PRE-BOIL HOPPING TIPS

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HEAVENLY HELLES

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THE HOW-TO HOMEBREW BEER MAGAZINE

JANUARY-FEBRUARY 2014, VOL.20, NO.1

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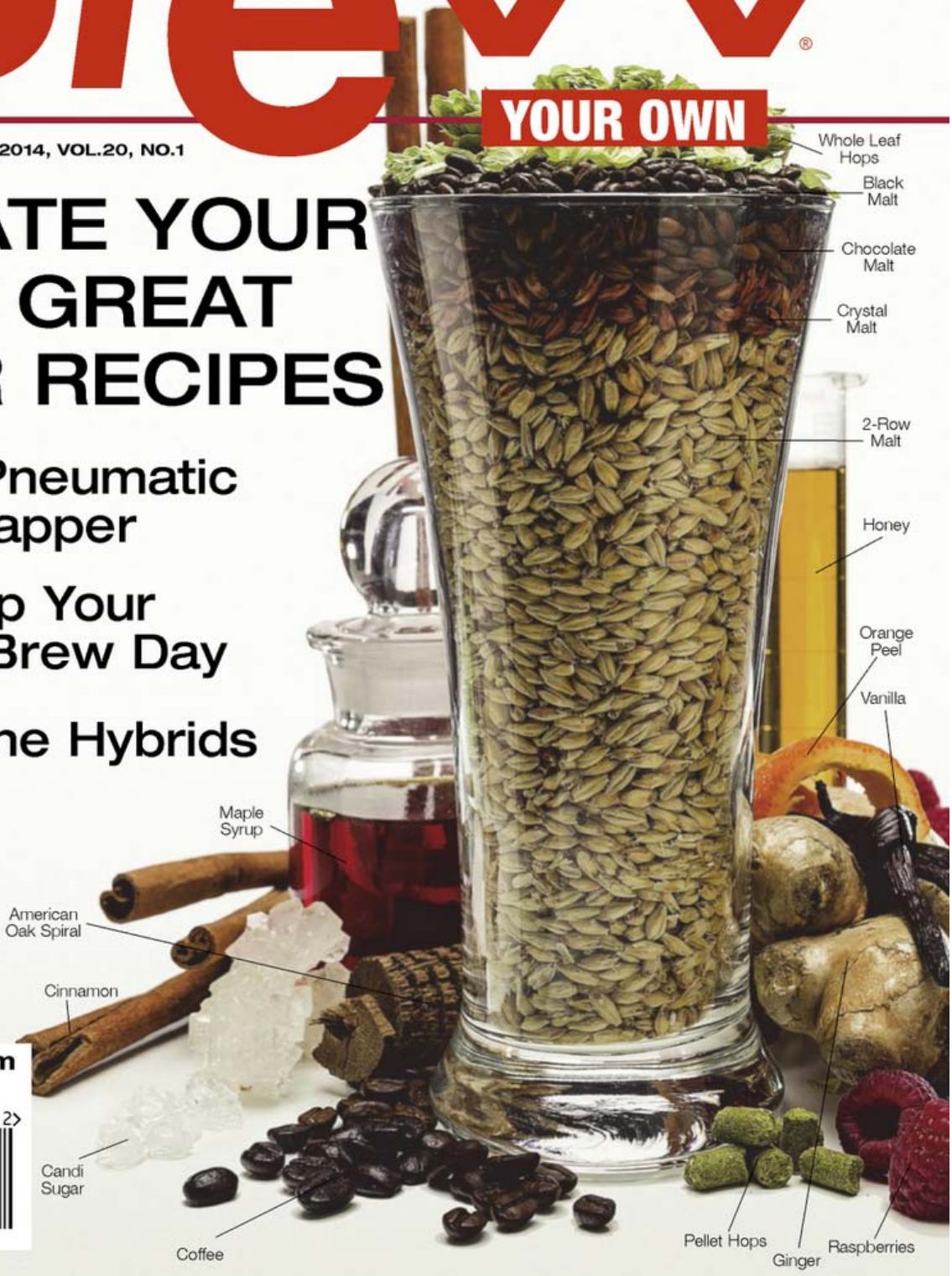
Speed up Your Extract Brew Day

Beer-Wine Hybrids



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BYO RECIPE STANDARDIZATION

Extract efficiency: *65%*
(i.e. — 1 pound of 2-row malt, which has a potential extract value of 1.037 in one gallon of water, would yield a wort of 1.024.)

Extract values for malt extract:
liquid malt extract (LME) = 1.033–1.037
dried malt extract (DME) = 1.045

Potential extract for grains:
2-row base malts = 1.037–1.038
wheat malt = 1.037
6-row base malts = 1.035
Munich malt = 1.035
Vienna malt = 1.035
crystal malts = 1.033–1.035
chocolate malts = 1.034
dark roasted grains = 1.024–1.026
flaked maize and rice = 1.037–1.038

Hops:
We calculate IBUs based on 25% hop utilization for a one-hour boil of hop pellets at specific gravities less than 1.050. For post-boil hop stands, we calculate IBUs based on 10% hop utilization for 30-minute hop stands at specific gravities less than 1.050.

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Dr Bell bred *Maris Otter* barley from a cross of *Proctor* and *Pioneer* - two top quality traditional malting barley varieties. To this day, *Maris Otter* seed is only sold to a select group of farmers who are specially chosen to grow the variety.

Soon after its introduction, *Maris Otter* barley malt became a favourite with brewers due to its excellent malting characteristics, low nitrogen content and forgiving brew-house performance.

Maris Otter is still highly prized in today's craft brewing industry providing independent brewers with a rare opportunity to create beers of unparalleled individuality and quality.

And now you can benefit from the unique characteristics of *Maris Otter* in your home brewed beers. Muntons *Maris Otter* liquid Malt Extract is a new addition to the Muntons Malt Extract range available in both 3.3lb cans and bulk malt.

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what's happening at BYO.COM

Evaluating Beer

Once your beer is bottled or kegged, you're done, right? Actually, you've got one task left as a brewer — evaluating your beer. Critically tasting your own beer can reveal avenues for improvement in your homebrewing.
http://byo.com/story1989

10 Steps to Better Extract Brewing

Extract brewing is not just a simplified form of all-grain brewing. It's a process that has its own set of challenges. Find out what these challenges are — and how to master them — without changing your whole brewing setup or spending a lot of extra time on brew day.
http://byo.com/story10-10

Build a Multiple Bottle Filler

A full 5-gallon (19-L) batch of homebrew requires filling 53 12-oz. (355 mL) bottles. What if you could fill more than one bottle at a time? We show you how:
http://byo.com/story375

A Barrel of Fun

The popularity of barrel-aged beer is on the rise in craft breweries and groups of homebrewers are forming to make their own barrel-aged creations. Learn how to use oak barrels for homebrews.
http://byo.com/story68

Brew Your Own — The How-To Homebrew Beer Magazine

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Cover Photo: **Charles A. Parker/Images Plus**

mail

Tube length question

I was interested when I saw Christian Lavender's "Perfect Pour" article on tips for operating draft systems in the November 2013 issue of *Brew Your Own*. I have been curious what length I should make my draft lines in my homemade kegerator. I was excited about trying the 'rule of thumb' presented in the article, but realized that the article did not actually allow me to use it. The rule of thumb was stated: "Take the ideal pressure, add five, and then divide by the line's restriction value per foot." This would have been useful, but no where else in the article does the author give me any help in estimating my line's restriction value if I don't know it. Is there a way to estimate it based on the dimensions (inner and outer) and the material?

Jason B. Lonon
Spartanburg, South Carolina

Story author Christian Lavender replies: Try vinyl beer tubing with a 3/16-inch inside diameter (I.D.), which has 3 PSI of restriction per foot according to Micro Matic.

First wort hopping vs. mash hopping

I read the "Mr. Wizard" reply in the December 2013 issue of *BYO* issue about mash hopping. I, too, read Mr. Steele's book on IPA and I reviewed my records and found five of my brews where the only hops added were in the mash. If memory serves, two were with whole hops and three were with pellets. There obviously was no flavor or aroma in the beers, but they were not sweet so bittering occurred. I did notice a reduction in trub with a corresponding increase in wort recovery. I re-read Mr. Steele's reply to my email and he had lumped first wort hopping together with mash hopping. I first wort hop a lot of my beers and there is a flavor transfer; no aroma, but flavor did remain in the beer. It appears that these are two separate hopping procedures.

Bob Haisen
Dearborn, Michigan

contributors

Brad Smith is the author of BeerSmith homebrewing software and host of the BeerSmith podcast on iTunes. Brad has been brewing for 26 years, is author of the book *Home Brewing with BeerSmith* and also created BrewWiki.com, the BeerXML beer recipe standard. Brad maintains a blog at BeerSmith.com which includes topics such as brewing tutorials, homebrewing techniques, product and book reviews, articles on brewing popular beer styles and brewing news. He also regularly speaks at beer-related events and writes on homebrewing.

In this issue, Brad makes his writing debut in *Brew Your Own* with a feature story about designing your own homebrew recipes. Read his article starting on page 50.

Dave Green is *Brew Your Own*'s Advertising Sales Coordinator and frequent office homebrewer. When he's not at work, *BYO* often convinces Dave to do some writing, including his past feature stories about hop stands, whirlpool hopping and "hop bursting" (in the March-April 2013 issue. http://byo.com/story2808) and a collection of clone recipes and tips from Vermont's highly-rated Hill Farmstead Brewery, Lawson's Finest Liquids and The Alchemist in October 2013. In this issue, in response to some reader questions about his past two stories, Dave discusses two pre-boil hopping techniques: first wort hops and mash hopping. Learn more about these methods by turning to his piece on page 60.

Todd Huizingh lives in Zeeland, Michigan and has a bachelor's degree in mechanical engineering from Michigan Tech University. He currently works full time as a product design engineer. Todd picked up the homebrewing bug in 2008, and in 2010, he created the popular EZ Water Calculator spreadsheet that he offers for free at www.ezwatercalculator.com. What really keeps his enthusiasm alive for the hobby however is the creative outlet it gives him, particularly when it comes to designing and building brewing equipment and other "beer gadgetry." In this issue he shows off his homemade pneumatic bottle capper and discusses how you can build one too. His story starts on page 36.

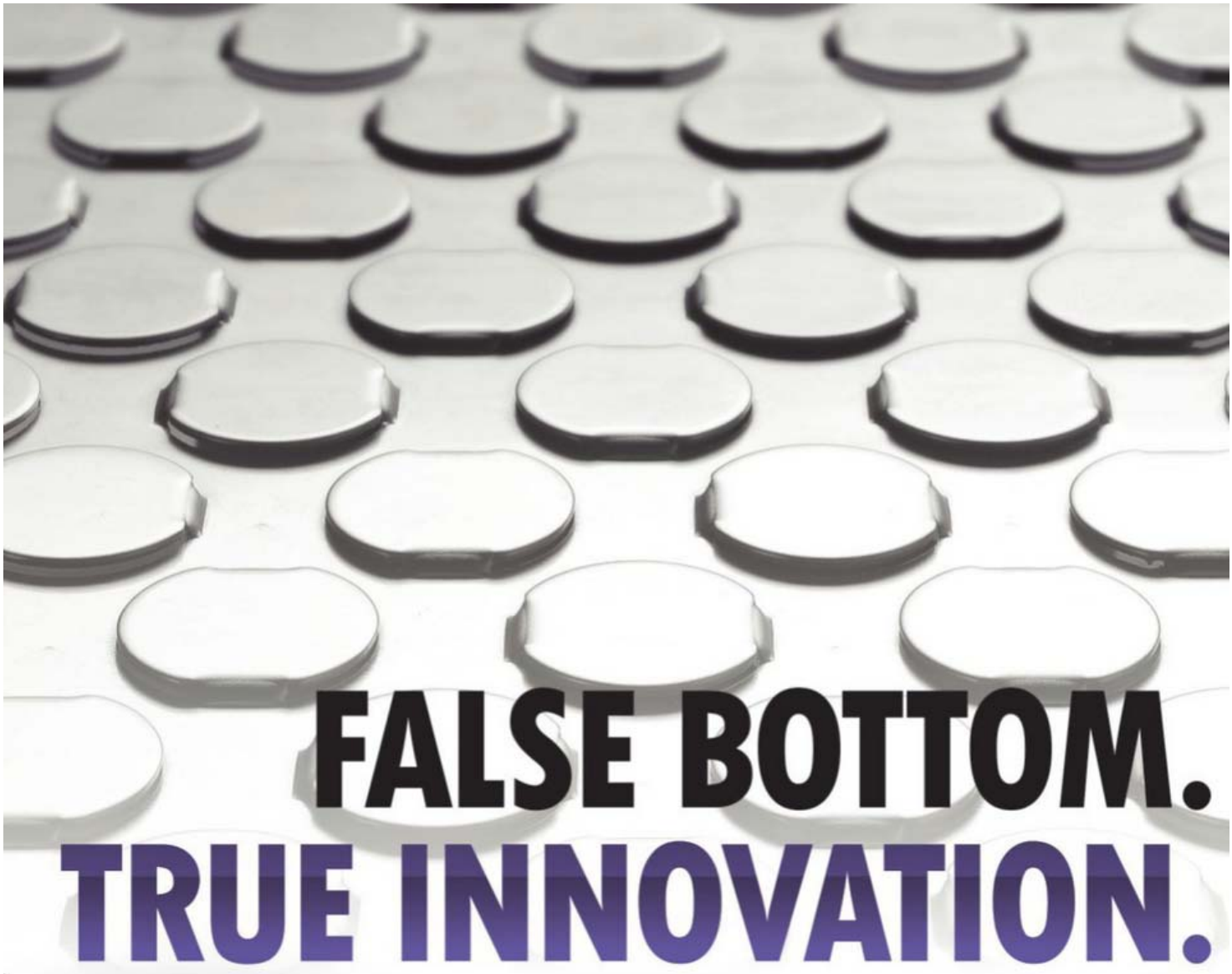
BYO *Editor Betsy Parks replies: Bob, indeed you are right — first wort hopping and mash hopping are two separate procedures. For more information about these two methods, check out the story on pre-boil hopping techniques in this issue, starting on page 60. Thanks for writing in!*

Polyclar question

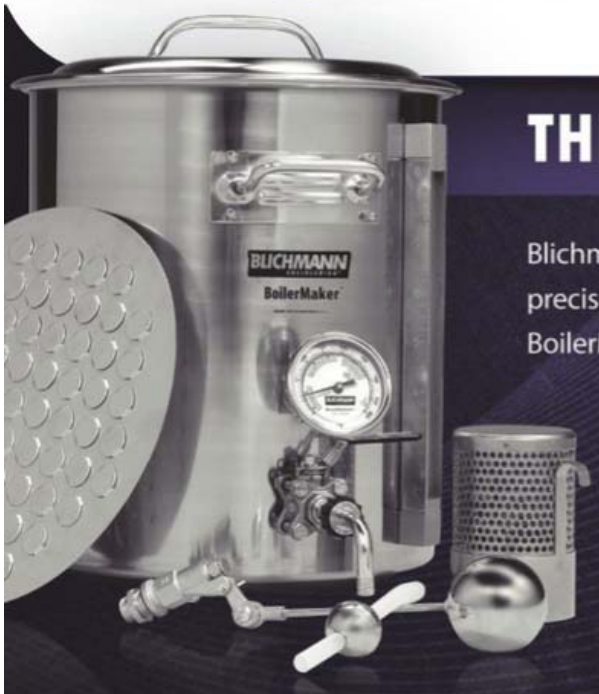
I had the pleasure of visiting Vermont this summer and had a few pints of Hill Farmstead and The Alchemist's Heady Topper. My wife's family luckily (for me) lives just outside of Waterbury. When we got back to Calgary, I set out to try and replicate some of the flavors of these beers through the whirlpool and hop stand methods Dave Green described in his previous article (March-April 2013). I am pleased to say, it was very successful! I would like to try The Alchemist's Holey Moley clone and am curious about Dave's use of Polyclar in the recipe from the October 2013 issue. I agree the beers using this hop stand method do not clear very well. My question is, when do I add the Polyclar? The recipe, as I understand it, says all in the primary, is this correct? If I was to do a 5-gallon (19-L) batch in a 6-gallon (23-L) carboy, would I do the Polyclar and dry hopping in the same primary? I'm asking because I have used Polyclar in the secondary after it has been chilled to 35 °F (2 °C) then kept for two weeks before kegging to clarify the beer. Your thoughts on this would be much appreciated. Kind regards, and excellent article.

Matt Lowe
Calgary, Alberta

Story author Dave Green responds: Hi Matt. Yes, dry hops and Polyclar can both go in the primary fermenter, which saves you cleaning a fermenter. With that said, there is nothing wrong with using Polyclar then racking over to a secondary vessel for dry hopping so long as you can flush the secondary vessel with carbon dioxide or other inert gas. My technique for Polyclar is to wait until all fermentation is complete in the primary (using a hydrometer to double check your FG is at an appropriate level is a good practice), and then add in the slurry of Polyclar or gelatin. The reason why I add the Polyclar is to get the yeast to drop out of solution so that the hop oils won't bind to them and subsequently fall out of solution. Then add the dry hops. After about seven to fourteen days, rack off the yeast and dry hops and get the beer into bottles or keg and carbonate for your enjoyment. If you want to cold crash at the end of those seven to fourteen days, that is fine, but the Polyclar should have achieved about the same result that cold-crashing would have. BYO



FALSE BOTTOM.
TRUE INNOVATION.



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homebrew nation

READER PROJECT: Beer-Filled Tap Handle

Kevin Shaw • Lancaster, Pennsylvania

In my five years of all-grain brewing I have always tried to build, instead of purchase, as much of my equipment as I could. I've built a portable brew rig that I roll out into my driveway each brew day, a stainless steel hop spider for protecting my plate chiller from clogs, and a 3-tap keezer that can also double as a lager chamber. After creating my keezer, the biggest thing I was missing was an easy way to remember which beer line was connected to each tap.

Part of that was solved with chalkboard paint on the side of the keezer, though the addition of these clear tap handles that I fill with the beer they dispense made it much quicker to recognize and remember which beer is in each draft. Or, for the more novice craft beer drinkers I have over who may not be familiar with a style I have on tap, these tap handles are an easy way to showcase what a style looks like before pouring them a draft. These homemade tap handles are also a great conversation piece whenever I have friends over for a brew.

The only materials you need are empty White Labs yeast vials, tee-nuts, hex nuts, sandpaper and a very strong adhesive. I experimented with a couple types of superglues and found that J-B Weld epoxy works the best. The most important step is scuffing up the top of the yeast vial cap and the top of the tee-nut so that the epoxy has ideal surfaces to adhere. Sandpaper works fine, though a rotary tool with a grinder or sandpaper attachment would be ideal. Once they are sanded and cleaned off, you just have to mix the 2-part epoxy, spread a little bit on the cap, and clamp the tee-nut into place until set.

Now all that's left is to fill up the vial and screw the cap onto it. It is best to fill the vial prior to carbonation just so it doesn't foam over. I use the hex nut as a decoration to cover up the connection to the tap. The finished product is a great way to discriminate between the styles that I have on tap.

Visit my website at www.downthehatchbrewing.com to find more information on the other homebrewing projects I have completed.

Tools & Materials

(1) Empty White Labs yeast vial
(1) Tee-nut, ⅜-inch, 15 coarse
(1) M16-2.0 hex nut
J-B Weld epoxy
Sandpaper (or rotary tool)

byo.com brew polls

Have you ever added oak alternatives to your homebrew?

No, but I would like to 43%
Yes, I love the added complexity 36%
No, I'm not interested 14%
Who needs oak alternatives when I have a barrel? 7%

social homebrews

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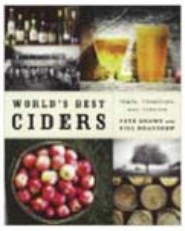
Follow *BYO* on Twitter at: @BrewYourOwn

what's new?

World's Best Ciders



World's Best Ciders, written by Pete Brown (who was named the 2009 and 2012 "Beer Writer of the Year" by the British Guild of Beer Writers), is a guide to more than 500 hard ciders from both artisan makers and global brands. Between the beautifully photographed pages are in-depth explanations and tasting notes that reveal all you need to know about the cidermaking process, producers and breweries across the globe. *World's Best Ciders* also includes a detailed history of hard cider and recipes for cider-based dishes. Available at major booksellers.

Chalkboard Tap Handles

Tap Boards has released a new line of dual faced chalkboard tap handles. The chalkboard handles allow users to write the name of the beer being served on tap, and then erase and reuse when the next keg is hooked up. With an elegant wood design, the handles are a great addition for any homebrewer serving beer on draft. To learn more, visit www.tapboards.com.

Critter Cutter

The Critter Cutter is a multi-tool with a unique design and functions as a bottle opener, box opener, can tab pry bar, can top punch, and keychain. The Critter Cutter is made of stainless steel in America, and because of its strength it will not wear. It was designed to feel comfortable in the hand and comfortable during use. For more information visit www.crittercutter.com.

calendar

January 19
Kris Kringle Challenge
Baker City, Oregon

The Good Libations Home Brew Club presents the second annual Kris Kringle Challenge at Bull Ridge Brew Pub. The competition accepts only BJCP Style 21B (Christmas/Winter Specialty Spiced Beer) entrees. The registration deadline is January 19. The Best of Show will be awarded 5 lbs. (2.3 kg) of whole hops.
Entry Fee: $7
Web: www.sites.google.com/site/goodlibationshomebrewclub

February 1
Beer Bacon Music Brewer's 6K
Frederick, Maryland

The Brewer's 6K Homebrew Competition will accept 50 entrants in 10 homebrew categories and award the largest homebrew competition prize ever of $6,000 to the Best in Show. Registration opened in November, so if you would like to register you should not delay as space is limited. Once you register, you will be sent instructions on submitting your homebrew and more details on the competition on Feb. 1. The event takes place May 17-18 at the Frederick Fairgrounds.
Entry Fee: $40 (subject to change, includes entry into the festival both days)
Web: www.beerbaconmusic.com/homebrew

February 22
War of the Worts
Montgomeryville, Pennsylvania

The War of the Worts homebrew challenge, presented by Keystone Hops, is accepting entries for all BJCP categories, including mead and cider. The competition will be held at Keystone Homebrew Supply. Prizes will be awarded for beers placing first, second and third in each category, as well as a special prize for Best of Show.
Entry Fee: $7
Web: www.keystonehops.com

homebrew drool systems

Bedframe Brew System

Joseph Cyr • Milford, Massachusetts

I started brewing during the dark ages of homebrewing (1976). I was already making wine and had most of the equipment needed to make beer, so I did. The homebrew process then was not much different from Prohibition brewing with an emphasis on alcohol, not taste. I failed to produce a drinkable beer in 3 attempts, so I stuck with winemaking. Fast forward to the '90s. With the craft beer boom, my brewing desire was reignited. I went all-grain, with my first brew being a step-decoction Oktoberfest. It turned out amazingly well and launched my modern-day homebrew hobby.

