



***BREWING LAGER BEERS***

**Corey Magers**

**Society of Barley Engineers**

**12/2/2015**

# Why Brew Lagers?

- Supremely poundable
- Delicious and pair well with a variety of foods
- Clean fermentation character allows ingredients to shine
- Don't hide flaws → improve faster as a brewer. Moar Gainz!
- They just look good



# What is a Lager?

- German for “store-room” or “warehouse”
- Hybrid bottom fermented yeast: *Saccharomyces pastorianus*. Able to ferment at cool temperatures. Can metabolize more complex sugars (maltotriose) than *Saccharomyces cerevisiae*
- Cool, slow fermentation at ~50°F minimizes esters, higher alcohols, and fermentation byproducts



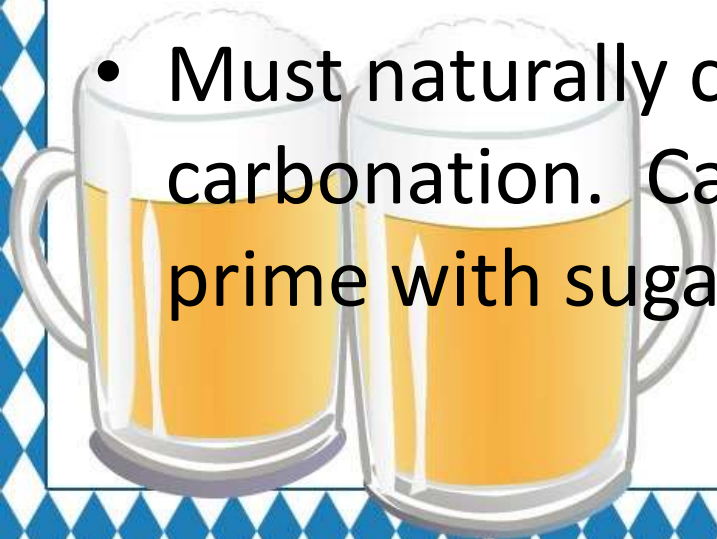
# What is a Lager?

- Extended cold storage at  $\sim 30-41^{\circ}\text{F}$  (lagering) for 3 weeks to 6 months
- Maturation can be warm or cold
- In the glass, a lager has a clean fermentation profile, has excellent clarity, and has good shelf stability



# Reinheitsgebot

- German Beer Purity Law, adopted in Bavaria in 1516
- Only allowable ingredients are water, barley, and hops. Oh, but yeast is allowed too nowadays.
- Must naturally carbonate, no forced carbonation. Can't use most finings. Can't prime with sugar. Can't add acids to mash.





## **Beer anarchy! Reject the Reinheitsgebot!**

- The law was created to ensure availability of wheat and rye for bread, and to protect Bavarian brewers from outside competition
- It helped shape the German beer styles, but is of little use to modern brewers.
- Feel free to use finings, to force carbonate, and to bottle condition with sugar. Most homebrewers will increase their beer quality using modern methods.

# ***INGREDIENTS***



# Ingredients: Malt

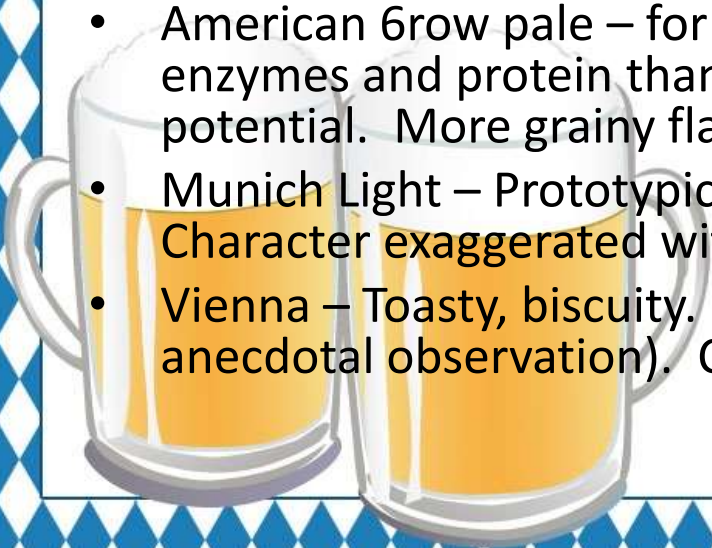
- Lager flavors and aromas are ingredient driven, use high quality ingredients!
- Download malt specs from interwebs
- Kolbach Index (aka Soluble Nitrogen ratio [SN]) – refers to the degree of malt modification, <40% is fully modified but could benefit from protein rest. >40% is highly modified, no protein rest.
- Large malting houses sell fully modified malt (>36%). For less modified malt, source through a craft maltster.
- German/czech pilsner malts generally have more DMS precursors (cooked vegetable) than Belgian or American malts





