CONSTRUCTION OF A PORTABLE ROLLER MILL MACHINE

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Abstract

The machine was purely made with locally available materials. It consists of shaft, rollers, bearings, hopper and stand. The body of the machine was covered with galvanized sheet and it has a moderated height. The rollers are driven by electric motor which reduces grains to moderate sizes. Preliminary test of the machine was carried out by turning the rollers manually. It was discovered that the rotation was smooth without producing any noise. Testing was also carried out with the aid of a motor which rotates the rollers smoothly. The efficiency of the machine is 81.25%

Key Words: Construction and Roller Mill

Introduction

Traditionally, grains and cereals were processed by our farmers using crude implements. Today more advancement in technology has eradicated the local methods of processing these grains. Many grinding machines are in circulation. One of these type is the roller mill which is an elaborate, cheap and efficient way of grinding wheat and grains. Modern milling equipment have been largely standardized.

Shellenberger (1965) reviewed fifty years of advances in milling technology and reported the following as major advances: Pneumatic conveying, air classification, free - swinging plansifer, improved wheat condition and automatic roll control. Nuret (1975) reviewed the changes in the French milling industry especially those associated with government policies. The outcome favoured the masses.

All new mill construction will include "air stabilization (Kice, 1968) systems to control cleanliness of air inside the building as well as the temperature, humidity and air circulation throughout the mill. Power is a major factor in overall milling production cost and this component is likely to become more critical in future (Kice, 1977). Locke (1962) outlined the requirements for proper and effective sanitation maintenance in the industry to assure cleanliness of plant and whole someness of product.

Several methods are use is to measure grain hardness. This has been classified by Simmonds (1974) into grinding, crushing, abrasion or indention by a status. Two tests used in routine testing of grain are the particle size index, PSI (Symen, 1961), the pearling resistance (Chesterfield, 1971). Property often associated with hardness is the virtuosity of the grain. The objective measurement of this property has been described by Chesterfield and Jacob, 1974.

A method of following movement of moisture through a wheal grain, using auto radiography to monitor the weak B - emission from (filiated water, has been described by Butcher and Stenvert and extended by Moss (1977) to measure the location of water at the cellular level. This technique has led to knowledge about the factor controlling water penetration into the grain (Stenvert and Kingswood, 1977; Moss, 1977).

An interesting approach to determining the origin of grain hardness was made by Barlow et al (1*973). A notahle feature of starch samples prepared by solvent notation is that granules from harder wheats have more protein adhering to them than those from soft wheat which are relatively clean (Simmonds, 1971). Stenvert and Kingwood (1977) proposed that it is unnecessary to invoke an adhesion theory for wheat hardness and that if the protein matrix as a whole is not continue, this can lead to variations in the strength of the endosperm structure.

Material and Method

The material used are locally made and the machine parts are constructed with the following:

Hopper:- The hopper is made with a galvanized sheet of gauge 18 and it is in form of a square (200 by 200mm).

The Stand: The stand is made of angle iron with breadth 500mm and length 540mm.

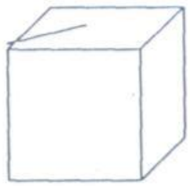
The Shafts: There are two shafts which are made of steel material with length 600mm and diameter/thickness of 22mm each.

Body of the Machine: The shape of the body of the machine is trapeziodal in appearance. The construction material used is galvanized sheet. The largest face of the machine has length 517mm and 200mm respectively. The smallest face of the machine has length 300mm and 200mm respectively. The dimensions were considered and selected so as to make the machine portable and to function effectively.

