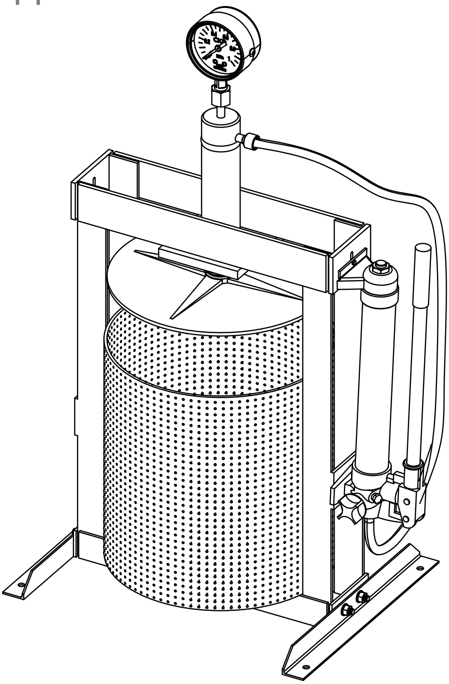
# How to evaluate the performance of CASSAVA PRESSES

Aditya Parmar & Marcelo Precoppe



Booklet 3

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# Preface

This booklet is the third of a 6-part series of booklets on performance evaluation of cassava processing equipment. These technical booklets are developed keeping in mind their target audience of local equipment manufacturers in developing countries, particularly Sub-Sharan Africa. The purpose is to determine the various performance parameters with simplistic techniques requiring no sophisticated instruments.

The online version of these booklets is available at: www.cassavatech.com.

At cassavatech.com we help cassava processors to learn how to choose suitable equipment and what performance parameters to ask for. These booklets series are a complement to that information provided, where equipment manufacturer can demonstrate to their potential customers the performance of the machine regarding the listed performance parameters.

A list of all the booklets in this series is provided below.

| Booklet Number | Name |
|---|---|
| 1 | How to evaluate the performance of CASSAVA PEELING MACHINES |
| 2 | How to evaluate the performance of CASSAVA GRATERS |
| **3** | **How to evaluate the performance of CASSAVA PRESSES** |
| 4 | How to evaluate the performance of CASSAVA PNEUMATIC DRYERS |
| 5 | How to evaluate the performance of CYCLONES |
| 6 | How to evaluate the performance of HAMMERMILLS |

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# CAVA II

Cassava: Adding Value for Africa (CAVA II) is a project led by the Federal University of Agriculture Abeokuta, Nigeria, working closely with the Natural Resources Institute. CAVA II aims to improve the livelihoods of smallholder farmers and processors in Nigeria, Ghana, Tanzania, Uganda, and Malawi.

CAVA II works across the value-added cassava chain, it interacts directly with farmers to improve the profitability of cassava sales, both through increasing overall market demand and through boosting farmer yields.

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# How to evaluate the performance of
# CASSAVA PRESSES

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## Contents



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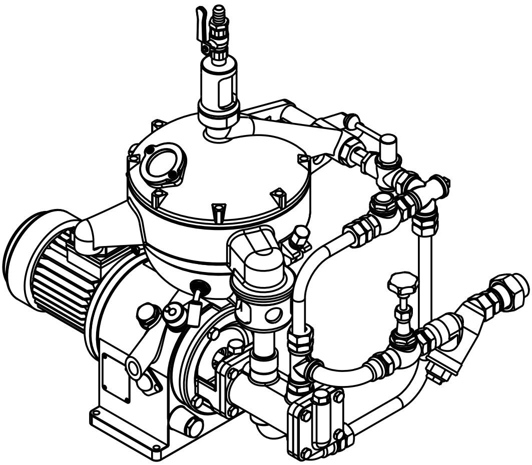
# Dewatering in the food industry

Food products are a complex mixture of various elements. Separating these fractions from each other is an important step towards preparing the raw materials to be further processed into value-added products. In the food industry, there are various separation classifications, however the most relevant in the context of cassava dewatering is **liquid-solid separation**.

