Kilned Versus Roasted: Do You Really Know Your Specialty Malt?

DAVID RICHTER – June 12, 2015

Briess Malting Company – Chilton, Wisconsin

The best handcrafted beer starts with the finest handcrafted malt.

Quick overview of discussion

1 - Malting 101
- Purpose of malting and mashing
- Flow diagram

2 - Kilned malt production vs roaster produced malt
- "Pros and Cons"

3 - Caramel malt production
- Aromatic Munich 20L and Caramel 20L samples

Purpose of Malting

- Activate enzymes for degradation of cell walls containing starch in the barley kernel, break down of proteins, and conversion of starch to sugar to nourish the germinating barley embryo during malting -- *AKA tricking Mother Nature it's time to grow a plant!*
- Conserve starch degrading enzymes for use during mashing
- Make malt friable for milling
- Develop color and flavor

Purpose of Mashing

- To convert starch from cereal grains to fermentable sugars, which through yeast fermentation are converted to ethanol

- This is driven by an enzymatic reaction at temperatures conducive to facilitate changes to the starch substrate that produces fermentable sugars

Super Basic Malting 101

- Drive moisture into barley kernel.
- Sprout barley.
- Remove moisture for storage.

EASY RIGHT!

As Maltsters we are making a *processed raw material*

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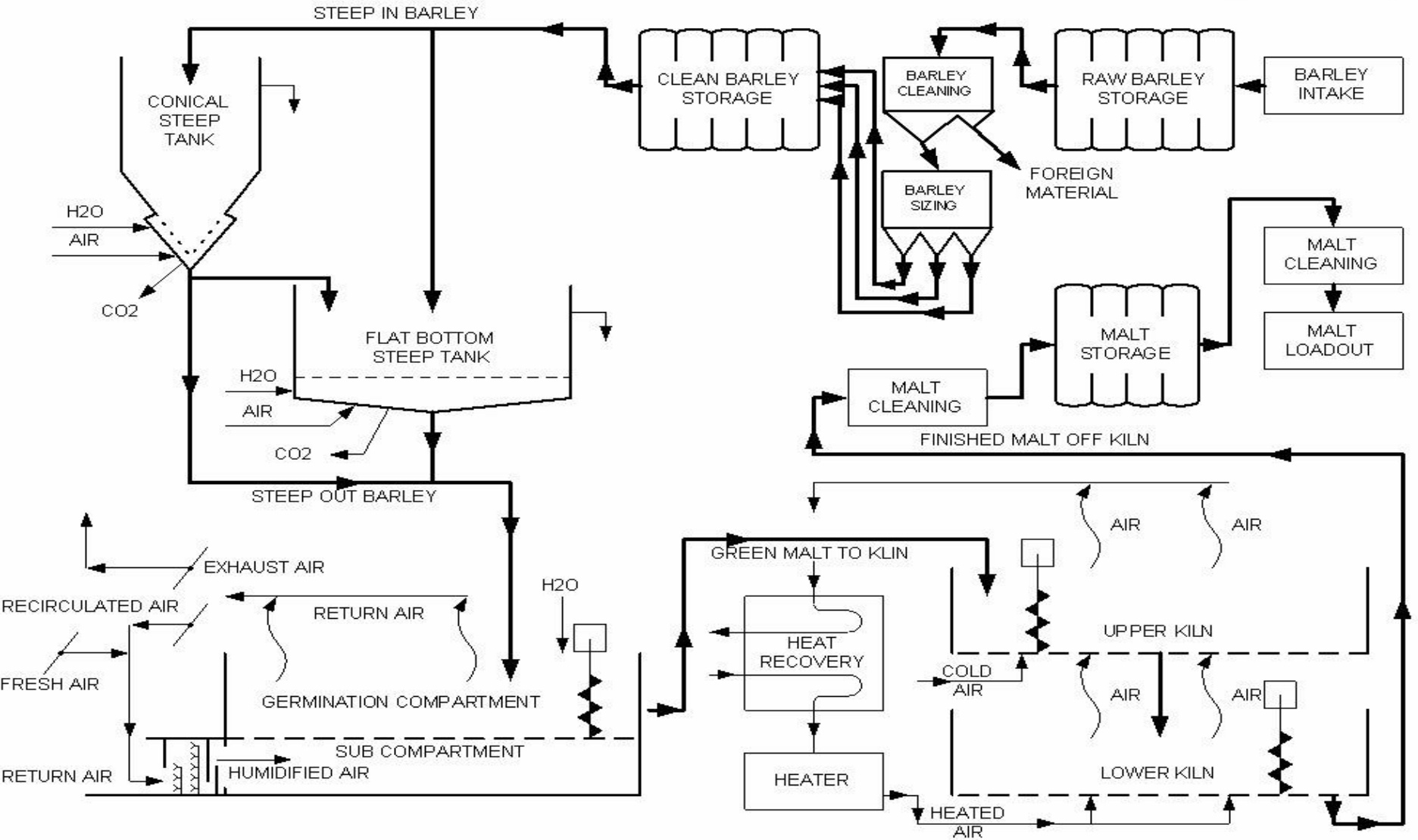
MALTING PROCESS FLOWSHEET

9 - 11 Day Process
45 Deg.F. → 180 Deg.F.



