BREWING INGREDIENTS: MALT
UNDERSTANDING MALT LINGO

BY DAVE GREEN

There are plenty of technical terms that surround the cereal grains that we brewers use as a source of sugar to make beer. Understanding the brewing jargon used when talking about malt can be very helpful. This column assumes you have a basic understanding of mashing already. If you would like to learn more on the basics of mashing, visit https://byo.com/article/your-first-all-grain-beer/

MALTING TALK

Most of the grains that brewers use are of the malted variety. The malting process takes the raw, whole-grain berries, another term for the raw seeds of the grain, and begins the germination process of the berry. Malt- ing is most often done on barley, but wheat, rye, and oats, are a few other popular grains maltsters will utilize. As the grain begins to become metabolically active, it sprouts or chits in malting lingo; some grains that are just barely modified before kilning are called chit malz. The germination process lasts about 3-4 days before it is halted at a certain point when the germination has progressed as far as the maltster requires. At this point the grains are kilned, or dried. Some specialty malts are roasted to varying degrees in a drum roaster, and others are changed by stewing before roasting. Stewing involves taking the newly germinated grains and raising the temperature into the same range that brewers mash their grains. This effectively converts almost all the starch in the grain to sugar prior to the drying/roasting process.

GET A REACTION

There is a class of chemical reactions that occurs in the malting process that every homebrewer should understand, a process known as the Maillard reactions. Maillard reactions create the lion’s share of the characteristic malty flavor and aroma compounds found in beer. Maillard reactions combine a sugar molecule with an amino acid to produce hundreds of flavor-active compounds. The aromas generated from the Maillard reaction intensify as the reaction progresses as temperature and/or roasting time increase. The progression of Maillard reaction products begin with cracker and light toast aromas, then into the caramel, toffee, honey, nutty realm, and finally into roasted aromas like chocolate, coffee, and burnt bread. Maltsters can adjust their process to guide their roast towards different sets of these Maillard reaction products.

Maltsters provide the color contribution of the malt in degrees Standard Reference Method (SRM) (which is based on the Lovibond (°L) scale), or in European Brewery Convention (EBC) units. Utilizing a good calculator, homebrewers can take the color contribution from each malt in the mash and combine them to come up with a general idea of the final beer color via the Morey equation. While this can give brewers a rough idea of the final color of a beer, it has its limitations such as not being able to distinguish brown hues versus red hues.

FEEL THE POWER

One of the most important concepts to understand is diastatic power of a malted grain. So what is diastatic power? It’s basically the grains’ ability to convert the starch into sugar via enzymes, particularly alpha amylase and beta amylase. The more amylase enzymes found in the malt, the more diastatic power. The highest level of diastatic power is found in green malt, in other words malt that has just finished with the germination process. Once the malt enters the kilning process, this level begins to drop as the heat from the kilning process tears apart these enzymes. In general, base malts will have enough diastatic power to convert the starch found in the mash in addition to starch from adjuncts, so long as the brewer does not dilute the base malt enzymes too much. If brewers are using lots of grains with little or no diastatic power, they may want to extend the mash time.

MEET THE FAMILIES

Steeping grains and mashing grains are two distinct classes of grains that homebrewers should familiarize themselves with. Steeping grains are generally limited to two families of grains, dark roasted grains (such as chocolate malts, black malts, and roasted barleys), and caramel malts (such crystal, cara-types, and Special B/Special W). Basically all other grain families fall into the mashing class, including base malts (such as Pilsen, pale, Vienna, and Munich), roasted malts (such as Biscuit, Victory®, and brown), specialty malts (such as acidulated and rauch), unmalted grains, and miscellaneous malts (like wheat, rye, and oat).

Here’s a truism for you: Mashing grains should be mashed. That’s not to say they have to be. Extract brewers can use them to add some flavor from their Maillard products; just don’t expect much sugar contribution from them if they are simply steeped. Mashing grains contain high levels of starch that brewer’s yeast cannot eat, but other microbes can, which creates an instable beer. Starch can also create a haze in the beer. Partial mashes are a great method for extract brewers who would like to try a mash, without the need for specialized equipment. For more on mashing versus steeping, visit https://byo.com/mr-wizard/101/.
Malt, hops, yeast, water. There have been extensive studies into each of these ingredients and their impact on the final beer product, but often it is the large flavor contributors such as hops, yeast, and specialty malts that get the most attention. While the influence of base malts in the final beer product might be subtle in comparison, it still will have an effect on your beer and knowing how they impact the final product can help you to better predict how your final beer will turn out. Base malts are exactly as they sound, the foundation the beer is built on. They are the major contributor of the carbohydrates (from starch), proteins, and enzymes in the beer. They are the workhorse of a malt bill and sometimes are just treated as such, but just because they are used primarily as a carbohydrate and enzyme source, that does not mean they are all interchangeable. Base malts have their subtle differences as well, and often there is a good reason why a specific base malt was used in a given recipe. Knowing the differences in the malts can help you choose the right base malt for your brew.

2-ROW VS. 6-ROW MALT

The first aspect to consider in choosing a base malt is whether it is a 2-row or a 6-row malt. Outside of the US, 2-row is basically the standard for all base malts, and you would be hard pressed to find a 6-row malt for brewing. Even in the US, for the most part, base malts will almost always be 2-row for a number of reasons. 2-row grows fewer grains on the head of the barley (2 per head instead of 6 per head). This allows the grains to grow plumper, and will typically result in a larger and more consistent grain size. 6-row on the other hand will usually grow different sizes of grains, partly because the barley head is more crowded, but also because the grains grow in pairs directly across from each other on the head of the barley, and often times two of the grains on the head grow larger than the rest. This leads to an inconsistent grain size with some of the grains being larger than the rest. Because of the larger grain size in 2-row malt, it is described as having a mellower/maltier flavor whereas 6-row is described as having a grainier flavor. 2-row also has a higher starch content and can produce a higher extract, which is one of the reasons it is often the barley of choice for most maltsters.

The grainy flavor of 6-row is partly due to the higher husk-to-malt ratio of the grain. The husks contain a majority of the tannins, polyphenols, and proteins in the malt, so with a higher husk ratio, you will extract more of these qualities in the produced beer. One advantage of the higher husk ratio of 6-row malt is in building the filter bed during the lautering process. Having more husks helps to build a better filter bed, so 6-row malt is often easier to lauter. 6-row malt also has higher enzymatic activity and it is a good choice when using adjunct starch sources or a large ratio of highly under-modified malt due to its increased enzymatic activity. That is one of the reasons why it is often the choice of large production breweries. Large breweries will use cheaper adjuncts such as corn and rice, and they need the increased enzymatic activity to fully convert the adjuncts. Another reason they will choose 6-row malt is that it may cost less than 2-row malt depending on where the brewery is located. The cost savings comes from the fact that more grain is produced per barley stalk than 2-row, so you can produce more malt per acre of planted barley, which lowers the cost per pound of the finished product.

As mentioned before, for the most part you will only be using 2-row malts in brewing, but 6-row does
have its place in beer production so it is good to be aware of its characteristics.

One final note, malted barley is not always going to be the only source of starch in a mash. Some styles will often call for other grains such as rye, oats, sorghum, and wheat. These will need the enzymatic activity from the malt to convert the starches, or enzymes will need to be added. If you are looking for a high ratio of adjunct grains, and you are not adding any extra enzymes, consider using 6-row malt for its higher diastatic power.

DIFFERENCES IN BASE MALTS

Another aspect to consider is the origin of the base malt. Outside of the US, base malts will almost exclusively come from 2-row barley, and can have slightly different flavor characteristics. There are a number of reasons that the flavor can differ in base malts of the same style, including where the barley is grown (terroir), what barley variety the maltster uses, the malting and kilning process the maltster uses, what characteristics the maltster is targeting, what moisture level the maltster is targeting, and many more choices that the maltster will make.

Without going into too much detail about malt production, the maltster will determine the best way to produce a malt that falls within specification, and as consistent as possible with their previous malt batches. The maltster will work closely with the farmers, and usually will receive and test the barley before committing to using it for malting. They will be looking for a number of parameters including, but certainly not limited to, dormancy of the malt, protein content, moisture content, and grain size. The maltster goes through a lot of hard work to produce a high-quality, consistent base malt, and will oftentimes make adjustments on the fly to ensure that the malt is within specified parameters.

A good starting point in choosing which base malt to pick for your beer would be looking at the data the maltster provides. They will often give an accurate description of the malt itself, and what characteristics you can expect when using their malt. Along with flavor descriptors, a maltster will provide some other specifications about the malt. The specifications may vary slightly depending on what methods were used, for example ASBC, IBID or EBC, and how many tests the lab decided to perform, but typically you can find information on the target range or minimum/maximum of specific qualities of the malt such as color, moisture, protein totals, expected extract, and usage rates. There may be more or less information, again depending on what the lab is testing for, but these characteristics are generally tested with most base malts and can offer some valuable information. In general, lower moisture malt will hold up better for storage. Higher protein can help with better head retention in the beer, and can offer greater nutrition for the yeast during fermentation. This information can give you an idea of how the malt will impact the final beer outside of its flavor and aroma contributions.

There are some general guidelines you will find in malt from various malt growing regions. North American malts can sometimes have an earther and grassier characteristic, but for the most part are considered fairly neutral. British malts are often described as being more biscuity, bready, and malty. Maris Otter, a barley variety often used in British malts, is a perfect example of the sweet, biscuity flavors that you will get in British malts. German malts can have a mild malty and sometimes slightly medicinal phenolic characteristic.

If you are looking to replicate a specific style, it can be a good idea to try and get base malt from that region the style originated, as that is most likely what the brewers producing that style are using. It is one of the best ways to try to be true to style, although imported malts will usually come at a higher price than domestic malts so that is something to take into consideration. You can sometimes see price savings buying malt in bulk by the bag, but when committing to a full bag of base malt you will want to be sure you find something that you like and converts well.

If you are new to the different base malts, one of the best ways to understand them is to get your hands on the different varieties and give them a taste. If possible, try to get a few samples of the same style (I would recommend pale malt or pale ale malt) from a few different maltsters. It can help you to better understand regional differences, and give you a better idea of what base malt you prefer. Certain styles will call for different base malts and using the right base malt will give you the best chance of brewing an awesome beer. Like specialty malts, base malts also come in a number of varieties. These include: Pale malt, Pilsner malt, pale ale malt, Vienna malt, and Munich malt.

