DESIGN AND FABRICATION OF A GROUNDNUT SHELLING AND OIL EXTRACTING MACHINE

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Abstract- Groundnut is the sixth most important oil seed crop in the world and is grown on small scale by farmers in developing countries like India. Lack of groundnut processing machines at affordable cost, especially groundnut Sheller and roller is a major problem of groundnut production and oil extracting. Number of groundnut Sheller and oil extracting machine are available in market , but they are not combined together. We are designing a machine in such a way that shelling and oil extracting should be done in single machine.

Keywords – Design and fabrication, groundnut shelling, oil extracting machine, locally sourced materials.

1. INTRODUCTION

Groundnut is the sixth most important oilseed crop in the world. It contains 46- 50% oil and 25 -28% protein, and is a rich source of dietary fiber, minerals and vitamins. It grows best on soils that are well drained, loosely textured and well supplied with calcium, potassium and phosphorous. Over 100 countries worldwide grow groundnut. The main purpose of this paper is to understand the knowledge of design and fabrication mechanism of portable groundnut Sheller machine. The design is very simple and eco-friendly which uses simple mechanism properties such as shelling system, automatic separating system and crushing chamber etc.

The study of manufacturing was very important for this project. In this project we are designing the different parts of shelling and oil extracting machine considering all forces and ergonomic factor for people to use, This project is mainly about generating a new concept of groundnut shell (crush) and oil extract that would make easier to transport anywhere and suitable to crush groundnut and extract oil. This machine shell about more than 5kg of groundnut per hour.

Oil extraction is the process of recovering oil from oil bearing agricultural products through manual, mechanical, or chemical extraction. The agricultural products are classified into oil-seeds, nuts and mesocarps or fruits. Bicycle technology is one of the oldest technology in world, it can be used to transmit power but in our machine we are using motor to transmit power.

In this groundnut shelling and oil extracting machine, the first step is to shell the groundnut using crusher and in the next step peanuts enters another machine and in that machine oil from peanut will extracted using roller.

2. METHODS OF SHELLING

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 foe one person and also this is very time consuming process.

Mechanized Shelling Method:- In mechanization 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.

3. MODELING AND SPECIFICATIONS OF REQUIRED COMPONENTS

- Frame
- Electric motor
- Crusher
- V-Belt
- Pulley
- Hopper
- Fan or Blower

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3.1 Frame:
The frame is used to support all the components. Material of frame is cast iron and height 840mm.

![Frame](image)

3.2 Electric motor:
This motor is used to rotate the roller by using belt and pulley.
Input = 230 volt
Current = 3.5 amps
Power = 0.37kw/0.5 HP

3.2.1 Crusher:
Roller is made up of hollow cylinder of 180mm dia. and 250mm length with the rods welded on its periphery. The material of roller is cast iron. The roller is used to crush the groundnut. The roller is attached to the pulley through shaft.

![Roller](image)

3.3 V-Belt:
V-Belt is used to transmit rotary motion of shaft of motor to the shaft of roller. Material of the belt is rubber or polymer for strength and reinforcement. The length of the v-belt is 1320mm

![V-Belt](image)
3.4 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. Pulley Dia. =75mm.

Fig.7 Pulley

3.5 Hopper
Hopper contains groundnuts before and during shelling process. It is use to continuous supply of the groundnut to the crushing unit. The volume of the hopper is 8190.8cm³.

Fig.8 Hopper

3.6 Fan or blower
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.9 Fan
4. ASSEMBLY AND FABRICATION

![Proposed model of Groundnut shelling and Separating machine](image)

Fig 10: Proposed model of Groundnut shelling and Separating machine

5. WORKING AND BLOCK DIAGRAM

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. Continuous pressing by means of expellers (also known as screw press) is a widely applied process for the extraction of oil from oil seeds and nuts. Groundnut Sheller is operated on the shearing action, blowing action and separating action. Firstly the inputs i.e. the groundnut are fed to the machine through the hopper. Then groundnuts come in contact with the two members, one is semicircular net and another is roll shaft. Semicircular net is a stationary member while the roll shaft is rotating member. When the groundnut comes in contact with these two members then the shearing action takes place here. Due to shearing action (crushing) the groundnuts gets shelled and divided into two parts, i.e. in the peanut and outer shell of the groundnut. There clearance is provided between the net and roll shaft. The clearance provided is depends upon the size of the groundnuts which is to be decocted. After shelling the groundnut the peanut and shells of the groundnut gets dropped from the semicircular net, in downward direction then a centrifugal force is applied by a fan on the peanut and shell of the groundnut. Due to more weight, the peanuts gets moved downward and collected in the separator. But due to lighter weight the shell of the groundnuts are thrown outside the machine and which are collected from the backside of the machine. From the shelling chamber the unshelled groundnuts also gets dropped in the tray. This groundnut gets dropped from the clearance made among the grill. The three kinds of the nets can be used with different size of capsule slots, size vies small, medium and large for various size of groundnuts. In this way the “groundnut Sheller” works.
6. DESIGN AND CALCULATIONS

