ISSN 2393-8471

International Journal of Recent Research in Civil and Mechanical Engineering (IJRRCME)
Vol. 2, Issue 1, pp: (48-53), Month: April 2015 – September 2015, Available at: www.paperpublications.org

Design and Manufacture of Groundnut Sheller

[1]Arjun Vishwakarma, [2]Prof R.H.kekan, [3]Anil K. Gosavi, [4]Sanjay Mandage, [5]Abhijeet Sonawane

[1,4,5] B.E Student, [2]Assistant professor, (Mechanical Engineering) Smt. Kashibai Navale College of Engineering, Savitribai Phule Pune University, Pune-411041, India
[3]Chairman (Climber Engineers) Climber Engineers 50/2/9, Gujarwadi Road, Katraj , Pune 411041, India

***Abstract*: This paper describes about the design and fabrication of various parts of a groundnut decorticator/ sheller. Overall, this machine involves processes like design, fabrication and assembly of different components etc. In India, Agriculture is the backbone. In India, groundnut is grown on a small scale by farmer. The major hurdle in the groundnut production in India is the inavailability or lack of groundnut processing machines available to farmer. In the beginning the peanuts were separated from its shells by the workers manually. The output from this method was very less and could not satisfy the market demand as it was very time taking process. Research-work for design, manufacture, and performance evaluation of a groundnut decorticator/sheller consisting of feeder hopper with a flow rate control device, shelling unit, separating unit and power system. Our main intension was to make such a machine, whose productivity is high & machine gets operated on 1 H.P. electric. The fresher and small farmer or business man can start business by investing less capital.**

***Keywords:* groundnut decorticator/sheller; evaluation; fabrication.**

I. INTRODUCTION

Our work contains the detail design report on an advanced groundnut decorticator. This machine is designed as prototype working model for particular crushing capacity say around hundred kilograms per hour. The tool used is (UHMW) rubber. It gives advantage of minimum grain split.

Another feature of this designed machine is feeder valve, which is not available in conventional machines. The feeder valve controls groundnut feeding rate. Thus facilitate crushing of groundnuts and over loading the tool .it avoids jamming of machine. A centrifugal fan is given below the tool mesh pot. It separate out hunks from the grains. If we make comparison with conventional machine this machine is compact, lightweight, easy to operate, slim, efficient in working, it has low maintenance. It consumes minimum electricity as compared with conventional machine. Overall this is an effort to overcome the limitations of conventional type groundnut decorticator.

II. LITERATURE

A. About Groundnuts:

Groundnuts are grown in tropical and subtropical climate regions and warmer parts of temperature regions. It is a low growing annual plant and has a variety of uses. Prior to its usage however groundnuts need to undergo preprocessing which include drying and shelling. Removing of kernels from the pod is generally referred to as shelling or “decorticating”. This is usually carried out on the farm just before the farmer sells his product fir the following two reasons: kernels do not store as well as nuts in the shell and groundnuts in the shell are fifty per cent heavier than kernels alone and are therefore costlier to transport.

B. *The First shellers:*

The groundnut for seedling was normally shelled by hand or by using a bamboo crusher. The bamboo crushers were the very first groundnut sheller. With these methods of shelling 0.75 kg of groundnut pod could be shelled in one hour. The average percentage of broken kernel was 1:1.

III. CONSTRUCTION AND WORKING OF GROUNDNUT DECORTICATOR

This advanced groundnut decorticator consists of following main components:

* Tool
* Tool mesh pot
* Upper hopper
* Lower hopper
* Fan
* Fan air duct
* Machine outer casing
* Belts
* Bearings
* Shafts
* Motor

A. *Working:*

Groundnuts are fed into the machine through the upper hopper, after which they come into the lower hopper, where the valve is rotating. The valve is a feeder basket which has four basket quadrants. The rotational speed of the valve is exactly half of the speed of the tool. The basket sends out fixed and timed quantity of groundnuts to the tool.

The tool is hexagonal drum, with UHMW (ultra high molecular weight) ABS plastic pads fitted on three, Out of six faces. The tool length is selected so as to ensure that at least seven groundnuts get successfully decorticated in each pass. The tool revolves in a mesh pot. The mesh pot consists of a mesh, having irregular holes cut out at random intervals. The mesh is welded to the pot. It is ensured that average groundnut will not pass un- decorticated through the mesh.

The mesh pot has an adjustable movement along the Y-axis. This is achieved with the help of screw and nut mechanism. The mechanism proves beneficial in cases, where groundnut batches are of varying size.

The decorticating action takes place when the groundnut gets entrapped in between the tool and mesh. The shells and grains thus fall out of the mesh. By supplying a sufficient air current with the help of blower, the shells are blown away. The grains are collected by gravity.

The machine is automated with the help of a 1hp motor which drives the tool shaft, machine shaft, valve shaft and fan shaft.

