COMPUTER AIDED DESIGN OF GARRI FRYING MACHINE

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ABSTRACT: *This research is a compilation of a report on the development of a compact software for the design of an efficient and effective garri frying machine. The authors here made use of a simple and common computer 'If' statement. A total of fundamental forty-eight variables were interacted with. A clear and direct flow charge was presented for the running of the programme. The users interface was printed and displayed as presented in the write-up. The summary of the results were tabulated. The algorithms used were basically fundamental and could be reformed, redesigned, manipulated, multiplied and modified before the final manufacturing.*

KEYWORDS: Computer Aided Design, Garri Frying Machine, Software, Manufacturing

INTRODUCTION

The present outburst of epidemic Lassa fever had made many Africans especially Nigerians to be septic to the consumption of locally and manually fried garri. The authors' reaction to the processing of neat, safe and secured garri product forms the basis of this research. In the developing world, most especially in West Africa, garri serves a daily meal to so many people in that there are several ways in which it can be prepared for meal. For instance, some people can determine to soak it in cold water on a very hot day before taking it; or some other people can prefer to soak it in hot water to make meal called "Eba" which will be taken along with soup depending on the choice of individual. However, there are different types of garri based on the processing methods, its grain size and the region of Africa where it is produced. In Nigeria, the Standards Organization of Nigeria (SON) classified garri into four major categories which are:

(i) extra fine grain garri, where more than 80% of the grain passes through a sieve of less than 350 micrometer aperture;

(ii) fine grain garri in which more than 80% of the grains pass through the sieve of less than 1000 micrometer aperture;

(iii) coarse grain garri, where not less than 80% of grains passes through a sieve of 1400 micrometer or less than 20% of weight passes through a sieve of 1000 micrometer aperture; and

(iv) extra coarse grain garri in which not less than 20% of grain is retained on a sieve of 1400 micrometer aperture (SON, 2000). Also based on the fermentation length of days and whether palm oil is added or not, we have the red garri- which is also called the "Bendel garri". This is derived from the inclusion of red oil after the cassava has been grated and allowed to ferment for two to three days which aids the reduction of the cyanide content

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METHODOLOGY

In this research, an 'If' statement was used for the software development. Forty eight fundamental variables were used to form the basis of the design algorithms. The design encyclopedia and Engineering design codes and relevant literature were consulted to extract these variables. Any further modification may not necessarily use all these variables because they are quite exhaustible. It forms a broad database for the design library

