Webinar 2:
26/03/20

Malt Milling

Mike Benson

Malt Intake & Storage

- Stored at delivery moisture to:
  - Discourage the growth of pests
  - Prevent any biomechanical changes
- Bags are stored dry & warm away from humidity
- Bulk malt can be unloaded using a standard tipper or by blower. The blower creates more dust and can break up the grain.
- Silos have smooth walls with hopper bottoms making it easy to remove the grain. They should be emptied at regular intervals to maintain stock management and traceability.
- Stock Rotation – Check the BBE
- Sample - While its unusual to be able to confirm the analysis supplied by the maltings, visual & sensory inspection may raise any potential issues.

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Malt Intake & Storage

- Sampling:

Visual Defects	Sensory Defects
Broken/damaged grains	Mouldy aroma
Untypical colouring	Rancid or butyric notes due to infection or contamination (baby sick)
Foreign bodies (including dirt and insects)	
Any mould/fungi	

- Kettle Test:
  - Add 200g of grain to 500ml boiling water and leave for 15 minutes.
  - Sieve the grain away and assess the aroma and flavor of the remaining liquid

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Malt Dust

- Risk of Explosion – DSEAR - https://www.hse.gov.uk/fireandexplosion/atex.htm
  - The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) place duties on employers to eliminate or control the risks from explosive atmospheres in the workplace.
  - A build up of malt dust can create an explosive environment. Do not allow dust to build up
  - ATEX Zone's - classify areas where hazardous explosive atmospheres may occur into zones
  - Reduce the risk of sparks – intrinsically safe electrical items, remove stones and metal.
- Effects on Health - https://www.hse.gov.uk/pubns/eh44.htm
  - Long term effect on mucous membranes of those who inhale
  - Use the correct grade of PPE and make sure it fits correctly.
    - Face fitting
  - Eye and skin irritation

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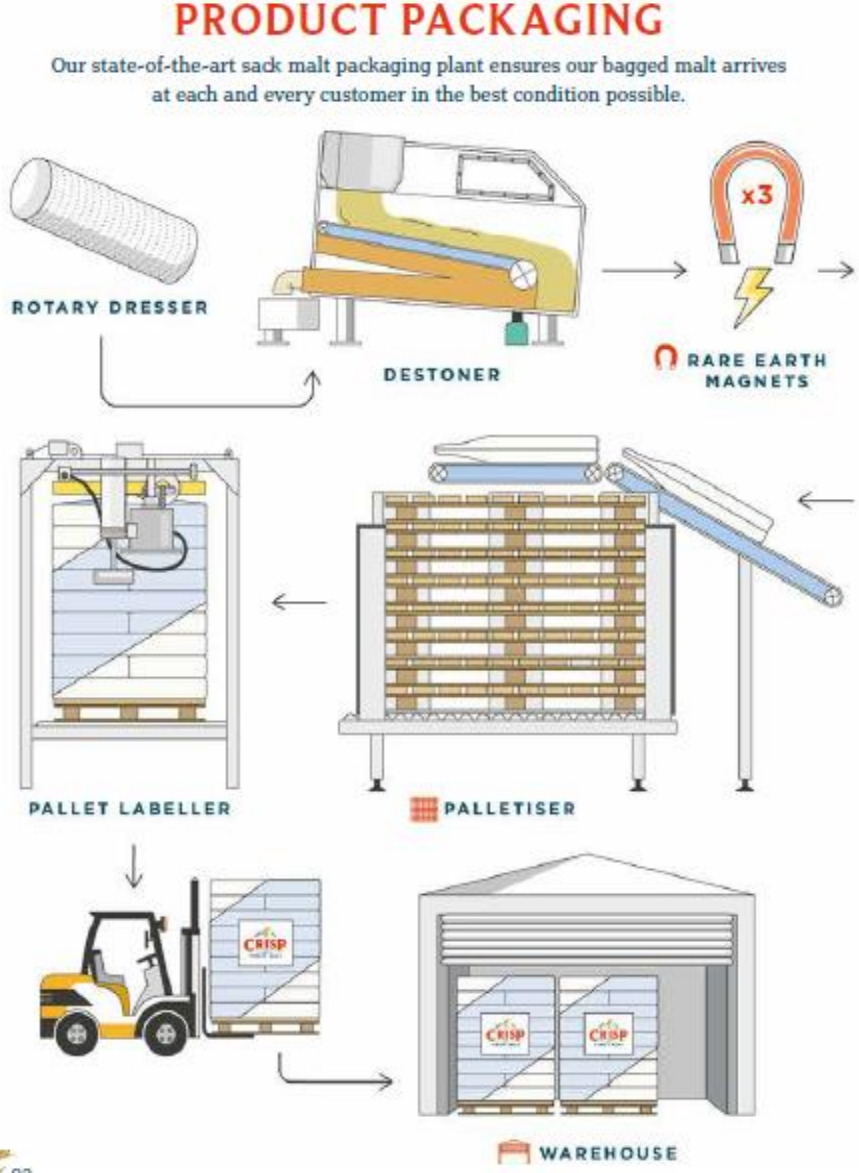
PRODUCT PACKAGING

