Home Brewing with BeerSmith ™

How to Brew and Design Great Beer at Home

Bradley J Smith, PhD
Author, Brewer, Engineer

BOOK SAMPLE OF CHAPTER 3

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Chapter 3: Beer Recipe Design

"Give a man a fish and he will eat for a day. Teach him how to fish, and he will sit in a boat and drink beer all day." - *Anonymous*

After you have a few batches of beer under your belt, you will want to understand the basics of recipe design. Recipe design is an important topic both for creating your own recipes, and adjusting recipes from a book or the web to fit your own brewing style and equipment.

Recipe Design Fundamentals

Over the years, I've come to realize that even experienced brewers misunderstand the basic principles of beer recipes design. In this chapter we're going to introduce some methods to design some great beer recipes at home. What follows is an overview of what I consider the essence of beer recipe design.

Starting a New Recipe

When I build a new beer recipe, I almost always start by picking a target beer style. This is not to say that the style defines the whole beer as there is plenty of room for interpretation and creativity, but by starting with a beer style, you establish the baseline for the beer you are going to brew.

A good starting reference is the Beer Judge Certification Program (BJCP) style guidelines (from the web site **bjcp.org**). This beer style guideline provides detailed specifications and suggested ingredients for nearly 100 different styles of beer. These guidelines also provide ranges for typical bitterness, color and original gravity for the beer that can help you achieve the appropriate balance for the beer.

Choosing the Ingredients

The next step in designing the beer is to pick appropriate ingredients. Beer is made from malt, hops, water and yeast (occasionally with a few spices). Before you jump to doing detailed design, do a bit of research to determine what ingredients in each category are typically used your target beer style, and in roughly what proportions. For proportions, I prefer to work initially in percentages such as 80% pale malt, 15% caramel malt and 5% chocolate malt – this makes it easier to scale things later on.

The BJCP style guide provides some information on typical ingredients used, but often does not have detailed breakouts of proportions. The style articles in the latter half of this book do provide more detailed information on the history of different beer styles and percentage of ingredients used. A number of online beer recipe sites have some great examples, though one must be careful when using someone else's recipe as often they are far from the traditional or historical beer style.

Another great resource is brewing books – one of my favorites is Ray Daniel's book Designing Great Beers, which has detailed analysis of percentages of ingredients used in award winning and commercial beer examples for many styles. Finally, you can often find articles or messages for a particular beer style using a simple web search or search on an online discussion forum.

The goal of all of your research is to determine ingredients appropriate to the style. Using the wrong ingredients, or selecting the wrong proportions will result in a beer with the wrong flavor and balance. For example, an English Bitter with American citrus hops would be atypical and likely deemed outside of the traditional style. You will rarely go wrong using ingredients that are authentic to the style.

Brewing by the Numbers

Once you have your ingredients selected, and have them apportioned in roughly the correct way it's time to actually enter the beer into a spreadsheet or program such as BeerSmith from **BeerSmith.com**, and run the numbers. This is an important step, which many beginning brewers skip, but if you don't have the recipe properly adjusted and balanced for your equipment and your settings you will likely end up way off your target style.

The critical parameters to look at as you enter and adjust your ingredients include the following. We're going to cover many of these in additional detail later in this chapter.

- **Original Gravity (OG)–** A measure of how much fermentable and unfermentable malt you have added to the beer. You measure the original gravity of your unfermented wort using a hydrometer after you transfer the beer into your fermenter. The original gravity typically determines how much potential alcohol you will have in the beer, as well as how malty the beer will be. The style guideline provides a range for this parameter.
- **Bitterness (IBUs) –** Bitterness from hops balances the flavor of your beer. For beer design, you want to estimate your bitterness in International Bitterness Units (IBUs). We will cover calculation of IBUs later in this chapter. Again you want to use the style guideline to determine the appropriate IBU range.
- **Color (SRM) –** You can estimate the color of your beer from the ingredients using a calculation we will cover shortly. Estimating the color is important, as you don't want your pale ale to be black or your stout to be blonde in color. Obviously darker malts add color.
- **Bitterness Ratio (IBU/GU) –** The bitterness ratio gives you a rough measurement of the bitterness to malt balance for the beer. A hoppy beer will have a high bitterness ratio,

while a malty beer will have a low one. We will show you how to calculate the bitterness ratio shortly as well.

