

Design and Development of Automatic Coconut De-husking and De-shelling machine

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Abstract— Today there is many methods used for de-husking and de-shelling of coconut. These methods are widely used for removing of the coconut husk but these methods have many problems and limitations while operating these machines. These problems affect the production rate of de-husking the coconut. Also these methods are more hazardous and harmful to user. To overcome the limitations and problems occurring in the present machine there is need of the method to be automatic and less harmful to the user. This paper presents the design and development of the automatic coconut de-husking machine. This machine eliminates the problems and limitations to a greater extent. In this way the production rate increases compared to the present coconut de-husking machine.

Keywords: coconut, de-husking, de-shelling, automatic,

I. INTRODUCTION

The machine proposed in this work basically does two processes. They are de-husking and crown removing, de-husking is the process of removing the husk from the nut. Majority of de-husking is carried out manually by machete or a spikes, it shows that there are no superior machines develop to handle the coconut. Coconut de-husking is the most fundamental issue in terms of finding labor and improving productivity.

The main aim of this project is to reduce the human efforts and to increase the rate of de-husking the coconut. This machine takes into consideration the dangers, hazards and risks involved in de-husking the coconut which will be efficient, productive, environmentally friendly, less labors, easy to use and most importantly cost effective in production, maintenance and repair.

The main purpose of coconut de-husking machine is to eliminate the skilled operator involved in de-husking the coconut and to completely automate the de-husking and crown removing process. Although coconut de-husking machines have already been demonstrated in the work and also in some small scale industries, the process is either manual or semiautomatic. A completely automated machine with manual loading and unloading of coconuts will yield productivity higher than the existing process. Because of that, the current work is mainly focused on an automated machine for de-husking and crown removing. Also, we can yield lot of useful and commercial products from coconut at various stages of its lifecycle.

Today there are various techniques are used for de-husking the coconut. These techniques have many limitations in process. Despite of that these techniques are widely used for de-husking. Those techniques are,

1. Manual de-husking:
 - a) By using machete or spike
 - b) By using traditional tool
2. Pedal operated de-husking
3. Hydraulic operated de-husking
4. Pneumatic operated de-husking

Many problems occur while operating these machines or methods. In the automatic coconut de-husking machine eliminates or reduces the problems and limitations present in these techniques. These problems might be injurious, hazardous for operator. But in the automatic coconut de-husking machine these problems are eliminated in tremendous amount. This leads to the safety and ease in removing the coconut husk.



