

Design & Fabrication of Groundnut Sheller Machine

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Abstract - Groundnut is grown on small scale by farmers in developing countries like India. Lack of groundnut processing machines at affordable cost, especially groundnut Sheller, is a major problem of groundnut production. Numbers of groundnut Sheller machines are available in the market but they are large in size, costly and not suitable for domestic applications, they are best suitable for industrial applications where mass production is required. Hence it is essential to design and fabricate a portable groundnut sheller machine for domestic application. This paper describes about the design of various components of groundnut Sheller machine. Hence in this design of various parts are necessary, and design of various parts due to which the design quality of those parts will be improved. Overall, this project involves processes like design, fabrication and assembling of different components etc.

Key Words: Groundnut, peanut, shell, crushing, hopper.

1.INTRODUCTION

Groundnut (*Arachis hypogaea*) is a species in the legume or beans family ([1], [2], [3]). It was first cultivated in Peru [9]. Its seed contains about 63% carbohydrate, 19% protein and 6.5% oil [1]. Groundnut is the sixth most important oilseed crop in the world. As the groundnut seed is contained in pod, which is usually developed underground, the pod is harvested by pulling or lifting the plant manually or by using the machine. The pods are stripped from the plant, dried, stored and processed. Shelling is a fundamental step in groundnut processing [1]. Shelling can generally be done by hand or machines.

As well as the study of manufacturing was very important in order to carry out this project to ensure that what are needs to do. This project involves the process of designing the different parts of this shelling machine considering forces and ergonomic factor for people to use. This project is mainly about generating a new concept of groundnut shell (crush) that would make easier to bring anywhere and easier to crush groundnut. After the design has completed, it was transformed to its real product where the design is used for guideline.

1.1 METHODS OF SHELLING

There are two methods of groundnut shelling.

1.1.1 Manual method

In Manual Shelling method groundnuts are shelled by hand simply. They are wrapped into the cloth and then rubbed onto the surface to decoct it. The cost for shelling is 5 to 6 Rupees per kg for one person and also this is very time consuming process.



Fig -1: Manual Shelling Method

1.1.2 Mechanized Shelling Method

In mechanization now we use large machinery for groundnut shelling. These machines are used in the industries where large production is required. They are having shelling capacity of 400 to 3300 kg/hr. But these machines are costly in order to purchase by the farmers.



Fig -2: Mechanized Shelling Method

2. OBJECTIVE

- The main and basic objective is to make low cost groundnut shelling machine.
- Another thing is that to shell maximum possible groundnut in shortest possible time.
- The machine should not damage the peanuts in according to earn profit.
- The cost of a machine should be affordable to the farmers.
- Space occupied by the machine should not be so large. It should be kept within the land.
- The machine should not have excessive weight. It should be such that it can be easily portable.

3. DESIGN AND CALCUTATION

A. Design of V-Belt

$$N_1=1440 \text{ rpm} \quad N_2=240 \text{ rpm} \quad P_d=0.5 \quad \text{HP}=372.85$$

$$W=0.307285 \text{ Kw} \quad D_{\text{roller}}=14 \text{ inch}=355.6 \text{ mm}$$

$$W=30 \text{ kg}=30*9.81 =294.3 \text{ N}$$

Designation of Belt

At $P_d=0.37285 \text{ Kw} =372.585 \text{ w}$ [P.no. 160 Table XV-8]
 Designation of belt is "A"

- 1) Width (w) =13mm
 - 2) Thickness (t) =8mm
 - 3) Pulley Dia. =75mm (D_1)
- Tension factor (k_c) =2.52

Calculate power per belt [P.no. 161 table no.XV-9 from B.D.Shivalkar]

$$\text{Power/belt} = (F_w - F_c) * (e^{\mu\theta/\sin(\alpha/2)} - 1) / e^{\mu\theta/\sin(\alpha/2)} * V_p$$

