

Design and Fabrication of Foot Pedal Operated Corn Deseeding Machine

Sushrut S. H¹, Syed Suhel², Chetan Baseganni³, Naveen Dinakar⁴, Mayur Gohil⁵

Assistant Professor, Dept. of Mechanical Engineering, K.L.E.I.T. - Hubballi, Karnataka, India¹

Students, Mechanical engineering, K.L.E.I.T., Hubballi, Karnataka, India^{2 3 4 5}

ABSTRACT: Corn deseeding machine is a machine with the mechanical links to separate seeds from the stem with the manual pedalling. In this machine, sprocket and chain mechanism is used for rotation of a disc. The disc has tapered teeth on its surface, which causes the deseeding of seed from the stem. Farmers with large fields having the large production of corns, thus they need machine which costs nearly about 1.5lakhs for deseeding the corn from the stem. As in the case of farmers with the small land within 1 acres, as they have less production, with implementation of large machine with labour would be costlier. Keeping this fact in mind and providing alternative solution for deseeding of corn to small scale and hill farmers, we are developing small manually operated corn deseeding machine which operates without electricity. The machine should be such that it should be adopted by the farmers who produce the corn in small scale. It is designed to reduce the cost of device, which separates the corn seeds from its stem which every individual farmer needs in their periodical agricultural activities. Size of the machine is convenient such that it is easily transported from one place to another place.

KEYWORDS: Deseeding, Sprocket, tapered.

I. INTRODUCTION

Maize is one of the most important cereal crops in Africa and Nigeria. Maize is botanically known as **Zea mays** and as corn. Maize are of various varieties which include dent maize, sweet maize, popcorn, flour corn, and waxy corn. Food industries use it as raw material. A large proportion of processed corn is consumed fresh. The production of maize is quick, easy, cheap, and economical when compared with other food crops like palm tree, and cocoa, which generally take several months for maturity.

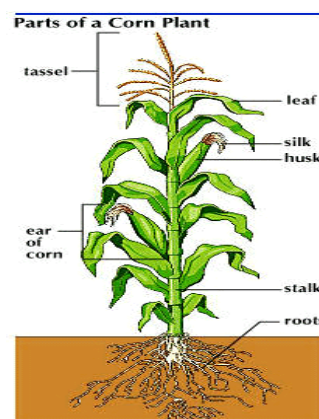


Figure (1): Parts of corn plant

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

Corn is an annual plant that grows seven to ten feet tall. The strong roots called prop roots help support the cornstalk. A tassel grows at the top of each jointed cornstalk and contains hundreds of small flowers that produce pollen long, sword like leaves grow outward from the stalk and end in a pointed tip.

1.1 Problem definition

The machines required for deseeding of corn cost nearly 1.5lakhs which is very costly for the farmer having Small field for small scale production of corn.

1.2 Objectives

The product which is to be designed is named as Foot Pedal Operated Corn Deseeding Machine. Design attributes of products with reference to identified established and problem statement is as follows:

- To make it affordable to common farmer so as to deseed small quantity of corn.
- To make it work without the use of electricity
- Minimumlaboursrequired.
- It should be eco-friendly.
- Should be simple in construction and should reduce damage of corn seeds.

II. PRESENT WORK

The machine should be such that it should be adopted by the farmers who produce the corn in small scale. It should be cost effective, which separates the corn seeds from its stem which every individual farmer needs in their periodical agricultural activities. Machine is portable so that it can be easily transported from one place to another. Bigger corn deseeding machine have disadvantages like higher cost and bulkier in size.

2.1 Design procedure

Before we proceed to the process of manufacturing, it's necessary to have some knowledge about the project design essential to design the project before starting the manufacturing. Maximum cost of producing a part of product is established originally by the designer.

