

GUIDE TO FLOOR MALTING OF SORGHUM AND MILLETS

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Disclaimer – Neither the authors, nor the University of Pretoria, nor INTSORMIL accept any responsibility in respect of these methods or their application.

Readers are, however, welcome to contact the author with regard to seeking clarity on how to perform any of the methods.

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GUIDE TO FLOOR MALTING OF SORGHUM AND MILLETS

1. INTRODUCTION

Malt (dried, sprouted cereal grain) is the major ingredient in most beers and in certain hot and cold beverages. It is also a useful ingredient in some cereal food products such as bread and infant porridges. In terms of nutrients, malt contains mainly complex carbohydrates (starch and dietary fibre), but also protein of reasonable quality and availability, B vitamins and minerals. Malt is a source of hydrolytic enzymes, especially amylases. In brewing, the malt amylases produce the sugars which the yeast ferments to alcohol and carbon dioxide. The amylases also increase the sweetness and improve the texture of food products such as bread and porridges.

Floor malting of sorghum and millet is a traditional craft that has been carried out throughout Africa for hundreds of years. The modern factory manufacture of barley malt and sorghum malt is in principle identical to traditional malting. This guide shows how traditional floor malting can be scaled-up into a small commercial-scale operation, through the application of simple, sound food manufacturing practices.

Note:

The guide is an introduction to the technology of sorghum and millet floor malting. It is not intended to provide complete instructions on how to floor malt sorghum and millets. If the reader wishes to undertake sorghum and millet malting and has had no previous experience, it is strongly recommended that he/she contacts INTSORMIL to be put in touch with an expert in sorghum and millet malting.

2. MALTING INSTALLATIONS

2.1 Grain store

The purpose of the grain store is to maintain the grain in a healthy condition so that it will germinate, and to prevent loss by fungi, insects, rodents and theft. The grain store building should be of sound construction. If it has windows, these must be covered with insect mesh. The store must be kept locked. In the store, the sacks must be stored on wooden pallets (see photo below) to prevent the grain from taking up moisture. The sacks themselves must be clean. If they have been used before, they must have been used for storing grain, not other substances like fertilizer.

A fumigant is required to prevent insects growing in the grain and to kill insects already present. The fumigant phosphine is often used for this purpose.

Caution: – Fumigant gas is highly poisonous. Strictly adhere to manufacturer’s instructions!

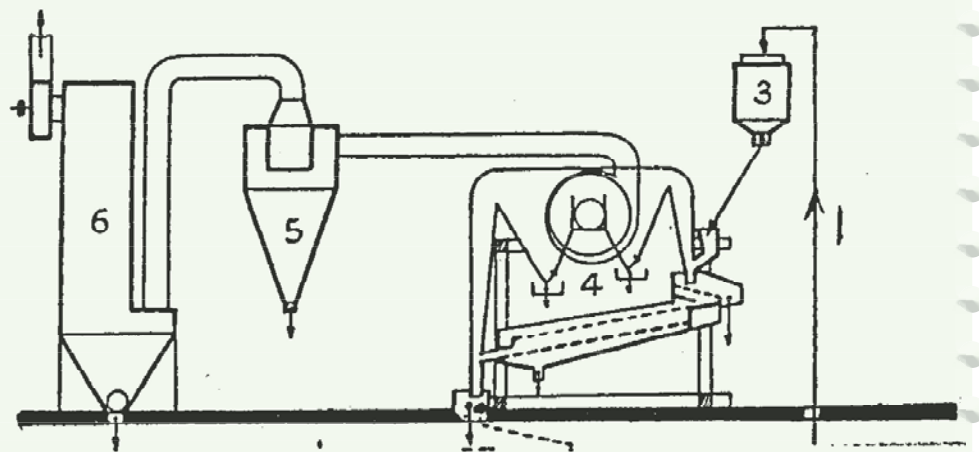


Wooden pallet

Proper storage of sacks

2.2 Grain cleaning equipment

Prior to malting, the grain must be thoroughly cleaned of foreign matter, dust and chaff. This is best achieved using a separator comprising vibrating screens, a suction fan and cyclone dust collector (see diagram below).

