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DESIGN AND FABRICATION OF COCONUT DEHUSKING MACHINE

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Abstract: **The main objective of this machine is to remove the coconut shell and to eliminate the skilled labour involved in dehusking. The coconut outer shell is a fibrous husk one to two inches thick. This paper deals with the design and fabrication of pneumatic operated coconut dehusking machine. This project is aimed at producing an efficient and more economical machine for coconut industry. The coconut is known for its great versatility as seen in many domestic, commercial, and industrial uses of its different parts. Coconuts are different from any other fruits because they contain large quantity of tender and when immature they are known as tender-nuts or jelly-nuts and may be harvested for drinking. When they mature they still contain some water and can be used as seed nuts or processed to give oil from the kernel, charcoal from hard shell and coir from fibrous husk.**

One traditional method used for coconut dehusking is using a machete. This is done by using human energy. This method is risky and tedious and yet requires skills. Hence an alternative is suggested in our project which reduces time involved in coconut dehusking and human effort. Depending upon the survey different sizes of coconut are determined. The machine is designed to accommodate different sizes of the coconut that are cultivated anywhere in the world.

Keywords**: coconut dehusking machine, coconut industry, fibrous husk.**

1. INTRODUCTION

1.1 Introduction

Generally, coconuts are dehusked manually using either a machete or a spike. These methods require skilled labour and are tiring to use. Attempts made so far in the development of dehusking tools have been only partially successful and not effective in replacing manual methods. The reasons quoted 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.

The present work involved the design, development and testing of a coconut dehusker 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 dehusking forces and their generation mechanisms. Details of a simple, sturdy and efficient pneumatic dehusker unit, financially beneficial to labourers and producers, are given here. Comparative assessment of this unit in relation to those reported in the literature is provided. Test results and assessment of the present unit in both laboratory and field conditions are also reported. Safety aspects are

Fig 1.1 A **Fig 1.1 B**

incorporated. The unit can dehusk about 450 coconuts per hour compared with about 40 nuts per hour from a skilled worker using the spike method. It can be operated by unskilled labourers. Cost benefit analysis indicates that it should be commercially viable.

1.2 .Coconut crown –

Coconuts are grown in more than 93 countries of the world, with a total production of 5.4 billion tons per year. An individual coconut fruit is made up of an exocarp,India is the second largest country to grow the coconut palms.Dehusking is the process of removing the outer covering called husk from the coconuts.The dehusking is necessary for matured coconut towards further utilization. Due to the complication in size the studies are still in initial stage.The commercially available machines like Motorizedand hydraulic coconut dehusking machines costs more, this has became major limiting factor in our country. The pneumatic system has gained a large amount of importance in last few decades. This convenience in operating the pneumatic system has made us to design this machine

Fig 1.2

1.3. Different methods to remove husk (shell) of coconut-

1.3.1 Foot Operated Coconut Dehusking Machine –:

The Coconut palm is struck manually against the closed teeth blades. As the paddle accelerates, the clamp action takes place to dehusk the coconut into two pieces. In this method the core is completely separated in one or two sequential (operation. This equipment is simple in construction, easily operated, and it is light in weight. It is so simple in construction such that it does not require power source as it is manually operated. The cost of this equipment is low and has higher efficiency compared to other manually operated methods.

1.3.2 Mechanical Coconut DehuskingMachine- :

In this power transmission takes place to rollers through helical gears. The powered rollers mounted on right side of machine, the outermost one carries sharp slightly curved spikes on its periphery. As the pressure applied on the coconut it makes contact with the rollers and the shell gets detached.This results in complete dehuskingof coconut.The dehusked coconuts are collected at outlets below the roller where there is a provision between the spiked rollers.

Fig 1.3.2

1.4 Design concept generation

Design concept generation refers to the actual conceptual design where the design concept is an approximate description of the technology, working principles and form of the product. It has a detailed description on how the product will satisfy and meet customer requirements. Existing design constraints may even be solved by having a good development in the design concept. For this project, many alternative concepts have been generated. The various generated concepts were then individually evaluated to find the most appropriate concept for the product. The concepts that gave the most advantages were considered as the best concept and awaits further evaluation. The product sketch for the chosen concept was further drafted. Design concept generation is usually expressed in the form of sketches or rough 3-D models and often accompanied by a brief textual description for the overall design concepts. For this semi-automatic coconut machine, four concepts were proposed, which are concept A to concept D. As such, the concepts need to be evaluated (scoring and screening) in order to find the final concept design of the semi-auto coconut machine.

