Barley Improvement Conference San Diego 2015

"One Brewer's Observations On Malt Flavor"

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Tonight's Talk Abouts

- Does barley variety make a difference in malt flavor?
- Winter malt vs. Summer malt
- English Pale Ale malt
- Color and enzyme impacts of flavor development
- Challenges to flavor execution in the malt plant
- Did Klages have a better flavor than AC Metcalfe?
- Suggested next steps for the interested parties

Does Barley Variety Make a Difference in Malt Flavor?

- Possibly, I simply do not know
- What I do know:
  - If they exist, variety driven flavor differences are very small
    - Wort tasting indicates malt plants have a signature, not varieties
  - If they exist, the execution of variety flavor differences through breeding is a long way off due to the typical breeding timeline
  - Heat applied, length of time of application, and the moisture level during application are the important flavor drivers on the kiln
  - Total protein level and degree of modification are important drivers of flavor development prior to kilning

Academically proven might not be process meaningful! If malt flavor is really process critical to you, can you wait 12-15 years for a small difference?

Winter Malt vs. Summer Malt

- Malt differences driven by seasonal changes in ambient temperature and relative humidity that cannot be offset with malt plant kiln capabilities
- Characterized as:
  - Summer malt – higher color, lower DP and ***more flavor***
  - Winter malt – lower color, higher DP and ***less flavor***
  - Typical differential - .5 ^{o}L color and 15 units DP
  - Summer malt described as slightly more sweet, more malty, fuller, with less green, grassy notes
  - Winter malt described as bland and featureless

Differences reveal a pathway to increased flavor and why pale lager malts might not have a preferred flavor

The Four Drivers of Kilning Rate

Time, Applied Heat, Airflow, Ambient Humidity

Drying rate is influenced by the capacity of ambient air to remove water and seasonal humidity is outside of the maltsters control

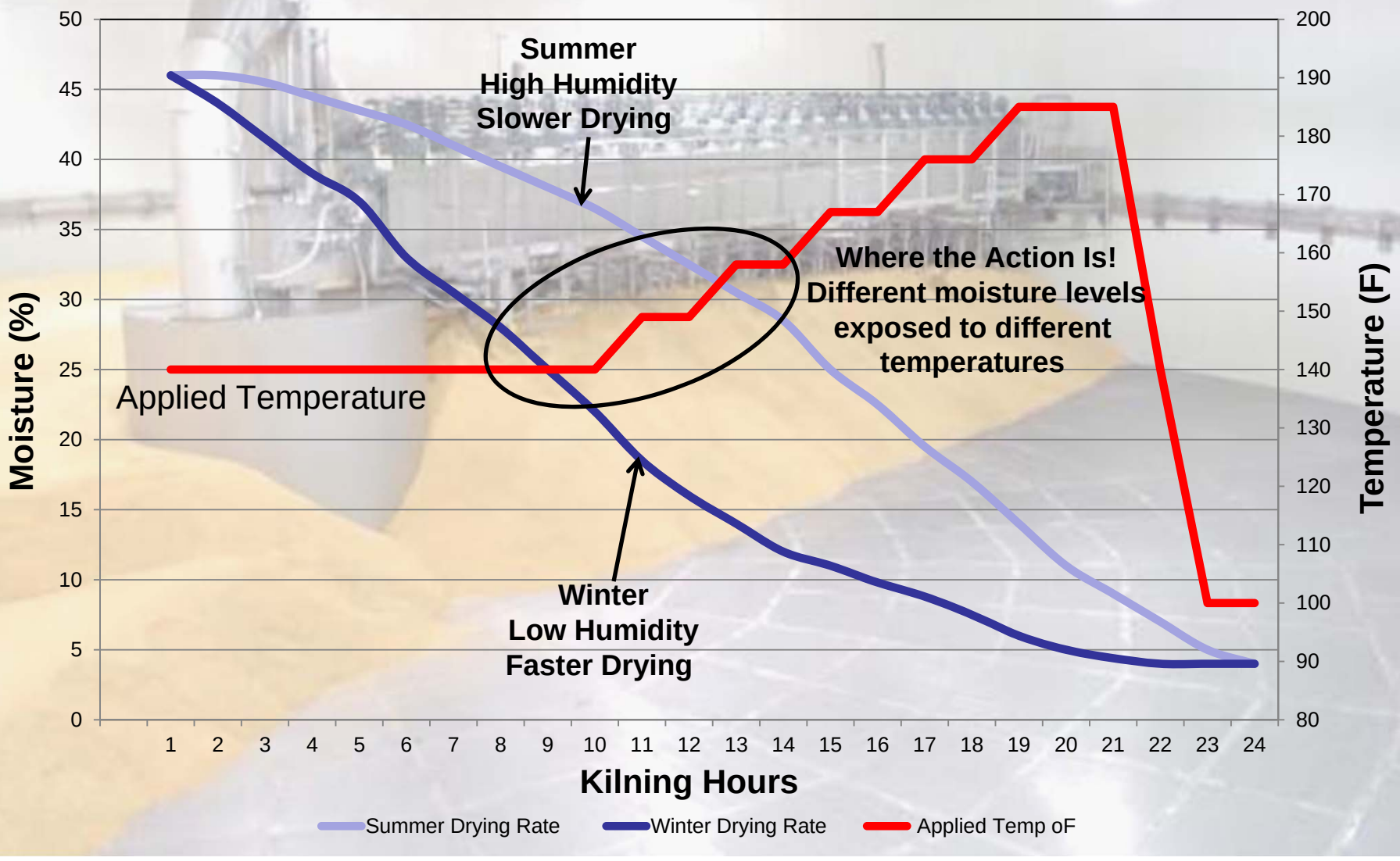
After time and final moisture are fixed, either airflow or heat must be altered to complete the drying on time