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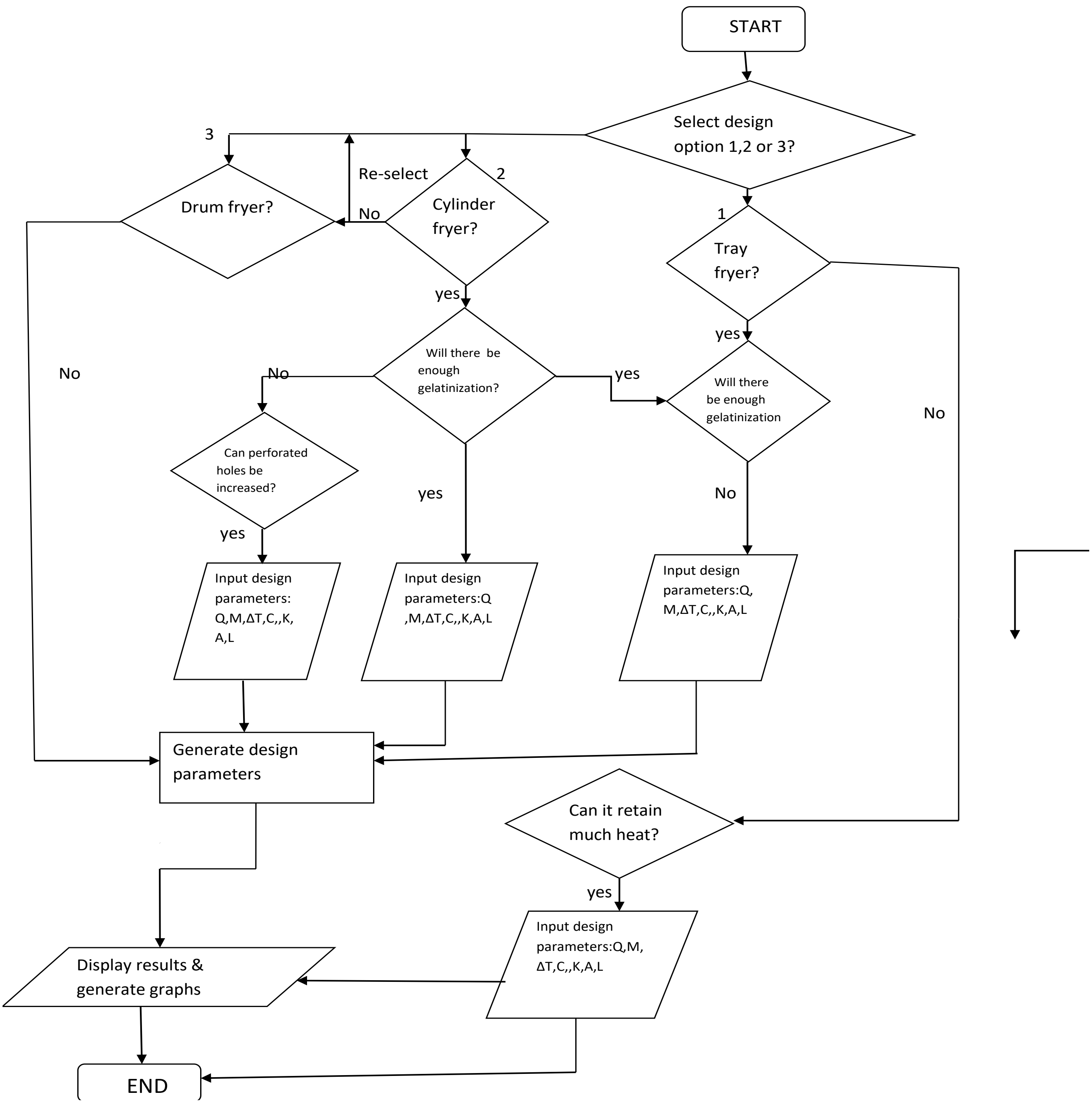
FLOWCHART OF GARRI FRYING MACHINE DESIGN



Written Commands

Vh = Volume of the hopper,(mm^3)

B = Base area of the hopper,(mm^2)

H = height of the hopper(mm)

L = length of the base (mm)

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W = width of the base(mm)

N = number of times the mash passes through the hopper

V = volume of mash that passes through the hopper, (mm^3)

V_h = volume of mash in the hopper(mm^3)

V_c = cylinder volume (mm^3)

R = cylinder radius(mm)

L = cylinder length(mm)

, V_m = volume of mash in the tray(mm^3)

Vc = volume of the tray(mm^3)

ρ = density of cassava mash (Kg/mm^3)

V_m = volume of mash in the tray(mm^3)

Q = Quantity of heat required (W)(KJ/K)

M = Mass of cassava mash in the cylinder(Kg)

C = specific heat capacity of the mash (J/kg^{0}C)

T = Temperature range (K)

K = thermal conductivity of the mash

S = surface area of the cylinder(mm^2)

T1 = Temperature change (K)

T2 = 300C (250C ambient temperature)

L = thickness of the mash in the cylinder (mm)

Lh = latent heat of transformation

P = power required to convey the mash(J)

W = work done in conveying the mash(N/mm)

T = time taken in competing the mash(s)

$\sum F$ = sum of forces involved in doing work

x = distance through which work was done (mm)

Δt = time required to dry the mash $= \frac{Q}{m}$

M = mass of the cassava mash (kg)

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a = acceleration of the mash along the tray

Δv = velocity of the mash along the tray(mm/s)

Δt = time taken in the same direction(s)

x = distance covered by the cassava mash(mm)

Δt = time taken to cover the distance(s)

μ = coefficient friction of the mash = 0.47

N = normal force acting on the mash,(N)

g is acceleration due to gravity = 9.81m/s^2

θ= angle of twist (radian)

T= Applied torque (ln-lb)

J= Polar moment on the shaft cross section

G= Shear modulus of elasticity of the shaft of the materials

J= Polar moment of inertia

C= Radius of shaft(mm)