Method of Construction

Each unit of the machine was constructed separately with the aid of workshop tools and thoroughly welded. The different parts of the machine are explain below:

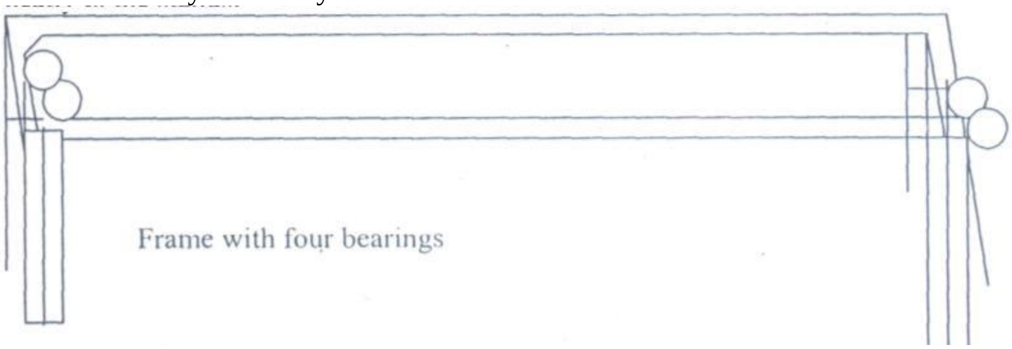
The Hopper: Four pieces of galvanized sheet was cut and welded neatly using an electrode, The hopper is in form of a square with length and breadth of 200mm by 200mm respectively.


200mm

200mm

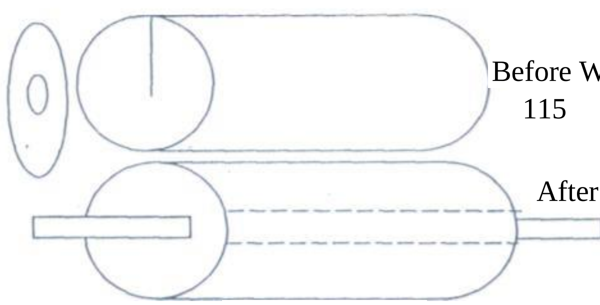
Square hopper

The Frame: Four angle irons with length 300mm was cut with hand hack-saw which was used for the stand. Four angle irons in which two was equally cut to the length of 517mm and two of the angle irons was cut to the length of 300mm. These four dimensions length were welded carefully and neatly to the stands.


Frame with four bearings

Bearings: Four bearings was used and weld carefully to the top of the breadth of the frame. The shafts pass through these bearings.

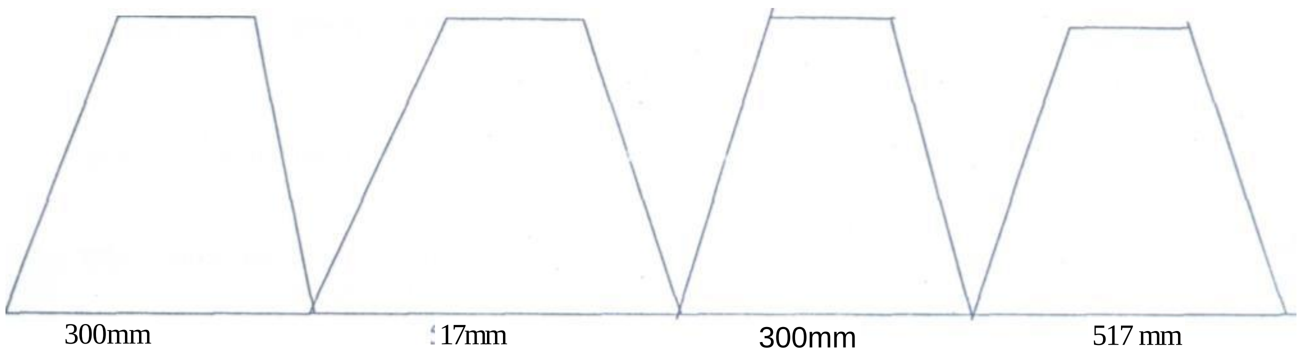
The Shafts with Rollers: The material used for the shaft is steel with length 600mm and diameter/thickness of 22mm each. The rollers are made with a hard thick hollow iron, which the shaft runs through. The rollers are in form of a cylinder. The cylinder face in shape of metal is welded neatly to the cylinder like-roller with a hole at the centre of the metal to give allowance to the shaft to pass through. The arrangement of the shaft and the roller passes through the bearing which in turn rotates the shaft together with the roller.


