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Design and Fabrication of Coconut Shell Breaker Machine

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ABSTRACT:

By expanding the scope of the coconut processing sector, the derivatives market for coconuts is expanding. This is demonstrated by the range of post-harvest coconut processing methods used to create both food and non-food items. Virgin coconut oil (VCO) is one of the edible by-products derived from coconut meat that appears to be promising and have a high market value. Pure coconut oil is converted into VCO, a substance that has numerous health benefits, including boosting immunity against degenerative diseases and serving as a high-value raw material for natural cosmetics. The goal of the current project is to create a technological package for turning coconut fruit into VCO[4].As breaking apart, the coconut shell—the hardest portion of a coconut fruit—is the first step in the manufacturing of CO. As a result, the shell breaker machine is created, consisting of many parts such as the screw adjuster, gearbox, coconut shell breaker frame, electric motor as drive, capacitor, belt cover, and sprocket safety cover. One coconut can be broken into pieces by the instrument in a matter of three to five seconds. A 0.25 horsepower AC motor and a 1:50 gearbox is used by the driver. The ergonomics and user safety were taken into consideration when designing this coconut shell breaker.The product of this research is a tool for breaking down coconut shells, which allows the meat to be removed without wasting any water, as the leftover shell may be used to wash coconuts in a later stage of the study.

KEYWORDS:

Coconut shell, crusher, powder, roller mechanism

I.INTRODUCTION:

All across Indonesia, plantations of coconuts are equally dispersed; nevertheless, 7.67% of all plantations in Indonesia are concentrated in the East Java region. Around 1.5 billion coconuts are produced annually on an area of 300 thousand hectares in the East Java region, where coconut production has reached surplus. The economic worth of all the coconuts produced in East Java, assuming a price of Rs 3,000 per coconut, comes to about Rs 4.5 trillion. In the meantime, each individual in East Java consumes about 30 coconuts annually. Multiplying this amount by the estimated 38 million people living in East Java,[3] yields an annual total of more than 1 billion coconuts.As a result, there is an annual surplus of around 500 million coconuts, which are then dispersed to different parts of Indonesia in addition to being exported in large quantities to other nations in 77 thousand tons. In actuality, there is a growing demand for products made from coconuts

on both the domestic and international markets. By broadening the coconut processing sector to include both food and non-food by-products, several potential enterprises based on coconut derivatives can still be produced. Oleo chemicals, dehydrated coconut, virgin coconut oil, natal de coco, furniture, fibre, coir, activated charcoal, and other items are some of the by-products. As a raw material for the coconut oil business, dried coconut meat, or copra, is what spurs the growth of coconut-based processing companies in Indonesia.[4].

Even with the growing popularity of coconut by-products, there are still issues in the processing sector, mostly related to raw materials, production, and marketing. The large percentage of old and damaged coconut trees that are unproductive—between 30 and 40 percent of the community plantation area—is another contemporary problem. In the meantime, a number of limitations resulted from the limited quantity and quality of raw materials available for production. These included the limited number of coconut-processed products and the use of basic, conventional methods in the production centres for Small and Medium Enterprises. Under these circumstances, it is imperative to expedite the development of processed new products, for which there is a growing market demand (demand-driven company).Global demand exists for a number of coconut by-products, particularly the derivatives

made from coconut meat, which are in high demand and have a high market value. VCO, often known as virgin coconut oil, is one of these byproducts.

VCO is a coconut fruit byproduct that has been shown to enhance health, particularly by boosting the body's resistance to degenerative illnesses and serving as a high-value raw ingredient in natural cosmetics. Pure coconut oil, or VCO, contains no broken bonds from heat and a high fatty acid concentration. As pure coconut oil, VCO has a range of medium-chain saturated fatty acids, including 48% lauric acid, which serves the same purpose as breast milk by building the body's immunity to illness.As far as the yield and quality of the VCO oil are concerned, each approach has pros and cons. Centrifugal technology will be used in this study because of its benefits, which include: a shorter processing time; no need for chemical additions; no contamination; and a higher-quality yield than that of mechanical and fermentation processes.

One of the primary suppliers of oil products is the coconut. There are several steps that must be followed in order to extract the oil from the coconut. Coconuts are picked, dehusked, their shells broken, dried, the kernels separated from their shells, and finally the oil is extracted. Because it requires physical labour, the coconut deshelling step of the method above takes the longest. Currently, the majority of the regions employ manual de-shelling. The coconut is split open by employing tools like hooks and knives. Time is lost in manual processes, staff shortages are a significant drawback, and there is a potential for mishaps when employing external devices.

