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Design and Fabrication of a Corn Sheller

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***Abstract*—A dry corn shelling machine presented in this paper helps to separate corn from the cob. The fabricated design consists of a body casing, drum, shelling unit, grain and cob discharge unit, machine frame, hopper (Feeding chute), bearing as some of the major component, It is powered by 2Hp electric motor connected via a belt drive which transmits torque from the electric motor to the shelling unit. A blower powered by a separate electric motor connected to the discharge unit helps to separate the unwanted particles from the shelled corn. The fabricated design was tested and found to be about 79percent efficient with operating capacity of about 63.95kg/hr. The design is relatively cheap, simple and portable when compared to imported product of similar capacity.**

Keywords—CORN, COB, DISCHARGE UNIT SHELLING UNIT AND DESIGN CAPACITY

1. INTRODUCTION

Corn is the most important cereal grain in the world, after wheat and rice, providing nutrients for humans and animals and serving as a basic raw material for the production of starch, oil and protein, alcoholic beverages, food sweeteners and, more recently, fuel. It is because of the important place of maize that it's handling, processing and preservation within the optimum conditions must be analyzed.

The problem of poverty, hunger and malnutrition would be alleviated if there is adequate production of corn, Corn also called maize plays an important dietary role in most parts of Africa, It is grown virtually everywhere, in tropical, subtropical and temperate regions where rain and irrigation is adequate (Messiaen, 1992), Tindall, 1983).

The major steps involved in the processing of corn are harvesting, drying, de-husking, shelling, storing, and milling. All these processes are costly and for the rural farmers to maximize profits on their produce, appropriate technology that suites their needs must be used. Corn processing not only prolongs its useful life but also increases the net profit farmers (users) make from mechanization technologies. It is in this line that one of the most important processing operations done to bring out the quality of corn is shelling. It is basically the removal of the corn kernels from the cob. This separation, done by hand or machine, is obtained by shelling through friction or by shaking the products; the difficulty of the process depends on the varieties grown, and on the moisture content as well as the degree of maturity of grain.

Corn is considered to be one of the most important staple crops in the world.

People in some parts of the world actually consider corn as their survival food. According to the D-Lab corn Sheller writing at the Massachusetts Institute of Technology (Accessed on Oct 4th 2013), corn accounts for 43% of the Latin American diet. Because of the high need of corn grains, it leads to the invention of a wonderful tool called the corn sheller which helps in shelling the kernels from the cob as well as makes shelling faster and easier. It. The first ever corn sheller was invented by Lester E. Denison at Sayville Middlesex country, connecticus.

Today, corn shellers come in wide variety of sizes and types. From the simplest hand-held device to the more complex bigger self-feeding machines powered by steam, corn kernel separation has been successful since then.

1.11 AIM: The aim of this article is to design an improved corn shelling machine that operates with high efficiency and flexibility

1.12 .OBJECTIVES

The specific objectives of the research work are to;

- Design a corn shelling machine that will operate with minimum noise.
- Construct a corn shelling machine that can effectively separate the corn from the cob.

1.13. RELEVANCE OF THIS WORK:

The expectation of this research is to solve the problem of manual shelling of corn and other short comings noticed in some of the existing designs visa−viz loss of corn during processing , stress, and time wasting experienced in other methods as well as cost of production

2. LITERATURE REVIEW

Depending on the influence of agronomic, economic and social factors, shelling is done in different ways:

(i) Shelling by hand, with simple tools;

(ii) Mechanical shelling, with simple machines operated manually.

(iii) Mechanical shelling, with motorized equipment.

Going through history, one can emphatically say that design and fabrication of corn shelling machine had been in existence from time immemorial. Although during that time, the fabricated designs by local welders lacks technological acuity. The type of metals as well as other materials used in construction were not well evaluated, such that when the machine were subjected to stress and strain or being exposed to some environmental factors while in use may react quickly to corrosion and wear

Oloko et al. (2002) developed a corn shelling machine driven electrically and powered by a 2Hp of electric motor. The machine weighed 80kg and the shelling efficiency is about 71% with the machine capacity of 54.5kg/hr. one of the limitations was that losses in corn during shelling was relatively high

2.1.1 Hand shelling

The easiest traditional system for shelling corn is to press the thumbs on the grains in order to detach them from the ears. Another simple and common shelling method is to rub two ears of corn against each other. These methods however require a lot of labour. It is calculated that a worker can hand-shell only a few kilograms an hour. Shelling of corn, as well as of sun flowers, can be more efficiently accomplished by striking a bag full of ears or heads with a stick. Maize and sunflowers can also be shelled by rubbing the ears or heads on a rough surface. Small tools, often made by local artisans, are sometimes used to hand-shell corn. With these tools, a worker can shell 8 to 15 kg of corn an hour.