Before Welding

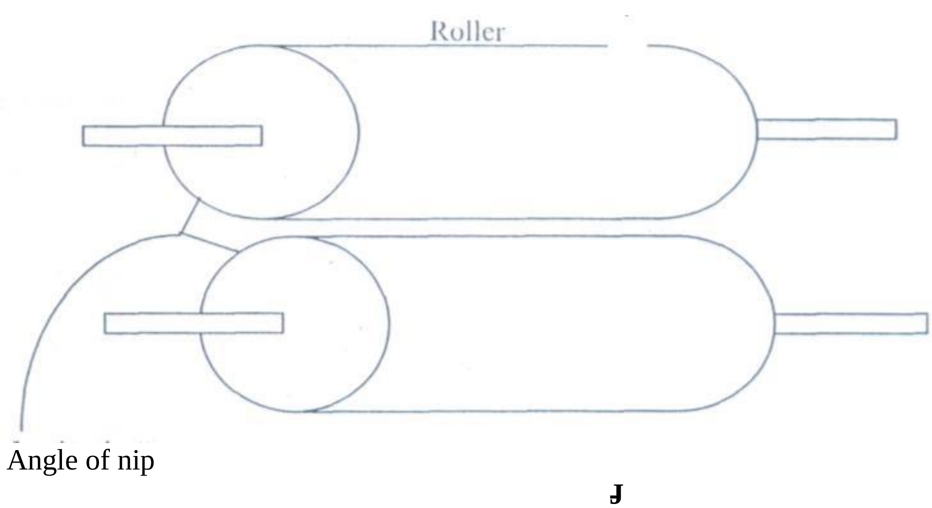
After Welding

Roller with shaft

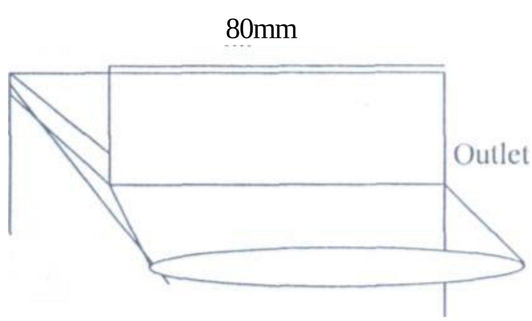
Body of **the Machine:** The machine has trapezodial shape in appearance. It was cut out in form of Kite. The tool used for the cutting was manual bench chain cutter and there were carefully and gently welded together. The bigger face of the machine has length 5 17mm while the smaller face has length 300mm with the same slant height of 430mm and top opening of 200mm. When this plates are folded it will give a shape of trapeziodal. This covers the internal mechanism of the machine. 200mm



The Angle of Nip: This is the angle between the two rollers. A spring loaded design or an adjustment at the edge of the frame was incorporated in this construction so as to control the gap between the rollers. This was included because the feed materials between the rollers are of different sizes

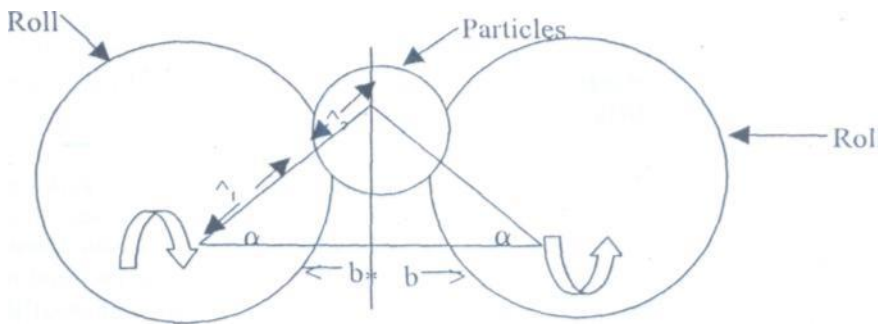


Outlet: This is where the grinded materials are received. The outlet are well dimension and welded together. The materials used for the outlet is galvanized sheet.