Time	x	*Applied Heat*	x	*Airflow*	x	*Ambient Air Humidity*
Maximum time is limited by malting schedule		Temperature is a key quality driver		Changes require variable speed fans		An atmospheric variable out of maltster control

When airflow cannot be altered, the applied heat profile must be altered and seasonal malt occurs

Preferred control is in higher humidity conditions, hold the applied heat profile constant and to increase the airflow

Drying Rate Illustration

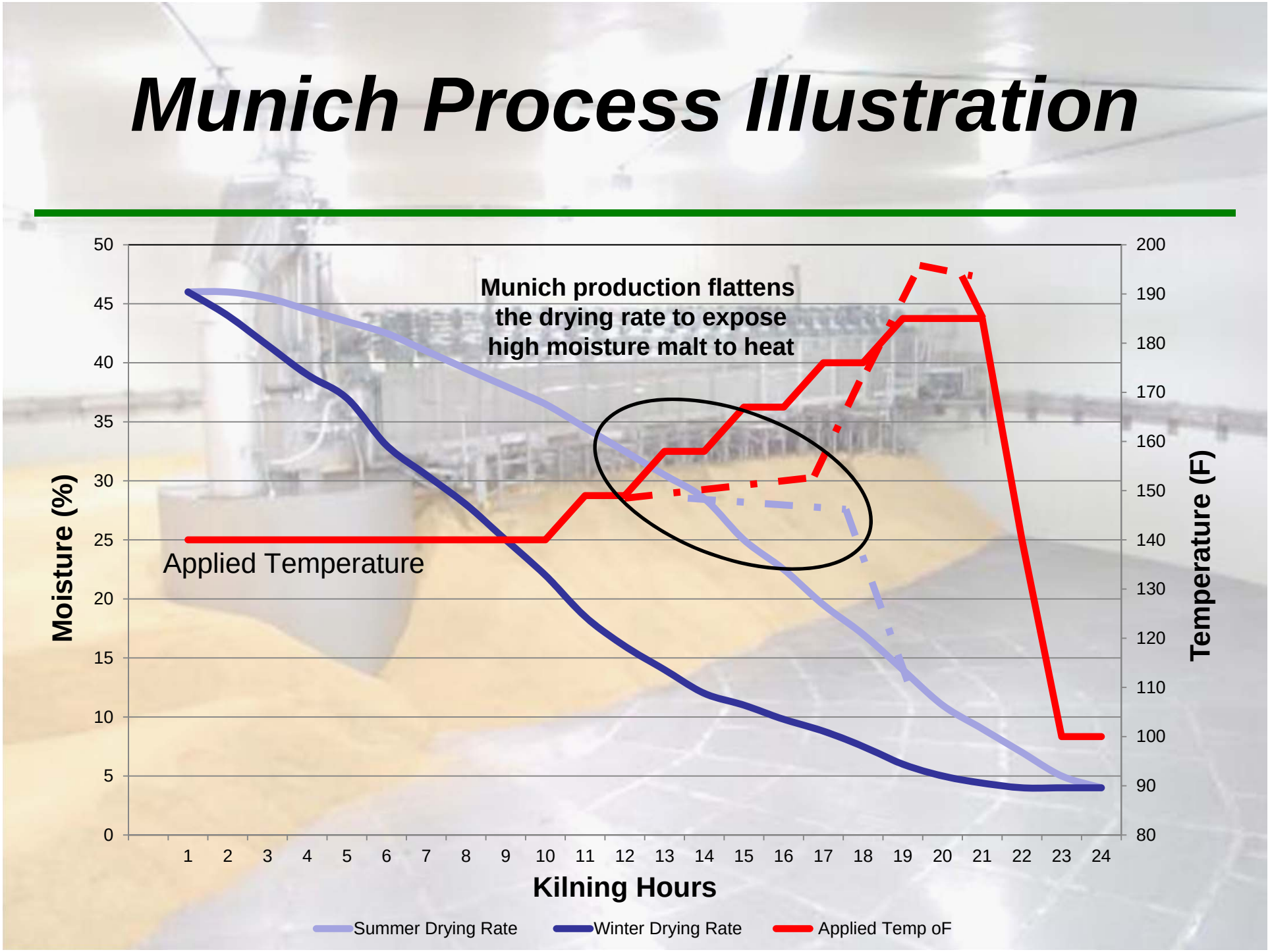


Summer Malt and Munich Malt

- Classic Munich malts are produced by holding moisture in the kiln with exhaust recycle to promote melanoidin precursor formation prior to curing
- Process detail:
  - Heat malt to 149-156°F (65-69°C) while moisture >20%
  - Maintain the temperature and moisture for a hold period
  - Final cure at 210°F (99°C)
- Characterized as:
  - 7-10°L (14-20 EBC) color and 45 units DP
  - Flavor described as aromatic with honey like, sweet and intense malty flavor notes

Summer malt simulates a "mini Munich" malt, with the flavor impacts of higher melanoidin precursor formation