Fig.1 Spike



Fig. Traditional tool



Figure. Traditional method of dehusking

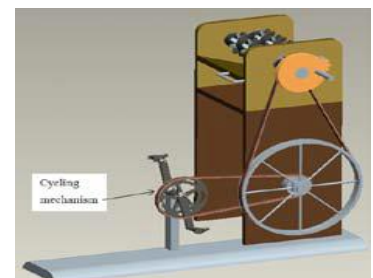


Fig.3 Pedal operated machine

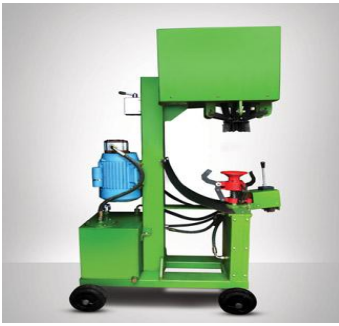


Fig.4 Hydraulic machine



Fig.5 Pneumatic machine

II. LITERATURE REVIEW

Venkataramanan S, Abhinav Ram B, Rahul R discussed the design and analysis activities involved in developing an automated coconut de-husking and coconut crown removal machine. The main purpose of this machine is to eliminate the skilled operator involved in de-husking the coconut and to completely automate the de-husking and crown removing process [1]. Y. Prashant, C. Gopinath, Vignesh Ravichandran discussed 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[2]. Mr. Vinod P. Sakhare, Mr. Ketan K. Tonpe, Dr. C. N. Sakhale discussed in "Performance Analysis of Hydraulically Operated Coconut De-husking Machine" paper that, we have many methods to de-husk the coconut. It is by manually, mechanically and also by the use of machines. Manual de-husking with knife is a common practice and there are also different methods of de-husking of coconut using machines such as two blade coconut de-husking machine and coconut de-husking by two roller machines[3]. S. D. S. Piyathissa, P. D. Kahandage discussed in "Introducing an appropriate mechanical way for coconut de-husking" paper that a preliminary experiment was carried out with hundred coconut selected from a properly maintained coconut plantation in order to find out the average measurement such as height and width of coconut, thickness of husk, height and width of nut[4]. Mr. Varad V. Bhalekar, Mr. Shubham M. Langarkar, Mr. S. B. Kamble discussed in "AUTOMATIC COCONUT DE-HUSKING AND DE-SHELLING MACHINE" paper the data about the present coconut de-husking methods their limitations and the need of the automatic coconut de-husking [5]. Stephen Kwasi Adzimah, Samuel Oppong Turkson, discussed in "Conceptual design of coconut de-husking machine" from this paper we get various traditional methods of de-husking the coconut as well as application, advantages and limitations of machine[6].

III. PROBLEM DEFINITION

In the present coconut de-husking machines many problems and difficulties are faced during the de-husking operation. These problems cause adverse effect on the working and productivity of the machine. It also affects the operator operating the coconut de-husking machine.

Many limitations are present in the previously occurring machine. Those limitations decrease many parameters of the machines such as productivity, durability, efficiency, ease of operation, etc. Also it tends to increase the human fatigue to the operator operating the coconut de-husking machine.

The limitations in present machines are,

1. Possibility of accident:

Due to the human interference in the operation of the machine there may be possibilities of accidents. In de-husking the coconut with spike or machete it may cause injury to human because of carelessness.

2. Less production rate:

In previous coconut de-husking machines the idle time required is more and takes more time for de-husking operation. Also the interference of the human is more so it takes more time for operation, so that the production rate is less.

3. More time is required for de-husking the coconut.

4. Skilled labor required :

To de-husk the coconut manually i.e. by using spike or machete is risky operation. So there is need of concentration during the operation, otherwise it is harmful to the operator. So the skilled labor is required.

5. Idle time is more.

IV. SCOPE AND OBJECTIVE OF THE MACHINE

Scope of Machine

At present, the de-husking of coconut is carried out by various machines like spike, traditional tool, pedal operated machine, hydraulic and pneumatic machines, etc.

From all above methods of coconut de-husking we understood that there are many limitations which create difficulties during coconut de-husking. To overcome these difficulties and to increase production rate, we have decided to make "Automatic coconut de-husking machine." And also for removing the shell of coconut, the special attachment is provided. The problems or limitations in the present machine and the improvements are represented in the following table

Limitations of previous machines	Improvement
Accident occurs.	Accidents are eliminated.
Less production rate.	Increase in production rate.
More time is required.	Time required is less.
Skilled labour required.	Fool proofing.
Nasty system.	Clean system.
Idle time is more.	Idle time is reduced.

Objectives

The coconut de-husking is one of the most difficult post harvesting operation. In India coconut is cultivated on a large scale. To process such a large number of production of coconuts some suitable mechanism needs to be identified or developed. Several attempts have been made to mechanize the de-husking of coconut. Some of them were manually operated and others were power operated. These mechanisms have their own advantages and limitations. Few of them required skill worker. Some of them were bulky, time consuming, power consuming, uneconomical. There is a need to develop some mechanism which would work satisfactory and must be economical. Depending upon the necessity the suitable mechanism needs to be selected.

Coconut production plays an important role in the national economy of India. Coconuts are known for its versatility as seen in many uses of its different parts. It also has cultural and religious significance in many societies. Copra is the dried meat or kernel of the coconut. Traditionally coconut shell is operated manually to get copra out. But it consumes more time and more Physical Exertion of workers, so the main objective is to reduce time consumption and Physical Exertion by introducing a machine to break coconut shell. It should be to operate with less wastage of copra. This machine reduces the accidents that may happen during de-shelling manually.

The present work involved the design, development and testing of a coconut de-husker which overcomes the drawbacks of the previously reported implements. The design and developmental stages called for a closer look at the magnitude and direction of the de-husking forces and their generation mechanisms. Details of a simple, sturdy and efficient hydraulic de-husker unit, financially beneficial to laborers and producers, are given here.. Cost benefit analysis indicates that it should be commercially viable.

Main purpose of manufacturing coconut de-husker is to reduce the human effort and increasing efficiency.