B. *Design:*

The design part mainly consists of design of shafts such as tool shaft, fan shaft, valve shaft and machine shaft based on loads. Material selected for the shafts is En9.

The design procedure for shafts is as follows:

Available data,

Yield stress for material En9 = 540 N/mm^2

Speed of rotation of intermediate shaft = 240 rpm

International Journal of Recent Research in Civil and Mechanical Engineering (IJRRCME)
Vol. 2, Issue 1, pp: (48-53), Month: April 2015 – September 2015, Available at: www.paperpublications.org

Belt tension for 3" pulley (going to valve),

$T_1 = 84.642$ N, $T_2 = 6.34$ N

Belt tension for 9" pulley (coming from I.S.),

$T_1 = 77.784$ N, $T_2 = 6.858$ N

Calculations of weights of the pulley,

$$W = (\rho \times \pi \times d^2 \times t) / 4 \qquad (1)$$

Where,

ρ = density of the pulley material,

$\pi = 3.14$,

d = diameter of pulley,

t = thickness of the pulley,

Weight of 3 inch pulley,

$W = (7200 \times \pi \times 76.22^2 \times 20 \times 10^{-9} \times 9.81) / 4 = 6.3617$ N

Weight of 9 inch pulley,

$W = (7200 \times \pi \times 228.6^2 \times 20 \times 10^{-9} \times 9.81) / 4 = 58$ N

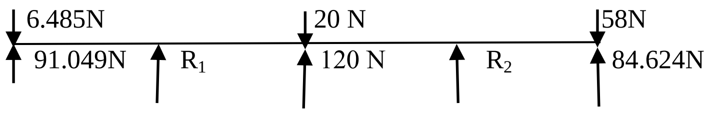

Fig.1 Loading Diagram

Taking moment about R_2:

$- (58 \times 30) + (84.642 \times 30) - (R_1 \times 300) + (6.485 \times 330) - (91.049 \times 330) + (20 \times 150) - (120 \times 150) = 0$

$R_1 = 140.35$N (2)

Applying $\Sigma F = 0$,

$6.485 + 58 + 20 = 91.049 + 140.35 + 120 + 84.642 + R_2,$

$R_2 = -351.55$ N or 351.55 N ↓ (3)

Therefore, Calculation of Maximum bending moment from Fig.1

$M_A = 0$ N-mm

$M_B = 2536.8$ N-mm

$M_C = 36286.5$ N-mm

$M_D = -4874.85$ N-mm

Hence, maximum bending moment will be,

$M = 36286.5$ N-mm (4)

Calculation of maximum twisting torque

Torque = $T = (P \times 60) / (2 \times \pi \times N)$ (5)

Where,

P = power required by the shaft = 100Watt

N = speed of the shaft (rpm)

Therefore,

$T = 3978.87$ N-mm (6)

Calculation of permissible shear stress,

Material selected for the shaft is En9 having yield stress = 540 N/mm^2

Paper Publications

International Journal of Recent Research in Civil and Mechanical Engineering (IJRRCME)
Vol. 2, Issue 1, pp: (48-53), Month: April 2015 – September 2015, Available at: www.paperpublications.org

Considering Factor of safety for shaft = $N_f = 2.0$

Working stress = yield stress / factor of safety = 270 N/mm^2

Shear stress (τ_{max}) is 56% of the working stress, therefore,

$(\tau_{max}) = 0.56 \times 720 = 151.2$ N/mm^2 (7)

Calculation of Equivalent Twisting Torque and Shaft Diameter:

$T_e = \sqrt{(K_t \times T)^2 + (K_b \times M)^2}$ Where, (8)

T_e = equivalent twisting torque, N-mm

T = maximum twisting torque, N-mm

M = maximum bending moment, N-mm

K_b, K_t = combined bending and fatigue factors = 1.1,

$T_e = \sqrt{(1.1 \times 3978.87)^2 + (1.1 \times 362867.5)^2} = 40154.32$ N-mm

Therefore, Diameter of the shaft

$(\tau_{max}) = (16 \times T_e) / (\pi \times d^3)$ (9)

$d^3 = (16 \times Te) / (\pi \times \tau_{max})$

d = 11.06 mm

Here, we round off the shaft diameter to 17 mm, owing to the benefits, as discussed in bearing selection.

Therefore, diameter of intermediate shaft at bearing seats,

d = 17mm

Similarly, all the other shafts used in the machine are designed.

