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DESIGN AND FABRICATION OF COCONUT DEHUSKING MACHINE

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Abstract : *Coconut husk is used in coir industry, shell as a fuel, copra as food, coconut water as nutritious liquid. The dehusking of a coconut is regarded as the most time consuming, tiring, and difficult operation to perform and involves much human drudgery. 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. This present work aims to design and develop a semiautomatic coconut dehusking machine with eliminating the above mentioned drawbacks of the existing tools and machines. The machine conceived shall have main parts like dehusking 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 tynes (cutting pins) on its surface. These rollers will rotate in opposite direction with different speeds so that the tynes 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. 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***.**

Key Words: coconut, dehusking , tynes , husk , cylinders

1. INTRODUCTION

This coconut dehusking machine peels off the coconut husk from coconut fruit to obtain dehusked coconut fruit with the help of two rotating rollers having spikes on their periphery. The coconut is placed in between the rollers lengthwise. The rollers are driven at two different speeds with help of gears and powered by electric motor. The rotational speed of two rollers should be different so that the coconut can be turned by means of this differential speed. The spikes penetrate into the coconut husk and further rotation of rollers result in peeling of the husk. The husk which is peeled off are pulled downwards by the rollers. After a 360^{o} rotation of the coconut, the husk will be removed completely and the fruit can be taken out.

1.1 LITERATURE REVIEW

Currently there are different methods for dehusking of coconuts. These methods generally includes, coconut 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

Venkataramanan SA studied about the physical and geometrical aspects of coconut by using universal testing machine results. He published the UTM results of coconut in "Design and Development of Automated Coconut Dehusking and Crown Removal Machine" which was found to be very helpful.

A brief study conducted by H Azmi on the need and importance of coconut dehusking machine in agriculture industries shows the relevance of the fabrication of machine for both small scale and large scale industries.

Journal paper " Design and fabrication of coconut dehusking machine" published by M D Akhir give the design details and overall working performance of an internal combustion powered coconut dehusking machine. It discuss a very powerful machine which has a dehusking rate of 250-300/hour.

1.2 OBJECTIVES

- To design a coconut dehusking machine
- To fabricate the coconut dehusking machine
- To improve number of nuts produced per hour
- To analyze spiked roller unit with the help of ANYSIS software

2. METHODOLOGY

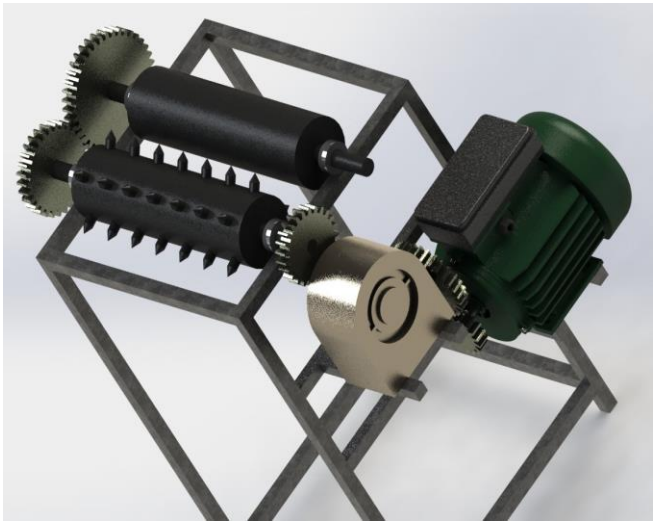
2.1 COMPONENTS AND DESCRIPTION

This project consists of the following components to fulfill the requirements of complete operation of the machine.

- Single phase induction motor
- Spiked roller
- Spur gear
- Frame
- Bearing
- Worm gear

2.2 DESIGN PROCEDURE – CAD

The model of coconut dehusking machine is created by using SOLIDWORKS 2016.



