

SHORT COMMUNICATION I

DEVELOPMENT OF SELF-PULVERISING, CHAFF-SEPERATNG GARRI SIFTER

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ABSTRACT

From locally available materials, a convenient, self-pulverising/sifting and self-chaff-separating garri sieve was designed, fabricated and evaluated. An electric motor (or an engine) drives both the pulveriser unit and the sifting unit simultaneously using shaft/pulley arrangement. The pulveriser positioned above the sifter receives the dewatered cassava cake, pulverises it and delivers it onto an inclined stainless steel sifter which is designed to vibrate horizontally employing cam and spring arrangement. This vibrating stainless sifter is the unit that handles the sifting and chaff separation. During the testing 85% sifting efficiency was achieved at a vibrating speed of 422cycles per minute and 6degrees sifter inclination.

Keyword: Self- pulverising, Sifting, Self- chaff- separation and Garri.

INTRODUCTION

Since 2004 when the Obasanjo administration of the Federal Government of Nigeria launched the Presidential initiative on cassava production, processing and export, a lot of work has been done by researchers, designers and even businessmen to provide machines required for this. The area of cassava processing into garri (the commonest food in Africa) was a major concern for most stake holders. Here, both manually and motorised processing machines have been developed. One of the processes involved in garri production is the pulverization and sifting of the dewatered cassava cake, a stage which comes in stage 7 before toasting as indicated on the flow chat below:

- (1) Harvesting—(2) peeling—(3) washing—(4) grating—(5) dewatering—(6) fermentation—(7) **pulverising/sifting**—(8) toasting—(9) bagging.

This work surveyed, existing methods used for sifting dewatered cake and observed that there is still lack of a machine that can conveniently pulverize the cake, carry out the actual sifting and separate the sifted garri from the chaff and which can be employed in a medium sized garri producing industry. Convenient because manual labour is minimized. Only one operator is required to operate the machine. Self- acting because the dewatered cake when loaded into the hopper of the machine, gets pulverized and sifted and at the same time separates the sifted garri from the chaff then discharge them from different outlets all without or with minimal human interference.

Following the outcome of the survey, a convenient, self-pulverising/sifting and chaff-separating machine was developed and tested in the National Root Crops Research Institute Umudike. During the survey, three major methods of sieving garri were observed to be in existence namely: manual method, horizontal vibration machine, and vertical vibration machine methods. The manual method is most common. It involves pulverising the cake with hand onto a manual sifter which may be made of plastic material, Indian bamboo or steel

mesh. The sifting is done by the operator rubbing the pulverised lot on the sifter with his/her two hands continuously until the process is completed. Sifted garri is discharged under the sifter into a standing container while the chaff is removed by hand. This method is found to be slow and many hands are required to produce enough for effective garri production.

The other two methods are motorised. While one employs a horizontally vibrating mechanism, the other employs vertical. All these show improvement in the manual method because a larger quantity of garri can be produced at any given time, however manual involvement is still much in use because the pulverisation and removal of chaff are done manually. The machine is stopped for the chaff to be removed each time a batch of the cake introduced into the machine is completely sifted. It would be difficult or impossible to incorporate these machines into a continuously producing line because of this manual involvement. For the machine now developed, manual involvement is minimized, and production volume improved.

MATERIALS AND METHODS

Design Criteria

Garri is a grainy foodstuff, the grain sizes ranging between 2mm and 3.5mm for good quality. It is on the basis of this property of garri that this machine is designed. The pulveriser unit ensures that the cassava cake is reduced as much as possible down to this structure. These passes through the mesh of the vibrating screen and are collected for toasting into edible garri. The remaining which could not be reduced to the required dimension and thus could not pass through the screen is classified as chaff and is collected for processing into other cassava products.

