*There is a need for the development of tools to support increased agricultural production, both before and after harvest. One of the key crops is coconut. Coconut husks have significant potential as raw materials for producing mattresses, carpets, car seat covers, pillows, and rubber fibers, with a promising future. Additionally, ground coconut shells, commonly known as cocopeat, and coconut fibers, derived from peeled coconut husks (cocofiber), are highly valuable. This study aims to design a coconut husk decorticator machine and calculate the output capacity of the decortication process. The research adopts a literature review approach, and the design process involves creating equipment sketches and calculating the development costs. The manufacturing process may include cutting, welding, drilling, and other relevant methods. The coconut husk decorticator machine comprises several components, including an electric motor, V-belt, pulleys, cover, frame, and bearing supports. The machine uses an electric motor with a power rating and speed of 1,800 rpm, operating with a shredding or decorticating method. Its dimensions are 700 x 600 x 207 x 250 mm, with a frame made of 4x4 cm (Calestindo Steel) iron angles with a thickness of 2 mm. The cover is made of 1.5 mm thick steel plates to enclose the blade shaft, and bolts are used to secure all parts during assembly. The test results show that the machine successfully processes coconut husks into cocopeat and cocofiber. Within 60 minutes, it can decorticate 8 kg of coconut husks, producing 6 kg of cocofiber and 1.2 kg of cocopeat.*

*Keywords: Coconut Husk, Peeling Machine, Cocopeat and Cocofiber*

## 1. INTRODUCTION

The dynamics of technology grow and develop rapidly in line with modern advancements through the promotion of suitable, versatile, and economical technologies. This is marked by the creation of new products in various regions. In particular, the agricultural sector, which is one of the main sectors and a livelihood for the majority of Indonesians, requires the development of tools to support increased agricultural production both before and after harvesting.

One of the primary crops is coconut. Coconut is widely cultivated in the community due to its significant economic value. Its applications in the manufacturing industry are quite extensive. Additionally, coconuts still hold added value from their

husks. Coconut husks, which some people discard and consider waste, actually possess substantial added value that can be beneficial to all of humanity. Raw coconuts may have limited uses, but processed coconuts can offer much broader applications.

The potential for utilizing coconut husks as raw materials for mattresses, carpets, car seat linings, cushions, and rubber fibers is vast, with a bright future ahead. Furthermore, ground coconut shells, turned into fine powder, are known as cocopeat. Coconut fiber, on the other hand, is obtained from peeled coconut husks, often referred to as cocofiber. In addition to being economical, cocopeat serves as an environmentally friendly planting medium, as it is made from the renewable (organic) coconut husk skin. As its name suggests, cocopeat comes from coconuts, specifically the mesocarp layer or part of the coconut that can be processed into cocopeat.

Partner industries face obstacles in producing high-quality products. This is because manual decortication tools yield coarse, dirty, and short fibers, resulting in substandard product quality. The planned machine will utilize an electric motor connected to a pulley-belt system, which will drive the blade shaft to process coconut husks. This machine is expected to assist small- to medium-scale coconut husk processors in maximizing the use of coconut waste and increasing its market value. The current manual process is time-consuming, making it ineffective and inefficient for producing large quantities.

The objective of creating this tool is to design and modify a coconut husk decorticator to improve the quality and quantity of production more efficiently and economically. Using a combination of an electric motor and modifications, this machine can be widely used by the community and reduce risks for users through its enhanced design. The machine is designed in a box shape to house the decorticator. Inside, there are cross-positioned decorticating blades, along with an inlet and outlet for feeding and releasing the processed husks. With this coconut husk decorticator, the resulting products are of higher quality, with finer fibers, thus increasing their economic value. Crushed coconut husks turned into fine powder are referred to as cocopeat. Meanwhile, coconut husk fiber is obtained from husks that have been shredded first. In addition to being economical, cocopeat is an eco-friendly planting medium made from the renewable (organic) coconut husk skin.

Coconut husk becomes highly economical when processed into cocopeat and cocofiber. Cocopeat can be used for agricultural purposes, while cocofiber is utilized in the automotive and furniture industries. Proper processing of coconut husk can significantly increase farmers' income. Currently, many farmers discard coconut husk as waste, often burning it, even though it has significant value and benefits for society. Burning coconut husk contributes to air pollution, potentially increasing global warming by up to 10%. Efforts to address this pollution must focus on utilizing and processing coconut husk into fibers and powder, which can become a source of income for farmers (Gafur & Muklis, 2022).

Coconut husk is the outermost layer of the coconut shell, consisting of fine fibers. When these fibers are separated, they produce cocofiber (fiber) and cocopeat (powder). With its various advantages, coconut husk can be processed and used to create cocopeat and cocofiber planting media. Cocopeat and cocofiber, derived from coconut fibers, are easily found in tropical countries such as Indonesia. Cocopeat has a water high absorption capacity and retains the chemical elements in fertilizers while neutralizing soil acidity. These properties make cocopeat an excellent planting medium for horticultural crops and a suitable growing medium for greenhouse plants (Putri Ayu et al., 2021).