Munich Process Illustration

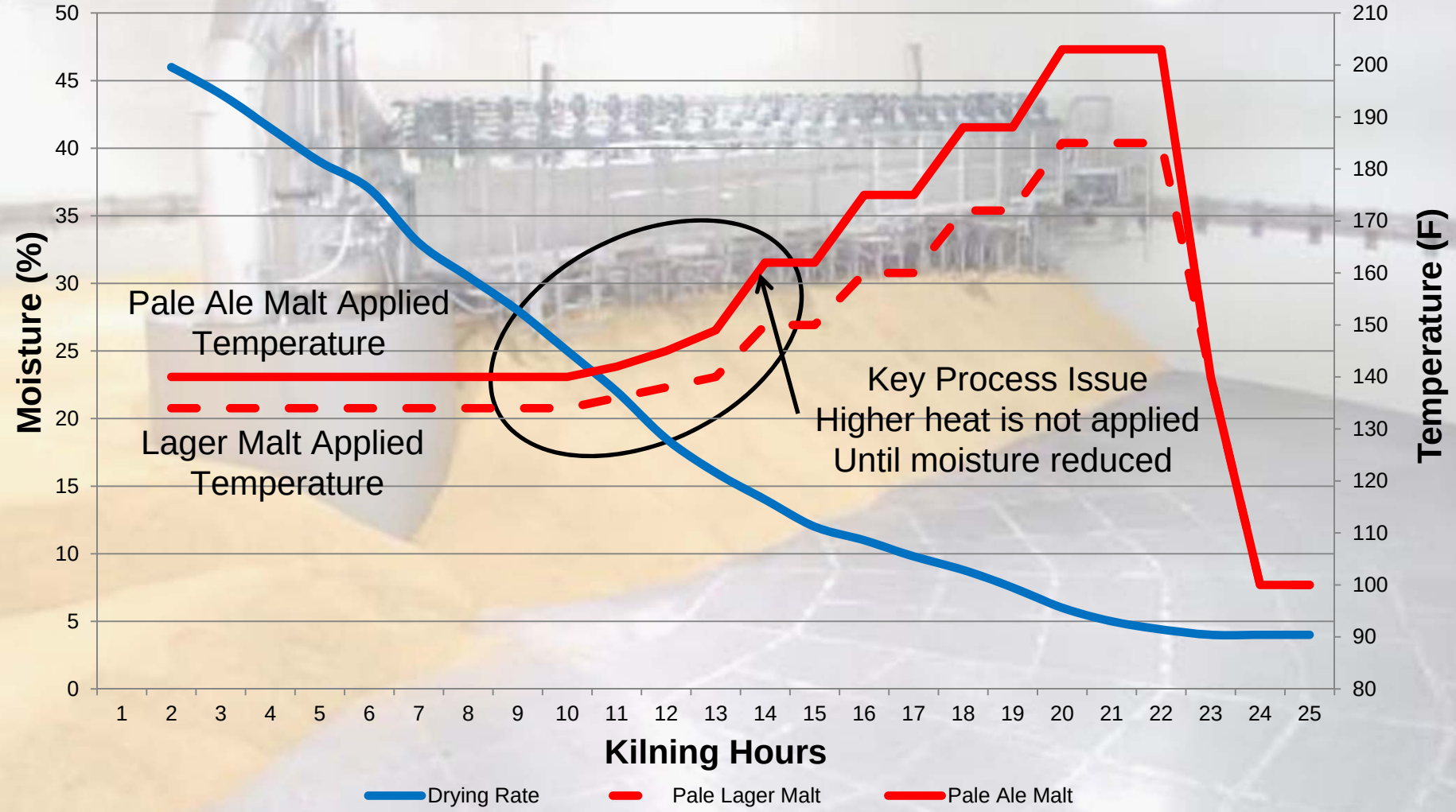


Lager Malt vs. Pale Ale Malt

- Flavor differences driven by a very different kiln curing profile, with elevated temperatures *only* after the withering phase moisture has fallen below 15%, avoiding any melanoidin precursor formation
- Characterized as:
  - Lager malt – lower color, higher DP and higher moisture
  - Pale Ale Malt – higher color, lower DP and low moisture
  - Pale Ale Malt – typically cured to 3.0-3.5% moisture
  - 1.0°L (2.0 EBC) higher color and 30 units lower DP
  - Pale Ale malt described as toasted, biscuity and nutty (very different flavor descriptors than sweet and aromatic)

Pale ale malt reveals another pathway to an increased but very different malt flavor

Lager vs. Pale Ale Malt Kilning Illustration



English Pale Ale Malt

- Classic English Pale Ale malts are produced with an aggressive curing cycle applied only after reaching a low moisture during withering
- Process detail:
  - Wither with applied air below 140°F(60°C) until break
  - Then heat to final curing and cure with several hours above 195°F(91°C) including time at 220°F(104°C)
- Characterized as:
  - 2.7-3.0°L (5.3-5.9 EBC) color and 50-60 units DP
  - Flavor described as toasted, biscuity and nutty
  - Similar outcomes as Vienna malt and Hidried malt

Pale Ale malt represents the flavor impact of aggressive kiln curing on "normal" melanoidin precursor formation

Definitions and Distinctions
The Three True Malt Types

- Pale Malt (Lager Malt) - <1.8ºL (<3.5 EBC)
  - **Process Emphasis** – limited melanoidin precursor formation, enzyme preservation, low color, final cure does not exceed 185ºF (85ºC)