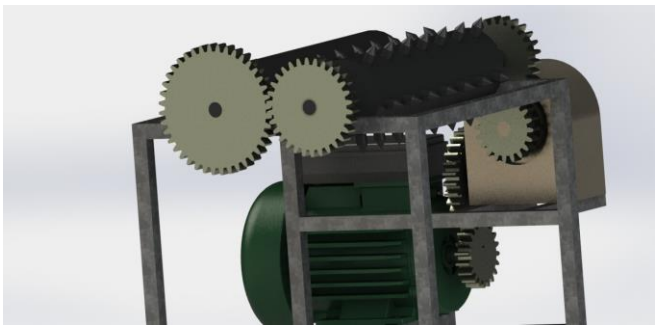


Fig 1: render image of machine in solidworks 2016

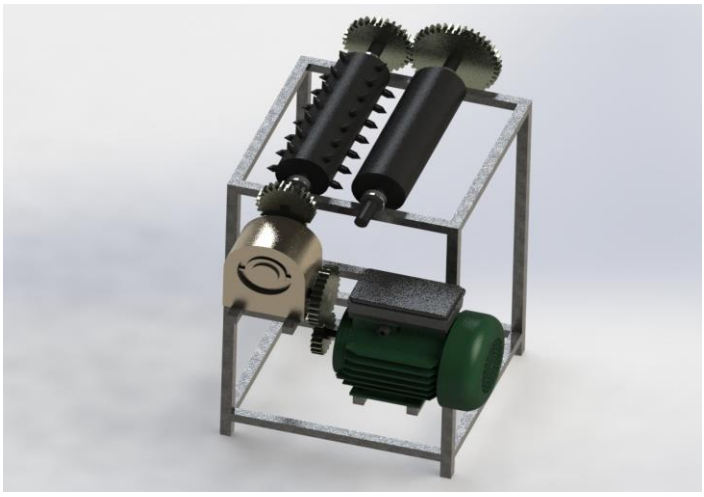


Fig 2: Final Assembly

2.3 COMPONENTS SPECIFICATIONS

Frame

Height : 780 mm

Dimensions : 330 x 360 mm

Material : Mild Steel

Worm gear

Material : Cast iron

Speed ratio : 13 : 1

AC Motor

Current : 2.5A

Voltage : 230 V AC

Output Speed : 60 RPM

Speed in rotor : 1440 RPM

Phase : Three Phase

Spiked Roller

Inner Diameter : 25 mm

Outer Diameter : 50 mm

Type : Mild Steel

Bearing used

Bearing number : SKF 6006(deep groove ball bearing)

Inner race bore : 20mm

Outside diameter : 45mm

Width : 12mm

Spur Gears

Material:Stainless steel

Gear G1	Gear G2
Pitch diameter = 40 mm	Pitch diameter = 110 mm
Number of teeth= 24	Number of teeth = 56
Plane width = 24mm	
Module = 40/24 = 1.67 mm	

Gear G3	Gear G4
Pitch diameter = 45 mm	Pitch diameter = 110 mm
Number of teeth = 18	Number of teeth = 56
Plane width = 24mm	
Module = 2.5 mm	

Gear G5	Gear G6
Pitch diameter = 110 mm	Pitch diameter = 110 mm
Number of teeth = 36	Number of teeth = 48
Plane width = 20 mm	
Module = 3.05 mm	

Spike

Material:Stainless steel

Diameter=15mm Height=25mm

Spike height=12.5mm

3. DESIGN ANALYSIS - ANSYS WORKBENCH

Structural analysis is done through ANSYS WORKBENCH 16.2.

