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## Optimization of Power Requirement for Dehusking husk of coconut.

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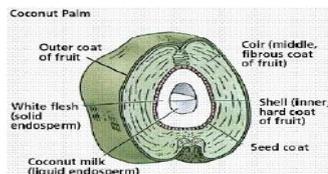
### Abstract

There are much ranch hardware, which are produced for the post gathering operations. For the most part all the post reaping operations are dull occupations to perform. The dehusking of a coconut is viewed as the most tedious, tiring, and troublesome operation to perform. Many endeavors has been done to play out this errand of dehusking physically and in addition automated. Customarily this assignment of dehusking was performed by utilizing diverse hand device like sharp edge device and some mechanical contraptions. The dusking of coconuts utilizing the above hand apparatuses relies on upon the expertise of specialist including legitimate preparing and practice. The power worked with self-loader and completely programmed machines are likewise created to dispose of the disadvantages of manual instruments, yet till these machines are not sparing and valuable to the minimal coconut cultivators. However these devices and machines are in creating stage in everywhere throughout the word, luckily not very many are well known, rest got vanished because of their particular impediments. In the present work these restrictions are viewed as and another machine with better outline with the deshushing tynes is composed and built up, the hypothetical and in addition exploratory work is led on the created machine to assess the appropriateness of the created machine to the minor coconut cultivators. The presence study the main imphase on the calculation of power requirement for dehusking of coconut at various motor torque. The results of dehusking are analyze and optimum power requirement for dehusking husk of coconut is finalized.

**Keywords:** Coconut dehusking, power requirement, post harvesting, manual dehusking tool, tynes, dehusking tool.

### 1. Introduction

Coconut (*cocosnucifera*) is one of the world's most valuable and imperative enduring plants. The coconut organic product is comprised of an external passage, a thick sinewy natural product coat known as husk; underneath is the hard defensive endocarp or shell [2]. The coconut palm is generally developed in the tropics. India is the world's third biggest maker of coconuts after the Philippines and Indonesia. Different makers are Thailand, Malaysia, Papua New Guinea and the Pacific Islands. With coconut estates reaching out over more than a million hectares, India delivers around 5500 million nuts a year. Copra created in the nation is around 0.35 million tons and India represents around 50 % of the world exchange coir.



**Fig.1** Section of Coconut

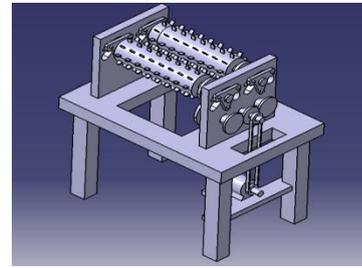
Coconut estates are for the most part gathered in the waterfront and deltaic areas of south India. In India, the yield is delivered basically by little and minor ranchers who number around 5 million. The normal size of holding is as little as 0.25 hectares. With rural work issues declining and water assets waning,

increasingly ranch land is being changed over from zone to coconut since the last is less demanding to develop and more profitable [6]. Coconut creation assumes an essential part in the national economy of India. As indicated by figures distributed in December 2009 by the Food and Agriculture Organization of the United Nations, India is the world's third biggest maker of coconuts, delivering 10,894,000 tons in 2009. Customary ranges of coconut development are Kerala (45.22%), Tamil Nadu (26.56%), Karnataka (10.85%), Andhra Pradesh (8.93%) and furthermore Goa, Orissa, West Bengal, Pondicherry, Maharashtra and the island domains of Lakshadweep and Andaman and Nicobar [1]. All the parts of coconut are valuable. The meat of youthful coconut organic product can be made into frozen yogurt while that of a develop coconut natural product can be eaten crisp energized for making destroyed coconut and domesticated animals sustain. Coconut drain is a reviving and nutritious drink while it soil is use for cooking and making margarine. Coconut oil is likewise critical in cleanser creation. The shell is utilized for fuel reason, shell gasified as a substitute wellspring of warmth vitality. The husk yields filaments utilized as a part of the fabricate of coir items, for example, coir floor coverings, coir geo-material, coir composite, coir seat straps, coir sheets, coir asbestos and coir essence [2]. Coir is an adaptable common fiber extricated from monocarp tissue, or husk of the coconut organic product. For the most part fiber is of brilliant shading when cleaned in the wake of