T= Torque

d= diameter of shaft(mm)

Ʈ= Shear stress(N/mm^2)

D= Diameter (mm)

d= Inside diameter(mm)

If the base length of the hopper = known, **Then**

Compute the volume of the hopper using ($V_h = \frac{1}{3} BH$)

Compute the number of times the mash passes through the hopper using ($N = \frac{V}{Vh}$)

Compute the cylinder volume using ($V_c = \pi r^2 h$)

Compute the mass of cassava mash in the cylinder using ($m = \frac{\rho}{Vm}$)

If the computed hopper volume < the computed cylinder volume, **Then**

Design is satisfactory

Else select a better base length and redesign until:

The computed hopper volume($V_h = \frac{1}{3} BH$) < the computed cylinder volume

End If

If the specific heat capacity of the mash = **known**, **Then**

Compute the quantity of heat required (W) using ($Q = MC\Delta T$)

Compute, using ($\frac{\Delta Q}{\Delta t} = \frac{KA(T2-T1)}{L}$)

Compute the area of the cylinder plate using ($A = 2\pi rh + 2\pi r^2$)

Compute the maximum time required to dry the mash ($\Delta t = \frac{\Delta mLh}{\Delta Q \Delta t}$)

If the computed maximum time ($\Delta t = \frac{\Delta mLh}{\Delta Q \Delta t}$) required to dry the average time required for the drying mash > the computed average time ($\frac{\Delta Q}{\Delta t} = \frac{KA(T2-T1)}{L}$) required for the drying , **Then**

Design is satisfactory

Else, select a better specific heat capacity and redesign until:

the computed maximum time ($\Delta t = \frac{\Delta mLh}{\Delta Q \Delta t}$) required to dry the average time required for the drying mash > the computed average time ($\frac{\Delta Q}{\Delta t} = \frac{KA(T2-T1)}{L}$) required for the drying

End If

If the weight of the cassava mash = known, **Then**

Compute the power required to convey the mash using ($P = \frac{W}{T}$)

Compute the force required to convey the mash using ($F_x = ma$)

Compute the frictional force opposing the movement of the mash on the cylinder using ($F_r = \mu N$)

Else If the weight of the cassava mash = unknown, **Then**

Compute the work done in conveying the mash in the cylinder using ($W = \sum Fx$)

If the computed frictional force opposing the movement of the mash on the cylinder < the computed force required to convey the mash,

Design is satisfactory

Else, select a better process able weight and redesign until:

the computed frictional force ($F_r = \mu N$) opposing the movement of the mash on the cylinder < the computed force ($F_x = ma$) required to convey the mash

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End If

Check for the factor of safety (n = $\frac{Pm}{0.008}$) for the electric motor using (θ = TL)

GJ

Compute the motor torque using ($S_c = \frac{Tc}{J}$)

Compute its angular speed using ($Ss = \frac{16T}{\pi D3}$)

If the computed motor torque (T = $\frac{P}{W}$) > the computed angular speed (W = $\frac{2\pi N}{60}$),**Then**

Design is satisfactory

End If

If the torsion on the shaft = **known, Then**

Compute its torsional shear stress using ($S_c = \frac{Tc}{J}$)

Compute the diameter of the shaft using (T= $\frac{\pi}{16}\tau D3$)

Compute its angle of twist using (ɵ= $\frac{TL}{GJ}$)

Compute the power of the shaft using [3] (P= Tθ)

If the computed value of the torsional shear stress ($S_c = \frac{TC}{J}$)