Operation Description of the Machine

Two rolls, one is adjustable bearing which rotate in the same directions and the clearance between them can be adjusted according to the size of the feed and the required size product. The machine is protected by spring loaded against damage from very hard materials. Generally, one roll is driven directly and the other by friction with the solids. The rolls arc suitable for effecting only a small size reducing in a single operation. If further reduction is to be obtained, the spring-loaded mechanism or adjusted design incorporated into the machine should be effected.



Particles feed to crushing rolls

The above is the pictorial view of the cylindrical face of the rollers together with feed of the constructed machine which shows a spherical or cylindrical particles of radius r2 which is feed to crushing rolls of radius r,. 2 oc is the angle of nip, the angle between the two common target of the particle and each of the rolls and 2b is the distance between the rolls.

From the geometry of the system it can be shown that the angle of nip is given by

$$\frac{H + b}{r_2 + r_2} = \cos \alpha$$

or

$$\frac{r_t + b}{r_2^2} = \cos \infty$$

The angle of nip gives the optimum distance 2b between the rolls, for maximum size reduction. It should be noted that roller mills are simple to construct but do not give a large percentage of grinding to smaller sizes.

Result and Discussion

Preliminary Testing of the Machine

The rollers were turned manually and it was observed that the rotation was smooth without producing any noise, this is as a result that the shaft is straight and it functions well. A handful of wet maize was poured through the hopper to the inner unit and the machine was turned manually. It was observed *that **the** wet maize was crushed to **smaller** sizes which were* received through the outlet.

The testing material is dry maize. The dry maize was poured through me hopper graawm^ «» the nip angle (gap between the two roller) where they were crushed to reasonable sizes. The machine is turned with the aid of a motor and the source of power is electricity. It was observed that the input is about equal to the output with little or no wastage. The efficiency of the machine is 81.25% from the calculation below:

Input - 80g

Output - 65 g

Efficiency - $\frac{65}{80} \times 100$

=81.25%

The second materials used for testing was wet maize. The efficiency of the machine for this testing is about the same when compared is with the testing of dry maize.

For Wet Maize

Input - 83g

Output - 66g

Efficiency - $\frac{66}{83} \times 100$

= 79.5%

Summary of **the** Test

Dry Maize Wet Maize

Efficiency	-81.25	79.50
Moisture Content	-10%	30%
Input	- 80g	83g
Output	- 65g	G6g

The efficiency of the machine is at the range of 79.5 - 81.25%. It was discovered that in the two testing, the efficiencies differs with 1.75%. The difference is due to the fact that one of the testing materials is wet. The wet maize reduces efficiency of the machine because most of the materials was sticky to the rollers due to the wet condition of the maize.

It was not so with the dry maize. Though the dry maize will require greater force before they can be crush to smaller sizes. This is not so for wet maize. This shows that it will take longer time to crushed dry maize than wet maize especially if the same force is applied to the rollers. This fact was observed during the testing of the machine.

In most of the existing mills, several rolls are incorporated in a system for continuous performance. But only two rolls are considered in this construction, which give fine crushing effect on cereals. The one constructed is a portable mill which can be easily transported. As earlier stated, the machine efficiency is at the range of 79.5% - 81.25% lor both wet and dry maize showing that the machine friction is less and as a result a high turn out was achieved. More efficiency can still be achieved if more effort is geared toward further development.