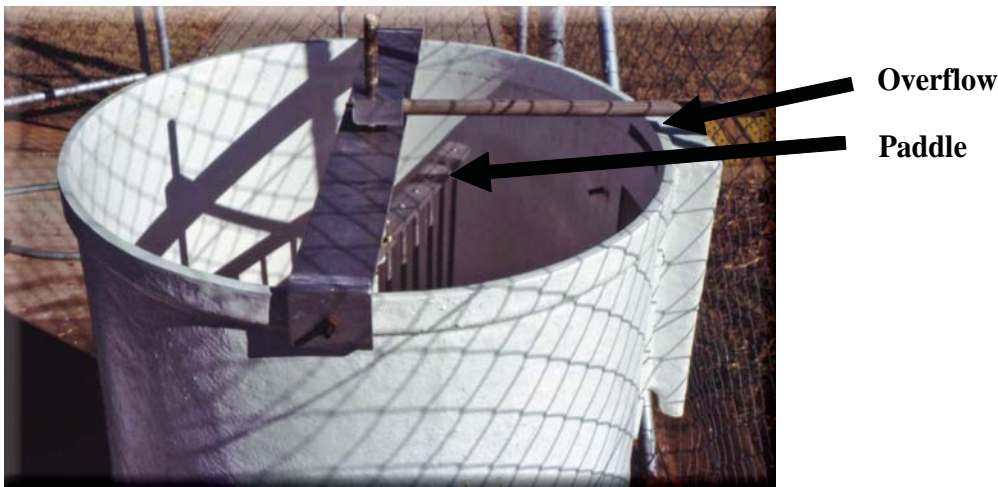


Separator with cyclone with: (3) automatic scale, (4) vibrating screens, (5) cyclone, (6) suction dust collector

2.3 Steep tank and equipment

This comprises a watertight vessel made of plastered brick, concrete, corrugated iron or plastic. It should be designed to hold a volume calculated on the basis of three times the weight of grain intended to be used as a daily batch for malting, e.g. for 50 kg of grain a 150 litre capacity tank is required. The steep tank should be fitted with an overflow at the top (see photo below), drain at the bottom and a port for the release of steeped grain. The steep tank should be mounted on a sturdy stand, such as a concrete structure, at such a height that the port level is high enough for unloading into, for example, a wheelbarrow.

A rotary rake-like paddle to agitate and wash the grain should be fixed in the steep tank (see photo below). A supply of fresh, unpolluted, potable (safe to drink) water piped to the steeping tank and germination beds is required, as well as an efficient, drainage system. An open concrete drainage channel system is suitable, but it must have a good slope to allow the water and malt debris to drain away.



Steep tank with rake type paddle and with overflow at the top

2.4 Germination beds and equipment

The germination bed comprises a water impervious, smooth concrete floor, with sufficient slope to allow drainage of excess steep water and wash water into the open drainage channel. Allow approximately 3 sq metres germination bed per 50 kg of grain. The germination bed should be roofed with, for example, corrugated iron and the sides must be open or with slatted wooden walls to allow ventilation (see photo below). The germinated grain should be covered with clean plastic sacking or plastic shade cloth to protect it from birds and excessive moisture evaporation.



Sorghum spread out in a floor maltings just after steeping (note slope of concrete floor) (courtesy of Mrs Ama Pagaa, Ghana)

Forks and rakes are required to level, turn, spread, heap and load the germinating grain. A thermometer is needed to monitor the temperature of the grain. The thermometer should preferably be a digital type with probe. A mercury thermometer must not be used. A wheelbarrow for moving the grain and malt is also useful.

2.5 Malt drying bed

The malt drying bed is essentially same as the germination bed but of twice the area. Ideally, there should be both an open air drying bed and roofed drying bed so that drying can still be carried out in rainy weather. The latter should not have walls, in order that there is a free flow of air across the drying malt.

