EVALUATION OF APROTOTYPE POULTRY FEED MIXER

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ABSTRACT

This design and fabrication of a 66 litre batch poultry feed mixer have an efficiency of 87.4%, at a low operating cost, easy to control and maintain. A choice of 1 horse power single phase electric motor was used to power the machine such that it rotates the blade attached to the shaft for a desired speed of 50rpm. The transmission from the power source to the mixer is from a gear box. The power source is separated from the mixer for easy servicing, the other various part of the machine are the hopper, trough, flange coupling, bearing, blades attached to the solid shafts and stand. The construction materials were chosen based on the availability and cost, so as to make it affordable to the average users. This machine was designed and fabricated at the rate of ₦75, 900 as against ₦380, 000 for those imported and available in the market.

Keywords: cost, efficiency, fabrication, machine, poultry

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1.0 Introduction

Feed production is the process by which feed ingredients are mixed proportionally to produce compound feed, in the face of high costs of compounded feeds combined with their thoughtful quality/quantity, most poultry and pig farmers would want to produce their own feed. The desire becomes more dominant when the farmer can lay hands on some non-conventional feed resources at moderate prices.

Under natural, free range conditions foul can usually find enough food to keep them alive. However, when they are to grow well and produce many eggs they must be given much more and better quality food that they can find for themselves (Ekocha, 1984).

Poultry feed mixer play a major role in poultry farm. The expenditures on the feeding of poultry species constituted about 75% of the cost of producing eggs and the species. With poultry feed mixer, the farmer can mix rations himself, be self-reliant and sure of the quality of the feed and can make some savings also since he/she is not buying an already prepared poultry feed (Ekeocha, 1984).

It is believed that eating to much red meat will result in high cholesterol level and heart disease of individuals. Research has showed that cutting back red meat will reduce the risk of having the disease and replacing it with healthy and less fatty source of protein like white-meat, chicken, can further lower prevalent death caused by the said illness. As a result of this, health conscious consumers have deviated completely from red meat to white-meat as an alternative which has resulted in high demand of poultry species (chicken) and exerted high pressure on poultry farmers to produce quality poultry feed for poultry species (Jaikaram, 1988).

Although the number of poultry farms decreased by half over the last 50years, output rose dramatically, from about 1.5 billion poultry species in 1959 to almost 8.9 billion at a turn of the twenty-first century. By 2002 poultry production has exceeded 38 billion pounds, reflecting a 3.2 percent increase from the previous year. Domestic poultry consumption grew 5.7 percent in 2002 to nearly 76 pounds. In the early 1990s, it had benefited from unprecedented consumer demands for poultry, in 1992 sales of chicken had outstripped those of red meat and by 2002, and chicken accounted for a 41.7 percent share of the meat market (Jaikaram, 1988).

Chicken was also being marketed more widely, particular in fast food restaurants. Between 1970 and 1990, about 25,000 outlet introduced chicken in the form of sandwiches or nuggets, and this numbers continued to grow into the 21st century. Despite a sustained drop in the price of chickens in 1994 and 1995, in 1996 wholesale price for broilers climbed to about 60% per pound, retail prices ranged for 98% per pound and in 1997, per capital consumption of chicken stood at 72.9 pounds (Jaikaram, 1988).

Various poultry farm species (like chicks, growers, layers, broilers, starter and broilers finisher) requires different quality of foods (mixture of protein, vitamin and mineral concentrate to be mixed with grains in a specific ratio). Hence with technology advancement, Machines are to be design and made to aid in the art of mixing the poultry feeds and to compare with the manual mixing practiced in the ancient time, this machine will help the average farmer to improve the quality and quantity of the feed produced and therefore increases the efficiency, reduce time spend, and health hazard

2.0 Materials and Method

The material used in fabrication of this work comprises of consumable and non-consumable materials. The consumable materials are materials that can be consumed when utilized; these are electrode and filler rod (made in China).

