Design and Fabrication of Groundnut Pods and Shell Stripper

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Abstract:*World is mostly concentrating on new inventions and running with updated technology. Farmers are back bone for every country in the world. Without farmer's livelihood is difficult. Groundnuts is grown on a small scale by farmer. The major problem in groundnut production in country like India is the lack of groundnut processing machines available to farmers. In the beginning the peanuts were separated from its shells by the workers. The output from this method was very less and could not satisfy the market demand as it was very time-consuming process. This project is mainly about to remove the barriers while removing the groundnuts. In this rotational mechanism is used. With the help this instrument the time gap reduces from removing of groundnut from plant and also the labor required reduces. This project makes the farmer to work easy and can save more time and investment. It is more efficient and can be available to all at minimum cost. With this mechanism the final outcome is nut from the shell.*

Keywords: *Groundnuts, time consumption, rotational mechanism*

I. INTRODUCTION

Agriculture is the back bone of the Indian economy. Many of the farmers work day and night for growing the crops [1]. According to the seasonal conditions farmers plant variety types of crops, in that groundnuts is one of them. Arachishypogaea.L. is the scientific name of groundnuts. It comes under the family of fabaceae. The favorable condition for growing this crop is dry climate. Around 7600 years onwards this crop is being cultivated. Earlier it was found in Peru because of its climatic conditions. This plant grows to a height of 30cm to 50cm [2]. The main parts of the groundnut are shell, cotyledon, seed coat, radicle and plumule.

Groundnuts has many pros such as food purpose (peanut oil, peanut butter, peanut flour, Boiled nuts etc.,) [3]. Malnutrition is reduced with the help of groundnuts because it has more energy and proteins. Groundnuts are useful for obtaining the oils. While extracting oil from the groundnut the waste produced is feed to the animals. It is used in many industrial applications such as paints, lubrication oil, vanish, leather dressing and furniture polish. It is also used for cooking oil purpose [4].

Even though there are so many advantages, groundnut shelling is a major problem in India [5]. In this project, we designed and developed a small machine to peel out the shell of groundnut so that farmers can reduce their labour cost and processing time and high profit by selling the groundnut.

The main motto of the design is to remove the pods from the roots of the plants and peel out the nuts from the shell. This equipment is eco-friendly and also have less maintenance cost. The cycle rim we used is to separate the pods from the plant and rotor to remove the shell of the ground nut [6]. For the preparation rotor we used arc welding and mild steel material. Plywood in this project is used as a base and also supports. Rotor is rotated with the help of the electric motor [7].

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II. LITERATURE REVIEW

Santosh Mangave and Bhagyesh Deshmukh [8] designed the portable groundnut sheller machine. They also fabricated it. The fabricated machine is manually operated. Sheller machine is used to shell only dry pods and it can be used as a groundnut Sheller machine for domestic application.

Ashok. S. Andhale et.al [9] designed and developed a groundnut separator machine which runs with a robotic arm. The main purpose of the robotic arm is to pluck the ground nut from the plant and put into the rotor which has blades. With this the human effort is reduced and also efficiency is increased as it is fully automatic.

Kulbhushan M. Shejole et.al [10] designed and fabricated the pedal operated groundnut crusher. It is a manual process where the groundnuts are removed from shell. The pedal is used for the movement of the crusher. There will be no energy consumption and the cost of production is less. It has less maintenance cost.

Ashish S. Raghtateet.al[11] designed and fabricated a groundnut sheller machine. It is very cheap and five experiments were performed with peanuts. Since this machine is made for small businessman or for farmers, therefore the work carried out by this machine is less. The decocting process of groundnut by this machine is more economical and faster than manual process or any other processes. "GROUNDNUT SHELLER MACHINE" will save the tremendous time, energy manpower and save financial input of the project, reducing the cost and time considerably which is the backbone of the present world economy.

Tushar Walke et.al [12] designed and fabricated the groundnut machine which is electrically operated. The working of the machine is power supplied to motor it rotates the roller.Groundnuts are supplied in crushing chamber through hopper and they get crushed between Semicircular net and the roller. Thus, the ground nuts are removed from the shell.

Ikechukwu Celestine Ugwuoke et.al [13] designed an electrically powered groundnut shelling machine. The machine was fabricated using materials that were sourced locally. It can be used for both domestic and industrial purposes. The advantage to be derived from the use of this machine far outweighs its shortcomings. The test result showed that the machine can shell a total of 400kg of groundnut in an hour.