I never really had the space for a standard homebrew system. Growing tired of assembling the hodge-podge of equipment in the kitchen each brew day, one day it hit me; I can make use of the two old bed frames in the garage, teach myself to weld, and create a portable, collapsible, three-tier brew sculpture.

My system is designed to produce 5 gallons (19 L) of average-strength beer very efficiently in a small footprint, yet almost disappear when not in use. And to that end, it works very well. The top tier is a 6-gallon (23-L) HLT with calibrated sight glass, thermometer, and standard propane burner.

The Second tier is the mash tun, made from a 5-gallon (19-L) water cooler with dial thermometer, perforated stainless steel plate false bottom and a rotating fly sparging unit. The bottom tier houses a cast iron Hurricane burner. I use the Flojet pump for filling the HLT and drawing the hot wort from the kettle, through a counterflow chiller and into the fermentation bucket.

beginner's **block**

OAK ALTERNATIVES

by dawson raspuzzi

Aging your homebrew in an oak barrel can add more dimensions to your beer by imparting complex wood characteristics such as vanilla, cloves, coconut, or caramel, but barrels are not ideal for everyone. If you are experimenting with oak for the first time you may not want to invest the money in buying a barrel, and there are also issues of space and additional time requirements to maintain the barrel. If barrels aren't for you, that doesn't mean you can't create the same depth of flavors to your beer. Instead of putting the beer in the oak, you can always put the oak in the beer. There are a number of oak alternatives available from homebrew retailers, whether you want to add oak chips, oak cubes, powder or liquid extracts.

The most common oak alternatives are oak chips and cubes, and there are many options of both – including American, French or Hungarian oak, as well as different levels of toast. American oak generally has a more aggressive oak and vanilla flavor, while French oak is more refined and adds a bit more spiciness. Hungarian falls somewhere between French and American oak. Toasting the oak brings a more caramelized, toasty flavor. Chips and cubes come in light, medium and heavy toasted levels, indicating how deep into the oak it is toasted and how much of the toasty flavors they will bring to your beer.

Both chips and cubes are generally added to secondary fermentation. Sanitize the oak by steaming or boiling it for about 15 minutes. Then add the oak (and water too, if you don't want to waste any of the flavor) to your secondary fermenter. Do not use a sanitizer as the oak will absorb it and transfer that flavor to your beer.

Another method used to kill any potential bacteria that may be living in the wood, while also adding flavors you would get from aging your beer in used barrels, is letting the oak soak in whisky, bourbon, or other spirits for anywhere from a couple of days to a couple of weeks depending on how much of the flavor you are looking to add to our homebrew.

An advantage of oak chips is the extraction time of the flavors is shorter — one to two weeks — because of their greater surface area, while cubes will take four to six weeks. Alternatively, because cubes have less surface area, some brewers believe cubes have a "fresher" taste as flavors deep inside them that have not been lost to air contact come out over time. Both options allow you the opportunity to periodically sample your beer and then rack the beer off the oak when you feel it is just right.

Also available are oak staves or spirals, which are larger pieces of oak with a greater surface area. They are generally used for larger batches than the average homebrewer is making, so they are not as frequently used for homebrewing. They can take months before the full flavor is extracted.

Other than chips and cubes, the other common products for homebrewers are oak essence and oak powder. Oak essence is a liquid oak flavoring and, like oak powder, can be stirred into your homebrew to get a quick and easy oak characteristic prior to bottling. It takes very little essence or powder, so be cautious with your additions. While these powder and liquid options are by far the fastest way to add wood characteristics, the flavor they impart may not be as authentic.

No matter the oak alternative you use, remember that adding flavoring is easy, removing a flavor is much more difficult and would require blending another batch of beer, assuming you have one on hand.

by marc martin

DEAR REPLICATOR, THIS SUMMER MY BROTHER AND I TOOK A ROAD TRIP, TRAVELING ON LOTS OF BACK ROADS. IN ONE SEGMENT IN WASHINGTON WE FOUND ICICLE BREWING COMPANY IN LEAVENWORTH, WHICH HAD EXCELLENT BEERS. NOT ONLY IS THE BREWERY VERY NICE, BUT THE WHOLE TOWN IS DECORATED LIKE A SMALL TOWN IN GERMANY. WE BOTH LOVED THE PRIEBE PORTER (WHAT IS UP WITH THAT NAME?) AND WOULD LIKE TO TRY OUR HAND AT BREWING IT.

THEO SANDERS
DENVER, COLORADO

Nestled in the mountains of north central Washington lays the quaint town of Leavenworth. It is like a step into old world Germany. Many years ago the city council decided to turn a dying town into a tourist destination. The result transformed a former railroad and logging town into a replica Bavarian village. What could be a better setting for an excellent brewery creating true German-style lagers and ales? That was exactly what owners Oliver and Pam Brulotte thought too. After opening what is considered to be the best beer garden in town, The München Haus, they came to appreciate some of the world's amazing craft beers. This led them to open a brewery to meet the local demand. It also made sense since their family history of hop farming goes back four generations.

Their dream started to become reality in May 2009 when they hired Head Brewer Dean Priebe. Dean was a homebrewer who brewed his first batch in college in 1988. They were first introduced to his skill when he won the 2008 Puget Sound Pro-Am with his robust porter. After that he was invited to brew this beer with Brewer Drew Cluley at Pike Brewery in Seattle. Pike sold a couple of the kegs to a Leavenworth restaurant that christened it Priebe Porter. It was an immediate hit in Leavenworth and it only seemed natural that Dean become the town's Brew Master.

With a brewer hired, a vacant lot was located and the brewpub building began to take shape. Good things take time and finally in April 2011 the doors officially opened. Now they supply approximately 190 taps throughout northern and eastern Washington. To meet this demand, Dean and his assistants (all accomplished homebrewers) Troy Chadd, Mark Magnuson and Jamie Wiley keep the 25 barrel system cranking constantly. Production has grown from just under 1,000 barrels in 2011 to a projected 4,000 barrels this year.

The Priebe Porter is a classic representation of an American robust porter. The color is very dark brown but still displays nice clarity and beautiful ruby highlights. It is topped by a fine tan head that laces the glass. The flavor is dominated by dark chocolate with a light roast finish. Hop bitterness is designed to just offset the residual sweetness.

Thomas, no need for a long back road trip because now you can "Brew Your Own" Priebe Porter. For more on Icicle Brewing Co. visit www.iciclebrewing.com. BYO

Icicle Brewing Company Priebe Porter Clone
(5 gallons/19 L, extract with grains)

OG = 1.064 FG = 1.015 IBU = 34 SRM = 29 ABV = 6.8%

Ingredients

6.6 lbs. (3 kg) Muntons light, unhopped, liquid malt extract
2 lbs. (0.9 kg) Munich malt
1 lb. (0.45 kg) 2-row pale malt
6 oz. (0.17 kg) crystal malt (40 °L)
6 oz. (0.17 kg) chocolate malt (350 °L)
6 oz. (0.17 kg) black malt (530 °L)
8 AAU Warrior® hop pellets (60 min.) (0.5 oz./14 g at 16% alpha acids)
3.8 AAU Palisade® hop pellets (15 min.) (0.5 oz./14 g at 7.5% alpha acids)
3.8 AAU Palisade® hop pellets (0 min.) (0.5 oz./14 g at 7.5% alpha acids)
½ tsp. Irish moss (30 min.)
½ tsp. yeast nutrient (15 min.)
White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) or Lallemand BRY-97 (American West Coast) or Safale US-05 (American Ale) yeast
Priming sugar (if bottling)

Step by Step

Steep the grain in 2.5 gallons (9.5 L) of water at 154 °F (68 °C) for 30 minutes. Remove grains from the wort and rinse with 2 quarts (1.8 L) of hot water. Add the extract and boil for 60 minutes. Add remaining ingredients as per the schedule. When done boiling, top off in fermenter up to 5 gallons (19 L). Cool the wort to 75 °F (24 °C). Pitch yeast and aerate the wort heavily. Ferment at 68 °F (20 °C). Allow the beer to condition for 1 week and then bottle or keg.

All-grain option:

This is a single step infusion mash using an additional 9.5 lbs. (4.3 kg) 2-row pale malt to replace the liquid malt extract. Mix all of the crushed grains with 4.5 gallons (17 L) of 172 °F (78 °C) water to stabilize at 154 °F (68 °C) for 60 minutes. Slowly sparge with 175 °F (79 °C) water. Collect approximately 6 gallons (23 L) of wort runoff to boil for 60 minutes. Reduce the 60-minute Warrior hop addition to 0.4 oz./11 g (6.4 AAU) to allow for the higher utilization factor of a full wort boil. The remainder of this recipe and procedures are the same as the extract with grains recipe.

Barrel Aging

tips from the pros
by Dawson Raspuzzi

Oak isn't just for whiskey and wine

THE POPULARITY OF BARREL-AGED BEER HAS GROWN TREMENDOUSLY IN RECENT YEARS, AS BREWERS LONG FOR THE ADDED COMPLEXITY IMPARTED BY OAK. HERE ARE THREE PROS WHO EARNED MEDALS AT THE 2013 GREAT AMERICAN BEER FESTIVAL FOR THEIR BARREL-AGED BREWS.

We use any type of oak barrels we can get — American, French, and Hungarian — and don't have a preference on the flavor impact each gives. We stick with previously emptied barrels to get an added complexity. Also I find new oak can be very aggressive and overpower beers.

Any beer style is free game for barrel aging, but typically it has to have some aging potential by being stronger in alcohol. When reusing spirit barrels I have found that residual sweetness in the beer often helps with the finished balance. Oak tends to dry out flavors in beers so some sweetness left behind helps.

We age anywhere from 2-3 months up to 2-3 years (for wild beers). It depends on what base beer is used and what overall effect is desired. It also depends on how much time I have to tend to them. We only use our bourbon barrels once. The flavor impact is so much lower on the second aging that it is sometimes not worth it. Plus, infection potential is greater each time you fill. With wine barrels, we'll keep using them until anything negative occurs in them.

We have also used oak spirals, which work nicely. The surface area is greater so it doesn't take as long, but you have to soak them first if you desire the character from the spirits. For homebrewers, keep everything clean and keep experimenting with wood types, aging times and beer styles. You never know when you'll hit that "a-ha moment" with a barrel. Experimentation is the name of the game.

Matt Van Wyk is the Brewmaster of Oakshire Brewing in Eugene, Oregon. He has been in the beer industry 12 years; in 2006 being named the Small Brewpub Brewmaster of the Year at the Great American Beer Festival as the Brewmaster of Flossmoor Station in Illinois. Oakshire's Hellshire III, a stout, won a gold medal at the 2013 GABF in the "Wood- and Barrel-Aged Beer" category.

We age Belgian styles, stouts, porters; anything we can think would create an interesting flavor profile. Sometimes it works, and other times it doesn't, that's the joy of experimenting.

We re-use everything from your standard bourbon barrels to rum, tequila, wine, Port, and Cognac for different projects depending on how the flavors will come together. We use all of our barrels for at least two separate beers. After the contributions from the spirit and wood diminish slightly from the first use we shift over to a subtler aging, or to a wild beer.

Aging times vary. Some beers like Resolute, our bourbon barrel Russian imperial stout, are aged over 10 months so we can pick up a ton of the vanilla characteristic, the mouthfeel gained from the wood and give the bourbon a long time to mellow out. Beers that we age in rum or tequila barrels are usually only aged a couple weeks. It really boils down to tasting the stuff and seeing where it's at.

We don't use oak alternatives at the brewery, but they are the only things I use homebrewing. Times are always a little different and you really have to try to take into consideration the amount of oxygen ingress. When homebrewing, you also need to be cautious about how much oak you use. With the push for more and more everything (hops, wood, alcohol, etc.) it seems that sometimes we lose sight that one of the most difficult things to do is balance a beer. This is particularly prevalent with barrel-aged beers where you can so easily make a beer taste like the base beer with a shot of a spirit in it. Time is generally your friend — let it age things out and don't rush it.

Last and certainly not least, keep brewing! Homebrewers are the lifeblood of this industry with so much creativity and enthusiasm. You are all an inspiration!

Adam Shifflett (right) and his brothers Jason (middle) and Tyler (left) opened Three Brothers Brewing Co. in December 2012 near where they grew up in Harrisonburg, Virginia. With a background in mechanical engineering, Adam started as a homebrewer four years ago and volunteered at O'Connor Brewing in Norfolk, Virginia before he and his siblings opened Three Brothers, which produced about 4,000 barrels in its first year. Three Brothers won a bronze medal at the 2013 Great American Beer Festival with their Rum Barrel Belgian Dubbel.

Sun King Brewing Co. is the brainchild of co-owners and brewers Dave Colt (left) and Clay Robinson (right). Opening in 2009, Sun King is now the second largest brewery in Indiana. The company's commitment to handcrafted seasonal and specialty beers has been rewarded with numerous recognitions, including a gold medal in the "Wood- and Barrel-Aged Strong Beer" category of the 2013 Great American Beer Festival for their bock-style American Delight.

Since opening more than four years ago we have put a wide variety of beers in barrels — including cream ale, Belgian ales, Scotch ale, lagers, porters and stouts — basically everything other than hoppy beers. We're not picky when it comes to the barrels we use. The majority of them are bourbon barrels, given our proximity to Kentucky, but we do have some barrels that previously held wine, scotch, rum and tequila. We have never used new barrels — we like the way that the previous flavors interface with the beers and we try to make sure that the style of beer we are brewing is going to marry well with the flavors of the barrel.

We only use the bourbon or spirits barrels once because we tend to extract most of the flavor from them in that first batch. Then we move them to our souring program in a separate temperature-controlled room and fill them with beer that we inoculate with bacteria. Those beers sit for a year or more before we get the results we are looking for.

For our other beers, the time we age in the barrel depends on what was in the barrel and what we put into it. We typically pull a sample after three months and then decide whether it's good to go or when we want to check again. Often the beer will age in the barrel for upwards of nine months at cellaring temperatures. We believe beer should always be stored cold in order to maintain its integrity.

We have also used oak spirals in bright tanks for a couple of beers. Because of the increased surface area, the aging process speeds up and it only takes a month or so to impart the oak flavors we are looking for.

Barrel aging is a process and it isn't for someone who demands results right away. When we are asked by homebrewers for advice, the best advice we can give is, "Patience young grasshopper, patience." BYO

Stinky Lagers

Airlock blowouts, barrel aging

help me
mr. wizard
by Ashton Lewis

Q MY LAGERS ALWAYS CONTAIN A LOT OF SULFUR (LIKE GARBAGE OR ROTTING VEGETATION) AROMAS. MY BOILS ARE TYPICALLY 75 MINUTES, FULL ROLLING BOILS UNCOVERED WITH OVERHEAD VENT FAN USING GAS PLUS ELECTRIC HEAT STICK AUGMENTATION. I USE BOTH LIQUID YEAST WITH STIRRED STARTERS AND DRY YEAST (ALL STYLE-APPROPRIATE LAGER YEASTS), ALL SCALED TO APPROPRIATE PITCHING RATES USING THE CALCULATOR AT MRMALTY.COM. TYPICALLY I CHILL TO 50 °F (10 °C) AND PITCH. THEN I FERMENT AROUND 52 °F (11°C) IN A DEDICATED FERMENT CHAMBER WITH EXTERNAL TEMPERATURE CONTROL, PROXY THERMOWELL IN A SEPARATE JUG OF WATER, AND FORCED AIR CONVECTION UNTIL FERMENTATION SLOWS, AND A SAMPLE SHOWS ABOUT 65-75% COMPLETE. THEN I RAISE THE TEMPERATURE OVER A COUPLE DAYS TO ABOUT 65 °F (18 °C) AND LET IT SIT FOR A WHILE. I HAVE READ A WARMER FERMENTATION AT THE END HELPS SCRUB SULFUR AND ABSORB DIACETYL. MY DIACETYL IS GETTING CLEANED UP, BUT NOT THE SULFUR.

FRANCISCO JONES
KANKAKEE, ILLINOIS

A Francisco, nothing in your description of your lager brewing throws up any warning flags related to sulfur production. It really sounds like you are doing a very good job with yeast pitching control and fermentation temperature control. The Mr. Malty yeast calculator is a nice tool and is fairly conservative, so I do not think your problem is yeast pitching rate, the root cause of many fermentation off-flavors.

Another key factor related to fermentation-related aromas is yeast strain. It is certainly true with lager yeasts that some strains do indeed produce more sulfur aromas than others. I have used several lager strains over the past 16 years at Springfield Brewing Company and settled on the Augustiner lager strain a couple of years ago and have been very happy with the results. One of the aromas I wanted to minimize in our lagers was hydrogen sulfide, which smells like a rotten egg. The Augustiner strain does produce sulfur during fermentation, but it dissipates in our process to yield very clean lagers.

For what it is worth, we cool our wort to 50 °F (10 °C) and ferment at 54 °F (12 °C). We use a spunding valve, a type of pressure relief valve commonly used to capture carbon dioxide in fermentation vessels, and the valve is put on the fermenter when we are about 1 °Plato above our projected terminal gravity. The beer is held at fermentation temperature for four days after spunding for diacetyl reduction. We then chill the beer to 38 °F (4 °C) and hold at this temperature for about 10 days. The lager yeast is still active at this temperature and diacetyl and acetaldehyde reduction continues during this time period. The beer is then cooled to 30 °F (-1 °C) for at least two days before filtration or racking in the case of unfiltered lagers.

"Another key factor related to fermentation-related aromas is yeast strain."

Like many brewers, I have some rituals that are based on a mixture of tradition, practical experience and science. What we do works for us, so we are not real keen on changing things. We cannot raise our temperature for a diacetyl rest, so we use a longer rest period to achieve our goals. I know from pulling samples during lagering that the sulfur profile of our lagers does significantly change during the time from spunding to serving. I have always believed that the slow, continuous release of carbon dioxide from the spunding valve during lagering helps scrub sulfur from the

Photo by Charles A. Parker/Images Plus

aging lager. One confirmation of this scrubbing is the aroma released from the valve; at the early stages of lagering the sulfur intensity is greater than it is towards the end. If you simply complete fermentation and keg or bottle your lager without this gas scrubbing process there is no mechanism for sulfur removal since yeast does not absorb these compounds as is the case with diacetyl and acetaldehyde. Homebrewers who keg their beer can scrub sulfur compounds by bubbling carbon dioxide into the beer from the spear, then slowly releasing the head pressure, and repeating the process several times. This not only will help to scrub sulfur aromas out of the beer, it is also part of the force carbonation process.

The aromas you describe could be associated with very high levels of dimethyl sulfide. It sounds like you have a very good boil, but if you do not quickly cool wort after boiling, residual S-methylmethionine (also called DMS precursor or DMS-P) will be converted in the hot wort to DMS. In the absence of boiling and steam stripping, the DMS will remain in your wort and can show up as a flavor defect in the finished beer. Most brewers using some sort of wort chiller to cool the wort fairly quickly after boiling do not have this particular problem. My gut feeling is that DMS is not your problem.

Two other things to consider are yeast nutrients and sanitation. While all-malt beers typically contain plenty of amino acids and phosphates, they can be deficient in zinc. Some yeast nutrients, especially types common to winemaking, are mainly comprised of amino acids and phosphates, and other nutrients are really designed to boost zinc levels in wort. We use Servomyces in all of our beers and I believe that this really helps us with producing very clean beers. This product is sold by White Labs and is a good source of zinc. Remember that aeration is important because oxygen is also a sort of nutrient and is integral to the synthesis of membranes during cell growth. Finally, poor sanitation can lead to microbiological issues that certainly can cause terrible off-flavors associated with bacterial contamination. Hopefully I have touched on something to help you produce better lager beers!

DOES HAVING TWO AIRLOCK BLOWOUTS DURING THE FIRST 12 HOURS OF FERMENTING MEAN THAT I HAVE A BAD BATCH?

NATE TOLVAISA
HAVERTOWN, PENNSYLVANIA

In the commercial world of brewing, one of the biggest fears is a fermentation that is slow to start or one that lacks vigor when it does come to life. These traits foreshadow problems lurking on the horizon. Any microbiological critters coming forward into the fermenter from wort production or bacteria associated with pitching yeast are much more likely to take hold in a fermenting batch of beer if fermentation does not take off quickly and with command of the situation. Alcohol production, pH reduction and oxygen consumption all occur in the early stages of fermentation and collectively help to build a hurdle for bacterial takeover. The combination of inhibitory factors is indeed known as the hurdle theory by those who study food microbiology. The more hurdles put before unwanted organisms reduces their ability to colonize the environment. In the world of beer, decreased pH, alcohol, reduced oxygen and the competitive nature of a healthy yeast population make it rough on unwanted guests, like spoilage bacteria and yeast. The opposite of this is true when funky, sour beers are being produced. Too many hurdles, especially hop bitterness, reduces the chances of being successful with these funky brews.

So blowing off your airlock is not a bad thing because it is an indicator of a healthy fermentation. But blowing your airlock is really not the best thing for your beer, your carboy or your home. Airlocks help protect your beer from the environment outside of the fermenter. When it launches from the top of the carboy you are no longer protected. Airlocks can become clogged and fail to launch like a missile from the carboy and this can cause carboys to break. When an airlock launches from the carboy foam may follow and when a carboy breaks beer is sure to follow. Both of these things are bad for the home. The take home message is that blowing off your air-lock should be avoided if at all possible.

Another problem associated with blowing off "stuff" during fermentation is loss, since beer is a major component of this "stuff." Commercial brewers typically have 25-35% headspace volume in fermentation vessels to minimize or completely eliminate blow off during fermentation. The take-home message is to consider using a 6-gallon (23-L) carboy for your 4- to 5-gallon (15- to 19-L) batches.

The best thing to attach to your primary fermenter is a blow-off hose that allows for a large volume of carbon dioxide and foam to escape the fermenter while preventing the formation of pressure that can cause the problems described above. All commercial breweries, ranging in size from the smallest to the largest, use some sort of device to allow gas and liquid to flow out of the fermentation vessel because this sort of problem can grow from a small-scale nuisance to a large-scale disaster.

The good news to report is the health of your fermentation seems to be excellent! I think future batches will be improved by the use of a blow-off tube better able to handle the active nature of your fermentation.

help me mr. wizard

Q I'M ABOUT TO PUT A GOLDEN STRONG ALE IN A BARREL. FIRST, SHOULD I USE STAR SAN IN THE BARREL? AND HOW LONG SHOULD I USE A BARREL FOR THE SECONDARY FERMENTATION?

