# DESIGN AND CONSTRUCTION OF MULTI-POWERED OPERATED PELLETING MACHINE FOR POULTRY FEEDS

**M. Zubairu, M.O. Ewaoda, and I. Bashiri**
**E-mail: Zubairumustafa@yahoo.com +2348036936373**
**Department of Agricultural and Bio-Environmental Engineering, Kaduna Polytechnic, Kaduna**

**Abstract**

*A simple multi-powered pelleting machine, for making poultry feeds was designed, constructed and tested. The machine was designed to make pellet for poultry production for small scale farmers or household user but has the potentiality of making other pellets for different animals production. The machine was tested using mixed feeds. And pellet were obtained over six trails. Test result reveals that weight of pellet obtained are 1134.9kg, 1164.9kg, 1182.6kg, 1175.2kg and 252.5kg respectively. The power required to operate the machine manually, using electric motors was obtained as 0.2kw, 1hp respectively. Efficiency of the machine was calculated at an average pellet of the six trials as 99%. And cost of the machine was determined to be as N 6230.00.*

**Keywords**: Design, construction, feeds, pellets, chicken

## Introduction

Poultry farming is an important practice which is usually made by farmers to enhance their productions. It is an aspect in which animals are kept in large scale unit whereby animals like chicken, broilers and layers are properly feed, vaccinated and grow them for production of eggs, and meat. Poultry production has been in practice by villagers long time ago. And chickens are allowed to roam about their environment in search of food. The chickens depend only on the locations where grains can be found to provide their growth. (Jroitter and Harrison 1998).

In poultry production, feeding is essential and is one that keep the chicken alive. Feed availability will enhance commercial purpose for the dry diet. The best nutritious diet which contain protein, fat oil, carbohydrate, vitamins in which is ground, mixed to produce pellets for poultry production. (Oluyemi et al 1980). The traditional method of feeding chickens in the communities is time wasting, uneconomical and unhygienic. Some communities uses hand to make pellets for animal feeds. These method have the disadvantages of wasting the feeds. And are slow and labourious. And has resulted in only small quantities of the feeds.

Three types of poultry feeds can be made by the use of this machine. Which includes, starting poultry feed, feed where poultry feeds are all mash ratio of feed to the required particles size in which the chicks up to the age of 8 weeks are feed. With the machine a plate can be replace with another to produce pellets that the younger chicks can consume. The second involves the growing poultry feeds. Here the chicks are growing up to 20 weeks and adopts this by laying. The third is the laying poultry feeds. This is rich diet feeds that is also mash into ratio for laying birds after 20 weeks to be fed or after laying commences and particle size of feeds, diet is completely utilized for the efficiency of the animals production. (Singh and More 1987)

In order to achieve these goals, a machine which is capable of making pellets for poultry feeds was designed and fabricated. The machine is portable and serve as a device for producing of animal stuff as pellets. Poultry feeding can be achieved by use of this machine which the feed undergoes process of grinding and mixing. Different sizes of pellet can be made by exchanging different plate using this machine. The machine can be either operated manually or mechanically using electric motors.

## Materials and methods

The materials used for the design and construction was sourced locally and materials used for making pellets was purchased at Kaduna central market. Galvanized steel and stainless steel was used due to their free rust characteristics and durability, since plastic materials are fragile and can fail under pressure (Brown, 2014)

**Design considerations**

**Design of hopper**

This is made from mild steel and was cut by hacksaw of weight 100mm with width 50mm. It was then cut and marked at height 100mm and width size 12mm with base 800mm and joined together to form the pelleting chamber, which was slanted at an angle of $45^0$ (Bosoi 1978)

The hopper capacity was determined using the relationship below.

$V_h = V_r + V_t$ (Restov, 1978)

Where,

$V_r =$
$Volume\ of\ a\ rectangular\ portion\ of\ hopper, M^3$

$V_t =$
$Volume\ of\ trapezoidal\ portion\ of\ hopp, M^3$

Therefore,

$v_r = l\ x\ b\ x\ h$

$= 0.8\ x\ 0.5\ x\ 0.10 = 0.04m^3$

$v_t = \frac{1}{2}(a+b)\ x\ h$

$= \frac{1}{2}(0.4+0.8)x0.1 = 0.06m^3$

Hence, $v_h = v_{r+}v_t$

**Shaft of pelleting chamber**

The shaft of this unit was carefully machine and was cut and marked to the length of 34mm. the shaft is subjected to forces of two bearing at the two end of the shaft. The equation used for its design, was as follows,

$$d = \frac{16}{\pi\delta_s}\sqrt{(k_t m_t)^2 + (k_b m_b)^2}$$

Where:

d= shaft diameter (mm)

$\delta_s$=allowable stress ($Nm^2$)

From, ASME code (1983) = $40MN/m^2$

$K_t$ = combine shock and fatigue applied to torsional moment

$M_b$ = maximum bending moment

$M_t$= torsional moment

Therefore d = 35mm

**Handle**: The handle was form and materials used for the construction was a mild-steal. It was cut with hakcsaw of a size 30mm x 20mm and fixed to the pelleting shaft which is rotated by the used of hand, when manually operated.

**Centre distance of pelleting chamber pulley - electric motor pulley**

The centre distacne (CD) between the two pulley was obtained as follows.

CD = max (2R, 3r + R)

Where r = radius of Electric motor pulley = 60mm

R = radius of pelleting chamber pulley = 90mm

Therefore,

CD = Max (2x90, 3 x 60 + 90)

= Max(180, 270)

Therefore two centre distances obtained, but the one selected is 270mm (maximum) distance was chosen.

Therefore, Let CD = 270mm

Therefore, let angle of Rep of pelleting shaft pulley ($A_{RP}$) and angle of Rap of Electric motor pulley ($A_{RE}$)

$A_{RP} = \pi + 2\sin^{-1}\left(\frac{180-120}{2x270}\right) = 16^o$

$A_{RE}\ \pi^{-1}\left(\frac{180-120}{2x270}\right) = 0.04^o$

**Volume of pelleting chamber**

The volume of pelletting chamber, $V_{p.}$ was obtained using the following equation.

$$v_p = \pi r^2 t$$

Where

d = diameter of end plate = 1mm

r = radius of end plate

t = thickness of plate = 1mm

Therefore,

$$v_p = \pi r^2 t$$

$$= 3.141x(0.30)^2x0.001$$

= 2.8 x $10^{-4}m^3$

A hole of 30mm was made at the centre of each plate to allow the shaft to passed through and which rotate freely when in operation. Therefore, volume of each plate was obtained as follows

Volume of hole $v_h = \pi r^2 t$

$$= 3.14x(0.015^2)x0.001$$

$$= 7.06\ x\ 10^{-7}m^3$$

Hence, volume of each pelleting chamber end plate = volume of plate – volume of hole

= 7.07 x $10^{-4}$ -7.06 x $10^{-7}$

= 7.06 x $10^{-4}$m

And mass of pelleting chamber = $m_{pc}$ = 2(volume x density)

= 2(7.06x$10^{-4}$ x 7800)

=11.02kg

**Length of belts**

The length of Belt was obtained using the expression below,

$$L = 2C + \pi\frac{PD_1 + PD_2}{2} + \frac{PD_1 - PD_2}{4C}$$

Where, L = length of Belt

$P_{D1}$ = pitch diameter of big pulley

$P_{D2}$ = pitch diameter of small pulley

C = centre distance between the pulley

**Power required to operate the machine manually**

The handle developed was turn eight times over a period of one minute.

1. 8% = 0.133rpm

2. 0.133rpm = $\frac{0.133x2x\pi rd}{60}$

$$= \frac{0.133x2x3.142}{60}$$

$$= 0.0139rds$$

But Average man can developed power of 146watt (Troitter –et al 1998)

Therefore P = $\frac{146}{0.0139} = 0.2KW$

**Power required to operate the machine using electric motor**

Here the powered required to operate the machine was chosen following ASME (1998) standard

1hp Electric motor was selected to power the machine.

**Material cost**

Table 1: Breakdown of construction materials and specification

| SS/N | Component | Materials of Construction | Quantity | Unit Price | Amount (₦) |
|---|---|---|---|---|---|
| 1 | Hopper | Mild steel | 1 | 1000 | 1000 |
| 2 | Shaft | Metal rod | 1 | 600 | 600 |
| 3 | Cylinder housing | Mild steel | 1 | 1500 | 1500 |
| 4 | Pulley (big) | Standard | 1 | 500 | 500 |
| 5 | Pulley (small) | Standard | 1 | 300 | 300 |
| 6 | Bolts/nut | Standard | 4 | | 400 |
| | | | | | ₦4,100 |

It is recommended that 30% of material should be considered as labour cost. ASAE (1998).

Therefore,

Labour cost =N4100 x 30/100 = N1,230

Miscellaneous cost involves cost of transportation machines, etc. = N1,000.00

Therefore, total cost of the machine =Total cost + Labour cost + miscellaneous cost =

=₦4100 +₦ 1230 + ₦ 1000

= ₦ 6230

**Experimental procedure**

Mixed feed was collected as sample. It was taken to a laboratory for test. Instruments used includes:

1. Beam balance
2. Paper

The beam balance was checked correct to be at point 0, graduation. Then mixed feeds are placed on the left side of the balance and on right side, 1000kg was on it, to have a balance as weight feed.

Table 2: Result of Experiment

| SS/N | Weight of Paper + Weight of Feed | Weight of Paper – Weight of Feed | Weight of Fine Weight (Palette) |
|---|---|---|---|
| 1. | 11.5.1+3.2 | 1138 – 3.2 | 1134.9 |
| 2. | 1168.1 + 3.2 | 1168.1 – 3.2 | 1164.9 |
| 3. | 1185.8 + 3.2 | 1185.3 – 3.5 | 1182.6 |
| 4. | 1126.9 + 3.2 | 112.9 – 3.2 | 1123.7 |
| 5. | 1178.4 + 3.2 | 1178.4 – 3.2 | 1175.2 |
| 6. | 255.7 + 3.2 | 255.7 – 3.2 | 252.5 |
| TTotal | 6068.1 | 6033 | 6270 |

Pelleting Efficiency = $\frac{Weight\ of\ material}{Total\ Weight\ of\ Time}\ x\ 100\%$

= $\frac{Total\ weight - Weight\ of\ hold}{Total\ Weight\ of\ Time}\ x\ 100\%$

= $\frac{6270-57}{6270}\ x\ 100\%$

= 0.991%

= 99%

**Conclusion**

Multi- powered pelleting machine was developed and tested. The result obtained was shown in table 1. An efficiency of 99% was also calculated. The materials used for the construction is cheap with power required to operate the machine manually is 0.2kw and using Electric motor of 1hp shows a satisfactory result. Pellete was obtained after six trials. Machine efficiency was obtained to be 99% and cost of production is also low of ₦ 6230

**Recommendation**

1. More test to be carried out on the machine using different feeds at different feed rate
2. Different plates to be made for making different animal feeds
3. It should be developed with a frame to have a stable footing
4. The machine is recommended for used to peasant poultry farmers in both villages and house-hold users for making pellets for poultry production in the houses
5. The machine can be modified to produce other animals pelleting feeds

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