Deshmukh Shubham et.al [14] designed and fabricated the machine that has the capacity of shelling 400kg of groundnut per hour with a shelling and separating efficiencies of 95.25% and 91.67% respectively. The machine was fabricated from locally sourced materials, which makes it cheap and easily affordable and also easy and cheaper to maintain. It is also of light weight and comprises of the hopper, crushing chamber, separation chamber and the blower unit.

Arjun Vishwakarma et .al [15] has designed and fabricated a machine whose production capacity is more & machine gets operated on 1 H.P. electric. The fresher and small farmer or business man can start business by investing less capital. groundnut decorticator consists of feed hopper with a flow rate control device, shelling unit, separating unit and power system.

A. N. Gitau1 et.al [16] has done investigations on two manually operated decorticators and were tested and modifications done on one of the decorticators to optimize its technical performance.The performance tests showed that the requirements of the farmers including low kernel breakages and high shelling efficiencies could be achieved by the modified decorticator.

Pratima G. Mungase et.al [17] designed and fabricated a machine where sprockets of a bicycle are rotated by pedaling action and this rotary motion is used to rotate the shaft of a screw conveyor. The peanut gets crushed in between the flights around the shaft and the casing of the conveyor.

By considering all these designs we designed our own equipment which is of low cost and less maintenance but higher efficiency.

III. METHODS AND MATERIALS

The materials used for the preparation of the equipment are:

- Ply wood (base of the equipment) (100cmx95cmx3cm)
- Cycle rim (20cm radius)
- Sheet metal (2mm thickness)
- Hollow Rotor shaft (OD 4cm and 1mm thickness)
- Hollow drum (D6inches)
- Electric Motor (1) (1/4hp,1400rpm,220-240volts,50hz, single phase)
- Blades (4 in number with length of 30cm)

We have considered these materials because of the availability and also low cost.

The methods used for the fabrication of the equipment are:

- Welding for preparation of the rotor.
- Wood work for finishing.

IV. DESIGN CALCULATION

According to the motor specifications: voltage: 220-260 volts

Current (amp): 2 amps

RPM: 1400

Capacity:1/4 HP

Power:

$$P=VI$$

P = 240 X2

= 480 Watt

We know that P = 2□NT/60

T = P X60 /2□N

T_{SHAFT} = 480X60/2□(1400)

= 3.27 N-m

Energy consumption:

$E_{IN\ KWH}$ = P X TIME

= 480 X 24

= 11520 W-hour/ day

= 11.52 kw- hour/day

For month,

= 11.52x 30 kw-hour/month

= 345.6 kw-hour/month

1-unit cost is 8.5 rupees

= 345.6 x 8.5 = 2937.6 /- per month.

Shaft calculations: We have diameter of hollow shaft as follows

Outer diameter= 40mm

Inner diameter = 38mm

The shaft experienced with two moments bending moment as well as twisting moment.

T/J= τ/R

We know that T = 3.27 N-m= 3270 N-mm

J = □/32 $((D_0)^4-(D_I)^4)$

= □/32 $((40)^4- (38)^4)$ = 46619.7 mm^4

=3270/46619.7 = τ/20

τ_{shaft} = 3270x20/46619.7 = 1.4 N/mm^2

Bending stress = M/I = σ/Y

Bending stress due to self-weight = 5kg

Weight = 5x9.81 = 49.1 N

Stress(σ) = P/A

= 49.1/ (□/4) $((40)^2-(38)^2)$

= 0.4 N/mm^2

For circular shaft: I= □/64 $((D_0)^4-(D_I)^4)$

= □/64 $((40)^4-(38)^4)$ = 23309.83 mm^4

Bending moment (M) = (σ X I)/Y

= (0.4X 23309.83)/20 = 466.197 N-mm

Shaft subjected to combined torsion and bending:

τ_{max} = (16 x d_0 / □ $((d_0)^4- (d_i)^4)$) $\sqrt{(M)2 + (T)2}$

= (16X40X3303.1)/ □ $((40)^4-(38)^4)$ = 1.41N/mm^2

σ_{max} = (16 x d_0 / □ $((d_0)^4- (d_i)^4)$) (M+ $\sqrt{(M)2 + (T)2}$)

= 16X40 X (3769.3)/ □ $((40)^4-(38)^4)$ = 1.62 N/mm^2

V. DESIGN OF THE EQUIPMENT

Design of rim:

We considered the cycle rim of diameter of 20mm and we kept shield around it so that the groundnut pods which move in random direction does not go out. The complete design can be viewed in fig.1.

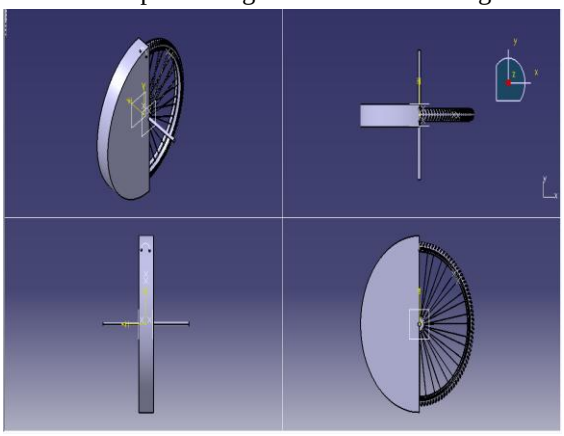


Fig-1: Design of cycle rim

Design of rotor and shaft:

We designed a rotor with the help of hollow shaft of diameter 4 cm and length of 48 cm. We also kept flat mild steel plate on four sides of the hollow shaft. The flat plat which we considered is of length 30 cm and thickness of 5mm. Curved plates are welded on the flat plates with the help of arc welding. This rotor helps to break the ground nut pods. Due to shear force between rotor and ground nut pods the shell of the pods breaks. The figure 2 shows the design of shaft and figure 3 shows the rotor complete design.

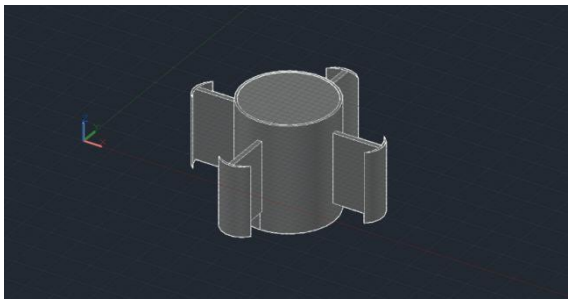


Fig 2: Design of the shaft

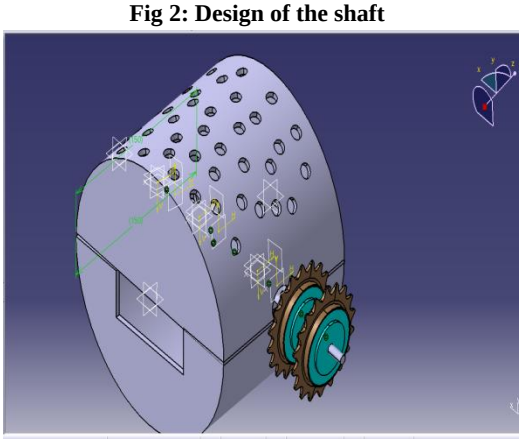


Fig 3: Design of the rotor

Design of complete equipment:

The complete equipment is shown in the figure 4. We assembled the rotor and cycle rim and a slope which can been seen in the figure. The slope is of at an inclination of 45 degrees.

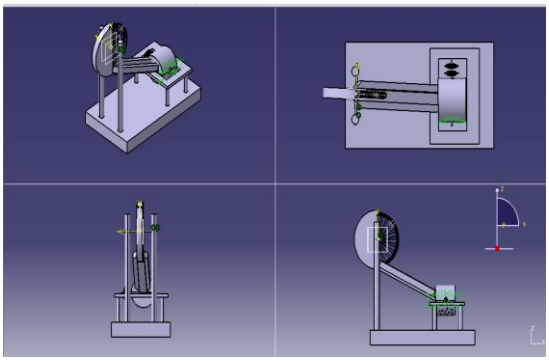


Fig-4Assembly of complete equipment

VI. RESULTS AND DISCUSSIONS

The sample is brought from market. It is sun dried for one day to remove moisture contend. Sample contains unshelled groundnut and some soil adhered to shell. In testing table following parameters are mention like, wt. of sample, wt. of shelled nuts and time required to shelled groundnut. The testing of the system was done and the following results were observed:

1: Testing Table

Sr. No	Total Wt. Of Groundnut In gms. (Qt)	Wt. Of Shelled Groundnut In gms. (Qs)	Wt. Of Undamaged Groundnut Seed In gms. (Qu)	Wt. Of Damage Groundnut Seed In gms. (Qd)	Time To Shelling Operation In Sec.
1	250	220	132	88	190
2	250	230	149.5	80.5	220
3	250	239	164.91	74.09	232
4	250	225	157.5	67.5	197
TOTAL	1000	914	603.91	310.09	839
MEAN	250	228.5	150.97	77.52	209.75

