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OCTOBER 2019, VOL.25, NO.6

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departments

where to find it

RECIPE INDEX

RECIPE STANDARDIZATION

EXTRACT EFFICIENCY: 65%
(i.e. — 1 pound of 2-row malt, which has a potential extract value of 1.037 in one US 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. Increase hop dosage 10% if using whole leaf hops.

Gallons:
We use US gallons whenever gallons are mentioned.

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A Powerful Monster Cleaner Atop A Versatile Bottle Tower.

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EDITOR
Dawson Raspuzzi

ASSISTANT EDITOR
Dave Green

DESIGN
Open Look

TECHNICAL EDITOR
Ashton Lewis

CONTRIBUTING WRITERS
Drew Beechum, Michael Bury, Denny Conn, Terry Foster, Colin Kaminski, Brad Smith, Gordon Strong

CONTRIBUTING ARTISTS
Shawn Turner, Jim Woodward, Chris Champine

CONTRIBUTING PHOTOGRAPHERS
Charles A. Parker, Les Jörgensen

EDITORIAL & ADVERTISING OFFICE
Brew Your Own
5515 Main Street
Manchester Center, VT 05255
Tel: (802) 362-3981 Fax: (802) 362-2377
Email: BYO@byo.com

SUBSCRIPTIONS ONLY
Brew Your Own
P.O. Box 469121
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Tel: (800) 900-7594
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Charles A. Parker/Images Plus

Q

If you could give one piece of advice to homebrewers, what would it be?

If you are into homebrewing because you like building cool tools, focus on a tricked out brewhouse and tap setup. If you are into homebrewing because you want to make the best damn beer possible, keep the focus on your fermentation kit and seriously consider building a small walk-in cooler in-lieu of that tricked out brewhouse.

Is your beer as good as it can be? Is it better than everyone else's? If not, what can you do to improve it? Even if your beer is great, can you make it the same every time? Or are some batches "better" than others? This is an indication that your process is not in complete control. What can you do to make exactly what you expect every time? Quality doesn't have a finish line. There are always improvements to be made.

I always preach to the all-grain brewers who are fly sparging in the group: Slow down your lauter runoff. The extract gain you get is amazing. Prost!

PUBLISHER
Brad Ring

ASSOCIATE PUBLISHER & ADVERTISING DIRECTOR
Kiev Rattee

ADVERTISING SALES COORDINATOR
Dave Green

EVENTS MANAGER
Jannell Kristiansen

BOOKKEEPER
Faith Alberti

WEBSTORE MANAGER
Julie Ring

PRINT SUBSCRIPTION CUSTOMER SERVICE MANAGER
Anita Draper

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ADVERTISING CONTACT:
Kiev Rattee (kiev@byo.com)
EDITORIAL CONTACT:
Dawson Raspuzzi (dawson@byo.com)

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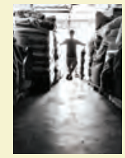

Understanding Malt Spec Sheets
Just as no two batches of beer are exactly alike, neither are lots of malt. Variations in rainfall, soil nutrients, and temperature during the growing season, along with storage and handling conditions, all affect the crop. How the maltster handles the grain can further affect the differences. Know what you're getting. https://byo.com/article/understanding-malt-spec-sheets-advanced-brewing/

MEMBERS ONLY

Malt Mills
If you're in the market for a new grain mill, whether low-cost or high-end, we've got a rundown on the latest models and accessories being offered to the homebrewer and small nanobrewer. Don't buy without giving this a read. https://byo.com/article/malt-mills/

Using Crystal Malt
Crystal malt has gained a bad reputation among many circles of homebrewers, but this often misunderstood malt family can be the key to many styles of beer . . . just not all. Learn about some of the basic concepts behind this type of malt and how to effectively incorporate it into your recipes. https://byo.com/article/using-crystal-malt-techniques/

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Brutus Ten Build
With the 12th anniversary of its publishing, the Brutus Ten brewstand design is still one of our most popular projects on Byo.com. If you've never seen it, be sure to check out Lonnie McAlister's famous stand that helped push homebrewers to a new level of bling. https://byo.com/project/brutus-techniques/

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MAIL

OXYGENATING WORT VS. OXYGENATING YEAST STARTERS

After reading Gordon Strong's article "The Hardest Styles To Brew" in the May-June 2019 issue (and then Denny Conn and Drew Beechum's "Techniques" column on hopping from the same issue), I was inspired to put my theory to the test. In Gordon's New England IPA (NEIPA) piece, he mentioned keeping oxygen out until an actively fermenting starter is added (re: limiting hot-side aeration). This made me think of Colin Kaminski's vitality starter method from his "Advanced Brewing" column in the March-April 2019 issue where he recommends spinning a starter (while bubbling pure oxygen) during brew day and then NOT oxygenating the wort itself; instead just pitching the well-oxygenated vitality starter. Kaminski also recommends ensuring you have enough yeast for fermentation, as the yeast will not grow during fermentation when using this method. Since one would expect some yeast growth during a standard fermentation process, I decided to pitch two packs of Imperial Yeast Juice into the vitality starter (which was pitched into 4 gallons/15 L) and direct-pitch a single pack of yeast into the other 4 gallons (15 L) from the same 8-gallon/30-L batch. The direct-pitch portion received my standard process of two minutes of pure oxygen. All of the yeast was about one week since manufacture date.

Other than the yeast variable, the beers were treated the same. After the beers where fermented, double dry hopped, kegged/carbonated, and carefully packaged into bottles using a Blichmann bottling gun, I took them to a Portland Brewers Collective homebrew club meeting. Fifteen participants (completely blind to the variable and beer style) were served three samples of these beers in clear plastic solo cups (marked with triangle, circle, and square on the bottom) — two cups had the straight pitch version, and one had the vitality version. Eight correctly identified the odd beer out, suggesting that tasters could reliably differentiate between a NEIPA fermented with a vitality starter method and one fermented with the standard homebrew method of oxygenating the wort and direct-pitching liquid yeast ($p<0.001$). Of those that correctly identified the odd beer out, 7 of 8 said they preferred the straight pitch beer.

My impressions: Other than appearance, these beers were

contributors

Jake Burnham is a civil/structural engineer who resides in Bremerton, Washington with his wife, Casey, and 3-year-old daughter, Audrey. He brewed his first batch of beer while working toward his master's degree at Washington State University. It was then that he learned his time as an engineer was just a means to an inevitable end as a brewer; as he is currently putting the pieces in place toward owning and operating his own brewery. He loves the science of beer and believes there are few, if any, hobbies that can teach you as much across a multitude of topics. He takes particular interest in English beer styles and, while he would never turn his back to a barleywine or imperial stout, his first true love will always be porter.

Beginning on page 62, Jake shares the steps that went into building his tricked-out, customized brewstand.

Mick Spencer is a retired U.S. Department of Defense analyst, award-winning homebrewer, and the author of BrewCipher homebrewing software. Mick leans toward the technical, analytical side of brewing, and spends some of his retired leisure time doing consulting and troubleshooting with commercial breweries, as well as the occasional collaboration brew. It's a taste of "going pro" without actually having a 9-5 daily grind. He's currently the Vice President and Webmaster for the Sons of Alchemy homebrew club in southcentral Pennsylvania.

In his third story for *BYO* beginning on page 68, Mick shares steps to build a "kettle" for kettle souring in a Corny keg, which addresses two of the biggest drawbacks of kettle souring — oxygen exposure and temperature control.

Jeremy Olsen lives in Minneapolis, Minnesota and has been homebrewing since 2008, with a focus in recent years on ciders and meads. He is active in the local homebrew community as Co-President of the St. Paul Homebrewer's club, is a BJCP National Judge, and a BJCP cider and mead judge. He is known for his ice ciders, wining several Best of Shows and a National Homebrew Competition final round gold medal.

Jeremy makes his *BYO* writing debut beginning on page 82 as he shares his knowledge about making ice cider at home.

MAIL

extremely different; and I could pick the vitality version out by aroma alone (as well as by taste). The vitality version had some light diacetyl notes in the nose and flavor, and had a more muted hop aroma/flavor. The straight pitch version was a beautiful expression of NEIPA — just exactly perfect. (For what it's worth — my NEIPA has won gold and Best of Show in local competitions, and last year got gold in both American IPA and Specialty IPA in the National Homebrew Competition first round, so I'd like to think I'm capable of making exceptional examples of the style). I appreciate Gordon's suggestion of limiting hot-side aeration. But in terms of yeast preparation and wort oxygenation, I will be sticking to the much easier method of straight pitching a pack of fresh Imperial Yeast and oxygenating the wort prior to pitching when making NEIPAs going forward.

Jordan Folks • *via e-mail*

Thanks for sharing your experience and feedback, Jordan! Conducting triangle tests can be very useful and it sounds like your objective was met! There are many ways to make incredible beer, and by putting both methods to a test you found the technique that works best for you, which is what homebrewing is all about!

STORING SANITIZER SOLUTIONS

I am curious about sanitizing solution after it is mixed with water. Does it have an expiration time or shelf life? Is it worth it to keep it in a covered pot and use it for a week or so, rather than making fresh batches every day? Only talking about experimenting with small batches.

Lighting Pete • *via Facebook*

It depends what you are using as a sanitizer. Iodine-based sanitizers (like Iodophor) lose sanitizing capacity within a day or two. You can tell because the brown tinge fades away. Acid-based sanitizers (such as StarSan or San Step) can last much longer, most notably if distilled or reverse osmosis water was used as the solvent. The carbonates in harder water will react with some acid-based sanitizers to neutralize their efficacy over time. The most precise way to tell when they lose their efficacy is using a pH meter. Some homebrewers have noted no discernable pH rise even after years of storage of acid-based sanitizers where distilled water was used. Check manufacturer data for the best handling and storage procedures for your particular sanitizer.

WRITE TO *BYO*

Have a question about something you've seen in *BYO*? Want to show off your latest DIY homebrewing gear or recipe? Write to us at: edit@byo.com, find us on Facebook: www.facebook.com/BrewYourOwn, Instagram: @brewyourownmag, or reach out to us on Twitter: @BrewYourOwn. BYO

BEGINNER'S BLOCK

BY JORDAN HEINGARTNER

PROPER CLEANING AND SANITATION

When it comes to homebrewing there are many elements that are essential to making your final beer turn out as expected: Fresh ingredients, sound techniques, and temperature control. But everything can easily fall apart if your equipment is not kept clean. A proper cleaning and sanitation regime prevents spoilage from unwelcome bacteria, yeasts, and mold as well as undesired flavors from old deposits. The process of cleaning and sanitizing can be time-consuming, however, doing it right in the short term can means big savings in the long run.

DEFINING THE TERMS

From the *Oxford English Dictionary*, clean means that you leave your equipment "free from dirt, marks, or stains." You will notice that after cleaning your glass equipment, it will be clear and see through with no residual film. Stainless steel should bring back a shine while aluminum is a bit tougher to see since the gray oxide layer should be left intact when cleaning. But upon feel and visual inspection, no obvious biological deposits should remain visible.

The *Oxford English Dictionary* has the definition of sanitized as, "make clean and hygienic, disinfected." In brewing, the sanitation step can only be achieved if larger biological deposits have been effectively removed during the cleaning process, so we always start by cleaning, before the sanitation step. Let's clear up two common misconceptions in the brewing world when it comes to sanitation: 1) Any equipment that touches the wort prior to chilling does NOT need to be sanitized, just cleaned! 2) Sanitation is not the same as sterilizing . . . you are never going to kill everything unless you autoclave. You are most likely simply greatly reducing the threat of infections, not removing them.

BE THE WORLD'S BEST JANITOR

You have two cleaning options, soak or scrub. Soaking may be more time-consuming while scrubbing takes a bit more elbow grease. There are often times when soaking is the only option while scrubbing is the best option in other places. Both should be employed when possible for the most effective cleaning. Often hot water and soap are the first weapons for scrubbing away residue. But this is ineffective when a surface is not exposed (such as draft lines or inside valves). In these cases, a rinse followed by a chemical soak should be employed. There are several chemical concoctions that contain either a caustic or peroxide for effective cleaning. Many can be found as a blend of chemicals that work in union to eradicate biological buildups by loosening their grip on the surface. These chemicals will make your hands slippery, something to be careful of when handling glass. The same chemical principles that make your hands slippery are attacking the biological buildup. A half hour soak with water at 160 °F (71 °C) mixed at the proper dilution ratio with a peroxide-based cleanser such as PBW (Powdered Brewery Wash), AmBrew Cleanser, or Craft Meister Oxygen Brewery Wash will clean those hidden spots with all water types. Cold water can be used when a caustic cleaner such as BLC (Beer-Line Cleaner) or Craft Meister Alkaline Brewery Wash is employed.