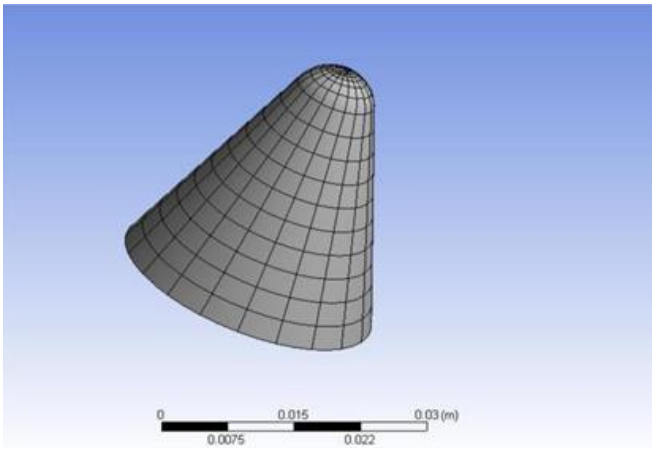
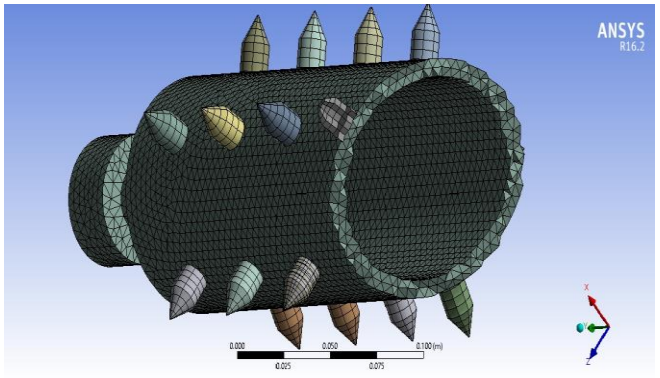


Fig 3: meshing of spike



Statistics	
Nodes	183601
Elements	95179
Mesh Metric	None

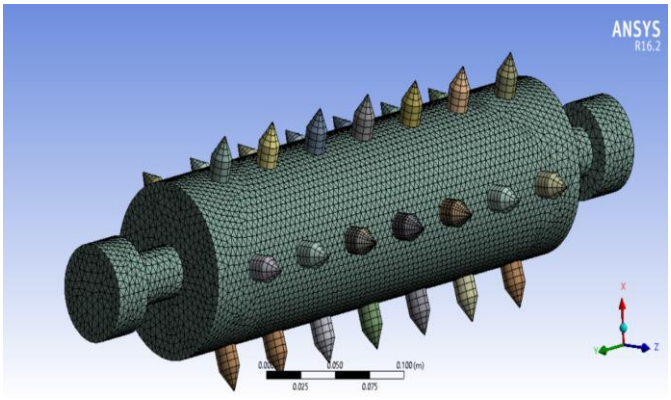


Fig 4:Meshing of roller

BOUNDARY CONDITION

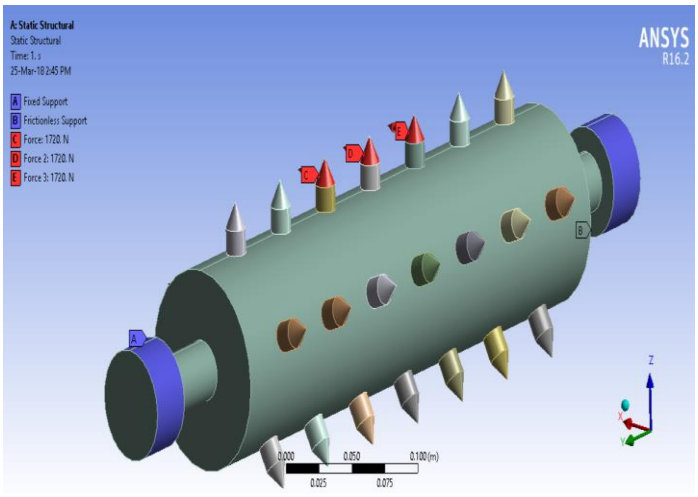
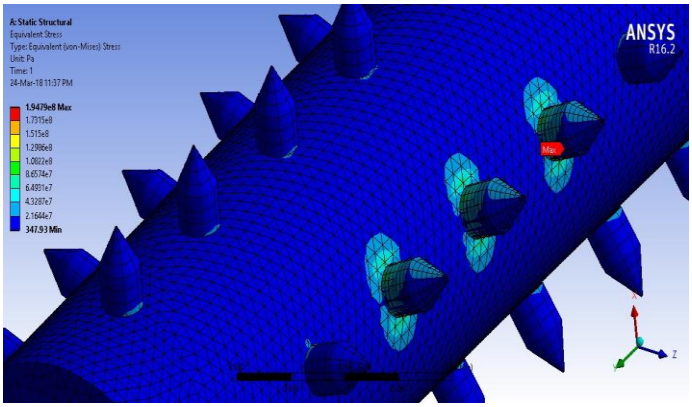
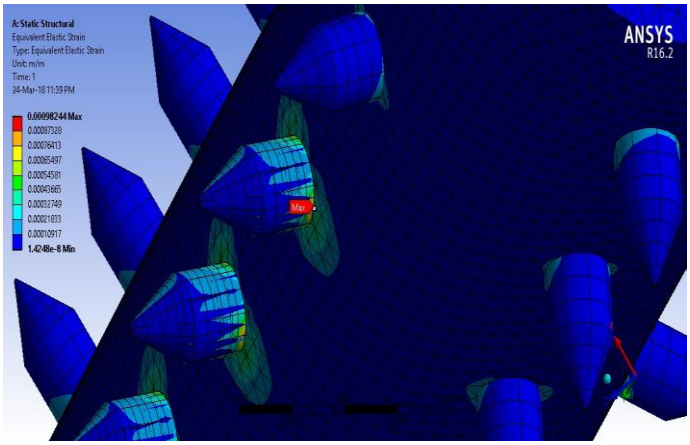


