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"Design and Construction of a Groundnut Decorticating Machine"

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Abstract

The design and construction of a manually operated groundnut shelling machine is intended for the rural farmers to ease post–harvest processing of nuts. Although the machine is named as above, it is universal in its operation, because it can be used to shell peanuts, bambara nuts, beans etc aside from groundnut. It consists of an outer body with its inner surface lined with a friction plate and an inner rotating drum wrapped also with a friction plate. The shelling action is accomplished when the nut is trapped in the clearance between the moving drum and the fixed body.

The friction plate lining on the body opposes the motion of nut conveying drum thereby resulting in the shelling action of the machine. The nut and the shell are both collected in the basin beneath the machine. The machine is easy to maintain and has the capacity to shell 50kg of nut per hour, with a minimum percentage of breakage.

Key Words: Design, Construction, Machine, Groundnut, Shelling.

Article Outline

1. Introduction

Groundnut (Macrotyloma gecoarpum), is a pulse belonging to the legume family similar, to that of the peanut. It is primarily produced in Western Africa, specifically in Benin and the surrounding regions. It can provide nutrition as well as generate income for the rural dwellers. Groundnut also has the ability to alleviate hunger, or to be used as appetizers before main food. Its yield is about 50kg/hr.

Following the construction of Nigerian railway system in 1896 in Lagos which was extended to Ibadan in 1900 and Kano in 1911, the Hausas of Northern Nigeria became major producers of groundnut. Within two years the peasant farmers of Northern Nigeria were producing so many tones of groundnuts that the railway was unable to cope with the traffic. As a result, the European merchants in Kano had to stock pile sacks of groundnuts in the streets which was known as the famous groundnut pyramids. Hence groundnut can be said to be a cash crop.

Nutritional Value of groundnut vary. for example : Per 100kg of dried grain, it consists of 9.7g of water, 348Kcal, 21.3g protein, 1.1g fat, 66.6g carbohydrates, 5.5g fibre, 103mg calcium, 15mg iron, 0.76mg thiamine, 0.19mg riboflavin and 2.3mg niacin.

Growing Conditions: In the northern part of Nigeria, temperatures fluctuate between 27–32 degrees Celsius in the dry season and 25 – 27 degrees Celsius during the lowest season. Groundnut pod develops in the ground in pods under the aforementioned climatic conditions.

Products of Groundnut: These include Groundnut oil, groundnut cake and animal feeds etc.

2. Literature Review

2.1. Traditional method of Groundnut Shelling: is done by hand by applying a little pressure on the shell of a previously dried groundnut. It is the oldest method known to mankind before the advert of technology. Peasant farmers in the ancient time married many wives and raise a large extended family in order to ease the accomplishment of farming activities and farm product processing after harvesting. Each member of the family especially the female and the younger ones are involved in the processing activities like shelling etc. There is a very minimal or no breakage of the nut and the separation of the nut from the shell is done simultaneously during the shelling operation. This method is slow and involves a lot of human labour.

Another traditional method is by gentle pounding of the groundnut in a mortar by a pestle. While the shelling operation is done in some places by packing a quantity of the nut in a sack and striking against a hard surface. In these later methods the nuts suffer a great deal of breakage and the separation of the nuts from the shell as to be done by winnowing, although, the shelling is achieved at a faster rate and less labour is required.

2.2. Mechanical Method

2.2.1 A decorticator (**from Latin**: *cortex bark*) is a machine for stripping the skin, bark, or rind off nuts, wood, plant stalks, grain, etc., in preparation for further processing.

In 1861, a farmer named Bernagozzi from **Bologna**, manufactured a machine called a cavezzatrice," a decorticator for hemp. A working hemp decorticator from 1890, manufactured in Germany, is preserved in a museum in Bologna. In Italy, the decorticator was invented in the United States in 1935. In 1916, there were already five different kinds of "machine brakes" for hemp in use in the United States, and still others in Europe.

