MODIFICATION OF A SEED DRESSING MACHINE

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MATRIC. NO. 2005/21615EA

BEING A FINAL YEAR PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING (B ENG) DEGREE IN AGRICULTURAL AND BIORESOURCES ENGINEERING. FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA. NIGER STATE.

JANUARY, 2011.

DECLARATION

I hereby declare that this project work is a record of a research work that was undertaken and written by me. It has not been presented before any degree or diploma or certificate at any university or institution. Information derived from personal communications, published and unpublished work were duly referenced in the text.

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CERTIFICATION

his is to certify that the project entitled "Modification of a Seed Dressing Machine" by .echukwu, Olisaemeka meets the regulations governing the award of degree of Bachelor of ngineering (B. ENG.) of the Federal University of Technology, Minna. And it is approved for contribution to scientific knowledge and literary presentation.

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DEDICATION

This project work is dedicated to God, Almighty for making it possible for me to complete my course of study.

ACKNOWLEDGMENTS

Throughout the effort, God has always been with me. I am therefore very grateful to the almighty for his provision, wisdom and guidance.

My sincere appreciation goes to my supervisor Engr. Dr. P.A. Idah, for the time, guidance, and inspiration put into this work, even with a limited time and tight schedule. I also appreciate my head of department Engr. Dr. A. A. Balami and Lecturers, for there wonderful assistance.

My special acknowledgement goes to Mr K.A. Bello, who was also very instrumental in the completion of my work, to my course mates and the entire staff of Agricultural and Bioresources engineering department.

I also wish to thank specially my lovely parents Mr. and Mrs Ilechukwu, for their immense support both financially, morally and most especially for being there when I needed them.

ABSTRACT

One major problem being encountered is the health hazard posed by allowing dangerous chemicals to come in contact with the body. In this study a manually operated seed dressing machine was modified to be operated by electric motor to reduce the labour and drudgery involved in the manual operation. The speed which was initial 40 r.p.m when manually operated was modified to a speed of 158 r.p.m using the electric motor. The result from the performance test shows that out of 11kg of grain (maize), 8.36kg was fully mixed, 2.2kg was partially mixed and 0.44kg was unmixed, and also the efficiency of the machine was obtained to be 76%. It is therefore recommended to use speed reduction gear to further reduce the speed of this electric motor for more efficient dressing. Chain and belt system could also work.

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NOTATION

L = Length

r = Radius

d = Diameter

V = Volume

m = Mass

g = Acceleration due to gravity

w = Weight

ρ = Density

W = Work done

n = Number of revolution

S = Distance

t = Time

ω = Angular velocity

f = Force

M = Moment

R_B = Reaction of point B

R_A = Reaction of point A

M_x = Bending moment

S.F = Shear force

T = Torque

J = Polar 2^{nd} moment of area

σ = Shear stress

Fr = Radial load

Fa = Axial load

M.C = Moisture content

N = Newton

hr = hour

K = Kobo

₦ = Naira

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

Seed processing in agriculture is one of the basic operations carried out on the farm, and its increasing demand for agricultural raw materials like maize, millet sorghum, e.t.c, has led new and existing industries to supply better quality seeds in more readily usable forms. These processing of raw materials, can be in form of dressing of seeds, before planting so as to produce crops with good quality and high yield (Alfa, 1981).

For research purposes and continuous production of agricultural products, seeds are of great importance. Therefore treatments of seeds are very essential to production. These treatments can be with chemicals designed to meet the desired purposes of production such as production of quality crops free from termites attack, insects and rodents (Bayer *et al*., 1980). There are various methods of seed treatment such as the use of calabash for treating seeds before they are planted on the farm (Raji, 1995). Some of these seed dressing machines include; revolving drum seed mixer, slurry seed treater, manual seed dresser village scale seed treater, and powder grains applicator and are usually on the industrial base. Treating seeds at the family level is usually done using bare hands to mix the chemicals with the seeds which is very dangerous healthwise.

1.2 Objectives of the study

The objective of this project work is:

To modify a seed dressing machine which was manually operated with handle, to electrically operated system so as to reduce drudgery and obtain better results.

1.3 Justification of the Study

The efficiency and performance of a manually operated seed dressing machine is usually slow and time consuming. There is therefore need for modification of this machine by including an electric motor to the design so as to control the speed and increase efficiency as well as rate of seed dressing.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Seed Treatment

Seed treatment is a term that describes both products and processes. Seed treatment can be done in one of the following types.

1. **Seed dressing:** This is the most common method of seed treatment. The seed is dressed with either a dry formulation or wet treated with a slurry or liquid formulation. Dressings can be applied at both farm and industries. Low cost earthen pots (calabash) can be used for mixing pesticides with seed or seed can be spread on a polythene sheet and required quantity of chemical can be sprinkled on seed lot and mixed mechanically by farmers (Alfa, 1981).
2. **Seed coating:** A special binder is used with a formulation to enhance adherence to the seed. Coating requires advanced treatment technology, by the industry (Alfa 1981)
3. **Seed pelleting:** The most sophisticated Seed Treatment Technology, resulting in changing physical shape of a seed to enhance pelletibility and handling. Pelleting requires specialized application machinery and techniques and is the most expensive application.

2.2 Reviews on Seed Dressing Machine

Improvement in technologies and the need for production of quality seeds prior to planting and storage, has given rise to need for seed dressing machines. Simple on-farm seed treatments are still necessary in many circumstances in developed and developing countries. A range of seed treating machines as described by Jeffs and Tupens, (1986) used dust and wettable powder.

Various methods used for on farm treatment include mobile commercial equipment specifically designed for this purpose, such as motor driven revolving drum system, drum mixer and home-made devices using auger, hand cracked revolving drum or gravity feed systems, and cement mixers (Jeffs et al., 1986). The modern equipment application criteria of such equipment are; accuracy and uniformity of application, ease of operation, ability to handle a range of formulation, and seed species (Halmer, 1994).

2.3 Seed Dressers

These are machines used for dressing and treating seeds with chemicals, practically eliminating risk to health.

2.3.1 Types of Seed Dressers

The modern method of seed dressing involves the use of machine which can be found in majority of the farms (Fream, 1985). Some of the devices used for seed dressing are as follows:

i. Slurry seed treater

ii. D – 1m chemical treater

iii. Manual / motor driven seed dresser

iv. Village scale seed treater

v. Powder grain pickle applicator

2.3.2 Slurry Seed Treaters

This machine is made to treat seed with chemicals in solution or suspension. It makes use of paddle which agitates the slurry of seed and chemical. The paddles are driven by V-belt and pulleys are powered by 0.75kw electric motor. The slurry tank is 120 litres. The machine could be used to treat 1000 to 1500kg of seed per hour (Fream, 1985).