2.1.2 Maize-shelling with Rotary Equipment

Manual shellers, which are relatively common and sometimes made by local artisans, permit easier and faster shelling of ears of corn. These come in several models, some of them equipped to take a motor; they are generally driven by a handle or a pedal. Use of manual shellers generally requires only one worker. A good example is the Antique maize shellers.

Figure 2.10: Antique Maize sheller

The major setbacks with these shellers are that their threshing capacities are low and most of them require to be fixed on benches before operation. Also their method of operation is too cumbersome from the fact that the crank handle is directly connected to the shelling chamber and therefore the effect of friction is too vigorous during the shelling process.

2.1.3 Mechanized shelling with motorized equipment

Nowadays many small corn shellers, equipped with a rotating cylinder of the peg or bar type, are available on the market. Their output ranges between 500 and 2000kg per hour, and they may be driven from a tractor power take off or have their own engine; power requirements vary between 5 and 15hp according to the equipment involved. For instance the French Bourgoin "Bamba" model seems well-suited to rural areas in developing countries because of its simple design, easy handling and versatility (maize, millet sorghum, etc.).

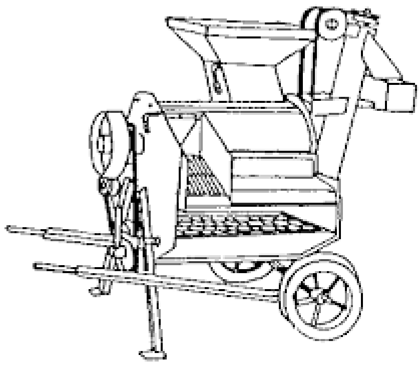

Figure 2.11: "Bamba" motorized maize sheller

Transportation of the product from the field to the threshing or shelling place must also be handled with special care, since it can bring about severe losses. Maize grain losses contribute to food insecurity and low farm incomes not only in Kenya but also in other SSA countries (Compton, 1992; Azu, 2002; Republic of Kenya, 2004). The losses are directly measurable in economic, quantitative, qualitative, (nutritional) terms. Economic loss is the reduction in monetary value of maize grain as a result of physical loss. Quantitative maize loss involves reduction in weight and therefore can be defined and valued. Qualitative loss although difficult to assess because it is frequently based on subjective judgments (like damage), can often be described by comparison with locally accepted quality standards (Magan and Aldred, 2007).Such losses lead to lower levels of food security, hunger and low on farm incomes (Republic of Kenya, 2004).

3.4. MATERIALS AND METHOD

To satisfy operational requirements and design purpose, standard values were used in developing the design consideration, specification analysis and drawing

The major components of the design include the Machine stand, shelling chamber, shaft diameter, volume of the hopper, motor capacity. The corn shelling machine was then assembled by bolting and welding. The shelling machine is made up of various components, these are: Body casing, Drum, Shelling unit, Grain discharge unit, Cob discharge unit, Hopper (Feeding chute). Electric motor, Blower and some other essential parts like the bearing shaft frame etc

The shaft was designed by considering the following:

a) Types of loading (i.e. static, shock or cycle loading).
b) The weakening effect of point stresses, concentration due to key ways and shoulders.
c) Combination of loading

The action of load on the shaft is generally one of the following

i. Torsion
ii. Bending
iii. Torsion combined with axial tension or compression.

i. Torsion shear stress $T_{XY} = \frac{m_{tr}}{T} = 16\frac{m_t}{\pi d^3}$.(3.1)

where T_{XY} = torsional shear stress in N/m^2

M_t = torsional moment in N/m

r = radius of shaft

d = diameter of shaft

ii. For bending loads on solid shaft, bending stress (S_b) tension or compression is given as:

iii. $s_b = \frac{M_{br}}{T} = \frac{32M_b}{\pi d^3}$. (3.2)

M_b = bending moment in Nm

T_s = Torsional shear stress in N/m^2

iv. For axial loads on solid shaft tensile or compressive stress.

$$s_a = \frac{4f_a}{\pi d^2}. (3.3)$$

where,

s_a = axial stress in N/m^2

F_a = axial load in N

v. For torsion combined with bending most rotating shaft carries gears and pulley in addition to torsion. In order to reduce bending moments, such machine element should be mounted as near as possible

$$s_s\,(\max.) = T_{XY} + \frac{56^2}{4}. (3.4)$$

where $s_s(\max)$ = maximum shear stress in N/m^2

From ASME code, the torsional and bending moments are to be multiplied by factors K_b and K_t respectively. Combine fatigue and shock occur during operation, therefore,

$$Ss_{(\max)} = 16(K_bM_b)^2/\pi S_s + (K_tM_t)^2. (3.5)$$

Where,

K_b = Combined fatigue factor applied to bending moment M_b

K_t = Combined shock factor applied to torsional moment M_t

S_s = Shear stress in N/m^2

M_t = Torsional moment in Nm

M_b = Bending moment in Nm.

