DESIGN AND DEVELOPMENT OF LOW COST COCONUT DEHUSKING MACHINE FOR RURAL REGION

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ABSTRACT

Coconuts can be dehusked manually by using a hand cutting tool. This method requires more efforts by labour and time consuming process. All the coconut growers cannot afford to own an automated machines used in developed countries because of high cost. The aim of this paper is to design and develop a coconut fiber extraction machine for farmers and small scale coir industries in India to provide an effective solution to the difficulties in existing process, reduce time and labour cost and to develop a compact coconut fiber extraction machine which could be used in remote villages so that unutilized husks from such areas could be tapped and fiber could be made available to the Coir Industry directly. This project was taken up to develop a promotional strategy for a new innovation and generate public awareness regarding the availability of a coconut fiber extraction machine in the market at a reasonable cost.

Keyword: - Coconut, Dehusking, coir, Machine, Mechanism, Productivity, Affordability

1. INTRODUCTION

Farm mechanization increases the effective utilization of machines to increase the productivity of land and labour. Besides it helps in reducing the drudgery, time and cost of cultivation in farm operations. In farm mechanization, the operations are divided into three i) Pre-harvesting operation ii) Harvesting operation iii) Post-harvesting operation. Coconut (cocosnucifera) is one of the world's most useful and important perennial plants. The coconut fruit is made up of an outer exocarp, a thick fibrous fruit coat known as husk; underneath is the hard-protective endocarp or shell. The coconut palm is widely cultivated in the tropics. India is the world's third largest producer of coconuts after the Philippines and Indonesia. Other producers are Thailand, Malaysia, Papua New Guinea and the Pacific Islands. With coconut plantations extending over more than a million hectares, India produces about 5500 million nuts a year. Copra produced in the country is about 0.35 million tons and India accounts for about 50% of the world trade in coir. Coconut plantations are mostly concentrated in the coastal and deltaic regions of south India. In India, the crop is produced mainly by small and marginal farmers who number about 5 million. The average size of holding is as small as 0.25 hectares. With agricultural Labour problems worsening and water resources dwindling, more and more plantation acreage is being converted from arca to coconut since the latter is easier to grow and more remunerative

Almost all the parts of coconut are useful. The meat of immature coconut fruit can be made into ice cream while that of a mature coconut fruit can be eaten fresh or used for making shredded coconut and livestock feed. Coconut milk is a refreshing and nutritious drink while its oil is use for cooking and making margarine. Coconut oil is also very important in soap production. The shell is used for fuel purpose, shell gasifier as an alternate source of heat energy. The husk yields fibers used in the manufacture of coir products such as coir carpets, coir geo-textile, coir composite, coir safety belts, coir boards, coir asbestos and coir pith. Coir is a versatile natural fiber extracted from mesocarp tissue, or husk of the coconut fruit. Generally, fiber is of golden color when cleaned after removing from coconut husk. Coir is the fibrous husk of the coconut shell. Being tough and naturally resistant to seawater, the coir protects the fruit enough to survive months floating on ocean currents to be washed up on a sandy shore where it may sprout and grow into a tree, if it has enough fresh water, because all the other nutrients it needs have been carried along with the seed.

1.1 Physical properties of coconut

Coconuts are of different shapes and sizes not all are the same. So that we can analyze the average of a coconut shape and size.

Table-1 Physical properties of coconut

Particulars	Dry coconut
Shape	Ovoid
Length, (mm)	210-270
Diameter, (mm)	160-206
Weight, (kg)	0.62-1.25
Shell Diameter, (mm)	80-120

2. LITERATURE SURVEY

Hydraulic Coconut De-husking Machine

Hydraulic power was used for operating the arm like structure which was used for opening coconut husks. Holding mechanism was used to hold the coconut in a standing position in which the eye was on the top position. It also consisted of some lifting mechanism (hydraulic powered) for lifting the holding mechanism. Husking was due to the combined action of lifting the holder and the arm. The major problem related to this machine was that it was bulky and had high power consumption. It also required skilled Labour to lift the coconut according the husk opening.

Mechanical Coconut Husking Machine

In this machine, power was transmitted to the roller through helical gears. The powered rollers mounted in the right row rotate at a speed of 50 rpm, the outermost one carrying a series of slightly curved sharp hook-like knives that engage with the husk when coconuts are fed from the mouth of the throat. The whole nut was fed through the feed chute holding it vertically by hand, towards the converging throat where it was caught between the two rollers. In the process, the sharp right roll consisting of slightly curved hook-like knives engage with the husk and left spring loaded rollers press the coconut towards the right spiked rollers. As the rollers rotated, the husk gets detached from the shell, effecting a complete dehusking of coconut. The de-husked coconuts falls outlet below the roller where the gap between the spiked rollers and spring loaded rollers and were collected.

Coconut De husking Machine

Locate the coconut onto the mechanical hand, the mechanical hand will clamp the coconut tightly and rotate itself. The cutter starts to cut while the mechanical hand is rotating. In the cutting process, the cutter could automatically adjust the cutting depth and thus avoid the spilling out of the coconut milk resulted from the damage of the coconut flesh. The mechanical hand is equipped with a pressure pickup on its subject site. The cutter will continue to poke in until it touches the pickup, and then the control system react and executive the order to pull out the cutter. The mechanical hand reset itself and the de husking process is completed.