2.3.3 D – 1m Chemical Seed Treater

This is a seed treatment machine which is made of an auger type mixer into which seed chemicals can be introduced in measured quantities. These seed treating may be used for powder or liquid chemicals (Buyer, 1980). Powder chemicals are loaded in the tall hopper while liquid treatment chemicals are loaded in a plain drum and fed to the seed by a pump. It is powered by 1.4kw motor and can treat tons of seed per hour (Buyer, 1980)

2.3.4 Manual / Motor Driven Seed Dresser

This machine is made up of a steel cylinder mixing drum. The drum is supported by metal frame which houses the bearing on which the drum rotates when rotated manually through the hand crank or electric motor (Alfa, 1981). The seed and chemical are loaded into the drum through a tightly fitting hatch by the side. After seed must have been thoroughly mixed they are off loaded through the hatch by the side of the drum. It is powered by 1.5kw motor and can treat tons of seed per hour (Kaul, 1985).

2.3.5 Village – Scale Seed Treater

This machine makes use of the power transmitted through foot peddling to mix seed and chemical. The machine has pedal operated pulley for driving the mechanism located in the treatment drum. The treater uses powder application. A battery powered spinning disc may be fitted internally (Alfa, 1981).

2.3.6 Powder Grain Pickle Applicator

This device is fitted at the inlet of a grain auger and it is driven by the exposed auger flight (Kaul, 1985). The device is used to coat cereals seed with powdered chemicals or pesticides before planting. The applicator is operated according to the speed of the auger and it also has a calibrated flow rate adjustment (Kaul, 1985).

2.4 Forms of Insecticides/Pesticides:

There are different types of insecticide/pesticides used for protecting crops, they are:

i. Emulsion concentrates (EC)

ii. Gels and Baits

iii. Powder

iv. Encapsulation

v. Suspo-Emulsions (SE)

vi. Wettable powder (WP)

vii. Dust (Stuart, 2003).

2.4.1 Emulsification Concentrates

These are oily liquids in a solvent. When diluted with water, a milky emulsion is formed in which the insecticide oily droplets are finely dispersed (Stuart, 2003). These concentrates are very expensive and inflammable. ECs are suitable for surface application but are not suitable for mist application (Stuart, 2003).

2.4.2 Baits

The active ingredient (such as Gamma BHC) is formulated in an edible bait. This is taken in by the target pest, usually having a longer term effect. This method is particularly useful for the control of cockroaches and Pharaohs ants, where the bait is also taken back to the nest (Stuart, 2003) Kumar, (1980) defined baits as the use of suitable attractant to lure the pest to the insecticides.

2.4.3 Powder

These are pesticides which are made in powder form. They are applied as dust and active ingredient in mixed with Talcum powder. The mixture must flow easily without forming lumps. Dust are used to protect stored produce and provide seed treatment (Cornes, 1963).

2.4.4 Encapsulation

This is the coating of the seed with chemicals which are toxic to insect. Maddleton (1973), pointed out that capsules can be produced in sizes from 1-2mm with encapsulation; The rate of chemicals in the field can be controlled.

2.4.5 Suspo-Emulsions (SE)

A suspo-emulsion is a formulation, consisting of a suspension concentrate coupled with an oil based emulsion (Stuart, 2003). It is designed to take advantage of the high residuality of the particulate SC (suspo concentrate) with the speed of the oil-in-water (emulsion)(EW). Whilst one part of the formulation (the EW) is fast acting, it is also broken down quickly in the environment but this is balanced by the particulates in the suspension that start to become effective after the water carrier has evaporated and remain active for long (Stuart, 2003).

2.4.6 Wettable Powder

This formulation also includes water dispersible powders (WDP). WPs consist of an inert powder impregnated with the active ingredient and incorporating a wetting agent to aid dispersion in water. Middleton (1973), stated that when the products are added to water the wetting agent enable the particle to be wetted and the dispering agent prevent the particles from aggregating together. These chemicals are cheaper than emulsifiable (Stuart, 2003).

2.4.7 Dusts

These contain a low concentration of active ingredient mixed with an inert powder. In domestic and food premises they should be applied primarily to inaccessible places They can be very effective in small quantities for wasps and ants nests control, in addition to effective barrier treatments. The can be applied by small puffer packs or with a range of pressure dusters and Motor-Blo etc (Stuart, 2003).

2.5 Methods of Seed Dressing

Dressing of seed can be classified into two groups based on the methods through which seed dressing is achieved. These are:

i. Mechanical methods of seed dressing

ii. Traditional method of seed dressing (Alfa, 1981).

2.5.1 Mechanical Methods of Seed Dressing

Mechanical methods of dressing seeds is the use of machine in the application of treatment chemicals to seeds. In an attempt to improve the traditional methods of dressing seeds, Alfa (1981) design and constructed a manually operated machine for dressing seeds, it consist of a drum with an opening for the seeds and chemical to be loaded and unloaded. The drum is placed on a frame, supported by a ball bearing at both end of the drum. The drum is made to rotate by manual turning of the handle cranks (Alfa, 1981).

The machine is made of locally available materials like metal sheets. But it is not adequately effective in the treatment of seeds, since the drum does not contain a shaft for proper mixing of chemicals and seeds (Alfa, 1981). Raji (1995) designed and constructed a manually operated seed mixer. The machine is made of metals, it consist of a drum which is welded to a shaft. The drum is positioned at an angle of 25° to the horizontal surface. The drum has a tightly fitted opening known as the hatch. Through the hatch seeds and chemicals are loaded and unloaded. The shaft with the drum is placed as a unit on a frame support and is supported by ball bearings on the frame. The drum is made to be rotating by manual turning of the hand crank, which is an extension of the shaft. The rotation of the drum creates turning and agitation of the seeds in the drum which resulted to proper seed dressing with chemical. It was discovered that there is need to carry out improvement on the machines as it is less effective in its operation.

Buyers and crop science (1980) discovered an electronic operated continuous wet seed dresser type VP4 to carter for the protection of seeds. The wet seed dresser strains the seed in the wet continuous technique by passing through the portion of the dressing can set up to exactly provide superior straining of the seeds. Norogard (1987) developed an electrically operated batch seed dresser. The machine uses dry formulation to protect the crop, and the machine is powered by electric motor. The treatment chemical is passed to the mixing chamber for proper mixing. Seeds were properly mixed at speeds ranging from 148 – 162rpm (Raji, 1995).

The machine which is effective in treating large quantity was developed at the National Centre for Agricultural Mechanization NCAM (1990). It has an opening where the chemical and seed are filled and discharged. The drum is rotated by the help of a handled cranked.

2.5.2 Traditional Methods of Seed Dressing

The earliest form of seed dressing used was to steep the seed in liquids such as urine or wine with the aim of protecting the seed (Alfa, 1981). At present there are various types of seed dressing chemicals such as Aldrex T, Femansan D and others. These chemicals are everywhere in Nigeria especially in Northern part where cereal like maize, rice, sorghum, millet guinea corn are largely produced (Alfa, 1981).