- **Final Gravity (FG) –** Final gravity is measured with a hydrometer after fermentation is complete. While it is very difficult to accurately predict final gravity ahead of time, I often look at the final gravity for the style to get an idea of the attenuation needed from the yeast. Some styles require high attenuation yeast to achieve a smooth clean flavor, while others need low attenuation yeasts for complex flavor.
- **Carbonation** – The carbonation of the beer should match the style. Carbonation is measured in volumes (vols), where one volume would essentially be a liter of carbon dioxide gas dissolved into a liter of beer. Fermented beer at room temperature with no additional carbonation contains about 1.0 volumes of CO2. Authentic English ales are often served with little or no carbonation (1.5-2.0 vols) while many German beers are highly carbonated (up to 3.0 vols). If you research the style, you can often determine the correct carbonation level for the beer.

Brewing Techniques

After you have the proper ingredients and have balanced the recipe by the numbers, the final step is to look at the techniques needed to brew this style of beer. Different styles definitely require application of a variety of brewing techniques. Some of the techniques we will cover in the coming chapters include:

- **Hop Techniques** – A variety of hop techniques are available, most of which are covered in the upcoming chapter on hops. Examples include first wort hopping, dry hopping, late hop additions, bittering hops, and use of a hopback. Different beer styles require different methods to achieve the appropriate balance.
- **Mash Techniques –** For all grain and partial mash brewers, adjusting your mash temperature is critical to achieving the

appropriate body for your beer. Lower mash temperature during the main conversion step will result in a lower body beer and higher mash temperatures result in more body. In addition, advanced brewers may want to consider techniques like decoction mashing or a multi-step mash if appropriate to the style.

- **Fermenting, Lagering and Aging –** The temperature for fermenting your beer should be appropriate for the yeast and beer you are using. Yeast manufacturers listings as well as most brewing software include appropriate temperature ranges for fermentation of each type of yeast strain. Aging and lagering should also match your target style.

Beer design is clearly one part art, and one part science, which is what makes it an interesting and enjoyable hobby. However, if you do your homework, select quality ingredients, run the numbers and follow good brewing techniques you can make fantastic beer at home using your own recipes.

Understanding Beer Color

Beer spans an endless array of colors. The deep black color and white foam of an Irish Stout, deep copper of a Pale Ale and cloudy light color of a Bavarian Wheat are all within the rainbow we call beer. In this section, we'll look at beer color, how it's measured, color limitations, and how to estimate the color of a beer recipe.

The History of Beer Color

The system used to characterize beer color has its origins in the late 1800's. The original lovibond system was created by J.W. Lovibond in 1883, and used colored slides that were compared to the beer color to determine approximate value. For decades, beer was compared to colored glass standards to determine the Lovibond color, and we still use the term "Degrees Lovibond" extensively today to describe the color of grains.

Over time, limitations of the Lovibond were recognized, not the least of which was that it depended upon a person's vision – which naturally has variations in color perception from person to person. By the mid-20′th century, light spectrophotometer technology was developed. In 1950 the ASBC adopted the Standard Reference Method (SRM) color system. Separately the Europeans developed another visual system called the European Brewing Convention (EBC). It originally used visual comparison, but some 25 years later changed to use a spectrophotometer in a slightly different way than SRM.

Measuring Beer Color

The SRM color of beer is measured using a ½" glass cuvette measured by a spectrophotometer at a light wavelength of 430nm. The SRM color is approximately 10 times the amount of absorbance, which is measured on a logarithmic scale. The SRM color is approximately equal to the old lovibond scale in most cases. The other common method, called the European Brewing Convention (EBC) is measured at the same wavelength but in a smaller 1 cm cuvette. In practice the EBC color is approximately 1.97 times the SRM color. (EBC = 1.97 * SRM).