2. LITERATURE REVIEW

2.1 Statement of findings

Anu S.C[1] et al in 2006 said that, coconuts are dehusked manually using tools. These methods required skilled labour. Attempts made so far in the development of dehusking tools have only been partially successful and not only been partially successful and not effective in replacing manual methods. The reasons stated for the failure of these tools include unsatisfactory and incomplete dehusking and breakage of the coconut shell while dehusking. Based on this hand operated coconut dehusking machine is being designed to solve this problem. This machine takes into consideration the danger, hazards and risks involved in the dehusking the coconut which will be the efficient, productive, environmentally friendly, less laborious, easy to use and easy to assemble and disassemble, most importantly, cost effective in the production, maintenance and repair.

Luise cancel[2] et al in 2000said that,Coconut is a primary yield of konkan district and dehusking of coconut is essential process in preparing the coconut for additional usage. Coconut dehusking includes expelling of the husk from the coconut. Conventional dehusking is difficult and troublesome procedure. To beat these difficulties, to improve the robotization and to give security to the workers, another structure of dehusking machine is presented and created. This dehusker includes utilization of two flat rollers with arrangement of sharp apparatuses which would shear the husk from coconut when moving against one another. Shear force is required for dehusking of green coconut and dry darker coconut. Shear force required is more for green coconut than dry coconut. Torque and speed decrease required for dehusking is determined by utilizing the power required for shearing coconut. Ideal number of spikes is orchestrated on the rollers to dehusk the coconut with least power.

Chandra Dinath[3] et al said that, A machine explicitly intended to remove the husks from the coconut natural product including a majority of rollers pivoting in inverse ways adequately toward each other wherein every roller incorporates a majority of infiltrating spikes honed to enter and viably connect with the husk segment of the coconut organic product. The connection of the rollers in blend with the holding activity of the spike serves to tear away the husk from the nut leaving the nut in class.

Sujaykumar[4] et al said that Coconut dehusking includes expelling of the husk from the coconut. Conventional dehusking is tedious and troublesome procedure. To beat these restrictions, to improve the machining and to give security to the administrator, another structure of dehusking machine is presented and manufactured. This dehusker involves utilization of two even rollers with arrangement of sharp apparatus which would shear the husk from coconut when moving against one another. Shear power is required for dehusking of develop green coconut and dry dark colored coconut. Shear power required is more for develop green coconut than dry coconut. Torque and speed decrease required for dehusking is determined by utilizing the power required for shearing coconut. Ideal number of spikes is organized on the rollers to dehusk the coconut with least power

2.2 Review of findings:-

Sr. No.	Author	Title	Findings
1	R S Khurmi & J K Gupta	A Textbook of Machine Design	The book provides easy and clear analysis of major topics such as manufacturing considerations in machine design, simple stresses in machine parts
2	R S Khurmi & J K Gupta	Theory of Machines	This book helps to develop the capacity to model actual problems into engineering problems and find a solution using the laws of mechanics.
3	David Kleppner & Robert Kolenkow	An Introduction to Mechanics	The book provides easy and clear analysis of major topics such as manufacturing considerations in machine design. it helps in clearing key confusion around the theoretical concept of machines.

3. PROJECT METHODOLOGY

3.1 Flow Chart - :

The chart describes about the process flow of the project along with the detail fragmentation of the steps to be followed. It provides the discussion about the flow to be carried out.

