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DESIGN AND FABRICATION OF MECHANIZED SIEVE FOR DRIED GARRI SEEDS PROCESSING

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ABSTRACT

This paper is on the design and Fabrication of Mechanized sieve for Dried Garri Seeds Processing. There is need for the development of commercial scale dried garri seeds sifting machine where the roasted garri can be properly monitored. Some design considerations used include efficiency, portability and safety of operations. Adequate care of chemicals present in cassava juice was considered in selecting materials for fabrication of the machine. The machine was clamped to reduce noise pollution during its operation. The machine runs on a single Phase 1HP, electric motor at a speed of 1400 Rpm.

The result obtained from performance evaluation test showed a sieving efficiency of 92.5% as compared with machine efficiency of 99.14%. This is an indication of the proper working of the dried garri seeds sifting machine as compared to one produced earlier with less than 50% efficiency.

Key words: Design, Fabricate, dried garri seeds, sieving, constraints, objective functions, machine.

Nomenclature

T_i= Initial tension, T_1 = Tension on tight side of belt, T_2 = Tension on slack side of belt, e = exponential, ϴ = Pulley belt on contact angle, β = Angle of groove, R_1 = Radius on the line shaft pulley, R_2 = Radius on the line motor pulley, C = Centre distance between two pulley, μ = Coefficient of friction between belt and pulley, V = Velocity of belt, V_1 = Velocity on engine pulley, V_2 = Velocity on shaft pulley, D_1 = Diameter of engine pulley, D_2 = Diameter of line shaft pulley, N_1 = Speed of the engine, N_2 = Speed of line shaft pulley, V_b= Volume of the shift box, Vg = Volume of grated cassava, L = Length of the belt, B = Breadth of the belt, H = Height of the belt, T = Torque or twisting moment, P = Power transmitted by belt, η = Efficiency, W_t= Weight of total garri, W_a = Weight of gangue, A_c = Area of discharge channel, T_e = Equivalent twisting moment, K_m= Shock factor for bending, M = Maximum bending moment, K_t= Fatique factor for tension, W = Axial load, L_s = Length of shaft, M_e = Equivalent bending moment, $ɗ_s$= allowable shear stress of shaft material, δ_b= Bending stress of shaft material.

INTRODUCTION

Cassava is a major source of carbohydrate in most developing nations of the world. It can be used as binder in the textile industries as well as many pharmaceutical and agro allied industries. Cassava (manihotesculenta crantz) is a short lived perennial tropical shrub growing about 1.0 – 3.5m tall. Believed to be first domesticated in South America, its cultivation has spread throughout the humid tropics and subtropics. Since 1990, Nigeria has surpassed Brazil as the world's leading producer of cassava with an estimated annual production of26 million tonnes from an estimated area of 1.7 million tonnes of land (ITA, 2004). Other major producers of community are Zaire, Thailand, Indonesia, China, India, Malaysia, Malawi, Togo and Tanzania.

Cassava processing thus deserves gerinis attention in order to meet the local and international demand for cassava products. The unit operations involved in cassava processing include peeling, grating, boiling/parboiling, drying, milling, pressing, sieving, extrusion and frying. Several processes have been mechanized successfully, however, cassava peeling remains a serious global challenge to design engineers involved in cassava processing. The way forward is the design of appropriate mechanical device and system for sieving dried cassava flakes.

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From the previous design it was discovered that the speed of the reciprocating shaft of the sifter was too high, which led to spilling of the garri instead of sieving it [2].

Mechanized sieve for dried garri seeds processing machine is basically powered by an electric motor of using belt and pulley system for transmission, which turns the worked crankshaft. The motion is further transmitted to the tray thus providing the forward throw while the spring returns the load on the backward throw. The right electric motor was selected and appropriate coupling designed which aided the performance of the sifter [3].

Mechanization in all its form ensures ease and speed of production. To ensure that cassava is processed with ease (reduce stress during processing) and improve the hygienic condition of processing within short period of time [4].

Traditional tools used in garri processing include millstone, grinding stone, and pestle and mortar. In this method we have low productive and low hygienic solution to these problems that led to the designing and construction of machines that can grate, mill, press cassava of high quality in a short period of time and reduce human drudgery. Some of the machines include cassava harvesters, grater, cassava pressing machine mill, grater, sifter and fryers.

There is an ever-increasing global demand for cassava chips and pellets particularly from China and Brazil. Cassava can therefore be referred to as a multipurpose crop for man and livestock. Cassava starch is an ingredient in the manufacture of dyes, drugs, chemicals, carpets and in coagulation of rubber latex (Hahn et al, 1986) [5].

