Brewing Formulas

From The Weekend Brewer (http://www.weekendbrewer.com/brewingformulas.htm)
08-29-1986

Conversions:

Some formulas are approximate. Simply round up or down.

- Dry Malt to Liquid Malt: Dry x 25%+= Liquid
    - Example: 3 (LB. Dry Malt) x .25 =.75+=3.75 pounds Liquid Malt
- Liquid Malt to Dry Malt: Liquid x 20% minus= Dry
    - Example: 6.6 (Lb. Liquid Malt) x 20% =1.32 minus=5.28 (Lb.Dry Malt)
- Grain to Liquid Extract: Grain x .75= Liquid
    - 10 Lb. (2 row malt) x .75 = 7.5 Lb. Liquid Malt Extract
- Specialty Grain to Extract:
    - 2 Lb. (Roasted & Chocolate Barley) x .89=1.78 (Lb. Dark Liquid Extract)

Calculating Bittering Units:

- AAU (Alpha Acid Units)
    - One Alpha Acid Unit is the amount of Acid contained in 1 oz. of 1% alpha acid hops.
- HBU (Home Bittering Units)
    - For a Five Gallon Batch- Multiply the ounces of hops used for Bittering by there Alpha Acid Number.
    - For Example: 2 ounces of Kent Golding Hops at 5% apha acid per ounce equals 10 HBU or 2oz. times 5 %(AAU) = 10 HBU

IBU (International Bittering Units)

To calculate Total IBU's from per gallon AAU's, first determine the approximate efficiency of hops isomerization. Hops boiled for 50 to 60 minuted will have 30% of the alpha acid converted. Hops boiled for 30 minutes will have 21% of the alpha acid converted. Hops boiled for 5 minutes will have 10% of the alpha acid converted.

Example:
First Hops Addition (60 min. boil time) of 1 oz. @ 5%(5 AAU's) x .30=1.5 AAU's
Second Hops Addition (30 min. boil time) of 1/2 ounce @ 5% (2.5 AAU's) x .21=.42 AAU's
Last Hop Addition (5 min. boil time) 1/2 ounce @ 3% (1.5 AAU's) x.10=.15 AAU's

1.5+.42+.15=2.07 (Total converted Iso-Alpha) divided by the number of gallons (5)=.414
Final Isomerized Alpha Acid Units=.414
To Convert this number to IBU's divide your final IAAU by .01335(one IBU) =31-IBU's the approximate number of IBU's in one gallon of your finished beer.

Color

- SRM (Standard Research Method)/ Lovibond:
  - SRM and Lovibond is mearsured on the same scale. American brewers use Lovibond to describe malts, while SRM is used to describe the color of the finished beer.
- EBC (European Brewing Convention Scale):
  - To convert EBC to SRM: Multiple EBC by .375 and add .46
- To predict the final color of the beer. Multiply the number of pounds of the grain or malt by the Lovibond of the grain or malt used. Then divide by the total of gallons of the wort.
  - Example: (14oz. crystal @ 55 lovibond plus 6 # Light DME @ 3.5 Lovibond) divided by 5 gallons. {(14/16)(55)+(6)(3.5)}/ 5=13.8 Lovibond

SRM RATINGS

Color	SRM
Clear	0
Light Straw	1 - 2.5
Pale Straw	2.3 - 3.5
Dark Straw	3.5 - 5.5
Light Amber	5.5 – 10
Pale Amber	10 – 18
Dark Amber or Copper	18 – 26
Very Dark Amber	26 – 40
Black	40 +

Kraeusening:

Priming your beer with unfermented Wort (Gyle)

- How Much Gyle to use?
  - Always use same batch of Wort if possible.
  - Multiply the gallons of your total Wort to be fermented by 12. (5 gallons x 12= 60)
  - Divide the the sum of the above (60) by the last 2 digits of your specific gravity.
  - If your your starting gravity before pitching the yeast was 1.040. Then Divide by 40.
  - 60 divided by 40 =1.5 or [1-1/2 quarts Gyle]
  - This number represents the amount of quarts used to prime your beer. This formula is the amount of Gyle used that would equal 5 ounces of Dextrose (Priming Sugar)

