Design of Coconut De-Husker, Cutter and Grater Machine

Anmol Bhatia[1*], Abheek Arora [2], Nischay Arora[2] and Vaibhav Manchanda[2]

[1]Assistant Professor, Mechanical Engineering Department, The NorthCap University, Gurugram

*Corresponding Author E-mail: *anmolbhatia@ncuindia.edu*

[2]U.G. Scholars, Mechanical Engineering Department, The NorthCap University, Gurugram

Abstract: The paper aims to present the design of a multipurpose machine that can do three operations namely dehusking, cutting and grating the coconut. In order to dehusk the coconut, the procedure is to have the coconut fixed between the toothed shaft containing spikes and incorporate the opposite movement to it. After the removal of the husk, coconut is removed out which is then sent for the cutting process, which has the provision of punch also, if the coconut water is desirable. The final process is the grating of the coconut with the help grating tool which has notches on its periphery. The model would be beneficial for the industries where the raw material is coconut.

Keywords: Cutting, Grating, De-husking, Spiked pins, Punching

I. INTRODUCTION

A special Indian fruit which is called coconut consists of a hard shell covering the soft portion. It is packed with a fibrous layer called husk. For the purpose of its usage, a coconut must be dehusked, which is a very tedious process as the process involves the person to get injured while dehusking it. In addition to that in a manual work of dehusking, the labour fatigue is a common problem. There are some commercially available machines in the market that are very costly and out of the reach of the small restaurant owners who require coconut as a raw material. Thus, there is a need to develop a multipurpose machine that can do the tasks like dehusking, cutting and grating simultaneously.

The coconut fruit is cultivated in the areas of Karnataka, Kerela, Tamil Nadu, Goa, Orrissa, West Bengal, Maharashtra, Pondicherry, Islands of Andaman-Nikobar and Lakshwadeep, this is also illustrated in figure-1. The major producer of the coconut is Konkan wherein 20,000-hectare production of nuts is there and table-1 indicates the data related to the district wise production and productivity. The major contributing regions like ratnagiri, Raigad, Sindhudurg and Thane is being shown.According to the data, the major land contributing the coconut production is in sindhudurg. The coconut available for selling in the market is either in the form of dehusked type or of partially husked type. The raw materials which requires transportation are partially husked which allows the minimum chance of breakage, otherwise on demand it can be fully de-husked. If we look at the traditional procedure of dehusking, the process is very dangeorous as it is done with a help of a sharp tool like a sicke to dehusk the same, also it requires a lot of human efforts.The method is not safe and may lead to an injury, many a times. Therby to overcome this limitation, a platform which containns spiked toothed cylinder is developed that moves in the opposite direction that can be able to dehusk the cocnut. If we compare the position of the person who is dehusking manually, then the person needs to be bent continously to dehusk the same, which is not an ergonomic process as far as the mass production is concerned. This developed model also overcomes this limitation as the ergonomic needs are also followed.

Fig 1: Traditional areas of coconut cultivation in India

The machine suits best for the mass production and increases the production rate because it overcomes all the difficulties which are being faced by manual dehusking process. In addition to that there is a provision of getting the coconut water by a special attachment of punch. The model is an improved version of the previously reported models. The model is also economically viable and suits the pocket of the small-scale farmers.

Table 1: Coconut production Konkan region

S. No	Districts	Area(ha)	Production(lakh)	Productivity(nuts/ha)
1	Ratnagiri	4882	443.91	9093
2	Raigad	2257	136.51	6049
3	Sindhudurg	10115	531.39	5254
4	Thane	2083.	202.09	9702
Total	=	19337	782.51	7524

II. LITERATURE REVIEW

Kedar deokar et al [1] presented a model that concentrates on compact machine concept i.e. performing three tasks with one machine Main aim is to reduce human effort and save time. Suraj SJ Vaish et al [2] presented a model also presented a compact machine which is able to perform three tasks with one machine Main aim is to reduce human effort and save time. PA wadile et al [3] presented the concept that shows the procedure and working of a foot operated coconut dehusking tools and some semi automated dehusking tools like virtual coconut dehusking machine. The paper

also showed how the automated tools are more economically viable and time saving options with low damage count. Krishnan R. et al [4] presented a simple mechanism to de-husk the coconut to reduce the production cost and make it affordable for small scale farmers. The author also presented an improved productivity enhancement study that involved very less human interaction.

III. METHODOLOGY

A. Design selection: On the basis of different research papers and the technical research done in the market is evaluated by a team member and comes to the conclusion after brainstorming session. Various designs were accepted from team members and came to a common conclusion after the brain storming.

B. Calculation and design validation: Designing phase is a very important phase as strength, fatigue, factor of safety, all technical points were kept in mind while doing calculations and design were validated on solidworks software.

C. Prototyping and analysis: After completing the calculations, prototype can be made for observing the actual conditions and that gives a view of the actual design and its strength that gives a chance to do testing of any kind possible.

IV. DESIGN OF THE MACHINE

The main factor to be considered while designing the machine is the available size of the coconut. The study illustrates that he coconut fruit is available in various sizes. The most widely used size of the coconut is with the dimensions: X=190mm, Y=100mm and Z=100mm.

A. DESIGN OF DEHUSKER

The coconut meets the cylinder in the dehusker machine. As per the available literature, coconut encounters the cylinder at an angle range of 20-30 degrees and $1/5^{th}$ the width of coconut is to be inserted into the space between the cylinder. The frame has the dimension of 762 x 762 x 915. The dehusking cylinder has the width of 30 mm and two rollers are also provided on the frame with an approximate length of 620 mm and diameter of 38 mm which are supported by ball bearings.