Design procedure:

- When a new product or their elements are to be designed, a designer may proceed as follows:
- Make a detailed statement of the problems completely; it should be as clear as possible & also of the purpose for which the machine is to be designed.
- Make selection of the possible mechanism which will give the desire motion.
- Determine the forces acting on it and energy transmitted by each element of the machine
- Select the material best suited for each element of the machine.
- Determine the allowable or design stress considering all the factors that affect the strength of the machine part
- Identify the importance and necessary and application of the machine
- Problems with existing requirement of the machine productivity and demand

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

- Determine the size of each element with a view to prevent undue distortion or breakage under applied load.
- Modify the machine element or parts to agree with the past experience and judgment and to facilitate manufacture.
- Make assembly and detail drawings of machine with complete specification for the materials and manufacturing method i.e. accuracy, surface finish etc.

Need identification

To design a small manually operated corn deseeding machine in order to reduce the cost for deseeding the small quantity of corn without the use of electricity.

III. EXPERIMENTATION



Figure(2): The corn deseeding machine

3.1 Working principle

The device is simple in operation consisting of following parts: Bicycle Frame, Chain and sprocket, Shaft, Fix support plate, Rotating disc, Teeth, Roller bearings, covering plate. This machine is a manually foot pedal operated type. It consists of chain and sprocket mechanism which rotate the circular disc which consists of teeth of same profile on one side of its surface. It consists of fixed support plate which is placed in front of disc teeth surface in order to provide close fitting to varying size of the corn. As the corn is inserted in between disc and covering plate, pedal is operated which rotates the disc and which in turn rotates the corn from stem. The disc tries to rotate the stem in direction in which it rotates. The supporting plate is designed such that the deseeded corn is collected separately in a collecting vessel below the rotating disc.

Mild steel is used as a fabricating material for rotating disc (6mm thickness), fix support plate, frame, covering plate and spikes (teeth). Holes of diameter 10mm are drilled on the rotating disc. A rod of diameter 10mm is taken and

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

is cut into pieces (teeth) of length 16mm. The front portion of the teeth is tapered to an angle of 45 degree. The teeth are mated on the hole on the disc, by welding process. The hopper is made up of sheet metal of 24mm gauge, and of length 740mm. Shaft material is EN8 (mild steel). The shaft has a diameter of 25mm and length of 150mm. The covering plate is nothing but the guide way for corn and provides close fitting of the corn to the rotating disc. It is made of sheet metal and is made by bending and welding process. The material used for supporting plate is mild steel and is fixed to the frame by welding process. The roller contact bearing is used to support the rotating shaft, and the bearing is fixed rigidly by welding it to the supporting plate. A sprocket is mounted on the shaft.