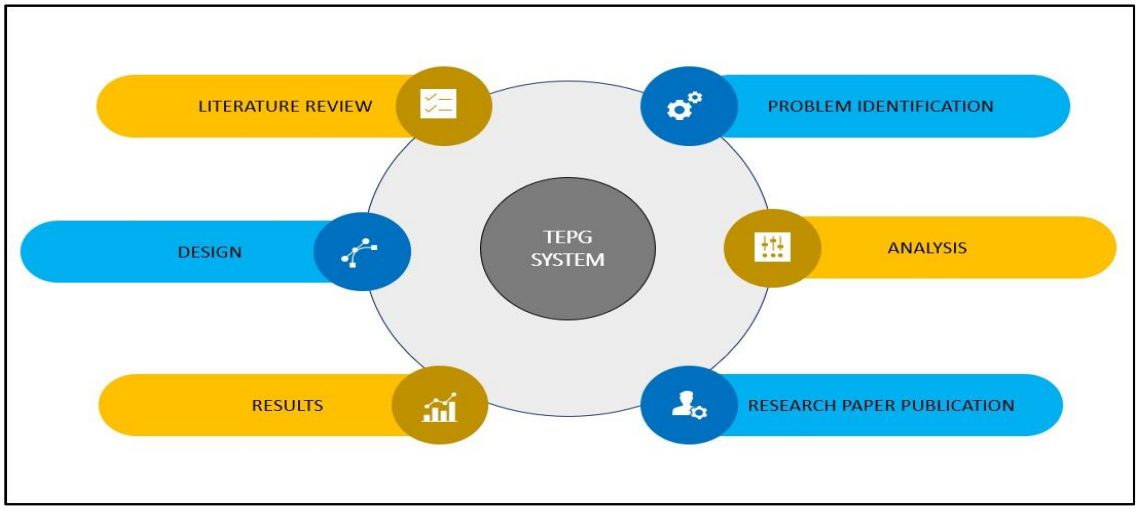


Figure 3.1. : Flow Chart of project

3.2 Description of Part

3.2.1 Supporting Frame -:

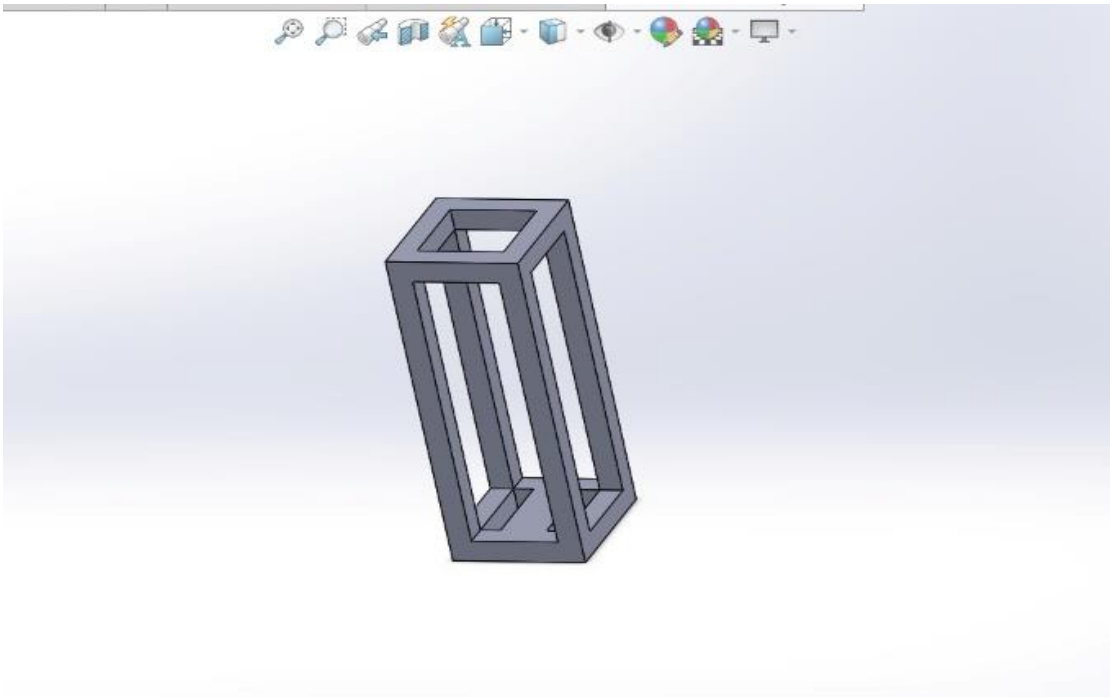


Fig 3.13.1

Supporting Frame Dimensions:

Table: Supporting Frame Dimensions

Sr. No.	Part	Length (mm)	Width (mm)	Thickness (mm)	Quantity
3	L Channel	600	40	5	4
4	L Channel	230	40	5	8
5	Steel Sheet	230	60	3	1

3.2.2 Pneumatic Cylinder -:

Pneumatic cylinders (sometimes known as air cylinders) are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion

Like hydraulic cylinders, something forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers sometimes prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts of space for fluid storage.

Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement. For example, in the mechanical puppets of the Disney Tiki Room, pneumatics are used to prevent fluid from dripping onto people below the puppets.

Specifications:

- **Bore Diameter – 32 & 63 mm**
- **Mode of action – Double acting cylinder**
- **Stroke length - 100 mm**

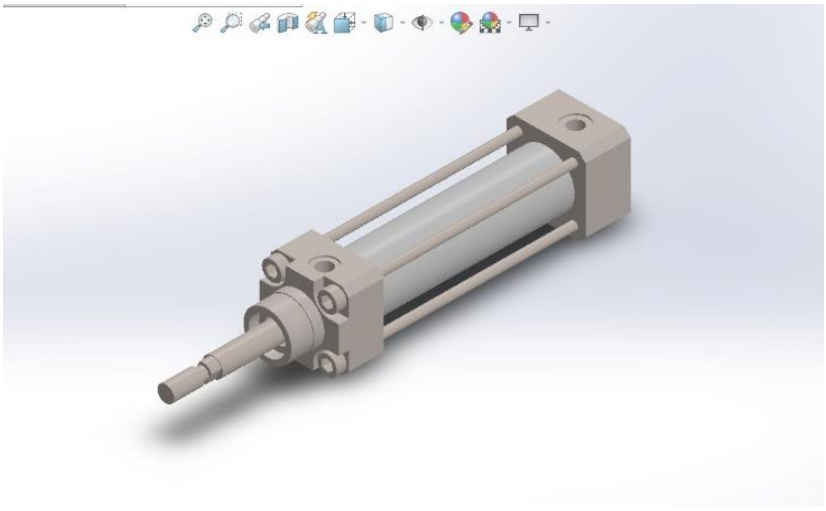


Fig 3.12.2

Sr. No.	Part	Length (mm)	Width (mm)	Quantity
3	Cylinder	153	75	2

3.2.3 Pneumatic 5/2 Hand lever-:

5/2 way is a five port, two position valve that will put a fluid or air into one end of a double acting device as well as allowing the other end vent to exhaust. Zero Differential are solenoid valves that can operate under zero head pressure (do not need a differential pressure drop across the valve to work)

Fig 3.13.3

3.2.4 Pneumatic connectors -:

A pneumatic coupling is used to connect compressed air tools to a compressed air line. A pneumatic coupler allows a tool to be easily connected or disconnected to a hose or pipe while it is under pressure. The system consists of two parts: the quick coupling (the female part) and the plug-in or nipple (the male part).

3.2.5 Pneumatic Pipe -:

Pneumatic hose and tubing is used to deliver pressurized air to where it's needed, such as tools, valves, and actuators.

- Pipe diameter - 5 mm
- Material - polyurethane, nylon, polyethylene, and polyvinyl chloride (PVC)

Fig 3.13.5

3.2.6 .Pneumatic control valve -:

An air-operated valve, also known as a pneumatic valve, is a type of power-operated pipe valve that uses air pressure to perform a function similar to a solenoid. As air pressure is increased, the compressed air starts to push against the piston or diaphragm walls which causes the valve to actuate.