PALE MALT

Pale Malt is the most common of the base malts used in beer. It is often called simply called “2-row malt.” This can be a little confusing to new brewers as basically all the malt they will be using is a type of 2-row malt. Just know that if a recipe calls for 2-row malt by name, they are referring to pale malt. Another name for the same type of malt might be the barley variety itself such as Maris Otter.

Pale malt is light in color and usually will be around 2–2.5 degrees Lovibond. It can be used to make basically any beer style and is highly modified so you will not have any trouble getting extract out of it. If you are not sure what base malt you should be using, start with pale malt. It works well in almost all situations. If you are
looking to buy malt in bulk and store it yourself, this is definitely a must-have.

**PILSNER MALT**

Pilsner malt is typically lighter in color than pale malt, falling into the 1.5–2 degrees Lovibond range. It is used for, as you probably guessed, making Pilsner beers — typically traditional German and Czech Pilsners. It has a lighter and crisper flavor than pale malt and the flavor is very subtle so it is best to use this malt with other light malts, or as the entire mash bill.

Within a region, Pilsner malts can sometimes have a bit higher soluble protein content versus other base malts depending on the barley variety the maltster uses, which can provide an added benefit for better head retention in the beer. This may not always hold true when comparing from a single maltster, as oftentimes the maltster is using a single barley variety for multiple malts they produce. You should check the soluble protein of the malt before using it, but if you are looking to add a little extra protein content to your beer, you can consider adding a high-protein Pilsner malt in smaller portions. If you want to replicate a traditional Pilsner style, using 100% Pilsner malt is definitely the best way to go.

**PALE ALE MALT**

Pale ale malt is slightly more kilned than pale malt and will have a slightly darker color. Usually in the 2.5–3 degrees Lovibond range. Pale ale malt has a more full-bodied flavor and you will get more of the malty aromas with pale ale malt.

It is a great choice for almost any ale — from pale ales and IPAs to porters and stouts. This is an especially good choice for English pale ales, and really any beer that you want a bit more body. Pale ale malts often have a sweet or honey characteristic to them as well, but this can vary by maltster so check if the maltster lists honey as one of its malt descriptors if searching for this characteristic.

**VIENNA MALT**

Vienna malt is a bit more highly-kilned than the other base malts, and will really shine with its malty flavors and aromas. It is slightly darker than other base malts and will usually be in the 4 degrees Lovibond range. Even though it is more highly-kilned than the other base malts, it still has enough enzymatic activity to complete conversion on its own.

Vienna malt will typically have a grainy, sometimes sweet, malty flavor and will be much more pronounced than any of the other previous base malts. Vienna malt is typically used in Oktoberfest lagers and Vienna-style lagers.

**MUNICH MALT**

Munich malt is the last on the list and is the most highly kilned of the base malts. Its color can range the most out of the base malts, weighing in anywhere in the 7–30 degrees Lovibond range, so it is good to check the color of the malt before using it as darker Munich malts and lighter Munich malts can have very different characteristics. Lighter Munich malts are less kilned than their darker counterparts so they will have more enzymes still intact and should still be able to convert the mash fairly easily. Darker Munich malts, on the other hand, because of the higher temperatures of the kilning, will have much less enzymatic activity and you should compensate with some other base malts in the mash bill to achieve full conversion.

The flavor of Munich malts tends to be deep grainy/malty, sometimes bordering on toasty depending on how highly they were kilned. Munich malt is usually called for in German-style dark lagers, bocks, Munich dunkels, and Oktoberfest styles.

You might be wondering why Vienna and Munich malts are on the list
of base malts. This is mostly because of their ability to convert starches to sugars and because these malts are used as base malts for classic styles from these areas. They still have enough diastatic power to do the work of base malts. They kind of bridge the gap between base malts and specialty malts and can be used as either. Vienna and light Munich can be used upwards of 100% in recipes, but more often they are used in lower percentages to add some color, body, and flavor to the beer.

**STORAGE**

Finally, a quick note on storage of base malts. Because base malts are not as highly-kilned as other specialty malts, they are usually not able to be stored as long as specialty malts. With proper storage, base malts can start to see loss of quality and flavor after 6 months. Specialty malts, on the other hand, can start to see loss of flavor and quality after 12–18 months.

A base malt that has started to go bad will see loss of enzymatic activity, may be harder to grind, and sometimes can add a haze to the final beer product. Moisture is going to degrade the quality of the malt so storing it in a cool, dry place will prolong the life and quality of the malt. Keeping the malt whole and protected by the husk until brew day is another important step in keeping the quality of the malt the same as when you bought it. If you do need to crush it and then store it, or if you purchased pre-crushed malt, keep it in a dark, cool, extremely dry place, and use it as quickly as possible. Unlike whole malts, crushed malts do not have an intact husk to add an extra layer of protection from excess moisture and can go stale much more quickly.

One quick and easy check is to give the malt a taste. If it tastes stale or unusual, it might have gone bad or be on the downturn. Another quick test would be to weigh the malt to see how much moisture the malt has picked up. If you had an exact weight of the fresh malt (say 50 lbs./22.7 kg) and the malt now weighs significantly more (say 50.5 lbs./22.9 kg) it has picked up moisture and that can lead to mold or undesirable flavors.

Base malts are some of the best to purchase in bulk because of how much of the grain bill typically consists of base malts and the savings that come along with purchasing 50-lb./22.7-kg sacks vs. just enough for each single batch individually. Investing in good malt storage containers can definitely help to prolong the life of the malt. Good storage containers should be made of a strong, durable material (plastic works great), and should be airtight. They should be able to keep out moisture and bugs to keep the malt dry and free of contaminants.

Base malts do more than just add carbohydrates and aroma to the beer, they play an important role in the final beer product. There are many base malt options available (maybe not as much as specialty malts), but knowing the subtle differences and choosing the right base malt can take your beer from great to amazing. Using the correct base malt will also help you to accurately replicate styles from around the world. While big, bold flavor contributors may be seen as the stars of the show, base malts still play an important role in your beer. Knowing the options of base malts available and choosing the right one is the foundation to building an awesome beer. 😊

*Base malts are the foundation beer is built on. They are the major contributor of the carbohydrates (from starch), proteins, and enzymes in beer.*
hat do I mean by the term specialty malts? In fact it is a bit of a vague term, and the best I can do is to say that specialty malts are those malts added in small amounts with the intention of achieving a special effect, such as coloring the beer or giving it a special flavor. As such, their contribution to extract yield is not overly important as compared to base malts. In that sense you can argue that crystal and black malts fit this definition, but we’ve been there, got the commemorative glass, so I will only talk about other specialty malts here.

Most of those I shall cover are either toasted or roasted, and several are quite distinct products and come in only one form, such as amber, brown, Victory®, Special B, and Belgian Biscuit. Chocolate malts on the other hand come in a variety of forms, varying in levels of roasting and color. Many specialty malts simply require steeping to pull out whatever goodies they have, so they are well suited to extract brewing, although some such as amber and brown may require you to do a partial mash. Their importance lies in the fact that their variety, when combined with the range of base malts available, permits you to produce beers with a huge range of flavors, colors and aromas. The possibilities are endless, a point not understood by most wine critics who think that it is their beverage that has the greatest variety of flavors, usually because they are ignorant enough to think there is only one style of beer!

BUSCUIT MALT

Let’s start with biscuit malts. There are three that I am conversant, Briess Victory® Malt, at 28 °L, Belgian Biscuit Malt (20 °L) and Briess Special Roast (50 °L). All of them yield a starting gravity (SG) of 1.022–1.024/lb./gallon (5.6–6.1 °P) at 65% brewhouse efficiency and add biscuit or bready notes to the beer, as well as some brown color. Special Roast is of course more highly flavored and colored than the other two, and is said to give almost a sourdough flavor so it needs to be used with care in paler and more delicate beers. However these malts can be used to your advantage in almost all beer styles, except pale ales and pale lagers. I particularly like to use Victory® malt in an IPA while Special Roast goes well in a robust porter or oatmeal stout. You can add them at the rate of up to 15% of the grist, though I generally prefer 5–10%, depending what other specialty malts are in the recipe in question. In fact, I have used as much as 20% of Victory® malt in an IPA where it is the only specialty malt, and I have been pleased with the results. For extract brewing, these malts are relatively starchy and perform best when mashed with a pale (enzymatic) malt.

MELANOIDIN MALT

Melanoidin malt is a German product and has some similarity to higher dried Munich malts, but is definitely more aromatic and provides a malty fullness in the beer. It has a moderate color at 23–31 °L, but with somewhat of a reddish hue. It will yield 1.024–1.025 SG/lb./gallon (5.8–6.3 °P) at 65% efficiency. It is a malt that is really designed for use in lagers, so that they mimic those produced by decoction mashing. That means that it can be used in most other beer styles where you are looking for a little more body and fullness without adding caramel or roasted flavors such as English bitter, brown ales, amber ales and so on. I also think it helps to soften the roasted aspects of the various forms of stouts. It can be added at rates up to 20% of the grist, but I prefer to limit it to about 10%, especially where significant amounts of other specialty malts are used. Using it in an extract brew would require a partial mash with pale malt to be carried out.

SPECIAL B MALT

Next is Special B malt, a Belgian product that is really a type of crystal malt, but the production process is such that it has a very different flavor from other crystal malts. Special B has been roasted 130–150 °L and has a strong caramel and raisin flavor, but without the roasty notes that may be conferred by crystal malts of a similar color.

Special B gives a relatively low ex-
tract yield of 1.020 SG/lb./gallon (5.1 °P) at 65% efficiency. It is quite versatile and can be used to your advantage in many beer styles, particularly mild, brown and amber ales, English bitter, porters and stouts. It confers a nice warm red hue in all styles except the darker stouts. I like to use it in East Coast IPAs, which tend to be more malty and balanced than their dry, highly-hopped West Coast cousins. It can easily be overdone, for it has a strong enough presence to unbalance the lighter beers and I would limit its use to no more than 5% of the total grist. It requires only steeping for use in extract beers.

AMBER MALT

Amber malt is drum-dried malt, but is subjected to a temperature only somewhat slightly higher than would be the case for pale malt. It is mod- est in color at 20–30 °L, and will give an extract yield of 1.022–1.023 SG/lb./ gallon (5.6–5.8 °P). Amber malt im- parts little in the way of sweetness, but does add some body and a biscuity nuance to beer.