Our state-of-the-art sack malt packaging plant ensures our bagged malt arrives at each and every customer in the best condition possible.

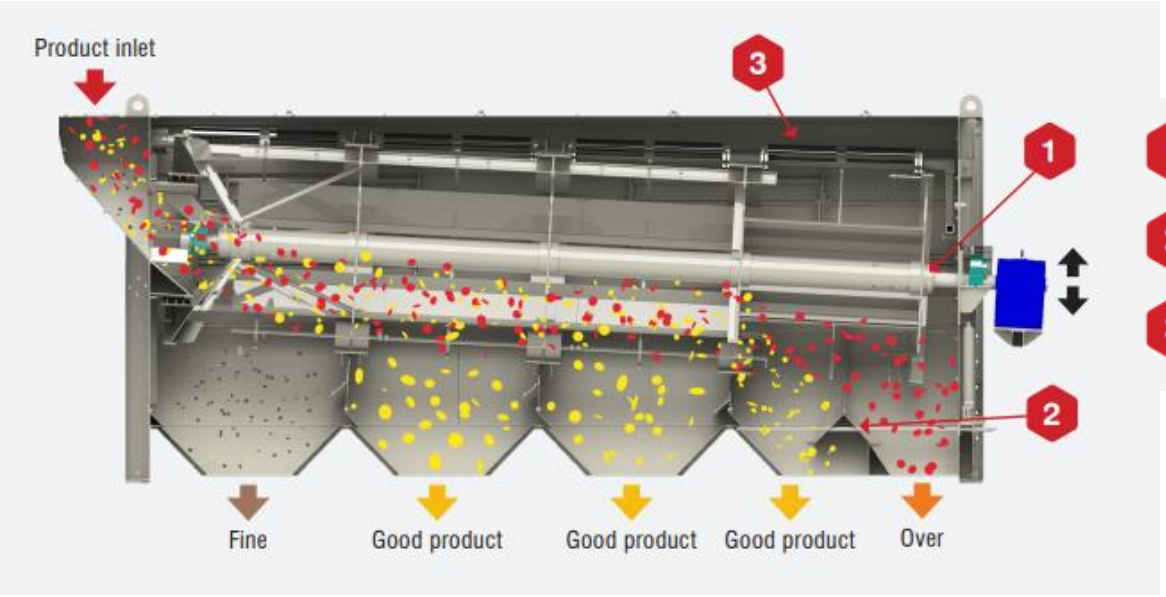


Our Packaging Line

- Three rare earth magnets prevent any metal particles passing through to the packaging line.
- The Weigher controls product flow and changeovers.
- Sacks are labelled with batch details and warehouse barcodes. QR codes link to the malt analysis CoA through the Crisp App.
- Palletising is automated and for best possible pallet stability they're wrapped in heavy duty film.
- Warehousing is managed using a stock/location barcode system. All stock is scanned to dispatch allowing full traceability.