Fig 3.13.6

3.2.7 Coconut Holder and other small parts - :

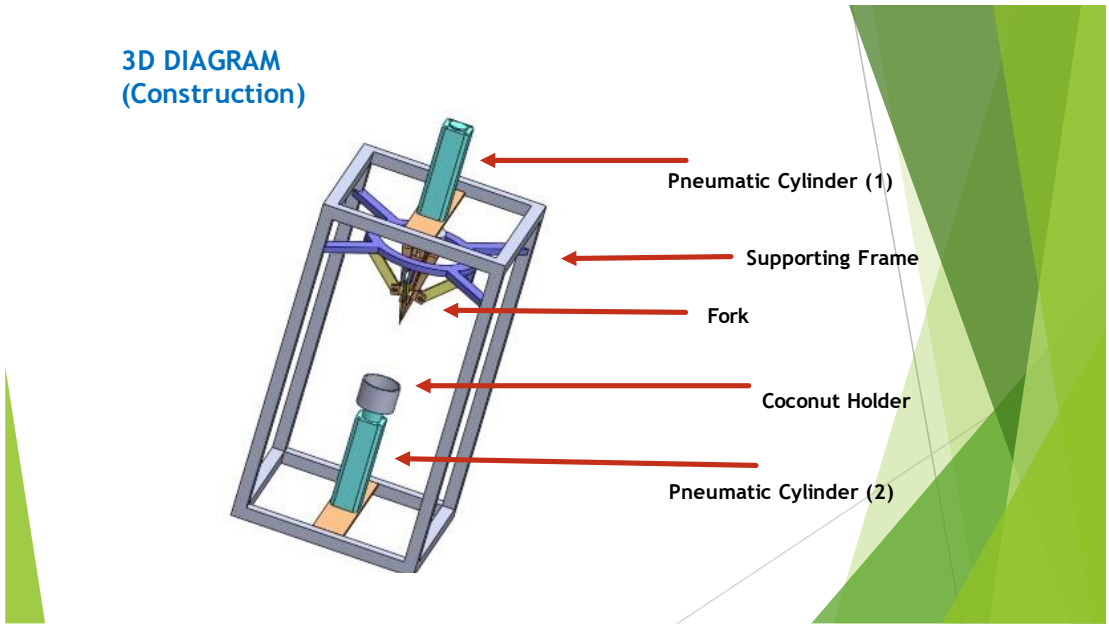
The best mixing holders are generally made from stainless steel, glass, ceramic, or plastic. Stainless steel mixing holders are inexpensive, lightweight, and will never shatter. They are nonreactive and are typically available in a wide range of size. This holder place at the bottom of structure. This holder use to hold the coconut.

Material – stainless steel

Fig 3.13.7

4. CONSTRUCTION AND WORKING PRINCIPLE

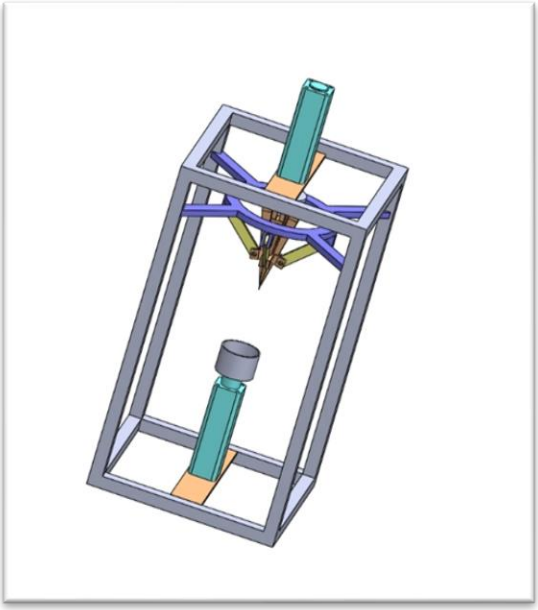
4.1 Construction -:



Coconut dehusking machine consist following parts-

- Supporting frame
- Forks
- Coconut holder
- Pneumatic cylinder
- Pneumatic control valve
- 5/2 hand lever

Supporting frame is major body of machine ,it gives support to all components of project. In this machine 2 pneumatic cylinders are used. One cylinder is mounted on upper side and another is mounted at base as shown in fig. coconut holder is attach with lower cylinder. Fork is an main mechanism of this project. Coconut husk is removed with the help of this forks.



4.2 Working -:

The pneumatic coconut husk remover is same as that of pneumatic punching machine. It consists of pneumatic cylinders, hand lever valve, sequencing valve, pneumatic operated holder and tool. The sequencing valve and hand lever valve helps to supply compressed air with high pressure and this high pressure is let inside the pneumatic cylinder. The dehusking of coconut is done by placing coconut in the pneumatic operated holding machine. Then the compressed air is supplied with the help of hand lever valve. The coconut moves upward with the help of compressed air which is connected to cylinder, the removal of husk is done by tool. The husk is loosened a lot which can be easily removed by hand. Thus, the whole dehusking process is carried out by using this pneumatic system.

