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

Unfortunately
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, lipids (fats), 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!
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 cold temperature only
- 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

- 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
  - Primarily used in wine making
Enzymes for Clarity/Reducing Gluten
- Clarity–Ferm/Brewers Clarex (White Labs) is one example available to home brewers
- Sold as a clarity aid – enzyme breaks down polyphenols to reduce chill haze
- Also breaks down Gluten protein chains
  - Typically less than 20 ppm (FDA: gluten free)
- Craft breweries experimenting with similar enzymes to reduce Gluten (Omission Beer, Stone…)
- TTB has ruled it can’t be labeled “Gluten free”
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
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
- Store your beer cold
Questions?

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

Questions?