Torsion combined with axial tension and compression: some shafts such as propeller shafts are subjected to torsion combined with direct axial loads and this gives;

$$S_S(\max) = 16(M_T)2/\pi d^3 + (F_aD)2/8. (3.6)$$

where: Ss (max) = maximum shear stress in N/m^2

Source: Khurmi and Gupta (2005).

Table 2.1: Criteria for Shaft Selection Factors

S/N	Types of Load For Stationary Shaft	K_b	K_t
1	Load applied	1.0	1.0
2	Load applied shaft	1.5 – 2.0	1.5 – 2.0
	For Rotating Shaft	Kb	Kt
1	Load applied gradually	1.5	1.0
2	Load applied suddenly (minor Shock)	1.5 – 2.0	1.0 – 2.0
3	Load applied suddenly (Heavy shock)	2.0 -3.0	1.5 -3.0

Source: (Butterwort et al., (1987).

ASME commercial steel shaft has allowable shear stress = $55Mn/m^2$ for shafts with keyways.

For the purpose of this research work, A 2Hp electric motor was selected with a speed of 1410 rpm. The voltage of the electric motor is 220V and power is 1.5 watt. Since we wanted speed reduction, the reduced speed is 331 rpm. The blower has 1Hp electric motor with a speed of 1910 rpm. The voltage is 230V.

3.4.3 BLOWER

This helps to blow off light particles away from the grain thereby producing clean-shelled grains. It usually fabricated and made of mild steel flat bar and is driven by the electric motor through belt transmission. Though in the design it was not constructed, the method of air blowing through the grains falling under gravity.

The torsional moment acting on a shaft was determined considering the following.

3.4.5 DETERMINATION OF OUTER AND INNER DRUM OF SHELLING CHAMBERS

Volume of drum = π × r^2 × h . (3.7)

Where h = Length/Height of drum

r = radius of drum

Volume of outer drum – volume of inner drum . (3.8)

3.4.6 DETERMINATION OF SHELLING QUANTITY

$$\rho = \frac{M}{V} . \quad (3.9)$$

Where ρ = density of an average corn

V = Volume of corn

M = mass of corn

3.4.7 DETERMINATION OF SHAFT TORQUE

The torque is determined as follows

$$T = \frac{(T_1 - T_2)D_2}{2} . \quad (3.10)$$

3.4.8 DETERMINATION OF SHAFT DIAMETER

$$S_S = \frac{16}{\pi d^3}\sqrt{M^2 + T^2} . \quad (3.11)$$

Where T is torque,

M_b is bending moment of shaft,

d is shaft diameter of the machine,

S_S is maximum shear stress.

Inputting values into the various equations to get designed values

3.4.9 DETERMINATION OF SHAFT PULLEY

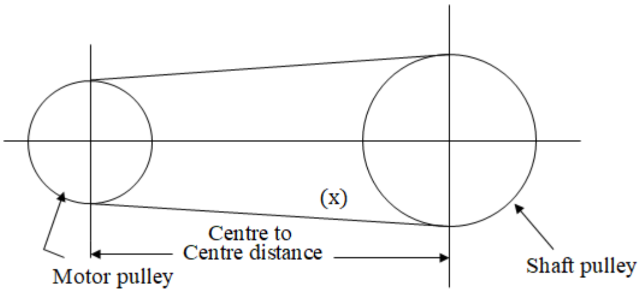

Fig. 3.1 Diagram showing the Pulleys

The diameter of the driven (shaft) pulley can be obtained using the relation.

$$N_1 d_1 = N_2 d_2 . \quad (3.12)$$

$$\frac{N_1}{N_2} = \frac{d_2}{d_1}$$

$$d_2 = \frac{N_1 d_1}{N_2}$$

Where

N_1 = Speed of motor pulley(driver)

N_2 = Speed of shaft pulley(driven)

d_1 = Diameter of motor pulley

d_2 = Diameter of shaft pulley

N_1 = 1410 rpm

N_2 = 331 rpm

$d_1 = 55\text{mm} = 0.055\text{m}$

$$\therefore d_2 = \frac{0.055 \times 1410}{331}$$

$d_2 = 0.234\text{m}$

$d_2 = 234\text{mm}$

3.5. THE VELOCITY OF THE BELT

The velocity of belt is defined by

$$V_b = \frac{\pi d_1 N_1}{60} . \quad (3.13)$$

Where d_1 = diameter of motor pulley

N_1 = Speed of rotation of motor

For our motor,

$d_1 = 55\text{mm} = 0.055\text{m}$

$N_1 = 1410$ rpm

$$\therefore V_b = \frac{\pi \times 0.055 \times 1410}{60}$$

$V_b = 4.061\text{m/s}$

3.5.1 THE TENSION ON THE BELT

Tension in the belt is given by

$$2.3 \log\left(\frac{T_1}{T_2}\right) = \mu.\theta \operatorname{cosec}\beta . \quad (3.14)$$