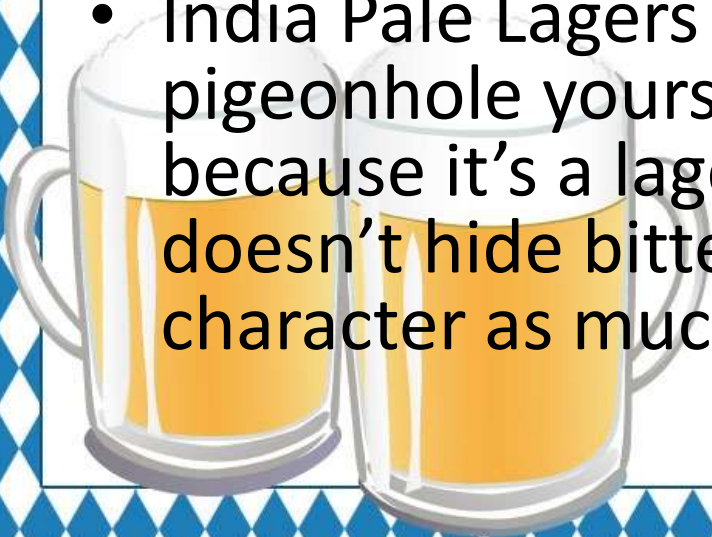
# Ingredients: Base Malt

- German pilsner – good all-around malt for german and czech style lagers, fully modified but can survive a short protein rest.
- Czech floor-malted Bohemian pilsner – similar to German pilsner malt but slightly less modified and sweeter, honey-like.
- Belgian pilsner – lightest pilsner malt, crackery/grapey. Similar modification level to German pilsner.
- American pilsner – less distinct flavor profile. Highly modified.
- American 2row pale – golden/corny color, looks “American”. For American/Mexican lagers. Highly modified.
- American 6row pale – for American/Mexican adjunct lagers. More enzymes and protein than 2row for converting adjuncts but less extract potential. More grainy flavor than 2row. Highly modified.
- Munich Light – Prototypical “malty” character. Sweet, bready, grape nuts. Character exaggerated with decoctions. Can convert itself.
- Vienna – Toasty, biscuity. Can be a little harsh in large quantities (my own anecdotal observation). Can convert itself.



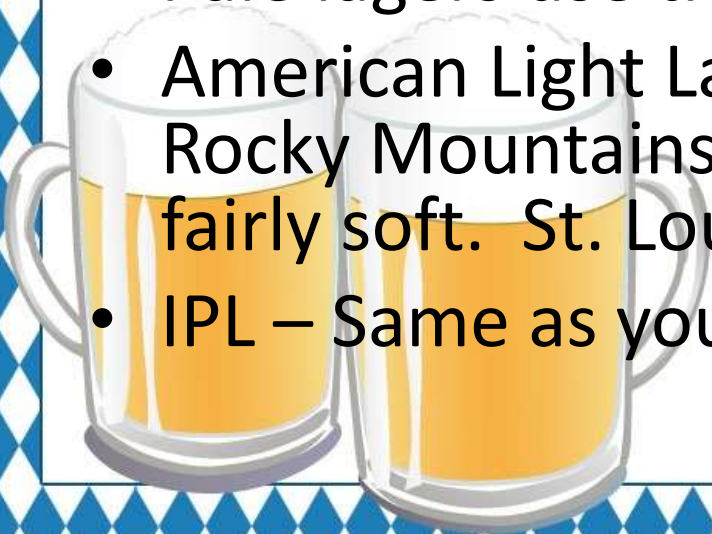
# Ingredients: Hops

- German lagers – Noble hops like Hallertau Mittelfruh and Tettnang for aroma, Magnum or Perle for bittering
- Add some late boil aroma hops, we live in San Diego after all
- Czech Pilsners – Saaz.....lots
- India Pale Lagers – Whatever you want, don't pigeonhole yourself into using noble hops just because it's a lager. Clean yeast character doesn't hide bitterness and grassy dry hop character as much as an IPA.



