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Design and Development of Coconut Dehusking Machine: A Review

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Absract

Coconut is very important ingredient of Indian food just because of its versatility in use. Extracting the edible part from a coconut is not so easy task when it comes to process it from its very initial state. To make it possible and easier, we have manufactured coconut de-husking, cutting and grating machine. Design and manufacturing of coconut de-husking machine consists of three operations, namely: Peeling of coconut fibers i.e. de-husking of coconut .India is the world's third largest producer of coconut after the Philippines and Indonesia. India alone accounts for about 70% of the world production of coir and coir products. The total output of coir and coir products in India is estimated to be aroundRs.1500.00 core including exports of Rs.350.00 core. All the parts of coconut orchard such as coconut husk, shell, copra, coconut water are useful. Coconut husk is used in coir industry, shell as a fuel, copra as food, coconut water as nutritious liquid. There are many farm equipment's and tools which are developed for the post harvesting operation of horticultural crops. The dehusking of a coconut is regarded as the most time-consuming, tiring, and difficult operation to perform and involves much human drudgery. Many attempts has been done to perform coconut dehusking manually as well as mechanized. Dehusking with traditional hand tools like machete or a spike depends on the skill of worker and involves training. Nowadays there is shortage of such skilled. Workers. The mechanized or the power operated machines are developed to eliminate the drawbacks of manual tools. Such manual tools and machines are developed all over the world and a very few have become popular, rest got vanished due to their limitations. The reasons for the failure of these tools include unsatisfactory and incomplete dehusking, breakage of the coconut shell while dehusking, spoilage of useful coir, greater effort needed than manual methods, etc. This present work aims to design and develop a semiautomatic coconut dehusking machine with eliminating the abovementioned drawbacks of the existing tools and machines. The machine conceived shall have main parts like deshuking unit mounted on a frame with electric motor as a power source along with speed reducing unit. The dehusking unit shall have a pair of cylindrical rollers with tines (cutting pins) on its surface. These rollers will rotate in opposite direction with different speeds so that the tines will penetrate into the husk and tear it away from the shell. The proper tearing of husk from shell occurs when the coconut offers good mesh with the tynes and it depends on the depth of insertion of nut into rollers and profile of tynes. As coconuts varies considerably in size and shape there is a need of adjustment in distance between pair of rollers for desired depth of in section also the suitable profile of tynes is required for effective dehusking. These tynes shall be attached to the cylinders with fasteners so that replacement can be easily done.

Keywords— *Tynes, Dehusking Unit, Peeling Strength, Penetration Strength, Coconuts, Machines, Time analysis.*

1. INTRODUCTION

Coconut (cocosnucifera) is one of the world's most useful and important perennial plants. The coconut fruit is made up of an outer excerpt, a thick fibrous fruit coat known as husk; underneath is the hard protective endocarp or shell [2].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 about5500 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.