Where

T_1 = Tension on the tight side of the belt

T_2 = Tension on the slack side of the belt

μ = Coefficient of friction between belt and pulley

θ = Angle of lap of the smaller pulley

2β = Groove angle of the pulley

$$\therefore \beta = \frac{1}{2} \times 2\beta$$

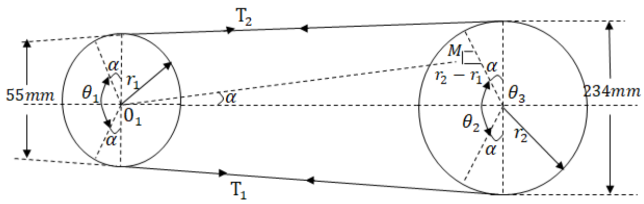

Fig. 3.2: Diagram showing belt parameters

For an open belt drive as shown in fig 3.

$$\sin\alpha = \frac{O_2M}{O_1O_2} = \frac{r_2 - r_1}{x} = \frac{d_2 - d_1}{2x} . \quad (3.15)$$

Where x = centre distance between two pulleys

$$= \frac{0.0234 - 0.055}{2 \times 0.48}$$

$\sin\alpha = 0.1865$

$\alpha = \sin^{-1} 0.1865$

$\alpha = 10.75^0$

and angle of lap on the smaller pulley (i.e. pulley on the motor shaft)

$\theta = 180^0 - 2\alpha$

$= 180 - 2 \times 10.75$

$= 180 - 21.5$

$= 158.5^0$

$= 158.5 \times {}^{\pi}/_{180}$

$= 2.767 \text{ rad } V_b^{\,2}$

. Centrifugal tension T_c

Where mass =1.06 (from the dimension of standard v-belt according to 15: 2494-1974)

$T_c = M.\ V_b^{\,2}.$ (3.16)

$= 1.06 \times (4.061)^2$

$T_c = 17.48N$

The maximum tension T_m transmitted, when centrifugal tension is given as

$T_c = \frac{T}{3}.$ (3.17)

$T_m = T_c \times 3$

$= 17.48 \times 3$

$T_m = 52.44N$

. Tension in the tight side

$T_1 = T_m - T_c$

= 52.44-17s.48

$T_1 = 34.96N$

For T_2 (Tension in the slack side of the belt), we know that from equation 3.14)

$$2.3\ \log\left(\frac{T_1}{T_2}\right) = \mu.\theta\ \operatorname{cosec}\beta$$

Where $\mu = 0.0025$

$\theta = 158.5$

$\beta = 17.5$ (Because groove angle $2\,\beta = 35^0$)

$$\therefore 2.3\ \log\left(\frac{T_1}{T_2}\right) = 0.0025 \times 158.5 \operatorname{cosec} 17.5$$

$$2.3\ \log\left(\frac{T_1}{T_2}\right) = 0.3962 \times 3.3255$$

$$\log\left(\frac{T_1}{T_2}\right) = \frac{1.3177}{2.3}$$

$$\frac{T_1}{T_2} = 3.7402$$

$$\frac{T_1}{T_2} = 3.7402 \text{ (Taking antilog of 1.27)}$$

$$T_2 = \frac{T_1}{3.7402}$$

$$T_2 = \frac{34.96}{3.7402}$$

$T_2 = 9.347N$

The power transmitted by the belt

$= (T_1 - T_2)\ V_b.3.18$

= (34.96 – 9.347)4.061

= 104.01W

P = 0.1040KW

The radius of pulley on motor shaft

$r_1 = \frac{d1}{2}$

$r_1 = \frac{0.055}{2}$

$r_1 = 0.0275m$

The radius of pulley on driven shaftd$_1$

$r_2 = \frac{d2}{2}$

$r_2 = \frac{0.234}{2}$

$r_2 = 0.117m$

The length of belt

$L = \pi(r_2 + r_1) + 2x + \frac{(r_2 - r_1)^2}{x}.$ (3.19)

$$= \pi(0.117 + 0.0275) + 2 \times 0.48\,\frac{(0.117 + 0.0275)^2}{0.246}$$

$= 0.4540 + 0.96 + 0.016688$

L = 1.4306m

$L \approx 1.431m$ Approx.