C. Selection of belts:

Motor to machine shaft

Data available,

- Speed ratio = 1:2
- Diameter of pulley on machine shaft D = 6 inch = 152.4 mm
- Rotational speed of pulley on machine shaft N_{large} = 720 rpm
- Diameter of motor pulley = 3 inch =76.2 mm
- Rotational speed of motor shaft, N_{small} = 1440 rpm
- Power to be transmitted P = 740 W

Calculation of Belt Parameters:

- Approximate center distance, C = D + d = 228.6 mm
- Therefore approximate belt length,
- $L_{approx} = 2C + \pi (d + D) / 2 + (D - d)^2 / 4C$
- $= (2 \times 228.6) + \pi (152.4 + 76.2) / 2 + (228.6 - 76.2) / 4C$

= 822.634 mm

- L_{pitch} = 820 mm (standard)
- Exact center distance is given by,
- $C_{exact} = A + \sqrt{(A^2 - B)}$ Where ,
- $A = l / 4 - 0.3925 \times (D - d)$

- $B = (D - d)^2 / 8$
- $A = 820 / 4 - 0.3925 \times (152.4 + 76.2) = 115.27$
- $B = (152.4 - 76.2)^2 / 8 = 725.80$
- $C_{exact} = 115.27 + \sqrt{(115.27)^2 - (725.80)} = 227.34$
- Therefore, C_{exact} = 228 mm

Calculations of Number of belts:

- Power to be transmitted, P = 740 W
- Taking application factor = K_a = 1.1,
- Design Power, $P_d = P \times K_a = 740 \times 1.1 = 814$ W
- KW rating V-belt = 1.57 KW/belt
- Belt length correction factor F_c = 0.9531
- Arc of correction factor F_d = 0.84
- Therefore, new KW rating = 1.57 x 0.9531 x 0.84 = 1.257 KW
- Therefore, No of belts = P_d / KW = 0.80905 / 1.257 = 0.64 = 1 belt
- Belt designation: A820/A31

Similarly, all the other belts are selected.

D. Selection of beaings:

- From shaft design, the maximum diameter of tool shaft comes out to be 10.675 mm. Hero Honda's CD100, which are widely used in rural areas use SKF 6203 bearings. Taking into consideration, this readily availability of SKF 6203 bearing in rural area, we select diameter of shaft as 17mm. In subsequent article, we show that SKF 6203 bearing is safe for all shafts.

Selection of bearing for tool shaft,

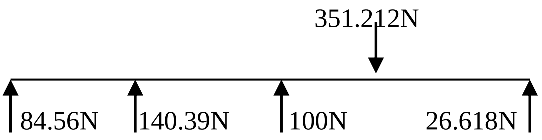

Fig.2Loading diagram

- For bearing: SKF 6203
- C_o = 4750 N
- C = 9950 N
- Recommended bearing life for agricultural applications, is 4000 to 8000 hours (PSG Design Data, page 4.5)
- $L_{10} = (60 \times N \times L_h) / 10^6$ where, (10)
- L_{10} = life in million revolutions,
- N = shaft speed in rpm,
- L_h = life in hours,
- L_{10} = life in million revolutions,
- F_r = maximum load on the shaft,

Therefore,

- L_{10} = (60 x 240 x 8000) / 106 = = 115.2 million revolutions
- P = (X x V x F_r) x load factor (11)
- P = (1 x 1 x 351.2122) x 2 = 702.424 N
- $L_{10} = (C/P)^3$ (12)
- $345.6 = (C/702.44)^3$
- C = 4929.4 N $<$ 9950N
- Therefore, selected bearing SKF 6203 is safe

Similarly, all other bearings are selected for the shafts.

E. Selection of motor:

Calculation of power consumption,

- Power P = (2π x N x Ta) / 60 (13)
- N = speed of tool shaft in rpm
- Ta = torque required at tool shaft
- Total power required by the machine = (100 + 11 + 84.59 + 31.955) watt= 227.54 watt.
- Hence, 1 hp motor selected.

IV. CONCLUSION

This work represents the design of an electrically powered groundnut shelling machine. The machine was fabricated using materials that were easily available. It can be used for both household and industrial purposes. The advantage to be derived from the use of this machine overcomes its shortcomings. This design gives major advantages in the case of power consumption. The required power for above stated capacity is 1 hp while 1.98 as for conventional machine. Our designed machine is light weight compact and slim in construction. It is easy to operate and transport from here to anywhere. The bearing is used to all four shafts. It does not required percent lubrication. But it is suggested to lubricate bearing by oil periodically. The self-lubricated bearing can be used for shafts, but it will increase cost.

REFERENCES

[1] J.N. Maduako, M. Saidu, P. Matthias, I. Vanke, Testing of an engine-powered groundnut shelling machine, Journal of Agricultural Engineering and Technology, 2006, 14.

[2] R.S. Khurmi, J.K. Gupta,A Textbook of Machine Design (S. I. Units), Eurasia Publishing House (PVT.) Ltd., Ram Nagar, New Delhi-110055, 2005.

[3] V.B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Education, 2010.

[4] SKF General catalouge, 5000E, june 2003; 304.