(1) Shelling efficiency (%) = [Qs / Qt] x 100 = (228.5/250) x100 = 91.2 %

(2) Material efficiency (%) = [Qu / (Qu +Qd)] x 100 = 66.1 %

(3) Mechanical damage (%) = [Qd / (Qu +Qd)] x 100 = 33.9 %

(4)Throughput capacity(kg/h)=[Qs/Tm] = 228.5/209.75=1.089 kg/hrs

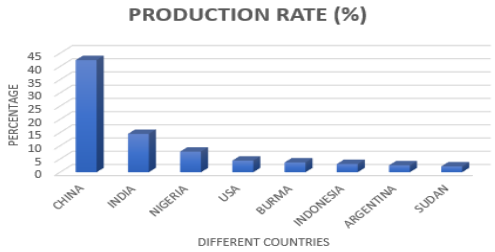


Fig-5: Production rate different countries

The above fig.5 shows that the production rate of groundnuts is more in chain compared to the remaining countries in the world. India ranks 2nd in the world.

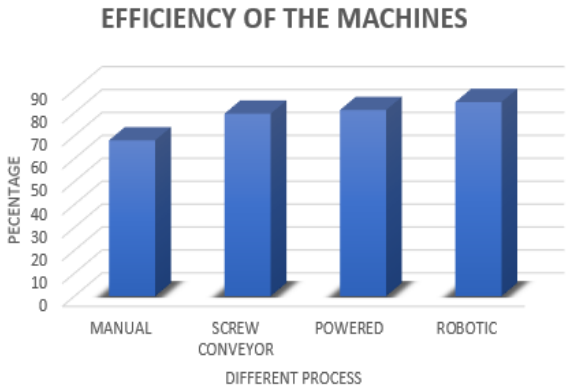


Fig.6: Efficiency of different machines

The above fig: 6 shows the efficiency of the different processes where the manual process shows the lowest efficiency compared to all and robotic shows the highest efficiency. Powered has the efficiency of 82% nearly.

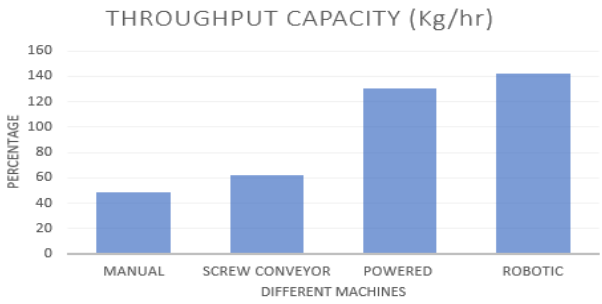
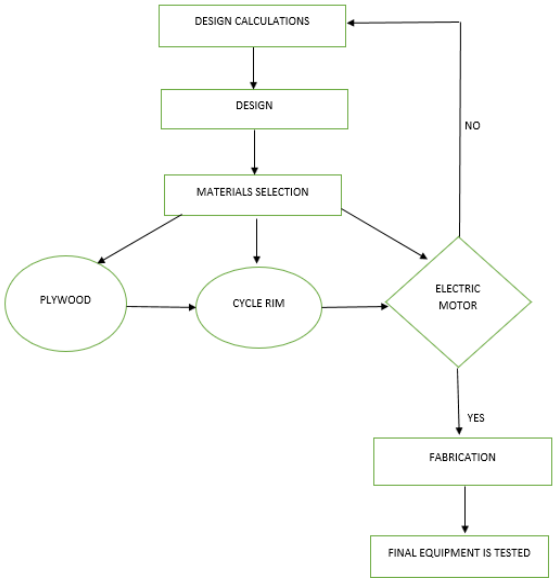


Fig.7 Throughput capacity of different machines

The above fig.7 shows the throughput capacity different machines in that the robotic has high throughput compared to remaining machines. Powered machine has a throughput of 130 kg/hr.

The below flowcharts show the process of making the equipment. The main part in the equipment is electric motor, if the motor is not suitable again check the design calculation and take suitable electric motor. If the electric motor is suitable then proceed for the fabrication.



The fig.8 is the final equipment which fabricated after considering the design and design calculations. The 1/4HP electric motor rotates the rotor shaft.

Fig-8: Final equipment

VII. CONCLUSIONS

1. This work presents the design of an electrically powered groundnut pods stripper and shelling machine.
2. It can be used for both domestic and industrial purposes.
3. The advantage to be derived from the use of this machine far outweighs its shortcomings.
4. It was also observed that groundnut with one seed per pod and those with two small seeds in their pods were the ones that came out unshelled or partially shelled.

VIII. ACKNOWLEDGEMENTS:

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