While these cleansers are great at what they do, if possible you should be breaking the equipment down on a semi-regular basis to see what is inside. And don't forget about other solvents such as rubbing alcohol for equipment like a plate chiller that can't be broken down or scrubbed with a brush. Learn to be the world's best janitor in order to be make great beer.

FOR SANITIZED SAKE

Many times the sanitation step can perform two duties: 1) Kill off all of the microorganisms the cleaning step exposed. 2) Neutralize the basic (alkaline) nature of the chemical cleaners mentioned earlier. So your mash tun doesn't actually need to be sanitized, but you probably want to hit it with some sanitizer if you use an alkaline cleaner.

There are generally two types of sanitizers that homebrewers use: Phosphoric acid-based sanitizers and iodine-based sanitizers. Both types of sanitizers are acidic and will effectively neutralize the basic cleaner. Bleach can be used to sanitize glass and plastics (never on metals!), but due to the fact that a thorough rinsing after the sanitation step is required when using bleach, I say don't use unless in extreme situations (like you left a dirty fermenter bucket on the back porch for a month that could be considered a biohazard by some government agencies. But who would do that . . .)

THE NITTY GRITTY

Kegs, wort chillers, transfer tubing, racking canes, fermenters, draft lines and taps . . . everything the wort and beer touch after the boil should be properly cleaned and sanitized. Cracks and scratches in equipment can pose the greatest threat to the cleaning and sanitizing task. If there are cracks in your equipment you will want to replace them with new equipment. Here is a sample of my keg cleaning regime: 1) Clean with hot water and soap, 2) Mix in an alkaline cleaner like PBW with hot water around 160 °F (71 °C), 3) Soak or recirculate for about 30 minutes, flipping the keg if not recirculating, 4) Sanitize with an acidic-based mixture. When it comes to any draft equipment it is a good idea to use a little stronger product like the lye-based BLC.

BYO

BYO POLL RESULTS — MAKING AN IMPACTFUL IPA

This summer we polled our followers on social media about what they think it takes to brew a flavorful and impactful IPA. Needless to say, there may not have been a clear message, but some themes emerged. But isn't that one of the great aspects that makes this style so vibrant? So without further ado, let's see what folks had to say about this topic . . .

Anthony Hornby — Closed transfer fermenter to keg. No exposure to oxygen.

Terry Brannon — I never put hops in to the boil or when the wort is close to boiling temperature. I get plenty of IBUs at flameout and whirlpooling down at low temps. Triple your hops and you'll get this.

Chris Jackson — Use "lifter" hop varietals in small quantities, along with your citrus and tropical heavy varietals. Focus on large whirlpool and dry hop additions and minimize cold side oxidation. I find mixing traditional (C-hops and CTZ) with modern "trendy" hops gives an interesting balance. I still use a small 60-min. addition to create a base bitterness.

Jason Kneupper — Minimize cold-side oxidation.

Tyler Anthony Smith — For me it's all about late addition hops, some strong bittering hops at first but then hit the late additions for all that wonderful flavour and aroma.

Shaun Gerrard — Multiple dry hop drops.

Drew Schaub — Late addition, late addition, and late additions. The later the better.

Shaun Hennessey — Let the beer drop clear before dry hopping. 🙂

Steven Douglas — Do not over-hop. Yes, a strong hops nose and flavour are traits of an IPA, but over-hopping is possible too.

Mike Iorfida — Whirlpool hops!!! 3 to 1 gypsum to calcium chloride . . . low bicarbonate . . . simple grain bill and little to no crystal malt . . .

Matt Black — Skip the hops in the boil and load up on them in the whirlpool.

Dave Edmonds — IBUs are only half the story. Watch your bitterness ratio and hop-bomb that thing late and a lot.

Rich Goetsch — Gypsum!

Roi Krispin — Whirlpool all the way.

Hammyofdoom — Water chemistry has a remarkable impact.

petervanbock — Yeast to accentuate hop flavor, water profile / salts to achieve the same.

fox.brewery — Add most of your boil hops in the last 10 minutes.

redcloveralecompany — Focus on pH and water chemistry as much as anything to do with the hops.

sandstormbrewing — Minimizing oxygen ingress is critical to hoppy beers.

walnutstreetbrewco — Do not overload hop quantity. Keep grain bill simple to let hops shine. Choose your hop blend with care. Minimize oxygen. Consume fast.

Todd Rice — In general, my process: Lactic acid, calcium sulfate at the start of boil. Heavy whirlpool hop addition. First dry hop 12 hours after fermentation starts. Second, smaller hop addition 3 days later. Overpitch yeast (healthy starter). Avoid O_2 like the plague after fermentation.

Eli S. — Flavor: Hopstand addition (post-boil) at a temperature of 180 °F (82 °C) for at least 30 minutes. Aroma: Whole leaf dry hop in a bag for 3+ days. My IPA flavors and aromas improved (intensity and duration) when I started to purge the keg with CO_2 prior to transfer from a carboy.

Christian Roessler — I follow all the tricks for a New England IPA and they're still not nearly as flavorful as my West Coast IPAs.

WHAT'S NEW

SULTANA™

Formerly known as the experimental #06277, Hopsteiner has recently announced a newly-named hop variety in their lineup. Sultana™ is a mix between 50% Nugget, 25% Zeus and 25% male USDA hop parentage and its aromatic oil components combined with strong disease resistance means it may make a big impact in the coming years in the hop market. Hopsteiner notes that it leads with a strong pineapple component, with pine and citrus characteristics not far behind. SMaSH anyone? For more info, visit: https://www.hopsteiner.com/variety-data-sheets/Sultana/

BREWBUILT COOLSTIX™

Controlling your beer's fermentation temperatures can make a world of difference in the final beer's flavor profile. The BrewBuilt CoolStix™ is a new "low-profile" temperature control unit that accommodates several different types of fermenters including carboys, buckets, Speidel, and any fermenter with a tri clamp fitting on top. The complete kit includes a submersible pump to circulate cooling solution, a digital temperature controller to regulate flow, thermowell, tubing, and clamps. A cooler of ice water is the only additional piece required. The complete CoolStix™ kit starts at $129.99. For more info, go to: www.morebeer.com/category/coolstix.html

THE SPIKE NANO SYSTEM

Spike Brewing enters the turnkey nanobrewing kit world with the announcement of their 1-BBL system. Features include a steam condenser that removes the need to build a venting system, a UL-approved electrical panel to power the Nano System, two custom logo plates to brand your system, and a drip tray located below the 3 vessels for easy cleaning from any spills or drips. Available in both single-batch and double-batch brewhouse capacity and in both home (240V) or industrial (208V) options depending on your power supply. The double-batch system is capable of supplying over 27,000W of power. At 1 BBL, this could be used for homebrewers, pilot batches, or for a nanobrewery. To learn more system details, check out: spikebrewing.com/pages/nano

BEER REMAINS #1

Photos by Shutterstock.com

According to a poll conducted by Gallup this summer, beer remains America's most popular alcoholic drink to imbibe. Some other notable factoids gathered from their survey was that beer was still the preferred drink of men while women still steered towards wine. Also folks in the Midwest and Eastern US were more likely to be partial to beer over wine and liquor. https://news.gallup.com/poll/264335/liquor-ties-wine-second-favorite-adult-beverage.aspx

In another news release, the Brewers Association's mid-year report found that craft beer sales continued its upward trend, holding steady at a 4% growth rate. In their report, the BA's Chief Economist Bart Watson noted that the growth continues to be found in the smaller brewery, taproom, and brewpub segments. "As of June 30, there were 7,480 active craft breweries, up from 6,464 during a comparable timeframe last year." https://www.brewersassociation.org/press-releases/continued-growth-for-small-and-independent-brewers/

Upcoming Events

OCTOBER 5

Fresh Hop Ale Festival

Located in Yakima Valley, Washington. This is a non-profit organization that hosts a combined beer festival with music and competition (homebrew and professional) to raise money for local art and science programs. 2019 marks the 17th annual festival, which has a goal "to drink some amazing craft beer, and do some good!" https://freshhopalefestival.com/

OCTOBER 19

2nd Annual CYC Beer Fest

Hosted by the homebrew club SoCal Cerveceros Y Cerveceras, the CYC Beer Fest is located at the Plaza De La Raza in Los Angeles, California. Homebrew and craft beer will be pouring, as well as a lineup of local food vendors, live music, DJs, and artisan craft vendors. This is a fundraiser event for Latino-owned businesses, charities, and non-profits. https://www.socalcerveceros.org/cycfest


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BY MICHAEL BURY

DEAR REPLICATOR,

A few years ago, in the cold winter months in Vermont, I came across Route of All Evil from Two Roads Brewing Co. It was in one of the coolest and creepiest cans ever, with a clown on a tricycle, outside an asylum. The beer was delicious, hoppy and dark, the perfect companion for Vermont winters. Unfortunately, the beer hasn't been around the last couple years so Replicator can you please help me recreate this amazingly hoppy, dark brew?

Andy Jadrnak
Colchester, Vermont

Great request Andy! And the thought of sipping this beer with a roaring fire crackling in the hearth and snow falling outside during a winter evening in Vermont certainly has a ring of appeal. Although I'm glad that Two Roads Brewing Co. is located in Stratford, Connecticut and not in Derry, Maine, especially with the presence of a creepy clown on the front of the can; cool but certainly creepy.

Entrepreneurship is about looking behind shabby facades and seeing the potential of a space or idea. For Two Roads, that meant repurposing a chemically-contaminated manufacturing warehouse into a powerhouse brewery. To this end, the brains behind Two Roads, Phil Markowski, Brad Hittle, Peter Doering, and Clem Pellani were awarded a grant from the Department of Economic and Community Development for $500,000 towards the remediation and refurbishment of the derelict warehouse to convert it into a modern brewhouse. The four credited the Stratford, Connecticut legislative delegation and specifically former Mayor John Harkins for the aid in securing the funds.

Furthermore to their plan, they sought to bring 70+ jobs to the area while providing a space to tour, sample, and buy high-quality craft beer. One of the many obstacles they needed to hurdle was a state law prohibiting breweries from selling pints of beer on-site to patrons who declined a tour. Once again, it was the local politicians on both sides of the proverbial aisle who rose to the challenge to aid Two Roads. And as a result, Two Roads is now situated in Stratford on ten acres featuring the brewing facilities, a wetland preserve, the Hopyard (which is an open, grassy field for hosting events), and a botanical garden where a variety of fruits are grown to be used in fermented beverages.

One of the hallmarks of Two Roads is their creativity of which their beer is merely a result. Unlike many start-up breweries, they decided against the philosophy of starting small and expanding the business as needed. As Robert Frost penned, "Two roads diverged in a wood, and I, I took the one less traveled by, and that has made all the difference." They indeed took the road less traveled and built brewery operations that far exceeded anything they personally needed (~190,000 BBLs/year), which opened the door for contract brewing by first intent. Evil Twin, Stillwater, and Lawson's Finest Liquids have all brewed beer at Two Roads' facilities. In 2018, Two Roads brewed 63,000 BBLs of their own brand while producing 72,000 BBLs of contracted beer; the venture seems to have paid off.

Another aspect of their inventiveness is wholly centered on their beer. Phil desired to produce sours but didn't want to run the risk of contaminating the brewery while having them take up valuable fermenter space. And voila! The Tanker Truck Sour Series was born. Several kettle-soured Goses are fermented in a repurposed milk tanker truck that resides outside of the brewery's walls, thereby removing the risk of contamination with airborne, souring bacteria.

But the human imagination knows no bounds and Phil wanted to craft sours the Belgian way. With the campus situated on 10 acres and free space available next door, the next evolution at Two Roads could become a reality. The 25,000-square-foot, $15 million expansion called Area Two Experimental Brewing opened its doors on March 11, 2019. As Phil succinctly put it, "Area Two will be a brewery of boundless experimentation . . . we will continue to innovate, redefine, and stretch the definition of beer." It features a 50-BBL coolship that will harness the microflora from the wetlands on site, an inventory of 1,500 barrels from wineries and distilleries including tequila, Bourbon, and Calvados barrels, and numerous lambics and other sour beers such as Sour'd Whiskey.