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Formulation of the objective function
The objective of the work is to design and fabricate a mechanized sieve for dried garri seeds processing using both motion transformation and vibration principles. Much energy is conserved and less time is consumed using this approach than traditional (manual) method. The resulting equation is given as;

$Ti = {T_2}/{T_1}\ e^{\mu \Theta cosec\beta}$--------------------- (1)

$\Theta = 180° — 2\alpha$------------------------------- (2)

Where $\sin \alpha = R_2 — R_I/C$

Design constraint
The following are the constraints used in the design method

The peripheral velocity of the belt (V) is given as
$V=\frac{\pi D_1 N_1}{60}$(mls) --------------------------------(3)

The length of the belt constraint
$L = \pi (R_2+R_1) + 2C + (R_2–R_1)^2/_C$ --------- (4)

The volume of the sieve box constraint
V_b=LXBXH(mm) ---------------------------5)

Area of discharge channel constraint
Ac=[L+B]h-----------------------------------(6)

The diameter of the shaft constraint

$D = \sqrt[3]{16T_e/\pi\delta s}$ also, $D = \sqrt[3]{\frac{32M_e}{\pi\delta b}}$--------- (7)

Efficiency constraint
$\eta = \frac{W_t - W_a}{W_t} \times 100\%$------------------------ (8)

Other constraints
The other constraints are rational ones that will provide the desired results. These are:

$T_e = \sqrt{(K_m + M)^2 + (K_t + T)^2}$ ----------- (9)

$T = \frac{P\ X\ 60}{2\ \pi N_1}$------------------------------------ (10)

$M = {(W\ X\ Ls)}/{4}$----------------------------11)

$M_e= \frac{1}{2}[(K_m \times M) + T_e$------------------------ (12)

Design examples
Table 1 show the input parameters used in the design and fabrication of mechanized sieve for dried garri seeds processing.

Table 1: Mechanized Sieve Input Parameters.

Input parameters	values
Power of engine(Kw)	3.7
Velocity of belt (m/s)	1.26
Speed of line shaft(Rpm)	12.0
Angle of contact between belt and pulley (Rad)	2.97
Coefficient of friction	0.264
Change in tension(N)	2.937
Length of belt (M)	2.0
Volume of sieve box (M^2)	0.0137
Torque due to power transmitted by engine (Nm)	88.38
Mass of grated cassava (kg)	7.8
Axial load (N)	76.8
Maximum bending moment of shaft (Nm)	7.0
Equivalent twisting moment on shaft (Nm)	88.99
Equivalent bending moment of shaft (Nm)	49.75
Distance of required shaft (mm)	21.8
Required shaft diameter (mm)	18.3
Area of discharge channel (m^2)	0.1906

Table 2: Show some of the Materials Used in the Fabrication of A Dried Garri Seeds Sieving Machine

S/N	Names	Materials Used
1.	Hopper	Mild steel
2.	Pulley	Mild steel
3.	Electric motor	1Kw single phase electric motor
4.	Bolts and nuts	Mild steel
5.	Belts	Rubber/leather
6.	Bearings	Ball bearing
7.	Wire mesh	Stainless steel

RESULTS AND DISCUSSION

Fig 1 & 2 show the front and end elevation view drawing of the mechanized sieve dried Garri seeds processing design and fabrication.

Test were carried out using the 5mm and the 2mm perforated sieve box with sample of grated cassava (mesh) and dehydrated (fried) garri respectively. It was observed that the machine worked effectively without any appreciable problems. It was also observably that the full load of the sieve box, the reciprocating movement of the box is reduced, while at reduced load the movement becomes faster.

The result of the design calculation and the resulting specification for the production of the designed work is shown in Table 1 computation of design calculation. The parameter may be varied to set designed specification of design work. Some of the materials used in the fabrication of a dried garri seeds sieving machine also shown in Table 2.

The various tests carried out and the results obtained demonstrate that the mechanized sieve for dried Garri seeds processing achieved its design and fabrication aims. The system worked accordingly to specification and quite satisfactory. The mechanized sieve for dried garri seeds processing is relatively affordable and reliable. It is easy to operate and it provides a high of increasing the speed of the entire garri production process supply when there are power outages. Finally, it reduces stress associated with manual.

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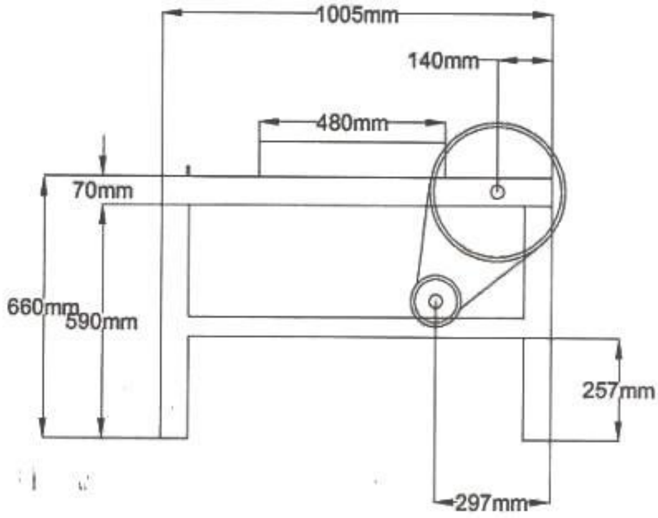


Figure 1: Front Elevation of the Machine.