If you don't have a spectrophotometer handy in your personal laboratory, a number of tools are available to help you measure the color of your beer. The most popular and easy to use is a beer reference color card, such as the Davidson guide, to do a visual comparison of your beer against standard reference colors. I recommend purchasing such a guide or color card from your local store. I don't recommend printing an online color card, as the variations in printer color will spoil your measurements.

Another method involves diluting your beer with distilled water and comparing it to known color standards such as mass produced commercial beer. Ray Daniels describes using commercial beer references in detail in his chapter on beer color from his book Designing Great Beers.

Estimating Beer Color for a Recipe

As a home brewer, I'm very interested in how to estimate the color of my beer for a given recipe in advance of brewing. In practice, good home brewing software like BeerSmith will automatically estimate the color of your recipe as you build it, but I think it is still useful to know what is going on under the hood.

A first iteration at estimating beer color involved simply calculating the Malt Color Units (MCUs) of a recipe.

MCU = (Weight_grain_in_lbs) * (Color_of_grain_in degrees_lovibond) / (volume_in_gallons)

For multiple grain additions, you can simply calculate the MCU for each addition and add them together. MCU provides a good estimate of SRM color for light beers, but starts to diverge as beer color exceeds 6-8 SRM, because light absorbance is logarithmic and not linear. For a more accurate estimate that holds for darker beers up to about 50 SRM, we turn to the Morey equation:

SRM color = 1.4922 * (MCU ** 0.6859)

The Morey equation provides an excellent estimate of beer color throughout the range from 1-50 SRM, and is the one used by most brewers today.

Limitations of Beer Color and Color Estimates

No matter how accurately your color estimate or measurement is, you need to recognize that all existing beer color systems have very real limitations. The SRM color system, for instance, is measured from the absorbance of a single wavelength of light. It can't tell the difference between similarly colored red beers and amber beer, for example. The subtle hues of red and brown may look identical at the 430nm wavelength.

In fact, it is not possible to specify the precise color of a beer with a single "beer darkness number" such as SRM. The subtle variations in red, brown, gold, copper and straw can't be captured in a single dimension beer color system. Irish Red is a good example – if you do an estimate of the color for an Irish Red you will likely get something that does not look very red at all on the color card. Yet, the addition of a tiny amount of roasted barley gives it the distinctive red hue that the SRM system simply can't capture.

Extract brewers need to be aware that liquid extracts in particular tend to get darker as they age, and also that extracts will darken in a process called carmelization as they boil. Both the aging of extracts and carmelization were covered in chapter 2. The net result of the aging and boiling effect is that many extract beers come out substantially darker than an estimate would indicate.

In practice, these issues are not a problem for the average home brewer, but commercial breweries often use coloring agents, mixing of batches and other techniques to achieve very precise color matching from batch to batch. For a home brewer, it is enough to know that a color estimate has limitations.

Hop Bitterness

How much beer hops is enough? It is important to understand the quantity of hops you need to properly balance your home brewed beer. Hops are a precious and often expensive commodity. Knowing exactly how much to use for your target equipment and beer style can save you a lot of money and enhance the quality of your finished beer.

Home Bitterness Units

My first book as a homebrewer was Charles Papazian's excellent work The Complete Joy of Homebrewing. In his book he introduces the Home Bitterness Unit (HBU) defined simply as the number of ounces of hops times the alpha content for that hops. Fuggles hops have an alpha acid content of about 4.5%, so 2 ounces of Fuggles hops would be 9 HBUs.

While HBUs are easy to calculate for beginners, they are not very accurate. An accurate estimate of bitterness depends on important factors like the size of the batch, size of the boil, original gravity, and boil time for the hops. HBUs just don't do it!

A much more accurate method to determine beer bitterness is the International Bitterness Unit (IBU). An IBU is measured directly using a formula with a spectrophotometer and solvent extraction. Professionals and advanced brewers use IBUs estimates exclusively to help them design world class beers.

Beer Style guides such as the BJCP Style Guide (**bjcp.org**) list the bitterness range in IBUs for dozens of beer styles. This provides an excellent guide for anyone who wants to know how much hops to add for a particular beer style. You can adjust your bitterness in IBUs to be within the beer style range.