3.2 DESIGN

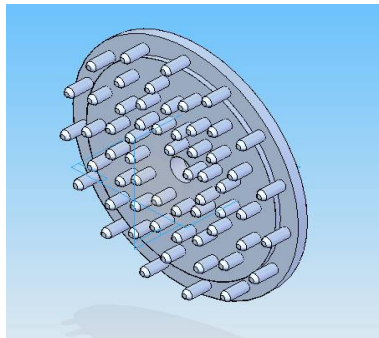


Figure (3): Rotating disc

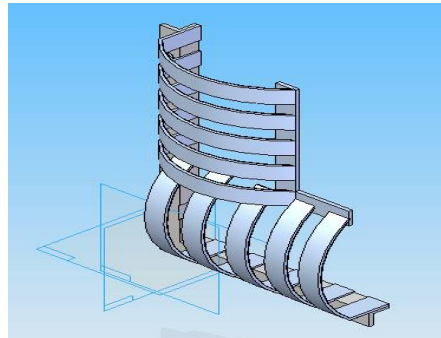


Figure (4): Covering plate

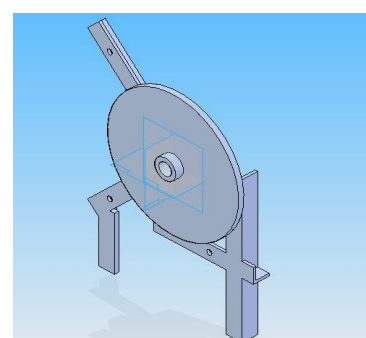
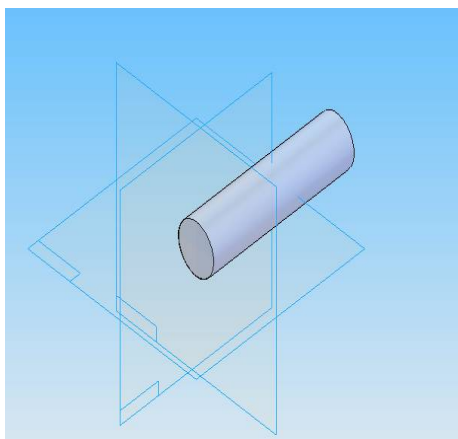
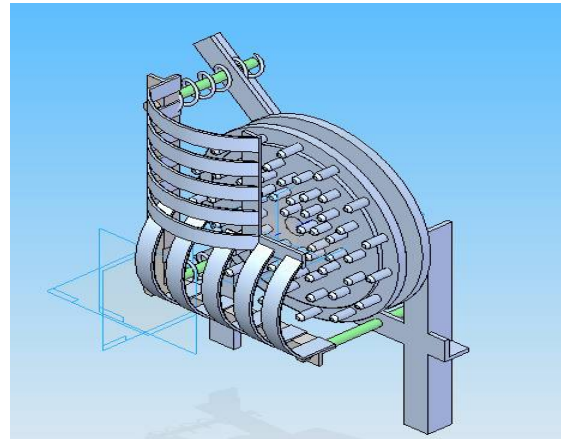


Figure (5): Fix support plate



Figure(6): Shaft



Figure(7): Assembled view of arrangement

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

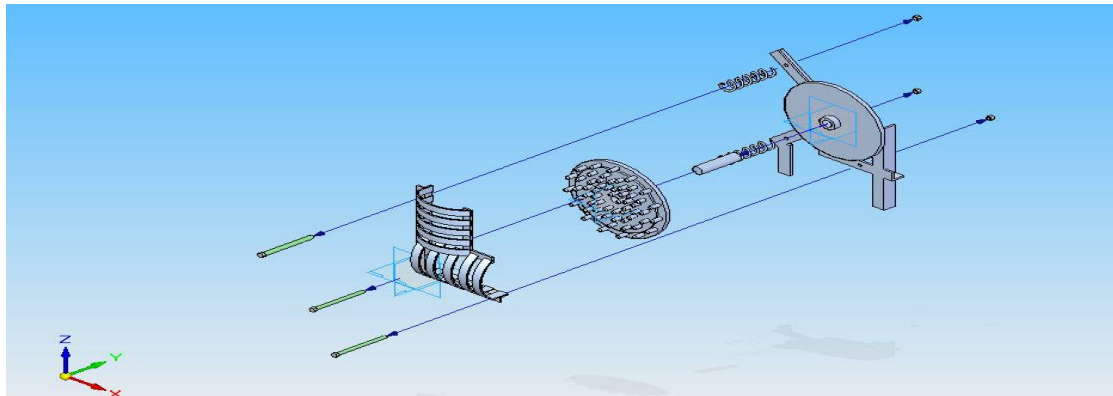


Figure (8): Exploded view of arrangement

3.3 DESIGN AND CALCULATION

Design calculations

$d = 25\text{mm}$ [taken]

d = diameter of the shaft

Torque required to rotate the disc,

$$T = \mu \times F \times r_m$$

$$\mu = 1.02$$

$$F = 5\text{kg [approximate]} = 49.05\text{N.}$$

r_m = mean radius of the rotating disc.

Outer diameter of the rotating disc, $d_o = 250\text{mm}$.

Inner diameter of the rotating disc, $d_i = 50\text{mm}$.

Therefore mean diameter,

$$d_m = \frac{d_o + d_i}{2}$$

$$d_m = \frac{250 + 50}{2}$$

$$d_m = 150\text{mm}$$

Mean radius of the rotating disc, $r_m = 75\text{ mm}$.

