DESIGN AND DEVELOPMENT OF COCONUT DE-SHELLING MACHINE

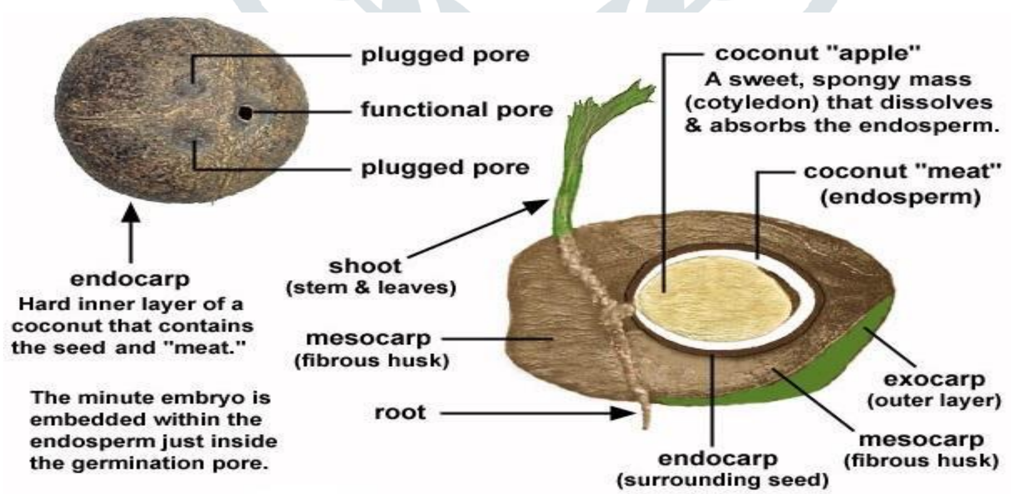
[1]Sangita G. Jambhulkar,[2]Dr. C. C. Handa,[3]Er.K.M.Kapgate

[1]M.Tech student,[2]Professor, [3]Assistant Professor
[1]Department of Mechanical Engineering,
[1]K.D.K. College of Engineering, Nagpur, India

Abstract : The paper is about fabrication of coconut de-shelling machine.The conventional method used in India, for de-shelling the coconut is labor intensive, unhygienic, time consuming and harmful to human body. To overcome this problem, there is a need to automate the de-shelling process. While automating the process the usefulness of the by-products are to be considered and carefully handled. A coconut de-shelling machine comprising of two cutter mounted on a same shaft with gear drive. Performances test analysis, show that the machine de-shelled the fruits without nut breakage as well as its average de-shelling efficiency is doubled and 300 coconut can de-shell per hour. All materials used in the fabrication of this machine are of standard specification and locally sourced. The estimated cost of producing one unit of the machine is twenty two thousand (Rs.22,000). The objective of project is to design and developed the coconut de-shelling machine and performance of machine which can remove maximum coconut shell at less time.. The construction of machine will be simple in design so that it can be easily manufactured in small workshop. Also the machinery will be of low cost so that an average farmer and small scale vendor can afford to buy it.

I. INTRODUCTION

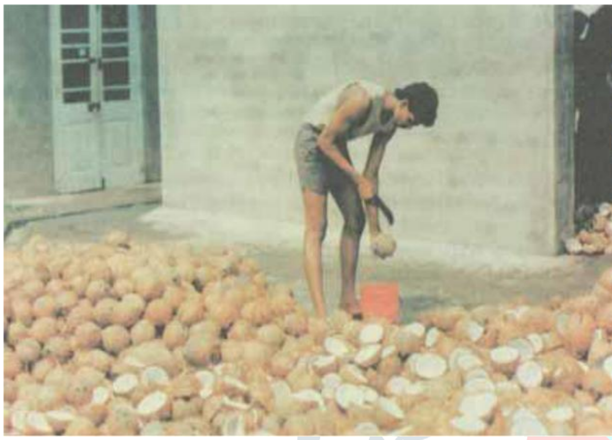
The main aim of this project is to reduce the human efforts and to increase the rate of de-shelling the coconut. This machine takes into consideration the dangers, hazards and risks involved in de- shelling the coconut which will be efficient, productive, environmentally friendly, less labors, easy to use and most important ly cost effective in production, maintenance and repair.
The main purpose of coconut de- shelling machine is to eliminate the skilled operator involved in de- shelling the coconut and to completely automate the de- shelling and crown removing process. Although coconut de- shelling 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 - shelling and crown removing. Also, we can yield lot of useful and commercial products from coconut at various stages of its lifecycle.