Fig 5: boundary conditions of forces acts on spikes

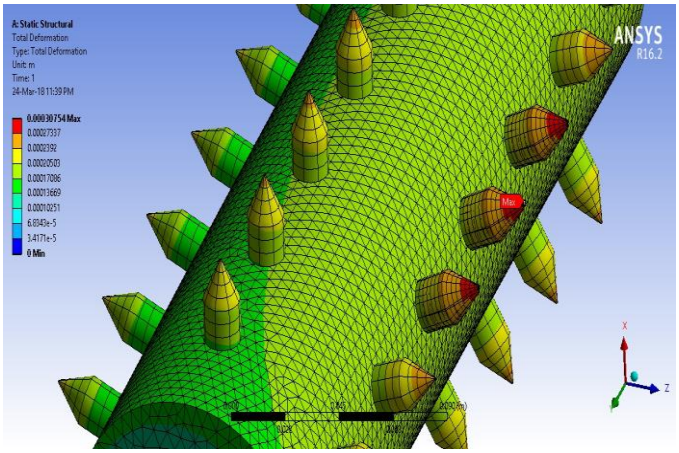
ANSYS RESULT



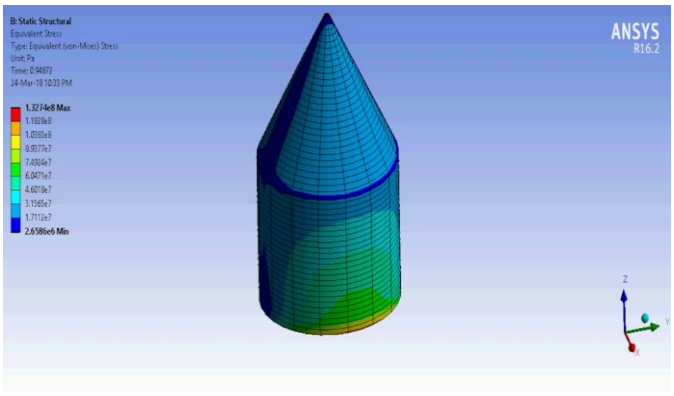
Maximum equivalent stress = 190 MPa



Maximum Equivalent strain = 0.0098



Total deformation = 0.03mm



Maximum Equivalent stress = 137 MPa

4. FABRICATION

The design was analysed and approved, then we started the fabrication part. The fabrication includes the fabrication of roller with spikes and gears.

Fig 6:roller with spikes

Fig 7:speed reduction unit

Fig 8: Fabricated model

5. CONCLUSION

A low cost coconut dehusking machine has been fabricated. The machine is appeared to be feasible, pollution less, economic. Number of nuts produced per hour depends upon the slack time and speed of roller units. Number of nuts dehuksed per hour is found to be 220 nuts which is above other existing similar machines.

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