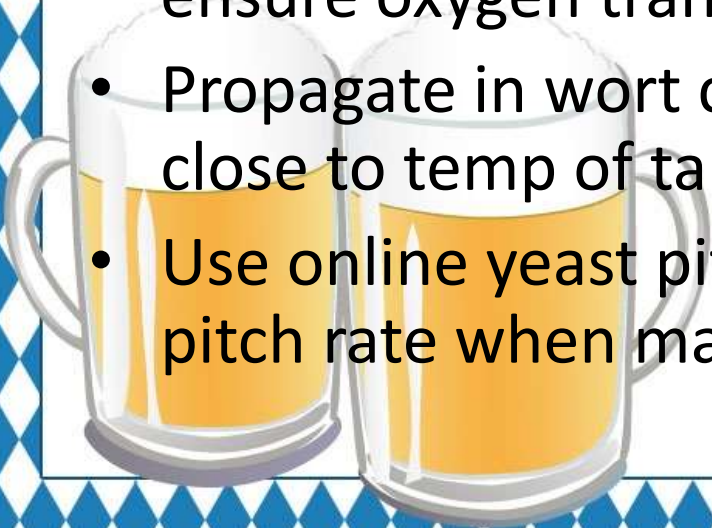
# Ingredients: Water

- Czech Pilsners – Very soft water. Use enough calcium to convert your mash. Don't waste your time with an acid rest, add some phosphoric acid to bring your mash pH down.
- German Lagers – More carbonates, better suited for darker beers (bocks/dunkels/schwarzbiers). Pale lagers use treated water.
- American Light Lagers – the TV says water from Rocky Mountains streams is best. CO water is fairly soft. St. Louis, MO similar to local water.
- IPL – Same as you would for an IPA.



# Ingredients: Yeast Starters

- Requires much more yeast than ales due to less growth, less growth means less growth byproducts from stressed yeast
- Lager yeast are slow and you might need to step the starter, plan ahead
- Use large vessel for starter, with plenty of headspace to ensure oxygen transfer
- Propagate in wort close to OG of target wort, ideally close to temp of target wort
- Use online yeast pitch calculator to determine yeast pitch rate when making a starter, I use Brewers Friend



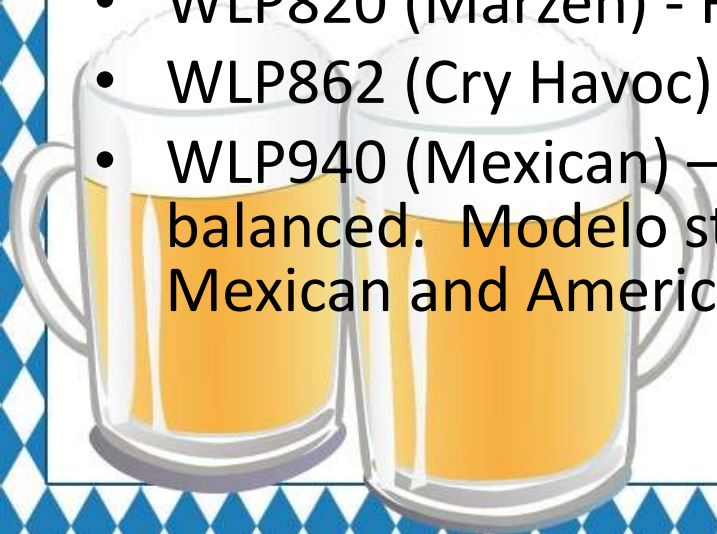
# Ingredients: Commercial Yeast

- White Labs vials and Wyeast pouches have ~100 billion cells when new. White Labs pure pitch pouches have ~160-170 billion cells when new.
- When using new, healthy commercial yeast, you can get away with using a lot less yeast (25-40% less) than starters or repitches because the yeast are healthy and ready to go