Foot Operated Coconut Dehusking Equipment

The Coconut is struck manually against the closed teethed blades. The paddle is accelerating turn around and the clamp action dehusk the coconut in two pieces. One or two subsequent operations are needed to separate the core completely. We can easily operate this equipment. Pedal operated Coconut de husking

equipment has a simple construction, it is light weight and handy which makes it portable. Pedal operated Coconut de husking equipment also is handled by unskilled person. This equipment is simple and there is no need of power source as it is manually operated. This coconut de husking equipment able to de husk 80-100 coconuts per hour. Pedal operated Coconut de husking equipment used in hotels, houses, and canteens etc. and also for commercial purposes. The fabrication cost of Pedal operated Coconut de husking equipment is in mass production is around four hundred rupees only. The efficiency of this equipment is higher when compared to other manually operated de husking methods.

3. PROPOSED DESIGN AND FABRICATION OF COCONUT DEHUSKING MACHINE

The scope of this project was to design and develop a coconut fiber extraction machine for farmers and small scale coir industries in India to provide an effective solution to the difficulties in existing process, reduce time and Labour cost and to develop a compact coconut fiber extraction machine which could be used in remote villages so that unutilized husks from such areas could be tapped and fiber could be made available to the Coir Industry directly. This project was taken up to develop a promotional strategy for a new innovation and generate public awareness regarding the availability of a coconut fiber extraction machine in the market at a reasonable cost. The project began with collection of information and data on user lifestyle and current process by which they perform their job. The current difficulties were analyzed. Interviews were held with users. A comparative bench marking study was done on similar processes used in other similar extraction processes. Along with this an ergonomic simulation was made to understand the user difficulties and manufacturing methods to get an overview to provide solution to the user to suit their requirement. Concepts were generated keeping benchmarked product in view. Five concepts were generated with different functions and operating processes for coconut fiber extraction machine. Final concept was selected by considering the users' operating environment and maintenance, which could be used in small scale coir industries and in the farm sector. Considering the users' needs and buying capacity, a prototype was fabricated. This machine works with gear mechanism, in which 2 barrels rotates in opposite direction to extract fiber from coconut. Cutting pins are inserted in indexed holes to separate fiber and to give linear motion to coconut shell.

3.1 Main Parts

The de-husking unit consists of the following major parts

- Main Frame Left
- Main Frame Right
- Top roller
- Bottom roller
- Blades
- Drive shaft
- Bearings for the rollers
- Moving pressure roller unit

• Scrapper unit

• Flywheel

3.2 Detailed Specification of Coconut Dehusking machine

1. Mechanism -Gears and Pulley with belt drive

2. Target Customer-Farmers or small scale Coir industry

3. De-Fiber Process -Motor operated

4. De-Fiber Function – Automatic

5. Material -M.S. for Shaft, Stainless Steel for Cutting tips, Steel for Fabricated body

6. Manufacturing-Machining, Indexing, Bending and Fabrication

7. Safety -Avoid sharp corners, Safety guards

8. Cost -Approx. 12000/- INR

9. Life of the product 2-3 years

10. Motor Specification -¼ HP Single phase AC motor, heavy duty, 1440 RPM

11. Major Pulley diameter -12" (12-B single)

12. Minor Pulley diameter -2" (2-B single)

13. Pulley Ratio -1:6

14. Working RPM -240 RPM

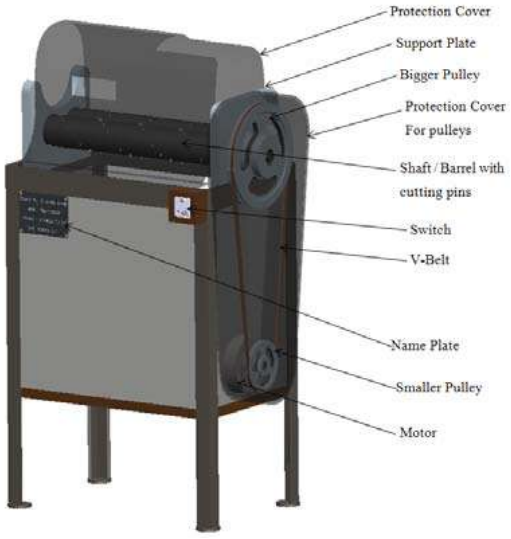

Figure-1: Coconut De husking Machine

CONCLUSIONS

Literature study is carried out based on the existing patents on coconut fiber extraction machine, and it is observed that there are difficulties for remote village to supply unutilized husks to coir industries directly. So there is a need to give solution to overcome their difficulties and to arrive at solution, importance is given towards users operating environment and mainly towards constrains like Safety, Function and reliability. A simple mechanism has been proposed in this project which will reduce the labour efforts and will improve the productivity within less time. At the same time care has been taken in terms of cost so that it will be affordable for farmers from rural region. The future scope of this work is to overcome the limitation of coconut size that could be dehusked and to automate the process of loading and unloading of the coconut.

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