Cocopeat is an organic planting medium, typically made from coconut husk powder. Sometimes, cocopeat is mixed with burnt rice husk. In addition to being environmentally friendly, cocopeat has high water retention capabilities. It can absorb water and loosen soil structure. Cocopeat retains significantly more water than soil, storing and maintaining water up to 10 times better. This property is particularly beneficial for plants grown in hydroponic systems. With its excellent water retention, plant roots are less likely to dry out and dehydrate. Cocopeat is environmentally friendly and biodegrades easily into the soil when it is no longer used (Augustien & Suhardjono, 2023).

The Coconut Husk Decorticator Machine functions to unravel or separate coconut fiber from its sponge or powder layer, allowing both resulting products to be utilized as needed. The working principle of the coconut husk decorticator involves striking the coconut husk until the fiber and powder are separated after being fed into the machine's hopper. The purpose of this process is to separate coconut fiber

(cocofiber) from the outer coconut shell (cocopeat), as each material has its specific function and market value. The processed output consists of fiber and outer shell that have been separated, though initially, these products may still be mixed. The machine operates using a mechanical process powered by an electric motor, with the shaft connected to the motor via a V-belt. The decorticator blades mounted on the shaft rotate, shredding the coconut husk fed through the hopper. This shredding process breaks down the husk into cocopeat and cocofiber. Cocopeat exits through the cocopeat output hopper, while cocofiber exits through the cocofiber output hopper (Satito et al., 2020).

### **3. RESEARCH METHODS**

This study was conducted with the aim of designing and manufacturing a coconut husk decorticator machine. The steps involved in the creation of this machine included the following: the first step was determining the research topic, conducting a survey to assess the needs of the surrounding community, and performing a literature review using scientific journals and books. After selecting the research topic and gathering references, the next step was initiating the design process. At this stage, load and capacity calculations were carried out to ensure the machine matched the specifications of the motor to be used.

The research was conducted at the mechanical engineering workshop of Tomakaka University over a period of one month. The tools used included a welding machine, bench drill, measuring tape, welding helmet, wrenches and rings, gloves, and a square ruler. The materials used included an electric motor, bolts and nuts, cutting blades, angle iron, 0.2 electrodes, sheet metal, S45C steel, and an MCB (Miniature Circuit Breaker). The method for building the coconut husk decorticator machine comprised several supporting methods, including a literature review, the design process, and the assembly process.

### **4. RESULTS AND DISCUSSION**

This machine is powered by a 1 HP electric motor with a speed of 2800 rpm. First, the motor's power cable is connected to an electrical power source. Once the motor starts running, its rotation is transmitted to the decorticator blade shaft. To process the coconut husk, the husk is clamped using a holder and directed towards the decorticator blade, which operates on a grating system to produce fibers.

The functional testing of the coconut husk decorticator machine aims to assess the design compatibility with the actual tool. During operation, the electric motor runs at 1,800 rpm, while the blade shaft rotates at 450 rpm. With the motor spinning at 1,800 rpm, the linear velocity of the V-belt connecting the two pulleys (the motor pulley and the blade shaft pulley) is calculated at 3.9 m/s. For testing, three sacks of coconut husks were prepared, each weighing 8 kg. The decortication process was carried out step by step for each sack, and the resulting cocopeat and cocofiber outputs are shown in Table 1 below.

Table 1. Testing Data for the Coconut Husk Decorticator Machine Capacity

Testing	Coconut Husk Weight(kg)	Cocofiber (kg)	Cocopeat (kg)	Decortication Time (minutes)
1	8	6	1,2	60
2	8	5	0,8	60
3	8	4,8	0,9	60

Based on the data in Table 1, the best testing result was obtained in the first test. In the first test, the machine was able to produce 6 kg of cocofiber and 1.2 kg of cocopeat within 60 minutes. In comparison, the second and third tests yielded less cocofiber and cocopeat. Thus, based on this data, the following conclusions can be drawn:

#### Test 1

With a decortication time of 60 minutes, the machine produced the highest amount of cocofiber and cocopeat, specifically 6 kg of cocofiber and 1.2 kg of cocopeat. This is because the coconut husk used in this test was semi-dry. The quality of the output met the expected standards.

#### Test 2

In 60 minutes, the machine produced less cocopeat and cocofiber compared to Test 1, with 0.8 kg of cocopeat and 5 kg of cocofiber. This was due to the coconut husk being too wet, which resulted in suboptimal production of cocopeat and cocofiber.

#### Test 3

In the third test, the machine produced 0.9 kg of cocopeat and 4.8 kg of cocofiber within 60 minutes. The coconut husk used was too dry and still contained remnants of coconut shell, leading to less-than-optimal results.



Figure 1. Cocopeat



Figure 2. Cocofiber

Based on the image above, the specimen from the coconut husk decorticator machine test shows that 8 kg of coconut husk can produce 1.2 kg of cocopeat and 6 kg of cocofiber.

## 5. CONCLUSION

The Coconut Husk Decorticator Machine uses an electric motor with a power output and speed of 1,800 rpm. It operates using a shredding or decorticating method. The machine has dimensions of 700x600x207x250 mm and features a frame made of 4x4 cm (Calestindo Steel) angle iron with a thickness of 2 mm. It also uses 1.5 mm thick sheet metal as the cover for the blade shaft and bolts to support all the assembled components. The testing results show that the shredded coconut husk is processed into cocopeat and cocofiber. In 60 minutes, the machine can decorticate 8 kg of coconut husk, producing 6 kg of cocofiber and 1.2 kg of cocopeat. The quality of the decortication results meets the expected standards.

## 6. REFERENCE

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