# Ingredients: White Labs Yeast

- WLP830 – good all-purpose German lager yeast. Weihenstephan 34/70 strain.
- WLP802 – grainy malt, peppery
- WLP833 – malty bock yeast, Ayinger strain. Not very active during lagering.
- WLP838 – malty, slight banana. Strong attenuator, keeps chugging during lagering. Long lag period, a little powdery.
- WLP820 (Marzen) - Finicky.
- WLP862 (Cry Havoc) - Estery. Didn't seem "lagery"
- WLP940 (Mexican) – clean, slight apple, malt/hop balanced. Modelo strain. Good multipurpose yeast for Mexican and American beers.

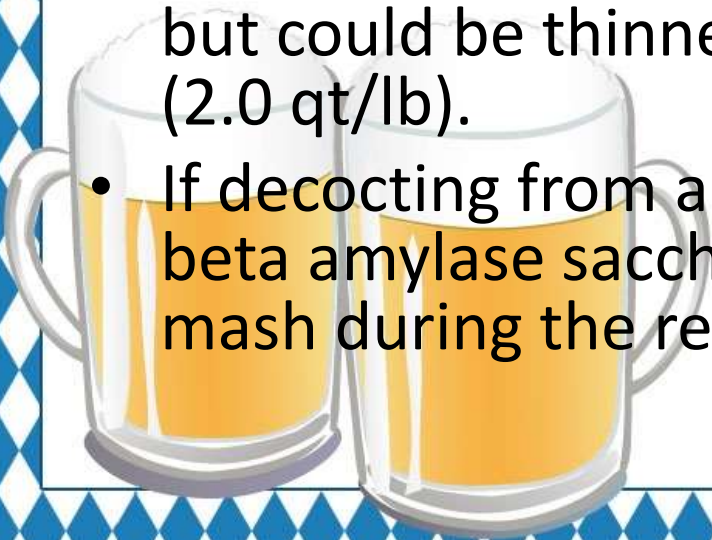


# ***BREWING/FERMENTING LAGERS***



# Process: Mashing

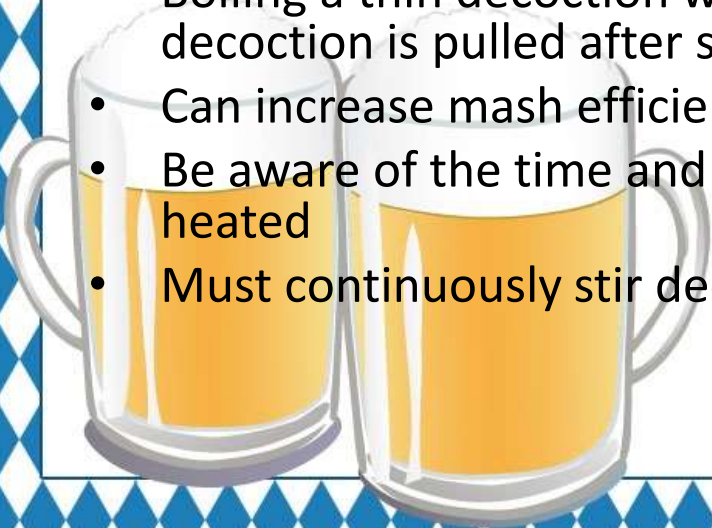
- Single Infusion, Step Mash, or Decoction will work
- Mash the malt you have (e.g. don't put a highly modified American malt through a protein rest)
- A short protein rest at 131°F could be done with malts with an SN ratio of 37-40%. A longer protein rest should be done with malts with an SN ratio under 37%
- Mash should be thick during protein rests (1.25 qt/lb), but could be thinner during starch conversion (up to 2.0 qt/lb).
- If decocting from a protein rest around 131°F, some beta amylase saccharification will occur in the main mash during the rest





# Process: Decoction Mashing

- Basically a step mash profile, using boiled mash to increase main mash temperature.
- Boiling the mash increases color, melanoidins, and malt aroma. In my own anecdotal opinion a decoction increases body
- Melanoidins are brown polymers that are formed when sugars and amino acids combine (Maillard reaction), they form better with less water. These are formed during decoctions, some try to simulate the effect by adding melanoidin malt (aka “super munich”)
- Typically remove a thick 20-45% of the mash to pull a decoction
- Boiling a thin decoction will destroy enzymes. Keep it thick unless the decoction is pulled after starch conversion.
- Can increase mash efficiency, especially with less modified grains
- Be aware of the time and temp of the main mash as the decoction is heated
- Must continuously stir decoction to prevent scorching

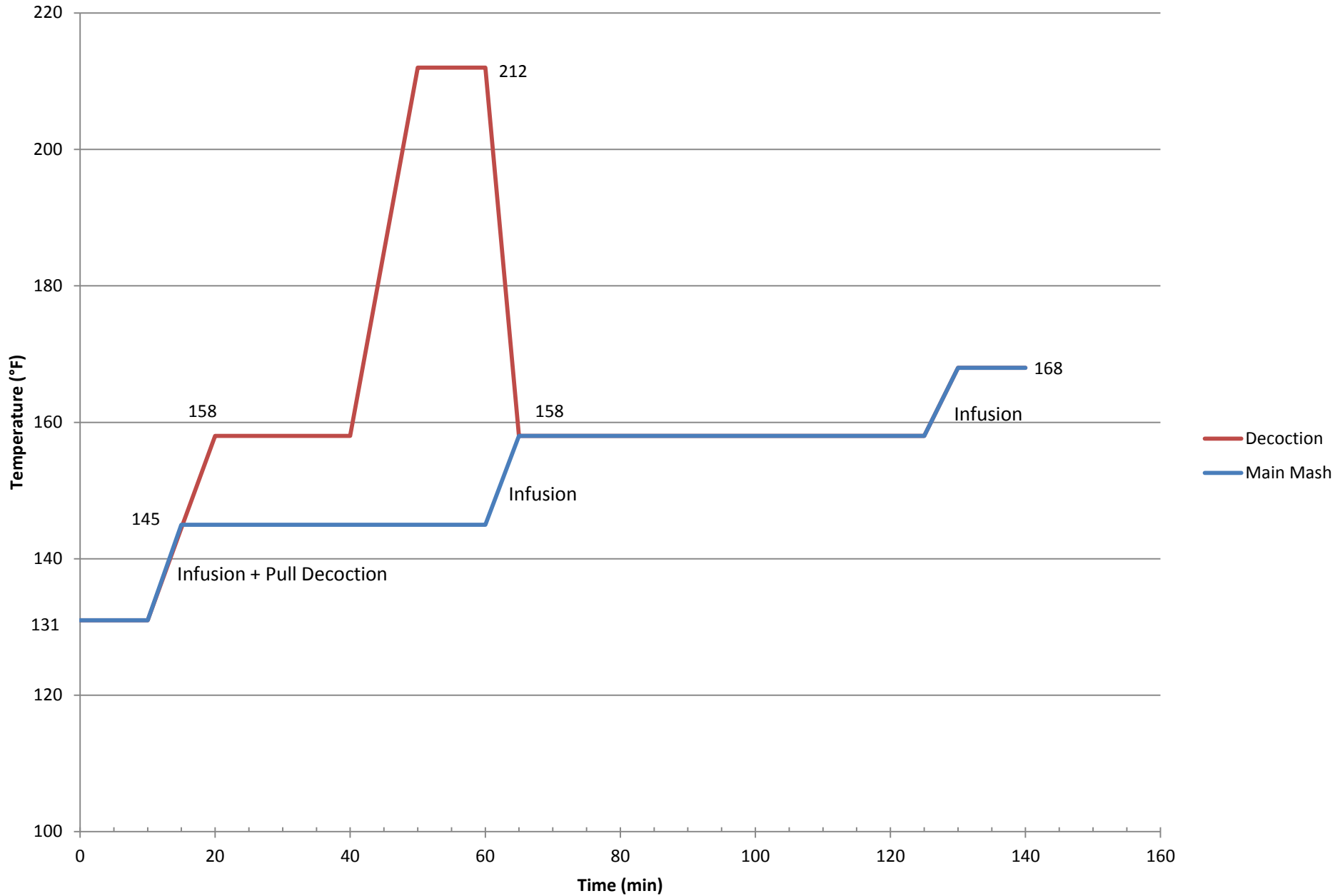


# My Mash Process for Lagers

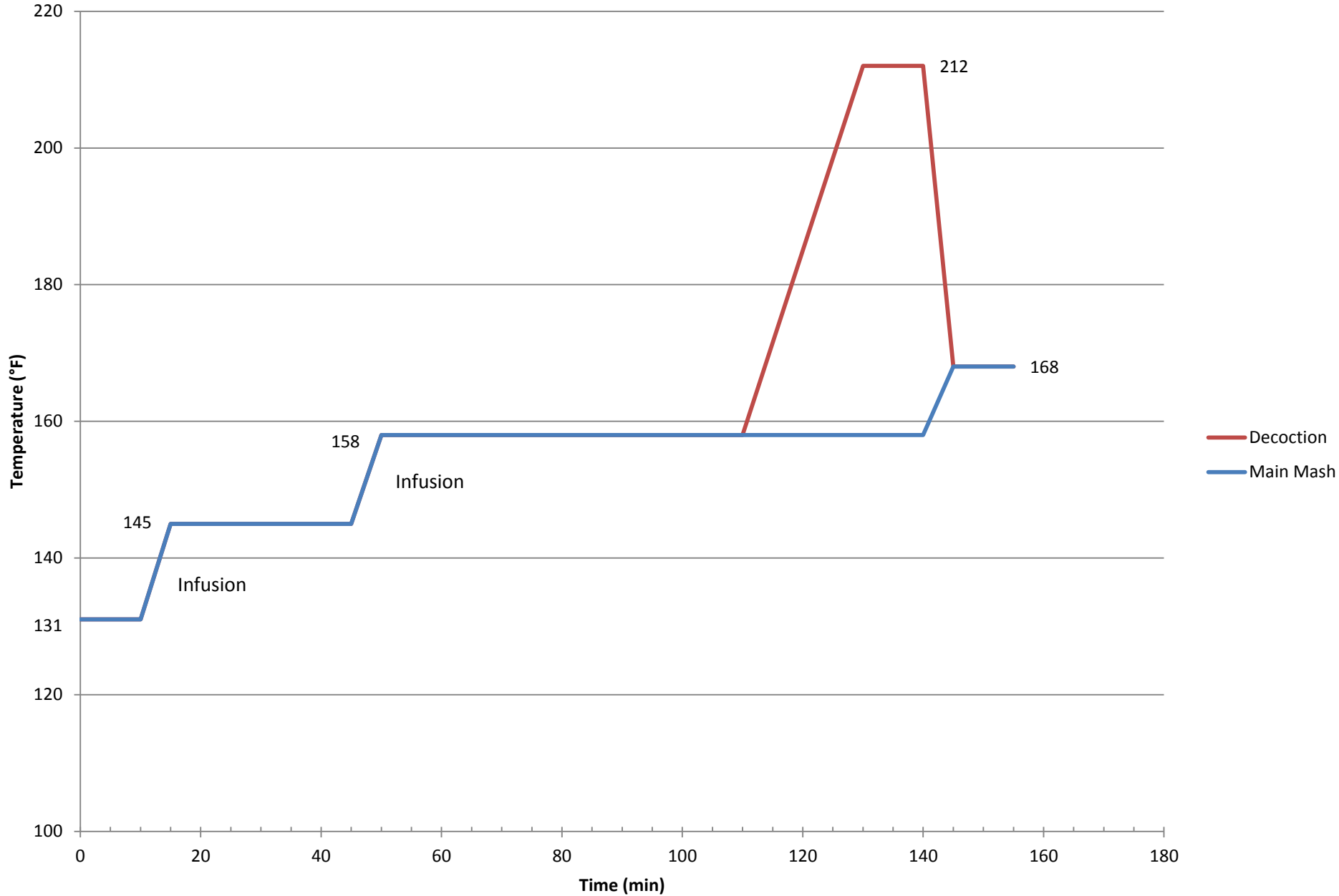
- I typically use a step mash-single decoction hybrid profile, non-decoction steps are done via boiling water infusions
- I use 2 kettles, one for boiling decoctions (usually normal boil kettle) and one as a boiling water HLT.