  - **Flavor Description** – no trace of melanoidin flavor, some green notes, and weak aroma
  - *European Pilsner malt , English Lager malt, "our" two row pale malt*
- Munich Malt - >7ºL (>14 EBC)
  - **Process Emphasis** – promote melanoidin precursor formation with high moisture "stewing", final cure must exceed 195ºF (91ºC)
  - **Flavor Description** – malty sweetness, very aromatic
  - *Light and dark Munich malts, Melanoidin malt, Aromatic malt*
- Pale Ale Malt - >2.5ºL (>4.9 EBC)
  - **Process Emphasis** – limited melanoidin precursor formation, aggressive heat up and cure after withering, final cure must exceed 195ºF (91ºC) and can reach 220ºF (104ºC)
  - **Flavor Description** – toasted, biscuity, no trace of raw grain flavor
  - *English Pale Ale, European Vienna, American Hidried*

What Else Do We Know?
Color and Enzyme Impacts

- Flavor and color are linked through melanoidin precursor formation and heat impacts on them and they cannot be totally separated
- ***More malt flavor requires that we give up the concept that pale malt should be <1.8ºL (<3.5ºEBC) on North American barley***
- Enzymes are destroyed by the additional heat required to create flavor and additional heat at high moisture accelerates enzyme destruction
- North American malt DP is abundant at 475 WK (140 ASBC)
  - Euro pale malt standard - >200 WK (62 ASBC)
  - Euro pale typical shipment – 280 WK (80 ASBC)
  - Euro Munich - 45 units lost DP, cannot be used as base malt
  - UK Pale Ale Malt - 30 units lost DP, can be used as base malt
  - ***N.A. two row has plenty of DP to "give up" for flavor***