KEY OBJECTIVE-

- To reduce human effort.
- To increase continuous work capacity.
- To increase efficiency than conventional system.
- Less harmful to user.

V. APPROACH AND TOOLS USED

After studying all present coconut de-husking machines, we got ideas to eliminate the difficulties and limitations occur in those machines and improve production rate.

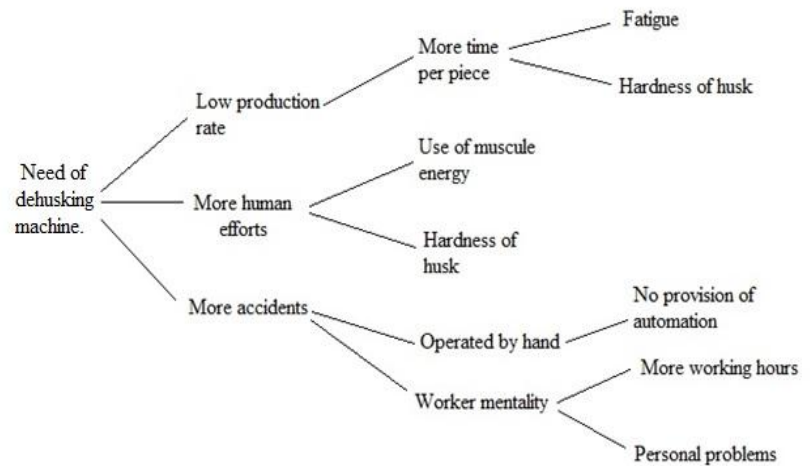
Time Study

We studied all the present machines used for coconut de-husking. By studying the processes and methods used for coconut de-husking, we collected the time required for production per hour.

Machine used	Coconut de-husked per hour
By spike	8 Qty
Traditional tool	15 Qty
Pedal operated machine	30 Qty
Hydraulic machine	80 Qty
Pneumatic machine	90 Qty

Root Cause Analysis

The root cause analysis is the way to analyze the need of the machine. In the root cause analysis method the question WHY is asked at every stage of the point. This way gets us to the main cause which is creating the limitations in the machines. After analyzing the data we get the right approach for the machine manufacturing.



Selection of proper specified component for coconut de-husking machine

There are various components used in the coconut de-husking machine. Such as gears, shafts, bearings, frame, drum, spikes, motor, cutter, metal sheet and hopper.

Different factors are to be considered while selecting the components of machine, viz., material properties, factor of safety, speed, torque, different types of loads, capacity to sustain the load. For designing the gear, the factors are to be considered such as speed reduction ratio, module, diameter, number of teeth, etc. Various loads are acting on the shaft, so by considering these loads shafts and bearings to be selected. For proper mounting of bearing, the pedestal bearing is preferred. Motor is selected on the basis of speed, torque, load, capacity and working hours. On the basis of material to be used spikes are designed and the number of spikes considered according to drum length.

The coconut de-shelling machine was developed based on the following consideration: The availability of materials locally to reduce cost of production and maintenance of the machine. The de-shelling rod was introduced in between and near to disc cutter without touching the disc cutter and smoothly conducts the operation. It is desired that the coconut fruits should be well de-shelled without nut breakage and also that cobra extracted should not be distorted, thus pulleys were carefully designed/selected to meet the required synchronized speeds of the de-shelling.

Assembly of components

Main part of the machine is frame which carries the total load of assembly. The material for frame is cast iron. Frame is to be joined by welding. The gears are fitted on the shafts by means of key and the shaft is fitted in the bearing. The pedestal bearing is fitted on the angle bar of frame by nut and bolts. The motor is mounted on the another angle bar of the frame by nut and bolts.

The extra attachment is provided for de-shelling of the coconut. For de-shelling the cutter is used. One of the shaft is extended and taken outside of the frame whose speed is suitable for de-shelling and the cutter is mounted on extended shaft outside the frame. The drums are mounted on top most shaft of the assembly and the spikes are welded on drums. The hopper is placed above the drum. The sheet of metal is riveted on the frame which plays role of walls and the whole assembly becomes closed, for the safety purpose.