expelling from coconut husk. Coir is the sinewy husk of the coconut shell. Being intense and normally impervious to seawater, the coir secures the natural product enough to survive months drifting on sea streams to be appeared on a sandy shore where it might grow and develop into a tree, on the off chance that it has enough new water, since the various supplements it needs have been conveyed alongside the seed. These qualities make the strands very helpful in floor and open air mats, aquarium channels, cordage and rope, and garden mulch. The husk contains 20% to 30% fiber of varying length [1]. Nowadays, the use of natural fiber reinforced composite is gaining popularity in automotive, cosmetic and plastic rubber applications because it offers an economical and environmental advantage over traditional organic reinforcements and fillers. The features of coir fiber from coconut husk such adorability, relatively water-proof and resistance to damage by salt water and microbial degradation makes it popular in fiber reinforced composite applications. It is also revealed that both fiber length and fiber orientation distribution player important role in its mechanical properties; increase in length of coir fiber, increases the flexibility of the composite product like seat cushions for automobiles. Thus, there is need for machines that can extract coconut husk/fiber without distorting its length [2] the processing of coconuts after they are harvested involved dehusking, which at present is labor-intensive. Dehusking the coconuts without damaging the useful coir is an art only skilled workers can perform. The husk around the shell exists in three distinct lobes. Although the nuts follow the same general pattern in their structure, they vary widely in size (viz. length, girth, thickness of husk and shell) depending on the species in the traditional way that coconuts are defused; the sharp blade tip pierces the husk with an impulsive force. Then the twisting action given to the tool or to the coconut will tear and peel off the husk from the shell. This requires the generation of piercing force sufficient to pierce through the husk, followed by a peeling force to remove the husk from the shell, in addition to holding force acting on the shell of the coconut while the husk is torn from the shell. This is followed by shearing the husk from the shell, if it is still attached to the shell at some.

**2. Materials and Methods**

The proposed coconut dehusker is consisting of the following parts,  
 Electric motor as a power source, Power transmitting gear train, Cylindrical Rollers, Threaded conical tynes, Swiveling Plates, Swiveling Plate Vertical Support, Shaft and Bearing Assembly, Gear Box, Cylinder intermediate distance adjustment mechanism, Supporting Frame



**Fig 2 - Cad Model of Coconut Dehusking Machine**

These elements mentioned above will be placed over the supporting frame. To transmit the power from motor to cylindrical rollers gear and pulley transmission system shall be incorporated. The dehusking unit is consisting of cylindrical rollers attached with tynes (cutting pins) over the surface. The coconut is placed in the intermediate distance between rolling cylinders. The rollers will rotate in such a way that there will be tearing of coconut fiber from the shell. With proper meshing of fiber with tynes effective dehusking is achieved with consuming lesser time. The shape and size of coconut is considered while designing the machine. From the studies conducted on the green and dry coconuts collected from the midlands of the two districts of Ernakulum and Kottayam of Kerala, India, the physical properties of coconut are as follows.

**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
Husk Thickness – at pedicel end, mm	62
Husk Thickness – at apex end, mm	34
Husk Thickness – 1/4 <sup>th</sup> distance from pedicel end, mm	32
Husk Thickness – 1/2 <sup>th</sup> distance from pedicel end, mm	24

### 3 Experimental set up and Performance



**Fig.3-** The fabricated Coconut Dehusking Machine.

The above photograph is of the final fabricated model of the coconut dehusking machine with a motor on the right side. This fabricated model is further tested and evaluated in terms of its performance. The coconut dehusking machine is fabricated as described above. The testing of this is been carried out. For that coconuts of different variety and size are collected. The testing comprises of the time required to dehusk the coconut, the percentage of dehusking i.e. moderate, satisfactory, excellent etc. also the amount of shell breakage. Few observations are also to be noted regarding condition of fiber after dehusking. The testing of the machine has to be carried out for both the raw/tender coconut and the dry/mature coconut. The samples of such tender and mature coconut of two varieties are collected and segregated for the testing. The testing of this machine is to be done on both the modes of the operation i.e. power motor operated and the manual hand lever operated. The readings thus obtained are studied and compared and evaluation of the performance has to be discussed.

#### 3.1 The force estimates using a Universal Testing Machine are as follows

**Table 2-** Force Estimates of Coconut Husk

Condition of Coconut	Force for Piercing (Kg)	Force for Peeling (Kg)
Raw (Green color)	230-250	35-40
Moderately Dry	250-280	35-45
Dry (Brown color)	280-300	35-45
Completely Dry (Greyish color)	300-320	40-45

#### 3.2 Power Transmission and Speed Reduction Unit

The power from electric motor is transmitted to the rotating cylinders through pulleys and gears. Power should have less speed and high torque at the rotating

cylinders and this is obtained by using a speed reduction gearbox. The gears and pulleys will be arranged in such a way that desired output is obtained by making use of readily available sizes of gears and pulleys, so as to keep the manufacturing cost low.