Malt Handling

- Screening / Dressing
  - Malt is screened and dressed to ensure uniformity.
  - The malt passes through rotating, cylindrical, oscillating or flat bed screens
  - Corns of unwanted size are removed along with straw, stones and metal
  - Dust control – Aspiration fan



1. Rotary drum with variable speed and pitch equipped with mixing baffles for an even product spread
2. Manual mobile bulkhead adjustment for a better precision on the last screen
3. Easy-Change screens with automatic deblinding system

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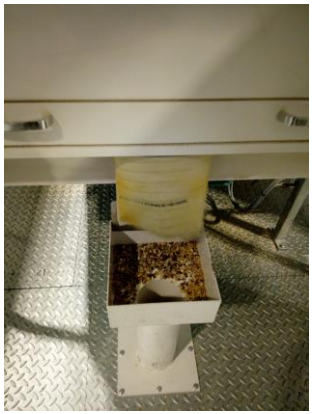
Malt Handling

- Magnets
  - Metal must be removed before it reaches the mill.
  - Sparks can cause an explosion or fire
  - Can be located on the dresser or the mill feed – clean weekly
  - Malt should flow over the magnet in a thin layer



- Destoner
  - Stones that pass through the dresser can damage the mill rollers and cause sparks
  - They separate material based on density. Air passes through the grain bed to make it fluid, the bed, set at an angle, shakes to make heavy objects move up hill.
  - Small stones the same size as malt can be removed
  - Dust control – aspiration fan

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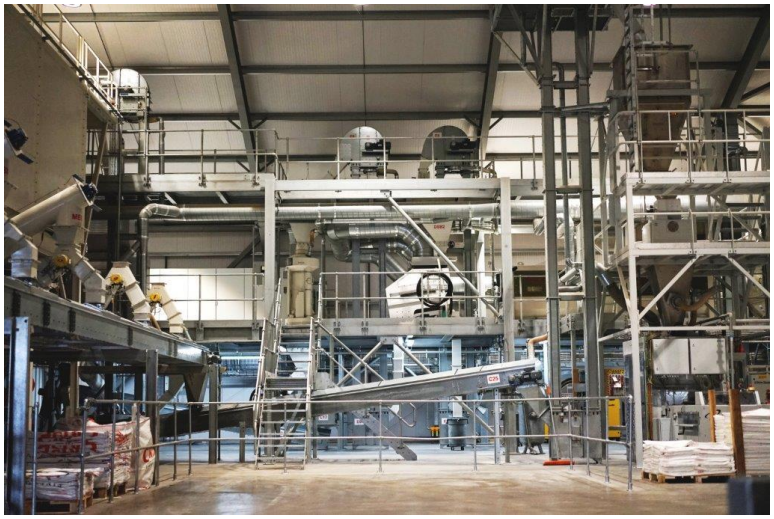
Milling

- Produce the highest yield of extract as efficiently as possible.
- The objective of milling malt is :
  - Particle size reduction
  - Particle size control
- Large grist particles
  - Fast Filtration = Reduced extract recovery
- Small grist particles
  - Slow filtration = Increased extract recovery



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Malt Milling

Corn Size

- Inconsistent grain size causes inconsistent milling
- Varies depending on:
  - Variety
  - Weather during growing season
- Add flaked torrified barley, flaked torrified maize, flaked torrified oats and flaked torrified rice after the mill.

	MARIS OTTER		WINTER BARLEY	
YEAR	2018	2019	2018	2019
CORNS < 2.25mm	6.0	3.5	4.0	2.3
CORNS > 2.5mm	79.8	87.5	88.4	92.1

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Malt Milling

Malt Friability

- A measure of how well the malt is modified and how easy it will mill.
- Some malts from the continent and some parts of the UK can have a friability of around 80%.
- Ideally it should be greater than 90%.
- Indication of good malting practice.
- Well modified malts produce fine grist and only need simple milling equipment
- Under modified malts produce coarse grist and require more complex milling equipment.
- Blending different levels friability will produce different particle sizes.

