DESIGN OF ANIMAL FOOD PROCESSING MACHINE

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ABSTRACT

Nigeria will continue to develop in technology as long as they rely on their fabrications to solve domestic problems. One of the famous foods cultivated by farmers in Nigeria, especially northern part of the country is guinea corn, maize, and millet. They are used for a different variety of food both solid and liquid food. After harvesting these type of plants, the part of the residue is stemmed. In most cases, these residues are left to waste and store them in a dangerous method. It is worth to note that these stems are still useful even though they are not put to better use. They can be processed and used as feeds for animals. This processing, if not done with fully dry stems, it can result in a negative way and be of harm to the animals. In order to benefit the valuable things from them and avoid their side effects, a good design tool for the processing is needed, such as machines that can safely grind and process the feeds in a hygienic way. This design is aimed at fabricating a machine that can grind and process them into healthy and economical form, they turn into powder and package them in sacks.

Keywords: Animals, Food, Stems, Powder, Dry, Preservation

INTRODUCTION

Fabrication of Animal Food Processing machine is a machine plan to ease processing of new form of animal food for a feeding of animals, especially to large-scale farmers of Animal Rearing. From the current economic crisis and the difficulties in the business management of capital, control of profit and loss, such type of animal rearing is highly encouraged.

The food imported are sometimes affecting not only animals but indirectly human for one reason or the other. Either the expiration of the preservatives or otherwise. The individual, those with the old stock, may not bear the loss. That is why National Agency for Food and Drug Administration and Control (NAFDAC) is stressing that no animal feed, pet food, and premix shall be imported, distributed, sold, or advertised in Nigeria unless it is regulated by the body (NAFDAG, 2014)

We can only advance our local animal food if we can fabricate our machines with the aim to control cost and reduce human labor. This Fabrication of animal Food Machine is going to produce food like powder for animals from the stems of maize, guinea corn, and millet or any other similar plant after harvest.

This is a new type of animal food which does not need any preservatives. The stem of the plant must be thoroughly dry no moisture remaining; it is only when the food can be kept for a long time without preservatives. Dryness is one of the best methods of preservation (Valencia,

2014) the stem will be fed into the machine, the beaters in the casing of the machine will turn it to powder,

Animals in the northern part of Nigeria are using the dry stem and their leaves but are wasted, and it makes surroundings of the animals very dirty, and untidy. Some of the animals may not eat if they have urinated on the stem. Also, women will be using part of them as a fuel to cook. Below is a capture of a section of a farm where Guinea Corn is planted.

Figure 01: Section of Guinea Corn farmland

The stems of the plant yousee in the image above are the type this fabrication will be made to grind and make it into food powder. We will be able to make as many sacks as possible for sales or personal use

STATEMENT OF THE PROBLEM

These types of crops are cultivated in almost all parts of north-western Nigeria, especially, Sokoto Zamfara, and Kebbi. These stems produced in large quantities include millet, guinea corn, and maize in different varieties. (Nigeria, 2015)After harvest the stems are dumped everywhere in the farms and the town, though they are stored for future use as animal food especially during dry season, dangerous animals like snakes are hiding inside, it takes place very dirty, sometimes fire outbreak which result in loss of lives and properties, and this can be preserved as animal food in a better form. People cannot stop farming them because of the economic values, the product of the plants are used for three square meals, they are also used for the preparation of some soft food and drinks, and they are used for temporary fencing and even local beds. Despite all, the stems are there in bunches. Therefore this made it very vital and justified the need for this Fabrication.

AIM OF THE FABRICATION

The Fabrication is aimed at converting the stems into powder form and solve the problems of poor preservation.

OBJECTIVES OF THE FABRICATION

1. One of the objectives of the study is to bring a proper method of preserving the animal food in a very healthy and economical way.
2. The Fabrication should reduce human labor in the process of converting the stems to powder form.
3. The Machine can be used for large scale and small scale business
4. The method does not need any chemical but to allow the stems to thoroughly dry

LITERATURE REVIEW

A machine can be defined as any device used to perform work. (Khurmi R. G., 2004)Moreover, Power may be defined as the rate of doing work. (Khurmi, 2005). According to engineering science, it can be as a device using which an external force or supply of energy applied at one part or position is transmitted to another so that it may be employed to achieve an advantage for some particular purpose. This Fabrication is a typical machine that performs a different type of job from the existing ones; the energy supply is going to be from a generator. Before going to discuss the physical features of this fabrication let us look at some images of similar machines.