3 Steps in Malt Production

1. Steeping
2. Germination
3. Color & Flavor Formation:
   A. Kiln Drying
   B. Roasting

The Malting Process: Cleaning

Preparing the compartment

Perforated floors allow air to flow through the germinating barley, which is necessary for temperature control. Compartments are thoroughly, and manually, cleaned between each batch of malt.

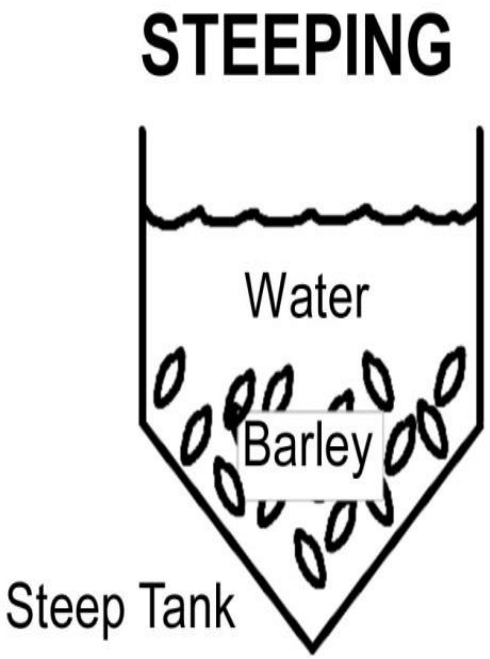
Ready for the next batch

After the compartment has been swept thoroughly clean, it is hosed down to remove any remaining chaff or kernels from the previous batch.