# Corey Magers' Single Decoction Mash Profile #1 - Decoct after Protein Rest, 45 min Beta Amylase Rest



# Corey Magers' Single Decoction Mash Profile #2 - Decoct after Starch Conversion, 30 min Beta Amylase Rest



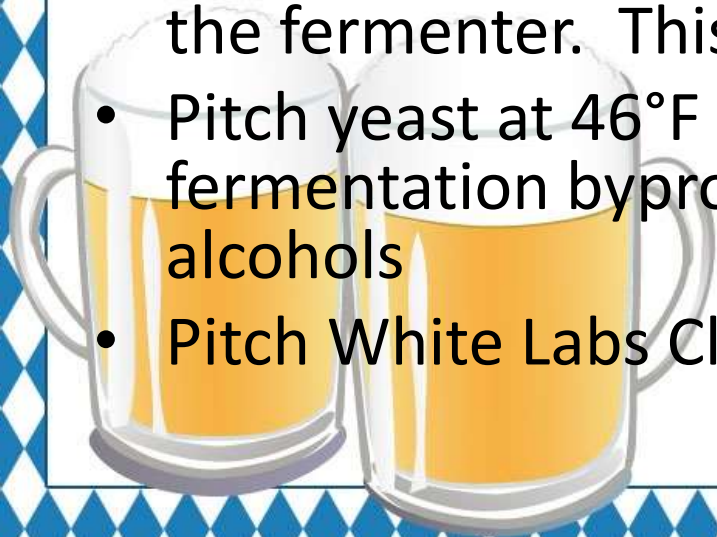
# Process: Boil

- Long boil and fast chill to minimize DMS (cooked vegetable flavor). 90 minute boil may not be necessary with modern malts, although I use it anyway for a little more color and melanoidins.
- German brewers started using first wort hops for bittering. FWH reduces boil-overs, get some flavor contributions, slightly smoother bitterness.



# Process: Chill Wort/Pitch Yeast

- If you have a pump, recirculate chilling water into a cooler with ice to get down to pitching temps (start recirc once the wort is down to 80-90°F).
- If no pump, use an in-line coil in an ice bath
- Need ~ 3lbs ice per gallon of wort in summer, half of that in winter.
- Whirlpool wort to keep hop and break matter out of the fermenter. This will help with clarity and stability.
- Pitch yeast at 46°F to reduce undesirable fermentation byproducts like diacetyl and higher alcohols
- Pitch White Labs Clarity Ferm to improve clarity



# Process: Ferment

- Over the course of 2 days ramp up to primary fermentation temperature (usually  $\sim 50^{\circ}\text{F}$ )
- Primary may take 2.5-3 weeks depending on yeast strain
- Once beer is a few points from final gravity it's ready for maturation



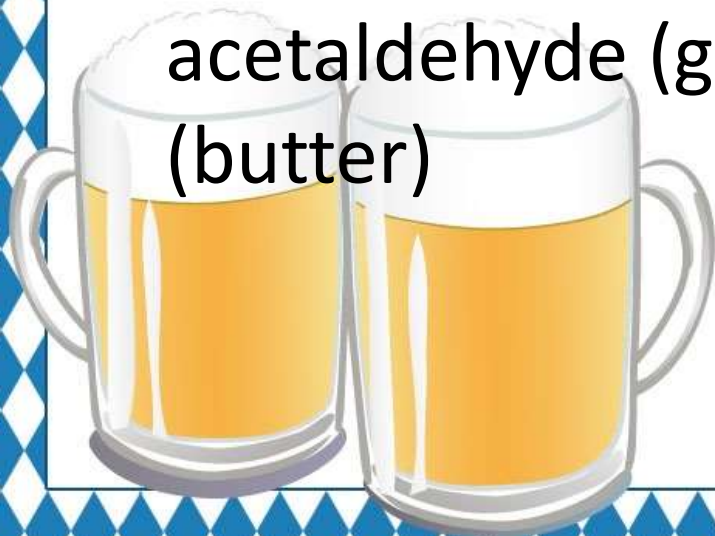
# ***LAGERING***





# Why lager my Lager?

- Long, cold conditioning (3wks+) allows time for yeast and haze forming protein and polyphenols to drop out
- Long maturation period gives yeast more time to clean up fermentation byproducts like acetaldehyde (green apple) and diacetyl (butter)