The torque transmitted by the driven pulley

$T = \frac{P \times 60}{2\pi N}.$ (3.20)

$$= \frac{1.5 \times 10^3 \times 60}{2 \times 3.142 \times 331}$$

$$T = \frac{90}{1470.456}$$

$T = 43.26914N/m$

$T = 43269.14N/mm$

The diagram of the shaft

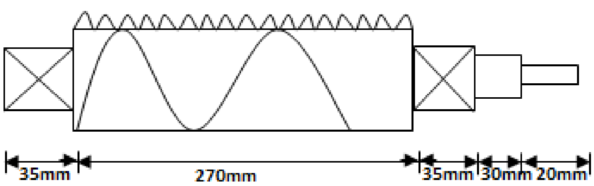

Fig 3.3 show the free body diagram of all the forces on the shaft

Converting the uniformly distributed load to a point load

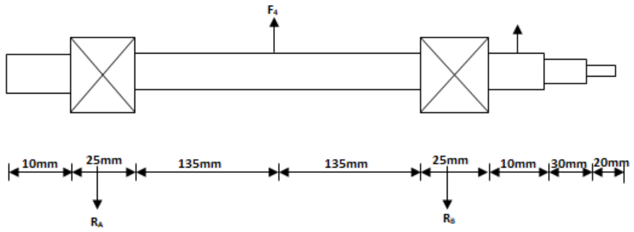

Fig 3.4 show the point load of the shaft

Since the driven pulley is overhung and the distance of the centre from the nearest bearing is 312.5, therefore bending moment M_b on the shaft due to the pull on the belt is:

$M_b = (T_1 + T_2 + 2T_c) \times M_b$. (3.21)

$M_b = (T_1 + T_2 + 2T_c) \times 312.5$

= (34.96 + 9.347 + 2 x 17.48) 312.5

M_b **=** 24770.94N/mm

Equivalent twisting moment T_e

$T_e = \sqrt{T^2 + Mb^2}$. (3.22)

$T_e = \sqrt{(43269.14)^2 + (24770.94)^2}$

T_e = 49857.98

Calculation of the diameter of the shaft

$T_e = \frac{\pi}{16} \times t \times d^3$. (3.23)

$49857.98 = \frac{3.142}{16} \times 12 \times d^3$

$d^3 = \frac{49857.98}{2.3565}$

d^3 = 21157.98

d = 27.66mm

3.5.2 The input end(hopper) can be assume to be in the form of a frustum which is Truncated pyramid and its volume can be calculated as follows

CALCULATING THE VOLUME OF PYRAMID

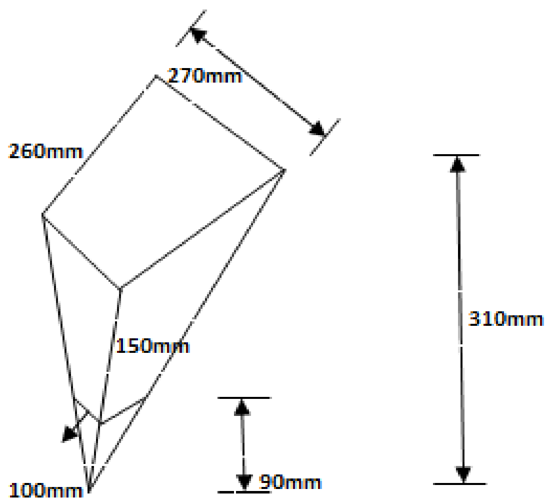

Fig 3.5 show the sectional area of the hopper

Volume of a pyramid = $\frac{1}{3}$ ah . (3.24)

Where;

a = Area of the base

h = height of pyramid

Area of the base = l x b

Length of the base = 0.26m

Breath of the base = 0.27m

Height of pyramid, h_1 = 0.31m

Volume of pyramid, $V_1 = \frac{1}{3} \times a_1 \times h_1$

$V_1 = \frac{1}{3} \times l_1 \times b_1 \times h_1$

$V_1 = \frac{1}{3} \times 0.26 \times 0.27 \times 0.31 = 0.007254m^3$

Therefore volume of pyramid $V_1 = 0.007254m^3$

Length of base l_2 = 0.15m

Breath of base b_2 = 0.10m

Height of pyramid h_2 = 0.09m

Volume of pyramid $V_2 = \frac{1}{3} \times 0.15 \times 0.10 \times 0.09$

= $0.00045m^3$

$V_{hopper} = 0.007254 – 0.00045 = 0.006804m^3$

= $6.804 \times 10^{-3}m^3$

= $6804cm^3$

CALCULATION OF OUTER AND INNER DRUM OF SHEARING CHAMBER

3.5.3 FIXED/OUTER DRUM

Length =760mm = 76cm

Diameter of drum = 260mm = 26cm

Where r = radius of drum = $\frac{d}{2} = \frac{26}{2}$ = 13cm

From equation (3.1), the Volume of fixed/outer cylinder

= $\pi \times r^2 \times l$. (3.25)