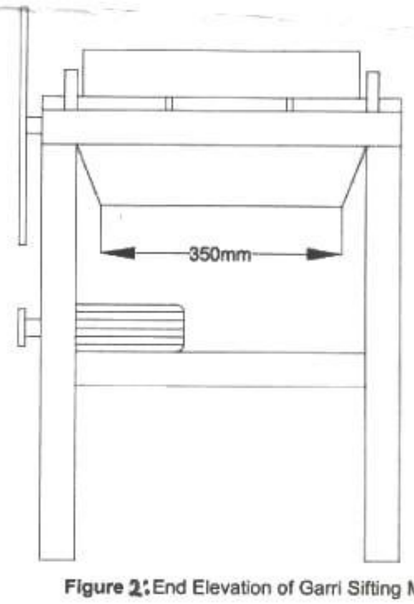
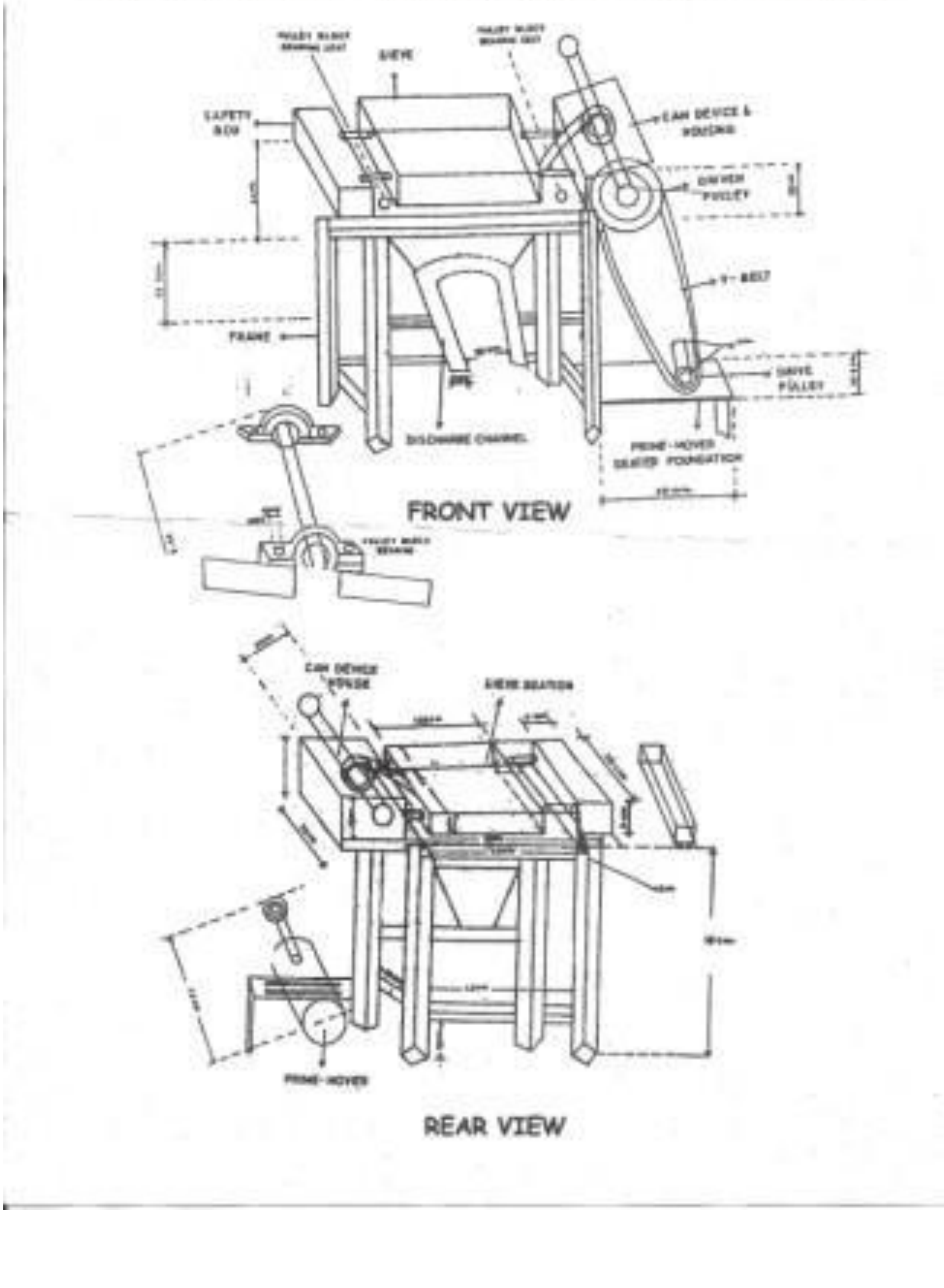


Figure 2: End Elevation of Garri Sifting Machine.

THE DRAWING OF MECHANIZED SIEVE DRIED GARRI SEEDS PROCESSING



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