This machine is used to crush food; the energy supply is from an electric power using an electric motor, it is entirely performing a different job. This cannot grind stems of a plant into food powder.

There are many machines, but they are just for grinding, crushing, thrashing food. The gab is that no one is prepared for this type of process.

Materials

Engineering materials are classified into metals and non-metals. Metals include ferrous and nonferrous metals. Metal that contains iron as main constituents such as cast iron, wrought iron, and steel is called ferrous metal. Metal that contains metals other than iron as its constituents such as aluminum, copper, brass, tin, zincand others is called nonferrous metal. (Kempster, 1981)

Engineering materials have both mechanical properties, such as strength, stiffness, elasticity, machinability, physical properties, such as density, melting point, thermal conductivity (Love, 1980), and chemical properties. The type of metals used in fabrication such as aluminum, zinc, copper, nickel, chromium, is known with properties which are compared with each other. Although specific properties for each material have been known and all are compared with low carbon steel as the base. (Kenyon, 1980)

DESIGN METHOD

In this regard material and Design evaluation will be considered. What is supposed to understand is that the machine is stationary and is not subjected to any temperature or any moisture, therefore, the following analysis ismade?

Material Consideration

Four factors were considered. The condition at which the machine will be subjected to service. The machine needs high force to beat the plant stem and turn the stems into an excellent powder. The hard material is required. There is no moisture, therefore, mild steel can be selected, the advantage is that no breakage, no room for corrosion in the working process and no temperature that will course any chemical change.

The material has to be amenable to the manufacturing process of the machine (Jayakody, 2011). Mild steel can respond to the production operations such as cutting, drilling, filing, bending,etc It is soft and malleable. Mild steel is available everywhere in the country. You can quickly obtain it for small and mass production when the needarises.

Cost of the material should be affordable to both producers and consumers. Mild steel is still affordable. It is cheap and available Some useful properties such as chemical and physical properties must be considered. Students can produce this machine or any other apprentice, under the guidance of the fabricators, as part of their practical work and also to develop their entrepreneurship. The machine consist of four main parts; a hopper which also forms the top of the machine; Casing of the machine which contains hammer mill arranged on a shaft; Frame which carries the whole weight of the machine and last part of the machine which is the supply of energy. It is a Generator. The dimensions, Detail drawing, and Assembly drawing are shown in dimensions of sizes.

Design Analysis

The design capacity depends upon the capacity of the engine and the Shaft diameter. The fabrication does not come with the manufacture of gears, but the torsional vibration from the shaft and vibration without dampers were considered. 175 or 165 diesel engine was the prime mover In this design. A different value of shaft diameter was used, for different evaluation of output. Some designs were selected.

Design of Shaft

The diameter of the shaft at various value and torsional stress were considered:

$\frac{\tau}{r} = \frac{T}{J} = \frac{C\theta}{l}$ where

τ = Torsional shear stress

r = Radius of the shaft

T = Torque or twisting moment

J = Polar moment of inertia

C = Modulus of rigidity for shaft of mild steel

θ = Angle of twist in radians on the length

l = Length of the shaft

However, the equation can be reduced to the following

$\frac{\tau}{r} = \frac{C\theta}{l}$Hence

$$\tau = \frac{r C\theta}{\iota}$$

Design of power transmission

Agricultural Machines like this Animal food processing machine transmits small speed up to 10m/s and use thelight drive. For mass production, complex services or commercial purpose the machine can be designed as medium or large speed transmission system which uses medium speed (above 10 m/s) or heavy drive (speed above 22 m/s) respectively.

In power transmission of this type, flat belt was chosen to transmit power usingpulleys. Different diameters of pulleys were designed to give excellent arc of contact between the belt and the pulley. The distance between the pulleys was considered to make the arc of contact in the smaller pulley as large as possible, see tables below. Velocity and tension were considered and are among the factors which influence anexcellent power transmission. Values of tension can be used to obtain a different result. The following relation is used to evaluate power transmission.

$P = (T_1 - T_2)V$

Where the following parameters are:

T_1 = Tensions in the tight side

T_2 = Tensions in the slack side

r_1 = Radius of the driving pulley

r_2 = Radius of the driven pulley

V = Velocity of the belt in m/s

The active turning (driving) force at the circumference of the driven pulley or follower is the difference between the two tensions i.e.$(T_1 - T_2)$

Work was done per second = $(T_1 - T_2)V$ the unit is N-m/s which is equals to one unit watt (W)

Power transmitted = $(T_1 - T_2)V$ W

Torque can be determined using radius of each pulley = $(T_1 - T_2)r_2$ and

P = $\frac{2\pi NT}{60}$ = $\frac{2\pi N(T_1 - T_2)r_2}{60}$

Any of the two values of P can be used in this design

Where N is Speed in r.p.m.

Vibration without dampers

Vibration without dampers is forced vibration. In the design of this machine, the load is assumed to be central point load; attached loads are neglected. The following relation is used:

$\delta = \frac{Wl^3}{48EI}$

Where

δ = Static deflection due to weight of the body in meters

W = Load on the shaft in Newton

l = Length of the shaft

E = Young's modulus for the material of the shaft in N/m^2

I = Moment of inertia of the shaft in m^4

Velocity Ratio of belt drive

Velocity Ratio.

$\pi d_{1N_1} = \pi d_{2N_2}$

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

Where

N_1 = Speed of the driver in r.p.m.

N_2 = Speed of the follower in r.p.m.

d_1 = Diameter of the driver

$\boldsymbol{d_2}$ = Diameter of the follower

Efficiency of the machine

Efficiency $\eta = \frac{Out\ put\ power}{In\ put\ power}$

DESIGN EVALUATION RESULTS

Table 1: Effect of parameters on Power Transmitted from torque and Torsional Stress

Parameters											Torsional Stress	Power/ Torque	Power Transmission
OPTION	r	l	θ	T_1 kN	T_2 kN	r_1	r_2	V ms	T N-M	N r.p.m	$\tau = \frac{rC\theta}{\iota}$	P = $\frac{2\pi NT}{60}$ kW	$P = (T_1 - T_2)V$
A	10mm	1m	5^o	6	2	-	-	3	1500	150	69.6	23.56	
B	20mm	1m	5^o	12	4	-	-	6	2000	200	139.2	41.88	
C	20mm	1m	15^o	18	6	-	-	9	1000	50	417.6	5.235	
D	20mm	1m	20	24	8	-	-	12	1500	50	556.8	7.852	
E	10mm	1.5m	5^o	6	2	-	-	3	2000	50	46.4	10.47	
F	10mm	2m	5^o	12	4	-	-	6	1500	50	34.2	7.852	
G	30mm	1.5m	15^o	18	6	-	-	9	1500	100	417.6	15.71	
H	40mm	1.5m	20^o	24	8	-	-	12	1500	150	742.4	23.56	

Table 2: Effect of parameters on Forced Vibration and Velocity Ratio

	PARAMETERS N		NM^2	m^4	mm		mm		Shaft	FORCED VIBRATN	VEL. RATIO
	W	l^3	E	I $\frac{\pi}{64}d^4$	N_2	N_1	d_2	d_1	d	$\delta = \frac{Wl^3}{48EI}$	$\frac{N_2}{N_1} = \frac{d_1}{d_2}$
I	30 kg	2.0m		0.04x 10^{-6}			60	20	30mm	0.68x10^{-6}	0.33
ii	40 kg	2.0m		0.04x 10^{-6}			60	10	30mm	0.9x10^{-6}	0.167
Iii	50 kg	2.0m		0.04x 10^{-6}			60	5	30mm	1.1x10^{6}	27.9
Iv	30 kg	1.5m		0.02x 10^{-6}			60	120	25mm	0.057x 10^{-6}	2
V	30 kg	3.0m		0.008x 10^{-6}			60	180	20mm	114.96	3
Vi	30 kg	3.5m		0.008x 10^{-6}			60	60	20mm	182.55	1

DISCUSSION

The effect of parameters of the torque and the speed in r.p. m. in power transmitted from table 1 above shows that the power increases when any of the two parameters increases and when any one of the parameters is kept constant. That is option **c**to **e** and **f** to **h.** This shows that:

$P \propto$ N

$P =$ TN

T $= \frac{P}{N} =$ constant

Moreover, for N constant $P \propto T$

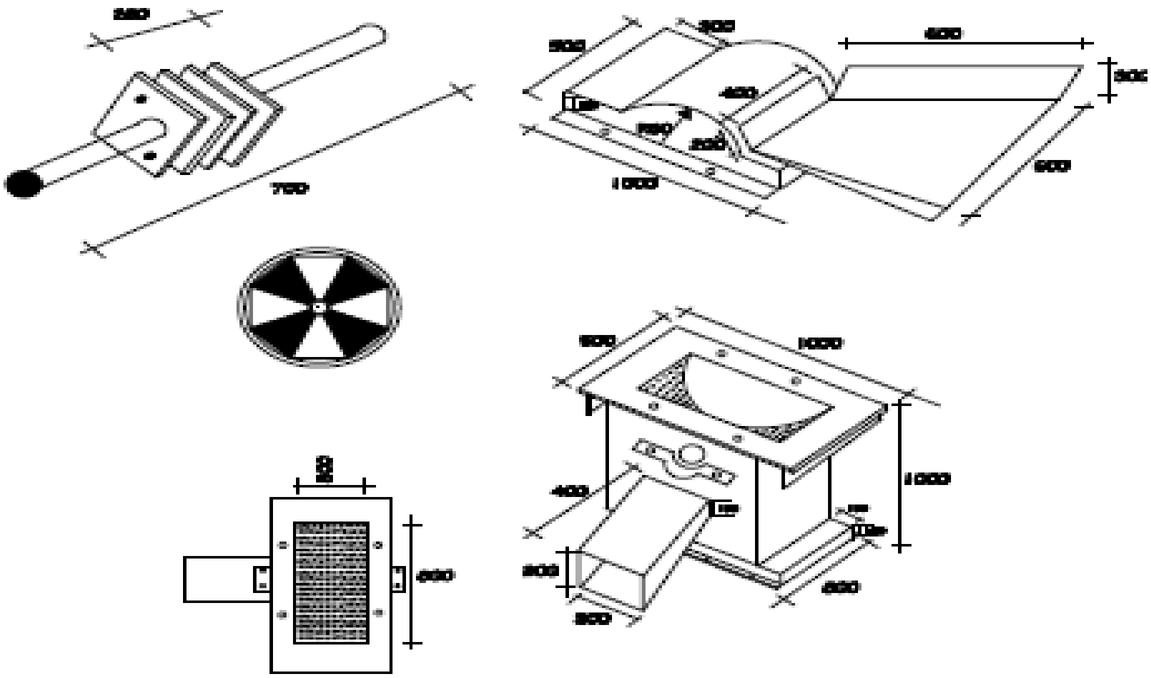
There is a need for a designer to consider when the diameter of a pulley driving the second pulley is negligible to the shaft diameter, the design may not work. From table 2 above in roman iii velocity ratio is up to 27.9

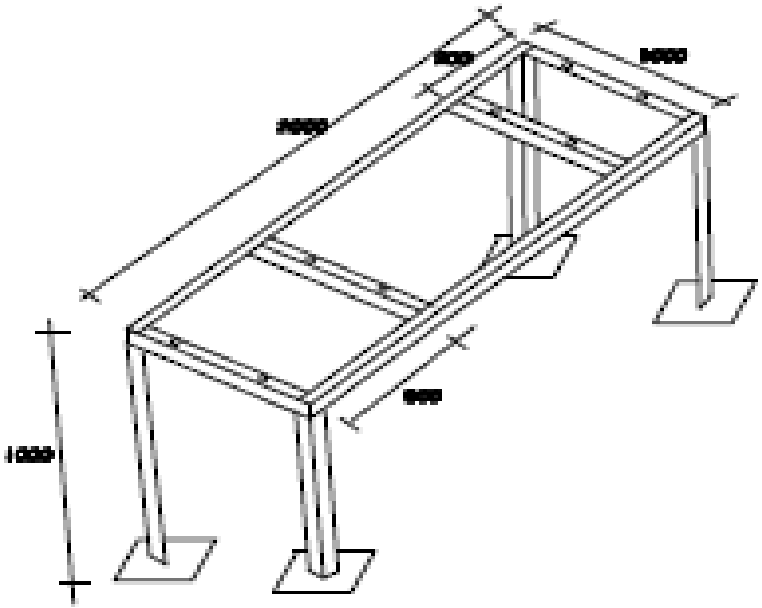
Secondly, the table also shows that deflection is as follows:

$\delta \propto Wl$When Load on the shaft in newton or Length of the shaft in meters is Constant.

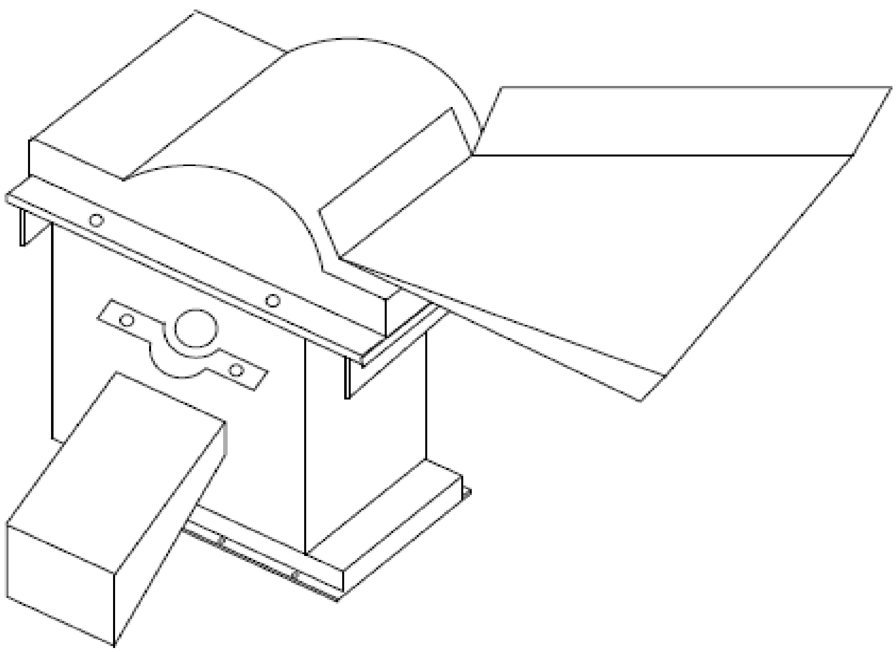
Findings from the design of sizes (length, breadth, and height) of the machine

DETAIL DRAWING AND DIMENTIONS





ASSEMBLY DRAWING



CONSTRUCTION METHOD OF THE FABRICATION

The parts will be fabricated in such a way that it will be able to crush the stems into powder from corns of different types of plant that is suitable for animal feeds.

The fabrication process will follow the procedure for bench work as highlighted below:

(1) Purchase of materials

The materials for the fabrication will be purchased from the market based on specifications.

(2) Measurement and Marking out

The metals will be measured and marked accurately according to the findings of the dimensions of sizes above in design analysis.

(3) Cutting of Metals and Other Materials

Metals to be used in the fabrication will be cut after marking out.

(4) Filling of Metals

Edges of the metals cut will be filled using the filling machine.

(5) Assembling

Metals will be joined together according to the dimensions.