II.PROBLEM IDENTIFICATION:

The coconut is one of the main sources of oil products. In order to obtain the oil from the coconut, there are number of process to be done. The processes are coconut plucking, de-husking, breaking shell, drying, de-shelling the kernel from the shell and finally extracting the oil from the kernel. In the above process, the time consuming is the coconut de-shelling, since it is done by using manual labors. Most of the regions use manual de-shelling at present. The coconut is de-shelled by means of using knifes, hooks, etc. Due to manual process, time is consumed, other major disadvantage is the labour problem and by using the external devices there may be a chance of accidents takes place. In order to avoid such kind of difficulties we go for the machining process.

- Traditional coconut de-shelling process is time consuming.
- These are aborious, time consuming, cost intensive and Involve various processing activity.
- In local methods hygienic conditions are not maintained.

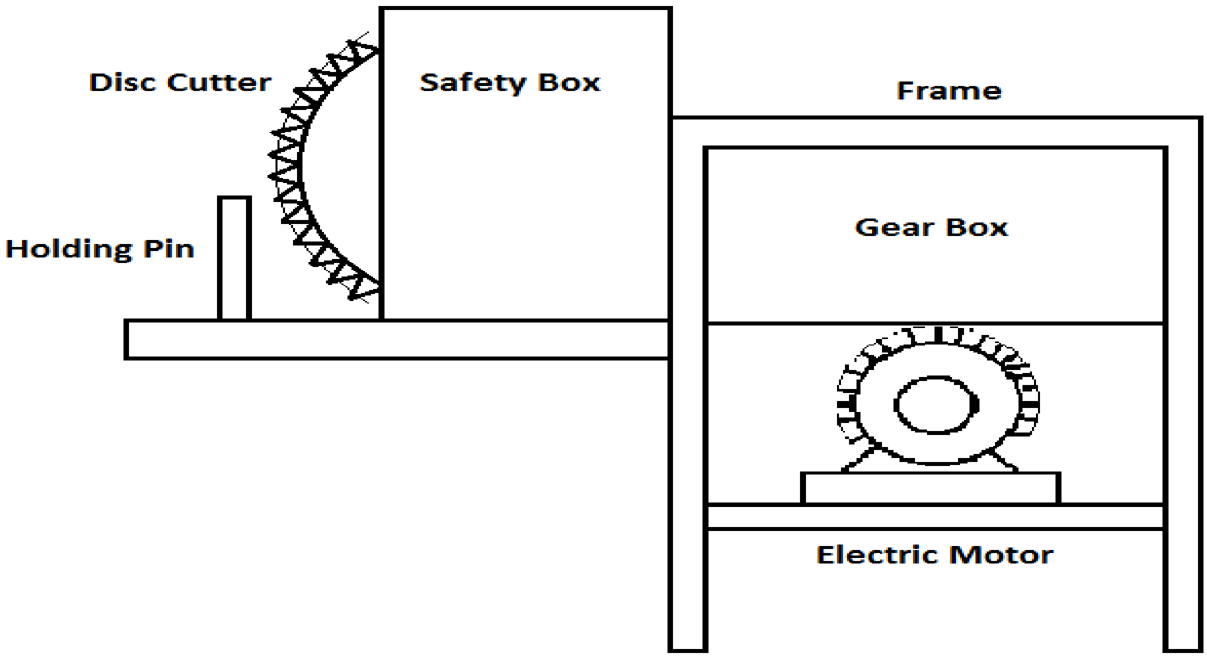



III. LITERTURE REVIEW

- T.Vidhan Singh and R. Udhayakumar [1] this literature gives a view to develop a power operated coconut de-shelling machine was designed and developed. The capacity of the machine is 200 nuts or 400 cups per batch. The loading and unloading is done manually. The optimum average moisture content for the maximum de-shelling efficiency (92%) was 35% (d.b). The optimum rotating speed of the de-shelling machine was 10 rpm and the time taken for de-shelling was four minutes per batch. The time saved by using the de-shelling machine was four times as compared to the manual method.
- Satip Rattanapaskorn and KiattisakRoonprasang [2] the author has analyzed the feasibility of an design and development of semi-automatic cutting machine for young coconuts. The purpose of this research is to design, fabricate, test, and evaluate the prototype of a semi-automatic young coconut fruit cutting machine. The design concept is that fruit cutting is accomplished by pneumatic press on a young coconut sitting on a sharp knife in a vertical plane. In operation, a young coconut is placed on the cutting base and the pneumatic control is switched on. The coconut is automatically moved to the ressing unit and cut in half by a knife set. The coconut juice flows down to the tank while the cut fruits are separated and moved into the other tank. The machine is found to operate safely without damage to the fruits. The machine capacity is 480 fruits/hr with the total operating cost of about 2.63 USD/1000 fruits.
