pH & Temperature in Beer

The importance of pH and Temperature in Beer

Beer is a food product that is fermented, and like all food products, process monitoring and sanitation are of paramount importance for clean, consistent results. From incoming raw materials to finished packaged beer, the pH, temperature, and a host of other parameters will determine whether the beer in the bottle will taste the same way every time.

Water and Grain

In all almost all cases, adjusting the brewing water pH is the first step of the process. Clean, potable water is the basis for all beer, but a specific range for pH is preferred for brewing water. Once heated, water is mixed with milled grain to produce a mash, usually with malted barley. Maintaining the correct pH for critical enzymes during the mash ensures the proper conversion of starches and degradation of haze causing proteins. There are naturally acidifying properties of malt, but many brewers additionally adjust the water with calcium sulfate or food grade acid. Brewers normally look for a mash of pH 5.2-5.5. Water and mash temperature is also very important at this stage, as enzymes can become denatured at elevated temperatures.

Filling the Kettle

The fermentable extract that runs off from the mash to the kettle is called wort. Once again, pH and temperature have a dramatic effect on the process, allowing for better protein precipitation during the boil. After the wort is brought up to temperature, hops are added to the kettle to impart bitterness and aroma. Lower pH slightly decreases hop utilization, but may improve the quality of the bitterness, while higher pH slightly increases hop utilization, and the harshness of the bittering compounds. Both protein precipitation and hop utilization are temperature dependent as well, requiring a full boil for 1 – 1 ½ hours.

Aging and Storage

At the end of fermentation, beer is usually cooled down to finish or condition. Most of the yeast and some protein will settle out at this point. The beer builds up carbonation, as the remaining yeast utilizes the last of the fermentable extract. Along with carbonation levels, brewers look at dissolved oxygen levels just before sending the beer to filtration.

Fermentation

At the end of the boil, the proteins and hop particulate are allowed to settle, then the wort is cooled to 10 - 20° C [50 - 68° F]. Yeast is added to the cooled wort and in the presence of oxygen, fermentation begins. As yeast utilizes sugars in the wort, the pH of the beer is reduced to the 4.1 – 4.3 range. The lower pH is normal with most yeast strains, but an overly acidic beer may show signs of infection from acid-producing bacteria, dropping the pH into the 3.4 – 3.7 range. On the other hand, increased pH of pitching yeast [4.6 – 4.9] is a sign of autolysis, a good indicator of whether or not to reuse the strain. Even healthy yeast can produce some less than pleasant compounds at elevated temperatures, so maintaining a cool fermentation is also important to keep the same flavor profile from brew to brew.

Filtering and Filling Bottles

Filtering and filling finished beer into bottles, kegs or cans is the last step of the brewing process. Beer can be treated to promote either selective protein or tannin precipitation so that filtration is more efficient and effective. Beer is measured for haze at this point, and a further measurement is usually taken once the beer is in the package. Oxygen pick up during filtration and packaging is detrimental to the shelf life of the beer, as well. Filtered beer can become stale rapidly in the presence of oxygen, giving the beer a papery or cardboard-like flavor. Other major considerations for finished beer are the level of alcohol, CO_2, hop bitterness [in bitterness units, or BU's], and the final color of the beer. All of these parameters help the brewer to make consistent, flavorful product, with a reasonable shelf life.

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