The non-consumable materials are the materials that cannot be consumed when utilized, these materials are:

1. Hacksaw, solid frame made in Germany
2. Trysquare 160mm x 300mm made in Germany
3. Welding machine made in U.S.A.
4. 1½" angle iron made in Nigeria
5. Rolling machine made in Germany
6. Filling Machine made in Germany

7. Scriber, divider and center punch made in China
8. Ø32mmSolid shaft of 900mm in length
9. Ø34mmSelf-centered bearing made in China
10. Bolt and nuts made in China
11. 1hp (746W) Electric Motor made in Germany
12. Hinges made in China
13. 1” angle iron made in Nigeria.

2.1 Design Specifications

The four major components of the poultry feed mixer are;

1) The mixing trough (u-shape horizontal trough).
2) A set of blades mounted on a solid shaft.
3) The electric motor (power source) and
4) The transmission system

In order to achieve the desired efficient poultry feed mixing machine, the following specification will be considered in the design of the components of the poultry feed mixer.

i)The mixing shaft is designed to rotate at a speed of 50rpm, hence speed variation by the use of a gearbox that will reduce speed from the source (electric motor of 1500rpm) to that required at the shaft.

ii)The weight of the machine will not be more than 600N to allow for a minimum force for its operation; therefore materials for parts will be selected based on only cost and strength with weight as a consideration.

iii)The size of the machine will not be more than 1300mm in length and 600mm in height to allow for ease of operation in a standing position.

iv) The design will provide for ease of operation and maintenance as well as safety of the operation.

2.2 Design of the Mixing Trough

The U-shape horizontal trough is composed of a rectangular box and a half cylinder. The trough is made up of mild steel with density of 7860kg/m^3 at room temperature with thickness of 2.0mm.

The internal dimensions of the trough:

Length of trough, L=600mm

Height of the rectangular box, H = 175mm

Width of the trough, W = 350mm

Radius of the cylindrical part, R = 175mm

Thickness of the trough, t = 2.0mm

2.3 Volume of the Mixing Trough (v_t)

The volume (V_t) of the mixing trough comprises the rectangular box (V_R) and half cylinder (V_C).

Mathematically;

$$V_t = V_R + V_C \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.1$$

Where, $V_R = L\ x\ H\ x\ W \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.2$

$=600mm\ x\ 175mm\ x\ 350mm$

$$V_R = 36{,}750{,}000mm^3$$

Where, $V_C = \frac{1}{2}\pi R^2 L \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.3$

$$= \frac{1}{2}\ x\ \pi\ x\ (175)^2\ x\ 600$$

$$V_C = 28{,}867{,}125mm^3$$

From equation 3.1

$$V_t = V_R + V_C$$

$$= 36{,}750{,}000mm^3 + 28{,}867{,}125mm^3$$

$$= 65{,}617{,}125mm^3$$

The volume of mixing trough, $V_t = 65{,}617{,}125mm^3$

2.4 Volume of the Material Used in Making the Trough(V_m)

Mathematically;

$$V_m = V_{to} - V_{ti} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.4$$

But,$V_{ti} = V_t = 65{,}617{,}125mm^3$

$$V_{ti} = V_{oc} + V_{oR} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.5$$

Where; V_{to}= Outside volume of the trough

V_{ti}= Inside volume of the trough

V_{oc}= Outside volume of the cylindrical part

V_{oR}= Outside volume of the rectangular part

$$V_{oc} = \frac{1}{2}\pi R^2 L \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.6$$

$= \frac{1}{2}\ x\ 3.142\ x\ (177)^2\ x\ 604$

$= 29{,}727{,}586.84mm^3$

$$V_{oR} = L\ x\ H\ x\ W \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.7$$

$604\ x\ 177\ x\ 352$

$= 37{,}631{,}616mm^3$

Therefore,

$V_{t0} = 29{,}827{,}586.84mm^3 + 37{,}631{,}616mm^3$

$= 67{,}359{,}202.84mm^3$

$V_m = V_{t0} - V_{ti}$

$= 67{,}359{,}202.84 - 65{,}617{,}125$

$= 1{,}742{,}077.84mm^3$

2.5 Weight of the Mixing Trough (W_t)

It is a function of the volume (V_m) of the material used, the acceleration due to gravity (g), and the density of the material used (ρ).

$M_t = V_r\ x\ \rho$

Density of mild steel, $\rho = 7860kg/m^3$

Volume of material used in making the trough, $V_m = 1{,}742{,}077.84mm^3$

$V_m = 0.00174208m^3$

Therefore, mass of material used;

$M_t = 0.00174208\ x\ 7860$

$= 13.693kg$

The weight of the empty trough, $W_t = M_t\ x\ g$

$= 13.693\ x\ 9.89$

$= 135.42N$

The eight of the feeder ingredients, W_f

$W_f = M_t \ x \ g \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..3.8$

Where, $M_t = 40kg$

Therefore;

$W_t = 40 \ x \ 9.89 = 395.6N$

The weight of trough with feed ingredient, W_{ft}

$W_{ft} = W_t + W_f \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..3.9$

$$= 135.42N + 395.6N$$

$W_{ft} = 531.02N$

Table 1: The Summary of Result

Volume of mixing trough	$65,617,125mm^2$
Volume of the material used in making the trough	$1,742,077.84mm^2$
Mass of the material used in making the trough	$13.694kg$
Weight of the empty trough	$135.42N$
Weight of the trough and feed ingredients	$531.02N$

2.6Ddesign of Hopper

Hopper has the shape of frustrum is the upper part or unit where the grinded ingredients is been poured through into the trough for mixing, in other word, hopper is the inlet of the machine. Base on this project a mild steel sheet of thickness 2mm will be used for the construction of the hopper. The internal dimensions of the hopper are as follows;

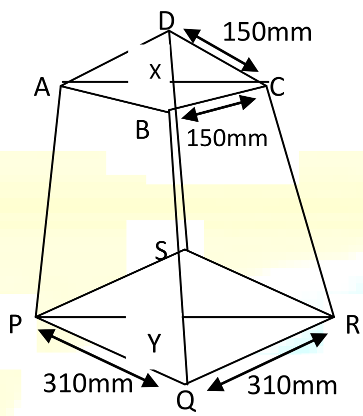
$The \ height \ of \ the \ hopper \ = \ 240mm$

$The \ square \ base \ of \ length \ = \ 310mm$

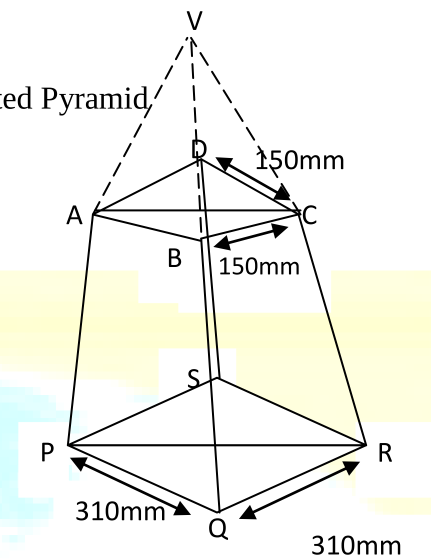
$The \ square \ of \ length \ = \ 150mm$

2.7 Surface Area of the Hopp

Frustrum



Completed Pyramid



Calculating the diagonals of the top and bottom

$$|PR|^2 = |PQ|^2 + |QR|^2 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .3.10$$

$$= 310^2 + 310^2$$

$$= 19220$$

$$PR = \sqrt{19220}$$

$$PR = 438.4mm$$

Diagonal AC

$$|AC|^2 = |AB|^2 + |BC|^2 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots 3.11$$

$$= 150^2 + 150^2$$

$$= 19220$$

$$|AC|^2 = 4500$$

$$AC = \sqrt{45000}$$

$$AC = 212mm$$

But $Cx = \frac{212}{2} = 106mm$

Calculating the height of the added pyramid

Let the height of added pyramid be h.

By similar triangle

$$\frac{h}{106} = \frac{h+240}{219.2}$$

$219.2h = 106h + 25440$

$113.2h = 25440$

$$:.h = \frac{25440}{113.2} = 2240.7mm$$

Therefore, the height of the bigger pyramid

$= 240mm + 224.7mm = 464.7mm$

Calculating the slant side of the smaller and bigger triangles.

Bigger triangle:

$|VR|^2 = |YR|^2 + |VY|^2$ ……………………………………………… 3.12

$= 219.2^2 + 464.7^2$

$= 263995m$

$VR = \sqrt{263995}$

$= 613.8mm$

The angle of hopper

$$tan\theta = \frac{|VY|}{|YR|} = \frac{464.7}{219.2} = 2.11998$$

$\theta = tan^{-1}2.11998$

For smaller triangles"

$|VC|^2 = |Cx|^2 + h^2$ ………………………………………………… 3.13

$|VC|^2 = 106^2 + 224.7^2$

$= 61726m$

$VC = \sqrt{61726}$

$= 248mm$

Using herds formular for finding the area of a triangular

Face $= \sqrt{S(s-a)(s-b)(s-c)}$

Where;

$S = \frac{1}{2}[a+b+c]$and a, b and c are sides of the triangle

Finding ‘S’ of big pyramid.

$S = \frac{1}{2}[a+b+c]$

$= \frac{1}{2}[514+514+310]$

$= \frac{1338}{2}$

$S = 669$

Area of a triangle face of big pyramid

$= \sqrt{S(s-a)(s-b)(s-c)}$

$= \sqrt{669(669-514)(669-514)(669-310)}$

$= \sqrt{669\ x\ 155\ x\ 155\ x\ 359}$

$= \sqrt{5770108275}$

$= 75961mm^2$

Area of 4 triangular of pyramid $= \mathbf{4x75961 = 303845mm^2}$

Area of the triangular faces of small pyramid;

Finding ‘S’ of small pyramid;

$S = \frac{1}{2}[a+b+c]$

$= \frac{1}{2}[248+248+150]$

$S = \frac{646}{2} = 323$

Area of a face $= \sqrt{S(s-a)(s-b)(s-c)}$

$= \sqrt{323(323-248)(323-248)(323-150)}$

$= \sqrt{323\ x\ 75\ x\ x\ 75\ x\ 173}$

$= \sqrt{314319375}$

Area of a face $= 17729mm^2$

Area of 4 faces= $4\ x\ 17729 = 90916mm^2$

Area of the base of the frustrum (hopper) $= L\ x\ B$

$$= 310\ x\ 310 = 96100mm^2$$

Area of the top of the frustrum (hopper) $= L\ x\ B$

$$= 150\ x\ 150 = 22500mm^2$$

Total surface area of the frustrum (hopper) = [Area of the 4 triangular faces of the big pyramid – Area of the 4 triangular faces of the small pyramid] + Bottom area + Top area.

$$= [(303845 - 70916) + 96100 + 22500]$$

$$= 351529mm^2$$

2.8 Volume of the Hopper

Volume of the hopper = Bigger volume – smaller volume

$$= \frac{1}{3} x\ Based\ area\ x\ h - \frac{1}{3}`x\ Base\ area\ x\ h \ldots\ldots..\ldots\ldots\ldots 3.15$$

$$= \frac{1}{3} x\ 310\ x\ 310\ x\ 464.7 - \frac{1}{3} x\ 150\ x\ 150\ x\ 224.7$$

$$= 14885890 - 1685250$$

$$= 13200640mm^3$$

2.9 Design of Transmission System

One (1) horse power, 1hp (746W) single phase electric moor that will be used in this project is purchased, the speed of the electric motor is 1500rpm and reduction is done through a gear box to 50rpm.

2.10 Torque (t) Transmitted by the Electric Motor

Torque transmitted, $T = \frac{60P}{2\pi N_2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..3.16$

Since,

The power transmitted, P = 1hp (746W)

The speed of the electric motor, $N_1 = 1500rpm$

The speed transmitted on the shaft, $N_2 = 50rpm$

Therefore,

$$T = \frac{60P}{2\pi N_2}$$

$$= \frac{60 \; x \; 746}{2 \; x \; \pi x \; 50}$$

$$= \frac{44760}{2 \; x \; 3.142 \; x \; 50}$$

$$= \frac{44760}{314.2}$$

$$= 142.46N - m$$

$$T = 142.46N - mm$$

2.11 Design of Shaft and Blade

The shaft is a transmission shaft. It transmits power from the source, electric motor. It is subjected to both bending and twisting moment. The helical blade is uniformly distributed to the shaft. The total length of the shaft is 800mm and the shear stress (τ_s) of the shaft is 50N/mm^2 (Khurmi, 1979).

2.13Reaction on the Shaft Bearing

Let R_A and R_B be the reactions at the bearings A and B respectively.

$$R_A + R_B = 10.72 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.16$$

Taking moment about A, $\sum R_A = 0$

$$R_B \; x \; 0.67 = 10.72 \; x \frac{0.67}{2}$$

$$R_B = \frac{3.912}{0.67}$$

From equation (3.16)

$$R_A = 10.72 - 5.36 = 5.36N$$

2.14 Shear Force on the Shaft

Shear force at B (where x = 0)

$$S_A = \frac{16x0.67}{2} = 5.36N$$

Shear force at C (where $x = \frac{l}{2}$)

$$S_C = \frac{16x0.67}{2} - \frac{16x0.67}{2} = 0$$

Shear force at A (where $x = l$)

$$S_A = 5.36 - 16\ x\ 0.67 = \ -5.36N$$

2.15 Bending Moment on the Shaft

B.M at B =0

B.M at A =0

B.M at C = maximum

$$Maximum\frac{WL^2}{8} = \frac{16x(0.67)^2}{8}$$

$$= 0.8978N - m$$

2.16 Equivalent Twisting Moment T_e

$$T_e = [K_m\ x\ M^2 + K_t\ x\ T^2]^{\frac{1}{2}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.17$$

Where $K_m = 2$ and $K_t = 1.5$ (Khurmi, 1979)

$$T_e = [2\ x\ (0.8979)^2 + 1.5\ x\ (142.5)^2]^{\frac{1}{2}}$$

$$= [30460.987]^{\frac{1}{2}}$$

$$T_e = 174.5n - m = 174500N - mm$$

2.17 Diameter of the Shaft (d)

$$T_e = \frac{\pi}{16} x\ \tau_s\ x\ d^3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.18$$

$$174500 = \frac{\pi}{16} x\ 50\ x\ d^3$$

$$d^3 = \frac{174500x16}{3.142x50} = \frac{2792000}{157.1}$$

$$d = \sqrt[3]{17772.1197}$$

$$d = 26.096mm$$

Say, $d = 32mm$

A flange coupling usually applies to a coupling having two separate cast iron flanges. Each flange is mounted on the shaft end and keyed to it. This helps to bring the shaft into line and to maintain alignment. The two flanges are coupled together by means of bolts and nuts. In order to design the flange coupling, the following data are taken are taken base on the material used.

The permissible shear stress for the shaft, bolt and key material is 50Mpa. The permissible shear stress for the flange material is 10Mpa and the permissible crushing stress for the bolt and key material is 100Mpa.

3.1 Designfor the Hub

It is an hollow shaft which transmits the same torque (T_4 as that of the solid shaft. The allowable shear stress (τ_c) for the hub material will be determined from this relation.

$$T = \frac{\pi}{16} x\, \tau_c\, x \frac{D^4 - d^4}{D} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..3.19$$

$but\ T = 142500N - m$ and d = 30mm

D = 2 x d = 2 x 32 = 64mm

From equation 3.19

$$142500 = \frac{\pi}{16} \text{x}\, \tau_c\, \text{x} \frac{(64^4 - 32^4)}{64}$$

$$\tau_c = \frac{2279360}{636255} = 2.95\text{Mpa}$$

Since the induced shear stress for the hub material is less than the permissible shear stress, the design of the hub is safe.

3.2 Design for the Flange

The thickness of the flange (t_f) = 0.5 x d = 0.5 x 32 = 16mm

The allowable shear stress (τ_c) for the flange material will be determined from this relation.

$$T = \pi \times \tau_c \times t_f \times \frac{D^2}{2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .3.20$$

$$142500 = 3.142 \times \tau_c \times 50 \times \frac{64^2}{2}$$

$$\tau_c = \frac{142500}{84834} = 4.5\text{Mpa}$$

Since the induced shear stress for the flange material is less than the permissible shear stress, the design of the flange is safe.

4.0 MaterialSelection

The selection of proper material for engineering purpose is one of the difficult problems for the designer. The best material is the one which serves the desired objectives at a minimal cost. The materials for each component of the poultry feed mixer were selected based on the desired objective at the minimum cost without compromising the availability and suitability of the materials for the working conditions in services were also considered.

The major properties of material which was considered in the design are; strength, stiffness, ductility, toughness, fatigue, resilience, hardness, creep and machinability, cast ability, weld ability, the material visual appearance, frictional properties and internal vibrational damping properties.

4.1 Fabrication of the Poultry Feed Mixer

The trough was fabricated from mild steel sheet of thickness 2mm, mild steel sheet was chosen due to its low cost, availability, machinability, good formability, weld ability and since the materials to be mixed are dried materials, corrosion is not paramount important. The trough is comprises of two sections, the rectangular and half cylindrical sections, the rectangular section was developed on cardboard paper with dimension of 600mm x 350mm x 175mm and half cylindrical section with 600mm x 350mm x 175mm, later transferred on sheet metal, cut with filling machine bend and formed with rolling machine. The two sectionswas joined together by welding.

The cover of the trough was also fabricated with reference of the length and width of the trough, 1 angle iron was used to lineup the edges with 3 pieces of hinges provided in other to joined it together with the trough and a squared space for the position of hopper was cut out from the centre of the cover with dimensions of 150mm x 150mm.

4.2 Hopper

The hopper was fabricated form mild steel sheet metal of thickness 2mm, the hopper which has the shape of frustum with base area at the top, 320mm x 320mm and bottom, 150mm x 150mm with height of 240mm was developed on a cardboard paper, transferred to the sheet metal, cut with filling machine and the sides was joined together by welding and latter welded together with the trough. The hopper can also be regarded as the inlet of the machine.

4.3 Blade Attached to the Shaft

The blades was fabricated from mild steel sheet metal of thickness 1mm, the blades which has a helical shape was developed on a cardboard paper, transferred to the sheet metal and cut with filling machine. First of all, a sheet metal of circular shape of 90mm diameter was cut out, then, cut a radius of 45mm from the centerline to the centre, latter was bend and formed to a helical shape and welded to the shaft.

4.4 FlangeCoupling

The rigid flange coupling was fabricated from mild steel metal, each flange was fabricated as follows, a circular shape of five (5) gauge of mild steel of 30mm in diameter was cut out, 34mm bore the at the centre and 3x3mm bores was drilled, 7mm length of hollow pipe internal diameter of 34mm was cut and welded together with the circular shape of metal. Each flange was mounted on the shaft end and keyed to it and also the two flanges was coupled together by means of 13 bolts and nuts.

4.5 Stand

The stand was fabricated from 1½ angle iron mild steel, the stand is comprises of two sections, the electric motor and the trough sections. The stand for electric motor was cut at dimension 600mm x 300mm x 580mm and for the trough 700mm x 390mm x 600mm, bolt was s

5.0 Assemble of Components

In assembling the different component that constitutes the mixer, preference was given to permanent jointing where stability and strength of the join is of paramount important. Temporary jointing were used parts are to be removed for maintenance purpose. Table 4.1 show the components and the source of the materials used.

Table 1. The component and Source of the Materials used

S/N0	Components	Source
1	Mixing trough	Fabricated
2	Electric motor	Purchased
3	Bearing	Purchased
4	Flange coupling	Fabricated
5	Blade attached to the shaft	Fabricated
6	Stand	Fabricated
7	Hopper	Fabricated

5.1 Fabrication Cost Analysis

The total cost of the poultry feed mixer is made up of two parts, the direct cost and the indirect cost. The direct cost comprises of the cost of materials and fabrication cost while the indirect cost is simply cost associated with the fabrication of this machine such as logistic and incidental expenses.