In its original form it was a classic porter ingredient in the late 18th and early 19th centuries, when many porter grist formulations consisted of equal parts pale, amber, and brown malts. Modern amber may well be different in flavor to the earlier type, but can still add complexity, especially in mild, brown and amber ales, and porters, although its flavor tends to be drowned in hoppy beers. Adding it at the rate of 10–15% of the grist in a mash is usually the best way to go and works especially well for a brown porter. Amber malt does contain some starch and must be used in a partial mash along with pale malt if you want to use it in an extract brew. You may want to use it in only small amounts along with the more flavorful brown or biscuit malts.

BROWN MALT

In historical terms, brown malt is the porter malt, for it was quoted as being the sole malt used on brewing porters. It was prepared by drying the green malt very quickly in such a manner that the grain would “pop” as the internal moisture boiled. Modern brown malt is different in that it is drum-dried rather than kilned, and is taken to a higher temperature than amber malt, making it darker in color (50–70 °L), with an extract potential of around 1.022 SG/lb./gallon (5.6 °P) for 65% efficiency. Until recently it was only an English product but Briess now offers their Carabrown® Malt WK, which they quote as being on the light side of the brown malt style at 55 °L.

Brown malt will add sweetness, some biscuity character, some toasted notes, caramel, toffee, and particularly licorice flavors. It contains some starch and can only be used when mashed along with pale malt. I think 20% of the grist would be a good top limit for most beers, but 10–15% would be sufficient in the case of lower gravity beers. Quite obviously it works very well in porters and in all forms of stout, but at lower addition rates it also adds something to mild, brown and old ales. In such cases it will give even better results when used with an equivalent amount of amber malt. I haven’t tried it, but a touch of brown malt might also work well in dark lagers, and even in black IPAs. It will be obvious from the above that you will need to do a partial mash with this malt and some pale malt, along with any other specialty malts you wish to use, in your extract beers.

CHOCOLATE MALT

Chocolate malt is an old favorite, which we all know as a high-roast product coming in at the far end of the spectrum just before the ultimate roasted product black malt. Yet it is not just one product, for the “degree of roast” and the color of chocolate malt covers quite a range and varies from one manufacturer to another.

In general, chocolate malt confers chocolate, nutty and light roasted flavors to beer. But the point I want to make from Table 1 is that the higher the color, the more highly the malt has been roasted and the stronger the flavor effect will be, for a given rate of addition. Indeed, at the very top of the color spectrum this malt comes close to the color of black malt, so the flavor can be expected to be somewhat harsh, with less cocoa-type, or nutty flavors. Note that Weyermann also has their Carafa® Special I, II, and III that are made from de-husked barley, so that for a given color level they will give a somewhat smoother flavor than other chocolate malts. Chocolate malts give an extract yield at 65% efficiency of 1.022 SG/lb./gallon (5.6 °P) and can be leached out by steeping in hot water, so chocolate malt is ideal for use in extract brewing. Just for the record, Weyermann goes even further and makes chocolate wheat malt (300–450 °L), and chocolate rye malt (188–300 °L), although I haven’t yet seen these in any of my homebrewing supplier’s catalogues.

Preeminent in porters and stouts, chocolate malts are usually used at the rate of 5–10% of the grist, depending on the style. But at somewhat lower rates they add something to a whole range of other beers from brown, mild, amber, and old ales to even English bitter in small amounts. The very pale types can also be used in dark lagers, especially doublebock, but the de-husked varieties are even more fitted for this purpose, and indeed are good in any brew where you want chocolate flavor without roasti- ness.

SUMMING UP

There are other specialty malts out there, such as oat malt, rye malt, peated and smoked malts that I have excluded, partly due to lack of space, but also because their use is limited to only a few beer styles. The malts I have dealt with have applications in a wide range of styles, and should be considered whenever you start to work out a new recipe, or want to get something extra out of an old recipe. I have dealt with them separately, but they are more commonly used in combination with one another, which means that the permutations of flavors you can achieve with these malts makes it easy to brew distinctive beers. When formulating a recipe, think carefully as to what you want to achieve, then run down the list of these malts and see if any fit what you are looking for.
The brewer’s mash is the last step of many taken, prior to lautering, to produce wort from starch. The process begins in the malt house where barley is germinated and then dried. Malting gives the grain a rich complement of enzymes that are stabilized by kilning. Brewers must control these enzymes during mashing to produce a wort with specific features.

On the surface the brewery mash appears to be a simple mixture of malt and water. When held hot for a period the mash begins to thin, producing a cloudy, semi-sweet liquid, then transforming into a mixture of clear, intensely sweet wort and spent grains.

Beyond these macroscopic changes lie important biochemical reactions that convert the starch found in the grain into sugar. Malt enzymes act as catalysts, in a sense causing these reactions.

Mashing begins when malt solids dissolve. These solids are primarily made up of starch but also include a significant portion of proteins. Included among the proteins are the catalysts, malt enzymes. The enzymes latch onto mainly starch and smaller carbohydrate molecule chains in a mash, bringing about a chemical reaction. These starch and carbohydrates are called substrates, because they are broken down by the protein-based enzymes during the reaction.

Smaller proteins, smaller beta-glucans (viscous gums that contribute to wort viscosity), sugars, and dextrins (unfermentable carbohydrates that add body to beer) are the products of enzymatic attack and their parent compounds — proteins, beta-glucans, and starch — are called enzyme substrates.

**TAKING CHARGE**

The brewer’s challenge is to let nature travel its free-wheeling road but in a controlled environment.

Mash temperature, mash pH, water chemistry, enzyme concentration, substrate concentration, and product concentration are the mash variables that can be easily controlled.

Mash temperature has a great influence on which enzymes are active, because enzyme activity depends on temperature. Temperature also can cause enzymes to denature and permanently lose their catalytic activity. The principle enzymes involved in mashing all have different optimal temperatures.

Like temperature, mash pH affects enzyme activity. Enzymes must be in specific pH ranges to be active catalysts. In general the mash pH should fall between 5.2 and 5.4, because the enzymes of interest to brewers are active in this range. With most brewing waters and malts mash pH naturally falls in this range, so pH is not one of the mash variables that demands vigilant monitoring.

Other attributes that affect enzyme action are the concentrations of enzymes, substrates, and their products. These features are very important, because they influence the rate at which starch is broken down in the mash. As this reaction proceeds, the concentration of products (such as smaller carbohydrates) begins to build up and can slow down the reactions occurring in the mash. In addition to the speed or rate of the reaction, concentration can affect enzyme stability.

**WHAT DOES IT ALL MEAN?**

The concentration of enzyme, substrate, and product fall under the umbrella of “mash thickness.” Mash thickness is the weight ratio of water in the mash to malt in the mash.

Since one liter of water weighs one kilogram, mash thickness is easily determined when malt is measured in kilograms and water is measured in liters. For example, if 12 liters of water go into a mash with four kilograms of malt, the mash thickness — or if you are British, the liquor to grist ratio — is 3:1. Although this is the most common way of expressing mash thickness, some brewers use the ratio of malt to water and express the ratio as a percentage. In the previous example the mash thickness
could also be called 33 percent malt. In both cases it is simply the weight ratio of water to malt.

Although there are infinite mash thicknesses to use in brewing, three generic ranges of thickness are used in practice. These are the “thick mash,” the “medium-thick mash,” and the “thin mash.” These terms do not define thickness in absolute terms, but they do convey some important messages to the brewer.

THE THICK MASH

In a thick mash the concentrations of enzymes, substrates, and products are all high, since there is a bunch of malt in a little bit of water. In numerical terms a thick mash is anything less than about 2.5 parts water to one part malt. The rule of thumb for mash thickness quoted in many homebrewing books is one quart of water per pound of malt; as a weight ratio that is 2.1:1. That is a pretty darn thick mash!

The thick mash has certain ramifications. The most striking feature is that it provides substantial protection to the enzymes present in the mash. In other words the enzymes are less likely to be denatured (stripped of qualities that allow it to catalyze the desired reaction) by high temperatures. This feature allows beta-amylase and alpha-amylase to work in concert, which is handy for a single-temperature mash. Without the protection of the thick mash, beta-amylase could be quickly denatured and the resulting wort would be predominated by the products of alpha-amylase action. Such a wort would have a high concentration of unfermentable carbohydrates. The resulting beer would have a higher terminal gravity and lower alcohol content than a beer made from a more fermentable wort.

ON THE OTHER HAND

Thick mashes do have obvious advantages, but there are some problems. Water is required to break down starch. Water is chemically inserted between the glucose molecules of the starch polymer during hydrolysis (the enzyme-directed breakdown of starch) and a shortage of water can cause incomplete breakdown of starch during mashing. Although mashes are rarely thick enough to cause incomplete starch conversion, very thick mashes can slightly decrease wort fermentability.

A less subtle result of thick mashes is noticeably lower extract yield. Thick mashes simply cannot bring all of the malt starch into solution. Although decreased extract yield is not going to send any homebrewer to the poor house, commercial brewers are not very fond of this side of the thick mash.

The last major problem with thick mashes is the high concentration of starch breakdown products. This feature is easy to spot when the specific gravity of the first runnings from the mash is taken. In thick mashes the first running gravity is usually greater than 20 Plato (1.078). These products can interfere with enzyme action, resulting in what is called product inhibition.

Product inhibition may serve to control the millions of enzymatic reactions occurring every second in the human body, but it is not the brewer’s best friend. In the mash, product inhibition can lead to incomplete starch breakdown and decreased extract yield and fermentability.

Some enzymes, especially proteases (enzymes that attack protein), are very sensitive to product inhibition and are not very active in such environments. Periodically stirring a thick mash can help to alleviate product inhibition, since stirring distributes the enzymatic products that naturally accumulate near enzymes.

MEDIUM-THICK MASHES

If a mash thickness less than 2.5:1 is thick, then a mash thickness between 2.5:1 and 4:1 should be medium. In practice a thickness of about 3.25:1 best captures the feel of the medium-thick mash. These mashes retain many advantages of the thick mash but few of the downsides. Additionally, mashes in this range of stiffness are easy to move around. This feature is important when conducting stirred, multi-temperature mashes as it allows for easier mixing and better heat transfer than a thick mash. These mashes are easy to pump, if required. Commercial breweries, for example, pump the mash from the mash vessel to the lauter tun.

Although thinning out the mash makes the enzymes less concentrated and hence more susceptible to temperature denaturation, this only occurs if the mash is conducted at an unacceptably high temperature. In general an infusion mash temperature of 150 to 195 °F (66 to 68 °C) in a medium-thick mash allows sufficient beta-amylase activity before rendering it inactive (beta-amylase usually begins losing activity above 149 °F/65 °C).

