NIGERIAN JOURNAL OF ENGINEERING RESEARCH UNICROSS (NJERU)

Volume 1, Issue 2, 1st June, 2024

Design And Development of Groundnut Peeling Machine

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Received: 10th July, 2024 Reviewed: 14th August, 2024 Accepted: 20th October, 2024

Abstract:
Significant variations in the economic importance of groundnuts for domestic and industrial purposes exist. Groundnuts are energy demanding and time consuming, an effective machine for the separation is developed. The machine employs a fibre sub-component in the peeler engine which is responsible for the peeling. The machine basically comprises of hopper, peeling chamber with sub-component (fibre), sifter (separator), 220 Volt AC motor, and a chaff container respectively. The machine is powered by the 220 AC motor with 1 HP providing a revolution of 120 rpm and manually controlled in the absent of power providing a revolution of 90 rpm. The materials used in the fabrication of the machine were sourced locally so as to ensure that the machine is cheap, affordable, and easily maintain by peasant farmers. Performance investigation carried out shows a good performance of the machine with a peeling efficiency, unpeeled efficiency, machine damage efficiency, cleaning efficiency and output capacity of 90%, 6.5%, 8%, 90% and 80kg/hour respectively, for groundnut seeds with 86.5% dryness. The result of the study also shows that the machine will be more suitable in today's groundnut farming with and without the presence of power to reduce stress, waste of resources, and increasing productivity.

Keywords: Groundnut, peeling, machine, traditional, researches, performance.

I. INTRODUCTION

Agriculture has been the back bone of the economy of some countries in the world. Many of the farmers work day and night for growing crops [21]. In regards to the changes in climate conditions, farmers cultivate diversity of crops, which groundnuts is included. (The scientific name of groundnuts is (Arachishypogaea). It appears inclusively in the plan tree of fabaceae. The condition more favourable in growing this crop is dry climate. The major parts of the groundnut include: shell, cotyledon, coat, radical and plumage, seed. It has much importance such as food (peanut butter, peanut flour, boiled nuts, (peanut oil etc). Groundnut has been a major source of economic empowerment for a lot of farmers and countries, this chapter discusses the relevance of groundnut and work done by different researchers. According to [14], groundnut is the sixth and most important oilseed crop in the world. It contains almost 50% of oil and 28% of protein, 10.2% of sugar, 500-600 calorific worth and 40.5% fat, and it is an extensive source of dietary fibre, minerals and vitamins. It grows more on soils that are well depleted, textured and well supplied with calcium, potassium and phosphorous. Over 100 countries and more grow groundnut. According to [17], groundnut is of the ultimate important to the oilseed crop worldwide. There consist of so many groundnut propagating countries in the world but only few are major producers like, China, Nigeria, India Sudan, Burma, Senegal and the United States of America with a world average yield of 1.4 metric tonnes per hectare.

According to [4], attributes of groundnut are their morphology, physical and mechanical properties such as variety, size dimensions, coefficient of friction, angle of repose cracking stress and moisture content,

Properties of seeds in machine design are seen as significant parameters use in determining the parameters of the machine. They are required when solving problems associated with machine design and also in analysis of the characteristics of products in agriculture. Dimensions such as arithmetic mean diameter, geometric mean diameter, aspect ratio and sphericity describing the size and shape of the seed which influence its characteristics in flow ability.

According to [11], identified the physical behaviour related to varieties of groundnut developed by the International Crops Research Institute during the Semi-Arid Tropics (ICRISAT) in Kenya. Results from similar research shows how large sized of varieties resulted into higher peeling efficiencies than their little sized counterparts for the same concave clearance and feed rate. According to [2] studied the size of groundnuts by carrying out measurement that shows their principal axial dimensions. The average major diameters of kernels were discovered to be 8.54mm, 6.93mm and 3.55mm respectively. Angle of repose of kernels on wooden surface was found to be 170 degrees. Behaviour of two divers of groundnut used has been practicalize and measured. The damp level of kernel relates to water quantity stifle in the kernel. According to [12], showed that peeling efficiency rises with reduction in wet stable for all varieties of groundnut studied. According to [9], observed out that growth in damp level leads to a rise in all angles of half of groundnut grain. Outcomes from practical's for Bambara nuts express that damp level has maximum result on production than feed rate. Thus, percentage grain damage rises with accretion in wet content while peeling order reduces with rise in damp content. According to [20], presented a feasible simplification of the consequence that when the wet standard rises, the efficiency reduces since the peeled become friable, tending to be stiff instead of cracking and crumbling therefore leading to a maximum proportion of unpeeled groundnuts.