JOHNNY HILL
LOUISVILLE, KENTUCKY

A Barrel aging is really a fun thing to do because it brings flavors and aromas to beer that are simply unachievable using other methods. New barrels can be used to introduce vanilla and toasted notes to beer. Oak spirals and chips can be used for similar flavors, but barrels do more than add oak flavor. As beer ages in oak it slowly oxidizes due to the ingress of oxygen through the porous structure of the staves. This is one of the reasons that microaerophilic organisms such as *Brettanomyces* species, *Lactobacillus* species, and *Pediococcus* species grow relatively well in barrels. It is also the reason why brewers and vintners are concerned about using used barrels if the idea is not to make funky beer or funky wine, which really has failed to become as popular as funky beer. OK, funky wine is totally unacceptable, but I digress.

Whether starting out with new or used barrels, there are a few things you can do to help ensure a positive barrel aging experience. With a new barrel you can tackle two concerns at once by filling the barrel with nearly boiling water to sterilize the surface of the barrel and hydrate the wood and help the barrel seal before use. Since wood is a good insulator the water will stay hot for several hours. I typically leave new barrels filled with water for 6 hours or so and then empty the barrel by syphoning the water to the floor. Allowing the water to cool to about 140 °F (60 °C) makes this process a little less steamy. After the barrel is empty you can go ahead and rack your beer into the barrel.

If you have a used barrel the chances of having microorganisms inside of the barrel are much more likely than starting with a new barrel. It is common to clean barrels by rinsing with cold water, then warm water and finally hot water after use to remove the different types of soils that are deposited in the barrel during use. It is not uncommon to use a mild cleaner, such as sodium carbonate, after the barrel has been thoroughly flushed with water. After cleaning and drying, elemental sulfur sticks can be burned and sealed in the barrel to create a sulfur dioxide fog that suppresses the growth of organisms. This process needs to be repeated about once every four weeks to preserve the

J JUNE, WE HEARD YOU LOUD AND CLEAR. BLOODY GOOD JOB INDEED.

Great beers are made with great malt. That's why BSG HandCraft works with suppliers like Crisp Malting Group to bring high-quality, select ingredients to homebrewing retailers in the United States. Homebrewers deserve to use the best, and we're dedicated to making that happen.

Ask for Crisp Gleneagles Maris Otter at your local homebrew shop. Cheers!

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integrity of the barrel. Using other types of sanitizers, including Star San, is not common with the use of barrels.

When it comes to barrel aging, the duration of aging depends on several factors. If you use a barrel that previously contained another product and your intent is to flavor your beer with this product you may find that little time is required. I have barrel aged stout in 8-gallon (30-L) whiskey barrels for four weeks and ended up with some really stellar products. I have also aged beer in new oak barrels for a few months and have extracted more vanilla flavors than I really wanted. On the other extreme I have aged beer in barrels with *Brettanomyces* and have had to wait more than a year to achieve the results I wanted.

One interesting side note about using bourbon and Scotch barrels is the subject of bacteria. It seems that these barrels would not be vectors for contaminants. Mitch Steele, Head Brewer of Stone Brewing Co., noted that they have actually found this assumption to be false and that used bourbon and scotch barrels can harbor bacteria. The likely reason for this is that these barrels are emptied somewhere, certainly not very near San Diego, stored, shipped and then used. During this time the interior surface of the barrel is exposed to air. Since the charred surface of whiskey barrels is porous, it is a good environment for bacteria to colonize.

When putting beer in a barrel you should consider drilling a small hole in the lower portion of one of the heads and plugging the hole with a stainless steel nail. The nail can be removed to pull a sample. This will help minimize damage to your beer from sampling with a thief. This is especially true if the beer has a *Brettanomyces* pellicle that helps protect the surface from oxygen and subsequent colonization by *Acetobacter*, which converts ethanol into acetic acid (vinegar). The other thing I strongly recommend is to be patient. If you sample the barrel and do not taste what you desire, wait at least a month for sampling again. Excessive sampling simply reduces the batch size. BYO

Munich Helles

A pale, malt focused lager

style profile
by Jamil Zainasheff

Today's craft beer world is full of creativity and innovation. There are many new, creative ideas coming to market and it is easy to imagine that every brewery is trying something new. However, a brewer friend of mine recently pointed out how much breweries are copying each other these days rather than coming up with new ideas of their own. He attributed it to the boom in craft beer breweries, with many just focusing on trends in the marketplace. One brewery brews a black IPA and it becomes popular. Very quickly, half of the craft breweries jump on that bandwagon to get a slice of that market.

I am all for creativity rather than mimicry, but this is not a new phenomenon. Take, for example, in the 1800s when pale beers became the rage. All of a sudden, everyone needed to have a pale beer in his or her portfolio. It is reported that Gabriel Sedlmayr (or possibly his sons) at the Spaten Brewery created the Munich helles style during this time. He was working on making a beer paler than what his competitors were making. Of course, it being Bavaria, the beer was not as hoppy and sharp as Pilsner, but rather more malt focused.

Munich helles is a pale gold German lager with a bready and grainy malt character that starts in the aroma and lasts all the way through the finish. The beer often has a slightly sweet malt character, but it is not a sweet beer. A good example of the style should be well attenuated and the malt sweetness is more an effect of the low to medium-low hop bitterness. This is a cleanly fermented lager with a soft, medium body. There should be no fruity esters, no diacetyl and a long, malty finish. Hop flavor and aroma are minimal and when present, often has a spicy or floral quality.

A common mistake when brewing a beer described as "malt focused" like Munich helles is to assume that maltiness and sweetness are the same thing. A beer with a lot of sweetness from malt is not necessarily "malty," it is sweet. It may or may not also have a lot of malt character. It is quite possible to have a dry beer that has lots of malt flavor and aroma or malt character. When most beer judges use the term "malty," they are referring to the rich grainy, bready, toasty flavors and aromas that come from the malt, not the residual malt sweetness.

A great recipe is relatively simple, but many brewers try to make it much more complex in an effort to increase malt character. The best way to achieve that great German lager malt character is with high-quality, full-flavored base malts and excellent fermentation practices. I would never attempt to make a Munich helles without using continental Pilsner malt. You can use other pale base malts if you have no other option, but the light, grainy taste of high quality Pilsner malt is right on target for this style. In addition, I like to add some Vienna or Munich malt, which adds to the malt character. Anywhere from 5 to 20% of the grist can be Vienna or Munich. If you go with Munich, use a lighter color Munich rather than darker and use it as a lower percentage of the grist. With those basic malts you should be able to make an excellent example of the style. You can add other malts as well, such as head and body forming dextrin malts. Avoid crystal malt — you want some grainy sweetness, but that comes from the continental Pilsner malt and a lower level of bittering.

Extract brewers can use a Pilsner malt extract with decent results. A

> "I would never attempt to make a Munich helles without using continental Pilsner malt."

MUNICH HELLES
by the numbers

OG:	1.045–1.051 (11.2–12.6 °P)
FG:	1.008–1.012 (2.1–3.1 °P)
SRM:	3–5
IBU:	16–22
ABV:	4.7–5.4%

Photo by Istockphoto.com

Continued on page 23

Munich Helles
(5 gallons/19 L, all-grain)

OG = 1.049 FG = 1.011
IBU = 18 SRM = 4 ABV = 5.0%

Ingredients

8.8 lbs. (4 kg) continental Pilsner malt (2 °L)
1.1 lbs. (0.5 kg) Vienna malt (4 °L)
3.6 AAU Hallertau hops (60 min.) (0.9 oz./26 g at 4% alpha acid)
1 tsp. Irish moss (15 min.)
White Labs WLP838 (Southern German Lager) or Wyeast 2308 (Munich Lager)
Priming sugar (if bottling)

Step by Step

I currently use Best Malz Pilsen and Vienna, but feel free to substitute any high quality malt of the same type and color from a different supplier. My hops are in pellet form and come from Hop Union, Willamette Valley, or Hopsteiner depending on the variety.

Mill the grains and dough-in targeting a mash of around 1.5 quarts (1.4 L) of water to 1 pound (0.45 kg) of grain (a liquor-to-grist ratio of about 3:1 by weight) and a temperature of 150 °F (66 °C). Hold the mash at 150 °F (66 °C) until enzymatic conversion is complete, which may take 60 to 90 minutes at this temperature. Infuse the mash with near-boiling water while stirring or with a recirculating mash system raise the temperature to mash out at 168 °F (76 °C). Sparge slowly with 170 °F (77 °C) water, collecting wort until the pre-boil kettle volume is around 6.5 gallons (25 L) and the gravity is 1.038.

The total wort boil time is 90 minutes, which helps reduce the S-Methyl Methionine (SMM) present in the lightly kilned Pilsner malt and results in less Dimethyl Sulfide (DMS) in the finished beer.

Add the Hallertau hops with 60 minutes remaining in the boil. Add Irish moss or other kettle finings with 15 minutes left in the boil. After the boil is complete, chill the wort in a sanitized fermenter to 50 °F (10 °C) and aerate thoroughly. The proper pitch rate is about 340 billion cells, which is 3 packages of liquid yeast or one package of liquid yeast in a 1.5-gallon (6-L) starter.

Ferment around 50 °F (10 °C) until the yeast drops clear. With healthy yeast, fermentation should be complete in about two weeks or less, but do not rush it. Cold-fermented lagers take longer to ferment than ales or lagers fermented at warmer temperatures. If desired, perform a diacetyl rest during the last couple of days of active fermentation. Rack your beer to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. If bottling, use the *BYO* priming chart available at http://byo.com/resources/carbonation. Target a carbonation level of 2 to 2.5 volumes. A month or more of cold conditioning at near-freezing temperatures will improve the beer. Serve at 43-46 °F (6-8 °C).

Munich Helles
(5 gallons/19 L, extract only)

OG = 1.049 FG = 1.011
IBU = 18 SRM = 4 ABV = 5.0%

Ingredients

6.9 lbs. (3.15 kg) Pilsner liquid malt extract (LME) or Munich LME
3.6 AAU Hallertau hops (60 min.) (0.9 oz./26 g at 4% alpha acid)
1 tsp. Irish moss (15 min.)
White Labs WLP838 (Southern German Lager) or Wyeast 2308 (Munich Lager)
Priming sugar (if bottling)

Step by Step

You have a choice to make as an extract brewer. Using Munich extract will get you more of that bready malt flavor, but it will probably turn out a little bit too dark for a Munich helles. You can go with just Pilsner extract, but often that does not have quite enough malt character for the style. Regardless, it is better to choose the freshest extract. If you cannot get fresh liquid malt extract, use an appropriate amount of dried extract instead. Using fresh extract is very important to this style. My hops are in pellet form and come from Hop Union, Willamette Valley, or Hopsteiner depending on the variety.

Add enough water to the malt extract to make a pre-boil volume of 5.9 gallons (22.3 L) and a gravity of 1.041. Stir thoroughly to help dissolve the extract and bring to a boil.

Once the wort is boiling, add the hops. The total wort boil time is 60 minutes after adding the hops. Add Irish moss or other kettle finings with 15 minutes left in the boil. After the boil is complete, chill the wort in a sanitized fermenter to 50 °F (10 °C) and aerate thoroughly. The proper pitch rate is about 340 billion cells, which is 3 packages of liquid yeast or one package of liquid yeast in a 1.5-gallon (6-L) starter.

Ferment around 50 °F (10 °C) until the yeast drops clear. With healthy yeast, fermentation should be complete in about two weeks or less, but do not rush it. Cold-fermented lagers take longer to ferment than ales or lagers fermented at warmer temperatures. If desired, perform a diacetyl rest during the last couple of days of active fermentation. Rack your beer to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. If bottling, use the *BYO* priming chart available at http://byo.com/resources/carbonation. Target a carbonation level of 2 to 2.5 volumes. A month or more of cold conditioning at near-freezing temperatures will improve the beer. Serve at 43-46 °F (6-8 °C).

Munich Helles Commercial Examples

Hacker-Pschorr Münchner Hell
Hacker-Pschorr Brewery
Munich, Germany
www.hacker-pschorr.de

Heaven's Helles
New Old Lompoc Brewery
Portland, Oregon
www.lompocbrewing.com

Helles
Square One Brewery
St. Louis, Missouri
www.squareonebrewery.com

Helles
Zum Stiefel
Saarbrücken, Germany
www.stiefelgastronomie.de

Helles
Hopfenstark
L'Assomption, Quebec
www.hopfenstark.com

Helles
Bayerische Löwenbrauerei
Passau, Germany
www.loewenbrauerei.de

Helles
Burgdorfer Gasthausbrauerei
Burgdorf, Switzerland
www.burgdorferbier.ch

Helles Bier
Naturbier
Madrid, Spain
www.naturbier.com

Helles Lager
Hangar 24 Brewery
Redlands, California
www.hangar24brewery.com

Löwenbräu Original
Löwenbräu
Munich, Germany
www.loewenbraeu.de

Victory Lager
Victory Brewing Company
Downingtown, Pennsylvania
www.victorybeer.com

better option might be using a Munich extract blend. Most Munich malt extract is a blend of Munich and Pilsner (or other pale malts) in different percentages. The Munich malt in the blend adds a nice bready malt character to the beer.

I like to avoid any work that I do not feel improves the beer, so I prefer a single infusion mash. Perhaps, historically, a brewer would use a decoction mash when brewing most German-style beers, but I find that high quality continental malts, a single infusion mash, and excellent fermentation practices will produce beer every bit as good as the best commercial examples. It is far more important to invest time and effort in fermentation, sanitation, and post-fermentation handling than decoction. If you have ensured that all of those other aspects

of your process are flawless, then decoction might be something of interest. For a single infusion mash, target a mash temperature range of 150-154 °F (66-68 °C).

Hop flavor and aroma are never more than moderate background notes in Munich helles. Hop bitterness is also restrained, just enough to balance the malt sweetness. I really like using German-grown Hallertau hops for flavor and aroma, though sometimes they are hard to source. Other German-grown hops, such as Tettnang, Perle or Tradition, work well also. These hops, when grown outside of Germany, can still work well but you should check with your supplier first if you are not sure how closely they match the German-grown hops. If you cannot get any of those hops, you do have some flexibility. The trick is to select hops with that same flowery or spicy noble hop character. The balance of bittering versus malt sweetness should always be close to even. The bitterness to starting gravity ratio (IBU divided by the decimal portion of the specific gravity) ranges from 0.3 to 0.5, but you will want to target the middle, 0.4. Rather than use late hop additions, I use low alpha German-grown hops for bittering. When you use a low alpha acid hop, you end up using a larger amount to make the same bittering level. Because of the increased volume of hop material, it can result in a subtle hop flavor that carries over from the bittering addition. Since there is very little specialty malt or fermentation esters, these small amounts of hop flavor are more noticeable than in a bolder beer style.

You can ferment Munich helles with almost any lager yeast, though my favorites are White Labs WLP838 (Southern German Lager) and Wyeast 2308 (Munich Lager). You will find that each lager yeast will emphasize different aspects of the beer. Some will have more malt character and some more hop character, but all can produce an excellent helles with proper fermentation. If you use dry yeast, Fermentis Saflager S-23 is a decent choice.

As when brewing any lager, it is important to control the fermentation temperature and to pitch plenty of clean, healthy yeast. You want the beer to have a clean, low ester fermentation profile, but you also want to make certain that the beer attenuates fully. This is the most common mistake new brewers make when attempting lagers. You need to make sure you pitch enough yeast, provide enough oxygen and nutrients, and use temperature control to not only start the fermentation on the cool side, but then raise it toward the end of fermentation. This rise in temperature not only helps reduce some of the unwanted compounds produced during fermentation, but it ensures that the yeast are active enough to attenuate the beer more fully.

When making lagers, I like to chill

the wort down to 44 °F (7 °C), oxygenate, and then pitch my yeast. I let the beer slowly warm over the first 36 hours to 50 °F (10 °C) and then I hold this temperature for the remainder of fermentation. If fermentation seems sluggish at all after the first 24 hours, I am not afraid to raise the temperature a couple degrees more. The idea is to reduce the diacetyl precursor alpha-acetolactate, which the yeast create during the early phase of fermentation. Once the growth phase of fermentation is complete, it is important that fermentation be as vigorous as possible to blow off aromatic sulfurs and other unpleasant compounds. Vigorous yeast activity at the end of fermentation also improves reduction of compounds such as diacetyl. Starting fermentation colder only works well if you are pitching enough clean, healthy yeast at the start. If not, you will need to start warmer (perhaps 55 °F/13 °C) to encourage more yeast growth. Even if you start fermentation warmer, you can still raise the temperature toward the latter part of fermentation.

Since diacetyl reduction is slower at colder temperatures, a cold fermented lager may require a diacetyl rest. To perform a diacetyl rest, simply raise the temperature into the 65-68 °F (18-20 °C) range for a two-day period near the end of the fermentation. While you can do a diacetyl rest after the fermentation reaches terminal gravity, a good time for a diacetyl rest is when fermentation is 2 to 5 specific gravity points (0.5–1 °P) prior to reaching terminal gravity. Brewers ask how they should know when fermentation has reached that stage. My advice is to wait until you see fermentation activity significantly slowing. It will not hurt the beer and it should help the yeast reach complete attenuation as well.

It seems that every beer improves with some period of cold conditioning and this style is no exception. Traditional lager conditioning utilizes a slow temperature reduction before fermentation reaches terminal gravity. The purpose of the slow cooling rate is to avoid sending the yeast into dormancy. After a few days, the beer reaches a temperature close to 40 °F (4 °C) and the brewer transfers the beer into lagering tanks. If you want to use this technique, you will need precise temperature control so that fermentation slowly continues and the yeast remains active.

I prefer to wait until fermentation is complete, including any steps such as a diacetyl rest, before lowering the beer temperature. The yeast is far more active and able to reduce fermentation byproducts including diacetyl and acetaldehyde at higher temperatures. Once I am certain the yeast have completed every job needed, I use a period of cold storage near freezing. This allows very fine particulates to settle out and the beer flavors to mature. In any case, great lagers take time, so do not rush things.

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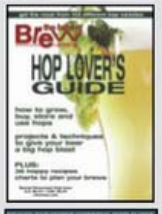

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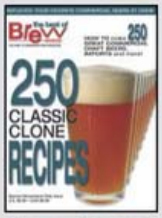

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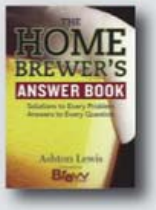

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by Anne Duany Whyte

5 GALLONS IN TWO HOURS

Photo by Charles A. Parker/Iages Plus

SPEED UP YOUR BREW DAY

I started homebrewing more than twenty years ago and I have followed a fairly classic learning curve in terms of my methods: extract with sugar, extract only, extract with specialty grains, partial mash and finally all-grain brewing. Each time I felt I mastered a level I was very keen to keep trying to improve my beers. Early on, as the beers I brewed kept improving, I set a challenge for myself: I am never going to run out of homebrew. That is my goal, as well as the goal of brewing the best beers I can brew and still have fun doing it. Most days if I have five hours to devote to a

Photos by Les Jorgensen

> When I am short on time and homebrew, I can still usually find two hours to brew.

brew day, I will do an all-grain recipe. But I have found over the years that when I applied my all-grain skills and equipment to an extract recipe, those recipes came out much better than in the early days.

Sometimes life interrupts my brewing schedule, however. But when I am short on time and homebrew, I can still usually find two hours to brew. I am happy to take some liberties with timing and technique as long as the quality of my homebrew isn't affected. I still enjoy the process. There isn't much time for having a beer or socializing, but hey, desperate times call for desperate measures.

Brewing in two hours requires a commitment to organization before you start actually brewing. The equipment required is not necessarily expensive or complicated. Everything I use is easy to find and handy for all levels of brewing. Traditionally, when I teach a newer brewer the process it goes something like this: You heat up some water in your 5 gallon (19 L) kettle, steep some grains, remove the grains, add extract, top off to boil volume and boil for an hour while you sanitize/rinse your equipment. Chill the wort in a sink with a water bath, top off with cold water to 5.25 gallons (19.8 L), check the temperature and pitch. This is going to take at least 3½ hours, and you can add time on if friends, beer and a football game are on.

EQUIPMENT YOU'LL NEED

Strainer

Brew Kettles
(one 5-gallon/19-L and one 2.5-gallon/9.4-L)

Fermenter

Liquid Measuring Cup

Wort Chiller

Thermometer

To do a 2-hour brew there will need to be some changes to your typical brew day. First, you can save time if you start sanitizing ahead of time if you ferment in a carboy. During the boil you can sanitize the funnel, strainer, etc. Next, you will steep the grains in a smaller kettle at the same time you dissolve the malt extract in hot water in the main kettle. You will be boiling and making hop additions while the grains are steeped, rinsed and brought to a boil. Next, you will need a wort chiller instead of an ice bath to speed up the chilling process. There is a slight compromise in the boil time with my method, but I think if you just increase bittering hops a bit, you can compensate for any loss of IBUs when you do a 60-minute boil. However, keep in mind that too short of a boil time can produce dimethyl sulfide (creamed corn), so keep that risk in mind for boils less than 60 minutes. If you don't want to take the risk, you can tack the extra 10 minutes on to be safe.

What You Will Need for Equipment

• **Two Brew Kettles.** For my two-hour brews I use one 5-gallon (19-L) kettle and a 2.5-gallon (9.4-L) kettle. The 5-gallon (19-L) kettle will be your main brew kettle. I bring about 2.5 gallons (9.5 L) of water to a boil, shut off the heat, and then mix in the extract with a flat edged paddle. The smaller kettle will hold your specialty grains while they steep.

• **Strainer.** I have a dual-layer, 10-inch stainless strainer that I wouldn't brew without. After the grains have finished steeping, you can lift the bag straight up and set the muslin bag in it. Let the grains drain well. I also heat a quart of water in the microwave to 170 °F (77 °C) and I rinse the grains with that. After that the strainer goes back into the sanitizer. Cooled wort is poured through the strainer to remove the spent hops (good to avoid clogging) and to aerate the wort (even better, cold frothy wort for my yeast!)

• **Wort Chiller.** If you are going to brew in two hours, you absolutely

> If you are going to brew in two hours, you absolutely must have a wort chiller.

must have a wort chiller. You can easily learn to brew, and brew well, without a chiller, but when you are ready to start adding equipment to a basic homebrew kit, this is one of the first pieces to consider. With a wort chiller you will be able to brew as much as your kettle can hold (you will still need some headspace for foam) and your stove burner can bring to a boil in a reasonable amount of time. The more dilute/bigger the boil volume, the less kettle caramelization. Less caramelization = cleaner flavor and lighter color. (Boiling a larger amount of water with this method will also increase hop bitterness, due to lower specific gravities during the boil, and greater hop extraction.) But for our purposes of brewing quickly, a wort chiller equals the fastest chilling time possible. Set your faucet to the temperature you want chill to, and in about 15 minutes you are good to go. I use a 25-ft. (7.6-m) copper immersion chiller. It's easy to clean and I've used it for 15 years. I expect to list it in my will.