2.6 Milling installation

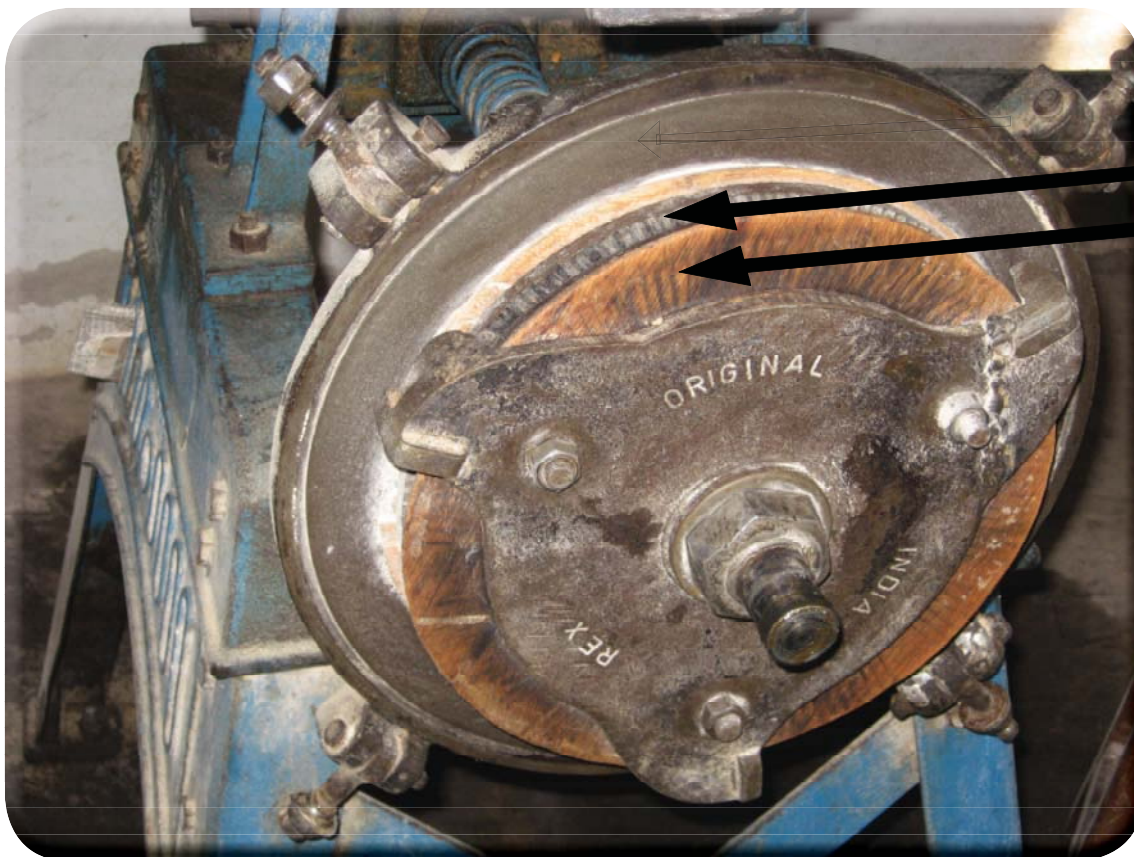
A suitable mill (e.g. hammer-mill or disk mill) is used to grind the dried malt to the required fineness (see photos below). There must be a separate well-ventilated milling room as milling generates large amounts of dust.



Screen

Hammers

Hammer mill - milling chamber



Disks

Disk mill (attrition mill) – milling chamber

2.7 Malt store

This may be same as the grain store but the bags should be stored quite separately, for example on opposite sides of the store.

3. MALTING AND RELATED PROCESSES

Remember – when you make malt you are making food!

Think of your maltings as your food kitchen. As in a kitchen, cleanliness and good hygiene are essential. Wash your hands before handling the grain or malt.

Ask yourself the question: “Would I put my food directly on any place that the grain or malt is in contact with, and then eat that food afterwards?”

If your answer is NO, then you are not practicing good hygiene in your maltings.

3.1 Grain quality

On receipt of the grain its quality must be checked. Firstly, make use of your senses. The grains should look clean and be bright in colour. The sack should not contain flour or have excessive broken kernels. The grain should not be mouldy, nor have any weevils (insects). It should smell fresh, not sour or musty. Pick up a handful and hold it tight in your hand. Then let it fall through your fingers. It must be free flowing, if it is not, it is damp.

Then the total percentage of defects should be measured using the method “Determination of Total Defects in Sorghum Grain” in the booklet “Five Simple Methods for the Determination of Sorghum Grain End-Use Quality (with Adaptations for those without Laboratory Facilities)”, which is also posted on the INTSORMIL website.

Next, and critically important for grain for malting, the grain’s germination must be determined using the method “Determination of Germinative Energy of Sorghum Grain” in the same booklet. If the grain does not germinate well, not only will it make malt of poor quality, the malt will probably become mouldy.

- If the batch of grain has too high a percentage of defects, negotiate a better price with your supplier, or refuse to take it.
- If the batch of grain received is damp, it should be dried by spreading out in the sun.
- If it is sour, or mouldy, it should not be used for malting or for human food.

- If it does not germinate well, it should not be used for malting.
- If there are insects in the grain, it must be fumigated immediately, before putting it in the grain store with the other grain.
- Before storage, clean the batch of grain using a separator

3.2 Steeping

Fill the steeping tank with fresh water. The temperature should be between 22 and 28°C, certainly not less than 20°C and not more than 30°C. Use approximately 1.5 times the volume of water to the weight of grain, i.e. for 50 kg grain use 75 litres of water.

Caustic soda (sodium hydroxide) is needed to “sterilize” the grain, in order to reduce mould growth during malting. The growth of moulds is the biggest problem in malting as not only do moulds taint the taste of the malt, they can produce cancer-causing toxins, called mycotoxins such as aflatoxin. Thus, it is essential to prevent moulds growing on the malt. Caustic soda is sold as a cleaner in supermarkets and hardware stores. It is in the form of granules or pellets.