# Why lager my Lager?

- During lagering some flavorful esters are formed, sulfur and other unwanted volatile compounds reduce
- Can naturally carbonate during lagering if desired (must know your yeast strain)



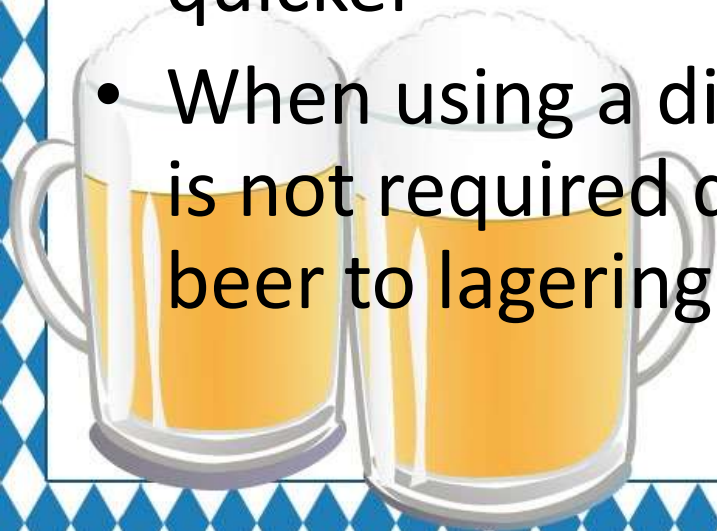
# Lagering: Cold Maturation

- Maturation can be done warm or cold
- Before beer reaches FG must lower temp slowly ( $\sim 3^{\circ}\text{F}$  per day) to around  $39\text{-}40^{\circ}\text{F}$  to avoid shocking yeast.
- Budweiser uses coated beechwood to keep yeast in suspension to quicken maturation.
- Cold Maturation takes several weeks, depending on yeast strain and OG



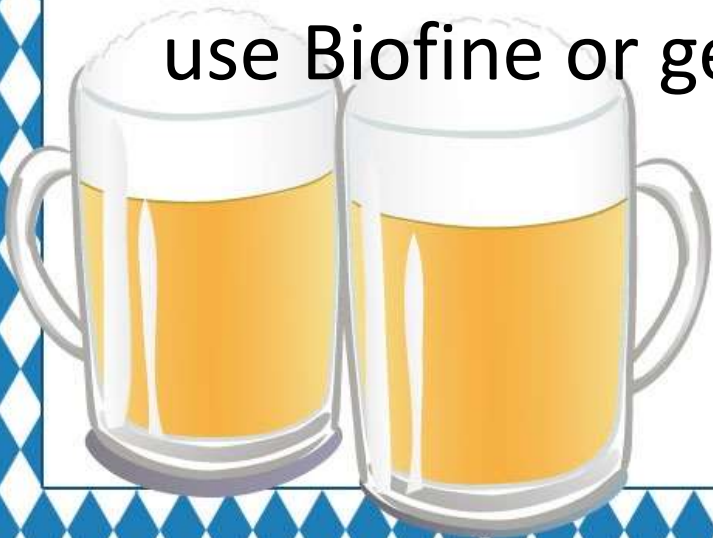
# Lagering: Warm Maturation

- Warm maturation known as diacetyl rest. A few gravity points before FG ramp temp up to 65°F for 2-3 days to increase yeast activity and re-uptake of byproducts.
- More reliable than cold maturation and much quicker
- When using a diacetyl rest, since yeast activity is not required during lagering, may cold crash beer to lagering temps if desired



# Lagering: Cold Conditioning

- A week before packaging, drop the temp as far as you can without freezing the beer (~30°F) to expedite precipitation of yeast and haze forming protein and polyphenols
- Use a fining agent if desired for best clarity. I use Biofine or gelatin



# Reading Material

- *New Brewing Lager Beer* – Greg Noonan
- Tips for Homebrewing Lagers (2015 NHC Presentation) – Jason Pratt
- *Brewing Classic Styles* - Jamil Zainasheff and John Palmer
- [Braukeiser.com](http://Braukeiser.com)



# Questions?!!