After beta-amylase is denatured, alpha-amylase remains active because it is less sensitive to these temperatures, it can survive up to 170 °F (77 °C). If multi-temperature mashing is used, then these problems are alleviated, regardless of thickness. But the thinner mash makes stirring easier.

The thinner mash also decreases the concentration of substrates and products. This minimizes the effects of product inhibition, the slowing of chemical reactions caused by build-up, and also eliminates the loss of extract associated with very thick mashes.

In general the medium-thick mash provides for good enzyme activity, allows for easy stirring and pumping, will produce a wort with a high degree of fermentability, and produces a good extract yield from the malt. However, if a mistake is made by mashing in too hot, then the chance of causing irreversible enzyme loss is higher than if the same mistake is made in a thick mash.

THIN MASHES

Thin mashes are any mashes where the water-to-malt ratio exceeds 4:1. Like the medium-thick mashes, thin mashes are easy to move around and provide excellent heat transfer. They also give high extract yields, since the malt solids are easily dissolved.

The problem with thin mashes is enzyme stability. Enzymes are less stable in a thin mash and denatur-
maltose in comparison to alpha-amylase. If beta-amylase denatures too quickly, then the resulting wort will have a decreased fermentability.

Some multi-temperature mash schedules suggest adding very hot water to increase temperature. This technique thins the mash and can render enzymes, especially beta-amylase, inactive when they are most needed. You may not like this method unless you want to limit fermentability.

**INTO THE THICK OF IT**

It may seem like the logical conclusion is to only use thick and medium-thick mashes. But for some special cases thin mashes may do just the trick. Suppose the goal is to produce a wort with good extract yield and a negative iodine reaction but with low fermentability (such as a low-alcohol beer).

Some brewers try to accomplish this goal by mashing at a very high temperature in hopes of killing off most of the beta-amylase before producing much maltose. In thick and medium-thick mashes, high temperatures are not as destructive as may be expected. Most of the so-called optimum temperatures for enzymes are for model systems carried out in laboratories. Since these temperatures are usually not representative of mashing conditions, exceeding textbook numbers does not always do the trick.

This is where varying mash thickness becomes an effective method of wielding control over the mash. To limit fermentability, a thin mash coupled with high temperatures (say 160°F/71 °C) may be more effective than mashing at 170°F (77 °C) in a very thick mash.

This topic has become of interest to many commercial brewers in recent years who have taken an interest in low- and non-alcohol beers. Although homebrewers are usually not looking to produce bland, low-alcohol products, some are dabbling with full-flavored but low-alcohol beers such as some mild ales. If these beers have tickled your taste buds, then mash thickness control may be the parameter you’ve been looking for to brew low-alcohol beers without sacrificing body.

The next time you’re mashing, consider mash thickness in addition to temperature and pH as one of the parameters that sets the stage for the dance of the enzymes.
Beer brewing is an art, and not just a technical exercise, as my friend Randy Mosher is fond of reminding me. Many of you know Randy as the author of great books like Radical Brewing and Mastering Homebrew, but he is also an accomplished graphic artist who approaches beer design from a much different perspective than my own engineering brain does.

A few years ago Randy approached me with some draft portions of his recent book Mastering Homebrew. He made the observation that there are relatively few kilned or caramel malts made in the color zone between 70 °L and 200 °L. The reason for this is that malts in this “harsh zone,” when used in excess, have unpleasant properties and flavors like burnt toast, burnt marshmallows, tannic bitterness, and harsh tones, which overpowers a beer.

**TYPES OF MALTS**

To understand the harsh zone, we first need to understand the different type of malts and how they are made.

The malting process starts with raw barley grain. The raw barley is typically immersed in water, bringing its water content up high enough to get the seed to germinate and sprout. The grains are allowed to grow for a few days until the small shoot, called an acrospire, reaches a length roughly equal to the length of the grain itself. Small rootlets will also form outside the grain, though these will fall off and be separated during kilning.

The grains are next dried, though the method used varies depending on the type of grain being produced:

- **Base Malts (1–10 °L):** Base malts such as pale, Pilsner, Vienna, and Munich malts are kilned at low heat. Typically, moisture is reduced to under 10% when kilning and often English malts are dried further.

- **Kilned Malts (10–70 °L):** Malts such as amber, melanoidin, honey, and brown are kilned and dried in the same process as base malts, initially at low heat, but then the temperature is raised significantly once the grains reach a certain dryness level to produce a darker malt with many base-like properties with few or no enzymes.

- **Kilned Caramel Malts (1–150 °L):** After the malt has been wetted and the acrospire has formed, it is transferred to the kiln, but not immediately dried. Instead, the temperature of the wet malt is raised to about 122 °F (50 °C) to begin a stewing process that mashes the sugars within the husk. Slowly, the temperature is raised to approximately 150 °F (66 °C), converting most of the starch in the grain to simple sugars. The grains are then dried in a kiln where the temperature can also be raised to produce darker caramel malts, much as we produce darker kilned malts. Non-homogeneity in the kiln bed leads to very dark malt on the bottom (exceeding 150 °L) contributing harsh notes even at moderately colored kilned caramel malts (above 60 °L). The caramel malts contain longer sugar chains called dextrines, which add body to the finished beer as they do not fully break down during fermentation. However, overuse of caramel malts can produce sickly sweet, unbalanced beers.

- **Roasted Caramel/Crystal Malts (1–120 °L):** Green malt is transferred from the germination compartment to the roaster where a relatively high level of moisture is retained in the malt during a conversion process that simulates a mini-mash occurring inside each kernel. Once conversion is complete, the malt is dried, and the product temperature is increased to achieve the desired color and flavor. Unlike caramel malts produced in a kiln, roasted caramel malts are homogenous and have a uniform, crystalline endosperm. The flavor of roasted caramel/crystal malts range from caramel, toffee, sweet to burnt sugar, roasted marshmallow, dried fruit. Green malt roasted beyond 120 °L may enter the “harsh zone” where it will take on a woody, dark toast, coffee flavor.

- **Roasted Malts (200–600 °L):** Roasted malts are made by taking dried base malts and putting them in
a drum roaster to be roasted at very high temperatures. The key to making great roasted malt is not only choosing the right temperature and point to stop roasting, but also rapidly cooling the grains when the appropriate roast level is reached. There is one exception, which is roasted barley, also called stout roast, which is made from unmalted barley roasted at very high temperatures.

**HARSH ZONE MALTS**

Moshier defines malts in the 70–200 °L color range to be “harsh zone” malts. This includes many popular dark crystal malts such as caramel/crystal 80 °L, 100 °L, and 120 °L, as well as Special B (which is also a caramel malt) and some malts on the edge of the harsh zone like brown malt and pale chocolate malt.

Used in small quantities, these malts can add dried fruit, plum, chocolate, mocha, coffee, toasted marshmallow, and caramel flavors. When overused, they result in flavors like burnt toast, burnt marshmallow, campfire character, and harsh tannic flavors akin to sucking on a tea bag.

A common “beginner” mistake, for example, is to add crystal 80 °L (or darker) malts to something like an English brown ale to darken the color. Often the beer will take on a very harsh finish and unpleasant character, as a relatively large portion of this moderately colored malt must be used to achieve a brown color. This is very common for extract brewers, who tend to use dark crystal and light roasted malts interchangeably. Malts in the harsh zone have unique flavors that should be used with caution and with the intention to add flavor rather than color. The following are generalizations about “harsh zone” malts and may not apply to every malt on the market with a similar name. Unique production methods will dictate the flavor of a malt, so it is suggested to familiarize yourself with a malt’s extractable flavor contribution before brewing.

Let’s look at each of the malts in and around the harsh zone, and the flavors you can achieve from them:

- **Melanoidin Malt**: A kilned malt that is generally below the harsh zone.
  
  Melanoidin malts are typically kilned in the 25–35 °L range but a few dark examples may be kilned up to 60 °L. Melanoidin malt is often used by brewers to “simulate” the malt flavors one might get from a decoction mash, and tends to impart a strong malty finish, with hints of biscuit and honey. Some variants take on a red hue, and most varieties of melanoidin are unlikely to impart harsh off-flavors due to the low color range, and are typically used for 3–10% of the grist.

- **Brown Malt**: Also a kilned malt that is on the lower edge of the harsh zone at 60–70 °L. Brown malt was once the base for traditional porter styles, though it is rarely used these days. It has a dark toasted grainy flavor and imparts mocha and bitter chocolate flavors. If used in excess, the bitter chocolate flavor can dominate and take on tannic, burnt grain, burnt toast, or burnt coffee notes. I like to use this malt in robust porters, but generally keep it below 5% and combine it with other dark specialty malts to add complexity and depth.

- **Kilned Caramel/Crystal 80 °L**: In my opinion, this is probably the most overused and abused harsh zone malt, as many brewers use it to “add color and body” to a recipe, not knowing that they are significantly altering the flavor balance. Crystal 80 °L, unlike its lighter siblings, takes on more of a burnt sugar flavor with hints of raisin and caramel. In small quantities, raisins, figs, or caramel will come through, but used in large quantities, the burnt sugar can be quite pronounced.

- **Caramel/Crystal 100–120 °L**: These malts have an intense roast sugar flavor, and can be quite bitter with a Turkish coffee finish. Used in small amounts you will get toasted raisins or figs, but overuse will lead to acrid bitterness and burnt flavors.

- **Special B 120–140 °L**: Special B is technically a very dark Belgian crystal malt usually roasted to 120–140 °L in color. It can have flavor elements of both the very dark crystal 120 °L malt and also light chocolate malt. Used sparingly you can get toasted raisin, figs, cherry, or plum notes from it. In large quantities you will get a pungent burnt sugar flavor along with acrid bitterness from tannins.

- **Light/Pale Chocolate Malt 200–250 °L**: From the name, one might assume that this is merely a lighter, gentler version of chocolate malt. While the color is indeed slightly lighter than chocolate malt, it actually imparts a more piercing coffee-like roast flavor to the finished beer. Because this malt is right on the edge of the harsh zone, it is more sharp and piercing than chocolate malt. Used in large quantities, you will often get harsh burnt-coffee flavors along with tannic bitterness akin to sucking on a tea bag. In small quantities, however, it can give a nice coffee-like finish particularly when combined with other specialty malts.

- **Chocolate Malt 350–400 °L (and Carafa® 1)**: Though these malts, like melanoidin, are outside the harsh zone, they do take on some of the sharpness and bitterness you will find in light/pale chocolate malts. In fact many people don’t know that chocolate and Carafa® malts are more piercing and bitter than black malt. These malts tend to be bittersweet, sharp with a coffee character, and bitterness can be dominating if used in large proportions. They taste nothing like chocolate! Carafa® tends to be a bit smoother than chocolate malt.