< the computed power (P= Tθ) of the shaft, Then,

Design is satisfactory

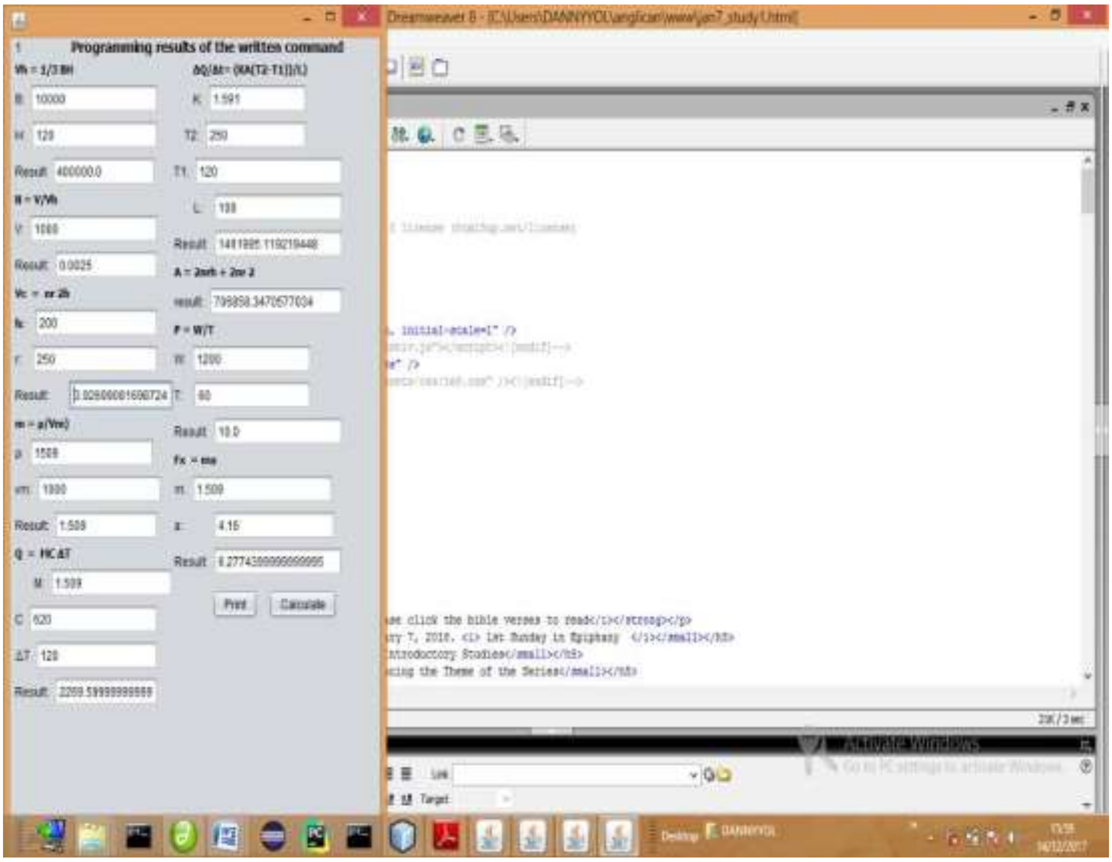
Else, select a better moment of inertia and redesign until:

the computed value of the torsional shear stress (S_c= Tc)

J < the computed power (P= Tθ) of the shaft.