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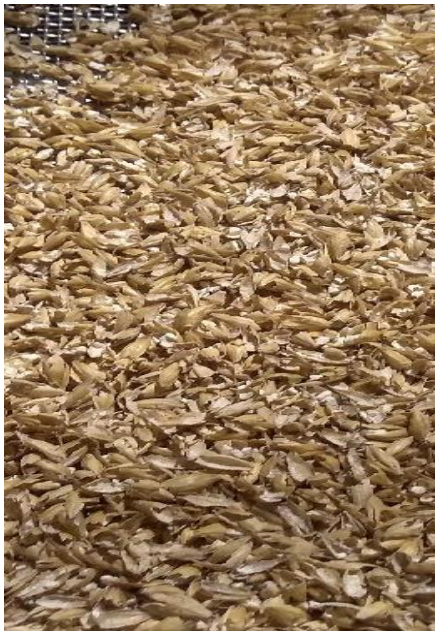
Malt Milling

Husks

- During wort filtration husks form part of the filter bed
- The husk proportion maintains bed porosity
- Low husk volume can cause:
  - Extended filtration times – In the brewhouse and down stream
  - Poor Wort Clarity
    - Poor beer clarity
    - Potential fermentation issues
- Husks also contain polyphenols. If extracted into the wort will:
  - Affect flavour – Astringent bitter flavours
  - Affect shelf life – Increased polyphenol extraction



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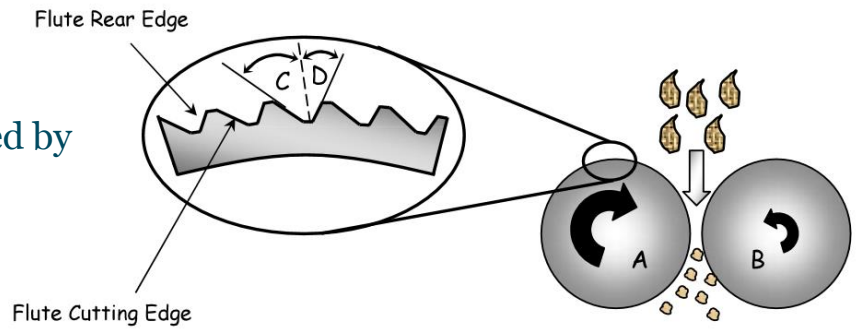
Malt Milling – Roller Mills

Compression & Shear



- The disruption of the grain structure is effected by
  - Direct compression on the grain
  - Shear Forces
- Grain is compressed as it passes through the rollers disrupting its structure to produce different particle size.
- Rollers running at different speeds will produce shear force.
- Flutes intensify the cutting action
- Mill efficiency and capacity are controlled by:
  - Roller length, Roller diameter, Roller speed, Roller gap setting & Roller surface friction (flutes)

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Malt Milling – Roller Mills

2 Roller Mills

- Single set of rollers
- Low cost
- For use with well modified malts
- Best suited to Infusion Mashing System
- Easy to use

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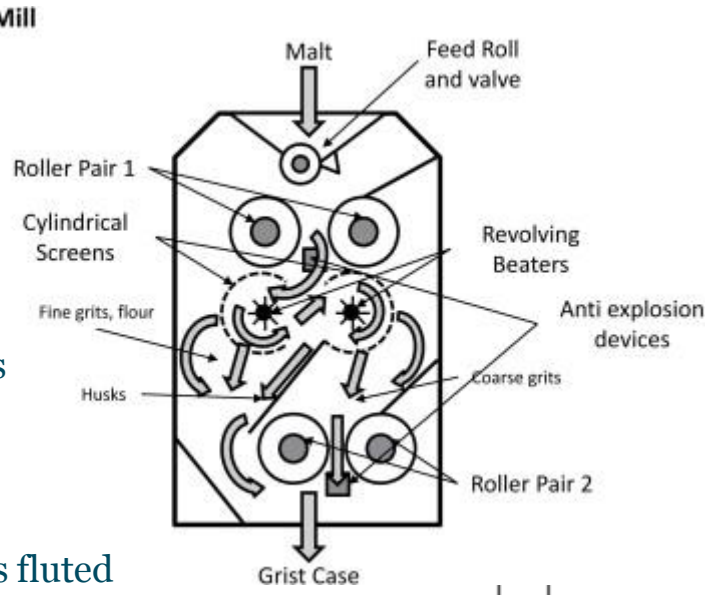
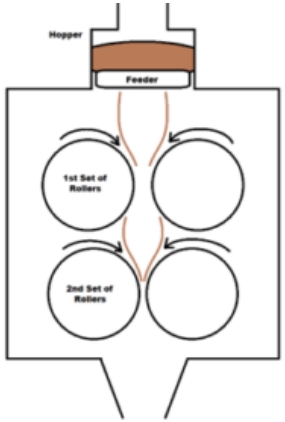
Malt Milling – Roller Mills