Not possible to make flavorful malt with low color and high enzyme

Challenges to Flavor Execution in the Malt Plant

- Malt flavor is not currently defined by a quantitative specification
- Absent a quantitative flavor definition, maltsters will run their kilns to stay on schedule, to be energy efficient, and to hit the specifications “numbers” they have, moisture, color, and DP
- Flavor improvement requires a precise dialog on the specific flavor goal and a narrative specification to cover kilning
- Some kilns do have equipment limitations – (16 - >10 of 38)
  - Single deck kilning is easier to manage than double deck
  - Not all kilns have variable speed fans
  - Not all double decks kilns have hot air bypass
  - Not all kilns can apply the temperatures needed (>195^{o}F)
- Malt plants do not like and will always resist any increase in the number of process recipes and SKUs

Kiln Equipment Requirements
The Three True Malt Types

- Evaluation of color and diastatic power are not enough to totally define malt types, the true types are fully defined by kiln processing

	German Pilsner English Lager Typical N.A. Pale	English Pale Ale European Vienna	German Munich Melanoidin Aromatic
Is kiln recycle required?	**NO**	**NO**	**YES**
Final cure applied requirements	**176-185°F (80-85°C) 185°F (85°C) is needed to depress DMSP and to destroy all LOX**	**195-220°F (91-104°C) Must exceed 195°F (91°C)**	**212-220°F (100-104°C) Must exceed 195°F (91°C)**
Kiln configuration comments	**Well suited for double deck kilning All N.A. kilns can make this malt**	**Better suited for single deck kilning Some N.A. kilns can make this malt**	**Better suited for single deck kilning Only a few N.A. kilns can make this malt**

If you are seeking "true to type" flavor, you must pursue "true to type" process!

Munich or Pale Ale Direction? There is a Third Flavor Pathway

- Does any of this pale base malt discussion make a bit of difference? Are the flavor intensity differences large enough for your needs?
- *"Pale base malt is the canvas we paint on….."*
  Wayne Wambles, Cigar City Brewing
- We paint on the pale malt canvas with high kilned malts, roasted malts, additional grains, and a wide variety of hops, both boiled and cold applied
- Doesn't the intensity of the range of flavors that can be created from these opportunities totally smother the pale malt flavor contribution?

Basic Malt Flavor Pathways

	Potential Range of Flavor Intensity	**Timing to Achieve**
Build Recipes Outside of Pale Malt	Vast	Start Tonight
Intensify Pale Malt Flavor in the Malt Plant	Modest but Meaningful	1-3 months
Flavor Improvement Through Breeding	Small to Negligible	12-15 years

A brewer has to assess which pathway best serves his product, both in degree of flavor intensity and in timing

Did Klages Have a Better Flavor Than AC Metcalfe?

- Possibly, but not due to barley genetics
  - We reject the premise that *"new varieties were selected for flavor neutrality over several decades"*
- European kilning profiles still include applying 180-185^{o}F (82-85^{o}C) for 3-5 hours. On lower protein, lower Kolbach green malt, this allows elimination of green, grassy notes, DMSP reduction, LOX destruction, ***and a low color.***
  - Currently threatened by thiobarbituric acid (TBA) initiatives
- We propose that the progressive increases in the proteolysis required for N. A. two-row has forced maltsters to subtly alter kilning profiles to maintain a color below 1.8^{o}L (3.5 EBC)
- On the European typical kiln cycle, higher North American total protein and Kolbach ratios cannot produce malt that is <1.8^{o}L (<3.5 EBC)

Did Klages Have a Better Flavor Than AC Metcalfe?

	N. American Two- Row 1960s	N. American Two- Row 1980s	N. American Two- Row Today	European Two-Row Today
Total Protein	11.0	12.2	12.4	10.4
S/T Ratio	38.0	43.5	47.4	40.9
Soluble Protein	4.2	5.3	5.9	4.3
FAN	*	210	240	138
Diastatic Power	90	135	160	80
Beta Glucan	*	120	95	180
	Betzes Hannchen	Klages Harrington	AC Metcalfe CDC Meredith	Grace Propino