Now onto the beer! Route of All Evil is a hoppy, roasty beer in a similar vein as a black IPA or Cascadian dark ale, depending on your location and persuasion. It is significantly hoppier than an American stout if you're following the 2015 Beer Judge Certification Program (BJCP) guidelines. Production of the beer is currently "On Sabbatical" at Two Roads even though it won a Gold medal at the 2015 Great International Beer Festival (GIBF). The description of the beer direct from Two Roads is, "Neither stout nor porter, this beer is full-bodied, bold and black with flavor characteristics of dark chocolate, mocha, molasses and dark fruits balanced by piney citrusy notes of Pacific Northwest hops." And if you're feeling a bit adventurous like two of Two Roads brewers, Roger and Colin, go ahead and add a dose of chopped chipotle and ghost peppers to this brew followed by aging in a rye whiskey barrel. Happy experimenting!

TWO ROADS BREWING COMPANY'S ROUTE OF ALL EVIL CLONE

(5 gallons/19 L, all-grain)
OG = 1.072 FG = 1.012
IBU = 30 SRM = 37 ABV = 7.9%

INGREDIENTS

11 lbs. (5 kg) 2-row pale ale malt
0.75 lb. (0.34 kg) dark Munich malt
0.75 lb. (0.34 kg) crystal malt (65 °L)
0.75 lb. (0.34 kg) black malt
0.38 lb. (0.17 kg) crystal malt (25 °L)
0.38 lb. (0.17 kg) Special B malt
0.38 lb. (0.17 kg) flaked barley
0.38 lb. (0.17 kg) flaked rye
0.25 lb. (0.11 kg) blackstrap molasses (15 min.)
6 AAU Magnum hops (60 min.) (0.5 oz./14 g at 12% alpha acids)
4.25 AAU Centennial hops (10 min.) (0.5 oz./14 g at 8.5% alpha acids)
2.25 AAU Crystal hops (10 min.) (0.5 oz./14 g at 4.5% alpha acids)
20 AAU Chinook hops (0 min.) (1.5 oz./43 g at 13.3% alpha acids)
2.25 AAU Crystal hops (0 min.) (0.5 oz./14 g at 4.5% alpha acids)
2.13 AAU Centennial hops (0 min.) (0.25 oz./7 g at 8.5% alpha acids)
1.5 oz. (43 g) Crystal hops (dry hop)
0.75 oz. (21 g) Cascade hops (dry hop)
0.75 oz. (21 g) Columbus hops (dry hop)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Mill the grains, then mix with 4.6 gallons (17.5 L) of 169 °F (76 °C) strike water to achieve a single infusion rest temperature of 154 °F (68 °C). Hold at this temperature for 60 minutes. Mashout to 170 °F (77 °C) if desired.

Vorlauf until your runnings are clear before directing them to your boil kettle. Batch or fly sparge the mash to obtain 6.5 gallons (25 L) of wort. Boil for 60 minutes, adding hops at the times indicated above left in the boil. At 15 minutes left in the boil, you can add either Irish moss or Whirlfloc as fining agents as well as the blackstrap molasses.

After the boil, add the flameout hops into the wort and whirlpool for 15 minutes before rapidly chilling the wort to 66 °F (19 °C). Pitch yeast. Maintain fermentation temperature and do not exceed 70 °F (21 °C) for this beer.

Once primary fermentation is complete, add the dry hops indicated and let them extract for 4 days. Bottle or keg the beer and carbonate to approximately 2.5 volumes.

TWO ROADS BREWING COMPANY'S ROUTE OF ALL EVIL CLONE

(5 gallons/19 L, extract with grains)
OG = 1.072 FG = 1.012
IBU = 30 SRM = 14 ABV = 7.8%

INGREDIENTS

6 lbs. (2.27 kg) extra light dried malt extract
0.5 lb. (0.23 kg) Munich dried malt extract
0.75 lb. (0.34 kg) crystal malt (65 °L)
0.75 lb. (0.34 kg) black malt
0.38 lb. (0.17 kg) crystal malt (25 °L)
0.38 lb. (0.17 kg) Special B malt
0.38 lb. (0.17 kg) flaked barley
0.38 lb. (0.17 kg) flaked rye
0.25 lb. (0.11 kg) blackstrap molasses (15 min.)
6 AAU Magnum hops (60 min.) (0.5 oz./14 g at 12% alpha acids)
4.25 AAU Centennial hops (10 min.) (0.5 oz./14 g at 8.5% alpha acids)
2.25 AAU Crystal hops (10 min.) (0.5 oz./14 g at 4.5% alpha acids)
20 AAU Chinook hops (0 min.) (1.5 oz./42 g at 13.3% alpha acids)
2.25 AAU Crystal hops (0 min.) (0.5 oz./14 g at 4.5% alpha acids)
2.13 AAU Centennial hops (0 min.) (0.25 oz./7 g at 8.5% alpha acids)
1.5 oz. (43 g) Crystal hops (dry hop)
0.75 oz. (21 g) Cascade hops (dry hop)
0.75 oz. (21 g) Columbus hops (dry hop)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Bring 6.5 gallons (25 L) of water to roughly 150 °F (66 °C). Steep all the specialty malts for 15 minutes before removing and draining. Add both malt extracts, while stirring, before heating to a boil. Boil for 60 minutes, following the remainder of the all-grain instructions.

TIPS FOR SUCCESS:

One of the hurdles in crafting this beer will be mash pH management and how you handle the black malt if you're an all-grain brewer. Personally, my well water is a bit on the hard side so the acidity that it brings allows me to hit a proper mash pH of 5.2–5.5 and so I add them right in the beginning of the mash. For others, you may want to consider adding the black malt during the vorlauf process (recirculation). The other sticking point will be dry hopping the beer as oxygen is the enemy of fresh, hoppy beer. Keg-to-keg transfers under CO_2 atmospheres is probably your best bet. Don't let the dry hopping go longer than 4 days for fear of extracting plant matter into the brew. But the option of performing a single, massive dry hop vs. dry hopping with individual varietals sequentially is completely up to you. BYO

BY DAWSON RASPUZZI

SOURING WITH *LACTOBACILLUS*

A quicker route to soured beer

Soured beer can be produced in the same amount of time as non-soured styles with the help of Lactobacillus. *Generally, this is done using the kettle-souring method for styles like Gose and Berliner weisse, however other methods and styles are sometimes in play too. Three pros share some sweet tips on souring with* Lacto.

We are looking for a clean, bright acidity and don't want the pH to be less than 3.2 or above 3.4.

Fal Allen is the Brewmaster at Anderson Valley Brewing Co. in Boonville, California. He started brewing professionally in 1988 for Red Hook Brewery and has also held brewing positions at Pike Place Brewery (where he won the Brewer's Association's Russell Schehrer Award for Innovation and Achievement in Craft Brewing), and Archipelago Brewing Company in Singapore (a division of Asi a Pacific Breweries). Fal has also published many articles and books on brewing including Gose: Brewing a Classic German Beer for the Modern Era.

At Anderson Valley we have about eight years of kettle souring experience. We use this method for making our Goses and, on occasion, other beers (like our Tropical Hazy Sour beer). We also do a fair amount of barrel souring beers — we have about 1,200 wood barrels in our sour beer production. This process differs greatly from the kettle souring process. It can take anywhere from nine months to four years to sour a beer this way; in contrast kettle souring can be done in less than 8 hours. The flavor that each process creates can be very different as well. We use kettle souring to create clean, sharp, bright tartness and we use our barrel souring process to create a more complex, deeper, funkier range of flavors. For kettle sours, we keep our temperature at about 108–112 °F (42–44 °C). We use a strain of *Lactobacillus delbrueckii* that seems to work best at that temperature, but each strain is different.

We have tried several sources for *Lacto*, but we prefer the one we get from a lab. It creates flavors we like, and it creates these flavors more consistently on a regular basis. It is also healthier than some other sources, which makes it easier to grow up to the proper pitching rate.

Prior to pitching the *Lacto* we look for the same pH as we would in any of our other beers (about 5.2). We do a very large pitch of lactic acid bacteria (LAB) and expect to see the pH drop in to our desired range within 6–8 hours. We also exclude oxygen from the process as much as possible and this helps retard unwanted bacteria with no deleterious effects on the LAB. We do not add extraneous acid to our kettle souring process other than to adjust the pH of the brewing water prior to mash-in (which we do for all our beers as our water is quite high in pH).

After the *Lacto* does its thing we prefer a wort pH of 3.35 to 3.25, but will accept wort between 3.4 and 3.2. We are looking for a clean, bright acidity and don't want the pH to be less than 3.2 or above 3.4. We also use titratable acidity to judge acidity and its quality of impact. Future fruit additions play into our target sourness level to a lesser extent. We are trying to achieve a harmonious balance of flavors and if a fruit has a very low pH we will factor that into our kettle souring process.

Other important factors for kettle souring is to get the wort off the grain (as you would with a "normal" beer) and into the kettle. This needs be done to avoid too much bad funkiness that you would probably get in your wort if you did not sour it fast enough. The second thing is sour your wort fast (in less than 24 hours). To achieve that you need to pitch a good amount of LAB into the kettle; slightly more than one million cells per mL per degree Plato. So about 12 million cells per mL for a 11 or 12 degree Plato wort (1.044–1.048 specific gravity). And the third thing is to exclude oxygen as much as you can. This will help keep the bad funk in check. We blanket the top of the kettle with an inert gas to help keep oxygen out of the process.

For much more on the subject, I wrote the book on Gose for the Brewer's Association's style guideline series and there is a lot of information about kettle souring in there.

Nicole Reiman (right) began her brewing career five years ago and is now the Head Brewer at Odd13 Brewing in Lafayette, Colorado, and a partner at Atom Brewing in Erie, Colorado. Amanda Oberbroeckling (left) entered the beer industry with a degree in biochemistry, a love of beer, and a background in physical therapy. In 2016 Amanda joined the Odd13 Brewing team as a packaging technician, and, over the course of the next year, worked as a cellar woman and brewer until she started the quality control lab in 2017.

At Odd13 we've been kettle souring for about five years. We employ this method any time we produce a sour with the intention of canning. The kettle souring method is perfect for our process because it provides us with a finished product that maintains the same flavor through the shelf life of the beer. Conversely, we use traditional souring methods with small experimental batches. Most of these are long-term souring processes, typically using *Lactobacillus* and *Pediococcus* and aging in barrels or foeders. We have also experimented with open fermentation in foeders.

We get our *Lacto* from Inland Island Yeast Laboratories, out of Denver, Colorado. We prefer *L. delbrueckii* because it gives us a quicker sour, keeping the wort at 115 °F (46 °C). In the past we have also worked with several other *Lacto* species at various temperatures, including *L. brevis*, and have found that at incorrect temperatures there is either less activity or too much activity. We chose our current temperature based on the recommendation from our supplier.

Our process across all of our production is to acidify our wort to a pH of 5.2 using lactic acid. Then, after the souring phase, we typically target a pH around 3.5; however, the decision to stop the souring process is ultimately determined from sensory evaluation of the wort. As we expand our portfolio to include more fruited sours we do take into consideration the acidity level of the fruit that will be added to the beer, and adjust the target pH accordingly. This typically results in a higher pH wort so that fruit additions don't turn the beer too sour.

The most important lesson we've learned is that kettle souring is its own process that requires great attention to detail, and has its own intricacies that don't necessarily carry over from traditional brewing methods. The kettle souring process introduces the possibility of less common off flavors, such as isovaleric acid and butyric acid. We've learned that it's important to make sure the process is dialed in — do your homework and come up with a plan before just jumping in. Monitor and control the process, including cleanliness, wort temperature and pH, and gas levels . . . oxygen makes *Lacto* angry!

Upon graduating from Trinity College in Hartford, Connecticut, Joe Mashburn entered the world of craft beer and began to hone his craft. In 2013, he joined Night Shift Brewing in Everett, Massachusetts, as a Certified Jack of All Trades — and yes, that was an official title. From day one, Joe had an immediate impact on the brand's growth, and today he is now the Head Brewer.

We don't kettle sour, but rather have a *Lactobacillus* fermentation phase, followed by a brewer's yeast fermentation for our Weisse Series releases. We've done a single kettle sour and weren't happy with it, so we moved on from that. Now, we never denature the *Lacto* and really like the consistency and results of this approach. We produce between 200–300 bbls (6,200–9,300 gallons/235–352 hL) of this style each month. We've also used *Lacto* for more time-intensive *Lacto/Brettanomyces/* brewer's yeast fermentations, which are generally destined for oak barrels that will have adequate time for the *Lacto* to produce acid and the *Brett* to do its thing.

For our Weisse Series beers, we target a pH of 5.2 in the kettle, just from normal mashing/sparging procedures. We haven't played around with acidifying prior to *Lacto* additions, mostly because the 5.2 gives us the results we're looking for.