The Malting Process: Step 1

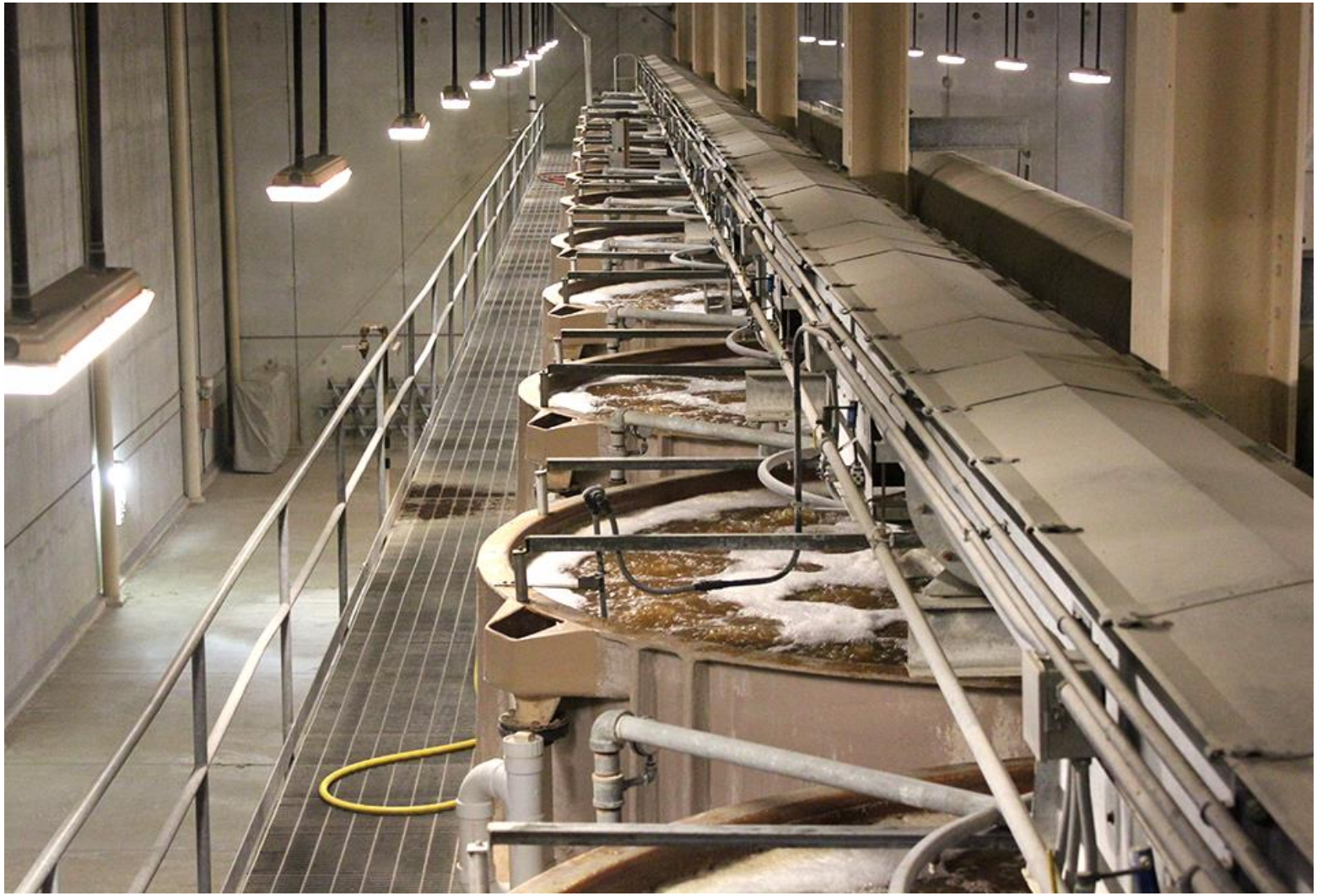
Steeping

Barley is alternately submerged and drained for 40-48 hours. This activates the embryo where production of hormones initiate enzyme development and growth of the rootlets.



Steep tanks - below

Steep Tanks - above



Objective of Steeping

- Bring moisture content up rapidly to ~30% which initiates metabolic activity.
- Provide aerobic conditions by supplying oxygen and removing CO_2
- Target a final grain moisture of 40 – 45% to ensure full hydration of the starchy endosperm material
- Obtain uniform primary rootlet development or "chitting" at steep out

The Malting Process: Step 2

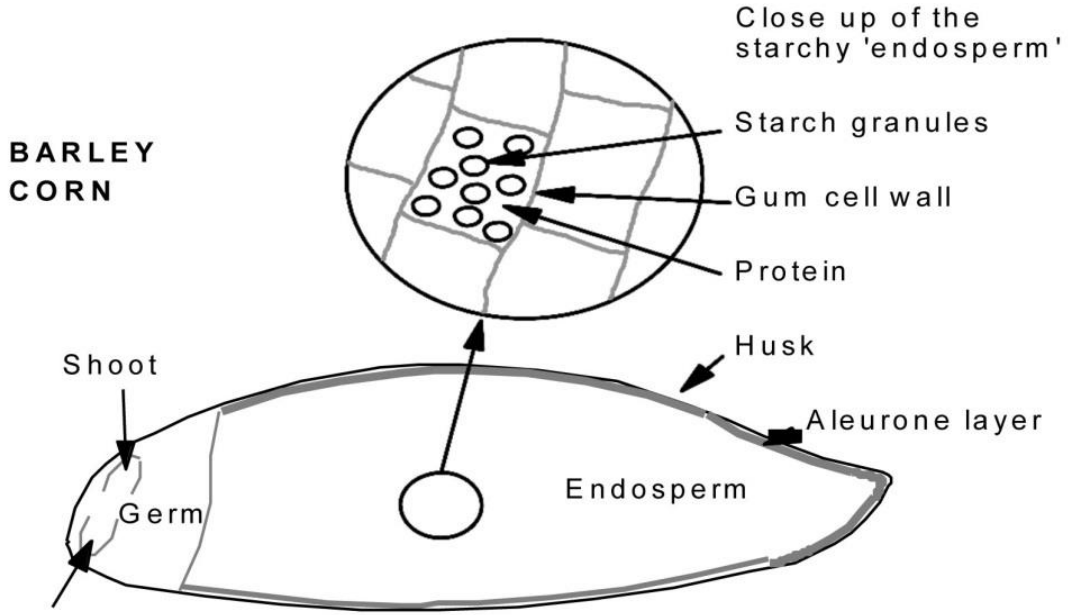
Germination

Germination continues in the compartment for 4 days where the acrospire develops and kernels undergo modification. Modification refers to the breakdown of complex proteins and carbohydrates which opens up the starch reserves.

Germination turning machine

Germination compartment

Objective of Germination



- The germ forms a rootlet (Chit), which stimulates the production of hormones – the kernel thinks it's time to grow a new barley plant!

- These hormones stimulate the production of enzymes in the aleurone layer which diffuse into the endosperm and break down the cell walls and protein matrix exposing the starch granules.

The Malting Process: Step 3

Drying

Drying on a **kiln** or in a **drum roaster** stops germination. Gentle kiln drying preserves enzymes necessary for brewing while developing malty flavors. Higher temperature applications results in more unique flavor development.

Handcrafting

Hands-on small batch production allows for variations in the moisture, time and temperature of the drying process which develops the unique flavor and color characteristics of each specialty malt.

From barley to beer

The color + flavor of specialty malts

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Kilned Base Malts

Sweet, delicate mild to mild malty

High Temp Kilned Malts

Lightly malty to intensely malty, biscuity

Roasted Caramel Malts

Sweet, mild to intense caramel, toffee, burnt sugar

Specially Processed Malts

Biscuity, toasty, nutty, woody, raisiny, prunes

Dark Roasted Malts

Rich roasted coffee, cocoa

Roasted Barley

Made from raw barley

Coffee, intense bitter, dry

- Pilsen (1.2 °L)
- Brewers (1.8 °L)
- Red Wheat (2.3 °L)
- White Wheat (2.5 °L)
- Rye (3.7 °L)

- Goldpils® Vienna (3.5 °L)
- Pale Ale (3.5 °L)
- Ashburne® Mild (5.3 °L)
- Bonlander® Munich (10 °L)
- Aromatic Munich (20 °L)
- Cherry Wood Smoked (5.0 °L)
- Mesquite Smoked (5.0 °L)

- Caramel 10-120L
- Caramel Vienne 20L
- Caramel Munich 60L
- Caracrystal® Wheat (55 °L)
- Carapils® (1.5 °L)

- Victory® (28 °L)
- Special Roast (40 °L)
- Extra Special (130 °L)

- Carabrown® (55 °L)
- Chocolate (350 °L)
- Dark Chocolate (420 °L)
- Black (500 °L)
- Blackprinz® Bitterless (500 °L)
- Midnight Wheat Bitterless (550 °L)
- Roasted Barley (300 °L)
- Black Barley (500 °L)

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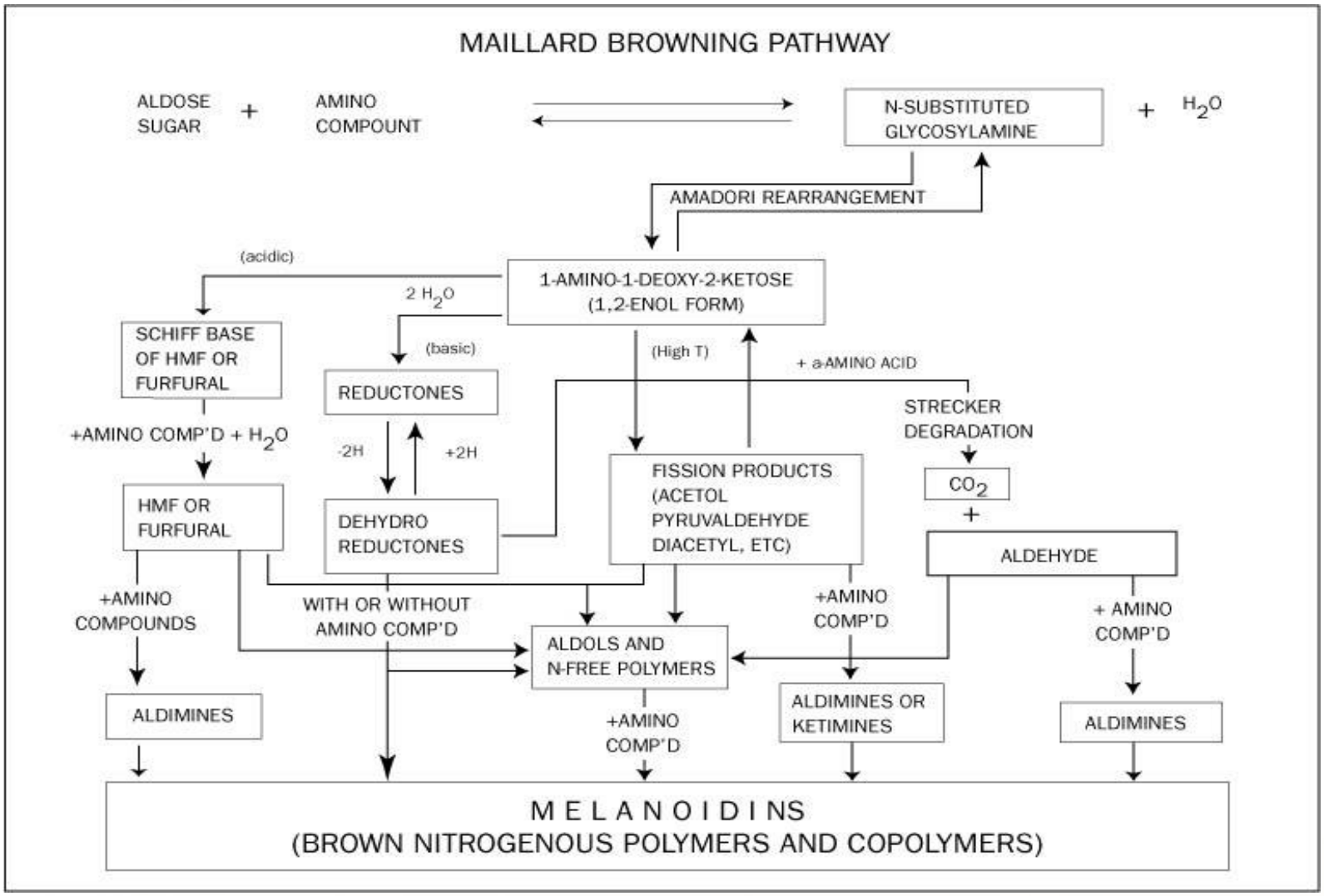
Objectives of Kiln Drying