Estimating IBUs

Measuring the actual IBU content of a beer requires a laboratory. As a practical substitute for an elaborate lab, home brewers use equations to estimate the IBU content of their beer. A simplified equation from Ray Daniel's Book Designing Great Beers for IBUs is:

IBUs = U% * (ALPHA% * W_OZ * 7489) / (V_GAL)

Where U% is the hop utilization in percent, ALPHA% is the percent alpha for the hop variety, W_OZ is the hop weight in ounces, and V_GAL is the volume of hops in gallons. This gives the IBUs for a single hop addition. If you have multiple hop additions, you need to add up the IBUs from each.

In this equation, the utilization percentage (U%) is the one factor that varies depending on equipment used, brewing methods used, boil time, boil size, and boil gravity. The variations between different hop estimation equations basically come down to different ways of estimating the utilization.

Hop Utilization: Practical Application

If your eyes glaze over looking at IBU equations – here's a practical guide. Hop utilization increases with boil time, so the longer you boil your hops the more bitterness and IBUs you will add. Late addition hops (boiled for 5-10 minutes) add very little bitterness, and are used primarily for aroma. Bittering hops are usually added for the full boil time (60-90 minutes).

Hop utilization also increases as you lower the gravity of your boil. If you are brewing a high gravity beer, or an extract brewer using a partial batch boil (small pot) you will get much lower utilization. This is why extract brewing requires more hops (in general) than all-grain brewing. Since different brewers use different equipment, it is important to take into account your own boil size and boil gravity when estimating the bitterness of your beer.

IBU Estimation

Three equations to estimate utilization (U%) and IBUs are most often used: Rager, Tinseth and Garetz. The equations differ in the way that they estimate the utilization percentage described earlier. Rager is most often associated with extract and partial mash brewers. The Rager equation takes original gravity of the boil into account, and tends to produce IBU estimates that are on the high side of the three equations.

Tinseth is often associated with all-grain brewers, or brewers that do full batch boils. It generally produces lower IBU estimates than Rager, but is considered very accurate. Many all grain brewers use Tinseth by default, though if using BeerSmith you can change this from the Options dialog. The Garetz equation is less popular than the other two methods, but generally provides estimates somewhere between Rager and Tinseth.

I won't go into the details of calculating each equation. A quick web search on any of these methods will yield a number of online calculators and spreadsheets. In addition, all major brewing software programs including my program BeerSmith offer the ability to estimate IBUs directly from the recipe. I recommend using a program or spreadsheet, as the complexity of multiple hop additions and late extract additions make it tedious to calculate by hand.

It's important to understand that the three estimation methods will provide widely varying results in some cases. Each provides only an estimate of bitterness, and none are perfect or all encompassing. I would not spend too much time worrying the differences. Choose a single estimation method and stick with it.

How Much Hops is Enough?

Now that we understand the basics of calculating IBUs, we come back to the original question of how much is enough? The answer varies by the style of beer we are targeting. The bitterness needed for an Imperial Stout is dramatically higher than a simple Pilsner. In general, beers with higher gravity need more bitterness to offset the maltiness of the beer. Similarly styles such as India Pale Ale where bitterness is a significant flavor component require more hops.

Fortunately, a number of beer style guides offer IBU ranges needed to achieve a particular beer style. The Beer Judge Certification Program (BJCP) maintains the most widely used US style guide. The 2008 BJCP Style Guide provides detailed

IBU ranges for dozens of popular beer styles from around the world. Other countries also have beer style guides that provide similar information. Programs like BeerSmith have the style guide built in for easy reference when designing a recipe.

Let's look at a BJCP example: From the standard, an American Amber Ale should have between 20 and 40 IBUs. If we target the middle of the range, 30 IBUs is about right. Using a spreadsheet or brewing software, it's easy to adjust your hops quantity and boil times to reach that target.