We use a *Lacto* culture from Lallemand, but we've also tried White Labs and Brewing Science Institute. The *Lacto* from Lallemand is incredibly easy to use and it comes as a dry pitch so it has a very long shelf life. For that addition we knock out at 100 °F (38 °C). This has been the same for the two different types of *Lacto* we've tried. When the pH reaches 3.2–3.3 we then pitch the brewer's yeast. Our sours are heavily fruited, so that low of a pH helps the acid come through.

When working with *Lacto*, watch your diacetyl production. We've had success eliminating and minimizing diacetyl by adding fruit early in fermentation (day 2). Additionally, during the *Lacto* fermentation, try to eliminate all oxygen. You could hook up CO_2 to an oxygen stone and continue to purge during knockout. If you don't have an oxygen stone, try not to splash during knockout. BYO

BY ASHTON LEWIS

TUNING IN TO WATER PROFILES

Also: Dry hop timing and sparge water

Q MOST WATER CALCULATORS I HAVE USED ARE BASED ON WATER PROFILES OF THE CITIES WHERE DIFFERENT BEER STYLES ARE BREWED. WOULDN'T IT BE A BETTER WAY TO SHOW THE WATER PROFILES OF THE BEER STYLES INSTEAD OF THE CITY WATER? WHEN I AM FIGURING OUT WHICH WATER TO USE FOR MY BEER BREWING I GET KIND OF CONFUSED AS TO WHICH ONES TO USE. FOR EXAMPLE, I WOULD LIKE TO SEE WHICH WATER PROFILE WOULD BE USED FOR A BROWN ALE, WHICH ONE FOR A RED ALE, AND THE WATER PROFILE FOR A STOUT. WE ALREADY HAVE THAT FOR THE OG, IBU, AND ABV WHEN WE PICK A STYLE OF BEER SO WHY NOT TAKE IT FURTHER TO SHOW THE WATER PROFILE OF EACH STYLE IN THE WATER CALCULATOR. AM I MISSING SOMETHING HERE?

RUSSELL WILLDEN
AURORA, COLORADO

Quite simply, breweries historically brewed beers that worked well with local waters and the topic of brewing water followed this tendency.

A I have never written extensively about brewing water profiles and cannot knowingly comment about why this topic is usually addressed by reviewing the water profiles of historically important brewing centers. But I think I have a pretty good idea why this has been the approach and will answer your question from an assumption about the why. Quite simply, breweries historically brewed beers that worked well with local waters and the topic of brewing water followed this tendency. The fascination and exploration of beer style is a relatively recent development in the history of beer, and part of this process has been reviewing brewing water and trying to determine the best water for a particular style. In fact, the knowledge that we take for granted today about water chemistry is very recent in the history of brewing and goes far beyond the knowledge of most brewers as recently as 60 years ago. Your suggestion totally makes sense and many brewers certainly do approach this topic from the perspective you describe.

A quick review of the water from three major brewing centers that are often referenced in brewing texts (see Table 1 on page 21), Burton, Munich, and Pilsen, does provide a good framework for the practical brewer. Without diving down the rabbit hole of water chemistry and the interpretation of water analyses, there are some clear differences that can be seen among these water profiles.

The first major difference is that Munich has a higher residual alkalinity (RA) than Burton or Pilsen. Table 1 expresses RA in °dH (degrees of German hardness); the key thing to know is that water with RA = 10 °dH will increase mash pH by ~0.3 pH units compared to using water with RA = 0 °dH, and water with RA = -10 °dH will decrease mash pH by ~0.3 pH units. RA is a value that considers how calcium and magnesium ions react with malt's phosphates to lower mash pH as well as how bicarbonate/carbonate ions absorb hydrogen to raise mash pH. Dr. Paul Kolbach published the concept of RA back in 1953 in his paper "Der Einfluss des Brauwassers auf das pH von Würze und Bier" (The Effect of Brewing Waters on the pH of Wort and Beer). Kolbach's research was very practical in that it

Table 1: Water Composition of Three Popular Brewing Cities

Analysis	Town		
	Burton	Munich	Pilsen
RA (°dH)	3	13	0
Carbonate Hardness (ppm)	270	295	16
Ca^{2+} (ppm)	263	76	7
Mg^{2+} (ppm)	62	18	3
SO_4^{2-} (ppm)	638	10	5
Cl^- (ppm)	36	2	5
Na^+ (ppm)	113	4	2

related to how breweries could use RA to predict mash and wort pH based on brewing water chemistry. This topic is not simple because mash pH is a result of reactions between malt and water, and both water and malt vary. This is one reason water pH has limited practicality to brewers.

In order to make sense of this, it is important to know that the pH of a mash made using pale malt and distilled water typically falls somewhere in the pH 5.6–5.8 range. Although a full malt analysis includes wort pH, it is important to note that the Congress Mash used in the ASBC and EBC methods produces a very dilute wort because the total water-to-malt ratio is 8:1 and the wort gravity is usually about 8 °Plato, which translates to about 1.032 specific gravity. This means that the typical 5.8–6.0 pH range for Congress Wort is higher than a typical brewery mash made using the same malt and distilled water as that used in a malt lab. By the way, the term "congress" used in this context means that the mashing method has been standardized by the brewing industry so that results from various labs are comparable.

Back to the typical analysis and the RA values. If water has RA = 0 °dH, the resulting mash pH will have a pH around 5.75 (A.J. deLange, 2004, "Alkalinity, Hardness, Residual Alkalinity and Malt Phosphate: Factors in the Establishment of Mash pH"). pH 5.6 is at the upper end of where most brewers want to be with mash pH and some sort of acidification is required for water with RA = 0 °dH. When the RA of brewing water is greater than 0 °dH, even more acidification is required, and if the water has RA < ~-7 °dH brewers should be cautious about driving the mash pH too low, especially when using darker specialty malts. Mash acidification can be achieved by using darker malts (for example 10% of 50 °L crystal malt reduces mash pH by ~0.3 units, and 10% roasted malt/barley also reduces mash pH by ~0.3 units) using acidulated malt, adding acids to the mash or brewing water, and/or using an acid rest to increase phosphate levels (which in turn react with calcium and magnesium to lower mash pH).

From a practical view, it is easy to see that Munich, traditionally known for its dark lagers, has water in need of some acid to bring the mash pH down from a predictably high level. The dark malts used for the production of dunkles lagers were the source of the acid used by Munich brewers well before our contemporary understanding of water chemistry was known. Although the water values given for Pilsen and Burton have much lower RA values, the predicted mash pH is still on the high side of the typical upper end accepted by most brewers these days. Burton is known for "pale ale," but higher kilned malts were, and still are, commonly used in the formulation of these beers. And while Pilsen is the home of the golden lager, the traditional triple decoction mash used for the style does include an acid rest and the mash pHs of historical lagers from Pilsen were probably a good fit for the style; otherwise Josef Groll's revolutionary pale lager that spread across the globe following its 1842 debut may have been a flop. Imagine being at that beer release . . . wow!

Aside from RA, a composite value calculated from carbonate, calcium, and magnesium levels, the balance of the water analysis from these cities does provide further insight for the practical brewer. Burton water contains notably higher levels of magnesium and sulfate, which are flavor active ions. These ions do contribute to the flavor of beers brewed there. Pilsen and Munich have little in the way of flavor active ions — sulfate, magnesium, chloride, and sodium.

From a practical perspective, it seems that the subject of brewing water is often made more confusing and more difficult to approach because of the ways brewing scientists and techno brewers speak about water. I like to simplify confusing subjects for myself so that I can apply them in everyday life. What follows is the way I think about brewing water and how it relates to style.

Mash & Wort pH

Most beer styles turn out well when the mash pH at 68 °F (20 °C) is between 5.4–5.6, and practical dogma tells me that wort flowing into the kettle should not have a pH greater than 6.0 at 68 °F (20 °C). Mash pH is important because enzymes are affected by pH and so is wort filterability during wort collection. If the mash pH is too low, for example when using high levels of dark malts, the easiest way to raise the pH is by adding baking soda (sodium bicarbonate) because it is soluble at mash pH, whereas calcium carbonate is not. If the pH is too high and the beer style being brewed does not (or should not) contain dark malts, add acid to lower the pH; acidulated malt, lactic acid, and phosphoric acid are the easiest ways to decrease mash pH.

Since mash pH is all about enzymatics and wort filterability, it is totally acceptable and functional to adjust mash pH after mashing in because enzymes are not denatured, or otherwise harmed, by slight changes in mash pH. There is nothing magical about nailing mash pH immediately upon the start of the mash! The reason that commercial brew-

"There is nothing magical about nailing mash pH immediately upon the start of the mash!"

ers want to nail pH at this stage of the game is because commercial breweries are businesses, and in the world of production brewing, time is money. Homebrewers operate by a different set of objectives and adding a bit of time at the start of the mash to tweak the pH is probably not going to ruin a brew day. This does not mean that homebrewers cannot learn from the past and adjust water before mashing, but it is far from a requirement.

Another key point here is that lighter styles, like Pilsner, often benefit from wort pH ~5.2 at the beginning of the boil. The lower pH suppresses color pick-up during wort boiling and is believed to make for a softer bitterness. Wort pH can be adjusted once the kettle is full by adding calcium, lactic acid, or phosphoric acid. Although this technique is well known, it seems that many brewers don't use it. I consider this a brewing trick because it can make a huge difference in the finished beer by doing something relatively simple!

Remember that mash and wort pH are a function of calcium, magnesium, and carbonate from your water, and phosphates, amino acids, and nucleic acids from malts. The most significant information contained in a water analysis, carbonate, calcium, and magnesium, relates to RA and by extension mash and wort pH.

Water Flavor

All the other "stuff" in water pales in comparison to RA. However, the flavor active ions cannot be overlooked. Sulfate enhances hop bitterness and can add a mineral finish to beers at higher concentrations. Magnesium is bitter and metallic; some beers have a distinctive magnesium flavor and adding magnesium sulfate (Epsom salts) is another trick that can be used to tweak a beer. Both chloride and sodium contribute palate fullness and a sort of sweetness to beer at moderate levels. Although the addition of sodium chloride is not something covered in many brewing textbooks, a healthy pinch of kosher salt (not iodized) can definitely enhance the flavor of many styles.

A couple of extremely important things that you will never see in a water analysis are water flavor and chlorine/chloramine levels. Municipal water supplies are chlorinated and the aroma of bleach or chloramine is easy to detect in most tap waters. Carbon filters are great at removing chlorine and are something that all brewers should use to prevent chlorine from tainting beer flavor. The other non-analytical parameter is flavor. Water can taste funky; musty, algal, sulfur, rusty/metallic, and fishy aromas are not uncommon. If you have funky smelling water, consider using another source. After all, beer is 90% water!

Summary

You are probably not thrilled with this answer because I did not give you what you seek. Quite frankly, I think there are way too many tables that attempt to relate brewing science to beer style. In my brewing opinion, the two topics are more often unrelated than they are related. I'll give you one example that relates to your question. A great brown ale can be made from water that has a RA = 10 or a RA = -3; the difference is that one brew will probably need a bit of bicarbonate to push the pH back up into the 5.4–5.6 range. A great brown ale can also be made by adding a nice dose of salt to the mash, boil, or beer to enhance fullness and sweetness, and a great brown ale can also be made by adding a nice dose of magnesium sulfate to push the beer into a dry, slightly metallic, and more bitter direction. The pH adjustment is brewing science, but the salt additions are part of the brewer's art and brewing is a blend of art and science.

Q WHEN YOU DRY HOP, DO YOU TYPICALLY BLOW MOST OF THE YEAST FROM THE FERMENTING BEER BEFORE YOUR DRY HOP DOSES OR DRY HOP ON THE YEAST? DO YOU BUY INTO BIOTRANSFORMATION REACTIONS OCCURRING BETWEEN HOPS AND YEAST?

WESLEY SMITH
VIA LIVE CHAT

A I have dry hopped during fermentation with yeast, blown yeast towards the end of fermentation and dry hopped, have racked beer from one fermenter to another before dry hopping, and have dry hopped beer in the keg. And yes, I do believe that yeast enzymatically change certain hop compounds during fermentation. I like these easy questions!

Digging a bit deeper into biotransformation seems timely as hazy/New England IPAs continue to be a topic of keen interest in the craft beer world. I am really glad that I am not a gambler because I would have lost big time on the longevity of this style, but that's another story for another day. Research into the ability of yeast to enzymatically change hop monoterpenes has been ongoing for at least 20 years. Brewing and hop chemists have clearly demonstrated that yeast are capable of liberating monoterpenes, primarily citronellol and nerol, from hop glycosides by enzymatic hydrolysis, and have also clearly demonstrated that the hop monoterpenes geraniol and linalool are enzymatically changed, aka biotransformed, during fermentation into other terpene compounds, such as citronellol, citronellyl acetate, geraniol, nerol, and α-terpineol. Similar research has been the focus of enologists (wine folk) since at least the early 1980s, and winemakers commonly use hydrolytic enzymes, such as beta-glycosidase, to liberate terpenes from grapes before fermentation. And like hop terpenes, grape terpenes are biotransformed by yeast during fermentation.

The topic of hop terpene biotransformation is a great example of how science follows practice. Dry hopping was generally uncommon before the growth of craft brewing in the early 1980s, and the very high hopping rates common today among craft brewers was almost unheard of as recently as 15 years ago. Now that more beers are dry hopped at varying rates and at different times in the process, more emphasis has been placed on the empirical results of these practices. Hop research will be very interesting to follow for the foreseeable future as scientists continue learning more about what is really happening as brewers continue to push the boundaries of hopping!

A practical challenge associated with adding piles and piles of hops to the fermenter is beer loss. These losses are largely due to beer absorption by hops and by the relatively low density sediment in tank bottoms that is easily disturbed and moved by beer during racking. New technologies, such as Sierra Nevada's Torpedo and Mueller's maxxLup, nicknamed the Odeprot by Anchor Brewing's Brewmaster Scott Ungermann and featured on a one-off beer called Odeprot IPA, have been developed to dry hop externally. Meanwhile, hop suppliers are continuing to develop new hop products to help deliver hoppiness to beer with reduced plant matter, brewers are improving brewing techniques to drive yield, and brewing scientists are looking at sensory saturation to determine when adding more hops ceases to add more perception. It's a great time to be a hop lover!

Q WILL SPARGING AT 169 °F (76 °C) INSTEAD OF A 10-MINUTE MASH-OUT REST AT 169 °F (76 °C) ACHIEVE THE SAME RESULT AND DENATURE MY ENZYMES TO LOCK IN MY SUGAR PROFILE?

LUC JOHNSON
VIA LIVE CHAT

A The short answer to this question is no, sparging at 169 °F (76 °C) does not achieve the same thing as mashing out at the same temperature. The reason for this is two-fold. Let's assume an infusion mash system comprised of 10.4 L (kilograms) water and 4 kilograms of malt (1.25 qts. water per pound of malt) at a temperature of 153 °F (67 °C) is mixed with all 19.6 liters (5.2 gallons) of sparge water at 169 °F (76 °C) required for the brew; assuming no energy from the sparge water is lost to the environment, the resulting mash temperature will be 163 °F (72.6 °C). Not only is this temperature much lower than the typical mash out temperature of 169 °F (76 °C), but this temperature is not possible until all of the sparge water has been added during the course of wort collection. And the reality is that temperature loss to the environment does occur and the mash will never reach the calculated temperature of 163 °F (72.6 °C). Is this significant and relevant to your question? Yes, and it brings up the second point to this answer.

Modern malted barley is an enzymatic powerhouse and the high enzyme level is generally a property of malt that has been very well-modified. Roll back the brewing clock about 25 years and this description of malt would have been believable if the conversation were about North American malted barley; however, malts from continental Europe and the United Kingdom were a bit different, both in terms of modification and enzymatic power, and the same description would not have been a good fit. But in the modern world of brewing, enzymatic power and full modification has become the norm. Why? Because brewers want malts that quickly and reliably perform in the brewhouse with simple mash regimens, and many brewers want malts that can handle enzyme dilution from adjuncts. This means that all-malt brewers need to pay careful attention to these "hot malts" because the high enzyme level and the high degree of modification may result in overly dry beers if the mash is too long.

The normal practice for many commercial craft brewers in the US using the infusion mash method, is to mash-in, quickly begin wort recirculation, aka vorlauf, and begin collecting wort in the kettle as soon as wort clarity is achieved. Since infusion mashing does not employ a mash-out step, enzymes from the mash continue activity in the kettle until the wort temperature is sufficiently high to cause the enzymes to denature. For this reason, it is common for brewers to begin heating their kettles as soon as possible following wort collection. This also reduces the length of the brew day, but that's just a fortuitous consequence of the main objective. In conclusion, I suggest mashing out if your brewing system allows you to do so easily, or using an abbreviated mash schedule if you want to brew a beer with more residual sugar. And, of course, you can always seek malts that are not so darn hot! BYO

BY GORDON STRONG

CREAM ALE

An American original

While the rise of cream ales was documented, there does not seem to be a good identification of the first brewery where it was made or how exactly the name came into being.

CREAM ALE
BY THE NUMBERS

OG:	1.042–1.055
FG:	1.006–1.012
SRM:	2.5–5
IBU:	8–20
ABV:	4.2–5.6%

Photo by Charles A. Parker/Images Plus

It's hard to write about cream ale without mentioning my good friend Curt Stock and his late wife Kathy, who together pretty much owned this style during competitions in the mid-to-late 2000s. You could always count on Curt and Kathy to have a medal-contending cream ale ready for a big competition, along with a double IPA and a variety of fruit meads. I credit Curt with teaching me about blending fruit mead with beer to create a fruit beer. I remember him winning a medal in Kansas City with a blackberry cream ale. When asked about the recipe, he said, "You're not going to like it — it's my cream ale blended with some blackberry mead." Brilliant.

What people opposed to blending might not appreciate is that you need good starting components to blend together, and Curt had a terrific cream ale and his meads were not too shabby either. In addition to his mixology lessons, I also found inspiration in his always having a good option available on tap for those looking for lighter flavors. Growing up in New York State, I had my share of experiences with Genesee Cream Ale, not always favorable. He showed me how good a neglected style could be, if brewed well.

Later in life, living in southwest Ohio, I discovered Little Kings Cream Ale. It made me wonder how far the style existed — turns out, pretty much limited to the region from New York to Ohio, including Pennsylvania. But it also had been around for many years, although not always in the same form. Yet it always was trying to serve the same purpose, to provide an alternative to light lagers by providing many of the same flavors in an ale format.

The Beer Judge Certification Program groups cream ale in Category 1 (Standard American Beer) along with American lagers and American wheat beer. While prepared differently, these styles together fill a similar role — they are broadly accessible to a wide audience, and are often some of the first beers someone tries. Cream ale is Style 1C in the guidelines.

HISTORY

Like many other styles, cream ale has changed over time and has come to mean something different than when originally made. Having its roots in the northeastern part of the United States in the second half of the 1800s, it was impacted by Prohibition and was later reborn in a different form. However, it is one of the few historical styles that did originate in the United States rather than being a derivative of a European style of beer.

American brewing had its roots in English traditions and styles. This changed in the second half of the 1800s as German immigrants brought their own brewing traditions and began creating lager beer. The paler, smoother, easier to drink beers became popular in America, as in other countries in the world, displacing traditional ales.

Cream ale was created as a response to the popularity of 19th century lagers produced in the United States. Not based on European styles, cream ale did use adjuncts (corn and sugar, primarily) to lighten the body and flavor of the beer and to provide a less heavy mouthfeel. Remember that domestic American barley of the time was six-row barley with a high protein content and a coarser character – lagers routinely used corn (or rice) to lighten the profile, make the beer easier to clear, and (probably most importantly) to save money on the recipe.

In 1901, Wahl and Henius wrote about cream ale in the *American Handy Book of Brewing, Malting, and Auxiliary Trades*. They described it as a top-fermented American beer that was made from 70–75% malt and 25–30% sugar or cereal grains. They did draw a distinction between cream, lively, or present-use ales, and the brilliant or sparkling ales. Cream ales were described as being like mild ales of England at around 1.056 in gravity (note that mild ale in this context doesn't mean dark mild; it means an unaged beer served quickly after fermentation). The brilliant or sparkling ales were 1.052–1.060 and were lagered ales (similar to the way Kölsch is produced).

The beers were quite similar in flavor, were bright and sparkling (clear, effervescent), and had an "ale taste" with the lighter mouthfeel and higher carbonation seen as making the beer more refreshing. Steam beer was also described in a similar manner (where "steam" was mentioned as the level of pressure, or carbonation, in the beer). The cream ale described by Wahl and Henius has more in common with modern blonde ales, except that blonde ales tend to be all malt.

While the rise of cream ales was documented, there does not seem to be a good identification of the first brewery where it was made or how exactly the name came into being. I've seen a few stories, but they all seem highly speculative, which is a big problem with trying to identify naming characteristics from two centuries ago. It's best to just say that the reasons are lost to history.

After Prohibition, these different styles seem to have been generally lost. Genesee Cream Ale was created in 1960 as a blend between their existing lager and ale products. Schoenling's Little Kings Cream Ale, in its iconic little green bottles, was created around the same time in 1958. New Glarus Spotted Cow is a Wisconsin-produced version using flaked barley. Most other versions that existed after World War II seem to have disappeared, although Sleeman Cream Ale from Canada might still be found. The craft-beer era has produced few new examples, although Indianapolis-produced Sun King Sunlight Cream Ale is a notable exception. Narragansett Cream Ale from Rhode Island is a more modern take on the more bitter pre-Prohibition examples.

CREAM ALE

(5 gallons/19 L, all-grain)
OG = 1.052 FG = 1.010
IBU = 14 SRM = 3 ABV = 5.6%

INGREDIENTS

3.5 lbs. (1.6 kg) German Pilsner malt
3.5 lbs. (1.6 kg) US 2-row malt
2 lbs. (907 g) flaked corn (maize)
1 lb. (454 g) corn sugar (15 min.)
1.15 AAU Vanguard hops (first wort hop) (0.25 oz./7 g at 4.6% alpha acids)
2.3 AAU Vanguard hops (60 min.) (0.5 oz./14g at 4.6% alpha acids)
0.25 oz. (7 g) Vanguard hops (5 min.)
Wyeast 1056 (American Ale), White Labs WLP001 (California Ale), or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

This recipe uses reverse osmosis (RO) water. Adjust all brewing water to a pH of 5.5 using phosphoric acid. Add 1 tsp. of calcium chloride to the mash.

Mash the malts and corn at 152 °F (66 °C) for 60 minutes. Begin the lauter process by recirculating the wort. Raise the temperature to 168 °F (76 °C) for 15 minutes.

Add the first wort hops to the kettle during the sparging process. Sparge slowly and collect approximately 6.5 gallons (24.5 L) of wort in your boil kettle.

Boil the wort for 90 minutes, adding hops at the times indicated in the recipe. Add the sugar in the last 15 minutes of the boil.

Chill the wort to 62–64 °F (17–18 °C), pitch the yeast, and ferment until complete. Cool to 32–34 °F (0–1 °C) and lager for four weeks.

Rack the beer, prime and bottle condition, or keg and force carbonate the beer.

CREAM ALE

(5 gallons/19 L, extract only)
OG = 1.052 FG = 1.010
IBU = 14 SRM = 3 ABV = 5.6%

INGREDIENTS

5.2 lbs. (2.4 kg) light liquid malt extract
1 lb. (454 g) rice syrup or rice syrup solids (15 min.)
1 lb. (454 g) corn sugar (15 min.)
1.15 AAU Vanguard hops (first wort hop) (0.25 oz./7 g at 4.6% alpha acids)
2.3 AAU Vanguard hops (60 min.) (0.5 oz./14g at 4.6% alpha acids)
0.25 oz. (7 g) Vanguard hops (5 min.)
Wyeast 1056 (American Ale), White Labs WLP001 (California Ale), or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Use 6 gallons (23 L) of water in the brew kettle; heat to 158 °F (70 °C).

Turn off the heat. Add the malt extract and stir thoroughly to dissolve completely. You do not want to feel liquid extract at the bottom of the kettle when stirring with your spoon. Turn the heat back on and bring to a boil. Add the first wort hops while raising to a boil.

Boil the wort for 60 minutes, adding hops at the times indicated. Add the sugar and rice syrup/rice syrup solids during the last 15 minutes of the boil.

Chill the wort to 62–64 °F (17–18 °C), pitch the yeast, and ferment until complete. Cool to 32–34 °F (0–1 °C) and lager for four weeks.

Rack the beer, prime and bottle condition, or keg and force carbonate the beer.

TIPS FOR SUCCESS:

All-grain brewers can swap out the 2-row pale malt with a quality continental Pilsner malt to build a more bready flavor profile. Flaked rice can be substituted for the sugar in the all-grain recipe as well.

The ale/lager blend found in White Labs WLP080 could make for an interesting substitute in this recipe. A steam beer lager strain would work best with a Chico strain if the White Labs strain is unavailable at your store.

Photo courtesy of Erik Cleves Kristensen

Schoenling Brewing Co. out of Cincinnati, Ohio started brewing Little Kings Cream Ale in 1958 and packaging it in their iconic 7 oz. (207 mL) bottles. It's a classic representation of the mid-century American-style cream ales.

SENSORY PROFILE

Cream ale is a pale, clear, smooth, highly-attenuated, and highly carbonated beer. It is designed to be very drinkable and refreshing, and a slightly more flavorful alternative to the more common mass-market American lagers. It tends to be a slightly stronger beer in its classic form, but modern examples are around 5% ABV. Hop character and bitterness is low, giving a balance that is perfect as a "lawnmower beer" or warm-weather quencher.

With its roots as a brilliant or sparkling ale, cream ale should be very clear and effervescent. The color is pale straw to moderate gold — the lighter shade is most typical. The effervescence should help form a white head, although the adjunct level tends to keep it from persisting too long since corn and rice dilute the foam-positive protein.

The aroma is mild with light hops and grain. Subtlety is the key, but the aroma should not be completely void of aromatics. A light fruity note can belie its ale roots, and the hops can show some floral notes. Malt can be lightly grainy, or have that subtle Pils malt crackery sweetness. A touch of corn is often found, which can sometimes be taken as a cooked corn or DMS (Dimethyl Sulfide) note. Not all corn is DMS, so don't be fooled into thinking a faulted example is acceptable (we've done enough damage with hazy IPAs already, thank you).

With a generally clean fermentation profile, light hopping, and high attenuation, the beer should not have too much remaining flavor. The hop levels should be high enough to avoid the beer seeming sweet, but it should also not be a strongly malty beer either. Like a good Kölsch, the balance can change from brewery to brewery, but never stray too far from the average. Strong flavors are a fault but each brewer chooses to emphasize some characteristic of interest.

The body should be relatively light with a crisp finish, although they can taste a bit fuller than standard American lagers. High carbonation is common, as is a smooth lager-like mouthfeel. The aftertaste is fairly neutral; lingering flavors are uncommon. Crispness should encourage another taste.

BREWING INGREDIENTS AND METHODS

Think of brewing a cream ale like creating an American adjunct lager. Pale malt with body- and flavor-lightening adjuncts is the rule. Traditionally the base malt would have been six-row brewer's malt, but modern American 2-row or Pilsner malt gives it a more refined profile. Curt Stock likes to go fancy and use German Pilsner malt as the base. Maybe that's one of the reasons his beer stood out.

Lightening the beer with 25–30% corn, rice, and/or sugar is common. Historical recipes have used corn and sugar, although Curt likes to use corn and rice. I like the smooth flavors derived from corn, while rice and sugar will tend to provide more of a neutral flavor. Complicated cereal mashes can be used to take advantage of unmalted cereal grains, or the more common homebrewer technique is to use ready-to-mash rolled cereal grains. Rice syrup is also ready to add to the boil.

Other small character grain additions are sometimes made, but these often add too much flavor. I've experimented with a dash of Vienna malt, but I tend to think that the more neutral examples taste more authentic. If you choose to add additional character malts, go very light (a few percent only) before you judge the impact. Adding darker malts is interesting, but moves the beer more into the Kentucky common style.

"Think of brewing a cream ale like creating an American adjunct lager. Pale malt with body- and flavor-lightening adjuncts is the rule."

If using flaked grains, mashing can be accomplished using a single infusion mash program in the 151–153 °F (66–67 °C) range. Step mashing can improve attenuation when using flaked grains, so adding in a 10- to 15-minute rest between 122–131 °F (50–55 °C) can help. Decoction mashing is not traditional.

Hopping is restrained, with IBUs typically falling in the 15–20 range. Historical versions can be higher at 20–30 IBUs, but modern palates aren't looking for a bitter beer in this style. Historical versions would likely use Cluster hops for bittering with imported European noble hops for aroma. Modern versions often just use European hops; I tend to hop mine like a helles, and use Hallertauer, Tettnanger, or Spalt.

American derivatives of these types of hops would also work.

A neutral, clean-fermenting ale yeast is most common. There are plenty of offerings such as White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), Imperial Yeast A07 (Flagship), Fermentis SafAle US-05, or Mangrove Jack's M44 (US West Coast) yeast. White Labs makes WLP080 (Cream Ale Blend) that incorporates both ale and lager yeasts, and is an interesting choice for those looking to have the Genesee-like character. Otherwise, a cool fermentation (59–64 °F/15–18 °C) followed by a few weeks of lagering near freezing temperature will produce the clean profile characteristic for the style.

HOMEBREW EXAMPLE

My example uses a mixture of German Pils and American 2-row malt, a common blend that I use when I'm trying to cut the flavor a bit in my beer. You can use the Curt Stock approach and use all German Pilsner malt, if you prefer. I'm also using the traditional corn and sugar. Rice can be substituted for the sugar.

I'm using a single infusion mash to keep it simple. When I brew with flaked corn in the mash, I often add a pound (0.45 kg) of rice hulls to the mash to assist in lautering. It's cheap insurance against a stuck mash.

I'm using Vanguard hops, but you can also use German Hallertauer Mittelfrüh, Liberty, or Mt. Hood hops. The gentle hop additions will give a trace amount of floral aroma and flavor while not dominating the beer.

A neutral yeast is a must for me, and the classic Chico-type yeast works well here. I do like the idea of the White Labs Cream Ale blend, though, so let me know if you try that one instead. I keep the fermentation cool to retain the neutral profile I am after, and I lager the beer to produce the characteristic smoothness.

I'm looking forward to having a cold one of these cream ales to relax. I'll be thinking of my friend Curt and toasting the memory of Kathy while doing so. Remembering your absent friends with a good homebrew should be a modern American tradition. BYO

HIGHLIGHTS

Vancouver, Washington • November 1 & 2, 2019

The Nano segment of craft brewing is growing fast with the majority of new breweries opening up falling into this small-scale, hyper-local segment working on brewing systems 5 barrels or under. But often this Nano niche can't relate to current educational events for the pro brewing industry because their scale of brewing and distribution models are so different from larger brewery companies.

Now's there's a conference just for you: The small-scale craft brewery. Learn the business, marketing, and brewing strategies targeted for your sized needs. From strategies to maximizing taproom sales to more accurately forecasting future ingredient purchases you'll learn over two days from experts and fellow Nano colleagues about actionable ways to improve – or launch – your brewery with ideas targeted just for your small-scale size and business direction.

30 BIG SEMINARS

Expert speakers will cover topics on brewing operations, sales and marketing, business operations, start-up and lots more all geared to Nano Breweries!

ROUNDTABLE DISCUSSIONS

Peer-to-peer learning bringing full audience discussions on a variety of subjects so you can learn what is working – and what isn't – from others working in the Nano Craft Beer segment.

TWO LUNCHES WITH KEYNOTE ADDRESSES

Learn during lunch with panel discussions on current Nano trends as well as expert tips for success on both the business and brewing side.

NANO-FOCUSED VENDORS

Check out the latest in equipment, supplies, and ingredients from leading companies focused on your Nano market and your specific scale and needs.

OPENING & CLOSING PACIFIC NORTHWEST BEER RECEPTIONS

Wrap up your full day of learning with sampling some of the Portland, Oregon region's finest craft beers served by the breweries on the trade show floor.

OPTIONAL 2-DAY PRE-CONFERENCE START-UP BOOT CAMP

Spend two full days leading into NanoCon learning from Steve Parkes, Lead Instructor and Owner of the American Brewers Guild, about the keys to starting up a new craft brewery both on the business side as well as the brewery side. This popular class has regularly sold out at past events.

OPTIONAL 1-DAY PRE-CONFERENCE BOOT CAMPS

Spend an immersive full-day workshop just before Nano-Con starts exploring several key topics: Dr. Chris White on Yeast Management for Nanos, Audra Gaiziunas on Brewery Financials, and Ashton Lewis on Hands-On Nano Brewing Science.

OPTIONAL PRE- AND POST-CONFERENCE PORTLAND-AREA BREWERY TOURS

Here's your chance to easily check out the Portland area's famed craft beer scene. We'll offer different tours on both the day before and the day after NanoCon. One trip will head across the river to explore breweries in Portland while the second tour will stay on the Washington side to visit local craft breweries.

NANO LEARNING TRACKS

BYO NANO CON

BREWERY OPERATIONS

Sponsored by BLICHMANN ENGINEERING

- Reliable Yeast Propagation Techniques
- 10 Mistakes Pro Brewers Make Impacting Beer Quality
- Brewing with Unmalted Adjuncts: From Flaked Oats to Coffee and Beyond
- Dry Yeast Techniques for Nanos
- New (and Classic) Pro Hopping Techniques
- Taproom Draft System Operations & Troubleshooting
- Do's and Don'ts of Mobile Canning & Bottling
- Nano Peer-to-Peer Table Topics

SALES & MARKETING

- Latest Email Strategies to Boost Your Business
- Brewery Branding Through Taproom Events
- Creating a Customer-Centric Nano Business
- Social Media Best Practices for Breweries
- Great Event Ideas to Pack your Taproom
- Leveraging Local Tourism to Boost your Brewery Business
- Training your Taproom Staff
- Nano Peer-to-Peer Table Topics

BUSINESS OPERATIONS

- Planning for Brewery Expansion
- Brewery-Specific Cash Flow Strategies
- 10 Insurance Mistakes Made By Small Breweries
- Your Biggest Legal Risks as a Brewery
- Roadmap to Better Brewery Financial Projections
- You're Never Too Small for Human Resources
- Understanding Taproom-Specific Accounting
- Nano Peer-to-Peer Table Topics

START-UPS

Sponsored by BLICHMANN ENGINEERING

- Keys to a Strong Nano Brewery Business Plan
- 10 Legal Steps to Take Before You Open Your Doors
- Nano Case Study: One Brewery's Journey from Idea to Reality
- Brewery Insurance 101: Protection from Conception to Operation
- 1 Barrel, 5 Barrel, or More? Determining System Size
- Branding Strategies for Start-Up Nanos
- Keys to a Successful Brewery Website
- Nano Peer-to-Peer Table Topics

PRE-CONFERENCE NANO BOOT CAMPS

- Starting Up a Commercial Brewery (2-day class, Oct. 30 & 31)
- Hands-On Nano Brewing Science (1-day class, Oct. 30)
- Yeast Handling for Nano Brewers (1-day class, Oct. 31)
- Brewery Financials (1-day class, Oct. 31)

PRE- AND POST-CONFERENCE CRAFT BREWERY TOURS

- Portland, Oregon Breweries
- Washington State Breweries

BYO.COM/NANOCON REGISTER BY OCTOBER 14 TO SAVE $50

SEMINARS & EVENTS

DAY 1 • FRIDAY, NOVEMBER 1, 2019 | 9:30 – 10:30AM

RELIABLE YEAST PROPAGATION TECHNIQUES

BREWERY OPERATIONS

Knowing how to properly and reliably step up the amount of yeast you need to pitch is a key skill for any professional brewer. And getting your fermentation off to a strong start with the right amount of healthy yeast is key to great beer. Take the guesswork out of this critical step by learning the correct techniques to propagate yeast in your brewery from one of the top experts in brewing yeast, Dr. Chris White, Founder and President of White Labs.

DR. CHRIS WHITE - PRESIDENT, WHITE LABS, INC.

BREWERY-SPECIFIC CASH FLOW STRATEGIES

BUSINESS OPERATIONS

Having a healthy cash flow is vitally important to any small brewing business (and helps owners sleep better at night!) As a business there are steps you can take to improve your cash flow to meet your spending needs. And as a brewery business there are industry-specific ways you can maximize cash flow with strategies that use the unique aspects of running a brewery to your advantage. Learn these specialized techniques to boost the amount of cash you have on hand with brewery financial expert Audra Gaiziunas. Who knows, you might even sleep better as a result too!

AUDRA GAIZIUNAS - OWNER, BREWED FOR HER LEDGER, LLC

BRANDING STRATEGIES FOR START-UP NANOS

START-UPS

Branding is essentially telling a story about your brewery. But with a start-up brewery you have an empty page of paper. Where do you start? How do you prioritize what you need to do with branding before you even pour a drop of beer? And how do you identify and then translate that story into a marketable package? Brewery branding consultant Ryan Wheaton is luckily here to help you make sure your first steps with figuring out your new brewery's branding strategies are the right ones and will offer a roadmap for future branding success.

