



#### BeerSmith.com Home Brewing

#### Beer Clarity Brad Smith, PhD

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### **Clarity Intro**

- When Clarity Matters
- Types of Haze
- Causes of Haze
- Solutions
  - Ingredients
  - Process
  - Finings
  - Filtering





#### When Clarity Matters







#### When Clarity Doesn't Matter







### **Measuring Haze**

- Radiometer Haze Meter
  - EBC scale
  - Uses a light beam to measure the amount of matter suspended in a liquid
- "Pseudo Haze"
  - Small particles may reflect light but not affect clarity of beer
- "Turbidity"
  - The particles that are visible





<u>Unfortunately</u> Measured haze is not always the same as turbidity

#### **Potential Causes**



- Proteins and Polyphenols from malt and hops
  - Most frequent cause of clarity issues in beer
- Other Causes
  - Yeast (mainly in immature beers)
  - Calcium deficient worts (Oxalates)
  - Wheat derived adjuncts (Pentosans)
  - Inadequately modified malt (Beta-glucans)
  - Dead bacteria from infection
  - Damaged yeast (Carbs and proteins)
  - Lubricants, excessive finings, foreign material



# **Types of Haze**

- Chill Haze
  - Haze that only shows up when the beer is cold (often near freezing)
- Permanent Haze
  - Haze that is present whether the beer is warm or cold
- Chill Haze often becomes permanent over time
- Haze Generally has no Flavor!



### Yeast and Clarity

- > Yeast cells a problem early on
  - Yeast is 5-10 micron in size
  - Tend to flocculate with age, chilling
  - Some yeast can remain suspended
- Mitigation
  - Choose high flocculation strains
  - Finings work well with yeast
  - Filtering can remove almost all yeast
  - Yeast is rarely the cause of permanent haze or chill haze





#### Proteins and Polyphenols (Tannins)

- Proteins are present in grains
  - Most malt sheets show the percent protein
- Polyphenols (Tannins)
  - Come from both malt and hops
  - Hops accounts for approx 20– 30% of polyphenols
  - Hop polyphenols tend to be less reactive than those from malt





#### **Chill Haze**





- Happens when a low molecular weight Polyphenol interacts with a Protein
  - Particle sizes range from 0.1 to 1 micron
  - Visible at room temperature, but not near freezing
- Prone to polymerization with other proteins
  - Leads to a permanent haze
  - Reaction is aided by oxygen in the finished beer

## **Ingredient Selection**



- Malt Selection
  - Can select low protein malts
  - Tannins (polyphenols) come primarily from husk, and some grains have de-husked versions
  - Tradeoff in foam retention
    - Some proteins (polypeptides) promote foam retention
- Hops (20–30% of Polyphenols)
  - Aroma hops do deliver slightly more polyphenols
  - Select hops for flavor, not phenol content

## Tips for the Boil

- Long, Rolling boil promotes precipitation of Proteins/Tannins
  - Recommend 60-90 minutes at a strong boil (90 is better!)
- Maximize Hot Break
  - Foam at beginning of boil is start of it (skimming?)
  - Chill as quickly as possible
- Oxygen in mash/boil not ideal
  - Effect is small primarily a commercial concern





### **Beer pH and Mashing**

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- Strive for Clear Runnings (no turbidity)
  - Avoid disturbing mash bed (raking, mixing, etc..)
  - Do a Vorlauf (recirculate first runnings until clear)
- Avoid oversparging
  - Most tannins (polyphenols) are in late runnings
- Low Mash pH is Better
  - Target a mash ph = 5.2
  - Higher pH associated with more phenols/protein extraction
  - Treat your sparge water as well lower pH is better



# The Cold Break and Finings



- Cold Break with Rapid Chilling
  - Starts forming around 140F (60C)
  - Coagulation of proteins, tannins and hop matter (hop polyphenols precipitate faster)
  - Effective cold break promotes clarity and flavor stability
  - Best to separate the break from the wort if possible before fermenting
- Irish Moss Boil 15 min
  - Positively charged ions aid coagulation of both proteins and polyphenols (tannins)
- Whirlfloc Tablets
  - Concentrated carrageenan
  - Similar effect, preferred by many Craft brewers



# Lagering and Cycling



- Cold Crashing
  - Take the beer rapidly down to near freezing after fermentation is complete (kegged beers only)
  - Aids in precipitation, improves clarity
  - Often used to prepare beer for cold filtering

#### Hot-Cold Cycling Test

- Used by commercial brewers to test stability of beer (simulate aging)
- Cycle beer to 100 F (37 C) for a week, then take it back down to storage temperature (and repeat)



## **Fermentation Finings**



- Gelatin
  - Available in "jello" section at grocery (unflavored) - works on proteins and tannins
  - Prepare 1 pkg for 5 gal (19 l) batch in hot water, add a few days before bottling
- Polyclar (PVPP) Plastic
  - Effective against both proteins and tannins
  - Used both by home and pro brewers (1 tbsp per 5 gal)
- Silica Gels
  - Effective at binding proteins
  - Add 6-10 grams per 5 gal/19 liter batch
  - Can affect flavor/foam if done to excess



# Fermentation Finings - Pro



- Isinglass
  - Derived from fish bladders, positive charge
  - Effective at removing yeast cells and proteins
  - Also removes some lipids, which improves foam stability
- Papain
  - One of the first finings used commercially
  - Negative impact on foam stability



#### Filtration

- Cold Filtering (kegging only)
  - Removes yeast, polyphenols and some proteins
  - Wait before filtering -
    - Important changes happen during late fermentation/lagering
  - Most home brewers place filter between two kegs with an inline, cartridge filter
  - Two stage filters (5 micro, 0.5 micron) less likely to clog





Plate Filter

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#### Storage

- Cold Store Your Beer
  - Warm temperatures or cycling temperature will make clarity worse over time
  - Can lead to permanent haze
  - Heat also leads to flavor instability

#### Oxygen

- Plays a significant role in permanent haze formation
- Oxygen during transfers are the largest risk for most home brewers





### Summary



- Key Points for Better Clarity
  - Select lower protein malts
  - Mash and sparge at a lower pH (5.2)
  - Don't oversparge, don't disturb grain bed (no turbidity)
  - Boil for 90 minutes, use a boil fining
  - Cool boil quickly for a good cold break
  - Consider cold crashing after fermentation, age cold
  - Use finings before kegging/bottling
  - Consider filtration
  - Avoid introducing oxygen during transfers or kegging
  - Cold store your beer

### Questions?

- BeerSmith Resources
  - BeerSmith.com
  - BeerSmithRecipes.com
  - Newsletter, blog, podcast
    - BeerSmith.com/blog

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#### Questions?