Liquid-solid separation comprises the separation of two phases, a liquid phase and a solid phase, that are part of a mixture. The key property of a mixture in liquid-solid separation is the **compressibility**. Factors such as density, particle size, particle size distribution, and shape of the solid particles in a mixture are the primary determinants of compressibility.

There are several liquid-solid separations, however, **conventional filtration** is the method relevant for dewatering of cassava. Conventional filtration is a method where suspended particles in a mixture are separated with the help of a filter. The solid particles that do not pass through the filter are called **filter cake.** The liquid that passes through the filter is called **filtrate**. Conventional filtration methods can be further sub-divided into gravity filtration, pressure filtration, vacuum filtration, and centrifugal filtration.

**Gravity filtration** is the method where the material flows through a filter by the force of gravity alone. This type of method is frequently used in wastewater treatment however is not so common within the food industry. **Pressure filtration** is the method where the material is filtered using pressure. This method is used in mechanical dewatering of cassava. **Vacuum filtration** is the method where the raw material passes through the filter under a partial vacuum. **Centrifugal filtration** is the method where centrifugal forces are used to flow the mixture through the filter.



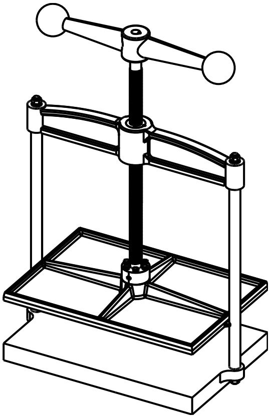
# Cassava dewatering

Dewatering serves two main purposes, firstly it reduces the mass of raw material which eases handling and transportation, and secondly it reduces product moisture content hence less energy and time is needed for further drying.

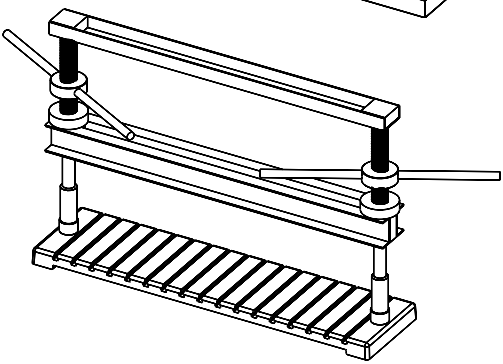
The most common equipment for dewatering cassava, particularly in sub-Saharan Africa, are **presses**. They can be **hand-powered** or **motor-powered**, but their principle of operation is the same. Some important factors influencing the effectiveness of a dewatering press are:

- Age and growing conditions of the roots
- How much the cells of the root have been disrupted during grating
- Amount of cassava mash loaded in each bag
- Number of bags containing cassava mash loaded to the press
- How fast the pressure is incremented
- The maximum pressure applied

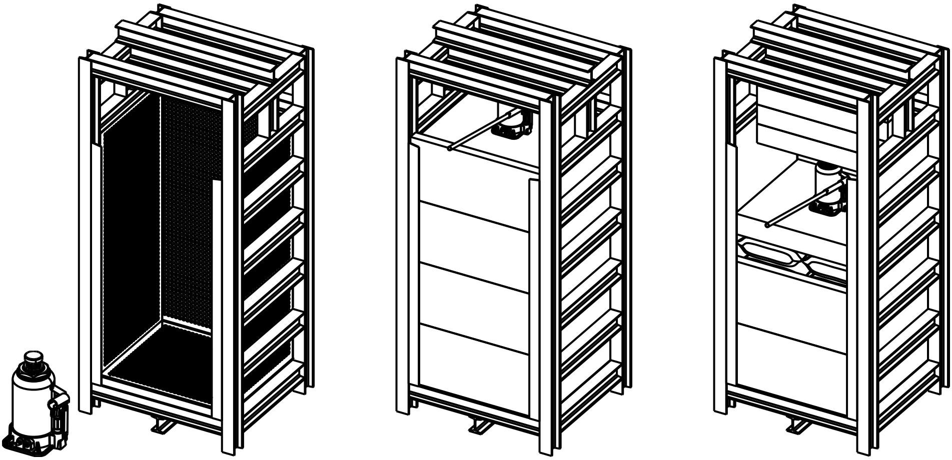
Hand-powered presses uses a **screw mechanism** or a **hydraulic lifting jack**. The one that uses the screw mechanism is common due to their simplicity and durability. However, the amount of force that can be generated with screw presses is inferior to what can be applied using the hydraulic jack.