The traditional method of dressing seeds especially in villages around Kaduna, Katsina and Niger State is to pour three mudus equivalents of 3.5 kilogram into calabash or gourd with one packet of either Aldex T or Femansan D. the gourd is then shaken for about 3 minutes for thorough mixing (Alfa, 1981). This method is of low efficiency and very tedious as large quantity of seed cannot be dressed within minimum time. Insufficient use of powder chemical adheres to the inner surface of gourd and some escape. The escape powder is dangerous to human life and health as these powder chemicals are poisonous; this method has the advantage of not breaking the seeds (Alfa, 1981).

2.6 Seed mixers

These are various types of machines used in mixing chemicals with seeds, with the aim of protecting the crops from the attack of pest, insect, fungi and nematodes (Raji, 1995).

2.6.1 Types of Mixers

All the machines used for seed dressing make use of the principles of mixing two or more properties, either solid with powder or liquid with solid. Mixing is an operation which two or more component is intercepted in space with one another (Raji, 1995).

The aim is to achieve a uniform distribution of the component by means of flow (Brenan 1981). Some of the basic types of mixers are:

i. The stationary vessel containing moving peddles vanes, plough screws and so on. These types of mixer are used for very high consistency mixing

ii. The stationary vessel which has a moving stirrer, these are widely used for low viscosity liquid (Raji, 1995)

In summary, the various types of seed treating equipment available in the market have one disadvantage or the other ranging from their cost to the operational difficulties especially by the rural farmers. It is thus necessary to provide simple equipment that can easily be managed by these groups, hence the need for this presents;

1. Revolving Drum Mixer
2. Auger Mixer
3. Horizontal Trough Mixer
4. Turbine Agitator

5. Spinning Drum Mixer
6. Vertical Screw Mixer
7. Impeller Agitator
8. Pan Mixer
9. Paddle Agitator
10. Propeller Agitator

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Design Consideration

In design, choice of material suitable for design is considered with regards to the conditions it will encounter during service. The process used to manufacture a component will influence the choice of material, which will require terms such as mechanical and physical properties of the material. The material may need to be strong, tough to twist and bend without breaking or to conduct heat or electricity. There are various factors considered in carrying out the design procedure of seed dressing and these factors include :

(a) size and weight of the machine,

(b) physical and mechanical properties of seeds

(c) physical properties of the material

3.2 Machine Description and Operational Procedure

The modified seed dressing machine is operated by a single phase electric motor. The power is being transmitted through the v-grooved belt coupled on the pulley of electric motor, which is smaller to the bigger pulley on the drum. The machine consists basically of a drum, a shaft, and some other component like the bearings, v-grooved belt and nuts and bolts. The power from the electric motor is transmitted through the v-grooved belt to the shaft, with the aid of the pulleys. The shaft in turn rotates the drum, which runs internally through the drum. The shaft has fan like structures on it which aid in mixing the seed and chemicals for effective dressing. The drum acts or rotates together like one body. The shaft is held in place by the bearings and for proper rotation. This seed dressing machine also incorporates a handle such that it acts as an alternate cranking device.

3.2.1 Description of Component Parts of the Machine

The machine is made of the following main components,

1. The frame
2. The cylindrical drum
3. The shaft
4. Ball Bearing
5. Iron of Angle Iron
6. Nut and Bolt

The Frame: The frame is made of square pipe angle iron fitted with the bearing seat, supporting the bearing. It is a mild steel metal sheet, contains up to 0.25% (percent) carbon which is used to produce a material with a hard case. Mild steel metal sheet is used for components where strength and wear resistance are of prime importance such as in body work and frame members. Mild steel metal sheet was used in the construction of the cylindrical rotating drum, which has resistance to corrosion actions.

Cylindrical Drum: The cylindrical drum is made of mild steel of 18 guage with outlet for the seeds and chemical; it is welded to shafts which pass through the drum supported on the frame by ball bearings. The drum is inclined at angle 25^0 to the horizontal surface.

Shaft: It is a rotating machine element which is used to transmit power from one place to another. Its delivered power by tangential force and resultant torque or twisting moment set up within the shaft permits the power to be transmitted to various machine linked up to the shaft.

It has the material properties of high strength, good machineability, low notch sensitivity factor, good heat treatment and high wear resistance. It is manufactured from material of carbon steel of grades 40c8, 45c8, 50c4 and 50c12, and in order to improve the properties of the shaft, other metals are added to the steel material such as nickel which improves the ductility and toughness of shaft by preventing excessive grain growth and chromium which increases the hardness of the metals. It is subjected to twisting moment or torque, bending moment, combination of both and to axial loads on it. Mild steel shaft was selected for this design, it resists bending or distortion load applied, it is strong and can withstand both tensile and compression stress and cheaper than others. The shaft with the drum are placed on a support and are supported by ball bearing on the frame, the drum is made to be rotating by action of the electric motor which is an extension of the shaft. The rotation of the drum creates turning and agitation of the seeds dressing with chemicals.

Ball bearing: It is a machine element which supports another moving machine element and it permits a relative motion between the contact surfaces of the number while carrying the load. It reduces frictional resistance and wear. In some cases carry away the heat generated and a layer of fluid known as lubricant may be provided. They have the properties of comprehensive strength, fatigue strength, conformability, bondability, corrosive resistance and thermal conductivity. The manufacturing material is cast iron, tin and lead base babbits (lead, tin and copper).

Iron of Angle Iron: This is also one of the cheapest and is most ductile which contains up to 35% (percent) of carbon is used to produce the material. It is used for components where strength and wear resistance are needed in the body work and frame members. A square pipe iron was selected for the construction of machine frame the square pipe is strong to withstand vibrations when the machine is in operation without failure. An angle iron of $50mm\ x\ 50mm\ x\ 5mm$ was chosen for the design.

Nuts and Bolt: the hexagonal nuts and bolts was selected because it is the commonest form for nut and bolt head with a change at the top of the bolt head and at each end of the nut to remove the sharp corners, hexagonal form of less space and is therefore lighter than a square having the same distance across flats round the corner. It is manufactured from Alloy steel and aluminum steel material which makes it strong to withstand vibration when the machine is in operation without loosening.

3.2.2 Size and Weight of the Machine

For ease of portability and transportation, machine bulkiness was avoided by putting the size and weight of the machine into consideration. Therefore materials with high rigidity, strength, durability that can withstand the design were used.

3.3 Design of Machine components

3.3.1 Determination of Weight and Volume of Cylinder

The rotating cylinder (drum) which is mounted on the frame and support by the ball bearing.

Volume of cylinder = $\pi r^2 l$ (1)

L = length of cylinder

R = radius of cylinder

$\pi = \frac{22}{7} = 3.142$ (taken)

The length of the cylinder, where l = 620mm, diameter d = 300mm

d = 2r, r = 0.15m

Volume of cylinder

$$v = \pi r^2 l \quad (2)$$

$= 3.142 \, x \, 0.15^2 x \, 0.62 = 0.044m^3$

According to P.S.G data (1985) density of galvanized sheet = 7,800kg/m^3

Mass = Density x Volume

Mass = 7,800 x 0.044 = 34.32kg

Weight of cylinder = Mass x acceleration due to gravity

Weight of cylinder = 34.32 x 9.81 = 336.68N.