Balancing your Beer with the Bitterness Ratio

The balance between bitter hops and sweet malts has always been important in crafting world class beer. Here, we take a look at the bitterness ratio and how you can use it to improve the balance of homebrewed beer recipes.

The sweetness of malted barley and specialty grains must be offset by bitterness. Early beers used all kinds of herbs including ginger, caraway, cinnamon, citron, coriander, juniper, mint, myrtle, saffron, hysop, dill, thistles, and many others to counterbalance the sweetness of malt. Most modern beers use hops for bitterness, though some specialty beers like Belgian Wit still make use of other spices.

The Bitterness Ratio

The idea of trying to quantify the hop bitterness to sweet malt balance is also not new. English brewers regularly used "pounds of hops per quarter of malt" over the last several hundred years to characterize the hops-malt balance. Modern brewers started using the modern equivalent, called the bitterness ratio or BU:GU ratio many years ago. The measure, determined by simply dividing the number of IBUs in a beer by the number of gravity units, provides a rough estimate of the balance between hop bitterness and malt sweetness. It is featured in Ray Daniel's Designing Great Beers book where he lists the average bitterness ratio for many popular styles.

To calculate the bitterness ratio we start with the number of international bitterness units or IBUs. For example, let's say we start with a beer that has 30 IBUs and original gravity of 1.048. We take the fractional portion of the original gravity (0.048) and multiply by 1000 to get the number of gravity points. In this example 1.048 would simply be 48 points. Now we take 30 IBUs and divide by 48 points to get a bitterness ration of 0.63. If you are using BeerSmith, the estimated bitterness ratio (IBUs/OG points) is displayed just below the color on the recipe design page.

The Bitterness Ratio and Beer Styles

Obviously the bitterness ratio needed varies depending on the style of the beer. A hoppy India Pale Ale is going to have a much higher target bitterness ratio than a barely hopped Weizenbier. To determine the correct target bitterness ratio, one needs to know the average IBUs and starting gravity for different beer styles. Fortunately, the BJCP style guideline provides just such a resource. To calculate your target average style BU:GU ration, determine the average IBUs for the style guide and divide by the average OG points for the style. I've calculated the average bitterness ratio for a few popular styles here from the 2008 BJCP guidelines:

- American Amber: 0.619
- Bohemian Pilsner: 0.800
- Oktoberfest/Marzen: 0.449
- Traditional Bock: 0.346
- Blonde Ale: 0.467
- California Common: 0.735
- Ordinary Bitters: 0.833
- American Pale Ale: 0.714
- Brown Porter: 0.576
- Dry Irish Stout: 0.872
- English IPA: 0.800
- Weizen/Weissbier: 0.240

- Belgian Trippel: 0.375

The above is just a sampling, but gives us some idea of the range of average bitterness ratios for different styles. A higher bitterness ratio corresponds to more bitter beers overall. Not surprisingly many of the malty or high wheat German beers such as Weizen and Bock have low average bitterness ratios (0.240-0.345), while IPAs, Pale Ales, and those with high concentrations of dark malt such as stouts have much higher average ratios of 0.800 or higher. Other popular styles lie in the middle range of around 0.500, such as Oktoberfest, Porter, and Blonde Ale.

The bitterness ratio does not tell the whole story, as it does not take into account the individual grains making up the grain bill. For example Oktoberfest/Marzen has a malty flavor from its Munich malt grain bill base that is not reflected in its mid-range BU:GU ratio. Irish Stout, which requires a higher BU:GU ratio to balance its high concentration of black/stout roast malt has a relatively high 0.872 bitterness ratio, but the dry flavor of the roasted malt dominates the flavor profile over hops bitterness.

Calculating the bitterness ratio for a given beer and comparing it to the average for your target beer style can help to create a beer with an appropriate flavor balance, especially when traditional ingredients are used. I personally like to do a sanity check on my bitterness ratio against the style guide to make sure I'm in the ballpark when creating a new recipe.

Ten Reasons to Use Home Brewing Software

Many homebrewers are not aware of how brewing software can dramatically improve the quality and consistency of their home brew. Brewing without doing the math is kind of like shooting darts blindfolded, and software makes the math much easier. Here, we take a look at some of the ways brewing software like BeerSmith can make a difference in beer design and how it can improve your brewing day.