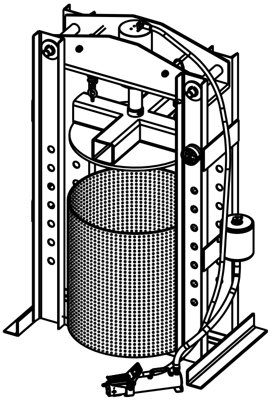
**Screw operated presses** consist of a ram which is driven upwards and downwards with the help of a screw and shaft. The top and bottom platforms are attached by a double or single screw that can make both platforms come closer or move them further apart. By placing the wet cassava mash in between the two platforms, and moving the platforms towards each other, a compression force is exerted which squeezes the water out of the wet cassava mash.



**Hydraulic jack operated presses** use a hydraulic lifting jack to generate the force. In a hydraulic jack, an incompressible liquid (in most cases oil) is pumped manually raising a piston and providing the compression force.



**Motor-powered hydraulic press** works on the same principle as a hydraulic jack with the only difference that the hydraulic fluid is pumped with an electric motor rather than a manually operated plunger pump.



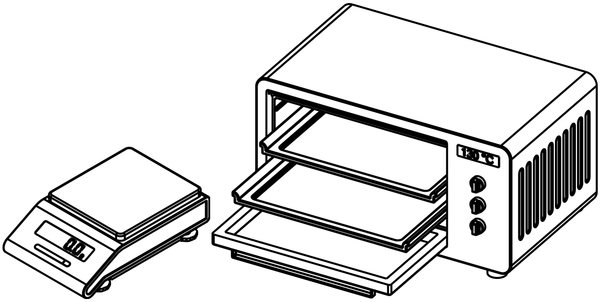
# Performance assessment

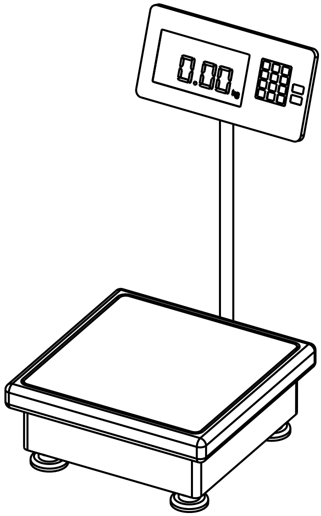
Performance of a dewatering press for cassava can be assessed based on the **throughput at 40% moisture content**.

### Throughput at 40% moisture content

The throughput at 40% moisture content of a cassava press depends on its dimension and the capacity of generating enough force to reduce the mash moisture content to 40%. Throughput at 40% moisture content is the amount of cassava mash (at 40% moisture content) obtain per unit of time. It is expressed in kilogram per hour (kg/h). If the moisture content of the pressed mash is above 40%, it needs to be returned to the press and the extra amount of time needed to reach a 40% moisture level need to be accounted for. To measure **throughput at 40% moisture content** it is necessary to have:

- Cassava mash
- Equipment for measuring moisture content
- Weighing scale
- Stopwatch or a regular watch




The **cassava mash** should be from freshly harvested and grated roots. The **Equipment to measure moisture content** consists of a benchtop weight scale and an electric oven.

**Step 1.** Fill the grated cassava into permeable bags made of woven polypropylene and load them in the press to its full capacity.

**Step 2.** Start the stopwatch when starting to press.

**Step 3.** After applying the maximum pressure and waiting for the water to drain, stop the stopwatch, note down the **time needed to press** and release the pressure.