- T. Roshni , J. Jippu, C. S. Ratheesh,and J. Sachin [3] The author has analyzed the feasibility of an power operated coconut punch-cum-splitter was developed for extracting coconut water and coconut meat. The nut of the screw rod was rotated with an electric motor and the drive was transmitted with a belt and pulley system. The tender coconut was placed on the top of the screw rod in natural rest position and was raised to press against either the punch or the blade fixed above the screw rod. The average energy requirement for punching and splitting of the selected range were found to be 11.74 kJ and 12.13 kJ. An electric motor assisted apparatus was developed to punch and split open the tender coconuts. The force required for punching and splitting was found with a mean value of 712 N and 1277 N, respectively.
- J.Bhaskar and V. K. Singh [4] this article focuses on an approach based on the aim of present investigations is to evaluate the physical property-water absorptions and mechanical property-compressive properties. Coconut particle reinforced composites were fabricated by reinforcing shell particle (size between 200-800μm) by wt% of 20, 25, 30 & 35 into epoxy matrix. Composites plates were made by casting in open mould. That is possible with very low cost and easy way. Experimental results showed that water absorption increases with the increase of wt% of particle but compressive properties increases upto 30wt% of particle approaches to actual compressive strength of epoxy.
- J.OlumuyiwaAgunsoye and Sanni O. Samuel [5] This paper discusses about mechanical properties of coconut shell reinforced polyethylene composite have been evaluated to establish the possibility of using it as a
- new material for engineering applications.. The result shows that the hardness of the composite increases with increase in coconut shell content though the tensile strength, modulus of elasticity, impact energy and ductility of the composite decreases with increase in the particle content. Scanning Electron Microscopy (SEM) of the composites (with 0% - 25% particles) surfaces indicates poor interfacial interaction between the coconut shell particle and the low density.