Where

$$V_p = \pi * D_1 * N_1 / 60 * 1000 = 5.65 \text{ m/sec}$$

$$\mu = \text{coefficient of friction} = 0.5$$

$$\alpha = \text{cone angle} = 36 \text{ degree}$$

$$\alpha/2 = 36/2 = 18$$

$$\theta_{\text{mean}} = \pi * (D_2 - D_1 / C) = \pi * [(450 - 75) / 525] = 2.43 \text{ rad}$$

$$V_p = \pi * D_2 * N_2 / 60 * 1000$$

$$5.65 = \pi * 240 * D_2 / 60 * 1000$$

$$D_2 = 450 \text{ mm}$$

Centre distance

$$C = D_1 + D_2 = 75 + 450 = 525 \text{ mm}$$

$$e^{\mu\theta/\sin(\alpha/2)} = e^{0.3 * 2.43 / \sin(18)} = 10.5$$

Now,

$$F_w = w^2 = 13^2 = 169$$

$$F_c = \text{Centrifugal tension (N)}$$

$$= k_c * (V_p / 5)^2 = 2.52 * (5.65 / 5)^2 = 3.2177 \text{ N}$$

$$\text{Power/belt} = (169 - 3.2177) * (10.581 - 1 / 10.581) * 5.65$$

$$\text{Power/belt} = 848.146 \text{ W/belt}$$

To find number of belt (n)

$$n = P_d / \text{power/belt} = 372.85 / 848.146 = 0.43 \approx 1$$

Therefore n=1

To find cross section of belt

For designation A

$$b = 3.3 \text{ mm} \quad h = 8.7 \text{ mm} \quad e = 15 \text{ mm} \quad f = 9 - 12 = 10$$

To calculate length of belt

$$l = \pi/2 * (D_1 + D_2) + 2C + ((D_1 - D_2)^2 / 4C)$$

$$l = \pi/2 * (75 + 450) + 2 * 525 + ((75 - 450)^2 / 4 * 525)$$

$$l = 1941063 \text{ mm}$$

Width of pulley

$$= (n - 1) * e + 2f$$

$$= (8.7 - 1) * 15 + 2(10)$$

$$W = 135.5 \text{ mm}$$

B. Design for pulley

$$D_s = 19 \text{ mm}$$

Calculate hub properties

$$\text{a) Diameter } (D_h) = 1.5d_s + 25 \text{ mm}$$

$$= 1.5 * 19 + 25$$

$$(D_h) = 53.5 \text{ mm}$$

$$\text{(b) Length } (l_h) = 1.5d_s$$

$$= 1.5 * 19$$

$$l_h = 28.5 \text{ mm}$$

$$\text{PULLEY} = 2$$

Type of construction

$$\text{At } d_2 = 450$$

$N_2=240$
 $W=135.5\text{mm}$
 So, arm construction
 $N=4$ no. of arm
 No. of sets=1

Moment of each arm

$$M = (T_1 - T_2) * (D_2 - DH) / H$$

Now tension in belt
 Belt tension (T_1 & T_2)

$$(T_1 - T_2) = P_d / R_p = 327.85 / 58.65$$

$$T_1 - T_2 = 6.29 \text{ (A)}$$

But, Belt tension ratio

$$T_1 / T_2 = e^{\mu \theta} = e^{0.35 * 2.43}$$

$$T_1 = 2.34 T_2 \text{ (B)}$$

Put in equation at (A)

$$2.34 T_2 - T_2 = 6.29$$

$$T_2 = 49.24 \text{ N}$$

$$\text{Then, } T_1 = 6.29 + T_2 = 6.29 + 49.24$$

$$T_1 = 115.23 \text{ N}$$

$$M = \frac{(115.23 - 49.24) (450 - 53.5)}{4}$$

$$M = 6541.258$$

But, $\sigma = \frac{M}{Z}$ assume $\sigma = 155 \text{ mpa}$

$$Z = \frac{M}{\sigma} = \frac{6541.258}{15} = 436.08$$

$$\text{Now, } Z = \frac{\pi b^3}{8}$$

$$436.08 = \frac{\pi b^3}{8}$$

$$b = 10.36 \text{ mm}$$

Face width,

$$w = 1.1b = 1.1 * 10.36$$

$$w = 11.39 \text{ mm}$$

Rim thickness, t

$$t = 0.375 \sqrt{D} + 3$$

$$t = 0.375 \sqrt{450} + 3$$

$$t = 10.95 \text{ mm}$$

4. COMPONENTS AND SPECIFICATIONS

- Frame
- Electric motor
- Roller
- V-Belt
- Pulley
- Hopper
- Fan

4.1 Frame:

The frame is used to support all the components. Material of frame is cast iron



Fig -1: Frame

4.2 ELECTRIC MOTOR:

This motor is used to rotate the roller by using belt and pulley.

