Design and Development of Corn Sheller Machine

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Absract- Farmers in developing countries such as India grow small-scale maize. Corn is sold a cob by farmers. The average price of the kernel is about twice the cob price. Farmers can therefore generate more income if corn is decorated and kernels are sold on the market themselves. But this requires a sheller of cheap, manually operated and efficient maize. The lack of maize processing machines, i.e. maize Sheller, is a major maize production problem, especially in our country India. The crop spread across America and spread to all corners of the region later around 1250 BC.Any significant or dense populations in the region developed a great trade network based on surplus and varieties of maize crops.

Keywords-shaft,key ,bearing,v-belt,wheel-tyre etc.

1. INTRODUCTION

Corn is grown by farmers in developing countries such as India on a large scale. More maize peeling techniques are used in our daily lives in India. The main problems with these techniques are that the use of old methods leads to more losses in the production rate. Therefore, today's farmers must use the new techniques to increase the production rate and also reduce man's power. But these machines are not affordable for farmers who have fewer farms and do not need these large machines.This is synopsis is about the idea of creating and machine for corn peeling and shelling machine, having compact size, more production rate and provision for separation of cobs and shells from one side at appropriate height and corn seeds from another side.

2. LITERATURE REVIEW

Prof.Y.V. Mahatale and V.P. Pathak "Physiological Evaluation of Different Manually A. Operated Corn Shelling Methods" Corn is the world's third largest cereal with an increasing production trend in India. The normal area of corn in India was 77.27 lakh hectares with production in 2007 of approximately 150.91 lakh tones. Rajasthan has the largest area under cultivation of 10.62 lakh hectares in all states with a total production of 21 lakh tones. Four shelling methods of corn: shelling of cob grain by h Prof.Ilori T. A., Raji A.O and O.S Kilanko "Modeling Some Ergonomic Parameters B. with Machine Parameter using Hand Powered Corn Sheller" In this paper the author studied about the economic situation in most developing countries have left farmers and processors operating at the small scale, hence the use of automated and electric power driven equipment is limited to the few large scale industries. The effect of ergonomic parameters, namely: Weight, age, height and length of the arm in relation to the resulting efficiencies; shelling efficiency, cleaning efficiency, mechanical damage and percentage loss of a hand powered corn sheller. The following conclusions have been drawn from the results obtained in this study: The shelling efficiency increases with the operator's weight and significantly with age and arm length. The operator's weight plays a major role in driving the machine. The mechanical damage observed from the performance evaluation has very low correlation with the ergonomic parameters.[2]

Prof.C. B. Ashwin Kumar and Shaik Haneefa Begum "Design, Development and Performance Evaluation of a Hand Operated Maize Sheller" " In 2012-2013, the author carried out research on the design, development and evaluation of hand-operated corn shellers at the College of Agricultural Engineering. Traditional shelling methods are rubbing the corn cobs against each other, rubbing on bricks or stone and using an iron cylinder made of wire mesh inside. Time consuming these methods involves drudgery. The study was therefore carried out to design, develop and evaluate hand-operated Corn Sheller. A cylinder and a concave consisted of the corn sheller. The cylinder is made of steel with a high carbon diameter of 21 cm. The length of the cylinder is 86 cm, with beaters rotating along the cylinder and separating the grains from the cobs. While the concave was made from mild steel rods of 5 mm size. The length of the concave was 91 cm and the opening slot was 30.3 cm2.5 cm. The author observed that Corn Sheller operated at a moisture content of 12 percent w.b for hand. The shelling efficiency, unshelled percentage and visible damage were found to be 99.56 percent, 0.44 percent and 1.07 percent at a feed rate of 130 kg / h..[3]

ProfOriaku E.C, Agulanna C.N, Nwannewuihe H.U, Onwukwe M.C and Adiele, I.D "E. Design and Performance Evaluation of a Corn De-Cobbing and Separating Machine" The author said here that, when processed into quality forms, agricultural products such as maize, soybean, millet and rice not only prolong the useful life of these products, but also increase the net profit produced by farmers from the mechanization technologies of these products. The de-cobbing or threshing of maize is one of the most important processing operations to bring out the quality of maize. A de-cobbing and separation machine was therefore designed, manufactured and evaluated its performanceThe experiment used maize at a moisture content of 15.14 percent db obtained locally and analyzed the data collected. The results showed that the average feed and threshing time for a total of 20 kg of the sample tested was 2.37 and 2.95 minutes. The average feed and threshing rate was 2.06 and 1.65 kg / min with an average threshing efficiency of 78.93%. The average efficiency of separation was 56.06 percent. These results show that the designed machine can be used to thresh and separate satisfactorily and can be used to process about 1 ton of maize per nine-hour shift..[4]