Under old methods, hemp was cut and allowed to lie in the fields for weeks until it" retted" enough so the fibers could be pulled off by hand. Ratting is simply rooting as a result of dew, rain and bacterial action. Machines were developed to separate the fibers mechanically after retting was complete, but the cost was high, the loss of fiber great, and the quality of fiber comparatively low. With the new machine known as a decorticator, hemp is cut with a slightly modified grain binder. It is delivered to the machine where an automatic chain conveyer feeds it to the breaking arms at the rate of two or three tons per hour. The hurds are broken into fine pieces which drop into the hopper, from where they are delivered by blower to a baler or to truck or freight car for loose shipment. The fiber comes from the other end of the machine, ready for baling… Schlichten spend 18 years and $ 400,000 on the decorticator, a machine that could strip the fibre from nearly any plant, leaving the pulp behind. His desire was to stop the felling of forests for paper, which h e believed to be a crime

In 1919, George schlichten received a U.S. patent on his improvements of the decorticator for treating fiber-bearing plants. Schlichten failed to find investors for production of his decorticator and died as a broken man in 1923.

2.2.2 The Universal Nut Sheller (UNS; formerly called the Malian Peanut Sheller) is a simple hand –operated machine capable of shelling 50 kilograms (119 1b) of raw, sun-dried peanuts per hour

It requires less than $50 USD in materials to make, and is made of concrete poured into two simple fiberglass molds, some metal parts, one wrench, and any piece of rock or wood that can serve as a hammer. It accepts a wide range of nut sizes without adjustment. Operators can make necessary adjustments quickly and easily. It is estimated that one Universal Nut Sheller will serve the needs of a village of 2,000 people. The life expectancy of the machine is around 25 years.

The full Belly project is working to establish local, sustainable businesses that manufacture and distribute appropriate technologies such as the Universal Nut Sheller

In 2001 Joek Brandis travelled to Mali to fix a small village's water treatment system. While there he met a woman who informed him that it would be of great to her village if he could find an affordable peanut Sheller for them. Upon returning to the United States he contacted peanut authority Dr. Tim Williams of UGA, who told Brandis of a Bulgarian peanut shelling design. Jock adapted the design with help from a friend, Wes Perry, Jock went through several iterations of a redesign and one year later he completed the machine which is now called the Universal Nut Sheller.

In 2003 Brandis teamed up with a group of returned Peace Corps volunteers from Wilmington, NC to form the Full Belly Project, dedicated to designing and distributing unique appropriate technologies in developing countries.

The user loads the desired crop in the space at the top. The user turns the handle, which rottes the rotor continuously. This movement facilitates the nuts falling down the gradually narrowing gap. The shell of each nut is broken at the point where the gap is sufficiently narrow and the rotor motion causes sufficient friction to crack open the shell. The adjustable minimum width of the gap allows a range of nut sizes to be shelled. The kernels and shell fragments fall into a basket and are later separated by winnowing. The device works best for Jatropha cucas. Shea dried coffee and peanuts (groundnuts). See Fig 1. In the appendix

The full Belly Project has developed a Pedal Powered Agricultural Processor. The Pedal powered Agricultural Processor places the Universal Nut Sheller onto a pedalling chassis. In

addition to the shelling method described, the pedalling apparatus is connected to a fan. The fan automatically winnows the harvest (separates the shells from the nuts). The pedal powered versions are capable of shelling the same variety of crops as the hand crank powered versions. The processor also provides access for the winnowing section to be used independently from the Sheller. This allows winnowing of crops that are not shelled, such as rice, maize, sorghum etc.

Problems

The Universal Nut Sheller has been less than successful in Ghana firsthand accounts relate almost universal breakage. Users can mitigate this breakage by pouring the nuts through initially at very broad settings and only later at finer settings, this practice does not eliminate the breakage and destroys the efficiency aspect, Groundnut shelling tends to be a social activity everyone engages in during their down time and there is rarely a need for a peanut Sheller.

The Universal Nut Sheller proved incapable of shelling Shea nuts in a manner useful for Shea butter extraction for the Shea nuts of Ghana However, there are reports that it works for Shea nuts from trees in Uganda.