= $3.142 \times 13^2 \times 76$

= $40355.848\ cm^3$

≈ $403556cm^3$

3.5.4 INNER DRUM

Length = 700mm = 70cm

Diameter of drum = 120mm = 12cm

Where r = radius of drum = $\frac{d}{2} = \frac{12}{2}$ = 6cm

From equation (3.1), the Volume of inner cylinder

= $\pi \times r^2 \times l$

= $3.142 \times 6^2 \times 73$

$= 8257.176cm^3$

$= 8257cm^3$

From equation (3.1), the volume of cylinder that will contain the sheared corn

= 403556 – 8257

$= 395299cm^3$

3.5.5 VOLUME FLOW RATE OF THE BLOWER

Volume flow rate = Area of the duct x velocity(3.26)

Where Area = L x B (3.27)

= 0.065 x 0.05

= 0.00325m

The velocity = $\frac{2\pi N}{60}$ (3.28)

$= \frac{2 \times 3.142 \times 1910}{60}$

= 200 m/s

Volume flow rate = 0.00325 x 200

$= 0.65m^3/s$

$= 65cm^3/s$

3.6. MATERIAL SELECTION

. Adequate care was taken in the selection of the materials for corn shelling machine as only the best material which serves the desired objectives at the minimum cost. were considered. Materials were selected locally to make the material sourcing easier Bearings and other components that are vital to the design were careful selected.

3,6.1 DESIGN SPECIFICATION AND ANALYSIS

In the design, certain factors were put into consideration. This includes volubility, capacity of speed, and efficiency of performance. Since the corn shelling machine will be employed to shell corn, and some relevant physical and mechanical properties of corn Sheller need to be understood.

Table 2.2 Design Specifications

S/N	PARTS	MATERIALS	DIMENSION
1.	Body casing	Mild steel sheet (2mm)	290mm x 150mm
2.	Hopper (feeding chute)	Mild steel sheet (2mm)	260mm x 270mm x 220mm
3.	Cob discharge unit	Mild steel sheet (2mm)	220mm x 100mm x 210mm
4.	Grain discharge unit	Mild steel sheet (2mm)	110mm x 120mm x 420mm
5.	Machine frame	1 ½ inch angle bar	840mm x 390mm x 700mm
6.	Bearing	Cast iron	Small size
7.	Electric motor	Copper	1.5kw/1410rev/min
8.	Pulley (driver)	Cast iron	55mm diameter
9.	Pulley (driven)	Cast iron	234mm diameter
10.	Motor (for blower)	Copper	1kw/1910rev/min

Table 2.3: showing the bill for engineering measurement and evaluation

S/N	DESCRIPTION	DIMENSION	QUANTITY	COST (N)
1	Electric motor	2 hp, 1410rpm	1	30000.00
2	25.4mm mild steel flat bar	3mm by 5480mm	2	3000.00
3	Mild steel Angle iron	50mm by 50mm	1	5,500.00
4	Mild steel Shaft	Ø27mm	1	3,000.00
5	Pulley driven	Ø234mm	1	3,000.00
6	1.5mm mild steel sheet	1200mm by 600mm	1	6,500.00
7	Mild steel angle iron	35mm by 35mm	1	3,500.00
8	Belt	A-side	1	400.00
9	Bearings	Ø75mm	2	1,800.00
10	Gauge 12 electrode	1 packet	1	1,500.00
11	Bolts and nuts		Sum	100.00
12	Motor (for blower)	1 hp, 1910rpm	1	10,000.00
13	Miscellaneous			6,900.00
	Total			₦75,200.00

After the assembling was completed, the machine was properly lubricated at the shelling hub end and bearing for smooth running. It was then observed from any noise or vibration, which is normal to all belt driven machines. The weight of this corn shelling machine is 75kg.

A specific quantity of corn was fed into the fabricated design one after the other, the following observations were made. Shelling was carried out for approximately equal size of maize and ten sets of test were recorded. The table shows the test carried out in increasing order of size.