**USING HARSH ZONE MALTS**

Here are a few rules of thumb to consider when adding harsh zone malts to your beer:

- **Don’t use harsh zone malts for color**: I avoid using harsh zone malts when I want to just add a bit of color to my beer. You are better off using either lighter crystal or kilned malts, or alternately very small quantities of chocolate, black patent, or stout roast. The darker roasted malts, in particular, can add significant color with only a small amount of malt that won’t throw off your flavor balance.

- **Use harsh zone malts sparingly**: Harsh zone malts are great flavor...
additions, but you need to use small quantities — typically 3–5% of your grain bill. For example, Special B will really help add depth, plum and raisin notes, and complexity to a porter or stout, but if you use too much the burnt sugar, burnt marshmallow, and acrid bitterness will come through.

**• Use malts with a purpose:** Avoid the “kitchen sink” approach to beer brewing where you add every malt in your cabinet to a recipe thinking it will make great beer. Make sure each ingredient has a purpose and fits the style and flavor profile you are trying to create.

**A HARSH ZONE EXAMPLE**

Harsh zone malts are very appropriate in certain styles of beer. For example, I enjoy adding them to stouts and porters, particularly English versions, as they create complexity and depth. Here’s an excerpt malt bill from a recent robust porter I brewed:

87% Maris Otter pale malt
3.6% Caramel malt (60 °L)
3.6% Special B
3.6% Chocolate malt
2% Black patent malt
47 IBUs from Centennial hops
White Labs WLP002 (English Ale Yeast)

My intention here was to create a complex, robust, slightly sharp porter with some depth and complexity, perhaps riding the line between a robust porter and a stout.

The Maris Otter base provides a strong foundation of English malt with a lot of character to it, and notice that nearly 90% of the malt bill is base malt. You don’t need to add 20–30% specialty malts to create a beer with depth of flavor. Caramel 60 °L gives the beer some English maltiness and character, but is also dark enough to provide some fruit hints without being overly harsh.

Special B is the only harsh zone malt, and it provides depth as well as character. At 3.6% of the malt bill it is enough to bring out toasted raisin, prunes, and some bitter notes without being overwhelming or cre-ating burnt or tannic bitterness. The Chocolate malt provides a strong roast finish to the beer, and finally just a bit of black patent gives the beer a roasty edge that you might expect in a robust porter.

To balance the beer, which is a bit edgy, I did hop with Centennial at a pretty high hop rate (47 IBUs), and then finish it with an English ale yeast, again to accentuate complexity, esters, and a slightly malty finish. I chose Centennial over a traditional English hop because I enjoy its aroma/flavor profile and it has enough alpha acids to deliver the bitterness needed.

After brewing, the beer did deliver the “robust porter” complexity I was looking for. Though I used only one harsh zone malt, that combined with the caramel 60 °L and chocolate malts from just outside the harsh zone plus a dash of black patent gave the porter some real depth. It’s not a one-dimensional beer, but instead has layers of flavor, which you can achieve by combining harsh zone malts with other specialty malts in appropriate proportions. Centennial fit in well with the beer, providing enough bitterness and flavor to offset the strong flavor profile of the malt.

I’m using the lessons learned from this beer for a Russian imperial stout that I hope to blend with mead to make a braggot. By stepping up the base malt, black patent, and chocolate proportions and swapping out brown malt for the caramel 60 °L, I should be able to get a very strong, rich imperial stout that can stand up to blending with a sack mead.

**CONCLUSION**

I encourage you to work hard to become familiar with the flavor profiles of all of the major malts available whether they are base malts, caramel malts, kilned malts, or roasted malts. Each malt has its own unique character, aroma, and taste, and unfortunately many malts are “misnamed” in that their name does not represent the flavor that is to be expected from them. A sensory evaluation is needed in order to fully understand the extractable flavor contribution of your malt.

Harsh zone malts can be a powerful tool if you are aware of their strengths and weaknesses and harness them to create great beer. Key concepts include the idea of having a clear purpose for every single malt you add to your grain bill. Use specialty grains sparingly, especially those in the harsh zone. Develop depth by combining a handful of specific flavors rather than adding everything but the “kitchen sink.” Finally, don’t use harsh zone malts to just “add color” to your beer, as this will destroy your flavor balance.
Steeping specialty grains is a common practice for many homebrewers, particularly those who brew extract or partial-mash recipes. As with many things in the beer brewing process, there are trade-offs to be made in time, labor, extract efficiency, flavor, color, body and foam when we compare one approach of brewing with specialty grains to another. Cold steeping specialty grains is no exception. There are some significant benefits to be gained in reduced astringency, increased flavor, color, and aroma, when using a cold-steeping process. However, there can also be a trade-off in extract efficiency. This can be compensated for by using a greater amount of specialty grains in the steeping process, segregating which specialty grains will go in the mash (or partial-mash) and which ones will be steeped in cold water, or by adding other adjuncts or malt extracts to make up any shortfall in original gravity.

The currently popular process of cold-brewing coffee provides an interesting parallel to cold-steeping specialty grains. Cold-brewed coffee results in a less acidic, smoother flavored, and potentially more caffeinated drink, at the expense of reduced efficiency of the amount of beverage produced from the amount of ground coffee beans used. The main benefit to cold steeping specialty grains is to reduce the astringency extracted from the husks of dark roasted barley or barley malt in the main or partial mash. Astringency occurs when the grains are held in water at higher temperatures than typical cold tap water. Astringency is the off-flavor resulting primarily from tannins, which are naturally occurring polyphenols found in grain husks. This is why some dark roasted specialty grains are offered in dehusked versions, to reduce the extraction of tannins in a typical mash while preserving the dark color and roast flavors in the wort. In a typical beer, the majority of the tannins present are derived from grain husks rather than hops, so addressing the reduction of tannin extraction from malt and specialty grain husks is important in limiting astringency in nearly every style of beer. So no matter what style of beer you are brewing, this reduction in astringency is precisely the point of pursuing cold steeping in your own brewing process.

Tannin extraction from grain husks (particularly dark roasted grains) is directly proportional to the temperature, pH, and the volume of water that the specialty grains are exposed to before they end up in the final wort. With that in mind, a long steep in a large volume of hot water at a high pH would extract the most tannins from grain husks and produce the greatest potential astringency. This scenario is often the tactic used for steeping a small amount of specialty grain in a few gallons of water as it is heated before adding malt extract to the water when brewing an extract kit that includes those specialty grains. Also, consider a typical mash where specialty grains are held in relatively hot water for an extended period of time, and we can see that there is a significant opportunity for tannin extraction from grain husks in either extract plus specialty grains, or all-grain brewing. Cold steeping dark specialty grains greatly reduces the temperature of the water that they are exposed to and thus the potential to extract tannins from those grains. Now that we have a handle on how astringency can happen, let’s take a look at the particulars of the cold steeping process to see how we can make it work to our advantage in making better beer.

Since darker roasted grains have the greatest proportion of husk polyphenols and thus potential for extraction of tannins, it would make sense to cold steep dark specialty grains such as black patent malt, chocolate malt, Carafa® malts, or roasted barley, to minimize the potential for astringency. Since these dark roasted grains do not contribute significant amounts of fermentable sugars when included in a mash, there is no particular reason to mash them at typical wort conversion temperatures of 148 to 158 °F (64.5-70 °C) in order to get the flavor and color we want from them. If you are a frugal brewer like me, you can include the not-so-dark specialty malts (Vienna, Munich, caramel, biscuit, etc.) that can contribute fermentable sugars in your mash instead of cold steeping them. As long as you take the usual precautions of sparging with water at a temperature of 168 °F (75.5 °C) that has been adjusted to a pH between 5.7-6.5, and cease collecting wort at a specific gravity of about 1.008, tannin extraction can be kept to a minimum. In this way, you can derive the most sugar from the grains in your mash while minimizing...
By segregating the dark grains in a cold steep, we can reap the flavor and color contributions they offer while minimizing potential astringency. If you choose to cold steep your lighter kilned grains together with the dark grains anyway, you can expect a sugar extract efficiency of between 25% from pale malts or 50% from any crystal malts. Crystal malts provide greater extract when steeped because they have already been “stewed” to achieve a greater degree of starch conversion to sugar within the kernel during the malting process. With that said, you can choose to increase the amount of the lightly kilned malts in a cold steep to compensate for the reduced efficiency or make up the difference in gravity points with more liquid or dried malt extract.

Cold steeping specialty grains can be accomplished in a variety of ways depending on the time and equipment you have available. The grains can be simply steeped in cold water, steeped in cold water with agitation, or in a virtual vorlauf by repeatedly recirculating cold water through the grains. Each method has its advantages and disadvantages, but each still requires a bit of advanced planning and basic brewing or kitchen equipment.

Simply cold steeping specialty grains can be accomplished by crushing the grains as you would for a typical mash and then steeping them at a ratio of 2 quarts (~2 L) water to 1 pound (0.45 kg) grain for 8 to 24 hours at cold (38 °F or 3 °C) to room (75 °F or 23.8 °C) temperature. At this water to grain ratio, dark roasted grains will typically acidify most tap water to near pH 6 that will naturally limit tannin extraction. If your tap water has an unusually high pH and is highly buffered by carbonates (hardness), it may be beneficial to acidify the grain/water mixture pH with lactic acid, a drop at a time and stirred, to get the mixture to near pH 6. A mixture with a pH greater than 6 will lead to tannin extraction and defeat the purpose of cold steeping the grains to diminish astringency.

With a little extra effort, you can speed up the process by following the same procedure as mentioned earlier for regular cold steeping, except to continuously but gently agitate the vessel and its contents for one hour. This could be accomplished by manually rocking or swirling a sealed bucket while watching your favorite sports team on TV, or any number of other imaginative systems or devices you may come up with to keep the mixture moving.

The third method for cold steeping is to implement a virtual vorlauf by placing the grains and water mixture in a mash tun equipped above a perforated false bottom and recirculating the liquid for about an hour, by drawing liquid from the bottom and pouring it back on top, or with the aid of a pump. This approach would simultaneously filter the resulting liquid, eliminating the need to separate grains and liquid with a screen or filter later on.

If you simply steeped the grains, you will need to separate the grains from the water with a fine screen or filter (layered cheesecloth, coffee filter, etc.) before adding the liquid to the rest of the wort in your brewing process. If you chose to recirculate using the virtual vorlauf method, the liquid should be fairly clear as is and likely won’t need additional filtration.