According to [20], survey the ideas which involve the feed rate rising with depressed consent. This was construe that the bigger the opening in the chamber the more peels that can be in surge per peeler. Trials on a guide peeler display that in pair of wood scull peelers, rubber, tyre and feed rate of between the average of100 kg/hr and 75 rpm does not convincing affect peeling production. According to [3], energy consumption in soy bean and cowpeas threshing is directly proportional to feed rate and tip cylinder speed irrespective of concave clearance.

According to [10], malnutrition is decrease with the aid of groundnuts because it contains extra proteins and energy. Groundnuts are practical for oils extractions, while removing oil from the groundnut, the dissipate produced is feed to the animals. It is applied in the industry in production of lubrication oil, vanish, paints, leather dressing and furniture polish. It is also otherwise used for heating oil purpose. Groundnut's peeling is a basic procedure, it permits the kernel and hull to be present for utilization. It contains up to 38% of post reaping costs [7]. Peeling by tradition has been found to be ineffective in consuming time and outcome in small production [12]. Hence, the need for motorised peelers is required. [1], the factors that affect influence groundnut peelers are classified into three basic types. Machine based which involve cylinder speed, concave clearance and fan speed, crop factors. The design is very simple and eco-friendly which uses simple mechanism properties such as peeling system, automatic separating system and crushing chamber etc The essence of this work is to reduce cost, make work easier, and to make this machine accessible to the local farmers.

There consist of two types of sieves which is consistently exercise namely; the wire mesh sieve and the slotted grate sieve. The choosing of sieve size is selected situated on the capacity of groundnuts to be peeled. The wire mesh size is applied through the practical's for manual peelers. The development of a groundnut peeler with a dimension of 34.5 kg/h, a hollow made of circle shape steel bars of 4.99 mm. [13], after the presentation that shows wire mesh sieve was better than the slotted grate. [11], Groundnut peels are dissolute when they get implant in the space between peeling blades and the hollow sieve where the peeling will be taken place, abrasion forces either singly or in combination with each other. The characteristics of the blades can likely affect peeling performance including; their shape, the figures placed on a material type. [13], discover that the efficiency of peeling, using rubber covered drum was smaller than that of pair steel and wooden drum. For peelers harness rowers, grain demolition due to wood propellers was found to be considerably less than that due to rubber covered paddles, while the difference in peeling efficiency was relatively small. According to [12], determined that peeling efficiency is relatively higher in steel rod beater peelers than wooden beater peelers as far as the number of beaters is concerned. [13], determined that an increment in number of drum beaters from 4 to 8 increased peeling efficiency at low drum speeds of 1.83 m/s and 4.58 m/s. Studies by [15], on pea peeling, employing L-shaped blades to provide maximum rubbing action, centrifugal impellers or rollers which revolve in counter directions are utilized in peeling kernels with hard pods. [23], designed and fabricated the pedal operated groundnut crusher. It is a manually operated groundnuts peeler. The pedal is

used for moving the crusher. There will be no energy loss and the cost of production is less. And it is less maintenance cost. [22], designed and fabricated a groundnut shelling machine. Experiments were performed with peanuts. Since this machine is made for small businessman or farmers. The purpose of decocting the groundnut is to make it affordable in case of cottage sector projects. The "groundnut peeling machine" can be applying cottage industry or even a former can also take profit from this machine. The decocting process of groundnut by this machine is more cheap and faster than manual process or any other processes. Therefore, by concluding this project, we have actualized that the "groundnut peeling machine" will save sufficient time, energy, manpower, and save financial input of the project, reducing the cost and time considerably which is the backbone of the present world economy. The weight of the machine is low it is handy to use and easy to move anywhere at the farms. Also, its cost is low and affordable for the farmers.