Prof.Mudgal et al. (2016) The development of hand-operated maize dehusker, pedal-operated maize dehusker, pedal-operated maize dehusker cum-sheller, power-operated maize dehusker and power-operated maize dehusker-sheller in MPUAT, Udaipur has been reported. Dehusker unit was built on steel rollers with a pair of rubber and spirally welded MS rod. Longitudinally, some tight blades were used to facilitate dehusking. By using half the cylinder length with rasp bars and the other with rubber strips in an octagonal cylinder, a combined unit for dehusking-shelling in one cylinder was tested to act as dehusker and sheller..[5]

3. FRAME MODEL

Fig no 3.1 Prototype of model.

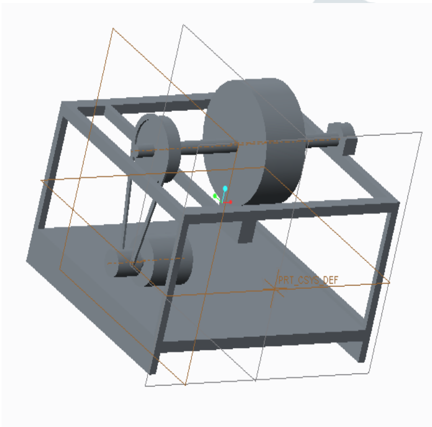
4. DESIGN

List of component:

Table no 4.1: List component.

Sr. No.	Name of component
1	Motor
2	V-belt
3	Shaft and keys
4	Bearings
5	Tyre and wheel
6	Pulley(driving and driven)
7	Upper casing and lower casing
8	Nut and bolt
9	Frame

Power required:



Our aim is to shell the corn without crushing and cracking corn seed.
1]the length required to without failure corn……..
2] the standard length of shelled corn L1=1.48*10^(-2) m.`
3]] the standard length of unshelled corn L2=20*10^-2 m. Kk=kick's constant=1.2
Fc= crushing strength required to crush the corn =200 N/m

Power require to shell the corn

P=Kk*Fc*ln(L2/L1)
=1.2*200*ln(20*10^(-2)/1.48*10^(-2))
=624.85 w
P=625 w or P=0.625 KW
But P=2π*NT/60
speed require for shellethe corn is between 300 rpm to 450 rpm by this speed taking the mean value is 3750 rpm . above the 450 rpm the corns seed are crush badly.[7] N=375rpm
625= 2*π*375*T/60 T=15.9235 Nm

Design of V-belt:

Power range -0.5 to 3.5 taking 0.625 Kw Minimum pitch diameter of pulley ,D = 75 mm Top width ,b= 13 mm
Thickness ,t= 8 mm
Take ,centre distance between driving and driven pulley is
C= 500 mm [6]
Assume ,belt speed V-speed range between 18 m/s to 25 m/s [7]

Velocity of V-belt:

V_b= 21.5 m/s
21.5 =π*d*1440/60*1000 d=0.285 m
taking angle of pulley 2Φ=38º α=19º
area =1/2*(top width + bottom width)*height
= 1/2*(13+6)*8
=312 mm^2
Maximum permissible tension

Material cast iron ,carbon steel casting or steel cast iron FG200(flake graphite 200n/mm^2)[8]
But , Sut= 730N/mm² Brinell hardness no,150
T allowable = 0.3*Sut(without key)
T allowable =0.75*0.3*Syt or 0.75*0.18*Sut Effect of keyway of a shaft strength
E= 1-0.2*(w/d)-(1.1*hk)/d Here,
e-shaft factor h- height of key
d- diameter of shaft hk- depth of keyway w- width of shaft

Tension on belt:

Tmax=σ*A
=1.53*312
=477.36 N

Centrifugal tension:

Tc=Tmax/3
= 477.36/3
= 159.12 N

Pitch line velocity of belt:

Tc=m*$(Vb)^2$ VB= 21.5 m/s
angle of contact , Θ= π-2α
=180-38
Θ=2.47 rad

Tension ratio:

Tvt/Tvs= μ*Θ/e² For v belt α=2Φ

Belt tension on the tight side due to friction effect:

Tvt= TmaxTcx
=477.36-159.12
=318.24 N

Belt tension on slack side:

Tvt/Tvc= 4.56
Tvc =-69.78 N
4.2.8. Max Power required to belt: P =(Tvt-Tvc)*V_b
=(318.24-69.78)*21.52
P =5.3 KW

Table no.- 4.3 Specification of V-belt.