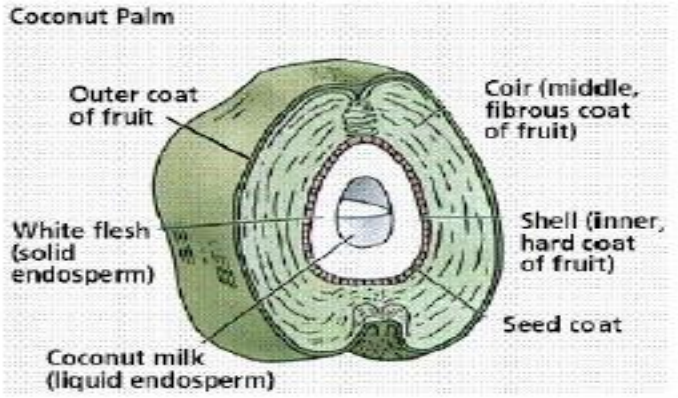


Fig.1 Parts of Coconut

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 area to coconut since the latter is easier to grow and more remunerative [6].Coconut production plays an important role in the national economy of India. According to figures published in December 2009 by the Food and Agriculture Organization of the United Nations, India is the world's third largest producer of coconuts, producing 10,894,000tons in 2009. Traditional areas of coconut cultivation are Kerala (45.22%), TamilNadu (26.56%), Karnataka (10.85%), Andhra Pradesh (8.93%) and also Goa, Orissa, West Bengal, Pondicherry, Maharashtra and the island territories of Lakshadweep and Andaman and Nicobar [1].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 roused for making shredded coconut and livestock feed. Coconut milk is a refreshing and nutritious drink while it soil is use for cooking and making margarine. Coconut oil is also very important in soap production. The shell is used for fuel purpose, shell gasified 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 [2]. Coir is a versatile natural fiber extracted from monocarp 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. These characteristics make the fibers quite useful in floor and outdoor mats, aquarium filters, 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. Present practices coconut dehusking world wide.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.

2.MEANING OF MANUAL COCONUT DEHUSKING MACHINE :-

Manual coconut dehusking machine defined as all operations of coconut dehusking is carried out by manually such as hand, foot, paddle etc. In manual coconut dehusking machine we have to apply large amount of human energy to operate this machine. Due to this reason limited amount of coconut are dehusked by Manual coconut dehusking machine.

2.1 Foot Operated Coconut Dehusking Tool :-

Foot operated coconut dehusking tool. It is also called as coconut cracker which was developed in Japan. It is tool consisting of 2 blades. The coconut has to be forced into blades so as to impale. The blades are operated on the force exerted by foot. The blades are also attached to the spring. When the force is released the blades goes to their original position. It requires 4 to 5 repetitions for complete dehusking he coconut. Firstly the coconut is strike onto the blades and then by foot the forced is applied so that the blades are opened i.e. moves away tearing the husk from the shell of coconut. When the force is removed due to inertia in spring the blades are forced to return to the own position. Such operation is a tiring and time consuming operation. Also when force has to apply by foot hence the operator loses his stability and it may lead to accident.

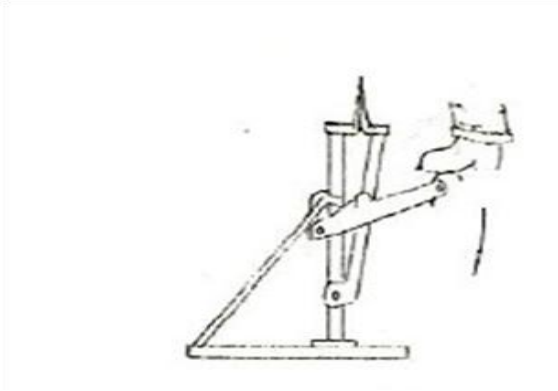


Fig 2.Foot Operated Coconut Dehusker.

Table 1 – Mannual 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	Foot operated coconut dehusker.	25-30	2 min.	10-12
II	Hand operated Coconut Dehuskimg machine.	30-50	1.5 min.	8-10

2.2 Hand Operated Coconut Dehusking Machine :-

In Hand operated coconut dehusking machine we have to put coconut top side of iron bar which made of two knobs. When we apply the force on leaver as shown the fig. the coconut press to knobs of iron bar and fiber of coconuts will be dehusked. in this operation we can dehusked one coconut at one time only. By this type of machine we can't dehusked large amount of coconut. Its installation cost is also low. it is mostly use in rural areas, villages.

Figure 3. Hand Operated Coconut Dehusking Machine.

3 .MEANING OF SEMI AUTOMATIC COCONUT DEHUSKING MACHINE:-

Coconut plant is one plant that all of the parts can be used every day. One part that can be used is coconut fiber. The fill in the coconut shell is multifunction which used in a lot of ways especially for making food and so on. The design of the machine is used to save time, which is usually the process of decomposition of coconut shell fibers take a long time to 10 minutes. By making this machine, the destined time to open up the coconut fiber is short and it has safety precaution in it.