Generate graphs

End



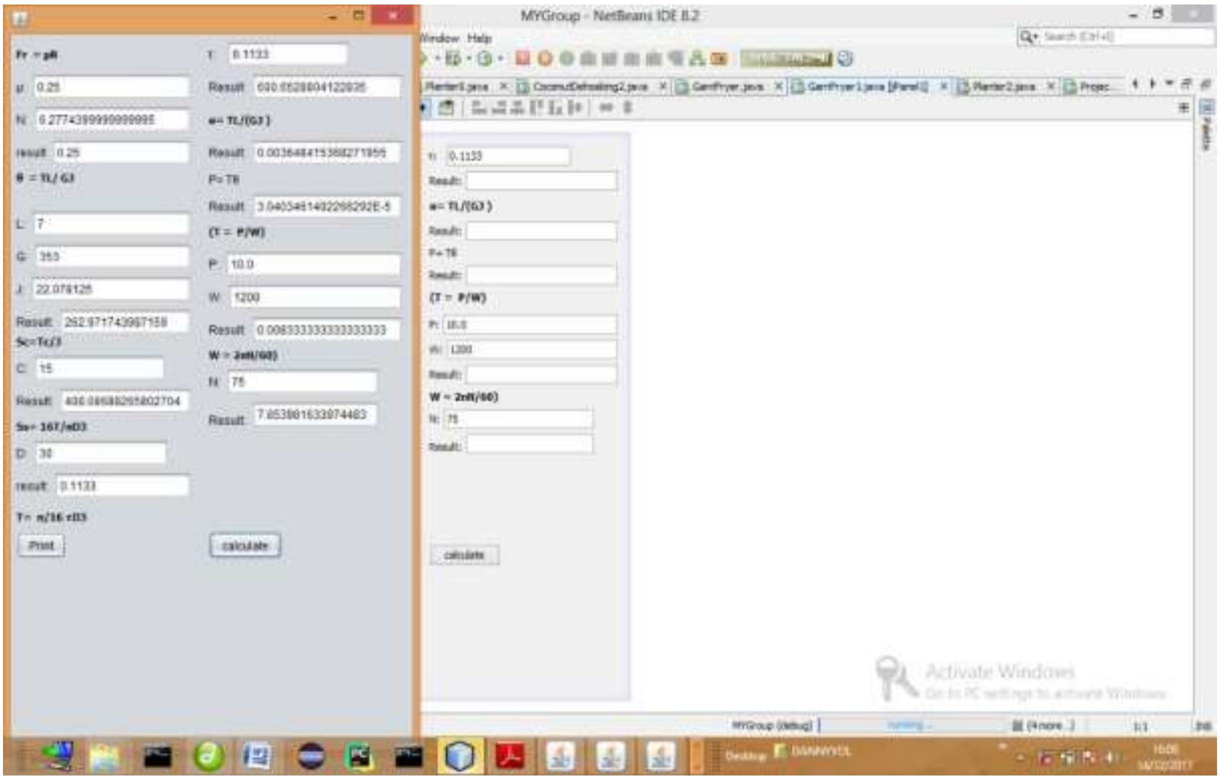


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Table 1: RESULT TABLE

S/N	COMPONENT	PARAMETER	RESULT/VALUE
1	HOPPER	Type volume	Square based 400000mm^2
2	CYLINDER	Diameter height Volume Area Heat capacity material	500mm 120mm 3926990mm^3 706858mm^2 2269Kg/KJ/K Mild steel
3	SHAFT	Diameter Length Torsion on shaft	30 210 0.1133Nm
4	IMPELLER	Area	
5	BEARING	Diameter Dynamic capacity Coefficient of fricton	30mm by 45mm 0.17
6	BOLT AND NUT	Diameter Helix angle	12mm 45^o
7	STAND/SUPPORT	Height thickness	400mm 60mm
8	HOLES	Diameter Number	10mm As many as possible

CONCLUSION

This paper had actually present a modern approach to a Broad Data Base (BDB) for the designing garri frying machined. The product machine will not only be fast but effective and the process highly hygienic. Modification, manipulations before manufacturing is flexible, easy and direct. This is the major beauty of this design.

REFERENCES

E.U. Odigboh and S.F. Ahmed. (1984)“Design of a continuous-process gari frying machine”, NIJOTECH, Nigeria. Vol. 8, pp. 25-33,.

E.U. Odigboh. (1985) “Prototype Machines for small- and medium-scale harvesting and processing of cassava, Yaounde, Cameroun. pp 323 – 338,.

G.A. Ikechukwu and A.I.V. Maduabum. (2012) “Improved Mechanized Gari Frying Technology for Sustainable Economic Development in Nigeria”, Proceedings of the International Multi-Conference of Engineers and Computer Scientists. Vol. 2. Hall Inc. New York.

J.C. Igbeka, M. Jory and D. Griffon. (1972) “Selective mechanization for cassava processing”, Journal of Agricultural Mechanization in Asia, Africa and Latin America . pp. 45-50.

ISSN 2054-0957 (Print), ISSN 2054-0965 (Online)

J.C. Igbeka. (1988) "Feasibility study on the establishment of a cottage-level gari processing industry",,.

J.C. Igbeka. (1995) "Recent developments in cassava frying operation and equipment used for gari production in Nigeria", Undergraduate thesis, Agricultural Engineering Department, University of Ibadan, Ibadan, Nigeria,.

J.O.I Ayatse. (2000) "Design and construction of gari fryers for local use", Free online Math Help, Education and Science. Calculus geometry.hubpages.com. http://www.freeonlinemathhelp.hubpages.com.

R.S. Khurmi and J.K. Gupta. (2005) "A Textbook of Machine Design", 14th Revised Edition, Eurasia Publishing House Ltd, New Delhi,.

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