Priming Bottles & Kegs

- (5) gallon keg
  - Priming with dextrose (priming sugar). Use only Five tablespoons Dextrose for the complete keg. (one tablespoon per Gallon) OR 1-tablespoon & 1 teaspoon Dry Malt Extract per gallon. Mix the primer of choice in two cups of the beer to totally dissolve prior to adding into the keg.
- Mini Kegs (5 Liter)
  - Use one LEVEL tablespoon dextrose per mini keg. PRIME Mini Kegs individually Not with a bulk mix. It is always best to add the primer to a small amount of the beer to totally dissolve first.
- Bottles: For bulk priming in the bucket, for 5 gallons of beer being bottled in 12 or 22 ounce bottles.
  - Use 3/4 cup to 5 ounces dextrose (priming sugar)
  - Or 1-1/4 cup Dry Malt Extract.
- Add the primer of choice to (1) cup of water and (1) cup of the finished beer. Bring the mix just to a boil and cool to the beer temperature that is being primed. Gently blend the Cooled primer mix into the container you are priming in, as you are transferring the beer. (do not splash - Fold IN) This will give you an even blend of the primer mix. After you have bottled half the batch, again gently blend the beer and continue bottling.

Force Carbonation

Method One: Cold Carbonation

- Cooler should be 38° - 40°
- Set the Co2 regulator to 15 PSI for Light malted Beers or 18 PSI for heavy malted Beers.
- Pressurize the keg until pressure equals set pressure. Disconnect the Co2 fitting to the keg. Shake the keg vigorously for 2 minutes. Repressureize the keg and let it equalize again to the Regulator set pressure. Let the keg remain in the cooler chilled.
- Repeat this process 2 to 3 times a day for two days. After the beer has retained the Co2 in liquid, reduce the keg pressure to 5 PSI. Reset the Regulator to 8 PSI for dispensing.

Method Two:

- Same techniques as in Method One but the pressures are higher and the keg is not chilled until before use.
- Set the Co2 regulator to 32 PSI for Light malted Beers or 38 PSI for heavy malted Beers.
- The keg remains at room temp during the carbonation. This may take a day or two longer depending on your room temperatures. After the beer has retained the Co2 in liquid, reduce the keg pressure to 5 PSI. Reset the Regulator to 8 PSI for dispensing.

Safety

- For Your Safety. Always store Co2 tank in the UPRIGHT position.
- Your Co2 tank should be secured in place with a safety chain at all times.
- The safety chain should be rated at 100 pounds or over. Always turn the tank completely on until the valve seats.

Common Mash Temperatures

	94°F	122°F	140°F	149°F	158°F	168°F	170°F
Optimum Activity	Phytase optimum-Acid rest Temp. for under modified malts	Proteolysis optimum--Protein rest temperature.	Beta-Amylase optimum--Starch converts to sugars	Diastase optimum--Alpha & Beta-amylase work equally well	Alpha Amylase --optimum--starch converts to dextrin's	Beta-amylase stopped/Alpha-amylase curtailed--Mash Out Temp.	Maximum sparge liquor temp.
Typical Mash Times	60 - 120 minutes	15 - 60 minutes	15- 90 minutes	45 - 90 minutes	15 -30 minutes	5-15 minutes	45-90 minutes
Effect on the Mash / Wort	Lowers mash PH when using low Calcium brewing liquor	Malt proteins and adjunct starches broken down	Yields Wort very low in dextrin's, high in fermentable's	Wort with well balanced ratio of dextrin's to fermentable's	Wort high in dextrin's, low in fermentable's	Reduces viscosity, aids run-off of mash (Mash-Out)	Possible tannin extraction from mash if 170°F exceeded.

Stephen Snyder- The Brewmaster's Recipe Manual 1994

Typical Step Mash Schedules

	Light Body Beer	Medium Body Beer	Full Body Beer	Under Modified Pilsner Malts
1st. Step	122 °F 30 min.	122 °F 30 min.	122 °F 30 min.	95 °F 45-60 min.
2nd.Step	148 °F 60 min.	152 °F 60 min.	155-158 °F 60 min.	122 °F 30 min.
3rd Step	165-168 °F Mash Out 10 min.	165-168 °F Mash Out 10 min.	168 °F Mash Out 10 min.	148 °F 60 min.
4th Step	168 °F Sparge 60 min.	168 °F Sparge 60 min.	168 °F Sparge 60 min.	165-168 °F Mash Out 10 min.
5th Step				168 °F Sparge 60 min.