3.1virtual Coconut Dehusking Machine:-

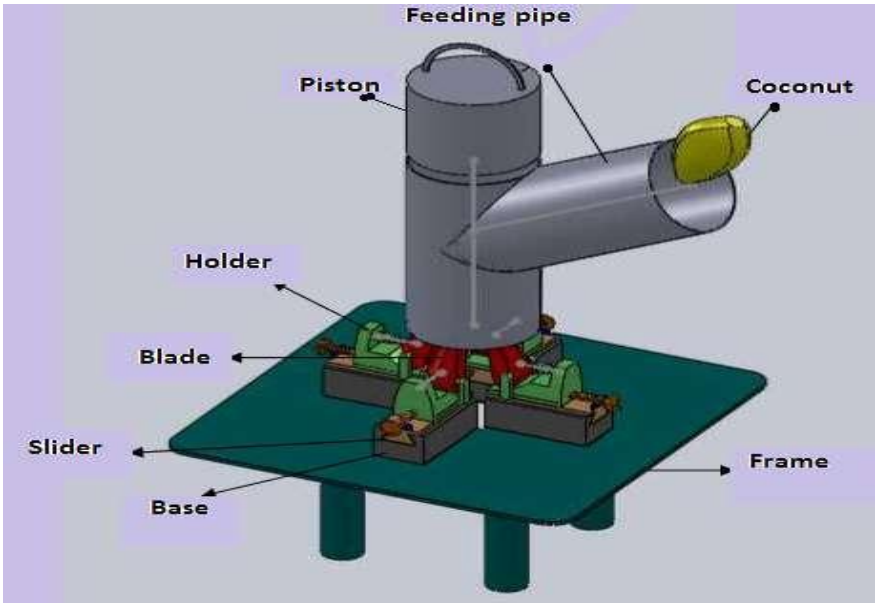


Figure 4. Virtual Coconut Dehusking Machine.

Feeding mechanism consists of main pipe, feeding pipe and hopper. Main pipe is having hollow cylindrical shape. The piston moves inside the main pipe and also coconut falls through this. Main pipe is placed just above the cutting blades such that the coconut gets placed at the required position on blades as shown in assembly. Feeding pipe is also designed same as that of main pipe and is inclined with the main pipe at an angle of 30˚. At this particular angle the coconut slides over feeding pipe as required for the dehusking process. Hopper is conical in shape and is narrowed at the feeding pipe end. There are four blades used to dehusk the coconut. This will give the efficient dehusking. The shape and sizes of blades are given in next chapter.

Table 2- 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

4. MEANING FULLY AUTOMATIC COCONUT DEHUSKING MACHINE:-

In this machine all the operations are carried out by advance technology machines. By using various kind of energy like electrical energy, hydraulic energy, pneumatic energy, solar energy, etc. in Fully automatic coconut dehusking machine three basic parts used like conveyor, electric motor (2hp), shaft and belts.

Figure 5.Hydraulic Coconut Dehusking Machine (Ref. Jintocheriyan.)

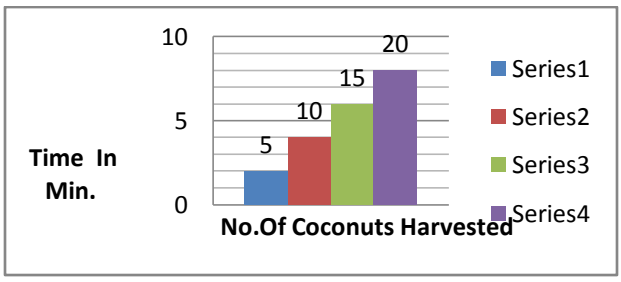
Hydraulic Coconut Dehusking Machine shown in fig. consists of electric motor, hydraulic system, arm-like structure, holding mechanism. The de-husking machine was powered by an electric motor which was powered by an electric motor which was at-tacked to hydraulic system. Hydraulic power was used to operate the arm like structure which was used for opening the 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 included some lifting mechanism for lifting the holding mechanism. The major disadvantage was that it is bulky and had high power consumption.Keramithra Coconut Dehusking Machinecon-sist of mainly a stationary wedge, a movable wedge, a hinged pin, a wedge seat, a lever and a pedestal with a base. The coconut was impaled with both the hands on the two juxtaposed wedge- like blades oriented upwards. On pulling the lever upwards by one hand, the movable blade or wedge placed on the load arm of the lever swings away from the stationary blade loosening a sector of the husk from the nut. By repeating twice or thrice the husk can be completely separated from the coconut. But it is not so good for large scale husking.