Description of the machine

The machine consists of two units –**the pulveriser** and **the sifter** both powered from the same source (electric motor or diesel engine) of 3kilowatts. The pulveriser is made up of stainless steel body which houses a stainless steel pulveriser wheel carried on a shaft which is directly driven by a 3kw motor via belt and pulley arrangement. The cassava cake is fed into this part of the machine which handles it first and delivers the pulverised lot onto an inclined stainless steel, plane sifter. This sifter is spring-loaded and caused to vibrate in a horizontal direction, perpendicular to the angle of inclination of the plane. The vibration is caused by a rotating cam-shaft which is driven by a belt through the pulveriser shaft. Hence the same motor drives both units. The angle of inclination of the sifter plane is variable between 4 degrees and 6 degrees. Below this plane is a collector shoot for the collection of garri while at the inclined lower end is a gutter which collects the chaff that could not pass through the sifter mesh. The chaff so produced can be re- introduced into the machine if need be to ensure that all garri is separated from it. (The orthographic drawing and photograph of the machine are in figs 1 and 2 respectively).

Testing and Evaluation procedure

Three sets of test runs were carried out indicated as: A, B and C (Table 1). The procedure includes:

- a.** Varying the angle of sifter plane inclination (between 4 and 6 degrees) at a fixed vibration speed for the angles using a fixed quantity of cassava cake (10kg) each time.
- b.** Varying the vibration speed of the sifter plane (from 179 to 422 to 990rpm) at a fixed angle for each speed and using the same quantity of cassava cake.

The various speeds were calculated based on different pulley sizes used as the driver for the cam shaft with the known relation:

$$N1/N2 = d2/d1 \quad (\text{or } d1N1 = d2N2)$$

Where: N1 = driver pulley speed
 N2 = driven pulley speed
 d1 = driver pulley diameter and
 d2 = driven pulley diameter

The efficiency was calculated from the relation:

$$E = (\text{quantity of garri obtained}/\text{quantity of cake used}) \times 100$$

Where: E stands for efficiency.

RESULTS AND DISCUSSION

After tests carried out, the results obtained were tabulated as shown in Table 1

Table 1: Testing and Evaluation of the Garri Sifter

SETTING	A			B			C		
	4	5	6	4	5	6	4	5	6
Set angle (deg)	4	5	6	4	5	6	4	5	6
Qty of cake (kg)	10	10	10	10	10	10	10	10	10
Vibration Speed (rpm)	179	179	179	422	422	422	990	990	990
Time taken to finish(min)	10.5	8	6.5	3.22	2.92	1.94	1.08	0.95	0.78
Garri Obtained (kg)first pass.	9.55	9.15	9.10	9.20	9.05	8.5	6.7	5.9	5.2
Chaff obtained (kg)first pass	0.45	0.85	0.90	0.80	0.95	1.0	2.15	2.5	3.05
Spillage (waste)kg	—	—	—	—	—	0.5	1.15	1.6	1.75
Efficiency at first pass (%)	95.5	91.5	91	92	90.5	85	67	59	52
Garri production rate kg/hr	54.70	68.63	84	171.43	185.96	262.89	372.2	374	400

The results show that:

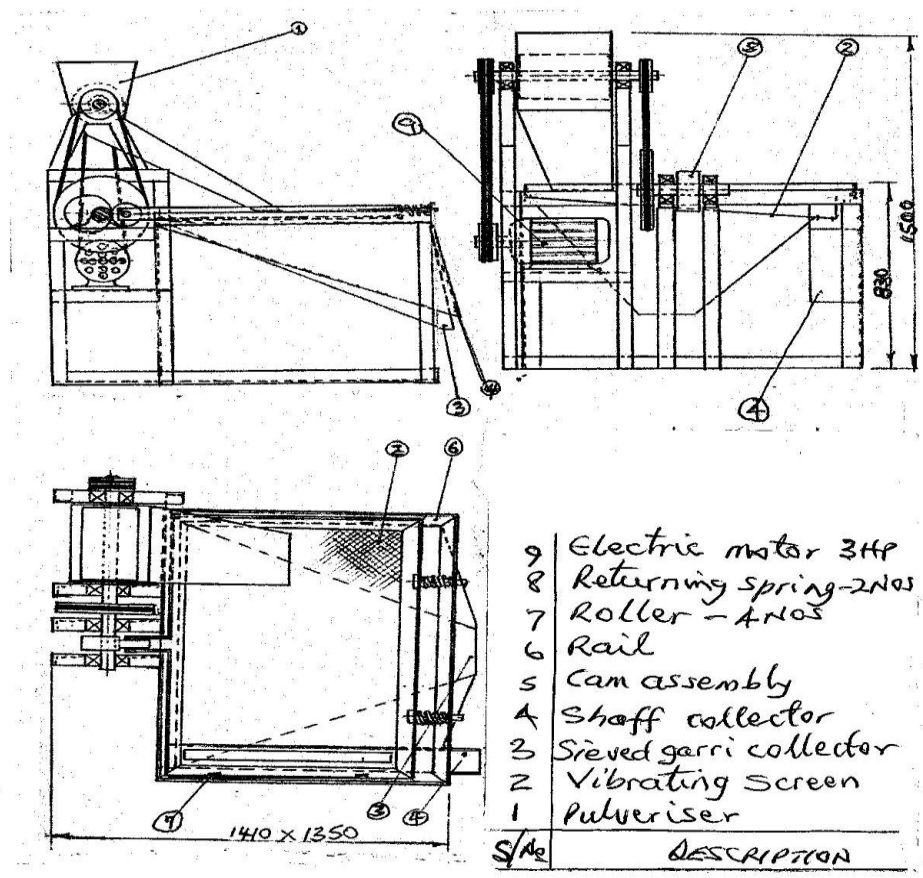
1. The more the angle of inclination of the sifter screen, the faster the pulverized garri passes over the screen. However the chaff is higher in its garri content. Thus the efficiency reduces.
2. As the vibrating frequency (cam speed) increased to 990rpm, the whole system vibrated violently with increased noise and spillage. Although the pulverized garri passed over the sifter screen faster and the efficiency was so low from 52% and 67%, the chaff was so rich in garri and need to be recycled more than once to get it to 80%-90% efficient. Since the vibration noise and losses observed in the entire system at higher speed, a speed not more than 500rpm of the cam shaft (i.e. 500 cycles per minutes of vibration) is recommended for this design at angles of 5 or 6 degrees for optimum production.
4. The best result was obtained using speed of 422rpm and angle of 6 degrees of the sifter inclination resulting in the production rate of 262.9 kg/hr and 85% efficiency.
5. At very low speeds of vibration time was wasted for the 10kg cassava cake to pass through hence very low production per hour is achieved.
6. Other features of this machine include:
 - (i) it can be operated by unskilled labour;
 - (ii) the safety of the operator is assured as all moving parts are guided properly;
 - (iii) it can be produced locally by local craftsmen employing locally sourced raw materials.

CONCLUSION

A convenient, self-pulverising/sifting, self-chaff separating garri sifter was successfully developed. It is better than other existing machines/processes in that it reduced manual involvements to the minimum (one operator was used to carry out the test very conveniently), higher volume can be produced within a specified period and can be incorporated into an automated production line hence can be employed for mass production.

REFERENCES

- Khurmi, R.S and J.K.Gupta (2004). A TEXTBOOK OF MACHINE DESIGN (S.I. UNITS) 2004. Eurasia Publishing House (Pvt.) LTD. Ram Nagar, New Delhi-110 055.
- Shigley, J.E and Charles R. Mischke (1986). STANDARD HANDBOOK OF MACHINE DESIGN. 1986. McGraw-Hill Book Publishers – NewYork.



Orthographic drawing of the machine

Fig. 1: Orthographic Drawing

Fig. 2: A photograph of the completed machine