B. DESIGN CALCULATIONS

To design the specifications, one has to calculate the required torque to dehusk the coconut. Torque can be calculated by the product of force generated and the perpendicular distance between the peripheries of the rollers.

Perpendicular distance between periphery of rollers = 50mm

Force generated by roller = 1880 N

Factor of safety =1.25

So, the Torque = 94x1.25 = 117.5Nm.

Power of the motor (P) = 0.5 HP

Speed of the motor (N) = 1440 rpm

Torque generated by motor = 60P/2πN =118.4 Nm

C. COMPONENT DESIGN

Table 2 shows the specifications of the components used in the machine.

Table 2: List of the components with specifications

Part	**Dimension**	**Description**
Frame	762mm*762mm*914.4mm	Material : Cast Iron Angle
Motor	--	0.5 HP RPM : 1440
Roller Roller Shaft	Diameter : 3.5 inch Length : 30 inch Diameter : 1.5 inch	Distance between 2 rollers: 2 inch Speed of rotation : roller1 = 30 rpm Roller2 = 60 rpm
Spikes	Base diameter : 1.5 inch Height : 1.5 inch Distance between 2 consecutive spikes : 1.18 inch	Spikes on each circle : 4 No. of circles : 5 Total spikes on each roller : 20
Gearbox	Reduction ratio : 1:50	Sprocket and chain
Cutting blade	13 inch	Stainless steel
Grating tool	Diameter : 2.5 inch	Stainless steel

V. FINAL ASSEMBLY OF THE MACHINE

The final design is presented in figure 2, which shows the dehusker, grater and cutter installed in a single system. The system consisted of a pulley in which the mechanism for the movement of the cylinder with sprockets are presented. The coconut will be inserted in between the grooves of the sprockets to dehusk the same, after that it will move to the cutter whwerein the process of cutting the coconut in two halves would be possible, secondly if the coconut water is required then the machine consists of a punch to get the water out of it. Then the coconut is transferred to the grater for the grating which can be further used for the preparation in the food items.

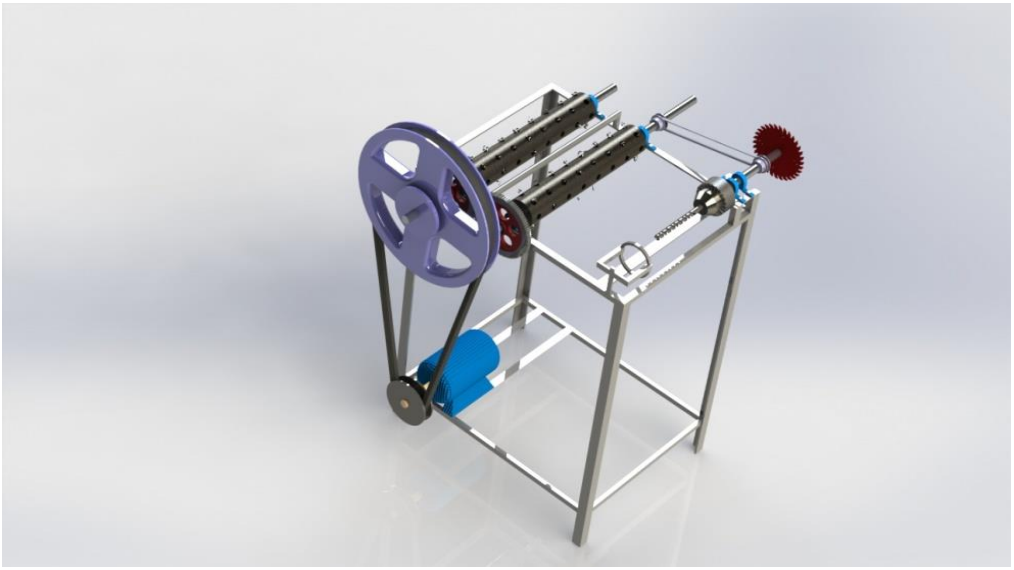

Fig 2: Assembly of the machine

VI. CONCLUSION

- The design of multipurpose machine capable of performing three tasks namely de-husking, cutting and grating machine is presented in the current study.
- The machine finds its applications in various areas such as temples or by retailers in market.
- The advantage of this machine is that it is eco- friendly and does not harm nature in any sense which can also be helpful to save the human effort.

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical statement: The authors declare that they have followed ethical responsibilities

REFERENCES

[1] Kedar Deokar, Kevin Malaviya, Karan Mistry, Prathamesh Chaudhari, Madhumita Dutta(2015). Development of coconut fibre extraction machine. Vol. 5, pp. 2321-9939.

[2] Sooraj SJ, Vaisakh VS, Sibin Raj PS, Jyothish JS, JInto Cheriyan, Vishnu V Chandran (2016), Development of a new Coconut Dehusking and Cutting Machine, International Journal of Scientific & Engineering Research. Vol. 7, pp. 2229-5518.

[3] P.A.Wadile, K.P.Kolhe (2017). Design and Development of Coconut Dehusking Machine: A Review. International Journal of Advance Engineering and Research Development Vol. 4(5), pp. 2348-6406.

[4] Krishnan R. ,Mahingam P.P., Samuel Ratna Kumar, and Babu T., Design and fabrication of an economical coconut Dehusking machine. International Juornal of Engineering and Technology. Vol. 7, pp. 588-591.

[5] Anmol Bhatia, Subrat Sharma, Tapish Sharma, Vishal Kapoor and Yash Singh. Design of Solar Powered E-Rickshaw. International Journal of Advanced Engineering research and Applications. Vol. 3.pp. 8-15.

