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Full Length Research Paper

Development of NCAM Reciprocating Cassava Mash Sifter.

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Abstract
Sieving is an essential process in the production of Garri which is one of the staple foods in Nigeria. Sifting is the pulverization of pressed mash carried out as a necessary measure to achieve efficient heat transfer during frying. Sifting will allow the production of different grades of Garri that will be suitable to different class of consumers depending on local customs and tradition. The NCAM cassava mash sifter was developed to tackle the problems of high labor, expense associated with manual sifting, time wastage, the tedious mature of the operation, injury to the hand or palm as one rubs against the raffia sieve continuously, back ache, caused by prolonged sitting in one position during manual sifting, low productivity, and the hygienically unsafe nature of manual sifting as products are exposed to germs. The test result show sifter has that the highest efficiency of 98.46% at the operating speed of 2400rpm. The output capacity of 1.1ton/hr was obtained and the sifting rate of 71.2% at 41.23% moisture content.The percentage recovery of the sifted cassava mash was 95.77% while the percentage loss was minimal.

Keywords*: Cassava, Mash, Sifting, Efficiency and Sifter.*

Introduction

Root and tuber crops are abundant in the rural areas of most developing countries and are often regarded as a cheap food. Increased production of root crop has brought about the need for the development of appropriate processing technology. Cassava *(Manihot esculenta crantz)* was introduced into Africa in the latter half of the 16th century from Central America, where its tubers have been used through the ages as a basic food (Bolaji *et al,* 2008)

Cassava is a major source of carbohydrate in most developing nation of the world; it is a short lived perennial tropical shrub growing from about 1.0 -3.5m tall. It is believed to be the first domesticated in South America; its cultivation has spread throughout the humid tropics and subtropics (Nweke *et al.* 2002).

The importance of cassava as a staple food in Africa has continued to grow because it possesses properties such as tolerance to drought, poor soil and even neglect. It is grown in over 30 African countries. Nearly over 200million people rely on cassava as a staple food, each person consuming an average of over 100kg of the crop per year (Bolaji *et al,* 2008). Total production of cassava in Africa has increased from 35 – 80 million tons between 1965 and 1995 (Ajibola 1995). Africa now produces cassava than the rest of the world combined with biggest increase from 22% to 35% (of African total production) in Nigeria and 4% to 8% in Ghana (FAO, 2002). In 2004, a policy was initiated to produce bread with cassava: wheat flour ratio of 1:9 in Nigeria bakery industry.

Presently, cassava is one of the most important and widely grown food crops in Nigeria. Over two – third of the total production of cassava goes to the fresh food market for human consumption; the rest is used as animal feed, production of ethanol for fuel, as a binder in the textile industry, as well as in many pharmaceutical and agro allied industries (Odigboh E.U, 1996). Cassava mash sifting is a vital unit operation in the processing of cassava root into gari and other food forms. Cassava mash sifting is not a new activity but has in fact been carried out locally using traditional methods.

Sifting is the pulverization of pressed mash carried out as a necessary measure to achieve efficient heat transfer during frying. Sifting will allow the production of different grades of Garri that will be suitable to different class of consumers depending on local customs and tradition. The NCAM cassava mash sifter was developed to tackle the problems of high labor, expenses associated with manual sifting, time wastage, the tedious mature of the operation, injury to the palm as one rubs against the raffia sieve continuously, back ache, caused by prolonged sitting in one position during manual sifting, low productivity, and the hygienically unsafe nature of manual sifting as produce are exposed to germs.

Materials and Methods

Description of the machine

The cassava mash sifter comprises of the main Frame, the Sifter which is made of stainless steel metal with 1 mm perforation, the sifting device is attached to a rocker which is powered by a 5 hp petrol engine via a belt pulley arrangement, and the sift discharge unit.

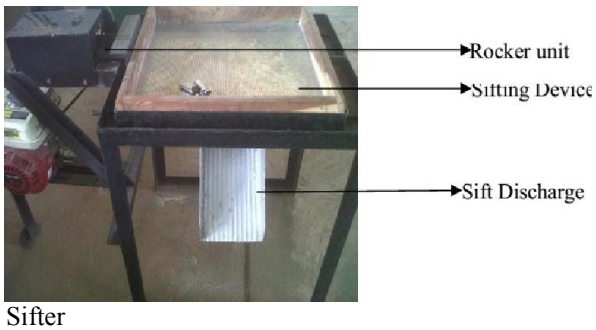

Fig 1: Pictorial view of the Mechanical Sifter

The Frame

The frame was made of 5cm angle iron with length of 71cm, width 71cm and height 81cm. The frame supports the whole equipment.