4 Roller Mills

- Double set of rollers
- For use with well modified malts and lesser modified malts
- Best suited to Infusion Mashing System or Lauter Tuns
- The second set of rollers are the same size as the 1st but less fluted breaks the hard-unmodified ends.
- In standard mills, flour and grits that do not need further milling pass through to the second set of rollers
- More sophisticated mills have a pair of revolving beaters after the 1st set of rollers that allow husks, fine grits and flour to avoid the second set of rollers





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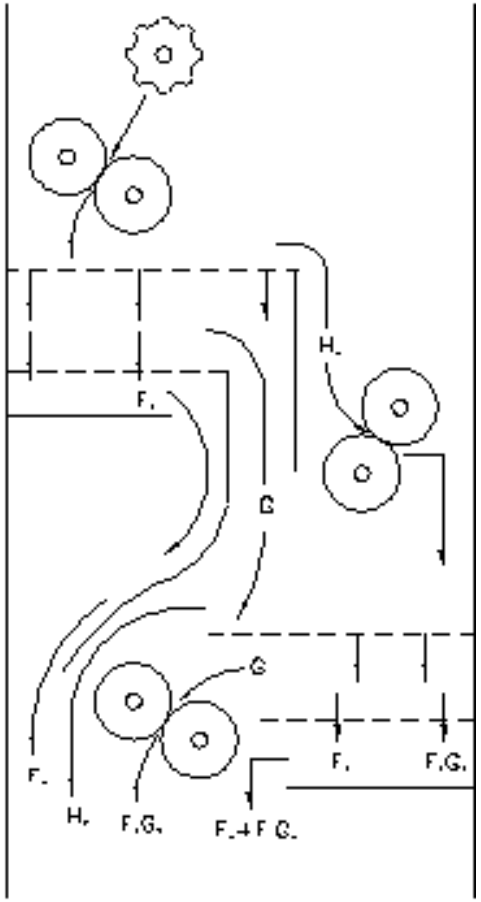
Malt Milling – Roller Mills

6 Roller Mills

- 3 sets of rollers
- Suited for use will all malts
- More effective at controlling each grist fraction.
- Best suited for use with Lauter Tuns or Mash Filters
- Flour from the 1st rollers fall directly to grist case while fine grits are screened to the bottom rollers
- In the second pair of rollers, hard ends are crushed from husks and coarse grits are reduced in size
- Only grits from the second set of rollers find their way to the bottom rollers



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Malt Milling – Roller Mills

Summary

- Not all mills are equal
- Malt mills are specially designed to protect the husk
- As the number of rollers increases, so does the ability to control each grist fraction and mill under modified malts
- The more complex the mill, the greater the capital and operating cost.
- If the maltster does a poor job, the brewer needs to spend more money on milling equipment!

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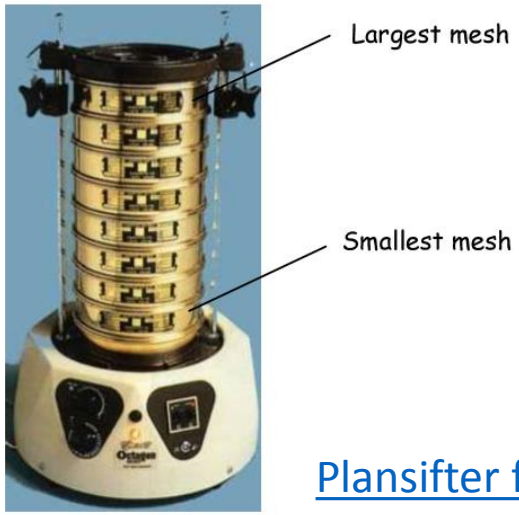
Grist Assessment

- Very important to check the grist ratio to diagnose or pre-empt issues
- Checks the integrity of milling
  - Poor extract
  - Poor filtration
- Different wort filtration techniques require different grist fractions



Plansifter from Endecotts

Grist box from Stevenson reeves page 44

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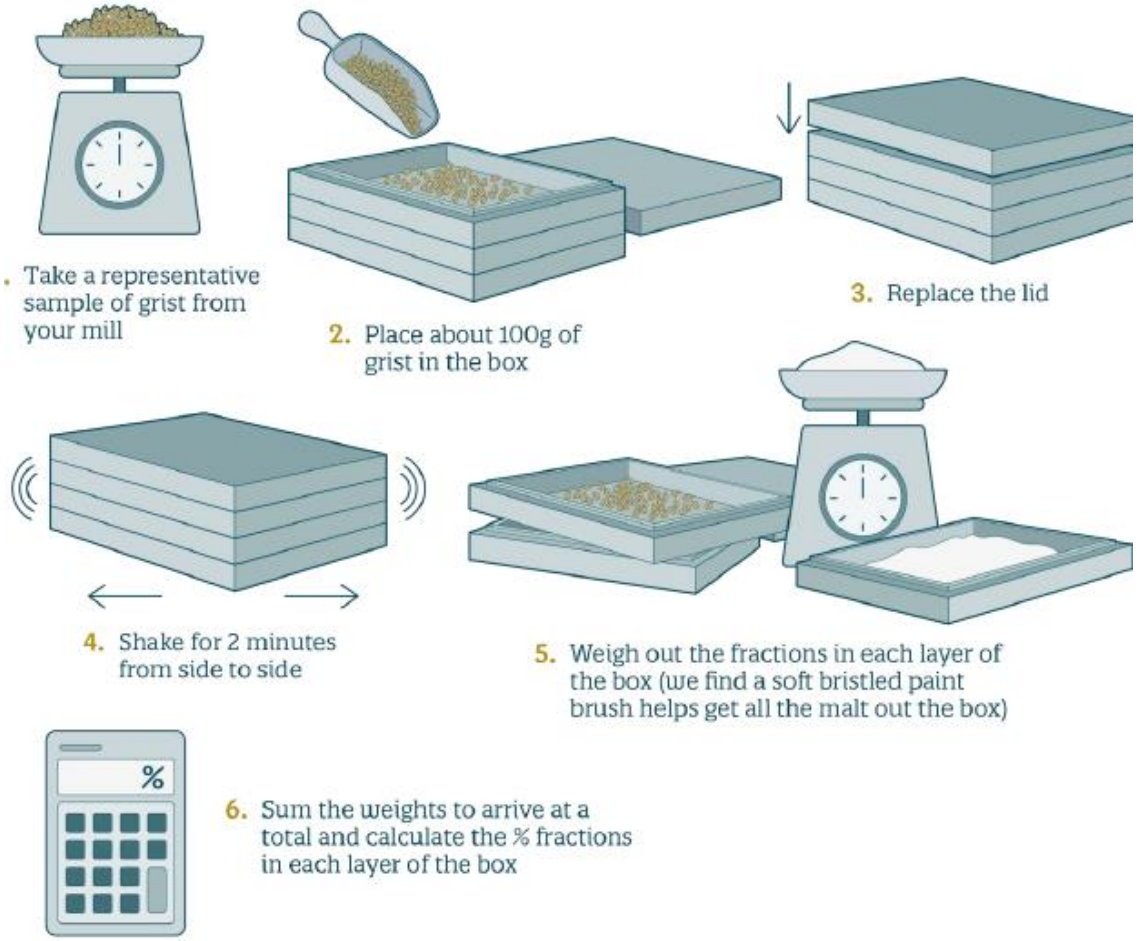
Grist Assessment



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Grist Fractions

- At Crisp, our crushed malt is optimised for traditional single infusion Mash Tuns

SIEVE	CRISP BASE CRUSHED MALT SPEC	TYPICAL LAUTER TUN CRUSHED MALT	DISTILLING – SEMI LAUTER	CRISP COLOURED CRUSHED MALT SPEC
COURSE (>1.98MM SCREEN)	40% - 50%	40%	20%	45% - 65%
FINE (<1.98MM SCREEN)	35% - 45%	30%	70%	25% - 45%
FLOUR (<0.212MM SCREEN)	MAX 12%	30%	10%	MAX 10%

CRISP MALT MILL SETTINGS (MARCH 2020)

BUHLER 4 ROLLER MALT MILL	
TOP ROLLERS	1.6mm
BOTTOM ROLLERS	1.5mm

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Adjusting the rollers

- When its time to make a change to the mill:
  - Make small adjustments of 0.1mm at a time
  - Make the gap smaller for a finer grist and wider for a coarse grist.
  - On a 4-roller mill adjust both sets of rollers by 0.1mm
  - Generally, set the top roller 0.1mm above the lower rollers
  - Check the gaps with feeler gauges across the whole area of the rollers. As the rollers age they wear making the gap size inconsistent
  - Record any changes
- If you need any help or advice speak to us. We offer advice and practical help through all stages of brewing.

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Whole v Crushed

WHOLE		CRUSHED	
PRO'S	CON'S	PRO'S	CON'S
The brewer is in control of the crush	Higher Capital Costs	No Capital Cost	Reliant upon supplier to guarantee crush
Possibility for upgrade to Big Bag (H&S)	Greater H&S – dust production	No cross contamination of colour	+£20 per tonne
No Crushing Fee	Higher Maintenance	No Maintenance	
	Finding the time for the grist sampling		
	Need for dresser and de-stoner?		

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Grist Fractions

A comparison between lab milled extract and our Buhler malt mill

- We often get asked, what's the difference in extract between the 0.7mm lab grind and the grind for the brewery? So we tested some samples.

Malt	Ex Pale	Best Ale	Maris Otter
Extract as is whole	298	298	300
Extract as is crushed	291	290	297
% of whole extract	97.6%	97.3%	99%

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Troubleshooting Guide

Issues	Differential	Things to check/ solutions
Sudden jump in extract	Wrong weight of grist	Check scales calibrated & correct grist made up
	Wrong volume of water	Check volume of HLT, check values not sticking
	Malt is milled too fine	Check mill setting, do grist analysis, visual check of milled malt
	Adding high % non-malted flaked product before mill	Add non-malted grains after mill
Low extract	Wrong weight of grist	Check scales calibrated & correct grist made up
	Wrong volume of water	Check volume of HLT, check values not sticking
	Malt is milled too coarse	Check mill setting, do grist analysis, visual check of milled malt
	Change in malt specification	Check COA, call Crisp for COA consultation.
	Low mash temperature, no gelatinisation	Check mash temp, check probes calibrated
High run off rate	Malt milled too coarse	Check mill setting, do grist analysis, visual check of milled malt
Low run-off rate ; stuck mash	Bed not floating	Mashing in issues.
	Lack of husk material	Check milling. Add hulls. Reduce huskless raw materials
	high beta glucan	Check COAs. Call Crisp for recipe check. Add beta glucanase
	Low mashing temp	Check mashing & sparge temp ok
Poor filterability	Poor break removal	Check copper finings regime
	Malt milled too fine	Check mill setting, do grist analysis, visual check of milled malt
	High beta-glucan	Check COAs. Add betaglucanase. Check with supplier.
	Blocked filters	Check filter condition. Adjust DE addition rate.
	High % of oats/ rye	Reduce %. Add hulls to mash. Increase vorlauf.

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Thank You

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