Therefore Torque,

$$T = 1.02 \times 49.05 \times 0.075$$

$$T = 3.752325\text{ N-m}$$

Torque applied on the cycle operated

$$T_c = T \times 4 \text{ [Speed ratio]}$$

$$T_c = 15.0093\text{ N-m.}$$

Therefore

$$T_c = F_c \times r_c$$

r_c = radius of the paddle = 180mm

Therefore Force required on the paddle,

$$F_c = \frac{T_c}{r_c}$$

$$F_c = \frac{15.0093}{0.18}$$

$$F_c = 83.33\text{N}$$

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

Design of shaft

Power transmitted

$$P = \frac{2 \pi N T_c}{60 \times 1000}$$

$$N = 30 \text{ rpm.}$$

$$P = \frac{2 \times \pi \times 30 \times 15}{60 \times 1000}$$

$$P = 0.0471 \text{ KW.}$$

Ultimate shear stress of mild steel, $\tau_u = 265 \text{ N/mm}^2$.

Factor of safety [FOS] = 12.

Allowable shear stress of mild steel,

$$\tau = \frac{\tau_u}{\text{FOS}}$$

$$\tau = \frac{265}{12}$$

$$\tau = 22.08 \text{ N/mm}^2.$$

Diameter of the shaft,

$$d = \sqrt[3]{\frac{16 \times T}{\pi \times \tau \times \eta}} \text{---19.49(DDHB)}$$

$$d = \sqrt[3]{\frac{16 \times 15 \times 10^3}{\pi \times 22.08 \times 0.75}}$$

$$d = 16.64 \text{ mm.}$$

$$d = 25 \text{ mm. [taken]}$$

Therefore the design is safe.

Chain drive

We know,

$$P = 0.0471 \text{ KW.}$$

$$N = 30 \text{ rpm.}$$

Speed ratio 1:4

$$Z_1 = 44 \text{ teeth.}$$

$$Z_2 = 12 \text{ teeth.}$$

Pitch of the chain = 12.7mm.

For pitch 12.7 mm, From Table 21.64

Chain no. : 08B.

Breaking load: 17.8 KN.

Measuring load: 127.53 N.

$$\text{FOS} = 7$$

Pitch diameter of sprocket

$$d = \frac{p}{\sin\left[\frac{180}{Z}\right]} \text{--- 21.126(DDHB)}$$

Pitch diameter of sprocket driving sprocket,

$$d_1 = \frac{12.7}{\sin\left[\frac{180}{44}\right]}$$

$$d_1 = 178 \text{ mm.}$$

Pitch diameter of sprocket driven sprocket,

$$d_2 = \frac{12.7}{\sin\left[\frac{180}{12}\right]}$$

$$d_2 = 49.06 \text{ mm.}$$

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

Velocity of chain,

$$v = \frac{p \cdot z_1 \cdot n_1}{60 \times 1000} = 21.105 \text{ (DDHB)}$$

$$v = \frac{12.7 \times 44 \times 30}{60 \times 1000}$$

$$v = 0.2794 \text{ m/s.}$$

Approximate centre distance,

$$C_p = 35 \text{ to } 38 \text{ pitches.} = 21.119 \text{ (DDHB)}$$

$$C_p = 35 \text{ pitches. [Taken]}$$

Length of chain in pitches,

$$L_p = 2C_p \cos \alpha + \left[\frac{Z_1 + Z_2}{2} \right] + \alpha \left[\frac{Z_1 - Z_2}{180} \right]$$

$$\alpha = \frac{d_1 - d_2}{2C} = 21.122 \text{ (DDHB)}$$

$$\alpha = \frac{178 - 49}{2 \times 35 \times 12.7}$$

$$\alpha = 0.145$$

Therefore

$$L_p = 2 \times 35 \times \cos 0.145 + \left[\frac{44 + 12}{2} \right] + 0.145 \left[\frac{44 - 12}{180} \right]$$

$$L_p = 98 \text{ pitches.}$$

Length of chain in mm,

$$L = L_p \times p = 21.125 \text{ (DDHB)}$$

$$L = 98 \times 12.7$$

$$L = 1244.6 \text{ mm.}$$

Correct centre distance in mm,

$$L_p = 2 \times \frac{C}{p} \times \cos \alpha + \left[\frac{Z_1 + Z_2}{2} \right] + \alpha \left[\frac{Z_1 - Z_2}{180} \right]$$