The cost also proved a significant barrier. It simply costs far more to produce (even excepting the cost of the mold, transport of materials to the village, travel to the nearest town to find someone capable of welding the metal parts, etc.) than individual growers were able to pay. However, growers unions who made the investment have been successful.

2.2.3 The Oscillating Decorticator: Is a threshing machine famous in the northern part of Nigeria, it consist of the main body which serves as the shelling chamber and a supporting frame for the threshing bar, it has a perforated base through which both the shelled pods with the shell is exited from the device. The threshing bar has prongs at the bottom by means of which the nuts are robbed against the perforated base. See Fig 2 in the appendix

3. Methodology

3.1 Samples of Varieties of Groundnut: samples from different communities were collected and measured, using the vainer calliper, to determine the length and thickness of an unshelled nut, thereafter, the samples were shelled by hand and the measurement repeated for the pods. This procedure was carried out, to determine the average clearance to be used in the machine,

for an average size of a shelled nut to minimize breakage. The result of the research is shown in the table 1.1.

3.2. Description of Machine: The machine consist of the feeding hopper, a rotating closed end mild steel cylinder, mounted rigidly on a shaft with two pillow bearing supported on an angle iron steel machine frame, with a handle fitted on the right hand end of the shaft. A friction plate (perforated tin sheet) is wrapped round the cylinder and held in place by means of tapping screws. The body of machine is segmented into two, the upper and the lower parts. The upper part is a rigid piece welded to the hopper of the machine. A friction plate is fitted on the inside of the concave frontal part of the upper body while another friction plate is fitted on the inside of the lower concave, the latter is connected to the upper concave by a pair of two hinges. The gap or clearance between the rotating cylinder and the lower concave can be adjusted by means of a bolt connecting the lower concave to the back of the machine. See fig 3 in the appendix

3.3 Shelling Action: The clearance between the upper concave and the rotating cylinder tapered from the throat of the hopper about 20mm down to a clearance of about 10mm at the end of the upper concave. The groundnut is trapped between the stationery friction plate and the friction plate on the rotating cylinder, as the latter is rotated a shearing force is set up thereby shelling the groundnut since the force from the two friction plates opposes each other. The shelled groundnut is collected in the basing in front of the machine; the smaller sizes of unshelled groundnut are shelled between the lower concave and the rotating cylinder.

3.4 Maintenance: All the parts of the machine can be sourced locally, the friction plates can be made from Cans of beverage like bournvita Can etc, the perforation is done by gentle nailing.

3.5 Power: Manually operated

3.6 Shelling Capacity: 50kg per hour

3.7 Cost Analysis: ₦ 40, 000 (See appendix for break down)

4. Recommendation and Conclusion

Recommendation: In view of the current rural electrification programme of the government, a consideration to construct a motorized model that will separate the shell from the nuts, and

to increase shelling capacity is necessary.

Conclusion: The machine is very effective and minimizes breakage to a tolerable degree. It is very durable and easy to maintained and can be used anywhere. It is also cost effective.

Appendix

Table 1: Showing the Average Thickness of Unshelled and Shelled Groundnut

Groundnut	Average Thickness in Millimetre
Unshelled	15mm
Shelled	10mm

Table 2: Material Required and Labour Cost of the Decorticator

Description	Quantity	Unit Price	Amount
Mild steel plate gauge 16	4x4 feet half full size	₦7,000	₦3,500
Mild steel plate gauge 20	2x2 feet	₦5,000	₦1,250
Pillow bearing 1” bore	2 pieces	₦2,500	₦5,000
Angle Iron 1”x1”	2 lengths	₦2,000	₦4,000
Shaft 1”	2 feet	₦1,000	₦1,000
Flat bar 1”	¼ of a length	₦3,000	₦750
Overhead			₦15,000
Labour			₦24,000
Total			₦40,000