METHODOLOGY

The peeling machine works with the mechanism that peels and separates the peeled groundnut grains from the chaffs (peelings). Measuring from the top to down as 1100mm height (hopper to sifter); 400mm breadths and 340mm in width (figure 1) present the processes involve in the design and fabrication of a groundnut peeling machine, the major steps considered were the design calculation, material selection, cutting/fabrication and the component obtained from these processes are the relevant part of the machines which are: the hopper, the peeler, a 220-ac motor, and the sifter respectively. Hence, the hopper, peeler, ac motor and sifter were used to commence the fabrication of the groundnut peeling machine after which the final fabricated machine was test run. Note that the main parts in the machine is electric motor, the motor is the major component that drives the machine with the help of the electric current, the voltage of the selected electric motor has to be suitable. If the electric motor is suitable then proceed for the fabrication. Another component such as the hopper, peeler and the sifter directly calculated and fabricated. A CAD design of the work is shown in Figure 2

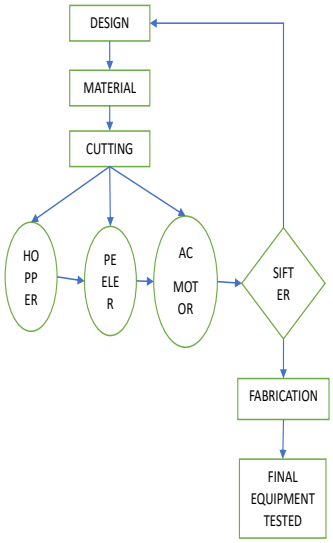


Figure 1. Design and fabrication processes

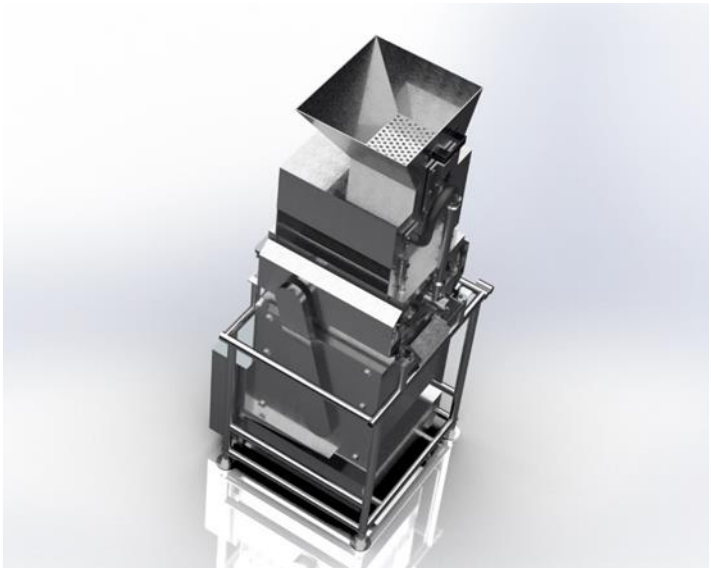


Figure 2. CAD design of the machine

A. Components and Specifications

The selected material part used in fabrication of groundnut peeling machine are displayed. The major components are: the hopper, the peeler, an AC motor and sifter. The machine also consists of other various parts that constitute the body of the machine, this component are primarily built within the machine, they are combining together to carry out a good quality work. Figure 3 shows the bill of material work of the various component of the machine, these components are:

- Hopper

- Peeler
- AC Motor
- Sifters
- AC to DC 12 VOLT converter
- Chain and Sprocket
- Hot air and cool air blower etc.

The material used especially for internal mechanisms are stainless and galvanized metal plate to avoid rust (iron-oxides) in case of water penetration.

B. *Design Calculation of Function*

The design calculation of function shows the working principle of the machine according to observation during the simulation of the working process as carried out in solids work. Some functions calculations used consist of: Energy consumption, Shaft calculations, and Shaft subjected to combined torsion and bending. Hence, they consist to determine a proper mechanism of the machine.