Table 2.4: test carried out in corn

Corn sample	Weight of corn (kg)	Time (sec) to shell the corn by the machine
1	0.11	5
2	0.12	6
3	0.14	8
4	0.16	8
5	0.13	6.5
6	0.16	8.5
7.	0.17	9
8.	0.18	12
9.	0.14	8
10.	0.20	14
Total	1.51	85 secs (1min: 25sec)

3.6.2 THE CAPACITY OF THE DESIGN

Average weight of corn = $\frac{1.51kg}{10} = 0.151kg$

If a corn of 0.151kg is shelled for 8.5 secs

The rate of shelling is

$$\mathrm{Xkg} = \frac{0.151 \times 60}{8.5} = \frac{9.06}{8.5} = 1.066\mathrm{kg/min}$$

In one hour the capacity of the fabricated design is

$$\mathrm{Xkg} = \frac{1.066\mathrm{kg/min} \times 60\mathrm{min}}{1} = 63.95\mathrm{kg/hr}$$

In 24hrs

X_2kg = 64 x (24)hrs =1536kg/day

1 tone = 1000kg It implies 1.536 tonnesperday can be shelled

3.6.3 THE EFFICIENCY (E) OF THE FABRICATED DESIGN

Weight of shelled corn = 1376g = 1.376kg

Weight of unshelled corn = 1742g = 1.742kg

$$E = \frac{\text{output}}{\text{input}} \times 100 \qquad (3.29)$$

$$= \frac{\text{Weight of shelled corn}}{\text{Weight of unshelled corn}} \times 100$$

$$= \frac{1.376}{1.742} \times 100$$

= 78.98

= 79%

3.7. CONCLUSION

.The design was found to be 79percent efficient with a capacity of 63.6kgperhour and about1.356tonnes [per day

The machine is effective and able to shell the grain at the tip of the cob as well as the remaining part of the cob. Materials used were locally sourced with reduced cost of production. The corn shelling machine is widely used in the farms, homes and in agricultural sector in general, featured by small size, little noise, simple process and compact arrangement, etc