RYAN WHEATON - FOUNDER, CRAFT BREW CREATIVE

LATEST EMAIL STRATEGIES TO BUILD YOUR NANO

SALES & MARKETING

Strategic email use can be a cost-effective way to boost beer sales, brand awareness, customer loyalty, special event attendance, and overall business in the taproom. But the key word is strategic – how much do you send, when do you send, and how do you even best build an email list? In this session you'll learn the latest email strategies other breweries are using to effectively build their sales and business from Alex Standiford, who consults and manages email programs for several small craft breweries.

ALEX STANDIFORD - DIRECTOR, FILLYOURTAPROOM.COM

10:30 – 11:00AM

COFFEE BREAK & EXHIBITS

NANO EXHIBITS

Grab a coffee and check out the latest in Nano-sized equipment, gear, ingredients, and supplies from dozens of craft brewing's top vendors.

11:00AM – 12:00PM

PLANNING YOUR BREWERY EXPANSION

BUSINESS OPERATIONS

Congrats! Your Nano Brewery is doing well. You've got customers buying your beer, your taproom is humming along, and you are maxing out the amount of beer your system and fermenters can handle. So you are starting to think about expanding your brewery, but where do you start? How big are you going to go and what are the different key brewery and business aspects to consider? Learn how to plan your brewery expansion in a thoughtful and strategic way to avoid future headaches and surprises with Deborah Wood of Brewers Supply Group who has helped numerous craft breweries in Canada grow and expand their beer volumes and revenues.

DEBORAH WOOD - BSG CANADA

SOCIAL MEDIA BEST PRACTICES FOR BREWERIES

SALES & MARKETING

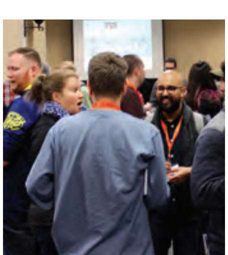
Anyone can use social media, but how to use it strategically as a brewery business is another story. From Facebook to Instagram to Twitter, there are plenty of opportunities to build your Nano business and create a more loyal community of potential customers. Learn how to make the most of your social media efforts whether it is to build your brand's personality, drive traffic to brewery events, fill up seats in your taproom, or reinforce your customer's connection to your brewery. Walk through many of the key strategies to use your social media effectively as a brewery business.

BREWERY INSURANCE 101: PROTECTION FROM CONCEPTION TO OPERATION

START-UPS

Starting up a brewery can feel like a big risk, but that doesn't mean you can't take steps to manage and protect your new business from unnecessary exposure. And the brewing industry comes with a whole set of specific insurance demands you need to know about before you ever even mash in your first batch of beer. Robin Campbell of CedarBrew Insurance will walk you through the commercial brewery insurance landscape so you better understand what coverage you need to consider both in planning and in year one of operation.

ROBIN CAMPBELL - RISK MANAGER, CEDARBREW INSURANCE



10 MISTAKES PRO BREWERS MAKE IMPACTING QUALITY

BREWERY OPERATIONS

Steve Parkes trains new commercial brewers for a living and over his decades of experience as one of the leaders in brewing education in North America he's seen it all. Now find out what are his top ten mistakes he sees fellow pro brewers regularly make that impacts beer quality. You'll walk away with an actionable list of ideas you can put to use in your brewery to make better beer. Get ready to learn how to avoid mistakes you may have never realized you were making – all in the name of better beer!

STEVE PARKES
BREWMASTER & OWNER, DROP-IN BREWING COMPANY
OWNER & LEAD INSTRUCTOR, AMERICAN BREWERS GUILD

12:00 – 1:45PM

GROUP SESSION
NANO EXHIBITS

Listen and learn after you enjoy lunch as a range of craft beer industry veterans discuss trends specific to the Nano segment from both the business as well as beer side. Nano exhibitors will also be available over lunch to visit.

2:00 – 3:00PM

EVENT IDEAS TO PACK YOUR TAPROOM ROUNDTABLE
SALES & MARKETING

Find out from your fellow Nano Breweries what's working in terms of hosting special events at your tasting room and what hasn't. From themed parties to special releases to different competitions, Nano Breweries have gotten very creative coming up with new ways to bring old and new customers in their doors. We'll have a panel as well as open up discussions for the entire room so everyone can learn new ideas from each other.

KEYS TO A STRONG NANO BREWERY BUSINESS PLAN
START-UPS

There are plenty of templates out there for creating a business plan. But the brewing business has its own specific needs and specialized considerations to keep in mind when you want to convert your dreams into a potential brewery launch. Luckily we have Audra Gaiziunas who helps craft breweries-in-planning write better business plans that will help your new brewery move off the drawing board and more successfully into business.

AUDRA GAIZIUNAS - **OWNER, BREWED FOR HER LEDGER, LLC**

YOUR BIGGEST LEGAL RISKS AS A BREWERY
BUSINESS OPERATIONS

Are you opening up your brewery business to legal risks without even realizing it? Join craft brewery lawyer Matthew McLaughlin to go over the biggest potential areas of exposure you face running a brewery. The brewing business is unique and one filled with specialized legal concerns as a result of alcohol production and intellectual property. Be prepared to be surprised about possible legal problems that could harm your business and get in the way of your mission of making great beer at your Nano Brewery.

MATTHEW MCLAUGHLIN - **FOUNDER, MCLAUGHLIN, PC**

BREWING WITH UNMALTED ADJUNCTS: FROM FLAKED OATS TO COFFEE & BEYOND
BREWERY OPERATIONS

Barley malt. Hops. Water. Yeast . . . and gummy bears, coffee, flaked oats, and so much more. Brewing commercial beers with ingredients outside the traditional big four is more popular than ever before and a big driver to customer interest and sales in your taproom. But how do you best tackle these unmalted adjuncts in your brewery since most equipment set-ups are designed for more traditional brewing ingredients? Pro brewer Ashton Lewis is here to help you get creative with your brewing recipes while getting the most out of them and making the best beers you can. He'll walk you through techniques and best practices to use unmalted adjuncts in your Nano Brewery.

ASHTON LEWIS
BREWMASTER & CO-OWNER, SPRINGFIELD BREWING COMPANY
SALES REPRESENTATIVE, BSG CRAFT BREWING
TECHNICAL EDITOR, BREW YOUR OWN

3:00 – 3:45PM

PACIFIC NORTHWEST NANO BEER BREAK & EXHIBITS

NANO EXHIBITS

Sample some local Nano craft beer from the Portland-Vancouver area as you check out the latest in Nano-sized equipment, gear, ingredients, and supplies from dozens of craft brewing's top vendors.

4:00 – 5:00PM

ROADMAP TO BETTER BREWERY FINANCIAL PROJECTIONS

BUSINESS OPERATIONS

Let's face it, if your business projections and forecasted budgets are not as accurate as they should be they won't do you or your brewery much good. Building your financial projections on a firm foundation will help you better anticipate the future money needs of your company and help you run it more strategically. The brewery business is highly specialized with unique accounting needs for this industry. CPA Maria Pearman focuses on the craft brewing segment and she will help you understand how to create more accurate projections for your Nano Brewery and give you a clear roadmap of what you should know and include in your forecasts.

MARIA PEARMAN - PRESIDENT, RADIX ACCOUNTING

NANO CASE STUDY: ONE BREWERY'S JOURNEY FROM IDEA TO REALITY

START-UPS

During the early start-up and planning phase of your journey to opening up a Nano Brewery, it is valuable to hear from somebody else who just walked that same path ahead of you. Mike Wenzel took his idea of opening a small-scale commercial brewery in upstate New York and turned it into a reality. Find out about the lessons he learned along the way, from what he got right and wrong in the planning stages to the current realities of the business side of making and selling his beer commercially. You'll be better prepared for your own journey to launching a brewery after you hear and learn from this Nano brewer who wants to share his very relevant experiences with you.

MIKE WENZEL - CO-OWNER & BREWER, HELDERBERG MOUNTAIN BREWING CO.

MOBILE PACKAGING DO'S & DON'TS

BREWERY OPERATIONS

With space and cash flow at a premium for many in the Nano niche of craft beer, the option of mobile canning and bottling lines opens up new sales channel possibilities without the required investment and upkeep with on-site equipment. Learn more about how to make the most of using a mobile packaging company so you can better take advantage of the flexibility these can provide you as a brewer and as a business.

OWEN LINGLEY - OWNER, CRAFT CANNING & BOTTLING

BREWERY BRANDING THROUGH TAPROOM EVENTS

SALES & MARKETING

Events in your taproom are a great way to bring old and new customers into your business to buy more of your beer. But events can also do much more than a one-time sales boost on a given day. Events can be a valuable tool in building and reaffirming your brewery's branding with customers (and even potential customers who don't attend the event but hear about it elsewhere.) Learn about the ways you can use your taproom events to not only drive sales, but also drive branding for your brewery as your story gets more defined in the public's eye. Ryan Wheaton, a brewery branding consultant, will walk you through how to incorporate branding into your taproom events that will help you long-term.

RYAN WHEATON - FOUNDER, CRAFT BREW CREATIVE

5:00 – 6:30PM

PACIFIC NORTHWEST CRAFT BEER OPENING RECEPTION

NANO EXHIBITS

We've invited some of our favorite Portland-Vancouver area craft breweries to join us to pour samples of their beer for you as a fun way to wrap up your first full day of NanoCon. You'll have the chance to talk with attendees, brewers, and visit with our exhibitors before you head out on the town to check out the incredible local brewery and taproom scene in the Vancouver-Portland area for the evening.

DAY 2 • SATURDAY, NOVEMBER 2, 2019 | 9:30 – 10:30AM

10 LEGAL STEPS TO TAKE BEFORE OPENING YOUR BREWERY

START-UPS

One of the biggest blind spots and areas of concern for new breweries starting up is getting a grasp on all the legal paperwork required for both a small business and especially a small business producing and selling alcohol. Federal, state, and local permits and licenses need to be completed as well as a host of other legal considerations as you get ready to open your doors. We're lucky to have Matthew McLaughlin, an attorney with years of experience helping start-up craft breweries, lead this seminar so you can better understand some of the most important checklist items on the legal side of your business well before you ever pour your first pint.

MATTHEW MCLAUGHLIN - **FOUNDER, MCLAUGHLIN, PC**

DRY YEAST TECHNIQUES FOR NANOS

BREWERY OPERATIONS

One option many Nano Breweries are looking at increasingly in their ingredient selection is dry yeast. Dry yeast has come a long way since the days of old, not-so-viable dusty packets found under the lid of a malt extract can during your earliest homebrewing days. More strains are being released and the quality has improved dramatically. Nano Brewers have taken notice while also attracted to the ease of storage and shelflife in their small breweries. But since dry yeast has been out of the mindset of many commercial brewers for the last few decades, what are the best practices to using yeast in a dry format? How do you make sure dry yeast results in the kind of fermentations you want with the end qualities in the beer you serve? José Pizarro from Fermentis will help bring you up to speed on the new world of dry yeast and how best to use it in your brewery.

JOSÉ PIZARRO - **NORTH AMERICAN REPRESENTATIVE, FERMENTIS**

LEVERAGING LOCAL TOURISM TO BRING IN MORE CUSTOMERS

SALES & MARKETING

You are doing your best to get the word out in a variety of ways about your craft brewery. But why not piggyback your efforts along with your town or region's own tourism marketing efforts? Craft beer remains a hot draw for visitors wanting to check out local spots of interest. And local visitors' bureaus know this fact and most likely would love to feature your business in their promotions. Learn how teaming up with everyone from city beer tourism operators to your local tourism office can bring more customers in your door to buy your beer and how you can take advantage of this team dynamic to raise awareness for your brewery.

MICHELLE MCKENZIE - **VISIT VANCOUVER USA**

UNDERSTANDING TAPROOM-SPECIFIC ACCOUNTING

BUSINESS OPERATIONS

The accounting behind making your beer and selling your beer in your taproom needs to have different rules applied if you want to run your business more strategically. Learn what the key accounting and financial guidelines should be for your taproom so you can understand your numbers more accurately to be in a better position to forecast your future and make key decisions. Learn what you need to know about the numbers-side of your important taproom-side of your business from CPA Maria Pearman, who specializes in working with craft breweries.

MARIA PEARMAN - **PRESIDENT, RADIX ACCOUNTING**

10:30 – 11:00AM

NANO EXHIBITS & COFFEE BREAK

NANO EXHIBITS

Refuel with a cup of coffee and check out the latest in Nano-sized equipment, gear, ingredients, and supplies from dozens of craft brewing's top vendors.