#### 3.2.1 Power calculation of Shaft of Cylinders

The design of shaft of cylinders on the basis of material selection and calculation of actual stress.

ASME code for design of shaft:

Since the loads on most shafts in connected machinery are not constant, it is necessary to make proper allowance for the harmful effects of load fluctuations. According to ASME code permissible values of shear stress may be calculated from various relation.

$$f_{s_{max}} = 0.18 \times \text{Ultimate tensile strength} \\ = 0.18 \times 800 = 144 \text{ N/mm}^2$$

Shaft is provided with key way; this will reduce its strength. Hence reducing above value of allowable stress by 25%

$$f_{s_{max}} = 108 \text{ N/mm}^2$$

This is the allowable value of shear stress that can be induced in the shaft material for safe operation. The value of torque on shaft of cylinder can be calculated as follows.

The distance between force and axis is ,

$$= \frac{162}{2} + 25 \\ = 81 + 25 \\ = 106 \text{ mm.}$$

The value of torque then can be calculated as follows,

$$T = \text{Force} \times \text{Perpendicular Distance} \\ = 320 \times 9.81 \times 0.106 \\ = 332.75 \text{ Nm} \\ = 333 \text{ Nm (Approx.)}$$

Assuming 100% overload.

$$T_{\text{design}} = 2 \times T \\ = 2 \times 333 \\ = 666 \text{ Nm}$$

Check for torsional shear failure of shaft.

Assuming minimum section diameter on shaft = 35 mm

$$d = 35 \text{ mm}$$

$$T_d = \frac{\pi \times f_{s_{act}} \times d^3}{16}$$

$$f_{s_{act}} = \frac{16 \times 666 \times 10^3}{\pi \times 35^3}$$

$$f_{s_{act}} = 79.15 \text{ N/mm}^2$$

$$As, f_{s_{act}} < f_{s_{all}}$$

We can say that, the actual torsional stress 79.15 N/mm<sup>2</sup> is well below the allowable tensile stress, hence shaft is safe under torsional load.

### 3.2.2 Power calculation of External Gears

The gears should transmit the power from the electric motor to the rolling cylinders at desired value of torque and the followed rpm depending the HP of motor. The following are some parameters depending on which the gears are designed as given below.

Parameters:

1. 1HP motor i.e. 746Watts
2. Required torque 333Nm.

From these parameters we will calculate the rpm over the shaft of rolling cylinders as follows:

$$\text{Power} = \text{Torque} \times \text{Angular Velocity}$$

$$746 = \frac{333 \times 2 \times \pi \times n}{60}$$

n comes out to be,

$$n = 21.40 \text{ rpm}$$

$$n = 21 \text{ rpm}$$

This 21rpm is the speed on one cylinder and we select 17rpm speed over the other cylinder as this helps in rolling of coconut over this gap of cylinder while dehusking.

From this the gear train will be selected and gears will be designed,

A gear box of 60:1 is selected and is connected to motor with 1400rpm.

Sr. No.	Name of motor (1HP)	values of RPM (n)	Values of Torque(Nm)	Power optimized (w)
1	1 Hp	600	11.86	745.18
2	1 Hp	800	8.90	745.78
3	1 Hp	1000	7.12	745.80
4	1 Hp	1200	5.93	745.20
5	1 Hp	1400	5.08	745.82

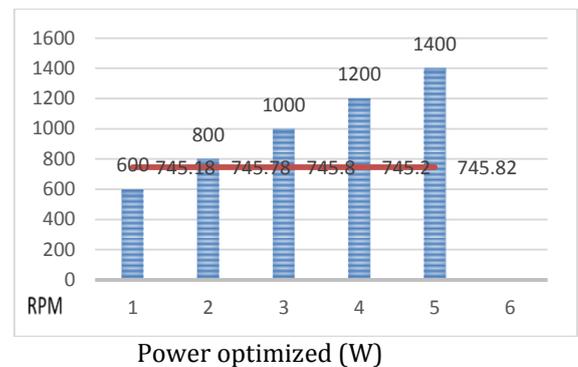


Fig4. Details of rpm processing vs. power optimized

Present practices coconut dehusking worldwide. The coconut dehusking machine are carried out in literature as - 1) Manual coconut dehusking machine. 2) Semi-automatic coconut dehusking machine. 3) fully automatic coconut dehusking machine.