Table 3- Fully Automatic Coconut Dehusking Machine-

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

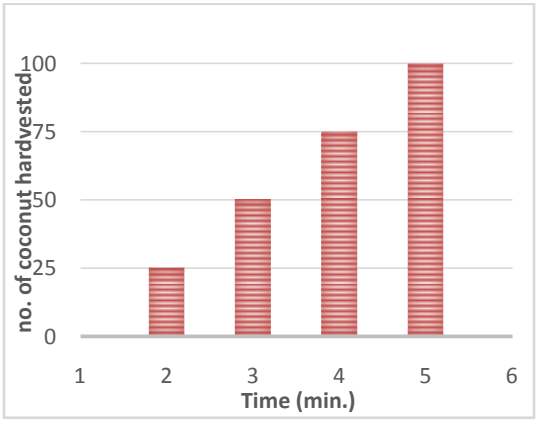
5 .RESULT AND DISCUSSION :-

5.1 Manual Operated Coconut Dehusking Machine



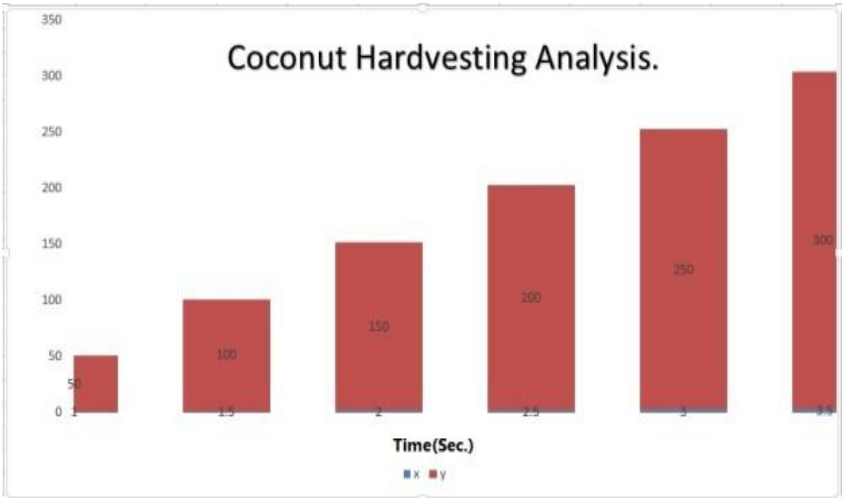
Graph 1- Graph Of Time Of Processing Vs. No. Of Coconut Had Vested.

5.2 Semi Automatic Coconut Dehusking Machine



Graph 2- Graph Of Time Of Processing Vs. No. Of Coconut Had Vested.

5.3 Fully Automatic Coconut Dehusking Machine



Graph 3.-Graph Of Time Of Processing Vs. No. Of Coconut Had Vested.

As per the operations performed, readings are obtained and plotted the graph which shows time taken by each process with respect to the different coconuts. we have to observed and finalize the Fully automatic coconut dehusking machine is very useful as compared to manually& semi automatic dehusking machine. This type of machine dehusked large amount of coconut while taking less time and installation cost also less. The parameter used for this machine as we disuse above i.e. shaft, roller, conveyor, belt, and percentage of damaging capacity of coconut dehusking machine is minimum.

6. CONCLUSION

The coconut dehusking 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 dehusking of coconut. Some of them were manually operated and others were power operated. These mechanisms have their own advantages and disadvantages. 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.

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