The Sifter

The sifter is made up of galvanized iron sheet with 580mm x 580mm dimensions which is been surrounded with a plank of 7cm thick. It is rectangular in shape for better performance.

The Sift Discharge Unit

It is made of 1.5mm stainless steel sheet. It is welded to the main frame and the sifted mash passes through it into the collecting trough.

Operation of the Machine

The machine is operated by reciprocating action of the rocker which is translated into a translator motion on the sifting device. The motion causes the dewatered mash to move to and fro. The sift is then collected at the bottom into the collector through the collecting chute while the bigger crumbs that could not pass through the sieve remain on the top of the sieve. The crumps can be collected by lifting out the sieve and pouring it off.

Design consideration

For efficient and reliability of the performance of its various components, in the design of the sifter the following were considered;

- Selection of materials that are resistant to corrosion, durable, water proof, non toxic and non absorbent were used so as to eliminate the possibility of contaminating the cassava mash and also to be able to withstand repeated cleaning.
- For affordability of the cassava mash sifter, locally available materials were used.

Performance parameters

The machine was evaluated to determine the following parameters:

Moisture Content

Moisture content (Mc) %: the percentage of moisture (in wet base) in the cassava mash before and after dewatering is its moisture content and is expressed by the following equation,

$$M_c = \frac{w_b - w_a}{w_b} \; x \; 100\% \quad \text{..... (1)}$$

Where,

w_b = *weight of the cassava mash sample before dewatering*

w_a = *weight of the cassava mash sample after dewatering*

Sifting Efficiency

Sifting efficiency (E_s) = $\frac{W_s}{W_l} \ x \ 100\%$..... (2)

Where,
W_s = *weight of sieved lump of cassava mash*

W_l=*weight of lump fed*

Output Capacity

Output capacity (O_C) kg/hr: this represents the quantity of cassava mash sifted per unit time, expressed by,

$$O_c = \frac{W_s}{t} \ kg \ hr^{-1} \quad \text{..... (3)}$$

Where;

t = sifting time in hrs.

Percentage Recovery

Percentage Recovery (R_p%) This determines the fraction of the sifted mash that is recovered at the outlet. This is expressed as:

$$R_p = \frac{W_s}{W_l} \ x \ 100\% \quad \text{---------- (4)}$$

Results and Discussion

Performance Parameters

Operating speed:	*2400 rpm*
Mash moisture content:	*41.23 % MC_{wb}*
Percentage recovery:	*95.77 %*
Sifting rate:	*71.2 %*
Output capacity:	*1.1 ton/h*
Sifting efficiency:	*98.46 %*

From the performance parameter, cassava mash sifter was found to be performing the sifting operation efficiently. The operating speed of 2400rpm increased the output capacity of the sifter to 1.1ton/hr. However, the highest sifting efficiency of the cassava mash sifter was 98.46%, at sifting rate of 71.20% and the cassava mash moisture content was *41.23 %.* The percentage recovery of the sifted mash was 95.77% indicating that almost all the cassava mash sifted were recovered during the sifting operation.

Conclusion

The NCAM cassava mash sifter was found to perform satisfactory. With percentage loss of 4.23% indicating that almost all the cassava mash were recovered during the sifting operation. The NCAM motorized cassava mash sifter can therefore be considered appropriate for use by our local cassava processors.