IV.PROPOSED METHOD

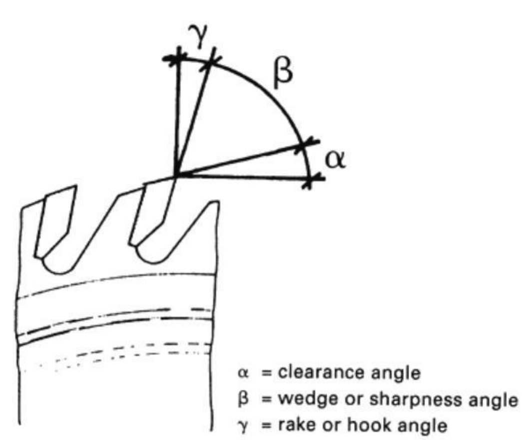
When the motor is given A.C power supply, then the output from motor is the mechanical power in the form of rotation of shaft. The de-shelling unit comprises of three shaft one is intermediate shaft(3) and shaft(2) and other is cutter shaft. . This motion is transferred to intermediated shaft which is attached the pulley and transmitted the power to shaft 2 for the speed reduction power is transmitted to the cutter shaft. Cutter is rotated at the clockwise direction which is near to knife rod. Then hold the coconut in hand and find the coconut eye of the coconut fruit and locate it to the de-shelling rod, without touching the disc cutter. Hold firmly the coconut fruit and slowly tilt it to the disc cutter until the de-shelling process started. Gently rotate the coconut fruit so the de-shelling process continues, until all the shell are cleared, and leave alone the de-shelled coconut fruit.



CONCEPTUAL MECHANISM OF COCONUT DE-SHELLING MACHINE

Cross Cutter (TCT-Saw Blade)

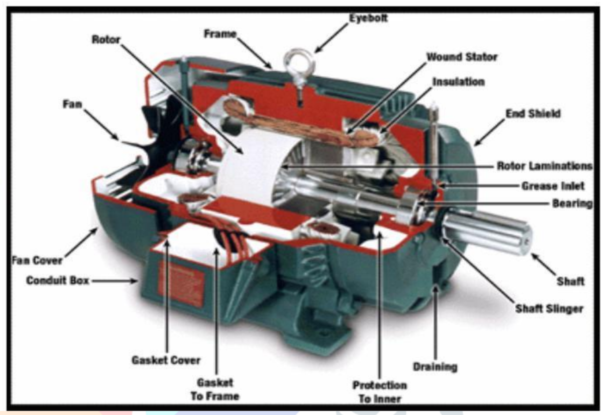
The main function of sawing is cutting wood to size (cutting to length, trimming, cutting to width) and cutting to shape parallel to and perpendicular to the grain. Circular sawing is used for primary processing and secondary processing of sawn timber. Compared to primary processing, considerably smaller cutting heights are required in



Electric motor

An electric motor is an electric machine that converts electrical energy into mechanical energy. In normal motoring mode, most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force within the motor. In certain applications, such as in the transportation industry with traction motors, electric motors can operate in both motoring and generating or braking modes to also produce electrical energy from mechanical energy.

Found in applications as diverse as industrial fans, blowers and pumps, machine tools, household appliances, power tools, and disk drives, electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current (AC) sources, such as from the power grid, inverters or generators. Small motors may be found in electric watches. General-purpose motors with highly standardized dimensions and characteristics provide convenient mechanical power for industrial use



V. DESIGN CALCULATION

DESIGN OF SHAFT

The power is essential to remove the shell from coconut which is taken by 373 watt. The speed required in this machine is 65 rpm, which is rotates the cutter and de-shell the coconut.

The diameter of sprocket (Dm) and the diameter of cross cutter (Dc) is mainly used and very helpful to design the machine and to generate power to de-shell the coconut

Power (P) =373 watt Speed (N) = 65 rpm
Diameter of Sprocket (Ds) = 65 mm Diameter of Cutter (Dc) =150 mm

Step 1):- Selection of Material
From Design Data Book (DOB)
Table II-7 Properties & uses of typical plain carbon steel
For the application of shaft 1 a selecting is C-30 (SAE 1030)
Soft material
Se = 527 MpaSyt = 296 Mpa
Sys =183 Mpa G = 79 Gpa