Design of Chain: The design parameters include

$$N1 = 1440\ rpm\ N2 = 240\ rpm\ Pd = 0.5HP$$
$$= 372.85\ W = 0.307285\ [\![KW]\!]\_Droller$$
$$= 14inch = 355.6\ mmW = 30\ kg\ = 30 \times 9.81$$
$$= 294.3N\ Designation\ of\ chain\ At\ Pd$$
$$= 0.37285Kw\ = 372.58w$$

Designation of chain is "A"

Width (w)=13mm

Thickness(t) =2mm

Sprucket Dia.=79mm (D1)

Tension factor (kc) =2.52

Power per Belt: These parameters include

$$\text{Power/belt} = (\text{Fw} - \text{Fc}) \times (e\mu\theta/\sin(\alpha/2) - 1/e\mu\theta/\sin(\alpha/2) * \text{Vp})\ \text{Vp} \quad (1)$$

Were

$$\text{Vp} = \pi \times 79 \times \text{N1}/60 \times 1000 = 4.22\ \text{m/sec}$$

$$\mu = \text{coefficient of friction} = 0.5\pi \times \text{D2} \times \text{N2}/60 \times 1000 \times 4.22$$

$$\alpha = \text{cone angle} = 24\ \text{degree}$$

$$\alpha/2 = 24/2 = 12$$

$$.\theta_{\text{mean}} = \pi - \times \left(\text{D2} - \frac{\text{D1}}{\text{C}}\right) = \prod - \left(470 - \frac{79}{525}\right) = 3.00\ \text{rad} \quad (2)$$

$$\text{Vp} = \frac{\pi \times \text{D2} \times \text{N2}}{60 \times 1000 \times 4.22} = \frac{\pi \times 240 \times \text{D2}}{60 \times 1000} \quad (3)$$
$$= \text{D2} = 470\ \text{mm}$$

Centre distance

$$\text{C} = \text{D1} + \text{D2} = 79 + 470 = 549\ \text{mm} \quad (4)$$

$$e^{\mu\theta}/_{\sin}(\alpha/_2) = e0.\times 2.43/_{\sin(18)} = 10.5 \quad (5)$$

Now,

$$\text{Fw} = \text{w2} = 132 = 169$$

$$\text{Fc} = \text{Centrifugal tension (N)} = \text{kC} \times \left(\text{vp}/_5\right)2$$
$$= 2.52 \times \left(5.65/_5\right)2$$
$$= 3.2177 \quad (6)$$

$$\text{power}/_{\text{chain}} = (169 - 3.2177) \times (10.581 - 1/10.581) \times 5.65$$

$$\text{power}/_{\text{chain}} = 848.146\ \text{W/chain} \quad (7)$$

Number of chain (n):

$$n = \frac{Pd}{\frac{power}{chain}} = \frac{372.85}{848.146} = 0.43 \approx 1\ Therefore\ n = 1 \quad (8)$$

Cross section of chain: These parameters include

$$For\ designation\ A$$
$$b = 3.3\ mmh = 8.7\ mme = 15\ mmf = 9 - 12 = 10$$
$$To\ calculate\ length\ of\ chain$$
$$l = \pi/2 \times (D1 + D2) + 2C + ((D1 - D2)\ 2/4c \quad (9)$$
$$l = \pi/2 \times (75 + 450) + 2 \times 525 + ((75 - 450)2/4 \times 525)$$
$$l = 1941063\ mm$$

Width of Gear: These parameters include

$$= (n-1) \times e + 2f = (8.7 - 1) \times 15 + 2(10)W = 135.5mm \quad (10)$$

Design for Sprocket or Gear: These parameters include

$$Ds = 19mm$$

$Calculate\ hub\ properties$:These parameters include

$$a)\ Diameter\ (Dh) = 1.5ds + 25\ mm = 1.5 \times 19 + 25\ (Dh) = 53.5mm \quad (11)$$
$$(b)\ Length\ (lh) = 1.5ds = 1.5 \times 19\ Lh = 28.5mm$$
$$GEAR = 2$$