The liquid portion of the specialty grain steep can be added to your brewing process at any time, from wort collection to packaging, depending upon the flavor and aroma impact you wish to have on the finished beer. If the steep solution is added after the wort has been chilled, you can run a risk of contamination by wild yeast or other microbes unless the cold-steeped solution is pasteurized by heating it to at least 145 °F (63 °C) for 30 minutes or 160 °F (71 °C) for several seconds. This can be worth the extra effort, particularly if you wish to experiment with how the steeped solution will affect beer flavor and aroma when added post-fermentation. Perhaps the simplest option is to add the solution near the end of the wort boil where it will experience a temperature over 160 °F (71 °C) to sanitize it prior to fermentation without driving off an appreciable amount of dark roast aromas. The potential for experimentation is extensive as to when the specialty grain cold-steep solution can be added in total, or in stages, to your homebrew recipe so take good notes.

For dark beers, where astringency is of particular concern, cold-steeping dark specialty grains can be an alternative to using dehusked grains or in cases where the specialty grains you wish to include in your brew are not available in a dehusked form. Beer styles such as dark European lagers, black India pale ale (IPA), oatmeal stout, or other dark beers where a smoother, less astringent flavor is desired are great candidates to experiment with the cold steeping process of dark specialty grains.

Cold steeping specialty grains also extracts a good portion of the proteins from the grains that contribute to head retention and mouthfeel. This can be used to great advantage when brewing lighter, lower alcohol beer that may typically be lacking in body and quality of foam. When brewing stronger beers, cold-steeping specialty grains can extract more malt flavor from those specialty grains without extracting sugars that are characteristically more complex and less fermentable. This can be used to your advantage if you desire a beer with a drier finish yet full flavor by using more fermentable sugars from adjuncts or pale malt mashed at cooler temperatures. This can provide big flavors with a clean finish for dark lagers or black IPAs.

Another point of consideration for frugal brewers who like to brew all malt strong ales is that since cold steeping specialty grains primarily pulls the color, flavor and FAN (free-amino nitrogen) from the grains, much of the convertible starch remains in the grain. Therefore, cold steeped grains can be added to a conventional mash to yield sugars contributing toward original gravity of another wort. The “recycled” specialty grains from a cold steep process would not contribute much color or flavor, but would still boost original gravity of the wort.

If dark beers are part of your repertoire, or if you shy away from dark beers because they are not as smooth as you would like, try cold steeping. With a preparation and experimentation, cold steeping dark grains may make your transition to “The Dark Side” a little bit smoother.
My summer crush began in the warmest months of 2017, shortly after quitting my corporate job to work full-time for MoreBeer! I know, most love stories don’t start with a change of occupation. Then again, this isn’t a love story, unless of course you count the love to learn more about brewing. Before signing on full-time, I had been working weekends at my local homebrew shop and a frequently asked question was, “What is the ideal gap setting for my grain mill?” On the surface it seems to be an easy, straightforward question with a simple answer.

There is a good starting range for most homebrew mills, but it’s not one-size-fits-all. The ideal gap setting to produce a “fine” crush on my mill might not work at all for your system and process. Your system might require more of a “coarse” crush to work efficiently. Not to mention that grain is an agricultural product and varies in kernel sizes and friability levels from different maltsters and harvests. Also, mills have different corrugation on their rollers, different roller speeds, and different roller differential (each roller operating at slightly different speeds to obtain more shear).

That’s the thing, there is no magic number when it comes to gap settings, and that’s why we are told to “mind the gap” and not “set it and forget it.”

WHY THE CRUSH IS IMPORTANT
When you purchase pre-ground malt from most homebrew shops it’s a coarse crush. This is the safest crush that will work on most any homebrewing system, but it’s not the best for efficiency. A lot of published homebrewing recipes take this into account on their grain bills. On a homebrewing scale, throwing a pound or two (0.45–0.9 kg) of extra malt into your batch really doesn’t cost much, but on a commercial scale it adds up over time. Pro brewers need high efficiency to keep the cost per batch at a reasonable level. For homebrewers, great efficiency is more of a bragging right and a demonstration of understanding more than a cost saver.

Knowing the difference between a coarse and a fine crush not only helps with efficiency and preventing a stuck mash, it also helps with consistency. And in brewing, consistency is king! There are a lot of steps down the line that need to be understood to become consistent as well, but it all starts with your first crush (pun intended).

But let’s get back to our story, shall we? I was now working full-time in the industry, doing what I loved, and one of the projects I was involved in had me learning more about malts in general. We were working with Viking Malts to develop a new base malt specifically geared towards the North American market. This is when I first learned how to use grain sieves to examine particle sizes on a crush and what all the attributes on a malt analysis sheet (also called a COA or Certificate Of Analysis) meant. If you have never taken a look at one of these

**THE PERFECT CRUSH**

*BY VITO DELUCCHI*

Photos by Vito Delucchi

Malt analysis sheets, also called Certificates of Analysis (COAs), should be available from every maltster and contain a lot of useful information about the malt you are using. In terms of the gap settings when crushing, friability and lot assortment are both critical.
sheets, I would recommend doing so. It might not be as sexy as a hop spec sheet but you’ll find a lot of important information on them.

Since this article is focused on grain mill gap settings, we will primarily be discussing two of the specs listed on these sheets: Friability and lot assortment.

**Friability** is a measure of how well the kernels modified from barley (which is not friable, or easy to break up) to malt (which is very friable). Low friability indicates that either parts of the kernels didn’t grow well or some complete seeds didn’t grow at all in the malt. Less friable malt will not give up its extract as easily as it is trapped in the unmodified parts by proteins and beta-glucans.

**Assortment** refers to kernel size. It is sometimes described in other terms depending on the maltster, such as “plump” or “sieving.” The higher the percentage, the larger the kernel size. Assortment is determined by performing sieve tests where four trays are stacked on top of each other with diminishing screen sizes — the top with a 7/64-inch screen bottom, the next with a 6/64-inch screen, the third with a 5/64-inch screen, and a solid tray at the bottom. After shaking the trays, the percent of kernels in each tray is measured, and the percent that are caught by the top two screens are added to make up the lot assortment percent. The smallest grains that fell through all of the screens and made it to the pan are often referred to as “thrus.” The thurs are very small kernels that can be almost unmillable. Maltsters also classify the kernels caught in the 5/64-inch screen differently. For instance, Briess refers to these malts as “thins,” while the larger malts that were caught in one of the two larger screen sizes are referred to as “plump.” It is difficult to properly mill the thins without crushing the plump portion when using just the single crush of a two-roller mill.

My original idea for this article was to crush several base malts at different specs. Then sieve test and perform a Congress Mash as well, reporting the results of both tests. After talking with a friend who has been doing this a lot longer than I have, he talked me into just focusing on the physical attributes of malts for this article. So we will save diastatic power and extract for another article.

Around the same time I started working on this article, Admiral Maltings, a local northern California maltster located in Alameda, sent out a marketing email saying they are now offering different milling specs on their pre-milled sacks of grain. My eyes lit up with beer geek love when I saw that. I had worked with the team at Admiral in the past with my homebrew club and thought who better to talk with about the physical attributes of malt than a maltster. Head Maltster Curtis Davenport was kind enough to answer my questions and walk me through their entire floor malting and testing processes step-by-step.

Having talked with a malting expert, I confirmed friability and kernel size assortment should have some impact on my crush research. But how much, and could I detect it by running sieve tests? So, I identified my question, it was now time to experiment.

**ON TO THE EXPERIMENTS**

I selected four different base malts — Viking Xtra Pale, Rahr 2-Row, Briess 2-Row, and Admiral Gallagher’s Best. I then used a 2-roller homebrew mill and crushed the malts using four different gap settings. The gap settings were 1.25 mm, 1.0 mm, 0.75 mm and 0.50 mm. I used a feeler gauge to verify these settings in between
I then performed a grain sieve test on the different malts and crushes, recording the results.

The method for performing a sieve test is pretty quick and straightforward. But let me tell you, doing 16 of them does take some time. You place three small rubber balls on each of the US standard test sieves #14, #30, and #60 and then place the bottom pan under the #60 test sieve. They must be stacked in the proper order with the widest screen being on top (#14) and the finest (#60) on the bottom before the pan. The grain sample being measured is then placed into the top sieve and the lid is put on prior to performing the test process.

I used 100 grams of each crushed malt to keep the math easy, but you can use up to 130 grams for this test with the US standard test sieves. The sample should be a good representation of the crush and include husks, kernels, and powder.

When performing the test, you need a smooth, flat surface, as you will be sliding the test sieves back and forth for several minutes. The sieves need to travel 18 inches (46 cm) in one direction and then the other, taking 0.5 seconds each way for a total cycle time of one second. Every 15 seconds you tap the sieves and pat downward on the working surface. This cycle is maintained for three minutes total. You then empty each individual sieve, being sure to brush them out completely, then weigh and record the results. Calculate the percentage for each sieve by dividing each fraction by the sum of all fractions weights and then multiply by 100.

Example:

\[ \text{#14 + #30 + #60 + Pan} = \text{Sum} \]

Then:

\[ \text{#14} / \text{Sum} \times 100 = \text{percentage} \]

This example equation will give you the percentage malt that was left on top of the #14 sieve. Repeat the equation for screens 30, 60, and the pan. Since we are using 100 grams of sample material, the percentages...
will be very close to their original fractions.

Having known the friability and lot assortment (Figure A, below) of these malts prior to this test, I originally suspected there would have been a greater variance. To my surprise, the greatest gap (pun intended) in percentages was 7%. Still, that’s almost enough of a difference to take you from a “standard” to a “fine” crush (Figure F, below) with the same gap setting by simply switching base malts. You can see why brewers are told to “mind the gap.”

But it’s not just an aphorism for a gap setting, it’s about understanding and checking with each batch you brew. I was also surprised at the percentages of fine particles that made it into the pan based on the milling spec sheet (Figure F). But looking at the different crushes, I would use some of the ones bordering on the low fine territory. It’s really dependent on your system though. A friend of mine who is opening a brewery in Hawaii is putting in a mash filter system. With that type of system you would use an extra fine crush and achieve really high efficiency.

As for the original question of “What is the ideal gap setting for my grain mill?” let’s assume we are talking most 2-roller homebrew mills with a 1.25-inch (3.2-cm) diameter roller and you are also using a mash tun with a decent false bottom. I would start with a little over 1.0 mm and go from there. If you don’t have feeler gauges you can use a credit card (normally 0.76 mm) to help measure it (or run down to the local auto parts store and buy a set for a few bucks). Ideally, you want to find a highly efficient but not troublesome (meaning it won’t cause a stuck mash) crush that works for your brewing system.

It’s not necessarily going to be solely based on a gap setting either, as the same malt can change from year-to-year, like Admiral’s Head Maltster Curtis Davenport mentioned. Similar to how we must adjust hop additions based on alpha acid%, we also need to adjust gap setting based on how the crush comes out of the mill if we want consistency. As long as you are monitoring this step in your process, over time you will develop an eye for it.

Milling your own grain not only allows you to use the freshest possible ingredients, it allows you to dial in your crush for maximum efficiency. Plus, the smell of freshly crushed malted barley is pretty awesome.

Just remember that gap settings are not universal, so the crush should be monitored every milling to ensure the barley you’re working with is being properly crushed. Barley is an agricultural product and friability and kernel size assortment vary from maltster-to-maltster and even harvest-to-harvest.

Sieve tests can be performed at home and will help you understand and dial in an ideal crush for your system. These sieves can be found online for a moderate investment. But by simply paying attention to your crush and monitoring it, each batch will help you develop an eye for it over time. A consistent crush equals consistent batches, and brewing consistency is a sign of a good brewer.

---

**Figure A: Unmilled Malts**

<table>
<thead>
<tr>
<th>Malt Tested</th>
<th>Friability</th>
<th>Lot Assortment*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viking - Xtra Pale</td>
<td>92</td>
<td>97</td>
</tr>
<tr>
<td>Rahr - 2-Row</td>
<td>92</td>
<td>98</td>
</tr>
<tr>
<td>Briess - 2-Row</td>
<td>89</td>
<td>92</td>
</tr>
<tr>
<td>Admiral - Gallagher’s Best</td>
<td>75</td>
<td>99</td>
</tr>
</tbody>
</table>

*This represents the percent of grain caught in the 3/64 + 1/64 sieve screen.

**Figure C: 1.00 MM Grind**

<table>
<thead>
<tr>
<th>1.00 MM Gap Setting</th>
<th>#14</th>
<th>#30</th>
<th>#60</th>
<th>Pan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viking - Xtra Pale</td>
<td>40%</td>
<td>34%</td>
<td>11%</td>
<td>15%</td>
</tr>
<tr>
<td>Rahr - 2-Row</td>
<td>35%</td>
<td>32%</td>
<td>16%</td>
<td>17%</td>
</tr>
<tr>
<td>Briess - 2-Row</td>
<td>40%</td>
<td>35%</td>
<td>13%</td>
<td>12%</td>
</tr>
<tr>
<td>Admiral - Gallagher’s Best</td>
<td>41%</td>
<td>36%</td>
<td>11%</td>
<td>12%</td>
</tr>
</tbody>
</table>

**Figure D: 0.75 MM Grind**

<table>
<thead>
<tr>
<th>0.75 MM Gap Setting</th>
<th>#14</th>
<th>#30</th>
<th>#60</th>
<th>Pan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viking - Xtra Pale</td>
<td>23%</td>
<td>39%</td>
<td>19%</td>
<td>19%</td>
</tr>
<tr>
<td>Rahr - 2-Row</td>
<td>27%</td>
<td>41%</td>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td>Briess - 2-Row</td>
<td>25%</td>
<td>43%</td>
<td>17%</td>
<td>15%</td>
</tr>
<tr>
<td>Admiral - Gallagher’s Best</td>
<td>25%</td>
<td>42%</td>
<td>17%</td>
<td>16%</td>
</tr>
</tbody>
</table>

**Figure E: 0.50 MM Grind**

<table>
<thead>
<tr>
<th>0.50 MM Gap Setting</th>
<th>#14</th>
<th>#30</th>
<th>#60</th>
<th>Pan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viking - Xtra Pale</td>
<td>15%</td>
<td>35%</td>
<td>24%</td>
<td>26%</td>
</tr>
<tr>
<td>Rahr - 2-Row</td>
<td>13%</td>
<td>37%</td>
<td>24%</td>
<td>26%</td>
</tr>
<tr>
<td>Briess - 2-Row</td>
<td>12%</td>
<td>40%</td>
<td>24%</td>
<td>24%</td>
</tr>
<tr>
<td>Admiral - Gallagher’s Best</td>
<td>19%</td>
<td>36%</td>
<td>22%</td>
<td>23%</td>
</tr>
</tbody>
</table>

**Figure F (Admiral milling specs)**

<table>
<thead>
<tr>
<th>Sieve #</th>
<th>#14</th>
<th>#30</th>
<th>#60</th>
<th>Pan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse</td>
<td>70 - 85%</td>
<td>10 - 20%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>Standard</td>
<td>45 - 55%</td>
<td>25 - 50%</td>
<td>10%</td>
<td>7%</td>
</tr>
<tr>
<td>Fine</td>
<td>30 - 35%</td>
<td>40 - 60%</td>
<td>5 - 15%</td>
<td>10%</td>
</tr>
<tr>
<td>Extra Fine</td>
<td>10 - 20%</td>
<td>20 - 40%</td>
<td>40 - 50%</td>
<td>10 - 20%</td>
</tr>
</tbody>
</table>
STORING GRAINS:  
“MR. WIZARD”

Q I have different types of grain stored in clear plastic containers that I keep on a shelf in my garage where I brew. The containers are not in direct sunlight, but sun does come into the garage through windows. The garage temperature ranges from about 39-104 °F (4-40 °C) depending on the season. Am I OK storing grains in this kind of environment, or is there something else that you would recommend?

A The most important thing to prevent when storing malt is an increase in the moisture content. When malt is kilned, the moisture content is normally reduced to about 5%. Since most parts of the world are not nearly this dry, it is important to prevent moisture pick-up over time. The best way to accomplish this important goal is by storing your malt in airtight containers. It sounds like you are doing that.

Storage temperature is a subject that is not as absolute. High temperature accelerates the effects of aging on all ingredients, but quantifying this with malt storage is not something found in the literature. In fact, none of my brewing textbooks make any mention of malt storage temperature.

The key to storing grain is keeping it dry. Whenever crushed grain is left to sit around, it begins to take up moisture from the air. Most malts have a moisture content between 4 percent and 6 percent, and there are very few climates in the world that do not cause malt to absorb water over time. My rule with crushed malt is to use it as soon as possible, which means don’t mill your malt until brew day. This, of course, requires a mill.

If you buy pre-crushed grain and want to store it for some time, you have a few options. One option is to measure the grain into convenient quantities, such as five- or 10-pound lots, and bag it in sealable plastic bags. You can use a fancy vacuum packer, but large freezer bags will do the trick, too. You also can store malt in a sealable container like one used for flour.

Some malts are even sold in woven nylon bags that have plastic liners. These bags work pretty well for extended storage if you roll up the open part of the bag and secure it to reseal the bag.

Malt can be stored at room temperature for extended periods without harm. As long as it stays dry and free of bugs, malt will keep for about a year — although like anything else it will lose its fresh flavor the longer you keep it. Because malt does contain a small amount of oil, it can go rancid if left unused for too long. Rancidity is more likely to occur if the malt is stored in a very hot environment.

I would not recommend storing malt in the freezer, mainly because it is not necessary. The other problem with freezers is their amazing ability to make things taste like they were stored in a freezer! I can’t imagine a beer that ended up tasting like a freezer, but I would guess that it wouldn’t be all that great.

Q I have been considering going to all-grain brewing. I have heard that it is sometimes better to buy malt in 50-pound increments to save money on grain. However, I do not plan to brew with more than 10 pounds at a time. How should I store the extra crushed grains? Can crushed grains be stored in the freezer, or should I just leave the grain in its paper sack at room temperature?

A I OK storing grains in this kind of environment, or is there something else that you would recommend?
Before I became a homebrewer back in 1992, I’d been involved in agriculture for a couple of decades. I began my journey in agriculture by working on a dairy farm in Wisconsin (which included an introduction to beer). But, it was not until I began learning how to make beer that I actually understood what malt and hops were and how they were used in making my favorite fermented beverage. I knew that barley was the basis for making malt and knew how barley was grown, but knew little of the mysterious process of turning barley into malt and malt into beer. Being trained as a scientist, I dove into the technical aspects of transforming barley into malt and learned of the complex bio-chemical progression that occurs as barley sprouts. I also began to understand how the malting process is managed to produce high-quality malt. It was then that I asked myself, “Why couldn’t I make malt at home?”

After realizing that I already had most of the equipment I would need to make malt, I began my hands-on learning by making my first batch of barley malt in 1999. This learning process naturally included a few mistakes along the way, but I eventually became proficient at making barley and wheat malt and have been doing so ever since.

BENEFITS OF HOME MALTING

There are a number of reasons why you might wish to invest the time and effort in making your own malt. For me, it is a combination of the personal satisfaction of taking my homebrewing hobby to the next level by making the main ingredient myself, as well as the lower cash cost of homemade malt vs. commercial malt. Since I can get locally-grown barley or wheat by bartering or purchasing it for the cash-grain price at a small fraction of the price of malt, I can make malt very inexpensively. This is especially true when you factor in the cost of shipping if the malt isn’t purchased locally. Another reason to make your own malt is to be able to source ingredients locally, rather than having them made and shipped in from afar. So whether you want to take more pride in the beer you brew, save a few bucks, or just reduce your carbon footprint, making your own malt can bring more fulfillment to your efforts as a homebrewer.

ACQUIRING BARLEY OR WHEAT

The first step in making barley or wheat malt is securing the grain in its natural condition that has not been processed in any way that would affect the ability of the kernels to sprout. Where I live in western North Dakota, there are thousands of acres of barley and wheat grown every year. Whenever I need some of either grain, I simply talk to some of my farmer friends and trade them a few bottles of homebrewed beer for the grain that I wish to make into malt. These farmers are particularly excited to later get some beer back that is made from their own grain. In the United States, Idaho, Montana, and North Dakota are the top three barley producers. Colorado, Wyoming, Minnesota, Washington, Pennsylvania, Oregon, and Arizona also grow appreciable amounts of barley. If you live in one of these states, you may be able to track down a grower and offer them some homebrewed beer or cash for barley. Your local county extension agent or conservation district may be able to help you locate farmers that grow barley or wheat in your area (the USDA and American Malting Barley Association also publish malting barley acreage statistics).

Regardless of where you live in the world, it is worth exploring the possibility of sourcing locally-grown barley or wheat. If finding a local grower isn’t feasible, there are retail seed or feed dealers that may be able to supply you with what you need. A third option for those with space for a garden or field is to grow your own grain (see section at end of this story).

If you are unable to find a local grower, then a local farm supply, livestock feed, or agricultural seed supplier may be able to provide you with a bag of barley for roughly half the price of a similar amount of malt. Make sure that the barley or wheat seed is whole (not milled, flaked, or otherwise processed) and is not treated with fungicide (as is sometimes the case with grain destined for planting as seed) unless you plan to plant the grain to grow your own crop. If you live in a big city that does not have any local
After the water has been drained away from the now sprouting grain for the second time, I immediately spread the moist grain about a two big roasting pans that I use for making malt. These pans are suited for that purpose. In order to continue sprouting, the grain must be kept cool and moist and turned twice daily prevent the sprouts from getting too warm as that can increase the potential for mold to develop. After the water has been drained away from the now sprouting grain for the second time, I immediately spread the moist grain about ¼-inch (2-cm) deep on shallow roasting pans or baking sheets and then loosely cover the pans with plastic food wrap to help hold in moisture. When the grain needs to be turned, the pan can be uncovered, the grain disentangled and sifted between your fingers, moistened by misting or sprinkling water on it, and the pan of grain covered with plastic wrap again to continue sprouting.

The tiny white rootlets (acrospires) will emerge from the embryo end of the seed and the shoot will grow starting from that same end of each grain. It’s important to keep turning over the grain twice daily during germination to untangle the rootlets. The shoot of barley will grow under the husk of the seed while the roots will grow out away from the seed. In order to track the growth of the shoot of barley, you will need to carefully cut the husk open on sample kernels and observe how long the shoot is relative to the kernel itself. The barley or wheat is fully “modified” when the shoot is very nearly the full length of the kernel of grain. Proper modification will usually take 3–5 days from the time that the grain was removed from the final steeping water and spread on the pans. The “smear test” is a simple way to determine
if modification is complete. To perform the smear test, simply start at the end of the kernel where the roots are protruding and attempt to smear the kernel between your thumb and index finger. Any unmodified part of the kernel will not be soft enough to smear into a starchy paste and indicate that the grain should be allowed to sprout for a bit more time.

Once the malt has shoots that are as long as, or longer than, the kernel and/or passes the smear test, it needs to be carefully dried to stop the sprouting process and preserve the starch and enzymes at their best.

To make standard pale malt, “green” (still moist) fully modified sprouts must be dried with care at temperatures less than 125 °F (52 °C) until the raw malt has dried down to 10% moisture or less (at which point the malt will be hard and crunchy). I dry my malt in a food dehydrator at 100–125 °F (38–52 °C) for 10 hours, then raise the temperature to 140–160 °F (60–71 °C) for eight hours.

[Image]

Once fully modified, I dry my malt in a food dehydrator at 100–125 °F (38–52 °C) for 10 hours, then raise the temperature to 140–160 °F (60–71 °C) for eight hours, in the finished malt and resulting beer.

Curing (a part of the kiln cycle — where the term “kilning” refers to all of the heating steps that happen on the malt kiln) can be accomplished in a standard kitchen oven. I spread my dried malt about a 1/2-inch (1.3 cm) deep on baking sheets and place them in a 185 °F (85 °C) oven for six hours. After the malt has been kilned it should be allowed to cool to room temperature and then stored in a cool (room temperature or cooler), dry place in a sealed container that prevents the malt from absorbing moisture from the air and excluding pests.

MAKING SPECIALTY MALT

Once you master making standard pale malt you may want to explore the world of specialty malts. Many specialty malts are “special” because they are kilned at different temperatures and lengths of time than standard pale malt, roasted in a heated drum to achieve darker colors and stronger flavors, or they are mashed to convert starch to sugar with the kernels intact and then roasted to form caramel or “crystal” malt.

The lighter non-caramelized specialty malts can be made by taking kiln-dried malt and kilning them for a different amount of time and at different temperatures than you would for pale malt. Pilsner malt differs from pale malt in that the malt is kilned for three hours at 158–176 °F (70–80 °C) to produce a malt that is lighter in color and flavor than pale malt. Munich malt is kilned at 183 °F (84 °C) for three hours, Aromatic malt is kilned at 195 °F (90.5 °C) for three hours.

A darker non-caramelized specialty malt, such as chocolate malt, can be made by taking kiln-dried malt and roasting it on pans in the oven at 400 °F (204 °C) for 40 to 50 minutes. Roasting malt above a temperature of 300 °F (149 °C) should be done with care and frequent monitoring. At higher temperatures, the malt can change from toasted to burned in minutes. By experimenting with different time and temperature profiles, you can create your own “house” dark specialty malt that may be a bit lighter or darker than standard chocolate malt.

Caramelized specialty malts are made by converting starch to sugar (as would typically be done in a standard mash) with the kernels intact instead of crushed. There are a couple approaches for home maltsters to make caramelized malts. The first method involves placing raw, undried malt in a dish with a well-fitting lid and holding it at a temperature between 140–160 °F (60–71 °C) for two hours to allow the enzymes to convert starch to sugar. The “stewed” malt is then spread out on an open cake pan or baking sheet and toasted at 250 °F (121 °C) until it is browned to the color desired. The second method of making caramelized malt is to mix uncrushed standard pale malt (homemade or purchased) at a rate of one quart (1 L) of water to one pound (0.45 kg) malt and follow the same procedure described above.

The longer the malt is kilned, the darker and more caramelized the sugars will become. Cara–Pils, Cara–Vienne, Cara–Munich, Special–B, and crystal malt are, from lightest to darkest, the various types of caramelized malts typically used by brewers. The flavor of these caramelized malts range from sweet to nutty as the malt is toasted from lighter to darker in color.
SUMMARY
Whether you are interested in simply making some of your own caramel malt from commercial pale malt, or feel the need to make a variety of malts from grain you grew yourself, becoming a home maltster will give you a better understanding of what it takes to brew beer. I have a certain fascination with doing things in my brewing process from scratch, the way folks had to be able to do so in the early history of brewing beer. Growing my own grain and making my own malt gives me a connection with the brewers of old and a satisfaction that I did it all myself from the ground up.

GROWING AND HARVESTING BARLEY OR WHEAT
Growing your own barley or wheat to use to make malt is no more difficult than growing anything else in your garden. Since the majority of readily available malting barley varieties are sown in the spring, I suggest that is the best way to go if you want to grow your own for most of North America.

While malt could be made from practically any variety of barley, there are several varieties that have been bred for making quality brewing malt. According to the American Malting Barley Association, major malting varieties of barley grown in the US and Canada include six-row types of; Celebration, Innovation, Lacey, Legacy, Quest, Thoroughbred, and Tradition. Two-row types recommended are AAC Synergy, ABI Voyager, AC Mescal, CDC Copeland, Charles, Conlon, Conrad, Endeavor, Expedition, Explorer, Harrington, Hockett, Merit 57, Moravian 37, Moravian 69, ND Genesis, Newdale, Pinnacle, Propino, Scarlett, and Wintmalt. The designation of six-row and two-row comes from the habit of how the florets are arranged on the pedicle (the head of grain at the top of the stalk), creating the appearance of six-rows or two-rows of seeds in each head. Charles, Endeavor, Wintmalt, and Thoroughbred are varieties of winter barley that are sown in the fall, then resume growth in the spring. All other varieties are sown in the spring and harvested that same fall in the Northern Hemisphere. Most homebrewers use two-row varieties of barley malt. Two-row malt has larger kernels and a bit less “husky” flavor than six-row malt.

In my experience growing barley or wheat in my garden, I usually harvest between 0.05–0.08 pounds (0.023–0.036 kg) of wheat or barley grain per square foot (0.1 m²) of area planted. Therefore, if you’d like at least 10 pounds (4.5 kg) of barley or wheat to malt, you would need to plant an area between 125–200 square feet (11.6–18.5 m²) in size. You will need at least 0.002 pounds (0.9 grams) of seed per square foot (0.1 m²) of area planted. Therefore, a 200–square-foot (18.5–m²) plot would require a minimum of 0.4 pounds (0.18 kg) of seed. This planting rate is based on placing the seed in rows approximately seven inches (18 cm) apart and an inch (2.5 cm) deep to achieve a stand of 30 plants per square foot (0.1 m²). If you simply broadcast (or broadly scatter) the seed, you should double the seed rate to 0.004 pounds (1.8 grams) of seed per square foot (0.1 m²) planted, as some of the seed will not germinate or it will be eaten by wildlife. If broadcasting seeds, follow up by lightly raking the area to allow dirt to cover the seeds. This will help protect the seeds from wildlife and from blowing away in strong winds.

If you plant your barley or wheat in rows it will be easier to control weeds that may grow along with your grain. If you plant an adequate amount of seed as soon as the soil temperature at a 2-inch (5-cm) depth is above 40 °F (4.4 °C) in the spring, the barley or wheat will usually grow faster than most weeds and keep them at bay. There are typically not many insect pests or diseases that will impact your barley or wheat crop except for birds that may also become interested in harvesting your grain when it is ripe.

By collecting only the heads of grain, you need to be separated from the head. The simplest way I have found to accomplish the threshing process is to spread the heads on a clean concrete floor or on a tarp or canvas on a hard surface and walk on them while wearing sturdy shoes or boots. After the individual kernels have been separated from the heads of grain the kernels need to be winnowed from the chaff. I have winnowed grain in a couple different ways. One method is to take the threshed grain/chaff mixture placed in a bucket and stand on some stairs or a step ladder outdoors on a breezy day and pour the contents of the bucket slowly so the grain falls onto a tarp or sheet and the chaff blows away (or at least to the far end of the tarp or sheet). If the breeze is sufficient, you should have a concentrated pile of grain closest to the stairs or ladder that you can collect as your cleaned grain. If you do not have a place outdoors to perform the winnowing operation you can slowly pour the grain/chaff mixture in front of a fan and the chaff will hopefully blow further away from the fan than the grain, allowing you to collect the grain separately. This method can make a significant mess, so it is best to do so on a hard floor where the mess is easier to clean up afterward.

Once you have your grain cleaned and dry, store it in a sealed container in a warm (77–86 °F/25–30 °C) dry place for a few weeks before placing it in longer-term storage at 60–65°F (15.5–18.3 °C) for a few more weeks to allow the kernels to go dormant. After this resting period, the barley should sprout uniformly with very few non-sprouting kernels to make the best quality malt.