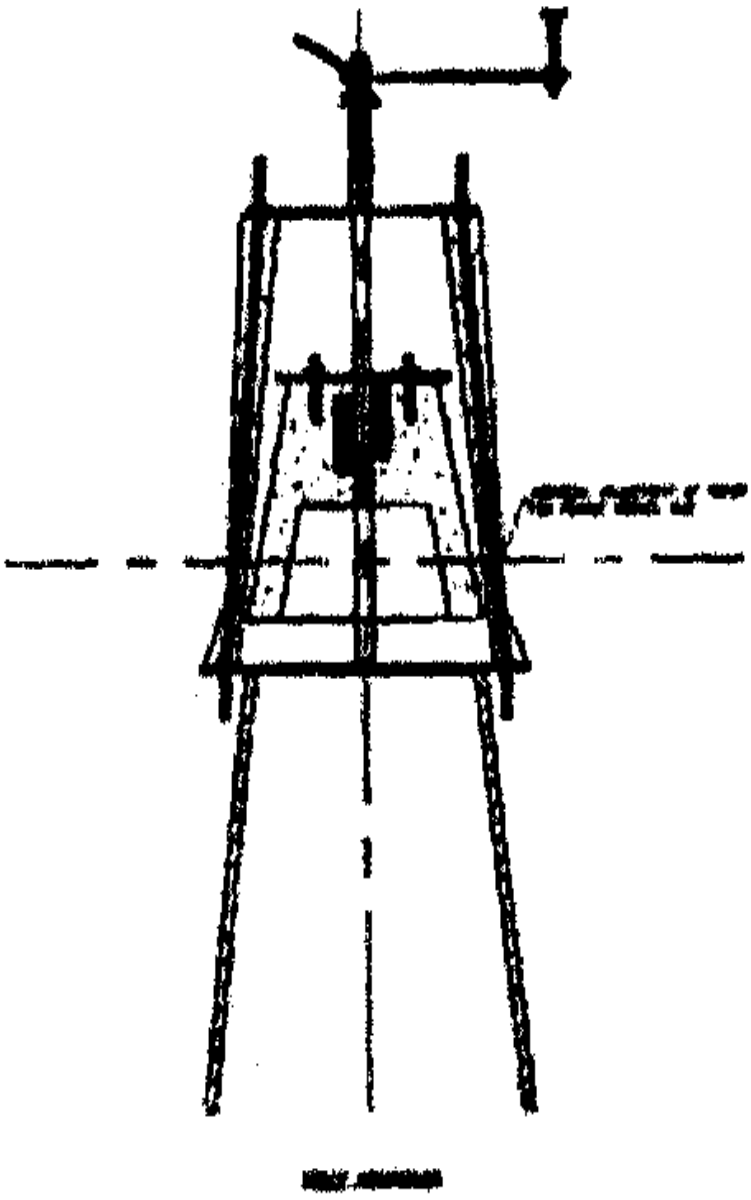

Fig. 1 Universal Shelling Machine

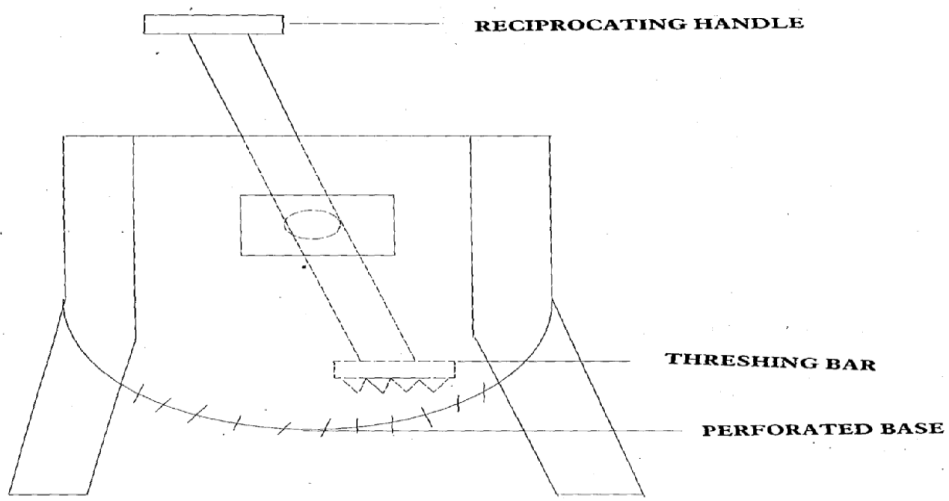

Fig. 2 Reciprocating Groundnut Decoration

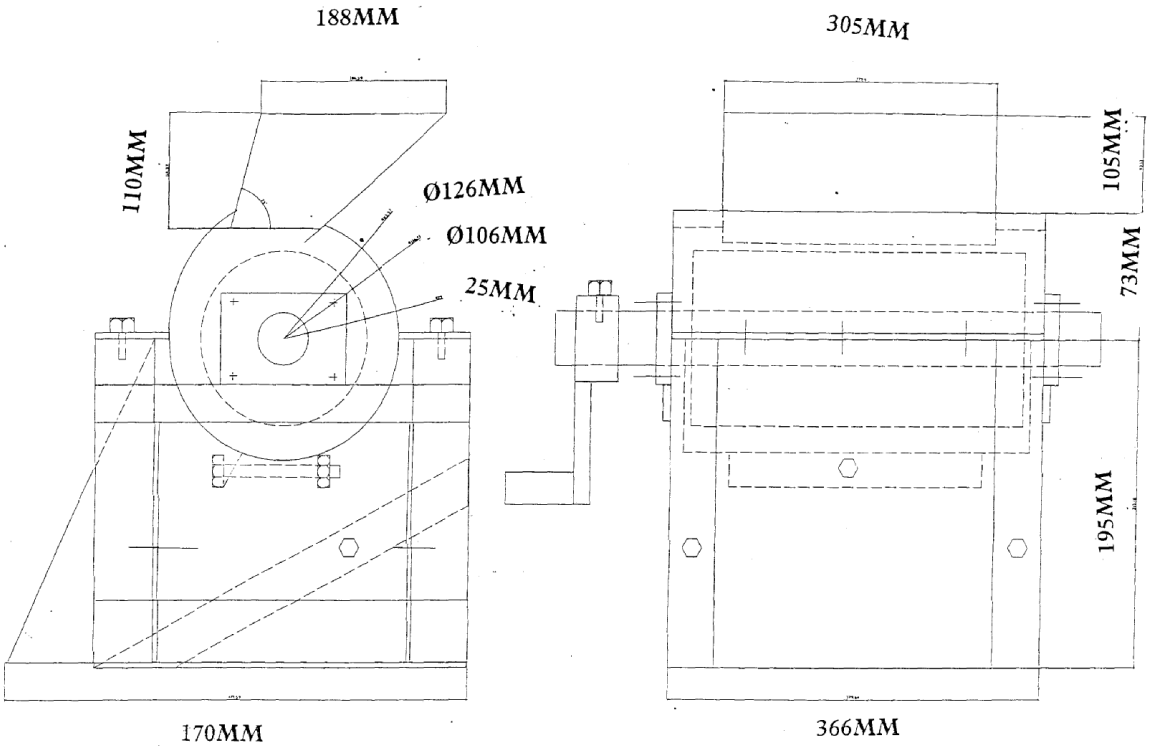

Fig 3 .Groundnut Decorticating Machine

References

- Paolo Ranalli and Gianpietro Venturi: Hemp as a raw material for industrial applications, Euphytica, Euphytical 140:1-6 2004
- Picture of an 890 GERMAN DECORTICATOR at Museo ella Civilta Contadina. San Marinot DI Bentivoglio, Bologna, Italy
- Pictures of many decorticators in internet
- For example in edits about hemp in Wikipedia
- Lyster H. Dewey: HEMP HURDS AS PAPER – MAKING MATERIALS UNITED STATES DEPARTMENT OF AGRICULTURE, BULLETIN No 404, 1916
- Geoge W Schlichten 1919
- History of hemp prohibition
- India MART Inter Mesh Limited Decorticators
- Full Belly Project- Non–profit organization which designs and distributes appropriate technology, including the Universal Nut Sheller