II.REVIEW OF LITERATURE

In 2014, S. Nithyananth et al.[3] designed a trash shredding machine. Similar to a ploughing attachment, the waste shredder machine is an addition. The shredder can be run using a tractor's power take-off shaft (PTO).Five circular blades and one fixed blade make up the Assembly. To help the farmer prepare for vermin compost, the organic materials will be shredded into little bits.The study project on Methodology for Design & Fabrication of Portable Organic Waste Chopping Machine was conducted out by Ajinkya S. Hande et al.,[4] (2014).Organic waste is supplied evenly using a tray and feeding drum. Because of the effects of tension, friction, and impact during the chopping process, the cut is also made inside the chopping house. The chopped particles then exit the machine through the concave holes in the sieve. Sieves with varying hole sizes can be employed.

The project, "Design and Develop a Coconut Fibre Extraction Machine for Small Scale Coir Industries," was completed by.Y. Prashant et al. in 2014. Between the barrels, coconut husk is fed from one end, and the spherical coconut shell is automatically transferred to the other end, where the separated fibre material is gathered in a sack below. Cutting pins have been press-fitted into an indexed hole on the barrel surface in this proposal. Cutting pins facilitate the removal of fibre and provide the coconut shell with a linear motion for escape. The cutting pin indexing angle and distance are crucial factors in the coconut fibre extraction process.

The objective of Kishana Naiki [6] et al.'s (2014) project is the fabrication of an apparatus for extracting areca fibre. In essence, this is the areca husk's fibre removal process. This machine has a 3-phase, 5-hp AC motor that is directly connected to the driveshaft. The driving shaft is housed in a casing that is engineered such that only dust is extracted and fibre emerges from a rectangular duct on the lower side of the casing. The driving shaft features blades that were created by altering the design of the coconut husk decorticating machine, and it is supported by two bearings.

III.MATERIALS AND METHODS

A.DESIGN of the EQUIPMENT:

The following steps are involved in the design of the coconut shell breaker machine, which is the first step in the production of virgin coconut oil:

- Determining the requirements of the home industry with reference to the existing coconut shell breaker or tool design and the limitations or issues encountered during use. The purpose of it was to extract the data needed for the design and production of the created coconut shell breaker machine.
- Technical drawings of the coconut shell breaker machine are used in the design process.
- Determining the materials needed to design the apparatus.
- Design tools are the execution of previously created technical drawings.
- Oversight of many workshops for work tracking.
- Measuring and examining the instruments to reveal overall performance of the tool.

In general, the home industry and vendors of coconut fruit continue to remove the coconut shell using relatively basic, conventional methods. A crowbar is a common instrument that is used by pounding it into the coconut shell until it breaks.[1] The actors in the coconut processing and sales process have to sit, stand, and gently bend their bodies when breaking the coconut shell, even if they have to peel more than 100 coconuts per day.It may give rise to back, neck, and waist joint issues or aches. Moreover, the knees used to support the body and the palms of the hands used to grip the coconut frequently hurt. Because breaking coconut shells is a highly vulnerable procedure, there is also a risk of accidents occurring when a sharp crowbar is used in an unprotected environment without the use of gloves or a tool cover [2].

B.FABRICATIONof theEQUIPMENT:

1)Motor:

To power the mechanism, a single phase induction motor is employed. Typically, this motor is employed in a variety of industrial drives. The gear box, which serves as the driven wheel, is directly connected to the motor, which serves as the driving wheel, by a belting system. The motor's output shaft rotates at 1500 revolutions per minute. A belting system that connects the motor's output shaft directly to the gear box will eliminate any gearbox losses. The machine's frame is firmly fastened to the motor bed. To reduce vibrations and maximise the motor's power, care was taken to ensure that the motor shaft and the gear box input shaft were joined in a parallel line.B. Mild steel Mild steel is defined as steel in which carbon, in the range of 0.12–2.0%, is the primary interstitial alloying element. As stated in the American Iron and Steel Institute's (AISI) definition. When no minimum content is specified or required for any element to be added to achieve a desired alloying effect—for example, chromium, cobalt, molybdenum, nickel, niobium, titanium, tungsten, vanadium, or zirconium—or when the specified minimum for copper does not exceed 0.40 percent—or when the specified maximum content for any of the following elements does not exceed the percentages noted—then steel is deemed to be carbon steel.