Type of belt	Specification (b*t) mm	Centre distance(C) mm	Max Velocity of belt(V_B) m/sec	Angle of v-belt (2Φ)	Area of belt=0.5 (top width+bottom width)* height(mm^2)	Material	Length of belt (mm)
V-belt	13×8	500	21.5	38^0	0.5(13+6)*8=313	Steel cast iron(FG200)	1614.3611

4.4 Design of Bearing:

Material =40c8 plain carbon steel C =0.4% and Mn =8%
Syt =-460 N/mm² and Sut =700 N/mm²
Ts =0.5*Syt/fos = 0.5*460/3 = 76.67 N/mm² Design of solid shaft
P = 2π*n*T/60*1000*1000

5.3 =2π* 375*T/650*1000*1000 T = 136.1093*10^3
Forces on pulley Tvt +Tvs =Fp 318.24+69.78
Fp =388.02 N
Reactin on the shaft is Ra = -47.95 N
Bending moment at point Mc = Ra*400
= 19182N
Mb =Rc*200
-= -77604 N
Dia of shaft using A.S.M.E code TE $=\sqrt{(Kb*M)^2+(Kt*T)^2}$
Te$=\sqrt{(1.5*77604)^2+(1.0*136109.3075)^2}$ Te =179098.05 Nm
τmax = 16Te/πD^3 D = 22.82 mm
Take d =25 mm by using standard dimension

Rolling contact ball bearing having, Bore diameter = 25 mm
Bearing series no=63 Outside diameter = 52 mm Width = 15 mm
Bearing series

Bearing no= 6305
6 – single rod deep groove ball bearing 3 – medium series of bearing load
05 – bore diameter in mm[10] Loads on bearing

Static load = 11.60 KN Dynamic load = 22.50 KN
Service factor ks =2 or moderate shock load no = 27.5 Values of service factor
Radial load factor , x= 1 and axial load factor = 0, Fr =534.075 N Fa = 0,andKa = 2

Equivalent dynamic load

Pe = (x.v. Fr +y.fa)*Ka Pe = 1*1*534.075*2
=1068.15N
Rating life of bearing

L10 = $(Cr/Pe)^n$
=(22500/1068.15)^3

Rating life of bearing L10 = 9346.53
L10 = L10h*60*n/10^6 L10 = L10h*60*375/10^6 L10h = 415401.730 hrs
Rating life of bearing in hours is 415401.73 hrs.

4.7 Pulley specification:

Table No.4.7 Pulley specification

Sr.No	Types of pulley	Specification(dia×width) mm	Material
1	Driving(small)	75 ×20	Gray cast iron
2	Driven(big)	300 ×20	Gray cast iron

Motor power = 0.625 kw
Motor driving pulley (D_1) = 75 mm Motor driven pulley (D_2) = 300 mm

Motor speed (N_1) = 1440 rpm Required speed (N_2) = 375 rpm

$\frac{□1}{} \quad \frac{□2}{}$

Table no. 4.4 Bearing specification

$N2 = D1$

$\frac{1440}{} \quad \frac{□2}{}$

Types of bearing	Specification	Material	Bore dia. (mm)	Outside dia. (mm)
Single row deep groove ball bearing	6305	Babbits	25	52

Wheel specification :

Wheel diameter = 320 mm
P195/55R16 85H
Where –
P-These tyre for passenger vehicle(metric size load and speed rating)
195-width of tyre (mm) 55-height of the sidewall R- Radial tire

D2 =300 mm.

Belt power required at

VB = □∗ 300∗ 375

60∗ 1000

Vb= 5.98 m/s

Power to drive pulley P=(Tvt-Tvs)* VB

=248.505.89

P=1463.88 W P=1.46 KW 375 = 7516-this tire fits 16 in (410 mm) wheel 98.1-load index (kg)
H- speed index

Casing:

4.6.1 Upper casing:
Upper casing radius = radius of wheel + corn diameter
=160+100
R=260 mm

Lower casing:
Lower casing =260+40 = 300 mm Width of casing = 200 mm
Standard lenth of corn is = 6 inch .=153.60 mm

Table No.4.6 Casing specification

Types of casing	Specification(dia ×width) mm	Gauge	Material
Upper	260× 200	18	M.S.
Lower	300 ×200	18	M.S.

By this power range motor require to drive the unit Hp = 0.75*(1.46)
Hp = 1.095

The standard selection of motor id 1.5Hp.

5.SCOPE

- This machine is expected to introduce new technology of corn shelling.
- This project will also help in separating corn seed.
- This innovation has made the more desirable and economical.
- This electrical and controlling system is totally environmentally friendly and contains no hazardous.