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Full Length Research Paper

Development of a Manually Operated Double Pole Dewatering Press

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Abstract
Dewatering is an essential process in the production of gari which is one of the major product(s) of cassava (as consumed) in Nigeria. It is necessary to dewater the cassava mash to remove the excess of cyanide content in the mash so as to make it more attractive and (also) increase the market value of the product. The development of NCAM double pole manually operated dewatering press became pertinent to reduce human fatigue, improve processing hygiene and ensure cleanliness of cassava mash during dewatering process. The double pole manually operated dewatering press developed is divided into the following parts; the fixed crosshead reinforcement, fixed crosshead, angle brace, hollow shaft, screw shaft, nut, moving crosshead, and base frame. The machine was evaluated in order to determine the efficiency using grated cassava mash. The test results showed that the press has an average dewatering efficiency of 36.12% at a moisture content of 60.45% wet basis, for fermented cassava mash, and 34.17%for unfermented mash at 60.22% wet basis moisture content. The mean dewatering time for fermented cassava mash was 451mins while that of the unfermented mash was 480mins.The cost estimate for the construction of the machine is forty three thousand fifty naira (₦ 43,050), the construction materials can be sourced locally.

Keywords: *Dewatering Press, Manually, Double Pole, Cassava mash, Development*

Introduction

Cassava is a major source of carbohydrates in human and animal diet; other areas of users of cassava are being explored. The crop tolerates many cultivation processes; this makes its cultivation popular. The cassava root cannot be stored long after harvest before decaying, so processing must follow immediately after harvesting; this involves peeling, grating, dewatering, milling and sieving. Cassava contains about 70% moisture content, which must be reduced to an acceptable level; this process may include fermentation, with the dewatering taking place-using available and suitable methods, some with stones placed on the sack and the use of jack-wood platforms to press off the excess liquid from the pulp (Igbeka *et al*.,1982) The production and processing of cassava roots (Manihot species) have now become a major economic activity in Nigeria due to the encouragement given by the government through her initiative on Root and Tuber Expansion Programme (RTEP)

Cassava roots can be processed into different products such as gari, lafun high quality cassava flour (HQCF), starch, etc. These products are obtained from the different unit operations after harvesting the roots as reported by Odigboh (1985).Such unit operations include: peeling, washing, grating, chipping, dewatering, and milling. Effort made in the mechanization of cassava processing in Nigeria dated back to the 1970s and mid 1980s. Mechanized gari and HQCF processing machines especially cassava graters, chipper, dewatering presses, Fryer etc. have become widespread in southern Nigeria. The mash can be transformed into two principal products, flour and gari after dewatering.

The engineering improvements required for cassava processing into food depend on the development that can be given to the traditional equipment technology, the aim of developing low cost with low energy demanding equipment. Traditional processing procedures aimed at reducing cyanide, improving storability, providing convenience and palatability. These starts with dewatering method adopted.

The recent call for diversification of cassava processing options in the IFAD assisted, Roof Tuber Expansion Programme (RTEP) is timely and required strong promotional efforts to popularize cassava chipping, drying, grating, dewatering and pelleting machines in the food and non-food cassava processing industries. Thus, as observed by Akintola (1996) the development of cassava processing machines offers a cost effective and speedy approach to achieving this objective. In addition, evaluation test on these cassava processing machines should not be overlooked for further improvement on the machines.

Dewatering as one of the unit operation play a major role in processing of cassava root into HQCF, and garri for it hastens the drying process of cassava mash in the production of HQCF, where the rate of drying determines the quality of the cassava flour obtained.

Description of Machine

Working Principle of the Machine

The double pole dewatering press is manually operated to squeeze out moisture from bagged cassava mash on flats wood plates placed on the base of the dewatering press. After loading bagged cassava mash on the flat wood plate placed on the base of the dewatering press, another set of flat woods plates will be arranged on the bagged cassava mash, where the moving crosshead will rest upon. The hydraulic jack will be placed on the moving crosshead where the jack will be pumped to exert pressure by moving crosshead against the bags of mash. Pumping is continued to exert enough pressure by the moving crosshead on the bags to make it drip its liquid content. Pumping of the hydraulic jack is later repeated intermittently until the bags stop dripping liquid. After dewatering to a required level, the nut on the two screw shafts are turned anticlockwise raising the pressure transfer by moving crosshead upward to release the bags of dewatered cassava mash. The capacity of the machine can accommodate four bags of 50 Kg of cassava mash per batch; the dewatering process will be aids by the hydraulic jack and the effluent drain out from the mash will flow on the ground.