The cost analysis of the machine as of 2001 is slated below:

No	**Materials**	Prices (£^)
1.	2 galvanized sheets	6,500.00
2.	3 Angle iron lengths	1,500.00
3.	2 Shafts	2,000.00
4.	2 rollers	1,000.00
5.	1 packet of electrodes	1,000.00
6.	1 pulley	1,000.00
7.	4 bearings	1.200.00
	Total	13,700.00

Apart from motor, the cost of the construction of this machine is Nl3.700.00 which the farmer can still afford to buy unlike the expensive ones which our local farmers cannot purchase with the mergre amount they have.

It is recommended that for our farmers to be encouraged in the farming system, they should always have the opportunity to afford to purchase any agricultural machine constructed for their use. If local materials are used for the construction, the cost will be reduced. It is also advised that portable and functioning machines should be always constructed so that it will attract the interest of the farmers toward agricultural productivity. The Government should provide money (fund) to the researchers so as to develop new ideas of constructing new machines.

Conclusion and Recommendations

The roller mill machine was successfully constructed using locally available materials. The difference between the one constructed and the existing one is that locally available materials were used for the construction. In this construction, only two rolls were considered (one adjustable and the other one fixed) and the feed was run through the rolls once. A fair crush product was produced. Feed like this is good for the feeding of chicks, fish breeding in ponds and other domestic animals.

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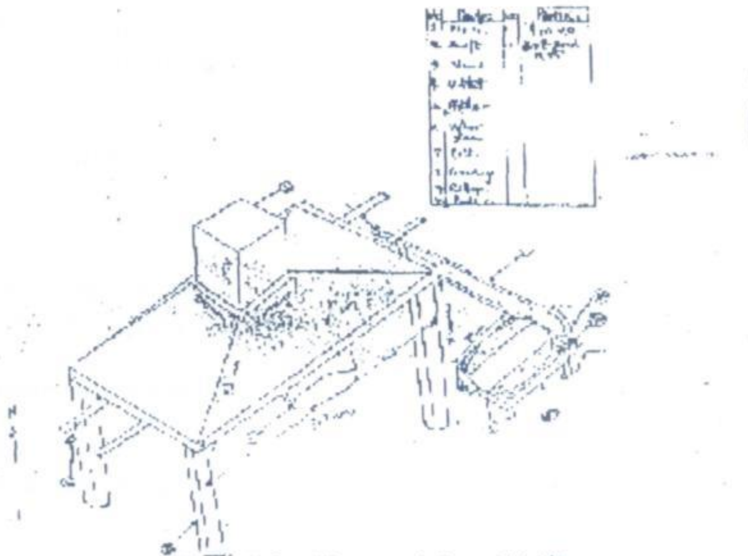
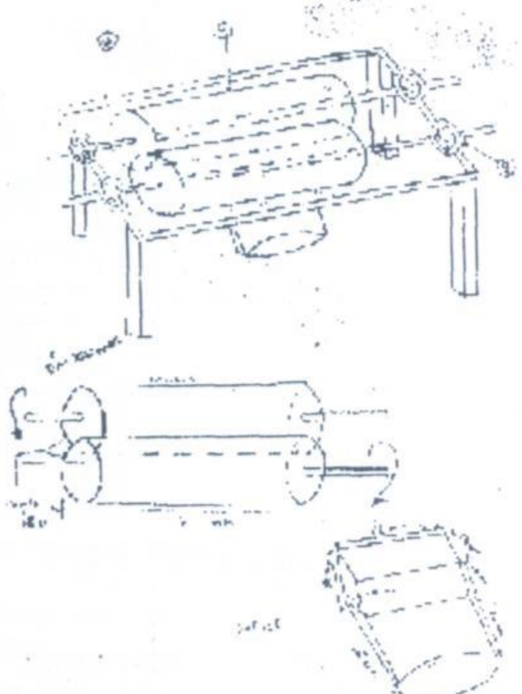


ROLLER MILL MACHINE



First angle Projection of the roller mill Machine