$$98 = 2 \times \frac{C}{12.7} \times \cos 0.145 + \left[\frac{44 + 12}{2} \right] + 0.145 \left[\frac{44 - 12}{180} \right]$$

$$98 = 0.157 \times C + 28 + 0.025$$

$$C = 445.7 \text{ mm.}$$

IV. RESULTS AND DISCUSSION

Machining time calculation

Machine time calculation indicates the average time required to remove the maize corns from the husk by maize corn seed separator. The dimensions of husks are not same, one is smaller in length and another one is larger in length, because of this the time also varies. To calculate the time, considering five different type of husk (specimen) which are different in length and diameter. After that, we calculate the time required to remove the corns from the husk for first specimen, and we do the same for remaining four husks. We get five different time requirements for different husks. By calculating the average time finally we are going to get the machine rate.

Here T_1 is the time required to remove the corns from the first specimen, and T_2, T_3, T_4, T_5 are the time for the four specimen respectively.

The average time taken to remove the seeds is,

$$T_{\text{mean}} = \frac{T_1 + T_2 + T_3 + T_4 + T_5}{5}$$

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

SPECIMEN	NO. OF SEEDS	LENGTH In 'mm'	OUTER DIAMETER BEFORE REMOVING SEEDS In 'mm'	OUTER DIAMETER AFTER REMOVING SEEDS In 'mm'	TIME TO REMOVE SEEDS 'T' (sec)
1	595	175	45	35	12
2	406	110	41	27	7
3	489	145	42	29	10
4	546	150	44	28	11
5	583	170	43	26	13

Table 1: Observations

The average time taken to remove the seeds is

$$T_{\text{mean}} = \frac{T_1 + T_2 + T_3 + T_4 + T_5}{5}$$

$$T_{\text{mean}} = \frac{12+7+10+11+13}{5}$$

$$T_{\text{mean}} = 10.6 \text{ seconds.}$$

V. CONCLUSION

After the completion of the project work we tried its working in our college machine shop, we noticed that it met the requirements for what it is meant. The manoeuvrability of the device is quite good and handling is quite simple. The seed discharging mechanism is effective and corn seeds can be discharged off very easily. This device is of low cost, and it is affordable to common farmer so as to deseed small quantity of corn. After the test is conducted, we found that there was no damage to the corn seeds. It is found that, the manual power required for pedalling was less, and the machine would deseed a corn in 10 seconds approximately. For commercial purpose one can improve the efficiency of the device effectively by increasing the diameter of the rotating disc, and providing multiple inlet port.

REFERENCES

- [1] S. P. Singh, "Ergonomics in developing hand operated maize Dehusker-sheller for farm women", The Ergonomics Society, 2011.
- [2] Nguyen QuangLoc, "Study the broken maize grain on tangential thresher", Nong Lam University, 1998.
- [3] Kareem Buliaminu, "Development of a Role in Orientation Machine for Maize Shelling", David publication, 2011.
- [4] D. K. Lingaiah, "Machine design data handbook", Suma publishers, 2006
- [5] Ali, U. Singh, J.Soni,A.K.Maheshwari, "Economics and Technical feasibility of maize dehushing and shelling, Journal of Agricultural Engineering (ISAE) 23 (1), 71e8

BIOGRAPHY

	Serving as Asst. Prof, Department of Mechanical Engineering K. L. E. Institute of Technology, Hubballi-30. Completed M.Tech in (Thermal Engineering). Have an Academic experience of about 6 years.
---	--

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

	Student, Mechanical Engineering, K.L.E.I.T., Hubballi.
	Student, Mechanical Engineering, K.L.E.I.T., Hubballi.
	Student, Mechanical Engineering, K.L.E.I.T., Hubballi.
	Student, Mechanical Engineering, K.L.E.I.T., Hubballi.