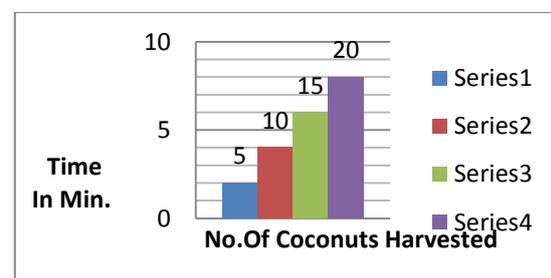
## 4 Results and Discussions

**Table3.** Power optimized for diff. rpm (single phase ac. Motor)

Sr. No.	Type of machine	No. of coconut hard vested in one hrs.	Time required to hard vested one coconut.	No. damage coconut.
I	Foot operated coconut dehusker.	25-30	2 min.	10-12

### 4.1 Manual coconut dehusking machine

**Table 4-** Manual coconut dehusking machine



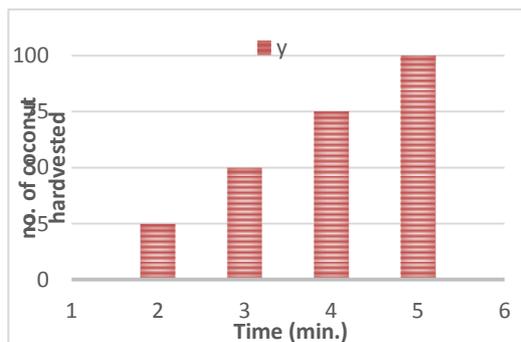
**Fig.5** - Details of time of processing vs. No. of Coconut harvested.

From the graph it can be observed that manual foot operated coconut dehusking machine no of coconut harvesting vs. time in min .Coconuts harvest 25-30 in one hours which requires 2 min ,damage about 10-12 coconuts.

**4.2 Semi-automatic coconut dehusking machine**

**Table 5-** Semi automatic coconut dehusking machine.

Sr.No.	Type of machine	No. of coconut harvested in one hrs.	Time required to hard vested one coconut.	No. damage coconut.
I	Virtual Coconut Dehusking Machine	75-100	1 min.	6-7

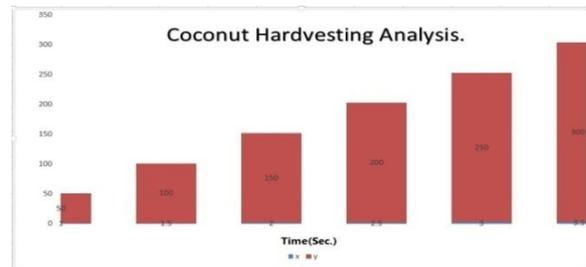


**Fig.6** –Details of time of processing vs. No. of Coconut harvested.

From the graph it can be observed that manual foot operated coconut dehusking machine no of coconut harvesting vs. time in min .Coconuts harvest 75-100in one hours which requires 1min ,damage about 6-7 coconuts.

**4.3 Fully automatic coconut dehusking machine**

**Table 6-**Fully automatic coconut dehusking machine



**Fig.7-** Details of time of processing vs. No. of Coconut Harvested.

From the graph it can be observed that manual foot operated coconut dehusking machine no of coconut harvesting vs. time in min .Coconuts harvest 150-200 in one hours which requires 1.5 sec. damage about 2-3 coconuts.

**5. Conclusion**

The fully automatic coconut dehusking machine founds more suitable as compared to the traditional coconut dehusker. The following conclusion are made areas.

- 1) Lowest time (1.5 sec.) is noted for the coconut dehusking using fully automatic coconut dehusking machine.
- 2) Damage of coconuts observed in fully automatic coconut dehusking machine are (2-3) coconuts per hours.
- 3) The no. of coconuts dehusks per hour noted by using fully automatic coconut dehusking machine are (150-200) coconuts per hours.
- 4 ) We concluded fully automatic coconut dehusking machine is more simple and easy for any type of coconuts dehusked.

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Sr.No.	Type of machine	No. of coconut hard vested in one hrs.	Time required to had vested one coconut.	No. damage coconut.
I	Hydraulic Coconut Dehusking Machine	150-200	1.5 sec.	2-3

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