Design considerations

In the design of the press, several factors were considered which encompasses: dewatering time, low energy requirement, high dewatering capacity and efficiency, availability of materials and cost implication. Other factors considered was the use of rigid load bearing members to prevent buckling during high pressure operation.

Construction/Fabrication of double pole dewatering press

The double pole cassava mash dewatering press can be divided into the following parts; the fixed crosshead reinforcement, fixed crosshead, angle brace, hollow shaft, screw shaft, nut, moving crosshead, base frame as shown in figure 1. Figure 2 showed the Isometric View and Figure 3 showed the Orthographic View of Double Pole Dewatering Press.

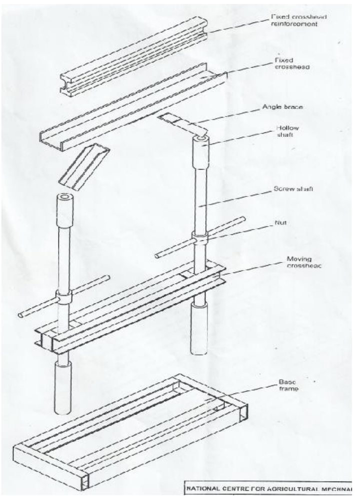

Fig 1: Part drawing of Double Pole Dewatering Press

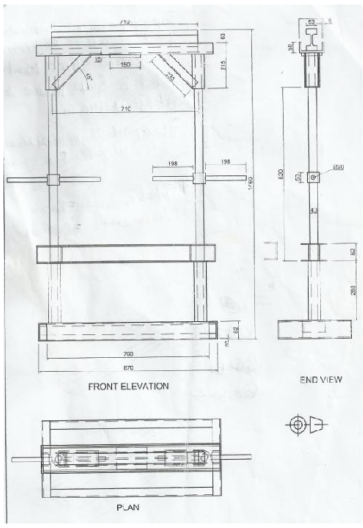

Fig 2: Isometric View of Double Pole Dewatering Press

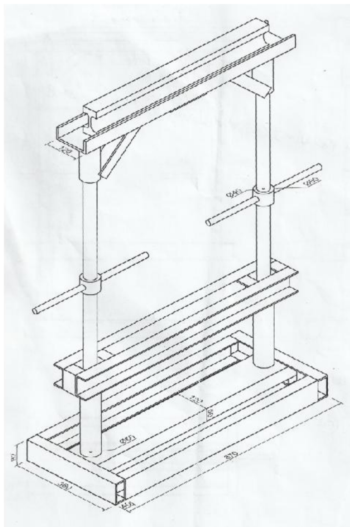

Fig 3: Orthographic View of Double Pole Dewatering Press

Fixed crosshead reinforcement: The fixed crosshead reinforcement is a rail track H-beam made of wrought iron. It is 710mm long and 63mm width attached to the fixed crosshead to prevent buckling during operation.

Fixed crosshead: The fixed crosshead is a U-channel made of mild steel. It is 870mm long and 120mm wide placed on the hollow shaft which the head of the hydraulic jack will touch when pump up during the dewatering process when the jack is place on the moving cross head.

Angle brace: The angle brace is a U-channel of 233mm long made of up mild steel tilted at an angle of450 attached to fixed crosshead and hollow shaft to support the fixed crosshead and the fixed crosshead reinforcement.

Hollow shaft: The hollow shaft is 215mm long and has a diameter of 60mm made of up mild steel attached to the upper and lower part of the screw shaft which supports the two vertical screw shafts for rigidity.

Screw shaft: The screw shaft is the two vertical pole made from alloy steel with 820mm long and 40mm diameter which support fixed crosshead reinforcement and fixed crosshead. The screw shaft served as a medium to rotate the nut upward and downward with the help of handle attached to the nut. The screw shaft is attached to the hollow shaft at the top and bottom of the screw shaft.