Table 2: Bill of Engineering Measurement and Evaluation (BEME) of the machine.

S/N0	**Components**	**Quantity**	**Cost of Material**	**Labor**	**Total**
1.	Electric motor, 1hp	1	25,000	-	25,000
2	Mixing trough	1	10,500	2000	12,500
3	Blade attached to the shaft	4	1500	1000	3500
4	Bearings	2	6000	-	6000
5	1 ½” angle iron	1	8000	2000	10,000

6	Painting	2	2500	1000	3500
7	Flange coupling	1	1500	1000	2500
8	Transportation			2000	2000
9	Logistics			6000	6000
10	Shaft	1	4000	-	4000
11	Bolt and nuts	17	400	-	400
12	1 packet of electrode	1	1500	-	1500
	Total		60,900	15,000	75,900

5.2 Results

The machine capacity is to produce 40kg of poultry feed within 3-6minutes.

1. First test starter chickens

Ingredients	Ratio	Mass of ingredient used (kg
Soybean meal	2	$\frac{2}{10}$ x $40 = 8$kg
Fish meal	2	$\frac{2}{10}$ x $40 = 8$kg
Blood meal	1	$\frac{1}{10}$ x $40 = 4$kg
Maize	3	$\frac{3}{10}$ x $40 = 12$kg
Wheat bran	1	$\frac{1}{10}$ x $40 = 4$kg
Broken rice	1	$\frac{1}{10}$ x $40 = 4$kg

After mixing the machine discharges 35.0kg of the feed

2.2nd test grower chickens

Ingredients	Ratio	Mass of ingredient used (kg
Soybean meal	2	$\frac{2}{10}$ x $40 = 8$kg
Fish meal	3	$\frac{3}{10}$ x $40 = 12$kg
Blood meal	1	$\frac{1}{10}$ x $40 = 4$kg
Maize	2	$\frac{2}{10}$ x $40 = 12$kg
Wheat bran	1	$\frac{1}{10}$ x $40 = 4$kg

Broken rice	1	$\frac{1}{10}$ x 40 = 4kg

After mixing the machine discharges 34.7kg of the feed

3.3rd test Finisher chickens

Ingredients	Ratio	Mass of ingredient used (kg
Soybean meal	2	$\frac{2}{10}$ x 40 = 8kg
Fish meal	1	$\frac{1}{10}$ x 40 = 4kg
Maize	3	$\frac{3}{10}$ x 40 = 12kg
Wheat bran	2	$\frac{2}{10}$ x 40 = 8kg
Broken rice	2	$\frac{2}{10}$ x 40 = 8kg
	10	40kg

After mixing the machine discharges 35.2kg of the feed

5.3 Summary of the Result

The summary of the above result after mixing by the machine are shown below:

Test	Input(kg)	Discharges (kg)
First test	40	35.0
Second test	40	34.7
Third test	40	35.2

From the result obtained above from the machine, it means that the machine was effective and efficient in its operation.

In conclusion the efficiency of the machine to calculate as follows:

$$\text{Efficiency} = \frac{\text{output}}{\text{input}} \text{x} \frac{100}{1}$$

$$\text{Average output} = \frac{35.0 + 34.7 + 35.2}{3}$$

$$= 34.9\text{kg}$$

$$\text{Average input} = \frac{40+40+40}{3}$$

$$= 40\text{kg}$$

:. Efficiency of the machine $\eta = \frac{34.97}{40} \times \frac{100}{1}$

$$= 87.4\%$$

5.4 Conclusion

Poultry feed mixer is a machine for mixing and blending of feed ingredients for use in both rural and urban areas.The mixer was constructed using mild steel metals; various machining and welding were carried out in fabricating the various parts. The parts of the electrically operated poultry feed mixer are as follows: the trough, stand, flange coupling, hopper, bearings, helical blades attached to the solid shaft and 1hp industrial electric motor. The machine has been tested and it work's efficiently with an efficiency of 87.4%.

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