• **Thermometer.** I use a metal clip-on thermometer to brew. I check the water temperature before I steep the grains. When you are using a separate kettle for the grains I aim for 1.25 quarts (1.18 L) of water, per pound of grain, heated to 167 °F (75 °C) or so. I have a stick-on thermometer for the fermenter.

• **Fermenter.** Time is precious in a two-hour brew. If you plan to use a carboy, have it filled with sanitizer, on the counter, the night before. That way you can simply siphon out the sanitizer into a bucket and sanitize all your other equipment. I prefer to use a large plastic bucket so I can sanitize all my equipment in the bucket (including the bucket) at the same time. That way I can siphon the sanitizing solution down the sink or into something else that needs to be sanitized.

• **Liquid Measuring Cup.** I use two of these all the time when I brew. You'll just need one for this brew. Glass is a good choice since you can use all kinds of sanitizer with it. I use it to measure the water for grain steeping. It will hold your grain rinsing water. I also use it at the end of the boil (after sanitizing it) to transfer chilled wort into the fermenter. I have had amazingly little success pouring wort from a kettle into the strainer. Since it is my kitchen and cleaning cabinets is not fun, I now scoop chilled wort one

Two-Hour Extract Countdown

Countdown	Large Kettle	Small Kettle	Bucket with Sanitizer
2:00 hours	Dried Malt Extract (DME); pour into dry kettle, spray water to blend about 2 gallons (7.5 L); stir well Liquid Malt Extract (LME); heat 2 gallons (7.5 L) of water to boil, remove from heat, add extract, stir well to blend		
1:55		Heat 3 quarts (2.8 L) of water to 165 °F (74 °C)	
1:50	Top off boil kettle to 2½ gallons (9.4 L); bring to boil		Fill bucket with sanitizer; sanitize equipment
1:40	Set timer for 50 minutes, start adding hops	Shut off heat, add grains to water, stir well, cover and steep for 35 minutes	
1:20		Heat up 1 quart (1 L) of water to 170 °F (177 °C) in microwave for grain rinsing	
1:25		Pull out grain bag, set grain bag in strainer and rinse	Strainer goes into sanitizer
1:30	Add immersion chiller to kettle to sanitize	Bring grain tea to boil and and add to main kettle	Start rinsing the equipment
1:00	Main boil is done, start chilling		
:15	Wort is chilled, transfer to fermenter		
:10	Top off fermenter as needed; pitch yeast		
:05	Clean up		
:00	Time for a well earned homebrew!		

quart at a time. When I am doing a full wort boil this is especially helpful. Coincidentally, after the wort chiller is removed, the hops will have settled to the bottom of the kettle. The clear wort will easily pass right through the strainer.

The Brew Day

Here's the breakdown of your brew day and the preparations to be done the night before:

The Night Before

If you are using a carboy, have it out on the counter, filled with sanitizer. If you are using a food-grade plastic bucket then you can sanitize your bucket and all of the other equipment while you are brewing. (You can do this with a carboy as well, but it's a bit more cumbersome.) Your kitchen or work area should be as tidy and free of clutter as possible. This is not part of the countdown, but it's nice to just walk in the kitchen or wherever you brew and get right to business. Have your equipment out. Double check your ingredients. Is your yeast ready? Do you need to make a starter

or activate a yeast? Can you get your recipe into your notebook or app ahead of time? The better prepared you are, the quicker you can get to brewing.

Brew Day

The timer is set: Two hours. (Follow chart on pg. 32.) In one kettle measure the grain water and heat it to 167 °F (75 °C). I target 1.25 quarts (1.18 L) of water per pound of grain. In your larger kettle heat 2 gallons (7.6 L) of water to a boil. While that happens, siphon sanitizer into a bucket and rinse carboy (if you ferment with a carboy) or fill your brew bucket with sanitizer. Double check your ingredients (do you need Irish moss?) Get the steeping grains ready in a muslin bag.

When the grain water is ready, shut off the heat and place grains in the kettle. Set the timer for 30 minutes. When the large kettle is boiling, shut off the heat and stir in the extract. Your target volume will be about 3 gallons (11 L) of wort. Variation: When I use dried malt extract (DME), usually for very light colored beers, I find it is easier to add water to the extract instead of the DME to the water. I pour the DME into my dry brew kettle and use the faucet sprayer to get the DME wet. I stir as I spray and the dried malt dissolves quicker. When I am satisfied nothing is stuck to the bottom, it goes on the burner.

When the large kettle comes up to a boil, set your timer for 50 to 55 minutes. I haven't found that decreasing the traditional hour boil time does any harm. An extra 10 minutes means a lot in a two-hour brew. (However, as I mentioned earlier this can increase the risk of that creamed corn flavor, so if you're not comfortable with that risk you don't have to take it. You'll just be adding a few more minutes to your brew day.) Meanwhile when the grains have steeped for 30 minutes they are ready to go in the big kettle. You are also following a hop schedule, so don't forget the hops!

Bring one quart of water to 170 °F (77 °C) (I do this in the microwave). Remove the grain bag and set in the strainer over the kettle. Rinse the

Two-Hour Recipes

Two Hour Brown Porter

(5 gallons/19 L, extract with grains)

OG = 1.050 FG = 1.013
IBU = 32 SRM = 30 ABV = 5.4%

Ingredients

5.25 lbs. (2.4 kg) amber dried malt extract
1 lb. (0.45 kg) Fawcett's pale chocolate malt (250 °L)
8 oz. (0.23 kg) amber malt (22 °L)
12 oz. (0.34 kg) UK crystal malt (60 °L)
8 oz. (0.23 kg) Weyermann Munich II malt (9 °L)
6 AAU Phoenix hop pellets (50 min.) (0.75 oz./21 g at 8% alpha acids)
5 AAU East Kent Golding hop pellets (30 min.) (1 oz./28 g at 5% alpha acids)
5 AAU East Kent Golding hop pellets (10 min.) (1 oz./28 g at 5% alpha acids)
Wyeast 1187 (Ringwood Ale) or White Labs WLP005 (British Ale) or Safale S-04 (English Ale) yeast
½-⅔ cup of priming sugar for lighter level of carbonation, as style requires (if bottling)

Step by Step

In a large brewpot, combine dried malt extract with 2 gallons (7.6 L) of water, stir well. Top up to 2.5 gallons (9.5 L) of water and bring to a boil. Add hops per the schedule in the ingredients list. At the same time, in a small brewpot, heat 3 quarts (2.8 L) of water to 165 °F (74 °C). Shut off the heat, add the grains, cover and steep for 35 minutes. Heat up 1 quart (1 L) of water to rinse the grains. Pull the grains out of the brewpot, place in a strainer and rinse with your hot water. Bring the grain tea to a boil then add to the main kettle.

When the boil is finished, chill the wort to to 60 °F (16 °C) and pitch the yeast. For step-by-step timing, refer to the brewing countdown on page 32. Bottle or keg as preferred.

German Style Pilsner

(5 gallons/19 L, extract with grains)

OG = 1.047 FG = 1.012
IBU = 32 SRM = 4 ABV = 4.7%

Ingredients

2.7 lbs. (1.2 kg) extra light dried malt extract
1 lb. (0.45 kg) German pilsner malt
1 lb. (0.45 kg) US or German white wheat malt
4 oz. (0.11 kg) flaked barley
1.7 lbs. (0.77 kg) honey, preferably domestic
4.3 AAU Perle hops (50 min.) (0.5 oz./14 g at 8.5% alpha acids)
5.7 AAU Hallertau Tradition hop pellets (30 min.) (1 oz./28 g at 5.7% alpha acids)
2 oz. (56 g) German Hallertau or Czech Saaz hops (or one of each) (1 min.)
Wyeast 2042 (Danish Lager) or WLP830 (German Lager) or Saflager S-23 yeast
¾ cup priming sugar (if bottling)

Step by Step

In a large brewpot, combine dried malt extract with 2 gallons (7.6 L) of water, stir well. Top up to 2.5 gallons (9.5 L) of water and bring to a boil. Add hops per the schedule in the ingredients list. At the same time, in a small brewpot, heat 3 quarts (2.8 L) of water to 165 °F (74 °C). Shut off the heat, add the grains, cover and steep for 35 minutes. Heat up 1 quart (1 L) of water to rinse the grains. Pull the grains out of the brewpot, place in a strainer and rinse with your hot water. Add the honey to the grain tea, stir and bring the grain tea to a boil then add to the main kettle. Chill wort to 60 °F (16 °C), pitch, aerate periodically until fermentation starts, then chill to 53–58 °F (12–14 °C) for the duration of primary fermentation. You can do both primary and secondary at these temperatures. Bottle or keg as preferred.

grains with hot water and let the bag drip for a couple of minutes. After a few minutes put the grains aside to compost and bring the grain tea to a boil. This will keep the large kettle boil going without a temperature drop.

When you get a chance, drain and rinse your sanitized brewing equipment. (I'm not going to get into the rinse/no rinse conversation here.)

The last 15 minutes of the boil is the time to place the chiller into the brew kettle. Any picking up/tidying before the chiller is connected that can be done, should be done now.

The Timer Rings

Your boil should be done, all hops added. Chiller is in the wort, sanitized. Equipment is ready. Connect your chiller and bring the wort down to yeast-pitching temperature. This should take about 15 to 20 minutes.

Once you're chilled it's time to pitch. If everything has gone to plan then your wort should be chilled, topped off, and ready for the yeast with about five minutes to spare. This is the official clean up time.

Basking in the Afterglow

You did it! Two hours for two cases of homebrew — small price to pay. I never said this was going to be the most relaxing brew you'd ever make, but when you really need to brew this might work for you. It's time to have a homebrew and relax — cheers! BYO

Related Links:

- Learn about malt extract's history, how it is made and what that all means for your homebrewing: http://byo.com/story1101

- What does an extract brew day look like? Grab a homebrew and check out our pictorial guide: http://byo.com/story2129

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Build a Better BOTTLE CAPPER

Story and photos by **Todd Huizingh**

One thing I really like about the homebrewing hobby is that it allows me to build various gadgets and equipment that I can use in my basement brewery. I am constantly thinking of ideas that will either make a process easier or at least make it more enjoyable. Recently I came up with a project that does both: A pneumatic bottle capper.

I came up with the idea one day after I came across a spare air cylinder. Immediately the idea of a pneumatically-powered capper came to mind. One of the first things I wanted to figure out was how to attach a capping bell to the end of the cylinder rod. So I brought my newly-discovered air cylinder home, located my bench capper and unscrewed the capping bell off of it. To my surprise, the threads were an exact match!

The next step was figuring out if the force generated by the air cylinder would be enough (but not too much) to do its job properly. To calculate the force output of the cylinder, I first figured out the area of the piston. The cylinder has a 2-inch (5-cm) bore which means the piston area equals pi x $(1)^2$

or 3.14in^2. The force is then calculated by simply multiplying the piston area by the PSI of the compressed air. So at 100 PSI, the cylinder will exert 3.14in^2 x 100 PSI, or 314 lbs. of force. This seemed like a lot to me until I compared it to my bench capper. The lever on that is 10 inches (~25 cm) long, and the distance from the pivot point to the capping point is 1.25 inches (3 cm). This means that the force exerted at the capping point is eight times greater than the force applied at the end of the handle (10/1.25 = 8). So, figuring backwards, in order to get a 314-lb. force at the capping point you would need to apply 39.3 lbs. at the handle (314/8=39.3).

I wanted a frame design that was simple, yet robust. The concept involved using a section of 2-inch (5-cm) square steel tubing sandwiched between two ½-inch thick by 2½-inch wide (1.25- by 6.25-cm) steel plates. I mounted the cylinder to the frame by using the appropriately sized hex nut welded onto the top plate. I thought this would be much easier than drilling and tapping such a large threaded hole into the steel plate. I based the height of the frame on a standard 9-inch (23-cm) tall longneck bottle, making sure that the cylinder would be somewhere near the end of its stroke (but not at it) when capping, allowing for plenty of room to load and unload bottles when the cylinder was retracted. Of course, this means that I would have to make adjustments if I were to use bottles of any other height.

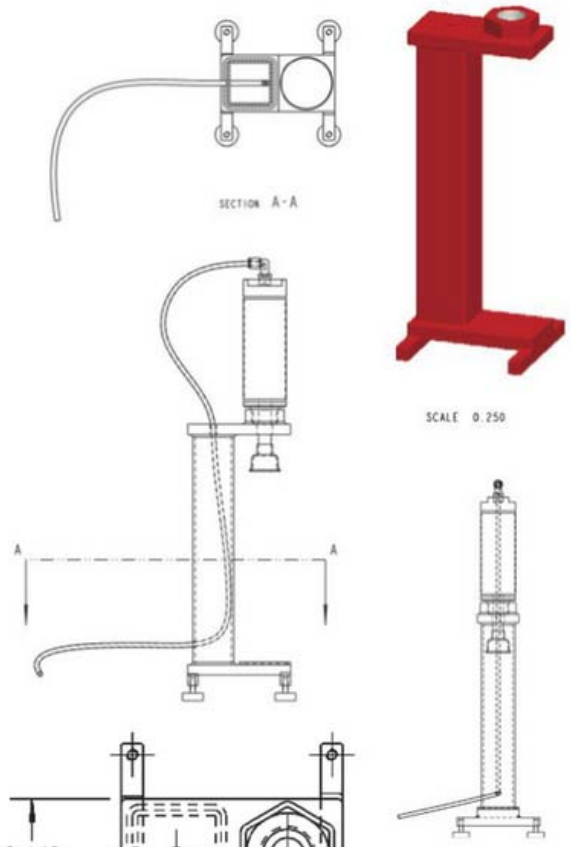
Once I had a frame design, I cut the steel bars and tubing, drilled the necessary holes and welded the parts together securely. After the weldment was thoroughly prepped and cleaned, I primed and painted it. Once the paint was dry, I screwed in the four rubber leveling feet, installed the air cylinder, and screwed on the capping bell.

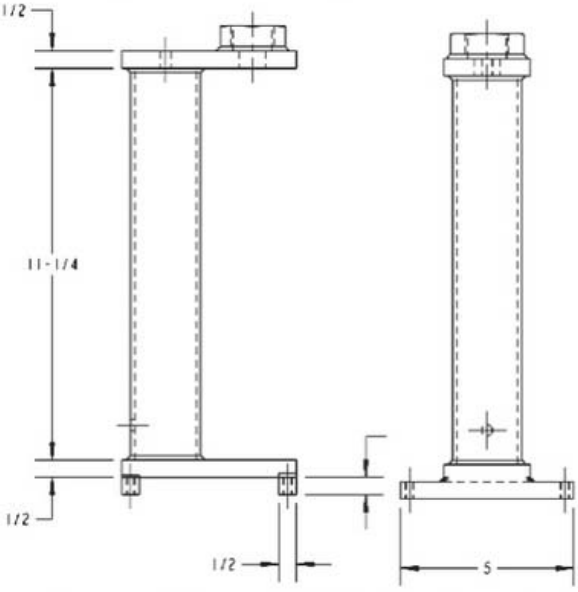
Looking at the finished capper frame I noticed that I needed a way to locate each bottle in its proper location, so I made up a guide by drilling a large hole in a thin piece of clear plastic. I cut it to size and adhered it to the base of the frame using double-sided transfer tape.

To initiate the cylinder's actuation, I used a foot-operated pneumatic valve. I routed the air tubing through the frame, then connected the tubing to the fittings on the air cylinder and foot pedal valve.

Materials and Parts:

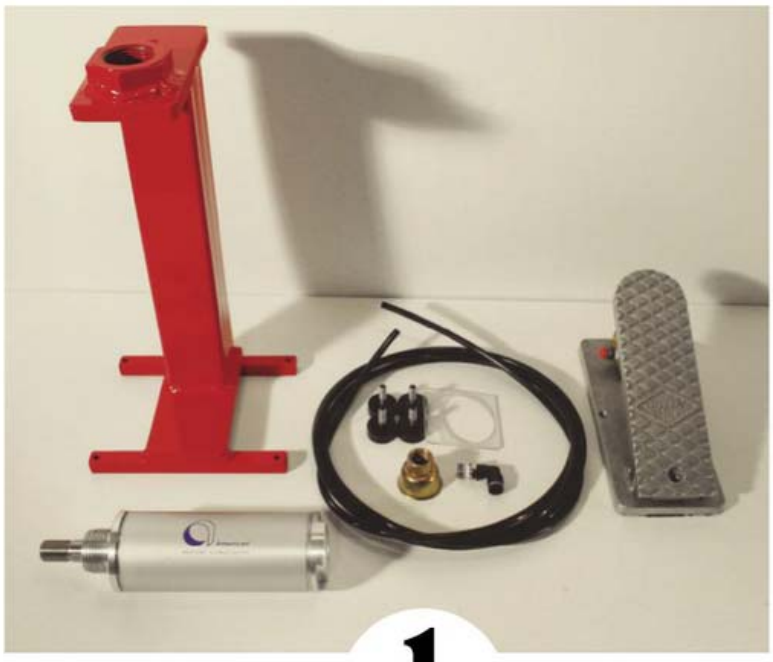
Steel for frame:
(1) 2-inch square by 0.135-inch wall tubing, 12 inches long
(2) ½-inch by 2½-inch bar stock, 5 inches long
(2) ½-inch square bar, 5 inches long
Capper:
(1) 2-inch bore by 2-inch stroke single-acting spring-return air cylinder with a ⅜-18 thread (American Cylinder part #: 2000SN-2.00)
(1) 1¼-inch-12 thin hex nut (aka: a jam nut)
(1) ¼ NPT by ¼ OD push-to-connect 90° air fitting
(1) Standard 26.5-mm capping bell
(4) Rubber feet
(1) Thin plastic sheet
(1) 3-way 2-position pneumatic foot-operated pedal valve and air fittings
¼-inch OD polyurethane air tubing, 6+ feet
Air compressor





Bottle Capper Diagrams

(also available at www.huizingh.net/capper)



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Safety Tip: Wearing safety glasses is recommended due to the potential of a bottle breaking if the bottle is not lined up correctly or the capper is not operating as designed.

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1. SKETCH UP PLANS

Begin by sourcing out all of the parts and components you will be using. This might take a little determination and a lot of searching but the effort spent here could save you a lot of money in the end. Also, as you gather your components begin sketching up your plans. Get a few sample bottles and take some measurements. Make sure that your frame is sized so that your air cylinder will cap bottles completely before reaching the end of its stroke. You might even have to wait until all your components are in hand before you can finalize your dimensions. A copy of my plans are available at www.huizingh.net/capper.

2. BUILD THE STEEL FRAME

If you have the tools and skills to make this yourself, then by all means give it a go. First, cut your steel pieces to size, then drill two holes in the top plate — one for the cylinder rod to pass through, and one to route the air tubing. Drill a hole in the back of the square tubing for the tubing to exit. Also drill and tap holes in the square bars if you will be using screw-in feet. Securely weld all of the pieces together, making sure that the large hex nut, top plate, and bottom plate are all aligned properly and that they are as parallel to each other as possible. Finally, clean and paint the frame. Note: For those of you without access to machine tools or a welder, take your plans to a local weld shop and have one made up for you.

3. ATTACH FEET, AIR CYLINDER AND BELL

Once the paint has dried, screw in or attach the four rubber feet. Now screw the air cylinder into the large hex nut on top of the frame and tighten it with a wrench. Next, attach the capping bell by screwing it onto the end of the cylinder rod.

4. INSTALL BOTTLE GUIDE

For this I used a thin piece of plastic that I cut a large hole into for the bottom of the bottle to fit in. Someone later gave me the idea to use two pins in the base of the frame, which I thought would work well too. I suppose you could even attach something to the upright portion of the frame that bottles would press against. It really doesn't matter which method you use, as long as you have something to provide for proper bottle alignment. I would imagine that trying to cap a misaligned bottle might not be a good thing.

Safety Tip: You can attach a clear plexiglass shield in front of where the bottle rests so, in case a bottle breaks, there is a barrier between you and the glass.

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Safety Tip: Never put your hand between the capping bell and the top of the bottle. Put the bottle cap on top of the bottle before placing the bottle below the capping bell.

5. INSTALL AIR FITTINGS AND CONNECT AIR TUBING

Screw the 90° push-to-connect air fitting into the top of the air cylinder. Also, screw a push-to-connect fitting into the output of your foot pedal valve. Attach the polyurethane air tubing to the two fittings. (You could also use polyethylene tubing, which is less expensive but is also less flexible). On the input of the foot pedal valve, screw in whatever fitting you need to connect to your air compressor.

6. CONNECT TO AIR COMPRESSOR AND TEST CAPPER

Now you should be ready to fire up your air compressor and connect it to the input of the foot pedal valve. You may want to start at a low PSI at first as you put it through the initial motions. Also, if you find that the air cylinder moves too fast (as they often do), you might need to put a flow control device somewhere in the air line to slow it down. Once you've got the cylinder moving up and down smoothly, it's time to try it out for real. Set a bottle in position and place a new cap on top. Make sure your hands are clear then press down on the foot pedal and hold it down until the cap has been completely crimped. Now release your foot and you should be left with one perfectly and effortlessly capped bottle. To check out a YouTube video of my pneumatic bottle capper in action, visit www.huizingh.net/capper. BYO

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Grain MEETS Grape

Beer and wine hybrids are bridging the gap between breweries and wineries

Photo courtesy of Captain Lawrence Brewing Co.

by **Gretchen Schmidhausler**

Photo courtesy of Dogfish Head Craft Brewery

America's ever-innovative craft brewers are at it again, finding new ways to push the envelope on beer styles. A current trend, which actually has its roots in the 90s, is the creation of beer/wine hybrids. Fruity and tart, with grape notes and a good dose of funk, these beers are often aged in used wine barrels for an extra touch of oak. Predictably, these crossover beers appeal to both craft beer enthusiasts and wine drinkers.

More and more craft brewers — and homebrewers — are experimenting with the union of grape and grain. Aging beers in old wine barrels adds a desirable wine character without actually adding grapes or juice. Even if you don't have an oak barrel, homebrewers can achieve close approximations of these beers using other techniques, including fermenting with wine yeast, adding grapes directly to the mash, and introducing grapejuice or must (freshly pressed grapejuice containing the skins, seeds, and stems) to the beer in progress.

More wine-infused than 50-50 blends, these hybrids use traditional beers — often Belgian styles — as a base. Hops may be used, although herbs and spices can also serve as substitutes. The *Brettanomyces*, or "*Brett*," yeast strain, which in brewing is most often found in lambic beers, is a typical choice for fermentation. When using *Brett*, which is known for its leisurely fermentations, beer can take months, even years, to break down sugars and form the characteristic funky, musty, horsey qualities associated with lambics. Patience is a must.

For the truly adventurous, beer-wine hybrids can also be made with *Pediococcus* and *Lactobacillus*, lactic acid bacteria that produce the sour flavor typical of Berliner weiss, sour brown ale and gueuze. A word of caution — when inviting these bugs into the brewery, it's important to practice excellent sanitation procedures in order to avoid unintentional contamination of other beers.