**Step 4.** Unload the press and measure the **weight of the pressed cake** using the weighing scale.

**Step 5.** Break the pressed cake into grits using a grating machine. Mixed the grits thoroughly.

**Step 6.** Take a sample of about 25 g. Using the benchtop weight scale, note down the **initial weight of the sample**.

**Step 7.** Place the samples in the **electric oven**, adjust the temperature to approximately **130 °C**, and dry them for **4 hours**.

**Step 8.** After 4 hours, remove the samples from the oven, let them cool down, and using the benchtop scale, note down the **final weight of the sample**.

**Step 9.** Subtract the final weight of the sample from the initial weight of the sample (Step 6). This is the **weight of the water**.

**Step 10.** Divide the weight of the water by the initial weight of the sample (Step 6). This is the **moisture content** on a wet basis.

**Step 11.** If the moisture content is above 40%, return the material to the press and repeat steps 2 to 10, until a moisture content of 40% is reached.

**Step 12.** Divide the weight of the pressed cake (Step 4) by the recorded time (in hours). This is the **throughput at 40% moisture content.**

# Worked examples

## Throughput at 40% moisture content

To measure the throughput at 40% moisture content of a press, freshly harvested cassava was grated and placed inside polypropylene bags. The bags were loaded into the press and the material squeezed. After **30 minutes** the pressure was released, and the press unloaded. The weight of the pressed cassava mash, measured with the weighing scale, was **100 kg**. The pressed cake was broken using a grater machine and the grits were mixed thoroughly. A sample was collected and its weight measure. The initial weight of the sample was **20 g**. The sample was placed in an electric oven adjusted to 130 °C and left there for 4 hours. After 4 hours, it was removed from the oven, cooled and weighed with the benchtop scale. The final weight of the sample was **12 g**. What is the throughput at 40% moisture content of this press?

$$\text{Moisture content} = \frac{\text{Initial weight of the sample - Final weight of the sample}}{\text{Initial weight of the sample}}$$

$$\text{Moisture content} = \frac{20\text{ g} - 12\text{ g}}{20\text{ g}} = \frac{8\text{ g}}{20\text{ g}} = 0.40 = 40\%$$

$$\text{Throughput at 40\% moisture} = \frac{\text{Weight of the pressed cake}}{\text{Time needed to press}}$$

$$\text{Throughput at 40\% moisture} = \frac{100\text{ kg}}{30\text{ min}} = \frac{100\text{ kg}}{0.5\text{ hour}} = 200\text{ kg/hour}$$

*The throughput at 40% moisture content of this press is **200 kg/hour**.*

To measure the throughput at 40% moisture content of another press, freshly harvested cassava was grated and placed inside polypropylene bags. The bags were loaded into the press and the material squeezed. After **60 minutes** the pressure was released, and the press unloaded. The weight of the pressed cassava mash, measured with the weighing scale, was **200 kg**. The pressed cake was broken using a grater and the grits were mixed thoroughly. A sample was collected, and its weight measured. The initial weight of the sample was **20 g**. The sample was placed in an electric oven adjusted to 130 °C and left there for 4 hours. After 4 hours, it was removed from the oven, cooled and weighed with the benchtop scale. Final weight of the sample was **10 g**. What is the throughput at 40% moisture content of this press?

$$\text{Moisture content} = \frac{\text{Initial weight of the sample - Final weight of the sample}}{\text{Initial weight of the sample}}$$

$$\text{Moisture content} = \frac{20\text{ g} - 10\text{ g}}{20\text{ g}} = \frac{10\text{ g}}{20\text{ g}} = 0.50 = 50\%$$

*The throughput at 40% moisture content of this press* ***cannot be calculated*** *because the moisture content of the pressed cake is above 40%. To calculate the throughput at 40% moisture content, the cake must be returned to the press and pressure should be applied once again. After pressing for the second time, the weight of the pressed material should be measured again as well as its moisture content.*

Dewatering is an important step in cassava processing. The most commonly used dewatering equipment is the press. In this booklet, performance indices for dewatering cassava with presses are described and a step-by-step guide to calculating these indices is presented along with practical examples.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