Output = 230 volt

Current = 3.5 amps

Power = 0.37kw/0.5 HP



Fig -2: Electric motor

4.3 Roller:

Roller is made up of hollow cylinder of 1ft dia. and 1ft length with the rods welded on its periphery. The material of roller is



Fig -3: Roller

4.4 V-Belt:

V-Belt is used to transmit rotary motion of shaft of motor to the shaft of roller. Material of the belt is



Fig -4: V-Belt

4.5 PULLEY:

Pulley is used to transmit the torque of motor to the roller. One pulley is directly mounted over the motor shaft and another pulley mounted on the shaft of roller. And both the pulleys are connected with the help of V-belt.



Fig -5: Pulley

4.6 Hopper:

Hopper contains groundnuts before and during shelling process. It is use to continuous supply of the groundnut to the crushing unit.

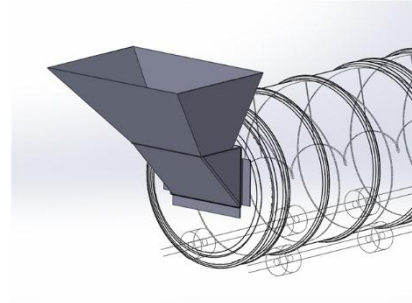


Fig -6: Hopper

4.7 Fan

Fan is mounted on the shaft of the motor just in front of pulley at some distance. This fan separates the shell and the peanuts.

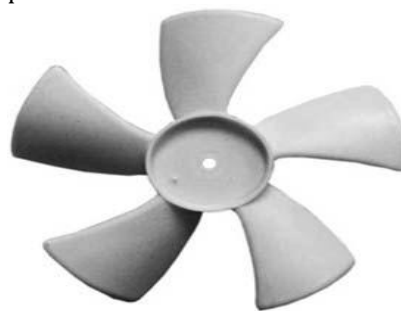


Fig-7- Fan

4.8 Semicircular Net

This semicircular net is fitted beside the roller at very small distance so that shell of groundnut should be easily cracked and peanuts remain uncracked.

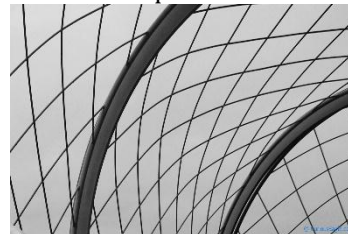


Fig-8- Semicircular Net

5. WORKING

The machine is operated with help of the Electric Motor which is connected to the external power supply. As 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.

Now we can collect both the cover of the groundnut and peanuts. These are passed in front of the fan so that shells are blown away due to light weight and peanuts falls down directly.

7. CONCLUSION

The cost of the machine is less and if the farmer buys this machine, farmer can recover the invested money back. By using this machine problem of the labor crises can be reduced. Comparing with manual harvesting only 1 labor is required. It makes the process faster hence reduces most of the shelling time and labor cost. This machine is helpful for both small and big farms.

6. ADVANTAGES

- Shelling time will be less
- Efficient work is done by using machine
- Limited number of labours are required
- Cost of shelling is comparably less as manual shelling

REFERENCES

- [1] 1. Santosh Mangave and Bhagyesh Deshmukh, "Design of Portable Groundnut Sheller Machine". Department of mechanical engineering, WIT, Solapur. International Journal of Mechanical Engineering and Information Technology// Vol.03 Issue 04// April//Page No: 1125-1129//ISSN-2348-196x.
- [2] 2. Ashish S. Raghtate and Dr. C. C. Handa, "Design Consideration of Groundnut Sheller machine". Department Of Mechanical Engineering, KDK College of Engineering, Nagpur. International Journal of Innovative Research in Science And Technology// Vol.01 Issue 1//September 2014//ISSN (online) 2349-6010.
- [3] 3. A. Atiku, N. Aviara and M. Haque, "Performance Evaluation Of Bambara Groundnut Sheller". Department of Agricultural Engineering, University of Maiduguri, Maiduguri, Nigeria". The CIGR Journal of Scientific Research and Development. Manuscript PM 04 002. Vol. 06. July, 2004.
- [4] 4. Ikechukwu Celestine Ugwuoke, Olawale James Okegbile and Ibukun Blessing Ikechukwu, "Design and Fabrication of Groundnut Shelling and Separating Machine". International Journal of Enigeneering Science Invention//ISSN (online):2319-6734//ISSN (Print):2319-6726//www.ijesi.org//Vol. 03//Issue 04// April 2014//PP.60-66.
- [5] 5. Designe data book by B.D.SHIVLKAR

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