5. DESIGN CALCULATIONS

5.1 Design calculation for pneumatic cylinder

Given data -:

- We know,
  - ✓ Minimum pressure applied in the cylinder (p) = 1 bar =100000 N/mm2
  - ✓ Diameter of the cylinder (D) = 63 mm=0.063m
  - ✓ Stroke length (L) = 100 mm

- Area of cylinder (A) = πd2/4 = π*(0.063)2/4 = 3.11 m2
- Force exerted in the piston (F) =Pressure * applied area of cylinder Force

= 100000 *3.11 F =312 N/m2

The force required is given by, 1 KG = 9.8 N/m2

Then,

We will divide force 312 N/m2 by 9.8 = 32 kg /m2

'Total Pneumatic force on cylinder' = 32 kg/m

6. COST ESTIMATION

6.1. Component cost & specification -

Sr. No	Components	Specifications	Cost (Rs)
1.	Supporting Frame	L channel - 600x40x5 = 4 qty. L channel - 230x40x5 =8 qty. Steel sheet - 230x60x3 = 1qty.	500 /-
.2.	Pneumatic Cylinder	Bore diameter – 50 mm. Mode – Double Acting. Stroke length – 100 mm. Qty – 2	6000/-
3.	Pneumatic Pipe	Pipe diameter – 5 mm. Pipe Material - polyurethane, nylon, polyethylene, and polyvinyl chloride (PVC).	200/-
4.	Pneumatic control valve	Material – SS and Plastic. Automation grade – Automatic. Working temperature – 5-50 degrees.	1500/-
5.	Pneumatic switch	Fitting- 5mm Qty – 1.	200/-
6.	Coconut holder	Stainless steel bowl type component	150/-
		Total cost	8550/-

6.2 .Manufacturing cost –

Sr. No	Process name /other	Cost (Rs)
1.	Milling, lathe, drilling machine operations	2000/-
2.	Welding cost	1000/-
3.	Other handling cost	2000/-
4.	Travelling	1000/-
	Total cost	6000/-

Total project cost = component cost + manufacturing / handling cost

= 8550 +6000

Total project cost = 14550 /-

7. OBSERVATION TABLE

Sr no	Coconut Diameter (in mm)	Compressor pressure (bar)	Time required to dehusk (sec)
1.	320 mm	7 bar	20.42
2.	340 mm	7 bar	18.59
3.	400 mm	7 bar	22.32

By this observation table ,

- Average coconut Dia = 353 mm
- Average dehusking Time = 20.44 sec

Thus, we can extract 180 coconut per hour.

Fig.6.1(A)

Fig.6.1(B)

Fig.6.1(C)

8. RESULTS AND CONCLUSION

8.1. Result -

❖ Low cost dehusking solution.

❖ Maximum scrap utilization

❖ Approx we can extract 180 nuts per hour

8.2 Conclusion -

From this review the following conclusions are made,

❖ The coconut dehusking is one of the toughest and time-consuming post harvesting operation.

❖ In India coconut is developed on an enormous scale. To process such an enormous number of generation of coconuts some appropriate system should be recognized or created.

❖ A few endeavours have been made to motorize the dehusking of coconut. Some of them were physically worked and others were power worked. These instruments have their own preferences and detriments.

❖ Some of them were problematic, tedious, power expending, uneconomical. There is a need to build up some instrument which would work acceptable and must be affordable

9. ADVANTAGES, DISADVANTAGES & APPLICATIONS

9.1 Advantages -

❖ Skilled labour is not required.

❖ Easy operation

❖ It can be transported easily from one place to another since dismantling and assembling is simple.

❖ Maintenance is easy.

❖ Investment is very low

9.2 Disadvantages -

- ❖ High initial cost
- ❖ Low rate of dehusking and Operational difficulty.
- ❖ Low efficiency when we compare to modern machines

9.3 Application -

These types of pneumatic coconut husk remover with shell cutter can be extensively used in -

- Industrial canteens,
- Agriculture purposes
- Hair oil refinery industries.
- Coir and Fuel industries
- Gunny bag industries
- Health benefits

Future scope

❖ In our country the people are looking for a job that has to be done in easier way. This machine reduces the human effort and also saves time to great extent.

❖ It is possible for us to obtain the more output. In many industries labours are used for processing of coconuts, it is both costly and time consuming. Our proposal reduces the cost and time ,as the machine is fixed once

❖ By implementing this human effort will get reduced. Chances of accidents in manual method is more, we can overcome in this design.

❖ Efficiency of machine will be maximum ,if proper care and service is carried out once in a week.

❖ The production rate will get increases,as the time required by this machine is less. It is not huge, so less space is required.

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