Design for Construction: These parameters include

$$At\ d2 = 450N2 = 240W = 135.5mm$$
$$So, arm\ construction$$
$$N = 4\ no.of\ arm \quad No.of\ sets = 1$$

Moment of each arm: These parameters include

$$M = (T1 - T2) \times (D2 - DH)/_H \quad (12)$$
$$Now\ tension\ in\ chain$$
$$Chain\ tension\ (T1\&T2)(T1 - T2) = Pd/RP = 327.85/58.65 \quad (13)$$
$$T1 - T2 = 6.29$$
$$But, Chain\ tension\ ratio$$
$$T1/T2 = T1 = 2.34T2 \quad (14)$$
$$Put\ in\ equation\ at\ (A)$$
$$2.34T2 - T2 = 65.99 \quad T2 = 49.24N$$
$$Then,$$

$$T1 = 65.99 + T2 \qquad T1$$
$$= 65.99 + 49.24 \qquad T1$$
$$= 115.23N$$
$$M = \ M = 6541.258$$
$$But, \sigma = m/2assume\ \sigma = 155\ mp \qquad (15)$$
$$Z = m/\sigma = 6541.250/15 = 436.08$$

$$Now, Z = \ ⟦mb⟧\ \hat{}3/9(3.16)$$
$$= \ 436.08 = \quad b = 10.36mm$$

Face width: These parameters include

$$w = 1.1b = 1.1 \times 10.36w = 11.39mm$$

Rim thickness:

$$t = 0.375\ + 3t = 0.375\ + 3d\ t = 10.95mme \ (16)$$

$$According\ to\ the\ motor\ specifications: voltage: 220 - 260\ volt\ Current\ (amp): 2\ amps\ RPM: 1400$$
$$Capacity: 1/4$$

HP Power: These parameters include

$$P = V \ \ P \ = \ 250 \times \ 2 \ \ = \ 500\ Watt \quad (17)$$
$$We\ know\ that\ P \ = \ 2NT/60$$
$$T \ = \ P \ \times \ 60\ /2N$$
$$T\ SHAFT \ = \ 500X60/2$$
$$= \ (15000)\ Rpm - N$$
$$= \ 4.3\ N - m$$

Energy consumption: These parameters include

$$E\ IN\ KWH \ = \ P \ \times \ TIME \qquad (18)$$
$$= \ 500 \times \ 24$$
$$= \ 12000\ W - hour/\ day$$
$$= \ 12.00kw - \ hour/day$$

$$For\ month,$$
$$= \ \ 12.00 \ \times \ 30\ kw - hour/month$$
$$= \ \ 360.3\ kw - hour/month$$
$$1 - unit\ cost\ is\ 8.5\ rupees$$
$$= \ 360.3 \ \times \ 8.5 \ = \ 3062.55\ /- per\ Month.$$

Shaft calculations: These parameters include

We have diameter of hollow shaft as follows

$$Outer\ diameter = \ 30mm$$
$$Inner\ diameter \ = \ 23mm$$

The shaft experienced with two moments bending mom

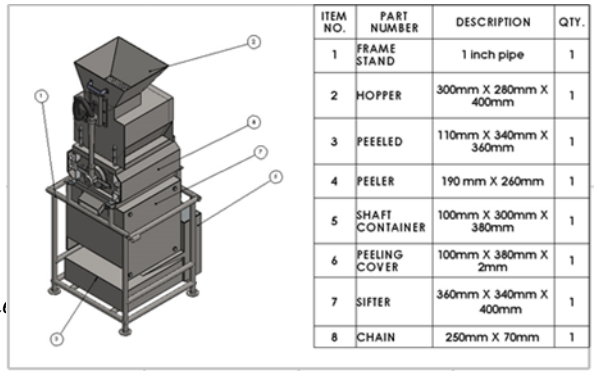
$$T/J = \tau/R \qquad (19)$$
$$We\ know\ that\ T \ = \ 3.7\ N - m$$
$$= \ 3062.55\ N - mm$$
$$J \ = \ x30\ ((D0)\ ⟦D\_0⟧\ \hat{}4 - (\ ⟦D\_I⟧\ \hat{}4\ )\hat{}4$$
$$= \ x/30((30\hat{}4) - \ (23\hat{}4\ )\hat{}4 \ = \ 26333.18\ mm$$
$$= 3062.55/26333.18 \ = \ \tau/20$$
$$\tau\ shaft \ = \ 3062.55x20/26333.18$$
$$= \ 234\ N/\ ⟦mm⟧\ \hat{}2\ 2$$
$$Bending\ stress \ = \ M/I \ = \ \sigma/Y$$
$$Bending\ stress\ due\ to\ self - weight \ = \ 5kg$$
$$Weight \ = \ 5 \times 9.81 \ = \ 49.1\ N$$
$$Stress(\sigma) \ = \ P/A$$
$$= \ 49.1/\ (x/4)\ ((\ ⟦30⟧\ \hat{}2 - (\ ⟦23⟧\ \hat{}2)$$
$$= \ 0.03\ N/mm$$
$$For\ circular\ shaft: I$$
$$= \ 𝛑/64\ ((\ ⟦D\_0⟧\ \hat{}4\ )$$
$$-\ (\ ⟦D\_I⟧\ \hat{}4\ )) \qquad (20)$$
$$= \ x/64\ ((\ ⟦30⟧\ \hat{}4 - (\ ⟦23⟧\ \hat{}4)$$
$$= \ 8835.98\ \ ⟦mm⟧\ \hat{}2$$
$$Bending\ moment\ (M) = (\sigma\ X\ I)/Y \qquad (21)$$
$$= \ (0.4X\ 26333.18)/20 \ = \ 526.66\ N - mm$$

Shaft subjected to combined torsion and bending: These parameters include

$$\tau\ max \ = \ (16\ x\ d0\ /\ \times \ ((\ ⟦d\_0⟧\ \hat{}4$$
$$-\ (\ ⟦d\_i⟧\ \hat{}4\ ) \qquad (22)$$
$$(M)2 \ + \ (T)2$$
$$= \ (16 \ \times \ 30 \times \ 3062.55)/\ \times \ ((\ ⟦30⟧\ \hat{}4$$
$$-\ (\ ⟦23⟧\ \hat{}4)$$
$$= \ 2.77N/\ ⟦mm⟧\ \hat{}2$$
$$\sigma\ max \ = \ (16 \ \times \ d0\ /\ 𝛑\ ((\ ⟦d\_0⟧\ \hat{}4$$
$$-\ (\ ⟦d\_i⟧\ \hat{}4\ ))(M) + \ (M)2$$
$$+ \ (T)2\ ) \qquad (23)$$
$$= \ 16X30(3062.55)/\ \times \ ((\ ⟦30⟧\ \hat{}4$$
$$-\ (\ ⟦23⟧\ \hat{}4) \ = \ 2.77\ N/mm$$

Design Drawing of the Equipment

Component design of the conceived groundnut peeling machine equipment was carried out using CAD software, revealed the drawing as shown in Figure 3.



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	FRAME STAND	1 inch pipe	1
2	HOPPER	300mm X 280mm X 400mm	1
3	PEEELED	110mm X 340mm X 360mm	1
4	PEELER	190 mm X 260mm	1
5	SHAFT CONTAINER	100mm X 300mm X 380mm	1
6	PEELING COVER	100mm X 380mm X 2mm	1
7	SIFTER	360mm X 340mm X 400mm	1
8	CHAIN	250mm X 70mm	1

Figure 3. CAD designed drawing of the groundnut peeling equipment showing its parts.

III. RESULTS AND DISCUSSION

A. *Description of the Equipment*

The groundnut peeling machine has five segments from top to down that is, Hopper, motor housing, peeler, sifter and collecting-can but three major components and they are: component is primarily built within the machine, they are combining together to

B. *Hopper*

This is a container that empties its contents into the peeling chamber at the bottom. Its dimensions are 300mm high, 360mm long and 340mm wide. The hopper also has a protruding end used to empty the grains to the peeler.

C. *Peeler*

This is the component that peeling is taking place within the system. It is the peeling mechanism that consists of sub-component parts.

Outer cylindrical casing: This is the housing for the peeling chamber.

Restraining fulcrum-can: It receives grains from the hopper and helps in restraining the grains by regulating their flow to the peeling chamber by the way of its inner spiral design.

Tapering Peeling Chamber: It is the mechanism that actually peels the fried ground-nuts. The peeling mechanism has a metal fulcrum with spikes and a meta-fulcrum with spongy-fibre; and metal-fulcrum with spiral-element that controls the flow of ground-nut grains into peeling chamber.

The spikes gadget (metal fulcrum) is stationary while the spongy-fibre gadget is rotary when operated; Distance between two spikes is 5.0mm, the height of a spike varies between 0.5mm and 1.0mm, the spongy-fibre is conically and spirally fitted, the metal spikes and spongy-fibre gadgets are fitted closely together in their conical casings which are being encased altogether by the outer cylindrical housing.

D. *220 Volt AC Motor*

It is used to motorize the peeler automatically. It has a 20 tooth-gear driving the peeler attached with a 40 tooth-gear.

The Manual Handle: the peeling work can be done manually by using the handle. Separate Stand: the peeler is built in a way it can be separated from the sifter and fixed in a special and separate stand while using automatically or manually.

Measurement of the Peelers Parts:

- The outer cylindrical casing is 190mm diameter and 260mm in length.
- The conical-fulcrum spike casing is measured 180mm and 150mm in their respective end diameters and its length is 210mm.
- The peeling mechanism has two-end frame-support with covers, 90mm by 340mm (rectangular) each.
- The spongy-fibre casing inside, measured 120mm in diameter, 90mm in diameter for both end-diameters with its length 210mm.
- The restraining fulcrum-can is 90mm in diameter and 60mm in diameter for both end-diameters and 210mm in length.

E. *Sifter*

The sifter is the mechanism that separates the grains (peeled groundnuts). The sifter is built with sub-component parts.

- Two (2) pairs of two-opposing movable sieves: the sieves shake off the grains after peeling to the stationary sieves and trap the chaffs into the Moveable retaining-can through them meshes (spoke network).
- Three (3) sets of stationary sieves with cans: they allow the peeled grains to run over them while trapping the chaffs (barks) into their stationary training-cans through their meshes, all sieves both stationery and movable are sloppy in their framework.
- Pair of chaff-evacuators: The two chaff-evacuators empty the chaffs from stationary retaining-cans by the action of running strings'.
- Four (4) sets of cogwheels (racks and pinions): they help to synchronize the backward and forward movements of a pair of moveable sieves.
- The sifter is measure 360mm in height, 150mm in width and 400mm in length.
- Cogwheel is measured 400mm in length, 45mm in width and 25mm in height with inbuilt racks and pinions.
- Movable sieve with can is measured 150mm by 120mm

The sample (unpeeled groundnut) for the test running was bought from the market. It was sun dried at a temperature of 30oC for one day to further remove the moisture content. In Table 1, the following parameters were considered: weight (wt.) of sample, wt. of peeled groundnuts, wt. of undamaged groundnut seed, wt. of damage groundnut seeds, time of peeling operation, total sample reading and mean reading. The test running of the system was carried out and the following results were observed, wt. of sample, wt. of peeled groundnuts, wt. of undamaged groundnut seed, wt. of damage groundnut seeds and Time of peeling operation were 940gms, 865gms, 621gms, 315.58gms and 804gms respectively. From the report, the result achieved was used to calculate the total sample reading (sum of the parameter figures) and the mean reading (the average figures of the parameters), the mean reading was further used to calculate the efficiency of the groundnut peeling machine. The sample readings are tabulated in Table 1.

