The Role of CO_2 in Draught Beer

For a better pour

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Draught beer is better. The carbon dioxide (CO_2) is largely responsible for that. Each beer is designed by its creator to use CO_2 in a specific way. The frothy foam broken out during a proper draught pour pulls flavors from the beer and brings them alive for the consumer's senses to enjoy. Without this reaction, they may be left wanting, or at the very least, they will miss the full experience the beer and its creator has to offer.

Water, malt, hops, yeast, and CO_2 are the foundational ingredients of beer. Soaking the malt in hot water builds a sugary base. The yeast is then set free to consume the sugars, resulting in CO_2 and alcohol. The hops can now be added depending on the creator's recipe and beer style. Fruits, flower petals, peppers, and different adjuncts are frequently used for more flavor options and each of these ingredients impacts the flavor.

After the yeast is finished converting sugar to CO_2, a process known as fermentation, the brewer is left with a carbonated beer at a low level. This level of carbonation is measured in Volumes (Vols).

Volumes of CO_2 in Beer: A volume of CO_2 stripped from a volume of beer at room temperature and 0 psi. if 1 gallon of beer was stripped of its CO_2, warmed to room temperature and lowered to 0 psi, however many gallons it filled would be that beers volume.

Natural carbonation through fermentation ranges in Vols from below one up to approximately 1.6. Levels at these Vols are found in older recipes, including many English ales and the like. The average Vols of CO_2 in a walk-in cooler today is about 2.5.

To achieve a range close to 2.5 Vols, the brewer will force carbonate the beer through a carbonation stone. The carbonation stone breaks the CO_2 into tiny, absorbable bubbles that latch onto all the other suspended ingredients mentioned above. The brewer then carefully transports the beer into the kegs. Assuming a storage temperature of 38°F, sea-level elevation, and a recipe with 2.5 Vols, this keg will measure about 12 psi. The beer in this keg is in a state of equilibrium.

Equilibrium: The same amount of CO_2 molecules are entering the beer from the headspace as are leaving the beer to the headspace.

The keg is delivered to the bar and properly stored at 38°F in a cooler dedicated to the draught system. To get the beer out of the keg, the restaurant attaches a coupler to engage the keg stem. Once engaged, the beer can flow to the faucet, and CO_2 from the restaurant source is introduced into the keg.

From the bottom of the keg, the beer flows up through the keg stem, through a length of tubing, through various hardware, through the faucet, and finally into the glassware. If the glassware is a standard pint, there will be about 14.5 ounces of beer in liquid state and about 1.5 ounces of beer in a foam state. Various styles of beers and glassware will have different ratios of liquid to foam.

The top half-inch to three-quarters of an inch of the pint glass foam, is CO_2 that broke out of the beer during the pouring process. The amount of foam on the very first pint of the keg to the very last pint of the keg should be the same. If there is a variance in the level of foam from the first pint to the last, the keg may not have been at equilibrium after it was introduced to the draught system. In other words, either more CO_2 was added to the beer or CO_2 was released from the beer in the keg once introduced to the draught system. Therefore, the consumer is not getting the full sensory experience as the beer is no longer the same recipe as intended by the brewer.

The pressure introduced to the keg when the coupler is engaged from the Chart MicroBulk CO_2 source, @ 110 psi, is stepped down by the secondary regulator inside the cooler. The secondary regulator pressure feeding the keg is determined by the resistance from the tubing, hardware, gravity, and the way the beer is poured and the selected glassware.

Remember that 12 psi of CO_2 gives us equilibrium in the keg, and at equilibrium, the amount of foam can't change. The only way for the foam to change in quantity is if the pressure feeding the keg goes up or down. If 12 psi is reduced to 10 psi, the foam will slowly reduce as each pint is poured. If the pressure is increased from 12 to 16, the foam will slowly grow over the life of the keg. These numbers assume no adjustment of any other variables in the draught system.

What if the length of tubing creates a resistance higher than 12 psi can overcome? Let's say that the resistance factor is 22 psi, but the secondary regulator is only allowing 12 psi of CO_2 into the keg. In this case, the beer will pour very slowly. The beer will not be packed tightly into the tubing, allowing agitation and an abundance of foam. However, the pressure cannot be increased to 22 on the secondary, or else the keg will be out of equilibrium and cause over-carbonation.

A 2.5 Vol beer in a keg is at equilibrium at 12 psi. If the pressure from the secondary into the keg is set at 10 psi, the Vols will be reduced to 2.4 over the life of the keg. This is not a huge decrease that many patrons would even notice. However, the slight decrease in foam from a cooler full of under-carbonated beer can add up for the retailer. Essentially results in giving more beer away for the same amount of money. Repeating the thought that the beer isn't exactly how the brewer intended it to be served. Adding more resistance to the system is one solution for this problem.

Consider, over the life of the keg, if we put 22 psi on a 2.5 Vol beer, the beer would increase to 3.5 Vols. This would be represented as an abundance of foam in the patron's glass. Foam of this magnitude would give the retailer an estimated loss of 24% of revenue on their draught system. Using a gas mix can be a solution to this issue.

When CO_2 breaks out properly at the top of the glassware, the patrons can smell and taste the beer as intended and envisioned by the brewer. All the hop aromas are enhanced. The sour notes from the various yeast strains, and the toasty malted notes are picked up by the patrons. When proper gas is introduced to the keg, the retailer increases profits. And if the distributors are a part of that solution, perhaps the retailer will pay their bill on time.

For information on Chart Industries, visit www.ChartBeverage.com

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