- **Design Great Beer in Minutes** – Building a recipe with beer software is as simple as picking the ingredients you want from a list. A typical package has several hundred varieties of hops, grains, yeasts and more that are pre-entered for your use. Picking from a list of ingredients is much easier than thumbing through a set of reference books and tables.
- **Brew Consistently Good Beer** – By tracking your ingredients, recipe used, original gravity and taste of your beer you can improve your brewing process and make more consistent, better tasting beer. You can keep track of old recipes, see how changes affect your color, gravity and bitterness, and design better beers.
- **Brew the Style you Want** – Brewing software lets you select a target beer style and match the color, bitterness and suggest ingredients as you build the recipe. As you add ingredients, the software estimates each of these and lets you compare the current values to the style you selected. This will help you come much closer to your target beer style the first time out.
- **Share Recipes** – Brewing software that supports open standards like BeerXML give you access to thousands of recipes online that you can download, import and customize to your taste. Many of the popular packages have dedicated recipe sites available. You can also email recipes to your friends, post them on a web site or share them in a variety of formats.
- **Get Step by Step Instructions** – Software like BeerSmith will generate step-by-step instructions customized for your recipe, equipment and methods. No fuss, no worries. After you enter your recipe you can get specific brewing instructions generated by the program with a single click.

- **Stay Organized** – Keep all of your brewing records in one place. Keep a brewing log of your past brewing sessions, schedule your next brew, record new ideas and manipulate recipes from the web. Refine your favorite recipes to perfect your brewing technique.
- **Match your Brewing Equipment** – The equipment you use to brew has a huge impact on the taste of your beer. With brewing software you can set up your equipment settings once and apply that to any recipe to get accurate calculations and estimates.
- **All Grain Made Easy** – Modern equipment and ingredients have made all grain brewing more accessible than ever. Infusion mashing for all-grain brewing involves a fairly complex set of calculations to determine the amount and temperature of water to be added at each step. In BeerSmith, you just pick the infusion profile you desire and the software provides detailed instructions that match your equipment and ingredients.
- **Manage Inventory, Track Prices and go Shopping** – The best brewing software includes tools to manage your inventory of ingredients, determine the cost of each brew and even generate shopping lists for a particular recipe for your next trip to the store. This makes it much easier to keep track of what you need and avoid those extra trips to the store.
- **Software Costs Less than a Batch of Beer** – Brewing software is cheap – typically from $20-30 for the top commercial packages. One bad tasting batch of beer costs more.

Converting All Grain Recipes to Extract

As an extract brewer and beer designer, you may quickly find that many of the beer recipes in books and on the web are designed by all grain brewers. Beginning brewers start with extract recipes but serious enthusiasts eventually make the switch to all-grain. Yet it is the expert brewers who write all of the brewing books and publish a large portion of recipes online. This can leave many extract brewers out in the cold.

Fortunately you can convert all grain recipes into extract recipes, often with very good results. The basic process for converting an all grain recipe to extract is as follows:

- Convert the base malt (usually pale malt grains) to an equivalent amount of extract
- Adjust the color of the beer down to match the original color
- Dial the hops up to match the IBUs of the original recipe

Converting a recipe is best done with the aid of brewing software or a good spreadsheet since you need to be able to adjust the original color, IBUs and original gravity estimates. At the end of the article, I will cover exactly how to do this using BeerSmith in a single step.

Converting Grains to Malt Extract

For the first step, convert your base malt to extract. The base malt is easy to identify, as it is the largest ingredient in the beer – typically 5-10 lbs (2.3-4.5 kg) of pale malt. For example, let's look at an all-grain ale with 8 lbs of pale malt and 1 lb of crystal malt. The simplest base malt conversion is to just multiply the number of pounds of pale maletby 0.75 to get the pounds of liquid extract. Therefore, 8 pounds (3.6 kg) of pale malt becomes 6 pounds (2.7 kg) of liquid extract.