3.3.2 Determination of Circumference

Circumference of cylinder = $2\pi r$ (3)

2 x 3.142 x 0.15 = 0.9426m = 94.26cm

3.4 Estimation of Forces Required for Rotating the Drum

3.4.1 Shaft Design

The size of shaft for particular loading may be determined in the bases of strength and ability to withstand failures due to torsion, bending and with loading.

The choice of shaft size must be such that the induced stress must not exceed the allowable stress of material. The action of loading considered in this design is the axis load

Data

Power of the electric motor, 1.5kw (1hp)

Speed of the electric motor, 1420rpm

Diameter of the driving pulley, 50mm

Diameter of the driven pulley, 450mm

The force acting on the shaft is as a result of

a. Axial load (F_a) due to the weight of drum, weight of the seed and chemical, weight of the driven pulley.
b. Torsional forces as result of the drive from the pulley.

The combined effect of these forces will cause

1. Bending moment
2. Torsional moment
3. Compression

To calculate the Torsional moment Mt, the speed of the driven pulley is given by the relationship

$N_1\ D_1 = N_2\ D_2$ (Khurmi and Gupta, 2006).

$$\frac{N_1}{N_2} = \frac{D_2}{D_1} \quad (4)$$

N_1 = Speed of the driving pulley, rpm

N_2 = Speed of the driven pulley, rpm.

D_1 = Diameter of driving pulley, m

D_2 = Diameter of driven pulley, m.

For these design a D.C motor having a speed of 1420 rpm and a diameter of driving and driven pulley of 50 mm and 450mm respectively are chosen , in order to reduce the speed from the motor by 1:9, these in turn increases dressing efficiency.

3.4.2 Determination of the Speed of the Driven pulley

The speed of the driven pulley can be calculated from

$$\frac{N_1}{N_2} = \frac{D_2}{D_1}$$

Substituting data

$$\frac{1420}{N_2} = \frac{0.45}{0.05}$$

$$N_2 = \frac{71}{0.45}$$

= 158 rpm.

3.4.3 Torsional Moment on the shaft

The torsional moment can be calculated from the formula

$$T = P\ x\ \frac{60}{2\pi N}$$ (5) (Khurmi and Gupta, 2006)

Where;

P = Power of the D.C motor, 1.5kw

N = Speed of the shaft, 158 rpm

π = 3.142

Substituting Data

$$T = \frac{1.5\ x\ 1000\ x\ 60}{2\ x\ 3.142\ x\ 158}$$

$$= \frac{90.000}{392.872}$$

$$= 229Nm$$

Tosional moment, Mt = 229Nm

3.4.4 Determination of Tight and slack side T_1 and T_2, belt tension.

For belt drive twisting moment is given as $Mt = (T_1 - T_2)R$ (6)

(Khuri and Gupta, 2006)

Where;

Mt = Torsional moment

R = Radius of Driven pulley

$T_1 = Tight\ side\ belt\ tention$

$T_2 = slack\ side\ belt\ tension$

Ratio of driving tension for v-belt is given as

$$\frac{T_1}{T_2} = e^{\mu\theta cosec\beta} \qquad (7)$$

Where;

$T_1 = Tight\ side\ belt\ tension$

$T_2 = slack\ side\ belt\ tension$

$\mu = Coeficient\ of\ friction\ of\ belt\ on\ pulley, 0.3$

$\theta = Angle\ of\ wrap\ or\ contact$

$\beta = Groove\ angle\ of\ pulley, 36^0$

But Angle of wrap, θ is given by

$$\theta = \frac{(180-2\alpha)\pi}{180}$$

$$sin\alpha = \frac{r_1 - r_2}{x}$$

$r_1 = Radius\ of\ driven\ Pulley$

$r_2 = Radius\ of\ driving\ pulley$

x = Distance between pulleys

$$sin\alpha = \frac{0.225-0.025}{0.6}$$

$$= \frac{0.2}{0.6}$$

$= 0.3$

$\alpha = sin^{-1}\ 0.3$

$\alpha = 19.47^0$

Therefore;

$$\theta = \frac{(180-2\,x\,19.47)}{180}$$

$= 2.78\,rad$

Substituting Data into equation 3.6.4

$$\frac{T_1}{T_2} = e^{0.3x2.94xcosec18^0}$$

$$\frac{T_1}{T_2} = e^{0.3x2.78x3.2361}$$

$$\frac{T_1}{T_2} = e^{2.69689}$$

$$\frac{T_1}{T_2} = 14.86$$

$T_1 = 14.86T_2$

But

$Mt = (T_1 - T_2)R$

Substituting $T_1 = 17.39T_2$ in the above equation and the value of Mt

$2.29 = (14.89T_2 - T_2)0.225$

$2.29 = (13.89T_2)0.03$

$2.29 = 0.4917T_2$

$$T_2 = \frac{2.29}{0.4917}$$

$= 4.66N$

$2.29 = (T_1 - 4.66)0.225$

$= 10.13 = T_1 - 4.66$

$= T_1 = 14.83N$

3.4.5 Length of Required Belt

The length is given by

$$L = \pi(r_{1+}r_2) + 2x + \frac{(r_1 + r_2)^2}{x} \quad (8)$$

Where;

r_1 = radius of driving pulley, 25m

r_2 = radius of driven pulley, 225mm

x = distance between pulley, 600mm assumed

$= 3.142\,(25 + 225) + 2 \times 600 + \frac{(60+30)^2}{600}$

$= 3.142\,(250) + 1200 + \frac{(250)^2}{300}$

= 785.5 + 1200 + 104.16

= 2089.66mm

3.5 Power Required In Operating the Machine.

To determine the power required to operate the machine at the expected speed of 158 rpm power.

$$\text{Power is given by} = \frac{2\pi NT}{60} \quad (9)$$

where, $\pi = 3.142$

N = speed of the driven pulley, 158

T = twisty moment, 2.29 Nm

$= \frac{2 \times 3.142 \times 158 \times 229}{60}$

$= \frac{899115}{60}$

= 1498.5 watt

= 1.5 kw

Therefore an electrical motor of 1.0 hp capacities can be used to power machine

From the expression,

$$P = \frac{\omega}{t} = \frac{f x v}{t} = f x v$$

(10)

But $v = \omega r$ (11)

$P = f x \omega r$

Where $\omega = \frac{2\pi n}{60}$ (12)

$$P = f x r x \frac{2\pi n}{60} \quad (13)$$

P = motor power requirement

V = number of revolution

n = number of revolution

r = radius of drum

S = distance

t = time

ω = angular velocity

From equations (4),

$$P = F x r x \frac{2\pi n}{60}$$

Making F, the suject of the formula

$$F = \frac{P \times 60}{r \times 2\pi n} = \frac{1.5 \times 60}{0.15 \times 2 \times 3.142 \times 158} = 0.60431KN$$

3.5.1 Speed of Drum

From equation (11)

$V = \omega r$

$$V = \frac{2\pi n}{60} \times r = \frac{2 \times 3.142 \times 158}{60} \times 0.15 = 2.482\ r.p.m\ , \text{i.e}$$

The number of revolutions per minute of the machine is taken to be 158rpm at full loading.

3.6 Loads on the Shaft

The following loads act on the shaft these include weight of metal plate, weight of chemical used

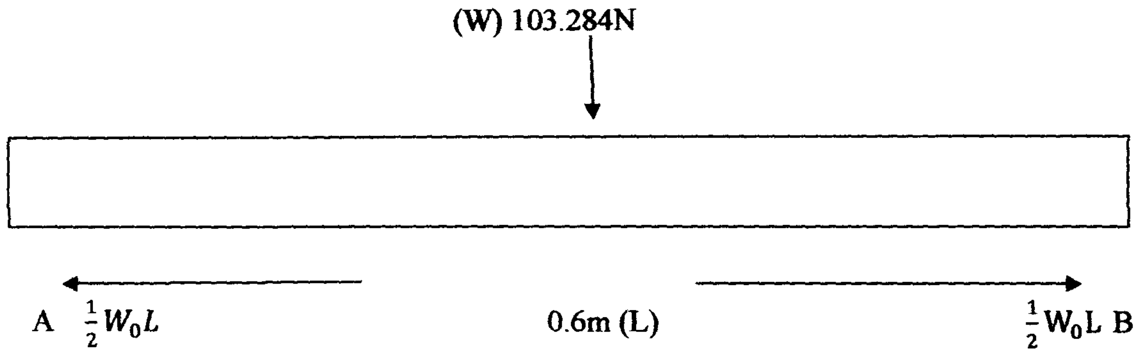
i. Weight of chemical 0.4kg = 0.4 x 9.81 = 3.92N

ii. Weight of metal plate 1.260N

iii. Weight of material = 10 x 9.81 = 98.1N

The total weight on shaft

1.260 + 98.1 + 3.924 = 103.284N



Taking moment about B at a distance X from the mid – point L

$$M = \frac{W_0L}{2}x - \frac{W_0x^2}{2} \quad (12)$$

$$\sum M_x = R_{AX\uparrow} = 0 \text{ (clockwise moment)}$$

$$M_x = RA - wx \quad (13)$$

$$\text{But } RA = \frac{wl}{2} \quad (14)$$

$$Mx = \frac{wl}{2} x (x - w).x.\frac{x}{2} \quad (15)$$

when $x = 0$, $Mx = 0$.

when $x = \frac{1}{2}$

$$Mx = \frac{wl}{2} x \frac{al}{2} - \frac{wc}{2} x \frac{1}{2}\frac{(l)^2}{2} - \frac{wl^2}{4} = \frac{2wl^2}{8} - \frac{wl^2}{8} = \frac{wl^2}{8} \quad (16)$$

Where;

W = weight acting on the shaft

L = Length of cylinder

R_A = reaction of point A

R_B = reaction of point B

M_x = Maximum bending moment

$M_x = \frac{wl^2}{8} = \frac{103.284(0.60)^2}{8} = \frac{37.18224}{8} = 4.6778\text{Nm}$

When x = l (from equation)

$\frac{wl}{2} \text{ x } l - wl \text{ x } \frac{1}{2} = wl^2 - wl^2 = 0$

$$\frac{103.284 \text{ x } (0.60)^2}{2} - \frac{103.284 \text{ x } (0.60)^2}{2} = 0$$

$M_x = 0$ at $x = l$

Shear force

$$\frac{wl}{2} = \frac{103.284 \text{ x } 0.60}{2} = \frac{61.9704}{2} = 30.985\text{N}$$

The bending moment diagram and shear force diagram are shown in figure 3.1

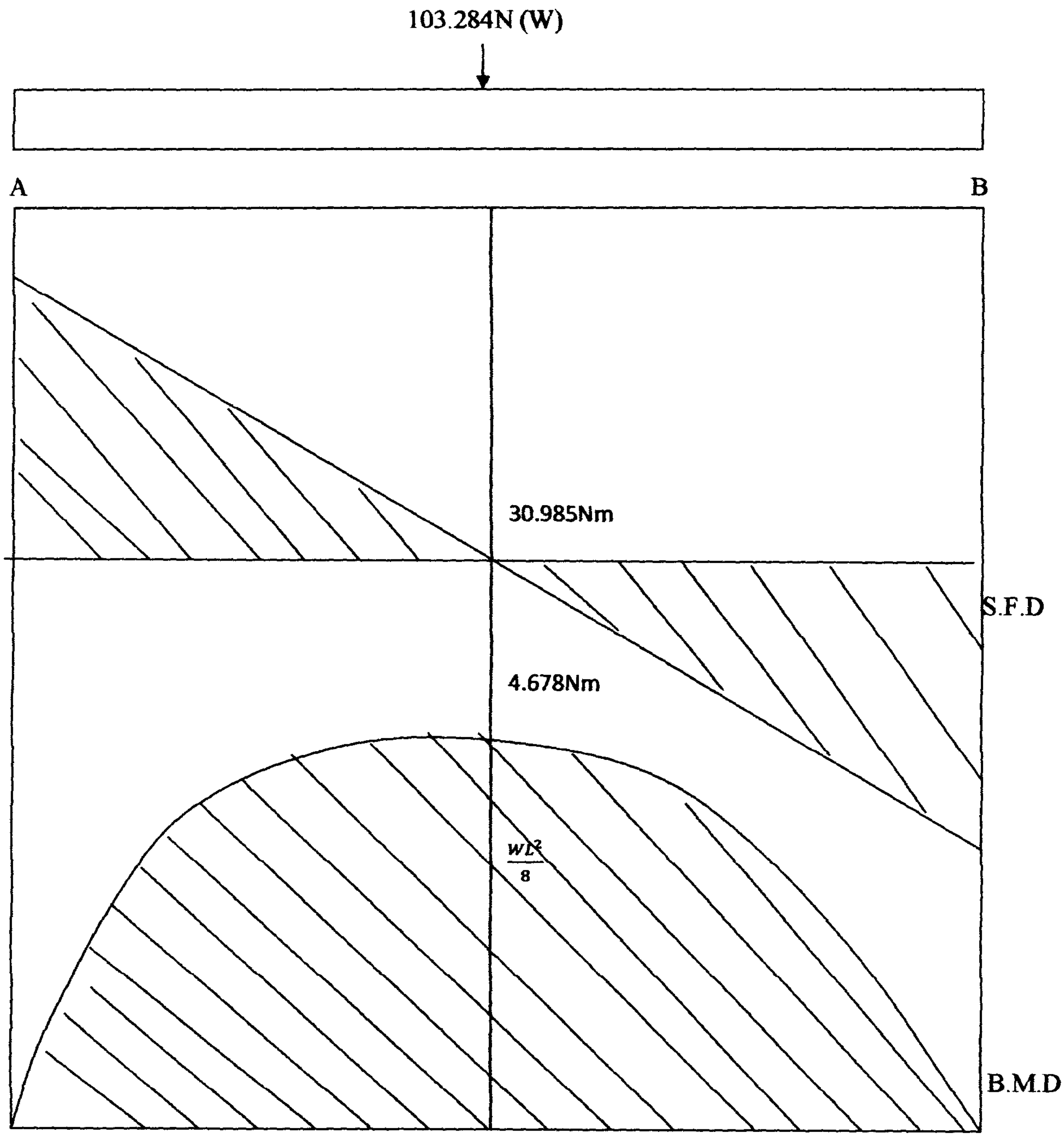


Fig 3.1: **BENDING MOMENT AND SHEAR FORCE DIAGRAM**

Where

S.F.D = shear force diagram

B.M.D = Bending moment diagram

3.6.1 Fatigue Loading on Shaft

Fatigue loading occurs when engineering components are subjected to various loads in this design, if the drum at 25^0 to the horizontal will create alternating loading which causes fluctuating bending load due to rotation of the shaft.

Fatigue loading has the effect of gradually enlarging small cracks in the material surface, the size of the crack and the extent of concentration of the stress continues to increases which may be high enough to cause sudden failure.

The fatigue limit of a particular material is the maximum stress which can be loaded on the material for an unlimited number of time without causing failure, if the applied stress exceeds the fatigue limit, the failure is expected to occur on the component, if its applied stress is below the fatigue limit on the component is expected to have unlimited life span.

The fatigue limits are often available in specification for materials. Therefore estimates of 40% (percentage) are used for steel as follows:

i. Torsional fatigue limit = 0.4 x shear stress

ii. Bending fatigue limits = 0.4 x tensile stress

From the above, bending fatigue limit was taken into consideration when finding the total shear force on the shaft.

3.7 Determination of Shaft Diameter

In order to calculate the shaft diameter, the torsion in the shaft, the factor of safety and the torsional fatigue limit were considered shaft torsion is a shear stress which is caused by the twisting effect of torque loading

Using the formula: $P = T\omega$

$$J = {}^{D^4}/_{32} \qquad (17)$$

$$\frac{T}{J} = \frac{\sigma}{r} \qquad (18)$$

P = Power (watts)

T = Torque (Nm)

ω = Angular velocity

J = Polar 2^{nd} second moment of area for a grid (mmt)

D = Shaft diameter (mm)

r = Shaft radius (mm)

σ = Shear stress (N/mm^2)

The average power which a motor can produce to do work is taken as hp (horse power) which is equivalent to 1.5kw. The number of revolution per minutes of the machine is also taken to be 158 r.p.m at full loading.

$P = T\omega$

$1500 \quad = \qquad T\omega$

But $\quad \omega = \frac{2\pi n}{60}$

$1500 = \qquad T \times \frac{2 \times 22 \times 158}{7 \times 60}$

$T = \frac{31332.0}{176.0} = 1796.09Nm$

Stress of mild steel is given as 324 N/mm^2

$$\text{Allowable stress} = \frac{324}{\text{Factor of safty}} \qquad (19)$$

$= \frac{324}{5} = 64.8\ N/mm^2$

And Torsional fatigue limit = 0.4

Therefore the allowable stress (with torsion) = $\qquad 64.8 \times 0.4 = 25.92N/mm^2$.

When the shaft is subjected to a twisting moment (or torque) only, then the diameter of the shaft may be obtained by using the torsion equation.

$\frac{T}{J} = \frac{\tau}{r}$

Where T, = twisting moment (or torque) acting upon the shaft (Nm).

J = Polar moment of inertia of the shaft about the axis of rotation (mmt)

τ = Torsional shear stress, (N/mm^2).

r = Distance from neutral axis to the outer most fiber (mm)

r = d/2: where d is diameter of the shaft

For round solid shaft, polar moment of inertia

$$J = \frac{\pi}{32} \times d^4$$

$$J = \frac{D^4}{32}$$

$$\frac{T}{J} = \frac{\tau}{r} = \frac{1796.1}{D^4/32} = \frac{25.92}{D/2}$$

$$\text{Therefore } D = \sqrt[3]{\frac{1796.1 \times 32}{2 \times 25.92}} = 50.35\text{mm}$$

The chosen shaft diameter is 50.mm to fit the bore of a standard 10mm ball bearing.

3.8 Torque Required to Rotate the Cylinder

The torque required is calculated from the expression $T = P/\omega$ (20)

Where;

T = torque in N/M

P = electric motor requirement.

ω = Angular velocity in rad/sec

$$\text{But } \omega = \frac{2\pi n}{60} = \frac{2 \times 3.142 \times 158}{60} = 16.55 \text{ rad/sec}$$

$$T = \frac{P}{\omega} = \frac{1.5}{16.6} = 0.0906 \text{ N/mm} = 90.6\text{N/m}$$

3.8.1 Impact Load

The impact load on the shaft is calculated from the expression

$$Fr = \frac{P}{2\pi r} \qquad (21)$$

Where;

Fr = radial load

P = Power required

r = radius or shaft diameter

$$Fr = \frac{1.5}{2 \times 3.142 \times 25} = \frac{1.5}{157.1} = 0.009548\text{N}$$

The density of shaft = 7840kg/m^3 (Norogard, 1987)

Where P = density of shaft (kg/m^3).

M = Mass of shaft (N)

V = Volume of shaft

But V = $\pi r^2 L$.

$V = 3.142 \times (25)^2 \times 0.70 = 13.75m^3$

Mass = density x volume

Mass = 13.75 x 9.81 = 134.9N

Axial load = weight on shaft

$$P \text{ impact load} = Fa + Fr \quad (22)$$

Where Fa = Axial load (weight on shaft)

Fr = Radial load

Impact load = 134.9 + 0.009548N = 134.9N

The seed is treated at 12.5% moisture content dry basis.

Apart from the motor, the handle crank which is an extension of the shaft is added to the designed such that human factor is considered. The average human height to the height of the machine was considered, the length of the handle was 10cm x 20cm using mild steel as the material.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1.0 Dressing Analysis

Time of dressing = 3 minutes

Quantity of grain (maize) =11kg or 11000g

1kg was taken as test sample for uniformity of mix

760g was obtained to be fully mixed

200g was obtained to be partially dressed

40g was obtained to be unmixed

Uniformity of mix therefore is;

For fully dressed grains(x_g)

In 1kg, 760g was fully dressed

In 11kg , x_g was fully dressed

By cross multiplying to get x_g, it becomes

$$x = \frac{11kg\ x\ 760g}{1000} = 8360\text{g}$$

=> 8.36kg was fully mixed

For partially dressed grains(y_g),

In 1kg, 200g was partially mixed

In 11kg, y_g was partially mixed

By cross multiplying to get y_g, it becomes

$$y_g = \frac{11kg\ x\ 200g}{1000} = 2200\text{g}$$

=> 2.2g was partially mixed

For undressed grains (z_g),

In 1kg, 40 g was unmixed

In 11kg, z_g was unmixed

By cross multiplying to get z_g, z_g becomes

$$z_g = \frac{11kg\ x\ 200g}{1000} = 440\text{g}$$

=>0.44g was undressed.

Therefore 8.360kg was fully mixed, 2.2kg was partially mixed and 0.4kg was unmixed

Efficiency of dressing

Using efficiency formula

Mixing efficiency (%) = $\frac{Q_p}{Q_t}\ x\ 100$

Where $Q_u = Quantity\ of\ fully\ mixed\ seeds\ in\ sample\ (kg)$

$Q_t = total\ seeds\ in\ sample\ (kg)$

$Q_p = 8.360kg, Q_t = 11kg$

Mixing efficiency (%) $= \frac{8.360}{11}\ x\ 100$ = 76%

Mixing efficiency = 76%

Rate of mixing $= \frac{Fully\ mixed - partially\ mixed + unmixed}{time}$

Where fully mixed = 8.360kg

Partially mixed = 2.2kg

Unmixed = 0.44kg

Rate of mix therefore $= \frac{8.360 - 2.2 - 0.44}{3}$ = 1.97kg per minutes.

4.2 Results

Speed of previous machine = 40 r.p.m

Speed of modified machine = 158 r.p.m

Capacity of previous machine = not mentioned

Capacity of modified machine = 11kg

Efficiency of machine = 76%

Rate of mix = 1.97 kg per minute.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The result from the performance test shows that out of 11kg of grain (maize), 8.36kg was fully mixed, 2.2kg was partially mixed and 0.44kg was unmixed. The efficiency of the machine was obtained to be 76%. Also, the low speed recommended by the initial author of this project could not be achieved due to the following reasons;

1. Inability to get a low speed motor for the project work
2. Absence of speed reduction gear

5.2 Recommendations

The required speed for effective mixing should be below 100 r.p.m, hence to achieve this, the following recommendations should be followed or observed.

1. Due to the vibration, the machine is expected to be bolted to the ground to avoid vibration
2. A very low speed motor should be used (less than 500 r.p.m)
3. A gear reduction gear should be used.
4. A bigger pulley should be used in the drum shaft
5. Every opening on the drum should be well sealed to avoid dropping of chemical and seed.

REFERENCE

Alfa A.A. (1981), Design and Construction of Seed Dressing Equipment, Unpublished Degree Project, Department of Irrigation and Agricultural Mechanization, University of Agriculture Markurdi, Benue State.

Bayer and Crop Science (1980), Seed Treatment, Bulletin 638, Seed Treatment Equipment. The Ohio State University. Pp. 4-6

Brenan J.G. (1981), Food Engineering Operation Applied Sciences, Publishers Limited London

Cornes F.B. (1963), Formulation and Application of Insecticides in Pest Control, Edward Arnold Publisher Limited London Pp. 204-227

Freall A,N and S.A Baselman. (1977), Physical Properties of Seeds, Gorssvenor press International London. Pp86.

Fream W. (1985) Fundamental of Agricultural International Books and Periodical Supply Service New Dehil

Halmer A.S holowenko and Laughing H.G. (1984) Theory and Problem of Machine Design Schaum Outline Services.

Jeff K.A. and Tupen R.J. (1986), Application of Pesticides to Seed in Seed Treatment, British Crop Protection Council U.K. Pp 12 – 45

Kaul R.N. and Egbo C.O. (1985), Introduction to Agriculture Mechanization Applied Science Estabishers pp 2 – 10

Mass and Middleton (1973) Formulation and Application of Insecticides in Insect Control Edward Arnold (publisher) Limited London Pg 204 – 227

N.C.A.M. (1990), National Center for Agricultural Mechanization, Illorin Kwara State.

Norogard A.B. (1987), Seed Trearment Guidelines Edward Arnold (publishers) Limited London.

Ojiha T.P. and A.M. Micheal (1989). Principles of Agricultural Engineering Volume 1. Applied Science Publishers,London, Pp 42 – 61.

Raji T. (1995) Design and Construction Of Manual Seed Mixer, Unpublished P.G.D Project, Department of Agricultural Engineering Technology , University of Agriculture Markurdi Benue State.

Sitkei Gyorky, (1986) Machanics of Agricultural Materials (Development in Agricultural Enginnering) F1 Server Service Published Amaerdam. Netherlands, Pp 103 -206.

APPENDIX

Table 4.2: Material Cost

S/N	Material	Specification	Quantity	Amount (₦)	Price (₦)
1	Galvanized sheets	Two square meters	Two	500	1000
2	Angle Iron	50mm x 50mm x 5mm	Twelve	12	1200
3	Bolt and nuts	Ten and eight millimeter diameter	Eight	8	800
4	Shaft	25 mm diameter rod	One	600	600
5	Electric motor	1.5kw	One	1500	1500
6	Electric cable	2mm thickness	Two yards	350	700
7	Belt	A80 V-Belt	One	200	200
8	Maize	*Zea Mays*	11kg	500	500
9	Seed Plus Ds	Insecticide/ fungicide	three	300	900
10	Gum		Two	500	1000
11	Welding			1000	1000
12	Labour cost			2000	2000
	Total				15,400

FRONT ELEVATION

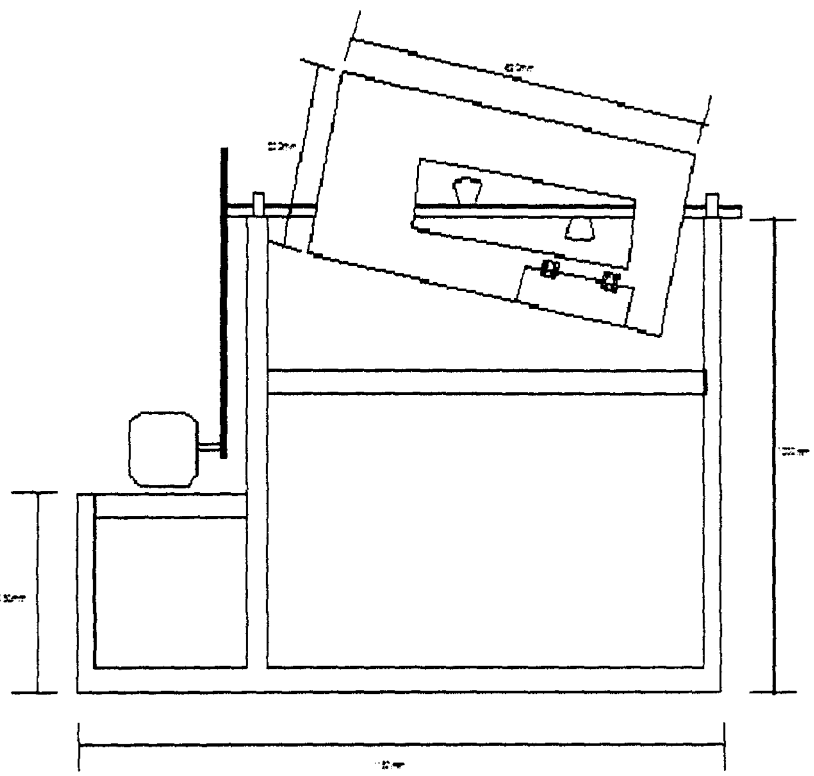


Plate 1: Front Elevation

PLAN

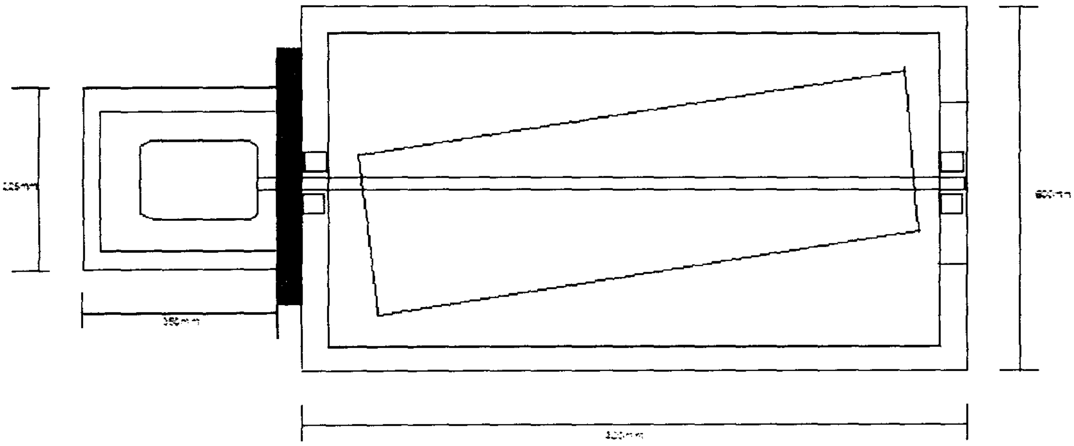


Plate 2: Plan

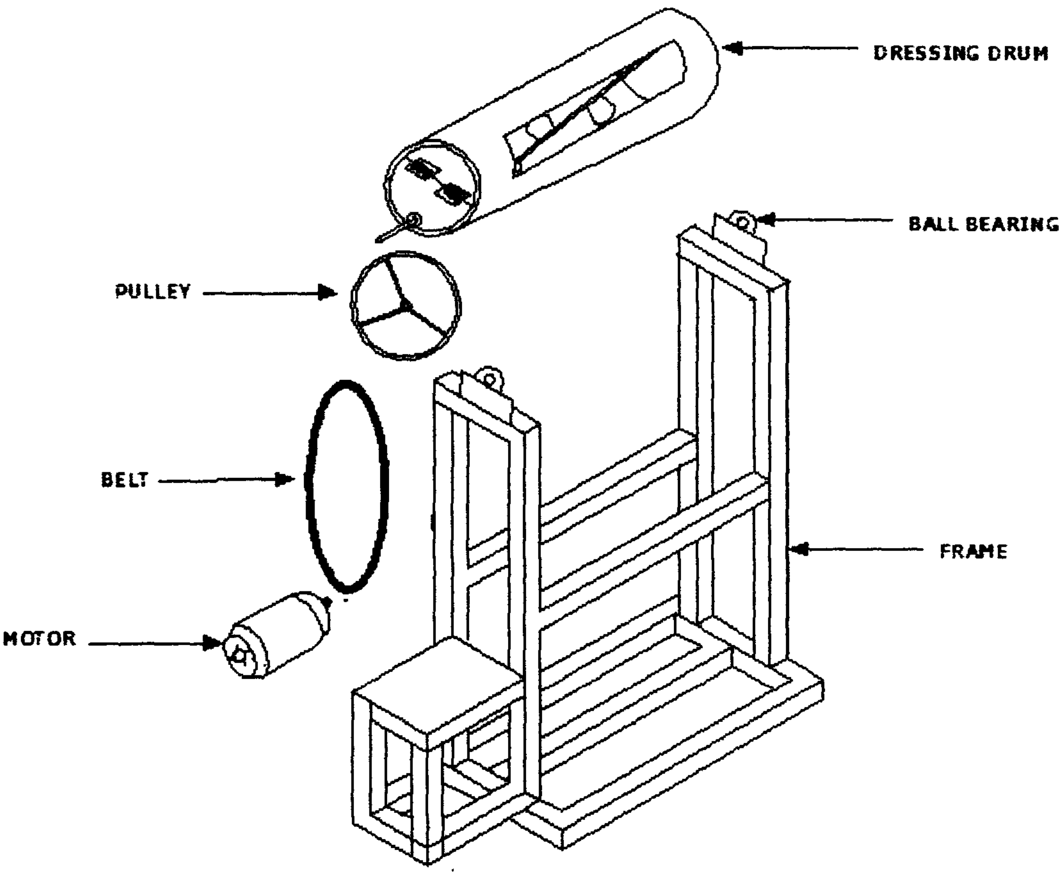
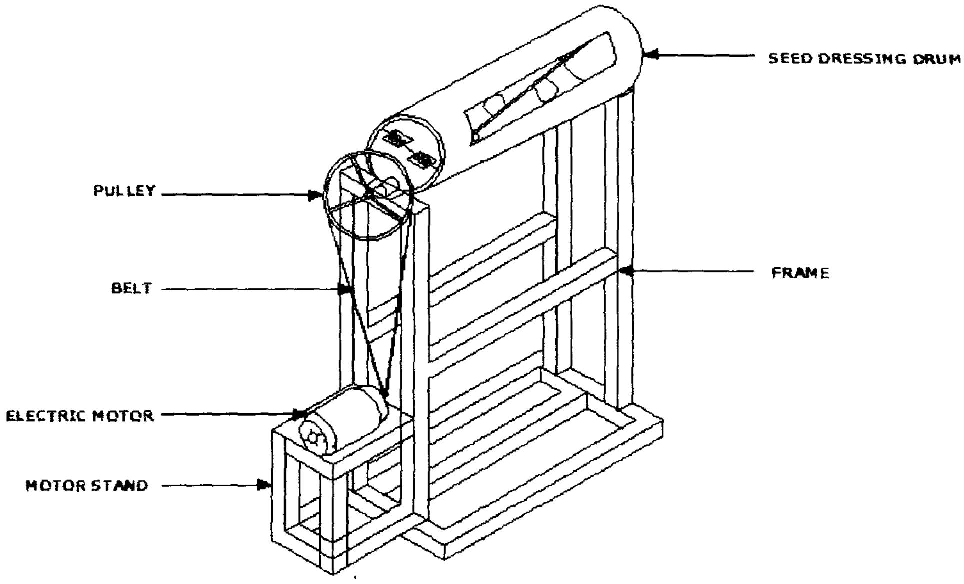


Plate 3: COMPONENT PARTS OF MACHINE



SEED DRESSING MACHINE

Plate 4: Seed dressing Machine