- Stop growth and modification
- Create shelf stability by removing moisture to 4-5%
- Keep naturally developed enzymes “alive” and active for later use during mashing in the brew house
- Create colors, and “Malty” flavors and aromas through *Maillard reactions* at low to medium heat

Reducing sugar + amino acid, begins at 110F and best with moisture at 5-15%

Maillard Browning Pathway



Kiln Produced Base or Specialty Malts

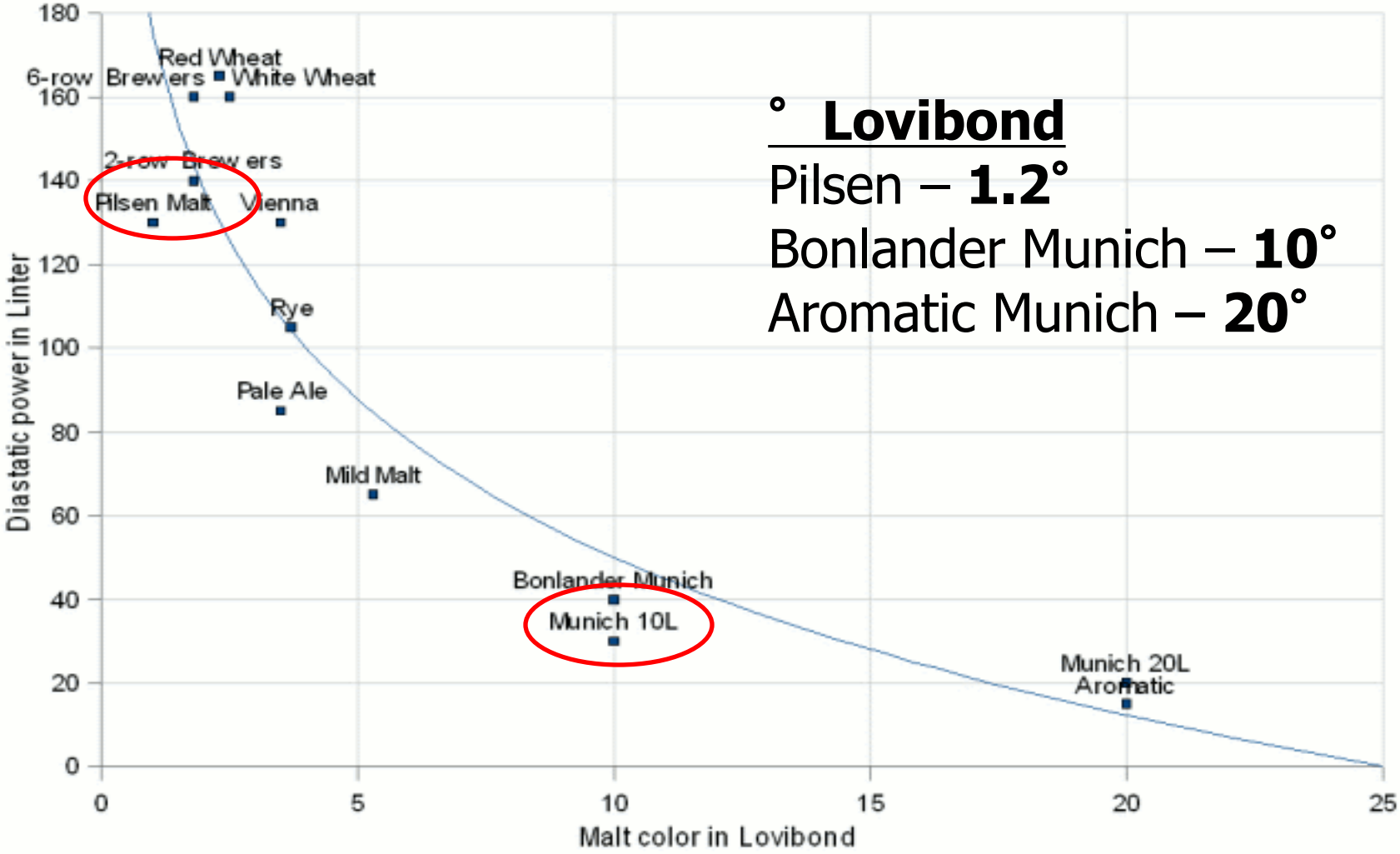
Objectives?