TABLE I
TESTING TABLE

Sr. No	Total Wt. Of Groundnut In gms (Qt)	Wt. Of Peeled Groundnut In gms. (Qs)	Wt. Of Undamaged Groundnut Seed In gms. (Qu)	Wt. Damage Groundnut Seed In gms (Qd)	Time To Peeling Operation In Second (tm)
1	235	211	142	88	186
2	235	220	149.5	77.9	218
3	235	215	163.91	72.18	225
4	235	219	166.5	77.5	175
TOTAL	940	865	621.91	315.58	804
MEAN	235	216.25	155.47	78.895	201

From test running, it's observed that time and money can be saved by using groundnut peeling machine. If 1kg of groundnut is filled in the groundnut hopper an output of 0.8 kg of peeled seeds will be achieved. Also, if 5kg of groundnut is filled in the groundnut hopper, an output of 5.8 kg of peeled seeds will be achieved. With this process, the higher the input the greater output in very short time. If a large amount is filled in the machine hopper a more output from machine with a minimum wastage will be achieved. groundnut hopper and output of 40 kg of peeled seeds is achieved.

$$Peeling\ efficiency\ (\%) = [Qs\ /\ Qt] \times 100 \quad (24)$$

$$= (216.25\ /\ 235) \times 100\ =\ 92.02\ \%$$

$$Material\ efficiency\ (\%) = [Qu\ /\ ((Qu + Qd)\ )] \times 100 \quad (25)$$

$$= [155.47\ /\ ((155.47 + 78.89)\ )] \times\ 100 = \ 66.33\%$$

$$Mechanical\ damage\ (\%) = \left[{Qd}/{(Qu + Qd)}\right] \times\ 100 \quad (26)$$

$$= \ [78.89\ /\ ((155.47 + 78.89)\ )] \times\ 100 = \ 33.66\ \%$$

$$Throughput\ \ capacity\left(\frac{kg}{h}\right) = \left[{Qs}/{Tm}\right] \quad (27)$$

$$= 216\ /\ 201 = 1.075\ kg/hrs$$

Finally, the groundnut peeling machine is better option for farmer instead of manually operated. The demands atomize peeling machine of farmer & other customers will be also considered while designing machine. Purpose of fabrication of the peeler was to determine the suitability of machine for farmer's use. Experiments were performed with groundnut. Since this machine is made for both small business and large farming system, therefore the work carried out by this machine is more. In comparison these "Groundnut peeler" is very cheap. Also, visualization shows that this "GROUNDNUT PEELING MACHINE" is the most critical equipment for the future growth and development of cottage sector projects. The "GROUNDNUT PEELING MACHINE" can be used in cottage industry or even a farmer can also take benefit from this machine. The peeling process of groundnut by this machine is more economical and faster than manual process or any other processes.

Hence figure 3 present the final completion of fabrication of the machine.

From the above problems been identified, we have equally certified that if our production is effectively invested on it may one day cover the global market as Nigeria may be independent in the farming system of groundnut, and may also become a large supplier of this particular production.

CONCLUSION

The cost of the machine is affordable and can easily be purchase by local farmers; if bought by the farmer, the tendency of recovering the invested money will be very high. The total involvement of this machine in both local and mechanise farming; the problem of the labour crises can be reduced. Comparing with manual harvesting, only a single labour is required. It makes the process faster, easy and productive, hence reduces most of the peeling tie and labour cost. This machine is helpful for both small and big farms. It can be used for both domestic and industrial purposes. It is also a two ways operational machine which consists of manually operated process and electrically operated process. This machine has the tendency of creating job opportunities, the process of operation is very easy likewise the cost. The machine is manufactured using the engineering principles. The machine is power operated, so less numbers of labours is required and

it saves the time. The higher separating efficiency is obtained using this machine. The machine is portable because of its light weight. The procedure to operate the machine is simple, hence no skill labour is required to operate the machine. The machine can be used for domestic application as well as small scale industries. Additional features such as wheels, flow rate sensors can be added to modify the machine. The above design procedure is been adopted for the fabrication of Automatic Groundnut Sheller machine which will make the product durable for long time as well as make it efficient also helps to understand the concept of design. Thus, with help of this design we can fabricate an automatic groundnut peeler machine to simply achieve high volume of profit as well as to reduce the human fatigue.

ACKNOWLEDGEMENT

This project study was sponsored/funded by Tertiary Education Trust Fund (TETFund) Institution-Based Research (IBR) of the Cross River University of Technology, Calabar (now University of Cross River State, UNICROSS, Calabar), Nigeria. We are highly grateful for the TETFund IBR Grant.

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