2) Gears

Worm gears tend to be used in high velocity ratio power transmission applications. The speed ratio of the gear box of this machine is 70:1. As a result, the speed drops to 21 rpm from 1500 rpm. Worm gear mechanism is the mechanism utilised in the gearbox. Through the use of a pulley attached to a v-belt, the gearbox and motor are connected. For attachment to the holding mechanism, the gear box's output is attached to a shaft that extends from one of the rollers' centres. The worm and the worm wheel make up this entity.The worm is essentially a cylinder with threads that resemble an in-voluterack. While the gear or wheel is typically made of bronze or cast iron for light duty, the worm is typically made of mild steel.

The specifications of this coconut shell breaker are:

- Tool dimensions: length = 60 cm, width = 60 cm, height = 85cm.
- Materials from carbon steel, stainless steel.
- The drive uses a 1:50 gear box and an AC motor ¾ hp.
- The capacity of the tool to break the coconut shell is 1 coconut within 5 seconds.
- AC Motor 1 hp(1440rpm), Voltage = 115/230W
- Gear box = 7.5, Gear Type = Worm, Power = 1.1KW till 22KW

IV. CONSTRUCTION AND PRINCIPLE

A. WORKING PRINCIPLE:

The breaking gear and coconut clamp on this coconut shell breaker are shaped like a box and can be modified to fit different sized coconuts.[3] This tool operates by combining the clamping, pressing, and shifting procedures in accordance with the cutting path of coconut fibre. An electric motor whose rotation has been slowed down to generate high pressure powers the coconut shell breaker blade. The hardest portion of a coconut fruit is its shell. As a result, this shell breaker is composed of multiple pieces, such as the screw adjuster, gear box, capacitor, belt cover, electric motor for driving, on/off switch, and sprocket safety cover for the coconut shell breaker.

B.CONSTRUCTION:

The frame, cross cutter, conveying unit, driven and driver pulleys, rubber belt and motor, and bearing housing are the main parts of the designed coconut deshelling machine.The frame serves as the primary structural support for the other parts of this machine. The frame is made of 50x50x5 mm angle iron that has been welded together. Its measurements are 650 mm in length, 740 mm in width, and 1000 mm in height. The two shafts that make up the de-shelling unit are the cutter shaft and the intermediate shaft. A mild steel rod with an intermediate shaft of 610 mm in diameter and 250 mm in length is also mounted, and it is supported at both ends by a ball bearing.Power is transmitted from a 1 HP (0.745) motor mounted on the stand's base to intermediate shaft No. 1 via single groove pulleys P1 (2.5") and P2 (11"), which are connected by V belt drive 680 and fastened to the motor shaft and intermediate shaft, respectively.[6]

V.CONCLUSION

Research has been done on the processes involved in creating and manufacturing coconut shell breakers.The instrument can split open a single coconut shell in five seconds. A gadget that costs Rp 17,000 to make and has a payback period of plus or minus eighteen days can be used for post-harvest processing in coconut-producing regions.As coconut is seen as a health food, there is a strong desire to see the market transition towards value-added products like the aforementioned coconut vinegar, cream, and milk. In addition to the items mentioned above, coconut husk, leaves, and shells are also used as fuel in factories and many rural regions for boiler operations. Wood, shells, husks, and other materials can be used to create a wide range of handicraft products, which boosts the earnings of small businesses. Value addition also lessens trash production and the deterioration of the environment. The items must be created, packaged, and distributed to the market in a way that satisfies customer needs in order to be used on a wide scale in the commercial sector.Due to the many culinary, medical, cosmetic, and industrial uses for coconuts, every effort should be made to market their value-added products on a national and international scale.

In order to support the growth of the coconut industry, research and development should also focus on investigating novel technologies.

VI. SCHEMATIC DIAGRAM

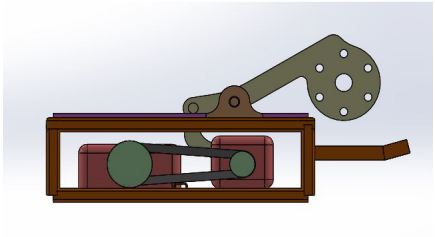

Fig.1

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