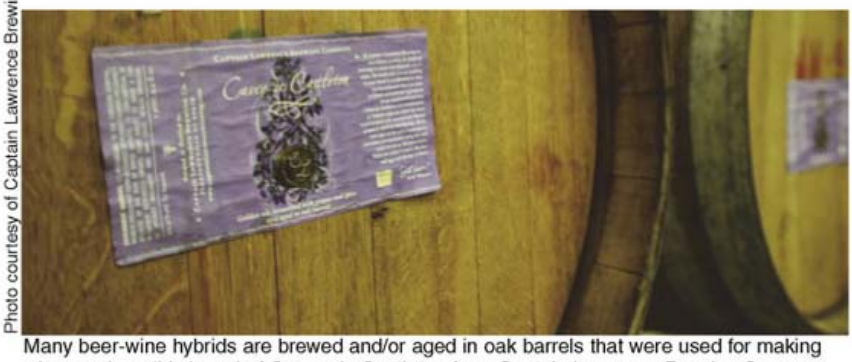
Hybrid Trailblazers

A lot of credit for the current interest in the style goes to Sam Calagione and Dogfish Head Craft Brewery in Milton, Delaware. Calagione is one of the first American brewers recognized for developing — or rather resurrecting — a unique hybrid beer back in 1999 with Midas Touch. Calagione's first "ancient ale," Midas Touch is a cross between wine, mead and beer and was formulated based on molecular evidence found in a Turkish tomb believed to have belonged to King Midas. Residue found in a 2,700-year-old drinking vessel became the basis of the sweet, dry beer made with honey, white Muscat grapes and saffron. (Brew a clone of Midas Touch and learn more about Calagione's ancient experiments at http://byo.com/story1537)

Another brewery that has been on the forefront of this style is Russian River Brewing Company in Santa Rosa, California, which has also been employing the wine-barrel-aging method since the 1990s. With a family background in winemaking, Co-owner and Brewmaster Vinnie Cilurzo satisfied his affinity for sour, barrel-aged Belgian beer by creating his own versions, including a sour beer aged in wine barrels called Temptation.

Temptation (1.062 OG, 7.5% ABV) is a highly sour blonde ale aged in used Chardonnay barrels from Sonoma County wineries. It is aged for about nine to fifteen months (depending on the age of the barrel) with *Brettanomyces*, *Lactobacillus*, and *Pediococcus*. The beer is medium-bodied with hints of oak and Chardonnay, and the trademark funky, flavor-

Photo courtesy of Captain Lawrence Brewing



Many beer-wine hybrids are brewed and/or aged in oak barrels that were used for making wine, such as this barrel of Cuvee de Castleton from Captain Lawrence Brewing Co.

ful *Brett* character.

Temptation was the first hybrid made by Russian River, said Cilurzo, although it has evolved and been tweaked over the years.

"The idea was that I wanted to take my favorite part of a lambic — *Brett* — and incorporate it into a barrel beer. Over time we worked bacteria into the beer," he said.

He notes that at the time, Russian River was one of the few US breweries experimenting with the style and so there was no market for the beers . . . at first. That soon changed, however.

"It really is amazing to see how far along these beers have come with the consumer," said Cilurzo, adding that Russian River now sells more than eight and a half barrels of Temptation each week at its brewpub.

"I don't think you can pin down any one type of consumer; not only do beer enthusiasts drink these beers, but it's wine drinkers as well, and we see a lot of them being in the middle of wine country," he said.

In October 2010, Stone Brewing Co. in Escondido, California introduced 10.10.10 Vertical Epic Ale, a one-time release. The Belgian strong golden ale was brewed with chamomile, and a blend of white wine grape juice — Muscat Canelli, Gewürztraminer, Riesling and Sauvignon Blanc — was added during fermentation.

Brewmaster Mitch Steele said 10.10.10 immediately appealed to Stone Brewing Co.'s fans, many of whom simply liked the brewery's experimental approach and were curious to try the results.

"I think one of the most interesting things about this beer is that it has aged beautifully," says Steele. "The wine character was a little disjointed when we first released the beer, but it has integrated wonderfully with the beer flavors as the beer has aged. People who enjoy nice wine should enjoy this beer also."

The trend in barrel-aged hybrids has also found its way to the East Coast. Brewer/Owner Scott Vaccaro of Captain Lawrence Brewing Company in Elmsford, New York says

the first true wine/beer hybrid made at the brewery was first brewed in 2006, released in 2007, and was the first gold medal winner in the American Sour Ale category at the Great American Beer Festival (GABF). Cuvee de Castleton is a golden ale aged in oak with *Brett* and Muscat grapes. The beer is aged for about 14 months in the oak, resulting in a tart, fruity and complex beer with a strong wine-like character.

Since then, Vaccaro has followed up with several other related beers, including Rosso e Marrone, a strong brown ale also fermented with *Brett*, Merlot and Zinfandel grapes and aged in oak barrels. In 2009, Rosso e Marrone (Red and Brown) also took a gold medal for American Style Sour Ale at the GABF.

For obvious reasons, Vaccaro is a big fan of the style. "I love the wide variety of flavors you can get from using different grape varieties and different base beers," he says.

Hybrid Challenges

Creating these complex beers is not without its challenges.

Steele explained that grapes are covered with wild yeast, including *Brett*. Typically, winemakers add the preservative sulfur dioxide (SO_2) during the crushing process to eliminate the wild yeast activity, but he noted that Stone Brewing Co. skipped that step to avoid adding sulfur to the beer.

This method presented a number of challenges, such as keeping the unsulfured juice at near-freezing temperatures to keep the wild yeast from fermenting.

"Once we received the juice at the brewery, we had to be very diligent in our sanitation, and isolating this beer from the rest of our other beers," said Steele. "The brewer's yeast did overcome any wild yeast during fermentation, but we still used specially selected hoses and fittings when we worked on the beer."

Steele also explained that grape juice is loaded with fructose, which can cause problems with fermentation. Brewer's yeast will take up simple sugars like glucose and fructose first, then have to adapt its cell structure to start taking up maltose, which is the majority of the type of sugar found in wort.

An abundance of simple sugar in the wort at the start of fermentation can make it difficult for the yeast to metabolize maltose, resulting in a stalled fermentation.

"That's why we added the juice late in the fermentation process, so the yeast was already successfully metabolizing the maltose," said Steele.

Then there's the element of unpredictability. But the experimental nature of brewing these beers due to the aging and blending aspects, the wide range of flavor characteristics, and not knowing exactly what the result will be is the attraction to many brewers.

Cilurzo said he loves the unknown component of the process.

"It is not like a regular beer where

you can predict the outcome in X number of days. With these beers, the beer really tells the brewer when it is ready," he said.

"I like the blending aspect of these beers; we have so many different things going we have a lot to play with to blend to a certain flavor or characteristic. I also love how these beers change over time — we bottle condition all our funky beer so once in the bottle we will hold it about eight weeks before releasing them. Although they taste great at release, just like a wine it will change and get better. In my book I feel like the flavors really come together at six to twelve months," Cilurzo said.

Steele concurs.

"I'm a former winemaker, and still enjoy wine. I like this style because it adds elements of both, dealing with grapes, and harvest schedules adds an interesting twist to scheduling the brewing. I just like it when flavors and ingredients that one wouldn't commonly put together work so well. The synergy is great,'" he says.

Another challenge for brewers is the lengthy aging process.

"One of the biggest challenges for brewers is simply patience. Brewers are not used to holding a beer for this long, so not tasting it every week or looking at it often is a hard thing for a brewer to deal with," Vinnie said.

Tips for Success

If the somewhat daring and unpredictable nature of the hybrid style appeals to you as a homebrewer, the pros I talked to offer some advice for making this style.

First and foremost, when making a beer-wine hybrid, the pros recommend choosing your style wisely. Base beers that best lend themselves to this style should not be overly aggressive or hop forward. Steele recommends Belgian styles, which tend to have a stronger yeast character, while Cilurzo says a blonde ale, saison or brown ale is a good bet. Vaccaro recommends styles that lend themselves to *Brett* fermentation, as they make a great complement to the flavors created by the use of wine grapes in beer.

"We use the entire grape — seeds, skins and all," said Vaccaro. Make sure if you are going to do that you use a fermenter that allows you to get the beer out and leave the grapes behind. Also don't start with a base beer that is overly aggressive. It will not allow the flavors to come together."

Vinnie Cilurzo also stresses the importance of choosing the right base beer for this hybrid style and advises homebrewers to heed the importance of temperatures.

"I believe a brewer should brew a specific recipe for their barrel beer," he says. "You can really hurt your beer if you store it too warm; we keep our barrels at 58–62 °F (14–17 °C). Temperature is a big deal, like I said earlier, and most brewers either pro or amateur don't have the proper temperature controlled room."

Beer-Wine Hybrid Clone Recipes

Stone Brewing Co. 10.10.10 Vertical Epic Ale clone

(5 gallons/19 L, all-grain)

OG = 1.069 FG = 1.003
IBU = 45 SRM = 12 ABV = 9.3%

Make sure to compensate for the extra volume of grapes or grape juice you will be adding to the primary fermenter. This recipe was designed so that at the end of brew day your fermenter only contains 4.5 gallons (17 L) of wort. The original gravity is calculated without the grape juice while the ABV is calculated with grape juice.

Ingredients

10 lbs. (4.5 kg) 2-row pale malt
1.4 lbs. (0.64 kg) flaked triticale (can substitute flaked rye and/or flaked wheat)
1.15 lbs. (0.52 kg) liquid amber candi sugar (90 min.)
0.8 oz. (22 g) dried whole chamomile flowers (0 min.)
2 qts. (1.9 L) white wine grape juice OR 6–7 lbs. (2.7–3.2 kg) crushed white wine grapes (primary fermentation)
11 AAU Perle hops (90 min.) (1.1 oz./31 g at 10% alpha acid)
Wyeast 3522 (Belgian Ardennes) or White Labs WLP550 (Belgian Ale) yeast
Priming sugar (if bottling)

Step by Step

This is a single infusion mash, with a conversion rest at 148 °F (64 °C) for 105 minutes. This helps provide a fermentable wort. Raise the mash temperature to 165 °F (74 °C) after conversion rest to stop the enzymatic conversion of starches to sugars before lautering.

Recirculate your wort gently for 5-15 minutes, depending on your system, before diverting wort flow to your kettle/boiling vessel. If you have a refractometer, check your "first wort" (unsparged wort) gravity, it should be about 1.088–1.092 SG. Sparge water should be between 165 and 170 °F (74 and 77 °C) to maximize extraction, but avoid going over 170 °F (77 °C) or you'll extract harsh compounds from the malt husks.

Sparge until you hit your target boil volume or until your wort gravity being drawn-off reaches 1.012 SG, whichever comes first. Don't lauter past this gravity, because when the sparged wort coming off the lauter is that low in sugar content, you risk extracting tannins and other harsh character from the malt husks.

Add all the hops at the start of boil. Stone typically boils their wort for 90 minutes to get about 8–10% evaporation. Depending on your boil parameters, you may want or need to add some portion of the hops before the boil actually starts (first wort hopping) to keep the foaming under control. Add the amber candi sugar after the boil starts so the sugar can't settle on the bottom of the kettle and scorch as the heat increases.

After the wort boil is complete, add the chamomile flowers (in a muslin brew bag) to maximize flavor extraction.

Chill the wort using an immersion chiller or a heat exchanger to about 65–70 °F (18–21 °C). Pitch enough yeast to get 20-25 million cells per milliliter (requires a starter). Stone uses the Wyeast 3522 Belgian Ardennes strain, because it doesn't produce a lot of phenolic clove flavors and ferments strongly to dryness. Stone used a fairly high pitching rate here, because they wanted to ferment at a lower temperature but still ensure the beer fermented out completely.

Ferment at 72 °F (22 °C) to maximize fruity ester formation and reduce the clove/spicy flavor formations, which form at higher levels with warmer Belgian yeast fermentation temperatures, above ~75 °F (24 °C). At 1.040 SG (about halfway through primary fermentation) add the grape juice. Use unsulfited juice to ensure fermentation will proceed, and add the juice at the height of the beer fermentation. Stone reports that their juice was approximately 35% Gewürztraminer, 30% Muscat Canelli, 20% Sauvignon Blanc and 15% Riesling, but any Muscat variety or blend would work.

After fermentation is complete, chill the beer down to about 35 °F (2 °C) or so, and let it sit until the beer clarifies, at least one week. Bottle or keg the beer as normal. The 10.10.10 Vertical Epic Ale clone will be wonderful fresh, but the wine flavors should develop further over time.

Stone Brewing Co. 10.10.10 Vertical Epic Ale clone

(5 gallons/19 L, partial mash)

OG = 1.069 FG = 1.003
IBU = 45 SRM = 4 ABV = 9.3%

Ingredients

3.3 lbs. (1.5 kg) pale unhopped liquid malt extract
1.8 lbs. (0.82 kg) light dried malt extract
1.5 lbs. (0.68 kg) 2-row pale malt
1.4 lbs. (0.64 kg) flaked triticale (can substitute flaked rye and/or flaked wheat)
1.15 lbs. (0.52 kg) liquid amber candi sugar (90 min.)
0.8 oz. (22 g) dried whole chamomile flowers (0 min.)
2 qts. (1.9 L) white wine grape juice OR 6–7 lbs (2.7–3.2 kg) crushed white wine grapes (primary fermentation)
11 AAU Perle hops (90 min.) (1.1 oz./31 g at 10% alpha acid)
Wyeast 3522 (Belgian Ardennes) or White Labs WLP550 (Belgian Ale) yeast
Priming sugar (if bottling)

Step by Step

Heat 6 qts. (5.7 L) strike water to achieve a mash temperature of 148 °F (64 °C). Add the crushed pale malt and flaked triticale to a muslin bag. Let the grains rest in the strike water for 45–60 minutes. Remove the grain bag and wash with 4 qts. (3.8 L) hot water. Top off your kettle to at least 3 gallons. Bring to a boil and follow the directions per the all-grain recipe.

Russian River Brewing Co. Temptation clone

(5 gallons/19 L, all-grain)

OG = 1.062 FG = 1.012
(going into the barrel)
IBU = 28 SRM = 4 ABV = 6.8%

ABV and final gravity are both based on the beer going into the barrel/secondary fermenter, prior to the souring process.

"None of our barrel beers are easy to replicate on a homebrew level as we are matching specific recipes with specific types of wine barrels. For example Temptation is aged in Chardonnay barrels exclusively. One suggestion for a homebrewer is to add a little bit of Chardonnay into the beer to get the wine character since they cannot get it from the wood like we do."

- Vinnie Cilurzo

Ingredients

11.5 lbs. (5.2 kg) 2-row pale malt
10 oz. (0.27 kg) acidulated malt
14 oz. (0.41 kg) dextrine malt
6.0 AAU Warrior® hops (90 min.) (0.4 oz./11 g of 15.0% alpha acids)
1.8 AAU Styrian Goldings hops (30 min.) (0.4 oz./11 g of 4.5% alpha acids)
1.4 AAU Styrian Goldings hops (0 min.) (0.3 oz./8.5 g of 4.5% alpha acids)
White Labs WLP530 (Abbey Ale) or Wyeast 1214 (Belgian Abbey Ale) yeast
Wyeast 5112 (*Brettanomyces bruxellensis*) or White Labs WLP650 (*Brettanomyces bruxellensis*) yeast
Wyeast 5335 (*Lactobacillus*) or White Labs WLP677 (*Lactobacillus*) bacteria or
Wyeast 5733 (*Pediococcus*) bacteria
1 cup corn sugar (for priming)

Oak barrel, staves, beans or chips
Chardonnay (optional)

Step by Step

Mash at 158 °F (70 °C). Boil for 90 minutes, adding hops at times indicated. Begin fermentation at 68 °F (20 °C) and free rise to 76 °F (24 °C). After primary fermentation, drop as much of the yeast out as possible and move beer to wine barrel or secondary fermenter (with oak alternative) where *Brettanomyces* is added. After eight to twelve weeks of aging with the *Brett*, add bacteria to beer and top barrel/fermenter with a neutral base beer or Chardonnay. From here the beer will sit for another six to nine months. After the barrel aging is complete bottle condition the beer using a wine yeast and an appropriate quantity of priming sugar to meet your desired CO_2 level. High pressure-rated barrels are strongly suggested.

Russian River Brewing Co. Temptation clone

(5 gallons/19 L, extract only)

OG = 1.062 FG = 1.012
(going into the barrel)
IBU = 28 SRM = 4 ABV = 6.8%

Ingredients

6.6 lbs. (3 kg) light liquid malt extract
1.75 lbs. (0.8 kg) light dried malt extract
0.25 oz. (8 ml) 88% lactic acid
6.0 AAU Warrior® hops (90 min) (0.4 oz./11 g of 15.0% alpha acids)
1.8 AAU Styrian Goldings hops (30 min) (0.4 oz./11 g of 4.5% alpha acids)
1.4 AAU Styrian Goldings hops (0 min) (0.3 oz./8.5 g of 4.5% alpha acids)
White Labs WLP530 (Abbey Ale) or Wyeast 1214 (Belgian Abbey Ale) yeast
Wyeast 5112 (*Brettanomyces bruxellensis*) or White Labs WLP650 (*Brettanomyces bruxellensis*) yeast
Wyeast 5335 (*Lactobacillus*) or White Labs WLP677 (*Lactobacillus*) bacteria
Wyeast 5733 (*Pediococcus*) bacteria
Oak barrel, staves, beans or chips
Chardonnay (optional)

Step by Step

Add 5 gallons (19 L) water, extract and lactic acid to the kettle being sure to add the liquid malt extract off heat to avoid scorching the clumped extract. Follow the instruction for the boil and fermentation (aging) schedule from the all-grain recipe. BYO

Home Recipe

•Create your own

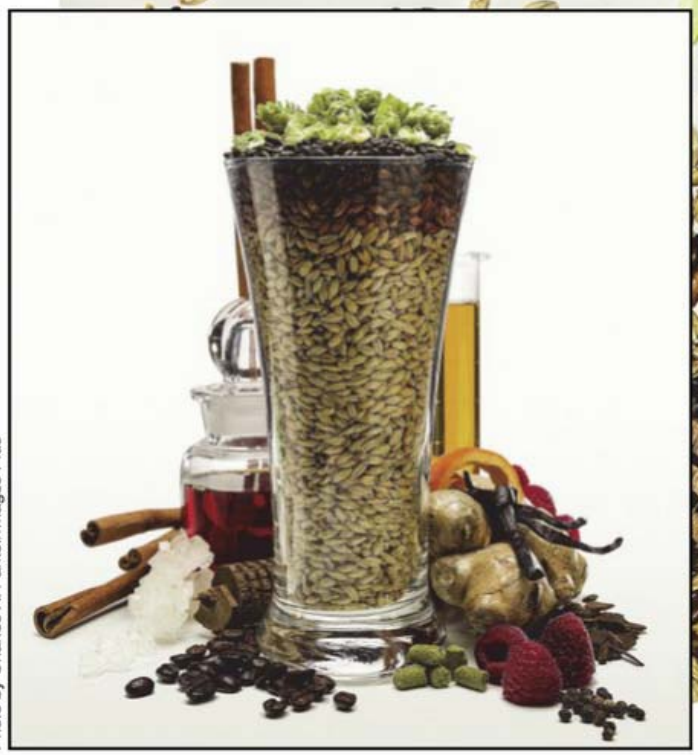


Photo by Charles A. Parker/Images Plus

If you asked me to create a cake recipe from scratch, I would probably stare blindly at you for a few moments before giving up. Yes, I know you can make a cake from some combination of sugar, butter, flour and flavoring, but honestly I would have no idea where to start on a recipe without opening a recipe book. The same is true for many homebrewers who want to make a beer recipe. We all know that you make beer from barley, hops, yeast and water, but some of us don't know where to start when designing a beer on our own.

The Two Schools of Beer Recipe Design

In the broad sense there are two basic approaches you can take to beer recipe design. I like to call these the artistic and the mechanical.

The artistic approach involves pushing the boundaries of a beer — using new or unusual ingredients in outrageous ways to create something new and unique. This is where many homebrewers excel since they are willing to take risks, experiment and try unconventional things. Jalapeños in your beer? Why not? Maybe it will go well with pizza! Try some juice, berries, cinnamon, fennel, chili, chamomile — or any other flavor combination you can think of. Brewers in this camp often make beer from what-

by **Brad Smith**

brew Design

signature brews

Photo by Charles A. Parker/Images Plus

ever they have around, often throwing ingredients together in rough proportions on the spur of the moment. This is how I think an artist might approach making beer.

In contrast, the mechanical approach takes a much more methodical approach to beer design. These recipe designers start with a known beer style or commercial beer they want to make, carefully research the ingredients and proportions used, and then calculate out the bitterness, predicted gravities and color to get exactly the combination they desire. It's an engineer's approach to beer making.

The artistic school is perhaps embodied best in Randy Mosher's book *Radical Brewing*, while the mechanical approach is best captured by Ray Daniel's book *Designing Great Beers*. Of the two, the body of knowledge around the mechanical approach is, I think, much better developed. I believe this is true, in part, because many of the major contributors to the beer brewing community over the last 25 years happened to be scientists and engineers, and these same people had early access to the Internet and tended to dominate the conversation as the body of work developed — especially in the 1990s when homebrewing really started to explode.

This isn't to say one approach is better or worse, and saying that there

Photo by Todd Hammond

are only two paths to follow is a simple way to look at it. Often times designing a recipe is a bit of both schools of thought. It's like saying that John Coltrane was not artistic because he really and truly understood and applied music theory to his improvisational style. *Radical Brewing* does not require a brewer to be ignorant of brewing calculations. And these calculations can be applied to funky ingredients like peppers to help maintain balance.

When I started creating my first homebrew recipes I was decidedly in the artistic camp, though in most cases I was finger painting as opposed to building great works of art. Later on my approach became much more methodical, but as I've matured I've moved back towards a balance. I think many of the best brewers do achieve a balance between art and science — much like Coltrane did with music; they know the numbers, but they also know how to use the ingredients to create something that is more than the sum of its parts.

A Structured Approach to Beer Recipe Design

For those of you just starting out in beer recipe design, it's important to understand a structured (more mechanical) approach to building recipes. There will be time as you grow to add more artistry, complex ingredients and techniques as you become more advanced and build up your understanding of ingredients. However, a structured approach will benefit a less experienced brewer in building a new recipe.

The basic process I follow when building a new homebrew recipe is a series of six steps:

1. Start with a well-defined goal for the beer
2. Research the target style and beer
3. Select the ingredients
4. Develop the specific grain bill, hop schedule and fermentation schedule
5. Apply specific techniques to help enhance the beer
6. Brew, judge the beer and iterate

Let's look at each of those steps more in depth:

Start With a Defined Goal

The first and most important step in creating great beer is to start with a well-defined goal. If you are stumped over what to brew next I recommend doing some personal reconnaissance at your local supermarket, craft beer pub or homebrewing event to sample a variety of beers and find something that piques your interest. Some examples of brewing goals include:

- Making a clone of a popular commercial beer
- Brewing a specific style
- Making a beer for a

SMaSH Brewing

Making single-malt and single-hop recipes

SMaSH brewing is an approach to homebrewing based on simplicity taken to the extreme — a beer made with just one hop variety and just one malt. It cuts to the heart of the flavor of the ingredients and is a great way to get to know your ingredients and also make great beer with less time and effort.

Most brewers, myself included, trend towards complex beer recipes when they start to design their own beers. We tend to add everything but the kitchen sink, but since our knowledge of ingredients at that point is limited, the result is often mediocre beer.

Some dedicated homebrewers have coined the term "SMaSH" based on simplified brewing. SMaSH stands for "Single Malt and Single Hop" beers. By breaking brewing down to its simplest elements you can gain a great understanding of the specific flavors that malt and hop varieties add to beer.

A large variety of popular beer styles can be made with SMaSH. When selecting grains, choose a flavorful malt such as Maris Otter or Munich as a base for more flavorful beers, or a simple pale malt base if brewing, say, a Pilsner.

For hop choice, many SMaSH brewers prefer medium- to low-alpha hops for beer balance using a single addition, but some brewers have been experimenting with high-alpha hops as they have more distinctive flavor and aroma profiles. You can use any hop you want, really — SMaSH is a great way for you to try out a new variety.

Once you have made your ingredient choices, I recommend running the numbers through your favorite beer software or spreadsheet to ensure that the beer is properly balanced and hits proper gravity and bitterness levels. Also you may want to consider multiple hop additions such as steeped/whirlpool hops and dry hopping for hoppier beer styles, such as an IPA, to maximize aroma and flavor.

Obviously SMaSH can be extended to include more than one malt or hop addition, though it is no longer strictly SMaSH at that point. Most of the BJCP beer styles can be made with just two malts — one base and one specialty malt. The key, again, is simplicity — add only the minimum number of ingredients needed to achieve your objective.

The key with SMaSH brewing is to take the time to learn more about the individual ingredients we use in beer, and also understand that simplicity is important in beer design. The "kitchen sink" approach is not the path to award-winning beer. The best brewers actually accomplish more with less by truly understanding what each ingredient contributes, and how to combine them to achieve their goals. Here is a great SMaSH recipe written by Drew Beecham, who has a lot of experience with SMASH brewing and has done many dozens of recipes:

Centennial Amber

(5 gallons/19 L, all-grain)

OG = 1.055 FG = 1.012
IBU = 27 SRM = 11 ABV = 5.8%

Be sure your Munich malt can self-convert. Some of the Munich malts in the 20 °Lovibond range will have trouble. Ask your local homebrew shop if you are unsure.

Ingredients

12.5 lbs. (5.7 kg) Munich malt (9 °L)
6.8 AAU Centennial hops (60 min.)
(0.75 oz./21 g at 9% alpha acid)
11.3 AAU Centennial hops (0 min.)
(1.25 oz./35 g at 9% alpha acid)
Wyeast 1272 (American Ale II) or White Labs WLP051 (California V)
Priming sugar (if bottling)

Step by Step

Heat 4.5 gallons (17 L) of strike water to 165 °F (74 °C) to stabilize the mash temperature at 154 °F (68 °C). Rest at this temperature for 60 minutes then raise your grains to a mash out temperature of 168 °F (76 °C) and begin lautering. Collect 6.5 gallons (25 L) of wort and boil for 90 minutes. Chill wort to 65 °F (18 °C), pitch an appropriate yeast starter and aerate the wort thoroughly. Ferment at 66 °F (19 °C).

homebrew competition
- A beer centered around a particular ingredient (such as smoked oats)
- A beer to serve at a certain event (like an Oktoberfest)
- Something really unique (Jalapeño-flavored Atomic Hop Bomb)

I highly recommend writing down a line or two defining what you are trying to do before you start coming up with a recipe. It could be really simple like, "Bass Ale clone," or could include a detailed description of the style in the case of a competitive beer. Define what is different or unique about your beer so that you have a solid plan to stick to when you start choosing ingredients.

Research the Target Style or Beer

Once I have a clear idea or goal defined of what I want to brew, I next will research the beer I'm going to make. Usually my first stop is the style guide from the Beer Judge Certification Program (BJCP) at bjcp.org. The BJCP style guideline includes 28 major categories of beer, mead and cider styles and some 96 individual descriptions. Each has aroma, appearance, flavor, history, key ingredients as well as the vital statistics such as bitterness level, original and final gravity and color ranges for the beer style. This is a great starting point.

Another major resource is books — including design books like those I mentioned earlier (Ray Daniel's *Designing Great Beers*) and also style and recipe books like *Brewing Classic Styles* by Jamil Zainasheff and John Palmer, or Jamil's *Best of Brew Your Own* special issue, *30 Great Beer Styles* (available at http://byo.com/store). If you like a particular beer style you can also consider the many style specific books such as *IPA: Brewing Techniques, Recipes and the Evolution of India Pale Ale* by Mitch Steele or any of the *Classic Beer Style* series of books.

If you don't have a large brewing library you can also find a huge amount of brewing information online. A quick search will reveal articles on brewing various beer styles, blogs, forums and recipe sites, such as my

own BeerSmithRecipes.com site and of course at byo.com. Compile a few recipes that are similar to the beer you are trying to brew, and take a close look at what ingredients they used and in what proportions.

Finally, my favorite method of research is first-hand research. Sample some beers similar to yours from the supermarket, a local craft brewery or those of other homebrewers. With practice you will be able to discern the major ingredients and also get a good feel for what the beer should taste like. This knowledge will come in handy when you go back later to judge and improve your own recipe.

List Potential Ingredients

At this point, make a complete list of the ingredients you want to use in the recipe, including the yeast to be used. (More advanced brewers can also include the water profile. More on this later in the article.) Don't try to determine the exact proportions yet — just focus on identifying the key ingredients and what they contribute.

Start with the ingredients that define the style. For example you can't make a Belgian wit without unmalted wheat, or a Bavarian weizen without the proper yeast to provide the banana/clove flavor. A complex, fruity ale yeast is a key ingredient for a classic English ale. This is where your research will really come in handy.

Next, consider what alternatives might be possible. Could you substitute an American hop variety for an English one? Use a specific barley variety like Maris Otter to give the beer more character? Add something really unique and off the wall like peppers or cocoa?

Finally, go through the notes and ideas that you've come up with and simplify. Many beginning brewers try to put everything but the kitchen sink into the beer. In contrast, most commercial beers are made with just a handful of ingredients because commercial brewers can't afford to maintain a huge inventory of dozens of types of grains and hops, but also because simpler is generally better. The best homebrewers are also ruthless in simplifying their recipes. They don't

add any ingredients to the beer without a specific purpose in mind.

One way to get used to brewing with fewer ingredients as well as understand your ingredients is to explore the Single Malt and Single Hops (SMaSH) style of brewing. In SMaSH you brew a beer with only one malt and only one hop variety. Surprisingly a wide variety of styles can be made including: Pilsner (all kinds), Vienna lager, saison, Munich dunkel, wild ales, IPAs and even barleywine. The advantage of SMaSH is that it gives you a really great feel for what each base malt and hop adds to the overall beer. It also gives you a good appreciation of what can be accomplished with few ingredients. (See the sidebar on page 54 for more about SMaSH brewing and a homebrew recipe.)

Develop the Specific Grain Bill, Hop Schedule and Proportions

After simplifying the ingredient list, the next step is to develop a specific recipe. At this point I highly recommend using some kind of recipe software or spreadsheet. Full disclosure: I develop and sell BeerSmith recipe software, but there are a number of free and paid alternatives (check out Forrest Whitesides story about brewing software in the May-June 2011 issue of *BYO* for a good list of what's out there). No matter what package or spreadsheet you decide to use, some kind of system for estimating the bitterness, color, gravity and alcohol content of your recipe as you build it is critical to designing a good, balanced recipe. It is even better if your software or spreadsheet can also take into account your specific equipment since equipment volumes can significantly affect these estimates.

Start first with your grain bill (or extracts). It is easiest at this point to start with percentages such as 80% base grain, 5–10% key grains and the remaining specialty grains (for example). Once you have the percentages right you can scale the weights for each grain up to reach your desired original gravity for the style.

Next, work on the hop schedule. While many homebrewers extol the advantages of continuous hopping additions, I prefer a simpler hop schedule. I will use one or two boil additions followed by an aroma addition at flameout. The boil addition provides bitterness, and the aroma addition the fragile hop aromas.

Recent research indicates that most of the hop aroma oils you want to preserve with late hop additions are boiled off in just a few minutes. So rather than adding hops the last 20, 15, 10 or 5 minutes of the boil, you are better off steeping hops at flameout, using whirlpool additions or a hop back. These options preserve the critical aroma oils in the beer. (Read more about hop stand additions at http://byo.com/story2808.)

Similarly, long exposure periods are a thing of the past with dry hopping. Recent research indicates that shorter dry hop contact times result in a better overall aroma and flavor. In fact as little as 24 hours of contact time when dry hopping can deliver peak aroma. I recommend dry hopping from 24–72 hours.

When selecting a yeast, you can rarely go wrong selecting the traditional strain to match your target style. However sometimes it is worthwhile to go "off-style" to achieve a particular effect. For example, I might use a dry, clean yeast like a California ale yeast if I want a very clean finish even if I'm not brewing a California ale.

A yeast starter is very important if working with liquid yeast. Liquid yeast has a shelf life of only six months and degrades about 20%/month. A typical large vial or smack pack has about 100 billion cells when produced, but that can degrade to 50 billion or so by the end of its life. In contrast, the ideal pitch rate for a 1.048 American ale is about 164 billion cells — so a 1-2 liter starter is required if you want to pitch plenty of yeast. Dry yeast does not usually require a starter — just hydration 15-20 minutes before use. (For more about making a yeast starter, check out Michael Dawson's story in the September 2013 issue of *BYO*.)

Water is often overlooked as a major beer ingredient, and can be a pretty complicated subject for new and intermediate brewers. Understanding how hard or soft your local water source is and what minerals it has is critical to making good beer. Hard water is high in calcium (Ca) and magnesium (Mg), which is usually good for brewing, while soft water is low in Ca and Mg, which usually needs to be improved. The actual problem is Alkalinity (carbonates) where high alkalinity is nearly always bad, and low alkalinity is nearly always good. In general, pale lager beer styles such as Munich helles benefit from lower amounts of minerals in the water, while the typically more assertive ale styles such as IPA and porter benefit from higher levels. If you have water issues, consider using bottled water. Adjusting water and mash chemistry is a pretty complex topic, and if you would like to learn more, there is a new book available, *Water: A Comprehensive Guide for Brewers*, by John Palmer and Colin Kaminski (Brewers Publications, 2013).

Apply Brewing Techniques

The last major stage in building a great beer recipe is to decide which techniques best apply to the beer you are brewing. This can be highly subjective as different techniques drive different effects, and you need to know which ones work best with various styles. Again, this is where your background research will come in handy.

For extract brewers, I recommend the addition of fresh steeped specialty grains to enhance your recipe. Steep grains like caramel, crystal or chocolate malt for 30 minutes at 160 °F (71 °C), then add the extract and start the boil. Another popular technique is to add the bulk of your extract late in the boil (last 10-15 minutes). This technique is called a late extract addition, and will reduce the darkening of the wort and production of atypical flavors that are associated with high gravity boils intended for later dilution in the fermenter.

All-grain brewers should vary the main mash step temperature to adjust the body of the beer. For a light body

beer, mash in at 148 °F (64 °C). For a medium body use 152 °F (67 °C) and for a full body beer use 156 °F (69 °C). Changing the temperature alters the fermentability of the wort, resulting in a light or full-bodied finished beer.

I recommend a single-step infusion mash for virtually any all-grain beer. If you want to use unmalted grains or cereals with a single-step mash, just use the flaked or torrified versions, which require no cereal mash step. If you are just getting into all-grain, I also recommend looking seriously at brew-in-a-bag (BIAB) techniques. Brew-in-a-bag uses a grain bag in the boil pot instead of a separate mash tun. This lets you get into all-grain brewing with less equipment and also saves some time when brewing.

For very dark beers, segregating dark grains and steeping them in a tea is another great technique to consider. Mashing very dark grains for a long period can lead to additional bitterness. If you separate them into a steeped tea as I described above for extracts, you can reduce the bitterness and get a smoother flavor. This can be a plus for certain dark beers like mild porters and milk or sweet stouts.

A variety of hop techniques are available depending on style. I've already mentioned the use of steeped/whirlpool hops after the boil as well as dry hop additions to enhance fresh hop aroma. Obviously you can vary boil times to change the bitterness of your beer. The other hop technique I recommend when all-grain brewing is first wort hop (FWH) additions. A FWH addition is added to the boil pot at the beginning of the sparging process. This allows the hop to steep for a short period before boiling. The net effect of FWH is to provide a smoother, more pleasing bitterness. So FWH is appropriate for beer styles where you are not looking for dominating bitterness. For more about FWH, check out Dave Green's story in this issue on page 60.

For fermentation, I've already mentioned the importance of a good yeast starter. Aerating your wort with air or oxygen before pitching the yeast will also enhance your fermenta-

tion. Temperature control is very important — ferment in a controlled vessel if possible.

Judging and Improving Your Recipes

It is no coincidence that just about every top-level competitive homebrewer I know is also a certified beer judge. Judging beer is a separate skill, but if you really want to make great beer it is one you need to master.

The BJCP score sheet available at bjcp.org provides a great guideline for evaluating your own homebrews. I like to use the following evaluation process for tasting my homebrews:

1. Evaluate the external appearance of the beer
2. Capture the aroma up front — right after the beer is poured
3. Evaluate color, clarity and head retention before testing
4. Taste the beer, noting the overall impression first
5. Evaluate finish, malt, hops, aroma, mouthfeel and obvious flaws

During all of this take notes on a score sheet so you can honestly evaluate what the strengths and weaknesses of your recipe are. Use these notes to make adjustments on your next iteration. A lot of homebrewers never brew the same recipe twice, but I can tell you that commercial (and competitive) brewers spend a lot of time perfecting a recipe on a pilot system before they brew 30+ barrels of it. If you want to brew your best beer it's wise to follow suit by brewing your recipe multiple times until you get it to where you want it. Your goal in judging and iterating is to make a better beer each time you brew that particular recipe.

Conclusion

Learning the art and science of beer recipe design and beer brewing is a lifelong pursuit. Even those who have dedicated their life to the study of beer are constantly learning new things. If you are just starting on this journey, I urge you to take the first steps by creating your own recipes from scratch using a structured process as outlined here. If you are an advanced brewer, take the time to become an expert in beer judging and also expand your repertoire of brewing techniques and you will be rewarded with ever better beers. BYO

Related Links:

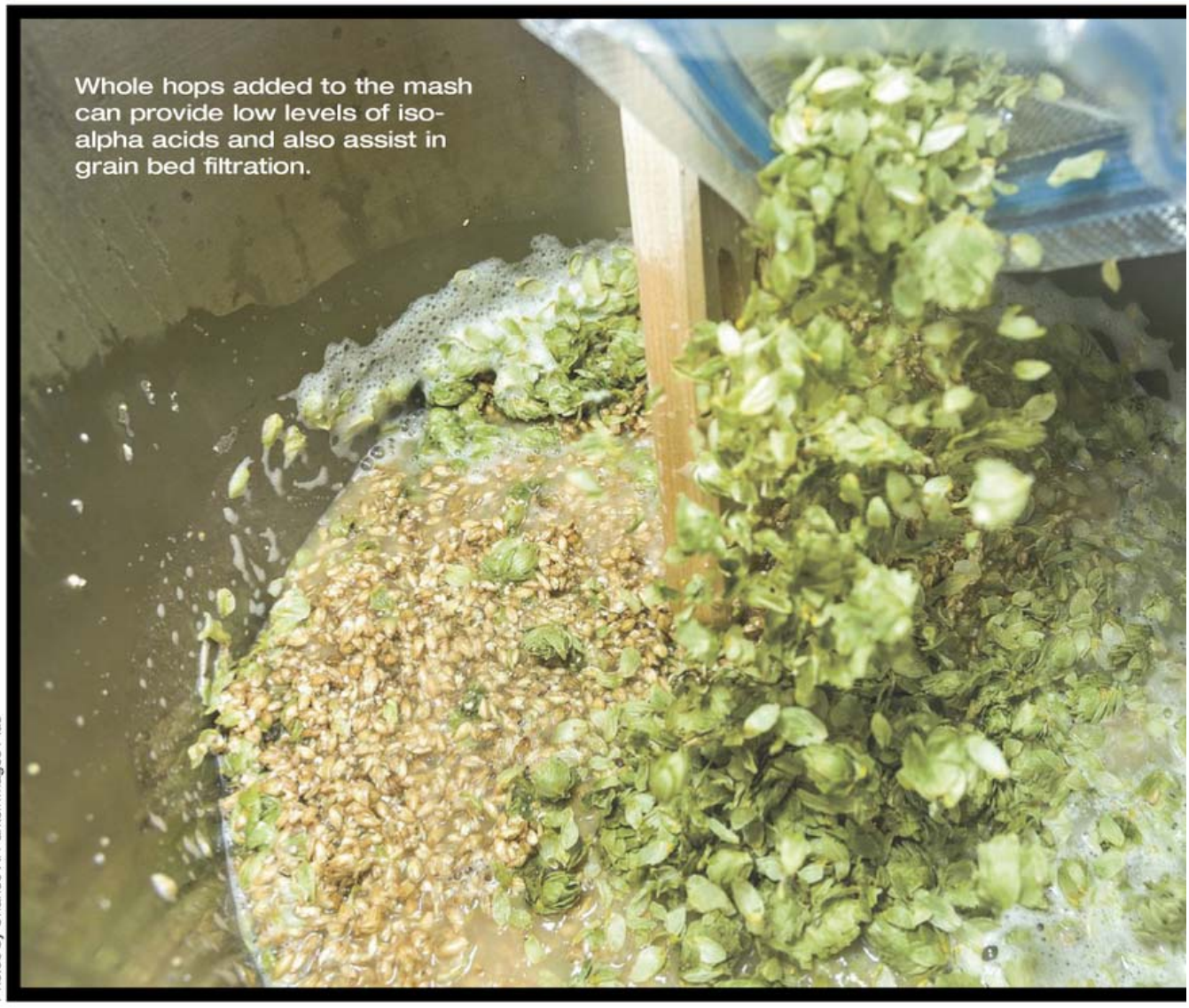
• Learn how to calculate measures of extract, real and apparent attentuation, alcohol content and how many calories are in your beer:
http://byo.com/story408

• To plan a brew, you need to know a few details about your ingredients and your brewing process. Learn how to plan the original gravity, bitterness level and color of your beer:
http://byo.com/story409

Pre-Boil HOPPING Techniques

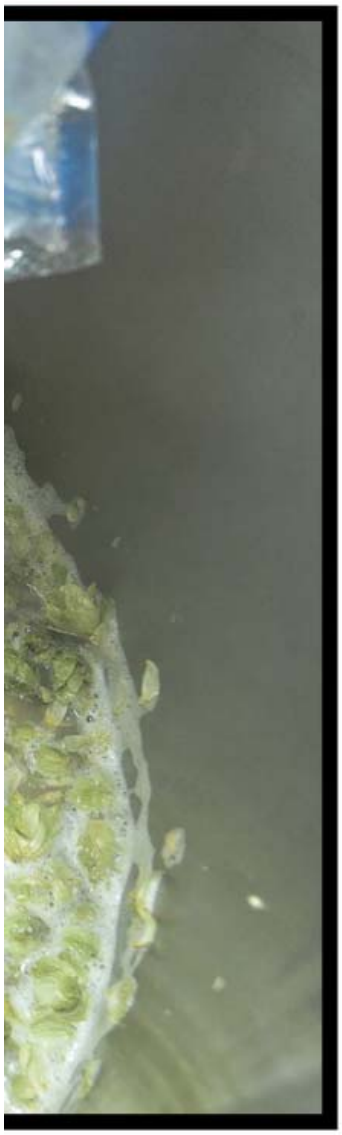
by Dave Green

First wort hops and mash hops



Whole hops added to the mash can provide low levels of iso-alpha acids and also assist in grain bed filtration.

Photos by Charles A. Parker/Images Plus



Breaking traditions has become a theme that both craft brewers and homebrewers alike strive for in their beers. One only needs to look at the US Brewers Association's definition of a craft brewer to see this: "The hallmark of craft beer and craft brewers is innovation. Craft brewers interpret historic styles with unique twists and develop new styles that have no precedent." I take that statement with a grain of salt since in my opinion many of these new and "innovative" techniques that brewers are using have roots in the past. Our forefathers had several millennia working on techniques and recipe development for the production of malted beverages. So to say something has no precedent, well I'll argue that more than likely, there is a precedent somewhere buried in the past.

During the dark ages of beer brewing post-World War II, when pale lagers came to dominate the global market, regional and subregional beer styles and generations of brewing knowledge were slowly and systematically snuffed out. Part of the renaissance of beer brewing over the past four decades has been in re-discovering these old practices. Germans, in particular, were relegated by law to brewing with a very limited range of ingredients to include in their beers. What evolved was a very technique-oriented brewing style where timing and ingenuity was required.

Two of those older techniques that fell by the wayside, first wort and mash hopping, have found new promise in modern brewing. First wort hopping is a hopping technique that was actually a very prominent form of hopping even one century ago in several brewing regions. Mash hopping is a less prominent technique that may have found a new place in the heart of our current brewing renaissance.

"Mash hopping is a less prominent technique that may have found a new place in the heart of our current brewing renaissance."

First Wort Hopping

As far as adjusting a brew day technique, it really doesn't get any easier than trying first wort hopping (FWH). While there is still some ambiguity that surrounds its overall affect on the finished beer, most brewers will either use it as a substitute for their bittering hop charge or their mid-boil hop charge. So why the ambiguity? Well it has been shown in tastings that first wort hopping can increase the perceived aroma of a beer when substituted for a traditional late hop addition to the kettle. Yet when a group of scientists tested the hop aroma components of FWH beers, they found that the aroma compounds were actually considerably lower in first wort hopped beers versus the same beer with that late hop addition. So let's delve into what first

"Mash hopping is simply adding a hop charge to the mash. . . . Mix the hops in at the beginning of the mash and do not change anything else about the mash."

wort hopping is and indicate when you possibly should and should not use this technique.

First wort hopping if you are not familiar with it, is very simple. Add a portion or all of your late boil hop charge or bittering hops before the wort comes to a boil. It does not matter whether you are an all-grain or extract brewer. Generally as an all-grain brewer I do this about 3-5 minutes into the sparging process of the grain bed. When I'm using extracts, I generally wait until the wort has gotten up to about 180 °F (82 °C) before tossing the FWH into the kettle.

So what does FWH do for your beer? What repeated studies have shown from blind triangle taste tests is that it creates a softer, more rounded bitterness than adding your bittering hops to a rolling boil. There are two studies in particular that document this effect. The first is a fairly comprehensive study put out back in 1995 by a German group of researchers Preis, Nuremberg, Mitter & Steiner titled "The re-discovery of first wort hopping," published by Brauwelt International. The second study was performed by US homebrew guru Denny Conn, whose results roughly affirmed that of the German researchers and presented his findings at the 2008 AHA Conference.

The German researchers utilized two breweries to test first wort hopping versus a late hop addition. The taste tests from both breweries confirmed that there is a distinct difference between a beer with first wort hopped charge and bittering charge and beers brewed with a traditional bittering charge and late hop charge. Among those on the panel, 21 out of 23 tasters were able to recognize the taste discrepancy in a Pilsner. Of those 21 tasters who distinguished some difference between the two beers, 19 of them preferred the first wort hopped beer. That is enough to raise my eyebrows. Denny Conn's study, which was performed with two groups of BJCP judges and professional brewers, tested FWH beers versus a traditional bittering charge. What they found in a blind triangle test was that seven of the eighteen tasters were able to distinguish the first wort hopped beer; still significant but not quite as striking as the German study. The general consensus among those that could distinguish among the two beer types was that the first wort hopped beer offered a smoother bittering profile than the reference beer.

The other aspect that the two studies confirmed is that first wort hopping will increase your bittering units without increasing the perceived bitterness. The IBUs of a beer that has been first wort hopped achieve on average ~10% more hop utilization when analyzed against the same beer with a standard 60 minute hop addition. The Germans found in the first Pilsner with FWH 39.6 IBUs, compared to 37.9 IBUs for the reference beer. The second Pilsner was found to have 32.8 IBUs and the reference beer had 27.2 IBUs. Denny Conn's beers when analyzed had 24.8 IBUs for the FWH beer and 21.8 IBUs for the reference beer. The German study also showed that the iso-alpha acid concentration was quite a bit higher for the FWH beers. But again, taste tests revealed that the actual perception of the bitterness levels are slightly lower for the FWH beers. In other words, they had less bite.

So when is it advisable to utilize the FWH technique? Pretty much any beer you plan a bittering addition to mid-boil hop addition could be FWH'd. I do tend to use this technique when brewing beers that are more malt forward, or with well rounded styles such as continental lagers, roasted grain- focused beers, wheat beers and Scottish ales to name a few. Sometimes I will skip FWH and stick to a more traditional hopping schedule when I'm looking for more bite in the beer, such as with American IPAs, double IPAs, robust porters or imperial stouts. I've used FWH with all those styles as well with great results. I've also split my bittering hops so that half go in at first wort, and the second half go in with 60 minutes left in the boil. Another counter-indication for me is if I'm planning on boiling more than 75 minutes. I don't like to have my hops in contact with boiling wort for more than ~75 minutes for fear of polyphenols leaching into the wort from the hops. With that said, it has been reported that Pilsner-Urquell first wort hops their classic Pilsner and boils for 2 hours. Hard to argue with a classic like a Pilsner-Urquell.

So why does first wort hopping work? That is still not fully understood

according to my research. All I can do is offer some theories as to why it provides a smoother bitterness. There are three primary alpha acids found in hops: humulone, cohumulone and adhumulone. Relatively, they are not that bitter, but when heated above about 175 °F (80 °C) they will isomerize (re-arrangement of the molecule) into iso-alpha form: iso-humulone, iso-cohumulone and iso-adhumulone respectively. At this point they are several times more bitter than their non-isomerized cousin. In the isomerization process each alpha acid is further divided into the *cis* and *trans* states. This is akin to left-handed vs. right-handed states; they are mirror images of each other, just flipped. Each of those forms acts slightly differently as well. Another factor that could play a key role here are hop glycosides which have been the focus of many discussions surrounding misunderstood components of hops. So why am I explaining all this? Well just to show that there is a lot going on in the bittering process. Add in beta acids plus oxidative reactions that are occurring on the various oil components and you can see that complex nature at a molecular level in your wort when hops are added.

The long and short of my hypothesis is that the isomerization reaction proceeds along slightly differently when hops are added off boil, 175–210 °F (80–99 °C). Maybe you get more *cis*-iso acids or vice versa. I don't have any empirical evidence for this theory, just anecdotal evidence when I've compared exclusively FWH beers to exclusively whirlpool hopped beers. We talk in similar terms when describing the bitterness of the beers hopped at off-boil temperatures, whether it is pre- or post-boil hopped. I have brewed both techniques on a cream ale, exclusively pre-boil FWH and exclusively post-boil whirlpool hopped beers and find the bittering qualities to match up fairly well. The whirlpool hopped beer had abundantly more hop nose and flavor, but the FWH beer had some hop aroma when compared to a standard American lager. My results are right in line with the German taste panel's findings, that FWH beers had slightly more hop aroma. The mystery deepens since this contradicts the German team's research when they performed gas chromatography on the resulting beers. What they found was that the FWH beers contained significantly less hop aroma compounds compared to the reference beers. The ultimate empirical answer to the mystery of why it works will have to await more scientific research. For now, I have to use my anecdotal evidence.

Mash Hopping

Mash hopping is a much different beast than FWHing. First off, it is for partial mash and all-grain brewers only. Second, iso-alpha acid conversion does not take place at an appreciable level at mash temperatures, so alpha acids do not undergo the isomerization reaction. The oils that are extracted from the hops will most all be driven off during the boil, so why would anyone give mash hopping a second look? Well there may actually be a reason to take a look down this worm hole for a very specific purpose.

Mash hopping is simply adding a hop charge to the mash. I have always used whole leaf hops when mash hopping since it will aid in grain bed filtration in a manner somewhat akin to adding rice hulls. Mix the hops in at the beginning of the mash and do not change anything else about the mash.

So if the alpha acids are not going to convert and say 98% of them are left in the mash tun and the oils will be driven off in the boil, why use it? Well what if you're planning on boiling the mash and what if the only time you're going to boil on that given brew day is during the mash? Two fairly well documented mashing techniques may come to mind; decoction and turbid mashing when answering the first question. The second question is found again by looking at what was done in the past.

Traditionally brewers have always boiled their wort after lautering for a minimum of 60 minutes. If Pilsner malt is used, that boil time is generally increased to at least 90 minutes to off-

Continued on page 67

First Wort Hop and Mash Hop Recipes

FIRST WORT HOP RECIPES

Weihen-not Hefe
(5 gallons/19 L, all-grain)
OG = 1.051 FG = 1.011
IBU = 13 SRM = 5 ABV = 5.5%

While I was going for a Weihenstephaner Hefe Weissbier clone with this beer, I found that using just wheat and Pilsner malt lacked the malt depth when compared to the original, even when I double decocted the mash. I added some dark Munich malt and melanoidin malt to try to coax a layer of complexity which the original German hefeweizen displays. I also adjusted the hops from a low alpha acid variety, Hallertau Mittelfrüh, to the higher alpha German Magnum to minimize extraction of polyphenols considering the longer contact time with the wort.

Ingredients
5.5 lbs. (2.5 kg) German wheat malt
4 lbs. (1.8 kg) continental Pilsner malt
12 oz. (0.34 kg) dark Munich malt (9 °L)
4 oz. (0.11 kg) melanoidin malt
Rice hulls (optional)
3 AAU Magnum hops (FWH)
(0.25 oz./7 g at 14% alpha acid)
Wyeast 3068 (Weihenstephaner Weizen) or White Labs WLP300 (Hefeweizen Ale) or Lallemand Munich Wheat yeast
Priming sugar (if bottling)

Step by Step
This is a step infusion mash. Dough-in the crushed grains to achieve a mash temperature of 112 °F (44 °C) for ferulic acid development. Let rest for 20 minutes then raise the mash temperature to 152 °F (67 °C) for saccharification conversion. Rest at this temperature for 45 minutes then begin lautering. If you are using rice hulls, add them prior to starting your lauter. Once you begin your run-off into your kettle add the hops. If you are fly sparging, be wary of the specific gravity — or more specifically the pH of your run-off. If your specific gravity drops below 1.010, shut down the sparge and top off the kettle. Collect 6 gallons (23 L) of wort and boil for 60 minutes. After knockout, begin a whirlpool and let the wort spin down for 10 minutes.

Chill the wort to 65 °F (18 °C), pitch an appropriate yeast starter (~1 qt./1 L) and aerate the wort thoroughly. Ferment at 68 °F (20 °C). Carbonate the beer to 3–3.5 volumes CO_2. For carbonation guidelines, visit, visit http://byo.com/resources/carbonation

Weihen-not Hefe
(5 gallons/19 L, extract only)
OG = 1.051 FG = 1.011
IBU = 13 SRM = 5 ABV = 5.5%

Ingredients
6.6 lbs. (3 kg) wheat liquid malt extract
0.5 lbs. (0.23 kg) Munich liquid malt extract
3 AAU Magnum hops (FWH)
(0.25 oz./7 g at 14% alpha acid)
Wyeast 3068 (Weihenstephaner Weizen) or White Labs WLP300 (Hefeweizen Ale) or Lallemand Munich Wheat yeast
Priming sugar (if bottling)

Step by Step
Add 5.5 gallons (21 L) water plus malt extract to your kettle. When temperature of the kettle reaches about 180 °F (82 °C), add the hops. Now follow the boil, fermentation and packaging instructions in the all-grain recipe.

Otto's Jacket Pale Ale
(5 gallons/19 L, all-grain)
OG = 1.058 FG = 1.013
IBU = 57 SRM = 6 ABV = 6%

For my first brew with Mosaic™, I decided to pair it with Chinook and Apollo. The resulting beer was pretty fantastic, something Lisa Simpson might liken to Otto's Jacket (credit to Jack Horzempa for the name). This one clocks in at 57 IBUs, but tastes more like 45 IBUs.

Ingredients
11.25 lbs. (5.1 kg) North American 2-row pale malt
8 oz. (0.23 kg) CaraVienne® malt (24 °L)
6 oz. (0.17 kg) honey malt
4.6 AAU Apollo hops (FWH)
(0.25 oz./7 g at 18.5% alpha acid)
9.3 AAU Apollo hops (5 min.)
(0.5 oz./14 g at 18.5% alpha acid)
11 AAU Mosaic™ hops (0 min.)
(1 oz./28 g at 11% alpha acid)
7 AAU Chinook hops (0 min.)
(0.5 oz./14 g at 14% alpha acid)
1.5 oz. (43 g) Mosaic™ hops (dry hop)
0.5 oz. (14 g) Chinook hops (dry hop)
0.5 oz. (14 g) Apollo hops (dry hop)
Wyeast 1272 (American Ale II) or White Labs WLP051 (California V) or Lallemand Nottingham yeast
Priming sugar (if bottling)

Step by Step
This is a single infusion mash. Heat 4.5 gallons (17 L) strike water to 165 °F (74 °C) to stabilize the mash temperature at 154 °F (68 °C). Rest at this temperature for 45 minutes then begin lautering. Once you begin your run-off into your kettle, add the first wort hops. Collect 6 gallons (23 L) of wort and boil 60 min-

First Wort Hop and Mash Hop Recipes

utes. After knockout, begin a whirlpool and let the wort spin for 20 minutes.

Chill wort to 63 °F (17 °C), pitch an appropriate yeast starter (~1 qt./1 L) and aerate the wort thoroughly. Ferment at 65 °F (18 °C). After primary fermentation subsides, add dry hops for 10 days before packaging. Carbonate the beer to 2.4 volumes CO_2.

Otto's Jacket Pale Ale

(5 gallons/19 L, extract with grains)

OG = 1.058 FG = 1.013
IBU = 57 SRM = 6 ABV = 6%

Ingredients

6.6 lbs. (3 kg) pale liquid malt extract
12 oz. (0.34 kg) light dried malt extract
12 oz. (0.34 kg) CaraVienne® malt (24 °L)
4.6 AAU Apollo hops (FWH) (0.25 oz./7 g at 18.5% alpha acid)
9.3 AAU Apollo hops (5 min.) (0.5 oz./14 g at 18.5% alpha acid)
11 AAU Mosaic™ hops (0 min.) (1 oz./28 g at 11% alpha acid)
7 AAU Chinook hops (0 min.) (0.5 oz./14 g at 14% alpha acid)
1.5 oz. (43 g) Mosaic™ hops (dry hop)
0.5 oz. (14 g) Chinook hops (dry hop)
0.5 oz. (14 g) Apollo hops (dry hop)
Wyeast 1272 (American Ale II) or White Labs WLP051 (California V) or Lallemand Nottingham yeast
Priming sugar (if bottling)

Step by Step

Steep your crushed grains in 2 qts. (1.9 L) water at 160 °F (71 °C) for 20 minutes. Wash the grain bag with hot water. Top off kettle to 6 gallons and stir in the extracts. When the wort hits about 180 °F (82 °C), add the hops. Now follow the fermentation and packaging instructions in the all-grain recipe.

MASH HOP RECIPE

Nicht-boil Berliner

(5 gallons/19 L, all-grain)

OG = 1.032 FG = 1.005
IBU = 5 SRM = 3 ABV = 3.5%

This recipe is inspired by Michael Tonsmeire's modern take on the no-boil method. Make sure to keep your IBUs extremely low (<5 IBUs) to insure that the Lactobacillus *will not be inhibited.*

Ingredients

4 lbs. (1.8 kg) Pilsner malt
2.5 lbs. (1.13 kg) wheat malt
Rice hulls (optional)
4.5 AAU Hallertau Mittelfrüh hops (mash hop) (1 oz./28 g at 4.5% alpha acid)
Wyeast 5335 (*Lactobacillus*) or White Labs WLP677 (*Lactobacillus* Bacteria)
Wyeast 1007 (German Ale) or White Labs WLP036 (Dusseldorf Alt) yeast
Priming sugar (if bottling)

Step by Step

One week prior to brew day, make a 1 qt. (1 L) starter with the *Lactobacillus*. Do not place the starter on a stir plate but try to get the starter in a spot near your house boiler where temperatures would be above room temperature or a similar location with elevated temperatures. This should give the *Lacto* a jump start in order to get a nicely soured beer. If you are able to find one of the Berliner weisse yeast blends, you can alternatively pick up Wyeast 3191 (Berliner Weisse Blend) or White Labs WLP630 (Berliner Weisse Blend) or East Coast Yeast ECY06 (Berliner Blend) yeast which would blend one or more strains of *Lactobacillus* bacteria as well as a German ale yeast plus sometimes a *Brettanomyces* yeast as well.

This is a decoction mash. Dough-in with 4 qts. (3.8 L) water, mix the crushed grains and hops to achieve a mash temperature of 95 °F (35 °C). Rest for 10 minutes then raise the grain bed to 135 °F (57 °C) with the addition of boiling water. Let rest for 10 minutes then pull (decoct) half the grains (thick mash with little wort) and boil the grains for 20 minutes stirring often to avoid scorching them. Return the decocted portion back to the main mash to help raise the temperature up to saccharification temperatures to 152 °F (67 °C) for saccharification conversion. Rest at this temperature for 45 minutes. At this point you can pull a second decoction, which would require you to cut down on your mash hop quantities to half an ounce (14 g) or you can simply raise your mash up to 170 °F (77 °C) by using a recirculating heat method or by infusing boiling water to the mash. If you are using rice hulls add them prior to starting your lauter. Rest for 15 minutes and begin lauter phase. Once you start running off, send the wort directly into the wort chiller or fermenter. If you are fly sparging, be wary of the specific gravity or more specifically the pH of your run-off. If the pH of your grain bed rises above 6, your brew is susceptible to tannin extraction. One solution is to acidify your sparge water to pH 6 with the addition of phosphoric or lactic acid.

Collect 5 gallons (19 L) of wort. If the wort is not chilled, place wort in a cool spot or fridge to get it down to about 110 °F (43 °C) and pitch the pure *Lactobacillus*. Make sure that you have raised the temperature of the *Lacto* starter up to about this temperature as well since you don't want to shock the bacteria. After about 12 hours when the temperature of the wort has cooled to yeast fermentation temperature of 65 °F (18 °C), pitch the ale yeast and hold at this temperature for duration of primary fermentation. Do not aerate the wort.

After primary fermentation is complete, you can raise the temperature of the wort up to around 80 °F (27 °C) to let the souring process occur more rapidly. One to three months of aging would be a minimal recommended time period to properly sour this beer.

Carbonate the beer to three volumes of CO_2. For carbonation guidelines, visit, visit http://byo.com/resources/carbonation.

You can serve this beer with a raspberry syrup known as Himbeere (red) or a woodruff syrup know as Waldmeister (green). This is a light and refreshing brew best enjoyed on a hot summer afternoon.

set the increased levels of S-methyl methionine (SMM) (the dimethyl sulfide/DMS pre-cursor molecule) found in this lightly kilned base malt. But in this brewing renaissance everything can be questioned and the requirement of boiling is one of them. A scan through the history books found brewers in the past who have tried this no-boil technique.

So let me explain the no-boil technique, then I can get into why mash hopping is perfect for this technique. I first learned about no-boil beers from reading Michael Tonsmeire's brewing blog "The Mad Fermentationist." In a post from 2008 he talks about reading Eric Warner's book titled *German Wheat Beer*. Mr Warner explains that traditionally a Berliner Weisse beer had the wort go directly from the lauter tun to the coolship, bypassing the kettle and boil process entirely. Tonsmeire took this concept and decided to apply it to his next Berliner weisse. There is one glaring problem with this, however: Berliner weisse uses a lot of Pilsner malt. Wouldn't DMS be a huge problem with the finished beer? Well what Mr. Tonsmeire and the ensuing wave of no-boil experimenters found was that DMS doesn't seem to be a major problem with these beers. Does the bacteria possibly mask the low levels of DMS that would be found in a no-boil beer or could the lack of a boil somehow prevents DMS or could it be that the DMS is oxidized by the acids produced by the bacteria or simply scrubbed out during the fermentation process? Once again, I could not find anything but anecdotal evidence that supports that no-boil beers will result in beers without the cooked cabbage like aromas that are associated with DMS. Needless to say, more intensive studies into this matter could result in some conclusive evidence as to why this may be the case by measuring DMS levels in the finished wort of a no-boil beer and the DMS levels post-fermentation.

Now to turn this back into mash hopping, what has evolved is a no-boil beer where a brewer can get their very small quantities of iso-alpha acids desired for a beer like a Berliner weisse from a mash that has been hopped, then isomerization occurs during the ensuing decoction process — depending on how much mash you are looking to pull for the decoction. So for argument's sake you have added hops in the entire mash and decide to pull half of the mash for decoction, then for calculation purposes simply consider that half of the hops are being boiled for the duration of the decoction boiling. Or you can save some money on hops by simply adding the hops directly to the pulled decoction. With a beer like a no-boil Berliner weisse whole leaf hops will now perform two functions, assist in grain bed filtration and provide the low levels of iso-alpha acids. Where else could you use this technique? Lambic-styled beers, gose and other sour beers seem like a good fit for mash hopping if boiling is not truly required in sour beers.

Fining Beer

Settling particles out of suspension

techniques
by Terry Foster

First, what does "fining" mean? Well, this is another piece of brewer's jargon, like "grain bill," "knock-out" and calling brewing water "liquor" — indeed one 18th century writer records that anyone using the word water in the brewery would be charged sixpence (a significant sum of money in those days). Fining is the process of adding a substance that will cause the suspended yeast (and other solids) to clump together and settle to the bottom of the vessel, leaving clear beer as the supernatant liquid. That is it makes the beer "fine."

In fact, fining is brewer's jargon for the process that is more widely known as flocculation. This term is applied to the process where tiny particles suspended in a liquid are caused to form bigger particles that can then settle out of suspension. Often the suspended particles are held so because they carry like surface charge and repel each other. Reduction of this charge by altering pH, such as by addition of calcium ions, results in agglomeration and settling of the particles, in a process known as coagulation (as distinct from flocculation).

If instead a molecule capable of absorbing onto the particles and large enough to join several particles together is added, we have true flocculation. The added molecule, usually a high molecular weight water-soluble polymer is known as a *flocculant*. Please note the distinction from *flocculence*, which is the property shown by particles that are *flocculant*. There are a variety of flocculants available, some of them naturally occurring such as carrageenan (Irish moss, used in the kettle to flocculate trub), gelatin and isinglass (used as finings in beer).

There is also a wide range of synthetic flocculants, dominant among which are very high molecular weight polyacrylamides and polyacrylic acid and its derivatives; I am not aware that any of these have been used to clarify wort or beer. Note that other polymers used in beer treatment, such as Polyclar and silica gel are not flocculants — they are insoluble and are used as adsorbents for proteins and tannins that cause chill hazes in beer.

You have probably come across these terms in regard to yeast, since the suppliers usually give a figure describing how flocculent the particular strains are, based on a specific settling test.

All yeasts show some tendency to flocculate without the addition of a flocculant, but what we are concerned with in fining is those particles that do not flocculate and settle only slowly. These fine particles do not settle well simply because they are too small to do so, though they will settle under gravity, given sufficient time. The "Advanced Brewing" column in the July-August 2013 issue of *BYO* titled "Clarification of Beer" deals with the mathematics of settling. In it, author Chris Bible gives an equation for the settling velocity of a particle in a liquid. Settling rate is proportional to the density difference between the liquid and the particle, to the square of particle diameter, and inversely to the viscosity of the liquid. In other words, increasing the particle size has a huge effect on settling rate, which we can do by the addition of a flocculant. That is good, because we cannot do much to change the other parameters when we are talking about treating beer.

> "... fining is brewer's jargon for the process that is more widely known as flocculation."

What are finings?

Finings are quite specifically substances to assist the removal of

Photo by Charles A. Parker/Images Plus

suspended yeast from beer, that is, to clarify the beer. There are really only two products that have been used to any extent in brewing, and they are gelatin and isinglass. They are somewhat similar chemically, in that they are both proteinaceous, which means they can carry either a negative or positive charge according to the conditions of their environment. That is good, for it is these charges that enable the molecules to adsorb onto the surface of yeast particles. They are both quite high in molecular weight (MW) — that is, they are much bigger in size than "regular" molecules — with isinglass being much higher MW than gelatin.

Both isinglass and gelatin are "natural" products in the sense that they are processed from natural materials. Gelatin is obtained by hydrolysis of collagen in byproducts from animals, such as bones and skin. It has a wide variety of uses such as capsules for drugs, a general thickening agent in foods, and, of course, as the principal ingredient of Jell-O. Isinglass is a collagen derived from fish swim bladders, originally those from Russian sturgeons, but now from a variety of other fish from around the world. Its use is largely limited to fining beer, and it has been used as such in Britain since the 18th century; it has also, of course, been used for fining wines.

Both products are available as purified solids and are quite stable against MW degradation in that form; isinglass may also come in a liquid form as an aqueous solution. Gelatin in fact can be treated fairly roughly, in that it is dissolved in hot (but not boiling) water without any degradation of the molecule, which makes it easy for the amateur to use. Isinglass, on the other hand, is more fragile and must be dissolved at room temperature or lower, usually in an acidic medium; in fact solutions will degrade relatively rapidly at temperatures above 70 °F (21 °C). When it does degrade it is not just a matter of losing MW, but of the polymer chains actually unraveling, becoming no longer useful as a flocculant. In the British brewing industry, it was common practice in the past to dissolve the isinglass in soured beer, but that is definitely not a practice followed today!

Note that these two fining agents have little effect on the development of chill hazes as the beer is stored cold. The sole reason for using these two products is to remove yeast from suspension.

When to use finings

Both products can be added to a beer as a final treatment when it is kegged or bottled, with the aim of ensuring that the yeast settles out quickly and the beer becomes almost as bright as a filtered beer. Having said that, this is where MW comes into play – remember the bigger the molecule the bigger the flocculated particle (or *floc*) and the faster

it settles. Therefore, use of gelatin will result in slower clarification than will the higher MW isinglass. As a result, gelatin is only moderately useful as a fining agent, but is used by some brewers to assist in filtration. That is because it forms relatively small, tightly formed flocs that will not block the filter medium and will easily form channels for the liquid to pass through and come out clear on the other side.

Isinglass is, in my opinion, the best fining material, for if properly used it will form relatively large, rapid settling flocs. These will form a tightly packed sediment that is not easily disturbed when the cask or bottle is moved. And if the movement is violent enough to disturb the sediment it will readily and quickly settle out again. That of course is a valuable ability, and for that reason isinglass is widely used by commercial brewers who want to ship out a beer quickly and have it soon be clear and ready to serve in the pub or bar cellar. In short, that means that isinglass fining is perfect for cask-conditioned beers, where yeast must remain in the beer so that a conditioning fermentation can take place in the cask. It is widely used for that purpose in Britain today.

But what about homebrewers? Well, it's arguable that if you are bottling your beer you do not need to fine it. Any suspended yeast needs to settle only a short distance in a bottle compared to that in a keg or cask. If you are planning to leave the beer in bottle for 2-3 weeks or more and have a reasonably flocculent yeast the beer should be nice and clear when you come to drink it. If, however, you want it ready quicker than that, or more importantly you have a low flocculating or "powdery" yeast, then you should consider fining the beer.

In the case of kegging, the yeast has to settle quite a long distance and you are drawing off the bottom, so you want the beer to be below the outlet tube when you draw it off. Again, if you give it sufficient time the yeast will settle on its own, but if it doesn't settle well, or if you want to drink the beer within a few days of kegging, then fining is the answer. Remember that if you keg an unfiltered brew you are essentially producing a cask-conditioned beer!

Personally, I make it a practice to fine all my kegged beers, for what that is worth.

How to use finings

Let's start with gelatin. You will need about ½-1 teaspoon (4-8 g) of the powder (regular cooking grade is fine) per 5 gallons (19 L) of beer. Some authors suggest adding it to cold water and allowing it to form a gel before heating the mixture. I prefer to add it to cold water (about 100 ml, or half a cup) and stir it thoroughly to wet the particles. This mixture is then heated (not boiled), while stirring thoroughly until all the particles have dissolved. The solution of gelatin is then added to the beer after it is racked from the secondary (see later). After the addition it is best to gently agitate the container before bottling or kegging. After 3-4 days look at the bottle or take a sample from the keg to judge how much progress has been made. It may, however, take 2-3 weeks before the beer becomes properly clear. If it does not do so by this time you will just have to be patient, and be prepared to double the dose of gelatin in the next brew.

> "Isinglass is, in my opinion, the best fining material, for if properly used it will form relatively large, rapid settling flocs."

Now for isinglass, which is tricky to prepare from scratch. But, you can buy it as a ready-prepared liquid, in which case you should add it (again to beer racked from secondary) as directed by the manufacturer. You should be aware that such solutions may deteriorate if they have not been stored cool, or if they have been exposed to heat during transport.

There is a brand of freeze-dried isinglass powder that, when dissolved, is claimed to be stable at room temperature. The supplier recommends using 1-2 grams per 5 gallons (19 L) of beer, and dissolving it in around 100 ml (½ cup) of cold water using a blender. This mix is also added to the beer after racking from the secondary, with gentle agitation of the container.

My own approach with the powder (freeze-dried or not) is somewhat different, because I prefer to make a large batch (at least 1 quart/1 L) up to 3-6 months before I intend to use it. I put 250 mL (~1 cup) of cold water in a 1-quart (1-L) glass jar, add 2 grams of mixed acid (available from any winemaking supplier), drop in a sanitized stirring bar, and put the jar on a magnetic stir plate. I adjust the speed to give a full vortex in the liquid and then very gradually dribble the powder (0.35 oz./10 g) into the side of the vortex (takes a bit of practice!). When it is all added, the solution soon becomes too viscous to stir further, and I remove the jar for the stirrer, add cold water to bring the volume up to 1 quart (1 L), and place it in the refrigerator. Every time I go to the fridge for a beer I give the jar a good shake, then put it back. The result is a 1% solution of isinglass and I add this at rate of 4 oz. (120 g.) to 5 gallons (19 L) of beer, using the procedure above.

Note that the reason for adding finings to beer racked from the secondary is that if there is too much yeast present they just will not work properly. The idea is to have a maximum of 5 million yeast cells/ml, and that should be about what you have after a week or so on secondary. (I have checked that with a cell count under a microscope, but you won't need to do that).

Conclusion

I have written this to provide you with another weapon in your brewing arsenal. I find them useful, you may not find that you need them; if that is the case, that's "fine"! BYO

Styles and Statistics

Style space and correlations

advanced brewing by Chris Bible

The concept of beer styles can be viewed in (at least) two different ways. One possible school of thought is that beer styles are merely ways in which people can categorize types of beer into pigeonholes. The mantra for this camp might be something like, "style boundaries are limiting and oppressive." An opposing school of thought is that the concept of beer styles can be a useful way to help us all deepen our understanding and appreciation of the richly diverse spectrum of beers that are brewed today, and that have been brewed throughout history. The mantra for this camp might be something like, "through quantification comes understanding and appreciation."

Both ways of thinking have merit. Innovative brewing, outside of style guidelines, is part of the great joy of homebrewing. Brewing unconstrained by the "boundaries" of style guidelines has allowed for the creation of many wonderful new kinds of beer. Eventually, these new, innovative kinds of beer may become so popular and well received by beer aficionados that a new style category is born.

No matter the school of thought with which a brewer is most closely aligned, the concept of beer styles can help deepen our appreciation for beer's diversity and even show us areas in which we might choose to focus our innovative brewing efforts. Using beer style statistics we can better understand beer, and the relationships between different beer styles.

BJCP vital statistics

Beer styles are defined by many flavor, odor and other sensory components. The Beer Judge Certification Program (BJCP) style components and vital statistics for their style guidelines are shown in Table 1 (right). According to the book *Evaluating Beer* (Brewers Publications, 1998), there are many, many different descriptors that can be used to articulate the flavor/aroma/hedonic style components within a given beer style. The flavor style components are certainly critical in defining a beer style, but they are somewhat difficult to quantify. A beer's vital statistics are, however, relatively easy to quantify and are well defined for a given beer style. A graphical comparison of beer styles based upon the 2008 BJCP vital statistics (www.bjcp.org) is presented in Figure 1 on page 74. Figure 1 shows the relationship between bitterness-to-OG ratio (BU:GU), color (SRM) and alcohol content (ABV) for many of the BJCP beer styles.

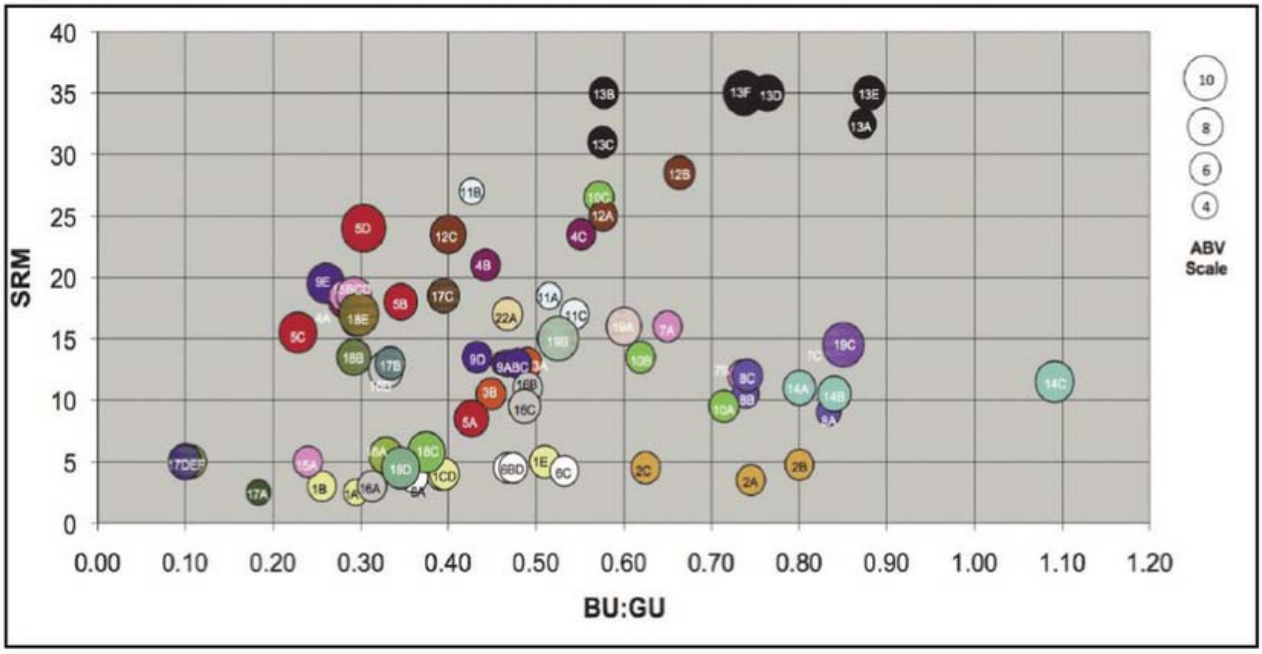
The colors of the circles in the graph are associated with the major BJCP styles (e.g. all style 13 sub-styles, 13a, 13b, 13c, etc. are the same color). The values for the ranges of vital statistics were calculated based on the ranges stated by BJCP for a specific sub-style. For example, the BJCP stated range for color (SRM) for a traditional bock is SRM = 6-11, so

> "Using beer style statistics we can better understand beer, and the relationships between different beer styles."

Table 1: Style Components and Vital Statistics for BJCP Style Guidelines

Style Component	Comments
Aroma	Malt aroma, hop aroma, yeast character, diacetyl or ester presence, DMS, etc.
Appearance	Color, clarity, head retention
Flavor	Sweet and malty, hop character/bitterness, carbonation-bite, acidity, diacetyl presence, fruity, clean, estery, etc.
Mouthfeel	Body, carbonation, astringency, etc.
Overall Impression	General impression that one should have regarding the style (e.g. "malty but fully attenuated" for a Munich helles)
Vital Statistics	**Comments**
IBUs	Bitterness
SRM	Color
OG	Original Gravity
FG	Final Gravity
ABV	Alcohol by Volume

Figure 1: BJCP Beer Style Relationships for BU:GU, SRM and ABV



the value used for the SRM for traditional bock is 8.5.

The bitterness-unit to gravity-unit ratio (BU:GU) helps understand the relative bitter vs. malt-sweetness balance within a given style category. A larger ratio generally means that there should be more hop-bitterness character to the beer style, while a lower ratio means that the beer style should generally be sweeter. According to the information in *Designing Great Beers* by Ray Daniels, this ratio is calculated by dividing IBU by original gravity as expressed by gravity units. Gravity units are calculated using the equation below:

GU = (OG-1) x 1000

For example, the BU:GU ratio for a beer with an IBU of 40 and OG of 1.050 is calculated as:

BU:GU = 40 / ((1.050-1) x 1000) = 0.80

Each circle's size and position on the graph represents the average values of the ranges for the BJCP sub-style category. The number and letter combinations within the circles correspond to the BJCP style category and sub-category designations (e.g. 13A = dry stout). Larger BU:GU means increasing hop bitterness character. Larger SRM values mean that the beer is darker. Larger circles mean higher ABV.

In addition to examining the overall beer-style space, it is interesting to look for correlations between various style parameters. For example, you may have heard someone say something like, "dark beers are usually bitter." A way to validate or refute this statement is to take the average values for the ranges of the vital statistics for the various beer styles and plot them against each other. Once this is done, a statistical regression analysis can be performed and the numbers charted to find which factors are and aren't correlated. (Visit http://byo.com/story2888 for three examples of this. In those charts, the R2 value that is displayed on the chart is indicative of the strength of the regression correlation; a number close to 0 means that the two factors are less correlated, while a number closer to 1 or -1 indicates that the two factors are more strongly correlated.)

Even factors that are not strongly correlated may be correlated to a sufficient degree such that their relationship is statistically significant. This statistical significance can be determined by applying a statistical test for analysis of variation (ANOVA) to the correlation regression. This test yields a number known as a "p-value." The p-value can be thought of as the probability that the two factors are not correlated. Generally, p-values can be interpreted as follows:

Table 2: Interpretation of p-value

p-value	Interpretation
<0.01	Overwhelming evidence; highly significant; more than 99% confident that variables are correlated
0.01-0.05	Strong evidence; significant; 95-99% confident that variables are correlated
>0.05	Weak evidence; less statistically significant; less than 95% confident that variables are correlated

The lower the value of p, the more likely that the two factors are correlated. Table 3 on the next page presents a

Table 3: Correlation Coefficient (R^2) and p-values for Style Variables

	BU:GU Average	Color (SRM) Average
Color (SRM) Average	p = 0.010	
	R^2 = 0.089	
ABV Average	p = 0.786	p = 0.133
	R^2 = 0.001	R^2 = 0.032

matrix that shows both the R^2 values and the p values for the factors that were considered in this analysis (for reference, I used Minitab Statistical Software to run these numbers). Remember, R^2 close to 1 = strong correlation, p-value close to 0.000 = high statistical significance.

Based on the p-values shown in Table 3, we can conclude that the only statistically significant correlations between any of the examined beer style variables is the relationship between BU:GU ratio and color. The relationship between BU:GU ratio and color is statistically significant (p=0.010), but the correlation is very weak (R^2 = 0.089). (To see these correlations charted, visit the web link I mentioned earlier on page 74.)

Conclusion

No matter your personal stance on style guidelines, I believe that it is only through an understanding of where we are that we may control where we are going. Innovative brewing can be most effective only if it is based on sound brewing techniques and guided by the knowledge that we have available (read more about this in Brad Smith's story on recipe design on page 50). Style guidelines should not be thought of as constraints and absolutes, but rather as well-defined possibilities within a broader realm. They can be thought of as windows through which we look out into the vast expanse of brewing possibilities that lie beyond our present experience.

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last call
by Rory Schmidt

Solera Homebrewing

A dream in a barrel

I'm not sure when I had my first barrel-aged beer, but I know that I've been hooked ever since. I think the fascination comes in two parts; the unpredictability that a barrel can bring to flavor, aroma and taste, as well as a connection with brewers from the past who only had barrels for their beer.

My first attempt at a barrel slipped through my fingers. I had a line on a 55-gallon (208-L) hogshead barrel from a distillery. The call went out to my homebrew friends, "Are you interested in helping me fill 55 gallons (208 L) of homebrew into this barrel?" The resounding answer was "Yes, but I can't do it now. Sorry." So my dream of barrel-aged homebrew was still just that, a dream.

I continued to think of barrel-aged homebrew and talk of one day buying a new barrel. Then one day in the fall of 2012 I received a call from two homebrewing friends, "We got one!"

"Got what?" I asked.

"A barrel, we got a barrel for our homebrew!"

The Solera Brewing Project became a reality. The barrel was a 10-gallon (38-L) bourbon barrel used at a local micro-distillery. The plan was set into motion to be ready to fill our barrel once it was in our possession.

A double IPA was the first beer we decided to age in the barrel. That October, with my friends Fawn and Derrek, we filled the barrel with what we intended to be 10 gallons (38 L) of the DIPA. Our numbers were off a bit and we only got in about 8 gallons (30 L), but later that week I brewed up a small batch and topped off the barrel. In three months we'd meet back up, bottle 5 gallons (19 L) to split and top it up with another 5 gallons (19 L). That began the solera process of keeping some of the original batch always in rotation while blending in a new or younger batch to top off the barrel.

We've learned every step of the way. Our first batch turned out flat. After calling a local microbrewery and speaking with the brewer I learned that our yeast had probably all died off. For the second bottling we decided to "yeast drop," a process of using tweezers to drop two to three yeast granules into each bottle to produce additional carbonation. The yeast dropping worked out great and we've implemented this ever since. The third and fourth bottling went well without any major foul ups. Each batch has been similar with oaky and vanilla notes, but still exhibits its own personality with bitterness and mouthfeel. We did a vertical tasting of our four DIPA batches from the Solera Brewing Project. This was a great idea and went over well. It's interesting to see the differences and similarities in these brews. The oaky and bourbon flavor is present in each batch, but most prevalent in batch number one. While batch number three was the overall favorite, having the best balance between bitterness, oakyness and bourbon flavor.

Chapter one is complete in the Solera Brewing Project. Chapter two, an original recipe imperial pumpkin ale named "Pumpkin Guy Ale" wrapped up as well, and was ready just in time for fall.

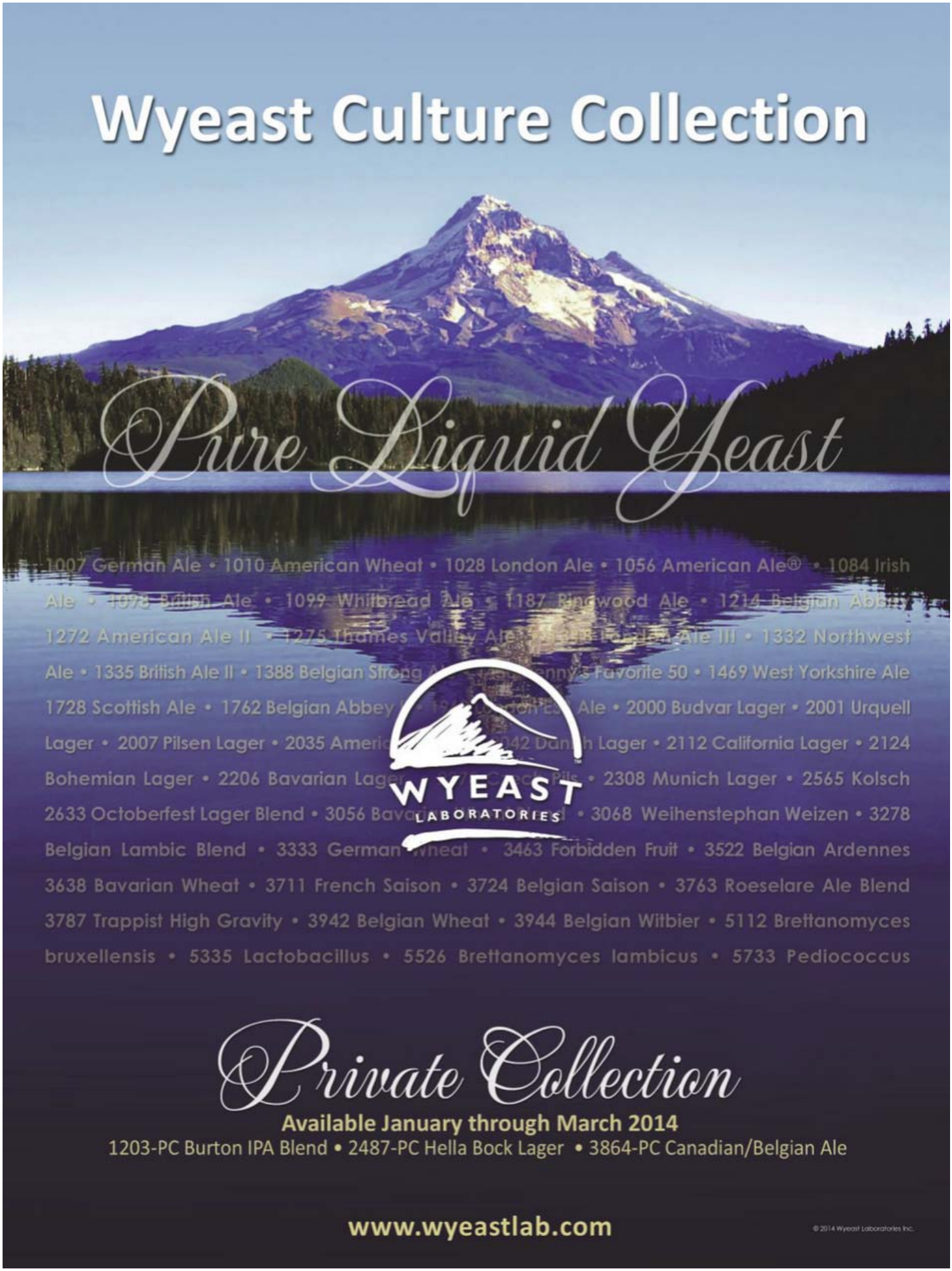
Now, we are on to chapter three; an imperial Russian stout brewed with lactose sugar. We plan on solera aging the imperial stout for 18 to 24 months, but only time will tell.

I think the best part about the barrel is that I, along with my friends Fawn and Derrek, can do whatever we'd like — whether we solera age a brew for two months,12 months, 24 months or for the next four years — we've got options and with those options we have the Solera Brewing Project.

If you would like to follow my homebrew adventures and the Solera Brewing Project, check out my beer blog at apuhihi.wordpress.com. BYO

> "Each batch has been similar with oaky and vanilla notes, but still exhibits its own personality with bitterness and mouthfeel."

Photo courtesy of Rory Schmidt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• 3463 Forbidden Fruit • 3522 Belgian Ardennes
3638 Bavarian Wheat • 3711 French Saison • 3724 Belgian Saison • 3763 Roeselare Ale Blend
3787 Trappist High Gravity • 3942 Belgian Wheat • 3944 Belgian Witbier • 5112 Brettanomyces
bruxellensis • 5335 Lactobacillus • 5526 Brettanomyces lambicus • 5733 Pediococcus
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