Mash Out

By the time the proteins have been broken down by any protein rest and the larger sugar molecules have been broken down to fermentable sugars, you're almost ready to Sparge and recover all those freshly prepared ingredients you want in your fermenting beer. But first there is one more step in the mash process killing all the enzymes that up to now you've been nice to. This Mash-Out process is accomplished by heating the mash to 168 degrees. This also helps the sparging since the sugary solution will flow better hot. However, don't go any higher than this temperature or you'll start to pull out husk tannins from the grains or cause some of the larger sugars to reabsorb into the liquid mash. If either happens, astringency and haze may result.

Water Use Calculations

- Water Use Calculations
  - When figuring your water remember your system can vary from others.
  - Use the 1.4 quarts water per pound of grain. This will be your mash and sparge water amount.
- Absorption
  - Absorption of water in the grain is near .3 for a recipe with up to 20 % adjuncts. (Roast, toasted, rye, wheat) and .35 for all base malt recipe with less than 5 % adjuncts. (mostly 2 row pale malt)
  - Example: 10 Lb's Grain with 20% adjuncts x 1.4 = 14 quarts water, divide by 4 quarts per gallon = 3.5 gallons mash water. 3.5 gallons of wort in the mash tun will yield 2.45 gallons after absorption from the grains.
  - OR 3.5 x .3 = 1.05 (3.5 gal. minus 1.05= 2.45gal.) 2.45 gal. wort plus 3.5 gallon sparge water = 5.95 gallons
- Evaporation:
  - If you loose ONE gallon in the boil from evaporation. = 4.95 gallons.
  - Knowing this you can do one of two things, Add 16 ounces of water to the Sparge or boil.
  - OR If you add a 16 ounce yeast starter (2 cups), you now have 5 gallons and 12 ounces.
  - After secondary, you end up with approximately 5 gallons.

Test for Starch Conversion with Iodine Tincture.

(from Brew Chem 101 p.46) Lee W Jason, PH.D.

- During the starch conversion stage of mashing, the iodine test (or iodine conversion test) is performed, a chemical test that tells just how well the larger sugars have been broken down to smaller, fermentable sugars. But, how and why does the iodine test work?
- Iodine in solution is yellow. However, if iodine comes in contact with a long, linear starch molecule such as amylose, the iodine molecule fits into spaces within starch

molecule. The solution turns dark blue (or black if there's enough starch). If the starch has been partially broken down or if has a lot of branches as with large starch molecules or amylopectin, the iodine and starch molecules won't fit together as well, and the solution will turn a reddish color. If no starch, amylose, or amyopectin are left to combine with the iodine, the solution will remain yellow.

- Using this test, the 'All-Grain Brewer' can easily determine how much breakdown of the mash has taken place. For example, a mash solution that is barely broken down will produce a black iodine test, partial breakdown will result in a red iodine test, and full breakdown to fermentable sugars and a few medium-sized sugars will result in the solution remaining the same yellow color. Intermediate shades of these colors are also possible, indicating that the degree of starch and sugar breakdown is somewhere in between the three examples.
- But beware: grain husks can also react with iodine and produce a black solution, even when all the sugars have been converted. So, the iodine test has to be conducted very carefully (be sure to get only clear mash liquid with no floating pieces of husk) and interpreted correctly.

Calculating potential gravity

$$PG = pppg * \frac{lbs}{gallons} * efficiency$$

where:
$pppg$ is the grain extract potential of the malt, typically 1.037 for base malts, and lower for more roasted malts and higher for simple sugars.
lbs is the weight of the selected grain
$gallons$ is the total volume of **finished** wort
$efficiency$ is the overall process efficiency of your system.

If you are adding sugars or extract to the boil, efficiency is 100%.