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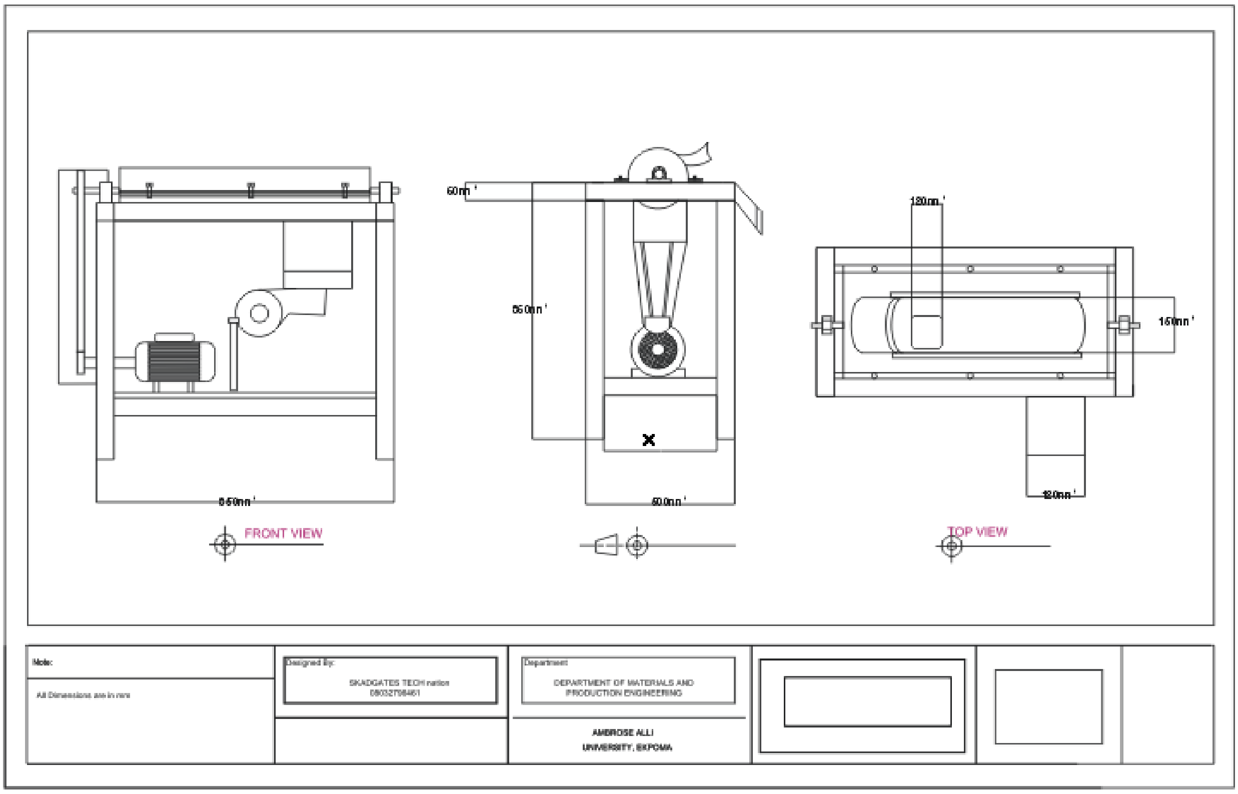
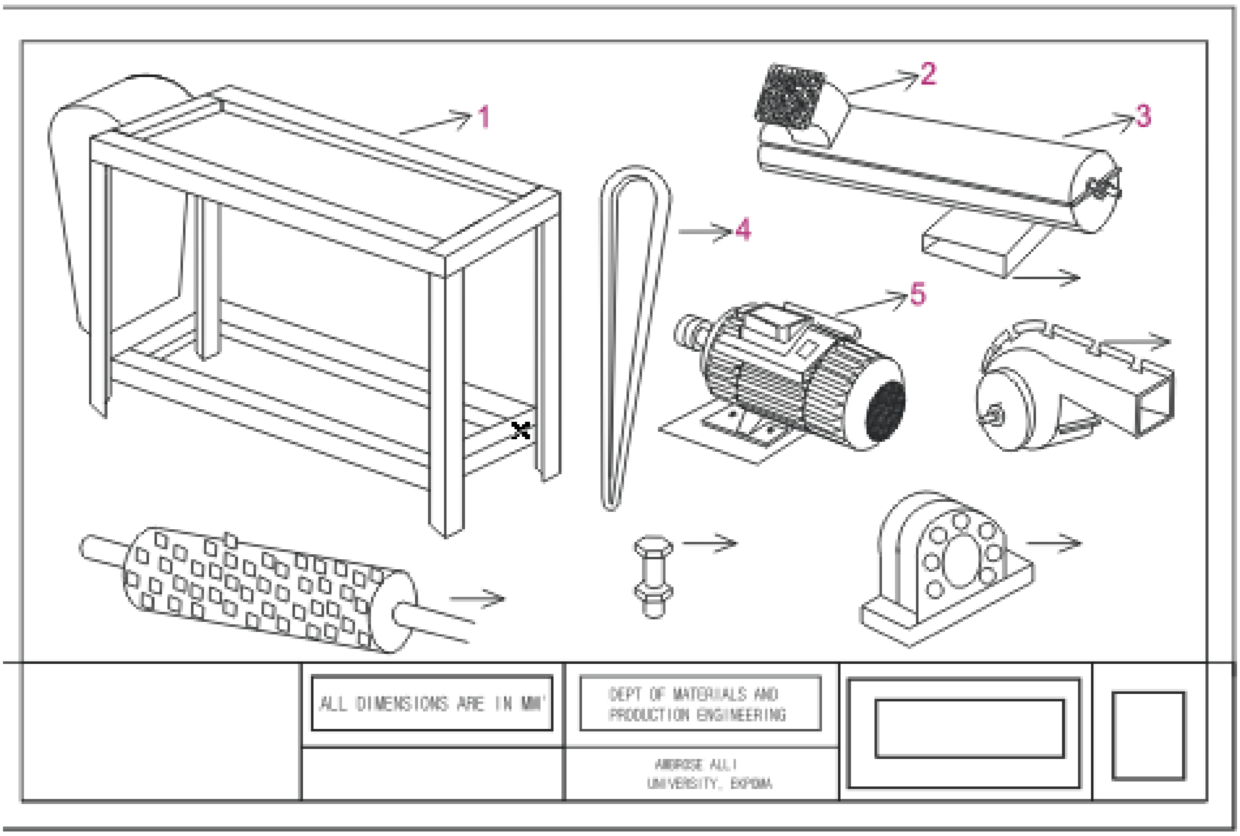
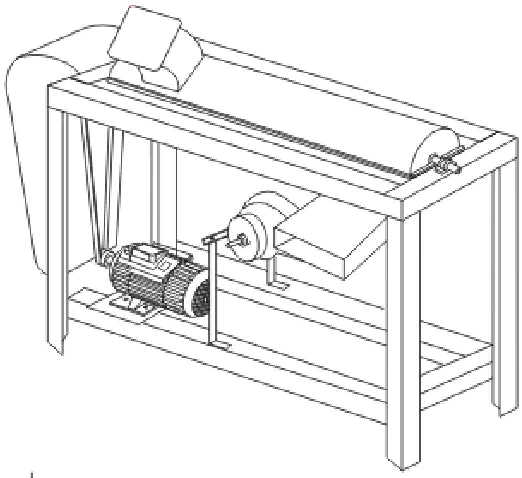
Appendix 1







ISOMETRIC VIEW OF A CORN SHELLING MACHINE

S/N	DESCRIPTION	QTY
1	FRAME	1
2	HOPPER	1
3	BODY CASING	1
4	BELT	1
5	ELECTRIC MOTOR	1
6	GRAIN DISCHARGER	1
7	BLOWER	1
8	SHELLING UNIT	1
9	BOLT AND NUT	1
10	BEARING	1

Note:

All Dimensions are in mm

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