Step 2):- Permissible shear stress (Z max
According to ASME Code
The permissible shear stress Z max for shaft without keyways is taken as 30% of yield strength in tension or 18% of the ultimate tensile strength of the material whichever is minimum.
Zind = 0.3; Syt = 0.3 * 296 = 88.8 N/mm2
Zind = 0.18; Sut = 0.18 * 527 = 94.86 N/mm2
Take (Zind = 88.8 N/mm2)
But the cutter & sprocket are keyed on the shaft therefore according to the ASME code Zind value reduced by 25%
Zmax = 0.75 N/mm2; Zind = 0.75 * 88.8
Zmax = 66.6 N/mm2

Step3):- Torque Transmitted (T)
P= 2π N Tmean / 60
7373= 2π * 65 * Tmean / 60
T = 54.78 N-m
As the sprocket and cutter are mounted on same shaft
Ts = Tc = 54.78 N-m
Ts = Fs * Rs → 54.78 = Fs * 0.065 / 2
Fs = 1685.53 N
Tc = Fc * Rc → 54.78 = Fc * 0.15 / 2
Fc = 730.4 N
Step 4):- Bending Moment (M)
Calculate the resultant bending moment from dig.
Vertical Loading Diagram (VLD)
Vertical Load acts due to only cutter.
Ra + Rb = 730.4 N
Ra = Rb = 730.4/2 (Due to Symmetric Loading)
Ra = Rc = 365.2 N
Vertical Bending Moment Diagram (VBMD)
VBMD = Ra x Ld = 365.2 x 0.16
VBMD = 58.423 Nm
Horizontal Loading Diagram (HLD)
The horizontal load acts due to only sprocket
Fs = 1685.53 N
Ra + Rb = 1685.53 N _________________________1)
Taking moment about point A)
O = 1685.53 * 0.08 – Rb * 0.32
Rb = 1685.53 * 0.08 / 0.32
Rb = 421.38 N
Ra = 1685.53-421.38 _____________from equation 1)
Horizontal Bending Moment Diagram (HBMD)
HBMC = Ra * Lc = 1264.14 * 0.08
HBMC = 101.13 N-m

Step 5):-Resulting Bending Moment (M)
Select max. Value of BM from the VBMD & HBMD.
Note **-** Select always the Like BM
We get from diagram
$M = \sqrt{(58.4.32^2 + 101.13^2)}$
M = 116.79 N-m

Step 6):- Diameter of Shaft (d)

As per ASME Code
Kb = 1.5; Kt = 1 (For gradual Load application)
Te = M + T
Te = √ (M2 + T2)
Π/16 * Zmax * d3 = √ (M*Kb) 2 + (T * Kt) 2
Π/16 * 66.6 * d3 = √ [(116.79000 * 1.5)2 + (1* 54.78000)2]
D = 24.12 mm
D = 25 mm
So the diameter of shaft is 25mm.

VI LOAD CALCULATION

On Universal Testing Machine the coconut will be De-shelled with load of 180 kgf.
For refer the above calculation and shows the result on Universal Testing Machine.
The required amount of force to De-shelled the coconut is 1765.1973 N.
F = 1765.1973 N
F = 1.765 KN

VII ADVANTAGES

- This machine provides easy and safe mechanism for removing the shell of coconut.
- As two cutter tools are using which enhance the production rate in same consumption of power
- So that efficiency is doubled
- Due to providing safety device, chances of accidents gets eliminated
- It decreases time consumption for the operation of de-shelling.
- It possiblesto maintains the hygiene of copra while handling it.
- Commercials to the small scale industries**.**

VIII. CONCLUSIONS

A power operated coconut deshelling machine was designed and developed. Coconut deshelling machine which deshelled coconuts without nut breakage and machine is easy to operate and perform with an average deshelling efficiency and capacity of 90% and 195 nuts per hour. Introduction of this machine eliminates the problem of extracted shell length distortion associated with the use of some risks involved in the use of cut and hold the coconut

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