6.1 Hopper Design
The hopper design is based on the rectangular section. The volume of the hopper is given by:

\[ V = \frac{H}{3} \left( X^2 Y - x^2 y \right) \left( X - x \right) \]

Where: 
- \( V \): volume of the hopper 
- \( H \): Height of the hopper 
- \( X \): Length of the upper rectangular base 
- \( Y \): Width of the upper rectangular base 
- \( x \): Length of the lower rectangular base 
- \( y \): Width of the lower rectangular base

Therefore, with given dimensions:
- \( H = 290 \text{ mm} \)
- \( X = 450 \text{ mm} \)
- \( Y = 185 \text{ mm} \)
- \( x = 250 \text{ mm} \)
- \( y = 30 \text{ mm} \)

\[ V = \frac{290}{3} \left( 450^2 \cdot 185 - 250^2 \cdot 30 \right) / (450 - 250) \]
\[ V = 8190800 \text{ mm}^3 \]

6.2 Pulley Design
Main Pulley speed: \( N_1 = 960 \text{ R.P.M} \), \( N_2 = ? \)
\( D_1 = 75 \text{ mm} \), \( D_2 = 50 \text{ mm} \)

\[ \frac{N_2}{N_1} = \frac{D_1}{D_2} \]
\[ N_2 = 640 \text{ R.P.M} \]

Secondary Pulley Torque:
Power = 368 watts
\[ P = 2 \pi \cdot N_1 \cdot T_1 / 60 \cdot 10^3 \]
\[ T_1 = 3.66 \cdot 10^3 \text{ N-mm} \]
\[ T_1 = \pi / 16 \cdot f_s \cdot d_1 \]
\[ 3 \cdot f_s (\text{Ind}) = 0.044 \text{ N/mm}^2 < f_s (\text{perm}) = 34 \text{ N/mm}^2 \]

Therefore, Design is Safe

Main Pulley Torque:
Power = 368 watts
\[ P = 2 \pi \cdot N_2 \cdot T_2 / 60 \cdot 10^3 \]
\[ T_2 = 5.49 \cdot 10^3 \text{ N/mm}^2 \]
\[ T_2 = \pi / 16 \cdot f_s \cdot d_2 \]
\[ 3 \cdot f_s (\text{Ind}) = 0.22 \text{ N/mm}^2 < f_s (\text{perm}) = 34 \text{ N/mm}^2 \]

Therefore, Design is Safe

For Load Calculation:
\[ F_t = 4P/\pi d_2 \]
\[ P = 704 \text{ KN} \]

6.3 Belt Design
Centre distance of pulley = 2 \((D_1 + D_2)\)
\[ C = 112.5 \]
\[ S = V = (\pi \cdot D_1 \cdot N_1) / 60000 = 3.76 \text{ m/s} \]

Arc of contact \( (\alpha) = 1800 - (D_1 - D_2) / C \times 600 = 1630 \text{ 330} = 2.85 \text{ Radian} \)
\[ L = 2 \cdot C + \pi \cdot (D_1 + D_2) / 2 + (D_1 - D_2) / 4 \cdot C \]
\[ L = 422 \text{ mm} \]
6.4. Motor specifications:
Power HP =1/2 , R.P.M. =1450 , Cycle=50, Voltage=230 volt, Phase 1.50 Hz , 2.253 Amp, 4 pole Starting Torque, Pull out Torque Efficiency 61 %, Power Factor 59 %

7. RESULT AND CONCLUSION

Results:

<table>
<thead>
<tr>
<th>Sl No</th>
<th>Wt. of groundnut in kg (Qs)</th>
<th>Wt. of shelled groundnut in kg (Qt)</th>
<th>Time in sec (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>1</td>
<td>0.81</td>
<td>330</td>
</tr>
<tr>
<td>02</td>
<td>1</td>
<td>0.80</td>
<td>300</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>1.61</td>
<td>630</td>
</tr>
<tr>
<td>Mean</td>
<td>1</td>
<td>0.805</td>
<td>315</td>
</tr>
</tbody>
</table>

Shelling Efficiency (%) = \[\frac{Qs}{Qt}\] * 100  
\[\frac{0.805}{1}\] * 100  
80.5 %

Oil extraction will be depend on amount of peanut input.

8. CONCLUSION:

Groundnut pods are hard and cracking methods are still traditional in rural areas. Groundnut shelling output per-man is as low as 1-2.5kg seeds per hour. Hence to increase the production rate, sheller machine is required. Most of the available sheller machines are manual operated, non-portable; hence design fabrication of a portable, power operated sheller machine is essential. Proposed sheller machine is used shell only dry pods and it can be used as groundnut sheller machine for domestic application. In our machine we are doing both shelling and oil extraction in one process.

9. REFERENCES