An equivalent conversion for dry extract is 0.6, so 8 pounds (3.6 kg) of pale malt becomes 4.8 pounds (2.2 kg) of dry malt. A more accurate conversion would actually take the potential of the grain and extract into account when converting malt, but this level of precision is rarely needed.

To simplify things, we leave the specialty malts (1 lb of crystal) alone and switch to steeping them instead of mashing them. Some specialty malts (notably wheats, Munich malt, flaked and terrified grains) cannot be steeped and need to be replaced with a reasonable substitute. For example, those grains listed in our online grain listing as “must mash” should not be steeped. The same is true if you have a large proportion of specialty malt.

A good rule of thumb is you should steep no more than 3-5 lbs (1.3-2.3 kg) of specialty grains in the final extract recipe. Obviously you want to choose your malt extract to match the original color and style of the beer. If you are converting a wheat beer, choose a wheat extract. Beers with large amounts of Munich malt require a Munich extract. If you are making a light colored beer, pick the palest extract you can find. Pale extract is always a good starting point.

Matching Beer Color

Once you have your base malt converted, the next step is to match your color. Malt extracts are significantly darker than the equivalent pale malt due to darkening in extract production and storage, so you will need to reduce the color and quantity your specialty malts to match the same color as the original beer.

To manually calculate the color of both your original beer and the final beer you can refer to the section on beer color. However, I recommend using your favorite brewing software or a spreadsheet to simplify the process.

If you don’t have home brewing software, the best way to match the color of the original is really by trial and error. You can swap the existing specialty grains with lighter color grains (try 40L Crystal as a substitute for 60L Crystal malt for example), or you can reduce the amount of your darker colored specialty grains until you match the color of the original recipe.

Some very light colored beer styles such as Koelsch may be impossible to precisely match using malt extract simply because commercial malt extracts are much darker than equivalent pale malt grains. In these cases, try to get as light as you can and consider using malts such as Carafoam (if appropriate) to replace crystal malts if appropriate to further reduce the color.

Adjusting Bitterness

The last step is to match the bitterness (IBUs) of the original beer. When going from all grain to extract this involves adding more hops because partial batch boils result in lower hop utilization than full batch boils used by all grain brewers. Some use a rule of thumb such as "add 20% more hops" but it is far more accurate to calculate and match the IBUs for both versions.

Again a spreadsheet or program is needed to calculate the International Bitterness Units (IBUs) of the original beer and final beer. Don't use HBU's (Home Bitterness Units) here since the boil sizes between all grain and extract brews are much different. Before starting, make sure you have the correct boil size both for the original beer and converted recipe set correctly when calculating IBUs. All grain brewers use full size boils of 6+ gallons (23 l) for a 5 gallon (19 l) brew, while extract brewers use much smaller boils of 2-3 gallons (7.6-11.3 l) for 5 gallons (19 l) of beer. This has a large effect on hop utilization in the IBU calculation.

Once you have both calculations set up, simply increase the hop additions incrementally until you reach your target bitterness. You now have an extract beer recipe that will closely match your all grain recipe.

You can use the above three step guide with any brewing software or well designed spreadsheet to manually perform the three steps (convert base malt, adjust color, adjust bitterness).

If you wish to convert back (extract to all grain), you can follow the same three steps, but this time divide by the conversion factor: 6 lbs (2.7 kg) of pale extract/0.75 = 8 lbs (3.6 kg) of pale malt.

BeerSmith has a nice conversion wizard built in to do all three steps in one shot. Open the recipe you want converted, click on the 'Convert Recipe' toolbar button. Select the type (All Grain, Extract, Partial Mash) of conversion you wish to perform. Pick the target equipment profile you wish to convert to (since your extract equipment likely has a much smaller boil pot) and press the OK button. The program will perform all three steps and give you the finished recipe. It is a very handy feature if you have recipes from a book or the web that you wish to convert quickly.

Thanks Again!

I hope you enjoyed reading Chapter 3 – you can get the rest of the book in paperback or for the kindle using the link on our main web page:

And again, you can help me out by retweeting the book announcement here: