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Development of a Molding Machine for the Production of Animals Mineral Block

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Abstract: *Livestock farmers in Nigeria have been encountering mineral block production problems. Despite the effort made in the past the problems persist. Therefore, there is the need to always make improvements on the existing methods. A manually operated mineral block production machine was designed, developed and evaluated. The machine is for the production of mineral blocks from multi-minerals available in Borno State. The procedure that was adopted is in three (3) stages and these are the design, development and evaluation. The design put into consideration the techno-economic status of the rural life. A test to ascertain the performance of the machine was carried out. Blocks from formulation I and II, with 60% Albino Tamarind was too brittle. The blocks prepared from formulations III, IV and V were acceptably hard, although a variable number of days were required for them to reach the desired hardness. It is also observed that the addition of Albino Tamarind plays a vital role as a binder by sticking the powdered potash together with the help of water. Finally it can be concluded that the blocks produced by this machine are satisfactory to be used by local farmers.*

Keywords: *Albino Tamarind, Potash, Mineral blocks, Animals.*

INTRODUCTION

Mineral blocks are hard, stone-like blocks scattered around the animal farm for animals to lick which contain a range of mineral elements to supplement the basic mineral need of the animals. The blocks usually contain salts (sodium chloride), but can also contain calcium, iodine, copper, cobalt, iron, selenium and zinc. Since most developing countries are characterized by poor quality roughages which constitute the major portion of rations fed to ruminants (*Hadjipanayiotou et al.,* 1993) and such poor quality roughages and crop residues are the major sources of feed used for feeding ruminant for most part of the year in the semi-arid region, it becomes necessary to supplement these poor quality feeds using mineral blocks. Mineral blocks are generally used to augment the rumen energy and ammonia level of ruminants when the energy and protein needs for maintenance of ruminants is low thus, animals on such diets are on negative energy and nitrogen balance during the dry season thus, (Preston and Long, 1987; *Mancini et al.,* 1997). Multi-nutrient block has been used for improving the nutritional status of animals (*Caper et al.,* 1986 and *Hadjipanayiotou et al.,* 1996). Many classes of livestock, including swine, poultry, feed lot cattle and dairy cows, mineral supplements are incorporated into concentrate diets, which generally ensure that animals are receiving required minerals (McDowell, 1996). Supplemented cattle on natural grasses in the semi-arid zone of Borno State, Nigeria, lost about 200 – 600g of their body weight per head per day due to one mineral deficiency or the other. As such, when wild grasses and cereal straw are given to ruminant animals alone or forms a high proportion of their diets the primary consideration is to overcome the effect of the resulting nutrient limitation by diet supplementation (Abbator, 1990). Thus, the poor quality of pastures fed to ruminant animals in such region inhibits their performance (*Mshelizah et al.,* 2015).The crude protein content of the grasses drops below 4% during the dry season (Crowler and Chleda, 1977), and are very low in phosphorus and energy (Norman, 1966). The natural grasses, crop residues, animal wastes and to a lesser extent agro-industrial by-products are most widely available low cost feed ingredients for ruminant in Nigeria (*Alhassan et al.,* 1985). Multi-nutrient blocks (MNB) are a commonly used supplement for ruminant (Leng 1984, Sansoucy, 1986; Garcia and Restrepo, 1995). They provide supplemental energy, non-protein nitrogen usually from urea, essential minerals and occasionally vitamin – mineral block for rabbit have been made in the past (Perez 1986; Rajkoman,1991). For the proper functioning of the animal body in addition to protein, carbohydrate, fat, vitamin and minerals resources required by ruminants include calcium (Ca), magnesium (Mg), phosphorus (P), potassium (K), sodium (Na), sulfur (S), and chloride (Cl) (McDowell, 2003).

Despite all the nutritional importance of the mineral block mentioned above, large amount consumption of the mineral block will be harmful to the animals of which most of the mineral blocks produced using hand may not get away from it due to less compaction. Therefore, there is need to develop a machine that will compact well, easy to operate and, maintain. Although the basic principle of block/brick making is the same, no commercially available locally made mineral block molding machines. Thus this development seeks to address the aforementioned challenges.

MATERIALS AND METHOD

This section presents the materials used and the method adopted for the construction of the machine.

MATERIALS

Materials: The materials selection for the development work was based on the availability of the material in the market, cost, durability, rigidity and ease of production. Therefore, mild steel sheet, steel plates, angle iron, mild steel bar and stainless steel shaft was used in the development work.

DESCRIPTION OF PARTS OF THE MACHINE

Mold boxes: These are of two types; the six inches cubic and cylindrical mold respectively.

Pressing stripper bearing frame: This positions the partial hopper and the stripper at a fixed position and also helps in obtaining the quantity of Mixture of minerals required, depending on the size of the block to be produced, the actual Stripper can be changed, with the aid of its grades. It slides along its Guides and it is operated manually shown.

Pressing stripper: Vertical Component used for pressing the sand mineral Mixture and also for stripping the mineral blocks.
Driving lever: A short lever for the compressing system (Automatic return).
Sliding guides: Used for guiding the horizontal movement of the Pressing Stripper.
Hand lever: A longer lever used for the displacing the mold box upwardly and downwardly during production.
Brakets: A Metal Block used for Centering and Fixing the Pallet.
Wooden bearing pallet: For universal application.
Pressing stripper locking devices: This is used for granting the exact height of the blocks and making the stripping operation easier.
Uprights shaft (right and left): They form the axes on which the Mold Box, the Upper Beam which directs the vertical movement of the Stripper travel.
Bearing bushing: It lifts up the Mold box.
Side bars: They link the counter lever and the bearing Bushing and affects the movement of the Mold Box.
Upper beam: It houses the pressing device and helps in the balancing of the Machine.
Counter lever: It houses the continuous Shaft, and forms the Base for the lever.
Lock nuts: Used to open and lock the lower beam.

METHOD

The design method that was adopted in this work is a conceptual design, which is based on analysis. The design analysis of various component parts was carried out and the machine was developed according to the results obtained from the analysis.

DESIGN REQUIREMENTS

For a machine to function satisfactorily, the following requirements have to be met.

FUNCTIONAL REQUIREMENTS

A machine is designed to perform a specific function. These functions should be performed at a relatively high efficiency that its performance should be at least better than a previous design; in that case, an improvement in a case where it is new, its efficiency should be as close as possible to the input.

STRESS AND STRENGTH REQUIREMENT

Machine components are subjected to external forces like torque, friction, inertial forces, internal forces (due to temperature difference), pressure and both normal and shear stresses. For the machine components not to fail, it should be capable of withstanding these forces. Furthermore, to design a machine capable of withstanding these forces, proper sizing of machine components and careful selection of material for the various components should be carried out.

ECONOMIC DESIRABILITY

Cost estimate for the machine, while still at the design stage is very important. The cost of the machine should be taken into account during the process of designing in as much as the sizing of components and material selection play an important role in the machine performance; machines are designed with the selection of those materials so that they could be produced at affordable process to consumers without incurring loss.