Nut: Nut is the component of the dewatering press with 60mm diameter made of up mild steel; the nut is turn upward on the screw shaft to allow the moving crosshead to move upward while accommodating the cassava mash on the base of the dewatering press. The nut is also turn downward to luck the moving cross head on the cassava mash already placed on the base of the press.

Moving cross head: This consists of two 870mm long and 82 width U-channels placed back to back made up of mild steel to transfer pressure to the bagged cassava with the help of hydraulic jack, the moving crosshead is supported by the two screw shaft.

Base frame: The base frame was fabricated from U-channels of 870mm long and 360 width, 82mm height and 40mm thick made up of mild steel, the base frame support the whole equipment and also carries the bagged cassava mash.

Fig 4: Pictorial view of Double Pole Dewatering Press

Construction Process

Fabrication was carried out at the fabrication workshop of the National Centre for Agricultural Mechanization (NCAM), Ilorin. The machines, equipment and tools used for the fabrication of the double pole dewatering press are as follows, drilling machine, lathe machine, filing machine, arc and gas welding machine, measuring tape, scriber, measuring rule.

Performance Test

The initial test of the double pole dewatering press was carried out at the National Centre for Agricultural Mechanization, Ilorin. Four bags of fermented and unfermented of 50kg grated cassava mash were loaded into the double pole dewatering press into separate batches. Moisture content of the mash was taken before and after dewatering.

The machine was evaluated to determine the following parameters:

(i) Dewatering rate (D_R) kg/s: this represent the quantity of moisture the machine express from the dewatered cassava mash per unit time. This is determine by the expression:

$$D_R = \frac{W_0 - W_1}{t} kg/s \quad \text{.................................} (1)$$

Where,

W_O = *weight of cassava mash before dewatering in (kg)*
W_1= *weight of cassava mash after dewatering in (kg)*
t= time taken to dewater in (s)

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

$$Mc = \frac{Wb - Wa}{Wb} x\ 100\% \text{.................................} (2)$$

Where,

W_b = *weight of the cassava mash sample before oven drying.*
W_a = *weight of the cassava mash sample after oven drying.*

(i) Dewatering efficiency (E_D)% : this is the efficiency at which the press dewaters which is expressed as,

$$E_D = \frac{W_2}{W_3} x\ 100\% \quad \text{...} (3)$$

Where,

W_2 = weight of fluid expressed by the press given by,

$$W_2 = (W_0 - W_1) \quad \ldots\ldots\ldots\ldots (4)$$

W_3 = total weight of fluid in the mash given by,

$$W_3 = \frac{W_{C1} \, x W_C}{100} \quad \ldots\ldots\ldots\ldots (5)$$

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

$$O_c = \frac{W_1}{\tau} kghr^{-1} \quad \ldots\ldots\ldots\ldots (6)$$

Where,

τ = dewatering time in hrs.

(iii) Input capacity (I_c) kg hr^{-1}: this determines the quantity of cassava mash fed unto the dewatering press per unit time and is expressed as,

$$I_C = \frac{W_0}{T} kghr^{-1} \quad \ldots\ldots\ldots\ldots (7)$$

Results and Discussion

The manually operated dewatering press was developed and evaluated. Investigation showed that the result of the test carried out on the dewatering press with cassava mash from roots harvested during the raining season showed that the press has an average dewatering efficiency of 36.12%at moisture content of 60.45% wet basis, for fermented cassava mash, and 34.17% for unfermented mash at 60.22% wet basis moisture content. The mean dewatering time for fermented cassava mash was 451mins while that of the unfermented mash was 480mins. This shows that using the double pole press, the fermented mash dewatered faster than the unfermented and might be as a result of the pressure from the double points.

Conclusion

It has been observed that

i. The two types of mash; Fermented and Unfermented mash dewatered properly and it shows that the double pole dewatering press can be used for both fermented and unfermented.
ii. The development of double pole manually operated dewatering press will boost and promote Gari production in sustaining national economy and alleviate the rate of poverty.
iii. It is portable and does not need a consummate to operate it.
iv. It is cheap to construct double pole dewatering press by farmers.

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