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APPENDIX

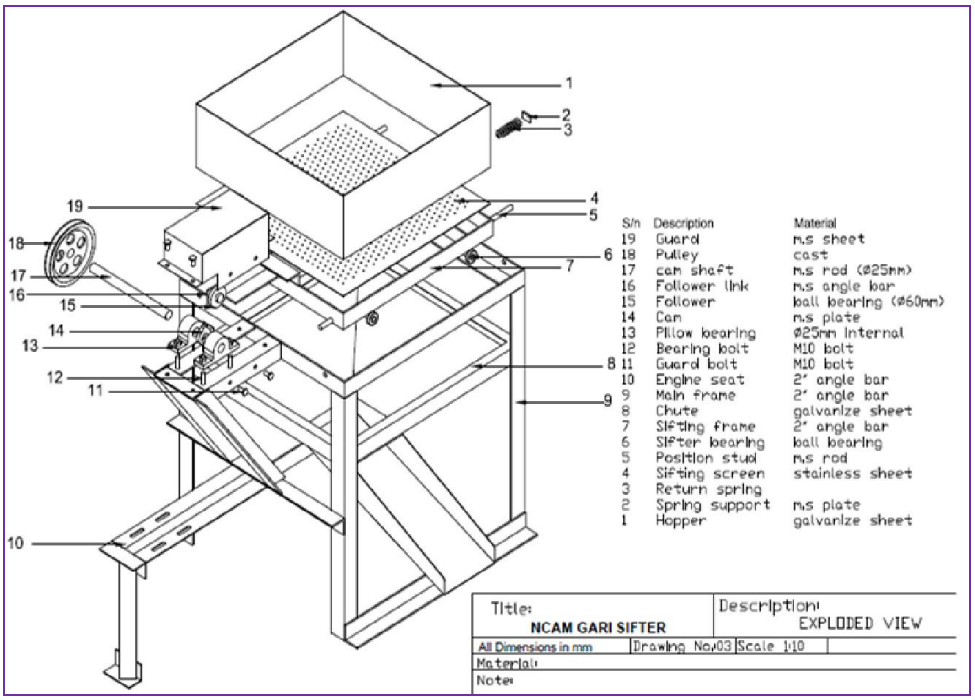

Fig. 2: Exploded view of the sifter

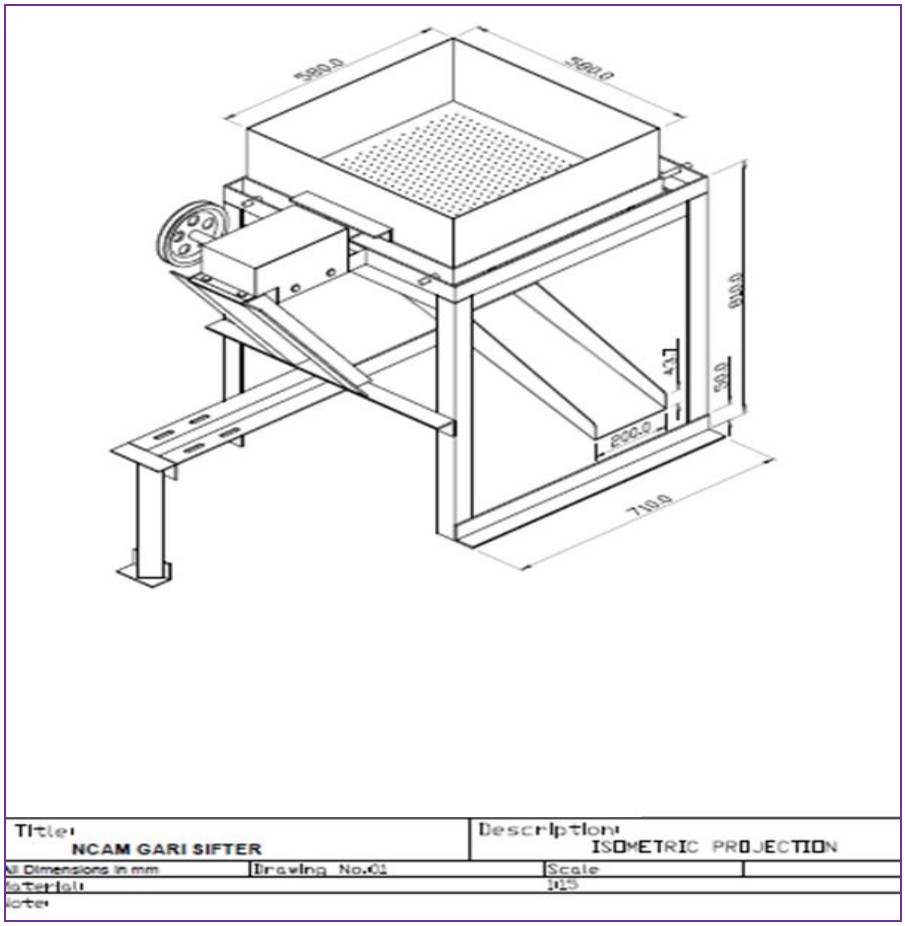

Fig 3: Isometric projection of the sifter.