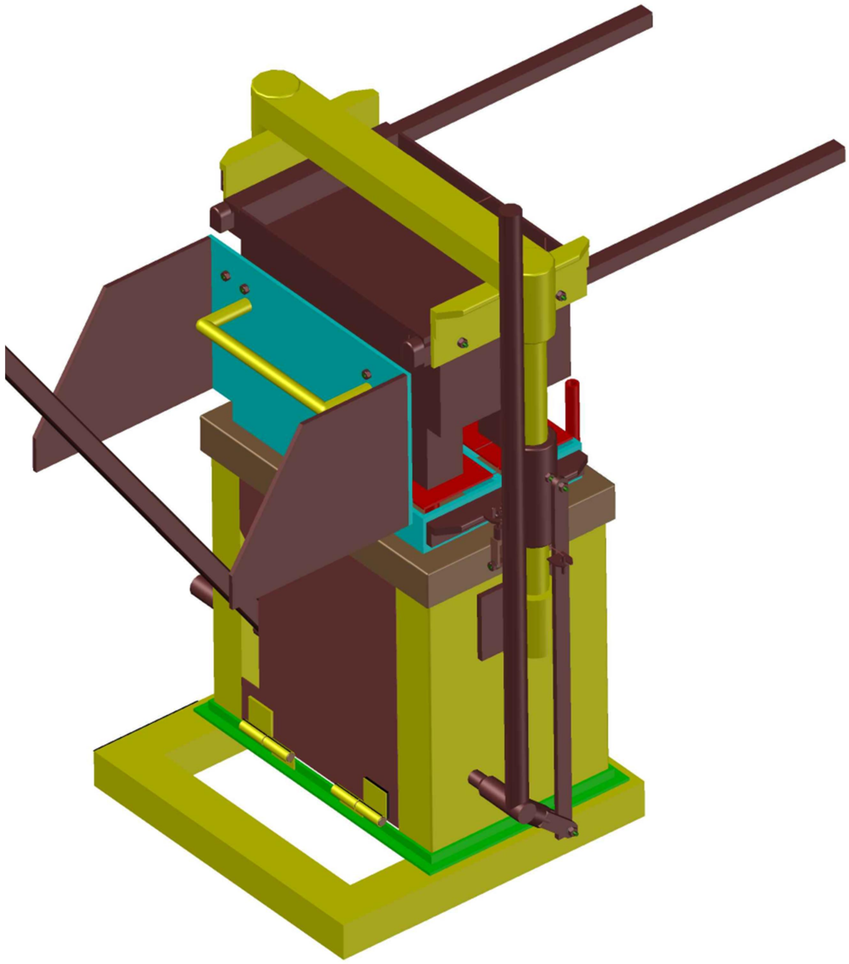
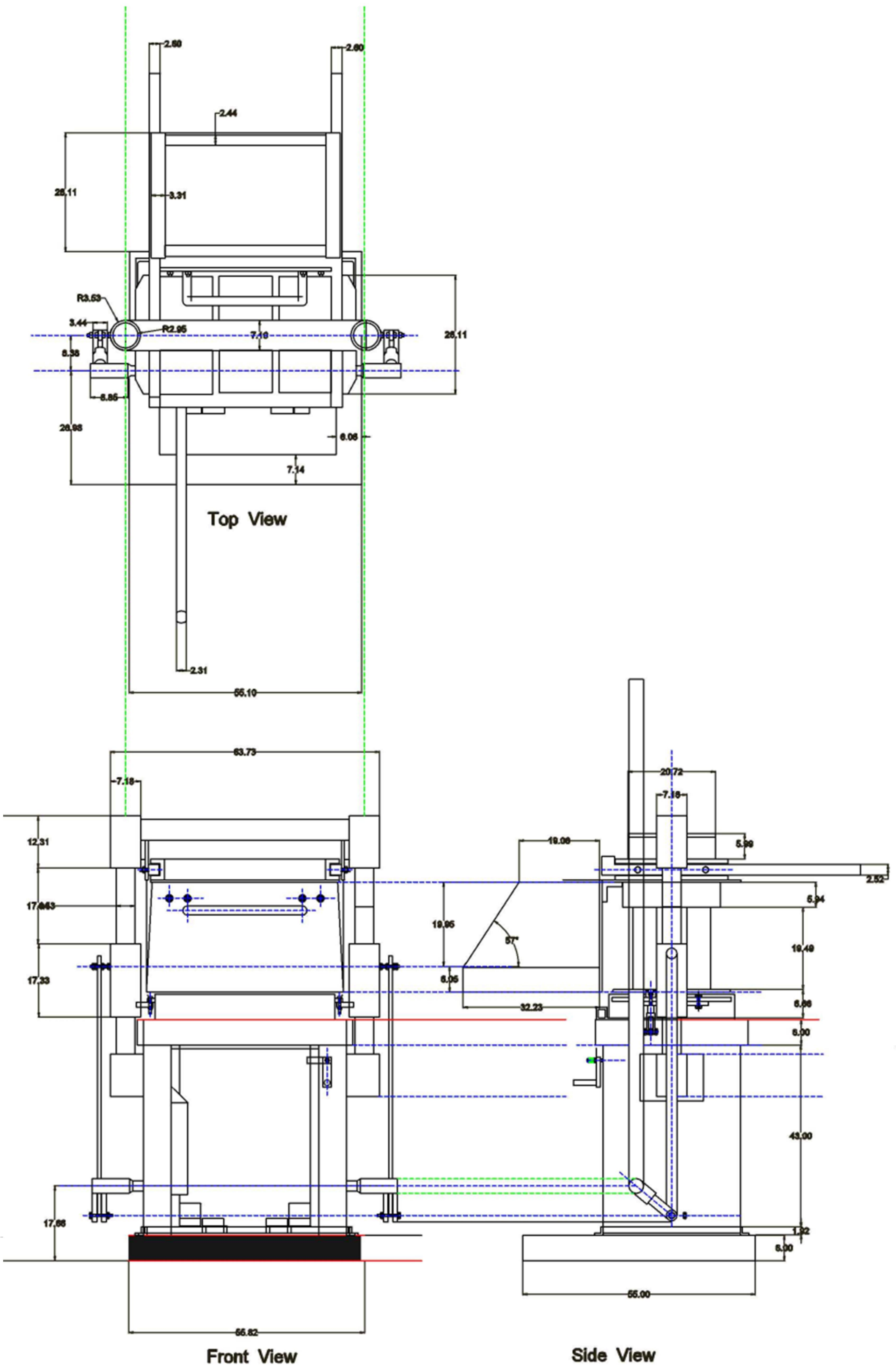