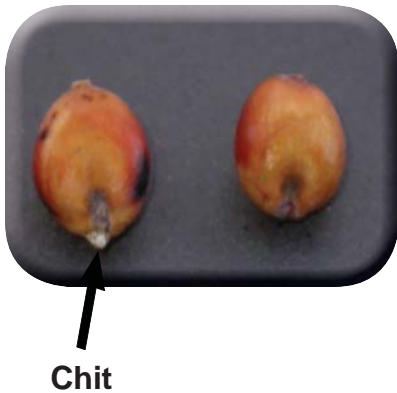
Thoroughly mix the caustic soda into the steep water to make a 0.3% solution, i.e. in 75 litres add 225 grams of caustic soda. After dilution, the steeping solution is safe to handle.

Caution: - When adding and mixing the caustic soda, wear rubber gloves, protective clothing and goggles. Concentrated caustic soda solution causes severe burns. In the event of a concentrated caustic soda solution getting on clothing, skin or in eyes, the affected area must immediately be washed with copious amounts of running water. If in doubt, do not hesitate to seek medical attention.

The grain should be steeped for 6 hours, with periodic turning of the paddle to free foreign matter from the grain. At the end of the 6 hours, the steeping vessel should be topped up with water to wash out the foreign matter through the steep overflow. The steep liquid is then drained out. The steep tank is filled with fresh water and agitated with a paddle. If the water temperature is warm, around 28°C, the water may be drained off the steeped grain immediately and then the grain is transferred to the germination bed, using a wheelbarrow.

If the water temperature is cooler, around 22°C, steeping should be continued for a period of up to 10 hours, periodically agitating with the paddle, and then transferred to the germination bed.

By approximately 16 hours from the start of steeping the majority of the grains should have started to germinate. The first sign of germination is the “chit”, emergence of the root (see photo below). It is then ready for transfer to the germination bed.



3.3 Germination

Load steeped grain on to the concrete germination bed. If the grain is cool, around 22°C, it should be made into couches (heaps) around 40 cm high until the temperature within the couch has reached 25°C, by which time virtually all grains should have started to germinate. If the grain is already at 25°C, it should be spread into a layer of around 10 cm high. Check malt bed temperature frequently to ensure that it does not get too hot or too cold. Maintain as close as possible a temperature between 22 and 28°C by spreading out the malt or heaping it into couches.

As mentioned in section 2.4, the germination bed should be covered with plastic shade cloth, or similar material. It is also essential to prevent birds and vermin from getting onto the germinating grain.

During germination it is essential to keeping the malt seedling moist, but not wet, so that the grains germinate uniformly. At intervals, generally once a day, but depending on the temperature, the germinating grain must be watered by controlled addition of water using a sprinkler or water hose. The water must be uniformly distributed throughout the depth of the grains by careful turning of the malt.

Germination is continued for 4 to 6 days, as demanded by the specification of the product. Generally, germination is considered as being complete when the malt shoots are on average 1-2 cm long.

3.4 Drying

The germinated malt is transferred to the drying bed using forks. It is spread out into as thin a layer as possible, preferably less than 5 cm. Tangled clumps of malt should be separated by hand, as clumps tend to support mould growth. The drying malt must be turned frequently to facilitate drying. It can be judged when the malt is dry by manipulating the roots and shoots between one's fingers. If they break cleanly, the malt is dry. If not, further drying time is necessary.

3.5 Milling and bagging

If the malt is required to be milled, milling should be done as soon as possible after drying. The malt must not be allowed to get damp again before milling.

The fineness of milling is dictated by the market.

The malt bags must be clean and be clearly labeled. The information on the label should include details such as:

Product – e.g. sorghum malt

Net weight

Date of manufacture

Batch number

Name, physical address and telephone number of manufacturer

Remember that malt is a food product and the labelling must conform to national regulations.

Some markets demand that the roots and shoots be removed from the malt before drying. This can be done by rubbing the malt on plastic mesh, such as insect mesh for windows, where the mesh size is just smaller than the malt grains. The roots and shoots fall through the mesh. They are rich in protein and can be used as minor component of animal feed.

Note. The roots and shoots should not be fed by themselves to animals because they can contain dangerously high levels of a chemical called dhurrin that releases hydrogen cyanide (prussic acid). Rather, they should be mixed into other feed such as grain, at low concentrations.

3.6 Malt storage and dispatch

The malt must be stored cool and dry and protected from insects and vermin.

Storage and dispatch of malt to customers must be according to the **FIFO** rule: **F**irst **I**n, **F**irst **O**ut. Malt has a maximum shelf-life of about three months.

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