- ✓ Stop growth and modification
- ✓ Create shelf stability by removing moisture
- ✓ Keep naturally developed enzymes active for later use in mash program

Kiln = large batches @ temps of 120F - 240F for 24 - 48 hours.

- ❖ Flavor: Neutral to Slightly Sweet, Malty, Biscuity, Intense Maltiness
- ❖ Color: 1.0 – 20L
- ❖ Kernel Characteristics: Mealy (powdery) with maximum enzyme preservation
- ❖ Provide fermentable starches, sugars and amino acids needed by yeast for fermentation

Enzyme vs. Color



° Lovibond

Pilsen – **1.2°**

Bonlander Munich – **10°**

Aromatic Munich – **20°**

Roaster Produced Specialty Malts

Objectives?

- ✓ Stop growth and modification
- ✓ Create shelf stability by removing moisture
- ✓ Create unique colors, flavors and aromas at high temperatures (Mailliard and/or caramelization)

Roaster = small batches @ temps of 120F – 750F for 2 – 4 hours

- ❖ Flavor: Intense sweetness, Toffee, Caramel, Roasty, Raisin, Molasses, Nutty, Toasty, Woody, Chocolate, Coffee
- ❖ Color: 10 – 140L for Roasted Green; 25 – 500+L Dry Roasted
- ❖ Kernel Characteristics: Full mealiness to full glassiness
- ❖ No enzymatic activity and is higher in non-fermentables

Drum roaster

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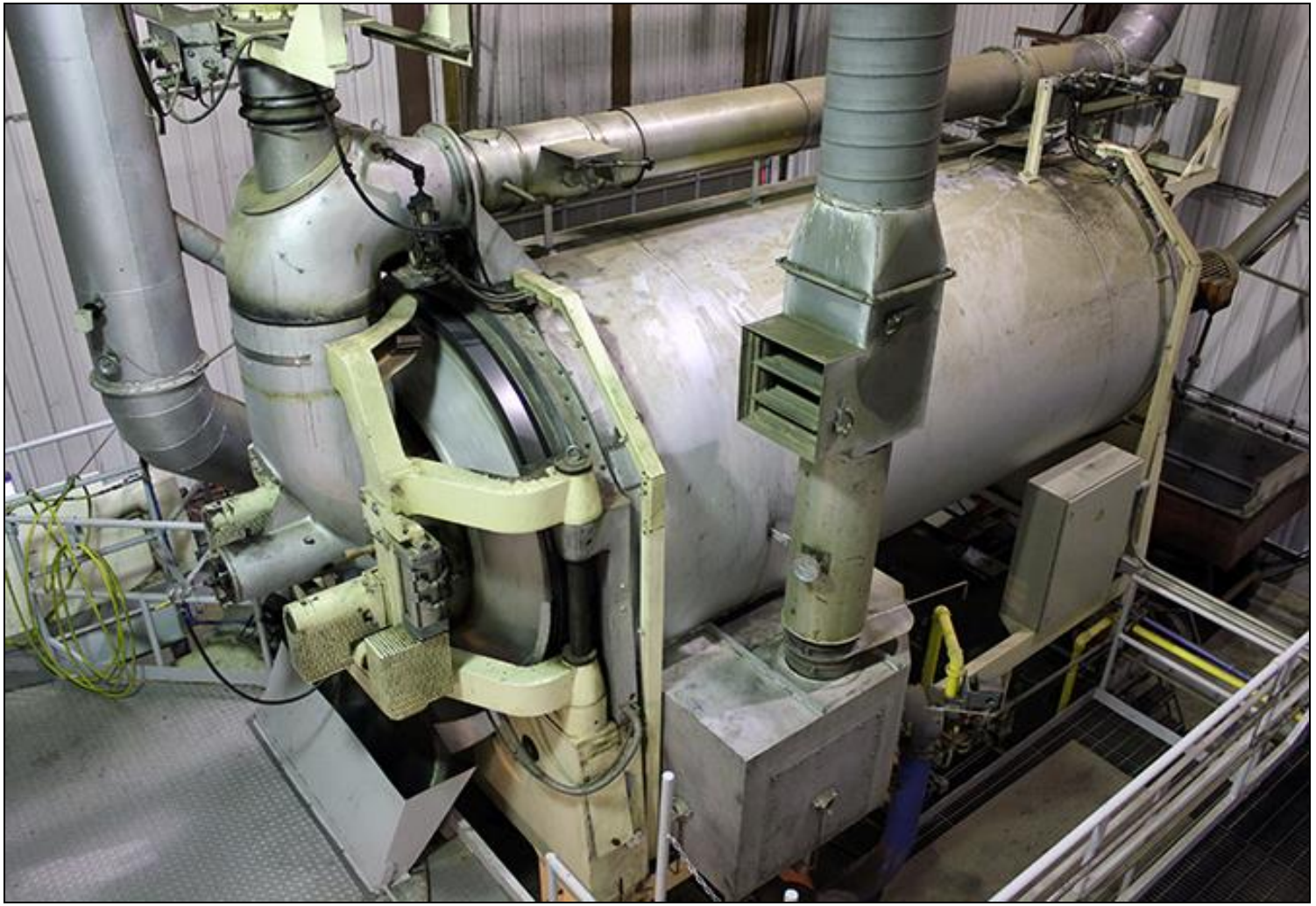
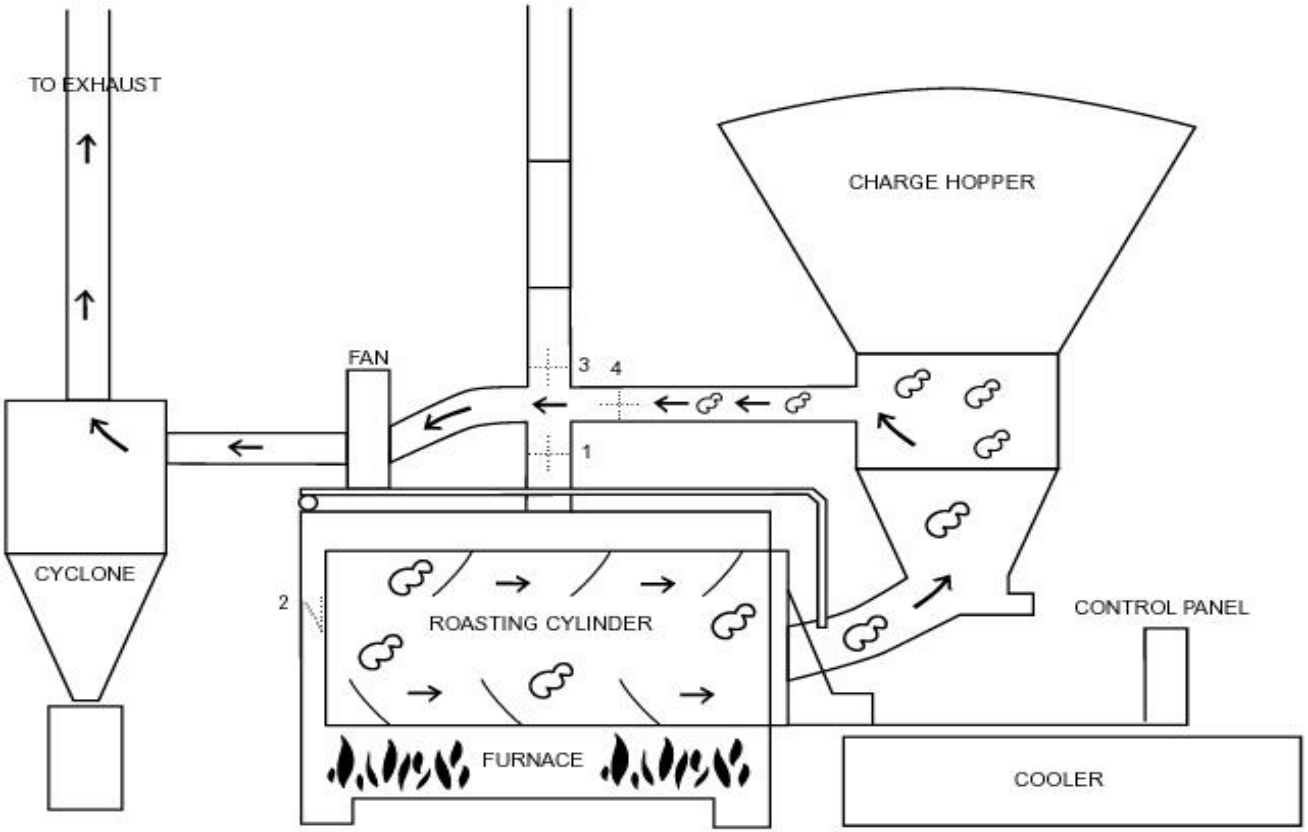
Drum roaster



Pulling samples from a drum roaster

Drum Roaster

Typical Drum Roaster Diagram



A TYPICAL ROASTING DRUM

Why Are Roasters Needed to Produce Some Specialty Malt Styles?

Major differences between Kilns and Roasters

- Engineering Design
- Efficiency and Heating Capacity
- Kernel Uniformity Within Batches
- Product Mixing Capabilities
- Moisture Retention Capability

Kiln vs. Roaster Engineering Design

Kiln

- A typical kiln is a large room with a heat source below the bed of malt and a suction fan at the top.

Roaster

- A roaster is a relatively small machine that houses a rotating steel drum. The burner is designed to apply heat directly to the drum and also to a small expanse of air (about a 4” gap) circulating between the housing and the drum.

Kiln vs. Roaster
Efficiency & Heating Capacity

Kiln

- Designed to economically heat and dry large batches, (typically 200,000 – 800,000 lbs), at high fan speed, relatively low applied temperature (120º - 240º F maximum) and batch times of 24 - 48 hours. *In summary, low temperature, long heating time and slow drying of large batches.*

Roaster

- Designed to rapidly heat small batches, (typically 5,000 – 10,000 lbs), at lower fan speed, widely variable applied temperature (120º - 750º F maximum) and batch times of 2-4 hours. *In summary, high temperature, short time intense heating and drying of small batches.*

Kiln vs. Roaster
Product Mixing and Uniformity

Kiln

- *Relatively inefficient* – turning machines used to mix the malt require 1-2 hours to move through the entire bed and studies have shown that at least 3 passes or more are needed to completely turn grain from bottom to top.
- *Kilns tend to promote non-uniformity* – kernels at the bottom of the bed dry faster and thus heat up and begin developing color before kernels at the top – a drying and heating "front" develops from the bottom to the top of bed. **This effect is magnified with increasing color targets.**

Roaster

- *Extremely efficient* – complete mixing within a couple of drum revolutions occurs in a matter of seconds.
- *Highly uniform* – the drum continuously rotates at ~20-30 RPM and paddles attached to the inner portion of the drum constantly mix the malt, providing uniform heat application, drying and color formation throughout the batch.

Kiln vs. Roaster Moisture Retention

Kiln

- Kilns are designed to dry, not to retain moisture. If attempting to re-circulate moist exhaust air to retain kernel moisture, the return air must be re-heated by passing over the burner, which in turn reduces the relative humidity and increases the drying capacity of the returned air.

Roaster

- Highly versatile – to retain moisture, heat is applied only to the drum and hot air is not passed through the malt allowing for nearly complete retention of the moisture liberated during heating – only enough saturated air is allowed to escape to prevent excessive pressure buildup. During the drying phase, dampers are reversed, allowing air and moisture to escape from the drum through a fan and cyclone system.

Categories of Roasted Specialty Malts

Roasted Green Malts

- Caramel Malt
- Extra Special Malt
- Caramel Munich Malt
- Caramel Vienne Malt

Dry Roasted Malts

- Victory Malt
- Special Roast Malt
- Chocolate/Dark Chocolate Malt
- Black Malt

Dry Roasted Grains

- Roasted Barley
- Black Barley

3 Main Steps in Caramel/Crystal Style Malt Production

Green Malt is taken directly from the germination compartment at 40+% moisture and goes through the following steps in the Roaster:

- Conversion
- Dehydration
- Color & Flavor Formation
- **"All crystal malts are caramel (type) malts, but not all caramel malts are crystal malts"**

Conversion

Mashing Within Each Kernel of Green Malt

Unique to Caramel Style Malts

- Rapidly increase and hold malt temperature to Beta and Alpha Amylase enzyme optimum temperature of 60º-70ºC (140-160ºF)
- Beta and Alpha Amylase rapidly convert starch into Maltose Sugar at their optimum temperatures
- Critical to maintain high moisture content during temperature hold to allow enzymatic breakdown to continue and starches to be fully converted to sugars

Malt Samples

- KILN - Aromatic Munich 20L malt
  - European-style Munich Malt with clean, slightly sweet, rich malty flavor – DP 40 - mealy

- ROASTER - Caramel 20L
  - Candylike sweetness with a mild caramel flavor – 0 DP - glassy

THANKS!

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david.richter@briess.com

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