Figure 1: Isometric Projection of the Mineral Block


Top View
Front View
Side View
2.60
2.60
2.44
25.11
3.31
R3.53
3.44
R2.95
7.10
26.11
6.38
6.85
26.98
6.06
7.14
2.31
55.10
63.73
7.18
12.31
17.963
17.33
17.66
55.82
20.72
7.18
19.06
5.99
2.52
5.94
19.95
57°
19.49
6.05
32.23
6.86
6.00
43.00
1.32
6.00
55.00

Calculation of the Forces

To calculate the force acting on the compression plate

The force Fc is the resultant force of the compression pressure which is equal to:

$Fc = P9 \times A$ 1

$where\ P9 = 3 \times 10 pascal$

A= Area

The friction between the guide cylinder and the compression cylinder will be neglected as well as between the compression plate and the inner mold. The length of the compression lever can be calculated according to the free body diagram of the lever.

$P = M \times G$ 2

Where;

P is the exerted force by an average user.

M is the mass of average user and

G is acceleration due to gravity

Also to calculate the thickness of the plate this formula was used

$$\boldsymbol{\sigma} = \frac{6 \times M}{e2} \quad 3$$

To calculate the forces acting on the Compression Cylinder the formula below was used

$$\sigma = \frac{F}{A} \quad 4$$

RESULST AND DISCUSION

FORMULATIONS USED FOR PREPARING MULTINUTRIENT BLOCKS

Table: 1 shows the preparation of the blocks; Albino Tamarind and potash were mixed together by shovel. Water is poured into the premix of the dry ingredients, prepared on a polythene sheet or in an iron pan, and mixed thoroughly. One or 2.0 kg of the semi-solid mixture was then put in the machine frame (6” x 6” x 3”), covered with an iron sheet (that fitted well into the iron frame) and pressed for 20–30 seconds by the pressure exerted by an adult hand (adult = person weighing 60–70 kg). The iron case was then pulled out leaving the pressed brick on the polythene sheet. The brick were left at room temperature for drying so as to be hard enough for handling, transport and feeding.

Table: 1

Ingredients (on percentage basis)	**Formulation**				
	I	**II**	**III**	**IV**	**V**
Albino Tamarind	60	60	50	50	50
Potash	20	20	30	30	30
Water	20	20	20	20	20

CONCLUSION

Blocks from formulation I and II, with 60% Albino Tamarind was too brittle. The blocks prepared from formulations III, IV and V were acceptably hard, although a variable number of days were required for them to reach the desired hardness. It is also observed that the addition of Albino Tamarind plays a vital role as a binder by sticking the powdered potash together with the help of water. Finally it can be concluded that the blocks produced by this machine are satisfactory to be used by local farmers.

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