VI DESIGN OF MACHINE

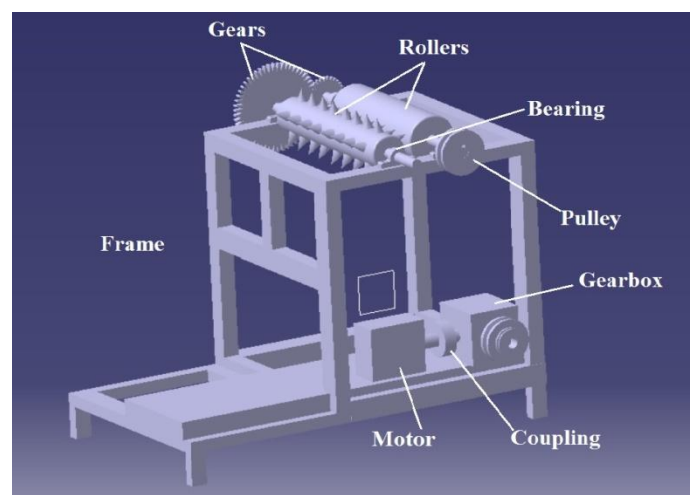
This is the catia model of the automatic coconut dehusking machine. The machine contains various components which are mainly used for dehusking of the coconut. The components are,

1. Frame
2. Rollers
 - a) With spike,
 - b) Without spike
3. Gears
4. Pulleys
5. Bearings
6. Motor
7. Gearbox.

These components are essential in working process of the automatic coconut de-husking machine

VII DEVELOPING PROCESS OF THE MACHINE

1. Making of frame



2. Selection of shaft and bearing
3. Development of two rollers - 1) with spike 2) without spike
4. Selection of motor and gearbox
5. Selection of de-shelling cutter
6. Design and development of spike
7. Selection of pulley and belt drive
8. Assembly of all components

VIII. WORKING OF THE MACHINE

First of all machine is started by using electric supply and the coconut is placed on two rollers. A spike roller is considered as the main mechanism of the machine. The lever is used to apply small force on coconut for piercing of spikes into husk. The roller without spike would rotate the coconut and the spike on the roller piercing in the coconut husk due to continue rotation. The spiked roller will grip the husks and tear the husks from nut. In this way the coconut de-husking takes place. During operation small vibrations are occurred so machine sometimes changes its position on plane surface, thus the special arrangement for removing the wheels is provided.

To have this kind of operation, the coconut should be placed horizontally into the machine. For de-shelling the coconut, the de-husked coconut is placed in front of the teeth of cutter. Due to rotation of the cutter the teeth of cutter is imparted on shell of coconut. Thus the breakage of shell takes place and the coconut de-shelling is carried out.

IX. ADVANTAGES

1. It is simple and fast process.
2. No need of skilled labor.
3. Accidents are eliminated.
4. Increase in production rate.
5. Time required is less.

X. LIMITATIONS

1. Initial cost is high.
2. Machine is bulky.

XI. APPLICATIONS

1. Coconut Oil Industries:

The coconut oil industries occupied a large space in industrial area. The requirement of coconut oil has increased vastly in recent years.

To get the oil from the coconut it is required to make some operations on coconut such as, removing the husk and de-shelling the coconut. These operations were carried out manually and also some other machines were present for conducting those operations. These processes have more limitations. But the automated coconut de-husking machine has a strong impact in the coconut oil industries. The automated coconut de-husking machine can make revolutionary and productive changes in coconut oil industries.

2. Coconut Farming:

Agriculture forms the backbone of our country economy. About 50-60% of citizens are depending on agriculture. For developing our country means providing our farmers with more advanced technology or tools, which would reduce overall time and cost required for work. This would make work more easy and comfortable.

XII. CONCLUSION

With this machine we can,

- Reduce human effort.
- Increase continuous work capacity.
- Increase efficiency than conventional system.
- Less harmful to user.
- Fool proofing.

A power operated coconut de-husking and de-shelling machine was designed and developed. Coconut de-husking and de-shelling machine which de-shell coconuts without nut breakage and machine is easy to operate and perform with an average de-husking capacity of approximately 200-250 nuts per hour. An automated machine for coconut de-husking and de-shelling has been developed for the small scale farm holder in the agriculture and rural areas. The operation of machine is simple, fool proofing and the maintenance of the machine is not expensive.

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