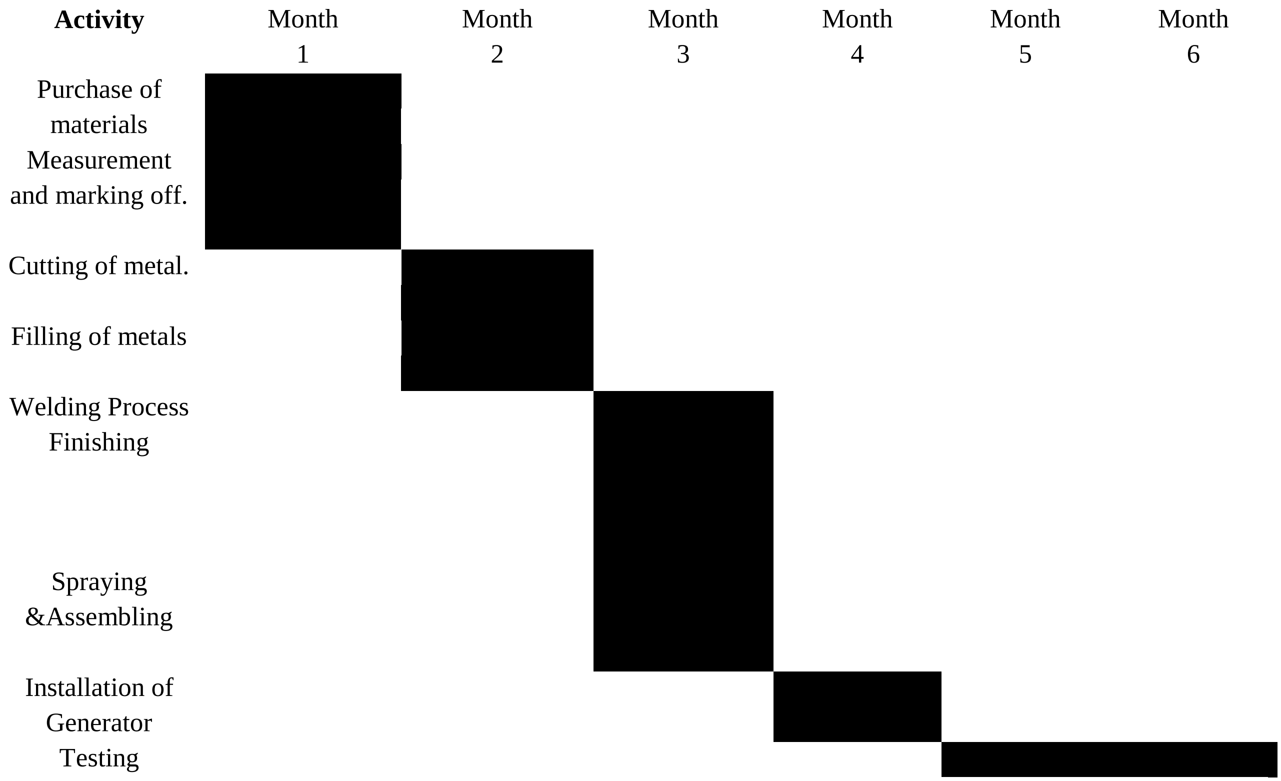
(6) Finishing

The fabricated unit will be polished, smoothened and painted.

(7) Installation of Generator and Testing.

TIMETABLE OF ACTIVITIES

Table 1: Schedule of the Project



MANUFACTURERS CATALOGUE

	ITEM	DIAGRAM	QUANTITY	SPECIFICATIONS
1.	Hopper	Refer to upper part of the grinder in drawings attached	1	**(1000&600)cm x 600cm**
2.	Hammermill	Refer to shaft of the grinder	1	**700cm, 30mmdia. Shaft, (15x15)cm^{2}square mill, (1x50)mm^{2}flat bar**
3.	Complete Casing	Lower part of the grinder	1	**(1000x1000x800)cm^3**
4.	Complete Base	Stand frame	1	**(2000x1000x1000)cm^3**
5.	Bearings		2	**Bt 10**
6.	Bolt & nuts		assorted	
7.	Shaft Clamp		2	**Curved & length (5x2)mm^2**
8.	Funnel outlet		1	**(300x50x50)mm^2**
9.	Belt		1	**200mm dia.**
10.	Diesel Engine		1	**ZS195 43HP**
11.	Pulleys		2	**20cm dia. & 10cm dia.**
12.	Complete Chassis		1	**(2x3)m^2**
13.	Bolt Clip		1	**50cm**

CONCLUSION

We expect that at the end of this fabrication the machine will be able to continue performing as long as the generator is working, and there is no need for re-sharpening because it will be using hammer mill. This will have easy maintenance with limited sound.The machine under test is expected to perform using another sort of plant-like stem of beans

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