* Not available

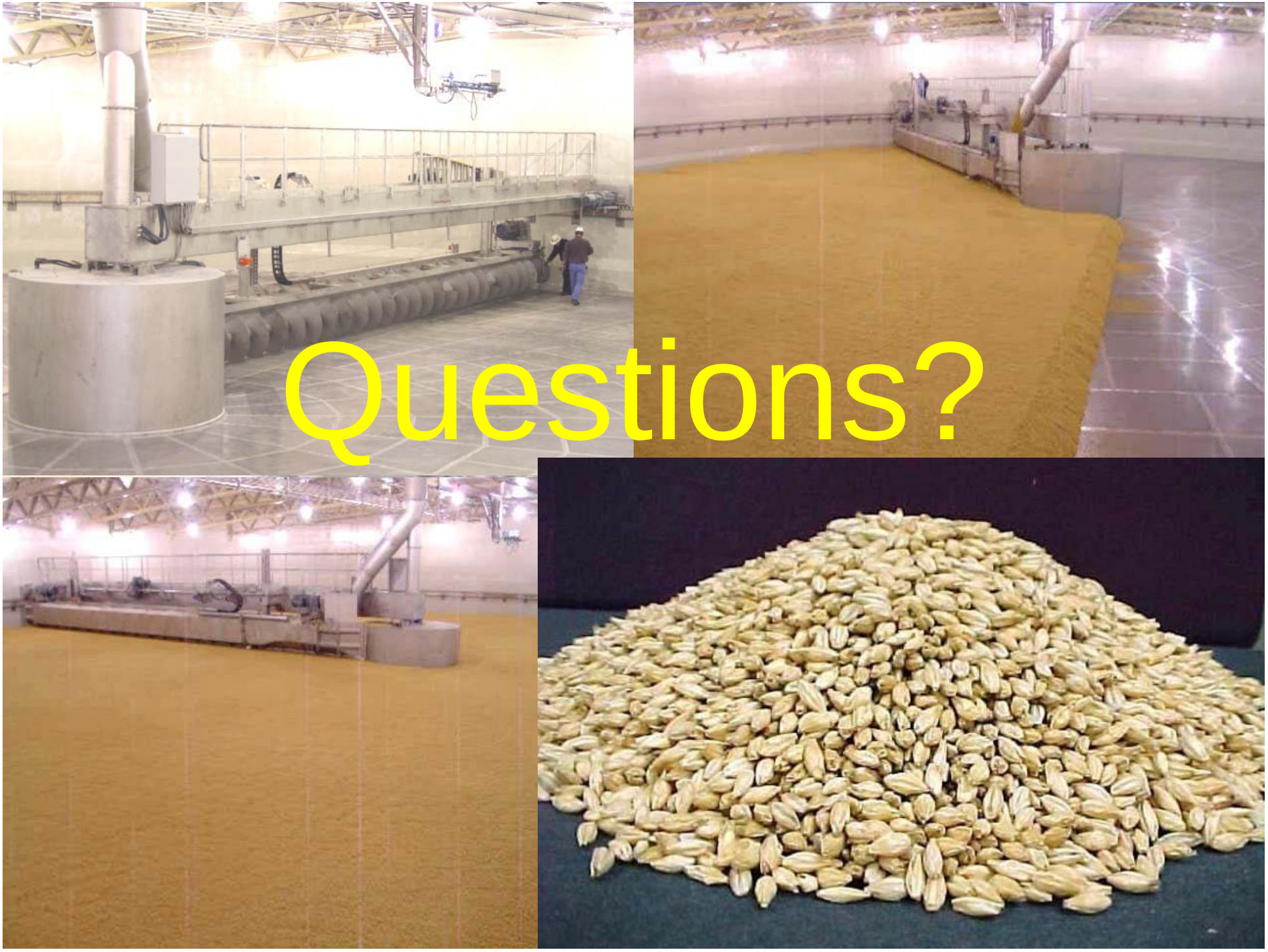
Premise: It is not possible to apply an identical kilning regime To these protein and Kolbach differences and to achieve the same color outcome, therefore, altered kilning is necessary achieve <1.8°L (<3.5 EBC) and flavor outcomes have changed

Summary

What should the interested parties be doing?

- Brewers:
  - Become expert wort tasters
    - It is a necessary “learn by doing” project
  - Refine your desired flavor goal, what are you seeking?
  - Give up the concept of 1.6-1.8ºL (<3.5 EBC) pale malt
  - Engage in comprehensive dialog with your malt supplier
- Maltsters:
  - Listen closely to your brewer customer
    - Why are there 49,000 tns annual non roasted malt imports?
  - Educate your brewer customer on the kilning process
  - Don’t tell a brewer what he can’t have, tell him the implications of what he wants

“When theory and practice disagree, practice prevails”, M Meilgaard
As long as barley variety flavor traits are theory, the knowledge of malt plant processing must prevail as practice in the search for malt flavor


Questions?