Beer Carbonation

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Carbonation

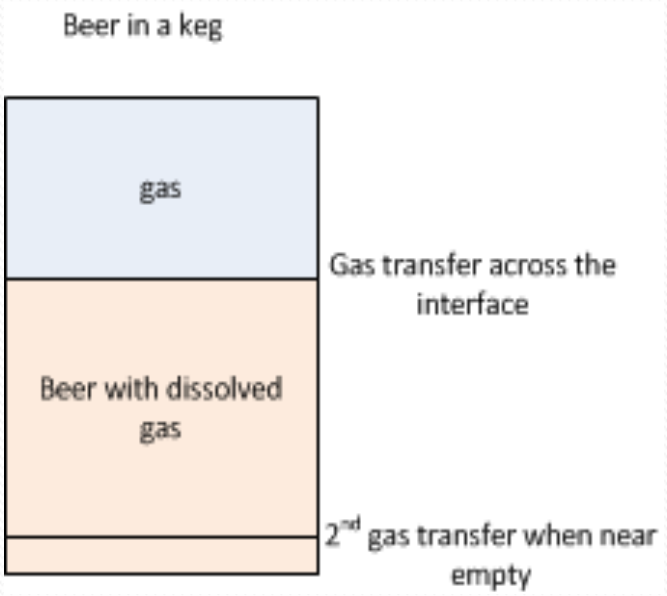
- How Carbonation affects beer
  - Presentation, mouth feel, taste & smell
- Experiment
  - Ferment more beer than can fit in a keg
  - At transfer time to keg, bottle with a carbonation ‘drop’
  - Is bottle conditioned better than forced?
- Reading BLAM – Monks do a yeast cell count before bottling made me realize that there is more to this topic
- Reference: A Handbook of Basic Brewing Calculations. MBAA – S Holle

Some Beer Carbonation Methods

- Forced CO_2
  - Easy to obtain the correct levels based on pressure and temperature
- During Fermentation time
  - Let the yeast do the work.
  - Cannot pressurize over 5 PSI in small systems
- At Bottle time
  - Add sugar or wort
  - Available yeast remaining may be too low to achieve correct levels of CO2

Forced Carbonation

- Beer is fully fermented and saturated with CO_2
- Henry's Law – concentration of gas in solution is directly proportional to the pressure of that gas at a constant temperature.
- Solubility increases as temperature decreases
- Surface area – lie keg on side



Natural Carbonation

- Carbonation occurs in the fermenter
- Not all of the extract is converted to CO_2 – only 46% to CO_2
  - Maltose + amino acid = yeast growth + ethanol + CO_2 + energy
  - 100g + 0.5g = 5g + 48.8 g + **46.8**g + 209kJ
- Multiply the fermentable extract weight by 0.46 gives the weight of the CO_2 produced
- 1 °P (1.0038) is equivalent to 1% of extract (e.g. 1g in 100g)
- 1 L water = 1000g of water
- When to seal the fermenter
  - Determine grams of CO_2 for style
  - $CO_2 \div 0.46$ = fermentable extract
  - Convert to °P

Natural Carbonation (continued)

- Determination (repeated)
  - Determine grams of CO_2 for style
  - $CO_2 \div 0.46$ = fermentable extract (or CO_2 x 1.976)
  - Convert to °P

- Relationship of CO_2 volumes to CO_2 weight
  - 1g of CO_2 in 1L = 0.506 volumes of CO_2 per liter at 50 °F
  - 2.5 volumes of CO_2 is equivalent to 4.94g of CO_2

Example: OG: 16.5 °P, FG: 5 °P with 5g of CO2

- Fermentable extract = 5g $CO_2 \div 0.46$ = 10.9g
- Convert to Plato: 10.9 / 1000g per liter = 1.09 °P (*metric system is great*)
- Bung the tank at 1.09 °P + 5 °P = 6.09 °P

Bottle Conditioning

- Secondary fermentation carbonates the beer
- 4.3g of fermentable sugar produces 1 volume CO_2 in 1L
  - 1 volume of CO_2 per liter = 1.976g of CO_2 at 50°F
    - (1.976 = 1/0.506)
  - Only 46% converts to CO_2
  - Therefore, 1.976 x 0.46 = **4.3g** per liter
- 4.3g/L -> 430g/hL -> 505g/barrel -> 0.57oz/gallon
- Assumption of 100% fermentability, or malt/corn syrup about 80%

Bottle Conditioning (Continued)

- Example using a 12oz bottle (or 330ml) at 2.5 vol
  - 4.3g per liter ÷ 330 = 1.45g per bottle for 1 volume of CO_2
  - 2.5 x 1.45 = 3.6g of sugar
  - 1 carbonation drop is 3.6g

Summary

Style	Yeast	Comments
Belgian Blonde	WLP500	
Scottish	GigaYeast Scottish Ale	
Heretic wort	WLP530	
Biere de Garde	WY 3725	Same wort as Tripel
Belgian Tripel	Secret Giga yeast	Same wort as Biere de garde
IPA		Use ISO extract