11:00AM – 12:00PM

NANO TABLE TALKS

GROUP SESSION

Peer to peer learning from your fellow Nano industry people at its best. We'll have dozens of tables each assigned a different topic of interest to Nano Breweries spanning brewing, sales, business, and start-ups. For 30 minutes you will trade advice and tips with the other people at your table on that specific topic. Then you'll switch tables to another subject of interest to you. So you'll have the chance to gain knowledge on two different specific subjects you want to explore (and maybe make some new friends and contacts along the way!)

12:15 – 1:45PM

LUNCH & NANO IDEA-O-RAMA ROUNDTABLE

GROUP SESSION

NANO EXHIBITS

Get ready to listen in as specialized craft beer experts each share their top favorite five ideas in a rapid-fire discussion after you wrap up lunch. Nano exhibits will also be open for you to explore during the lunch session.

2:00 – 3:00PM

NEW (& CLASSIC) PRO HOPPING TECHNIQUES

BREWERY OPERATIONS

The last few years have seen a change in how professional brewers look at hopping schedules and techniques with a shift towards late hopping. But there are still hopping techniques that have stood the test of time that also need to be considered as you pull together your next recipe. Pro brewer Ashton Lewis will cover both the new wave of hopping techniques as well as hit the classic hopping techniques you need to know as well. He'll cover both the hows and whys of the techniques so you can better understand when you make your hopping decisions.

ASHTON LEWIS
BREWMASTER & CO-OWNER, SPRINGFIELD BREWING COMPANY
SALES REPRESENTATIVE, BSG CRAFT BREWING
TECHNICAL EDITOR, BREW YOUR OWN

YOU'RE NEVER TOO SMALL FOR HUMAN RESOURCES

BUSINESS OPERATIONS

Yes, you are a small business. Maybe you are even the only employee or have one or two others to help you out with the brewing and selling your beer. But that doesn't mean you shouldn't follow some basic guidelines when it comes to human resources. Having procedures in place will help you navigate any potential trouble spots that can pop up and cause you much more than just headaches. Nano Brewery owner and Human Resources consultant Sean Lopolito will help you understand what you should minimally have in place for your brewery business from a human resources standpoint to protect yourself and your business. It might not be as fun as brewing beer, but in many ways it is just as important.

SEAN LOPOLITO
OWNER, LOPS BREWING
PRESIDENT, PINEHURST CONSULTING GROUP

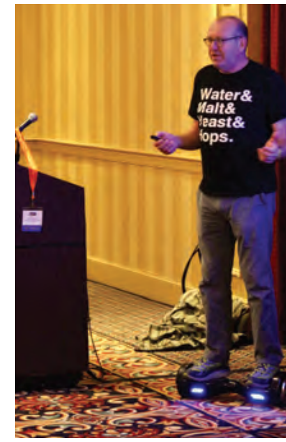
2:00 – 3:00PM

CREATING A CUSTOMER-CENTRIC NANO BUSINESS

SALES & MARKETING

The old saying is "The customer is always first." But what exactly does that mean and how do you implement a customer-centric business? And what are the actual benefits of being customer-centric as you hand a pint of beer to a patron across the bar in your taproom? Get the answers to these questions and how being customer-centric can positively impact your bottom line with Audra Gaiziunas who works with craft breweries on the financial side of their businesses. She is all about hard numbers so you'll leave knowing more about the financial upsides of being customer focused.

AUDRA GAIZIUNAS - OWNER, BREWED FOR HER LEDGER, LLC



1-BARREL, 5-BARREL, OR MORE? DETERMINING SYSTEM SIZE

START-UPS

How big or small a brewing system do you want to have in place at your planned brewery? That's a pretty big question to answer and there are lots of factors to consider. How much beer do you want to produce? How much beer do you think you can sell? How often do you want to be brewing each week? Are there space limitations for your brewhouse? Walk through these questions and many more with John Blichmann who helps craft breweries figure all this out as a producer of small-scale brewing systems. During his years of selling small-scale systems John has heard all the questions and is the perfect person to help you on the path of deciding how big or small a system you should have in place on day one.

JOHN BLICHMANN - PRESIDENT, BLICHMANN ENGINEERING

3:00 – 3:45PM

PACIFIC NORTHWEST NANO BEER BREAK & EXHIBITS

NANO EXHIBITS

We've invited a new group of local Nano Breweries from around Portland and Vancouver to pour samples and visit with as you check out the latest in Nano-sized equipment, gear, ingredients, and supplies from dozens of craft brewing's top vendors.

4:00 – 5:00PM

TRAINING YOUR TAPROOM STAFF

SALES & MARKETING

Your taproom staff is the frontline of interacting with your end customers. They can easily help or hurt beer sales based on how well they interact with visitors. And ultimately they are a reflection of your brewery and will influence the enjoyment of your beer being served. Learn the best practices for training your taproom staff and how to make them more knowledgeable about your brewery's beers they are being asked to sell to customers. A server or bartender more knowledgeable about your beer will translate to a better customer experience, which then translates to more sales. Learn how to make sure your staff maximizes the opportunity to turn a first-time visitor into a longtime customer with the right training about your beer.

JESSICA FERRELL - INSTRUCTOR, BUSINESS OF CRAFT BREWING PROGRAM, PORTLAND STATE UNIVERSITY

TAPROOM DRAFT SYSTEM OPERATIONS & MAINTENANCE

BREWERY OPERATIONS

You work hard to produce great beer in the brewery. Shouldn't you work just as hard to make sure that beer makes it from keg to glass in great shape? Cleaning draft lines and making sure your draft system is operating properly should be a priority when running a taproom. Learn the right cleaning techniques, how often to clean, and what other regular maintenance you should be doing so your draft system does the beer you brewed justice. Nick Klein, who works in the Portland, Oregon area working with draft systems, will teach you what you need to know so you can better take care of your draft beer back home at your brewery.

NICK KLEIN - ACCOUNT MANAGER, NORTHWEST DRAFT TECHNICIANS

4:00 – 5:00PM

KEYS TO A SUCCESSFUL BREWERY WEBSITE

START-UPS

Your website will be your billboard to the outside world for your new brewery. But what website elements need to be included as you design this new brewery website? Website budgets can quickly spiral upward if you aren't strategic about pages you need versus those that won't matter as much. You'll learn these website planning strategies from Alex Standiford who builds websites for breweries and has first-hand knowledge of what works and what doesn't for craft breweries. And ultimately what will drive more business to you and dollars to the bottom line.

ALEX STANDIFORD - DIRECTOR, FILLYOURTAPROOM.COM

10 BREWERY INSURANCE MISTAKES TO AVOID

BUSINESS OPERATIONS

Are you underinsured or even not insured and exposed to risk without realizing it? Craft brewing is a specialized industrial business with plenty of potential problems in addition to all that wonderful beer. Having the right insurance coverage in place, including policies specific for brewing beer, will reduce your exposure to unwanted risk. Robin Campbell will walk you through her top ten list of insurance mistakes you can avoid as a brewing business. You'll learn from other brewery's mistakes and leave with a better understanding of where you stand right now and what insurance moves you might want to consider.

ROBIN CAMPBELL - RISK MANAGER, CEDARBREW INSURANCE

5:00 – 6:30PM

PACIFIC NORTHWEST CRAFT BEER CLOSING RECEPTION

NANO EXHIBITS

We've invited some more of our favorite craft breweries from Vancouver and Portland to join us to pour samples of their beer for you as a fun way to wrap up NanoCon. You'll have this final chance to talk with attendees, speakers, local brewers, and visit with our exhibitors before you head out to check out the Portland-Vancouver area's breweries and craft beer taprooms for Saturday night.

As an attendee, you'll have the opportunity to check out the latest Nano-sized brewing equipment, products, supplies & services from leading craft brewery vendors Friday & Saturday in the Heritage Ballroom.

Thanks to our BYO NANO CON Sponsors!

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GREAT CONFERENCE HOTEL IN THE BEERVANA OF PORTLAND-VANCOUVER!

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The 2019 NanoCon is being held at the Vancouver Hilton just across the river from Portland, Oregon. The Portland-Vancouver area is an international leader in the craft beer world with 80+ local breweries to discover. You not only have the chance to learn strategies to be more successful at your own brewery all day at the conference, but we've set up the schedule so you can also explore on your own this incredible local craft beer scene at night.

Vancouver Hilton
301 W. 6th Street
Vancouver, Washington 98660

Telephone Reservations: 360-993-4500

Mention group name "BCI" to receive a special discounted rate.

Web Reservations:

byo.com/nanocon

Group Discounted Room Rate:

$169 per night for a room with either one king bed or two queen beds.

Hotel Information: We have reserved a limited number of rooms at a special discounted rate for attendees. Contact the hotel directly for your room reservations. When making your reservations make sure to say you are attending the "NanoCon" to receive the special discounted group rate for your room. Rooms are available on a first-come, first-served basis. The special discounted rate will be available until the conference group block of rooms is sold out (which it did last year), so reserve your room right after registering for the conference.

**Please make sure you have already successfully registered for the conference before making your hotel room reservations or any other travel plans.*

COME EARLY OR STAY LATE: PRE- AND POST-NANOCON ACTIVITIES

BYO NANO CON

WEDNESDAY, OCTOBER 30 & THURSDAY, OCTOBER 31

STARTING UP YOUR OWN COMMERCIAL BREWERY BOOT CAMP

10 a.m.–5 p.m. both days
With Steve Parkes ($450 for NanoCon attendees, $525 for non-attendees)

Over Wednesday & Thursday you'll walk through the steps, planning decisions, and keys you need to know on both the brewing and management side to successfully open a commercial craft brewery with the Lead Instructor and Owner of the American Brewers Guild Steve Parkes, who had trained hundreds of professional brewers. Learn from Steve's decades of expertise and wide range of experience to help you better achieve your goals. Over two full days you'll be guided through all the various elements you'll have to know for the next big step toward starting a craft brewery. This two-day workshop is the perfect lead-in to the main NanoCon event if you already have a brewery in planning or are just starting to consider the possibility of opening one up yourself.

WEDNESDAY, OCTOBER 30

HANDS-ON NANO BREWERY SCIENCE

10 a.m.–5 p.m.
With Ashton Lewis ($225 for NanoCon attendees, $275 for non-attendees)

Get hands-on with pH meters, slants and loops, stir plates, centrifuges, and other brewing science gear with professional brewer and *BYO* Technical Editor Ashton Lewis. Ashton will walk you through what your Nano Brewery should have in terms of scientific testing equipment and how to best use this gear to improve quality control over your beer. You'll have the chance to understand how to not only use and care for the equipment properly, but also how to use the results to boost the consistency and quality of your brewery's beer. This workshop will focus only on those pieces of equipment suitable – and affordable – for a small-scale Nano craft brewery.

THURSDAY, OCTOBER 31

BREWERY FINANCIALS

10 a.m.–5 p.m.
With Audra Gaiziunas ($225 for NanoCon attendees, $275 for non-attendees)

You'll start the day by gaining an understanding of the importance of finance and accounting in craft beer and learn the top financial mistakes craft breweries make (and how to avoid them). You'll then be introduced to the basics of the brewery balance sheet, income statement, and cash flow statements to understand how they all tie together for your brewery business. You'll also learn basic ratio analysis to better communicate with bankers and investors. Brewery cost accounting will be covered including beer recipe costing and overhead allocation. Plus during this full-day workshop budgeting, inventory management, and standard operating procedures you should have in place will be discussed. You'll leave this workshop armed with the tools and confidence to better understand and manage your Nano Brewery's financial needs.

THURSDAY, OCTOBER 31

BEST YEAST HANDLING PRACTICES FOR THE NANO BREWERY

10 a.m.–5 p.m.
With Dr. Chris White ($225 for NanoCon attendees, $275 for non-attendees)

Join Dr. Chris White of White Labs as he discusses how to master different yeast-related techniques for your Nano Brewery. This full-day workshop will cover culture selection and explore preparing yeast for pitching, what to expect when re-pitching, working with multiple cultures, and how to troubleshoot fermentation issues related to poor yeast-handling practices. Plus you'll learn from Dr. White on the collection and storage of yeast, utilizing yeast for multiple generations, determining proper pitch rates, yeast nutrition, creating ideal fermentation conditions, and fermentation troubleshooting when problems do occur.

THURSDAY, OCTOBER 31 AND SUNDAY, NOVEMBER 3

WASHINGTON CRAFT BREWERY TOURS ($175)

Thursday, October 31
5 p.m.–9 p.m.
Sunday, November 3
11 a.m.–3 p.m.

This four-hour tour includes round-trip transportation from our NanoCon hotel, the Vancouver Hilton, while tasting and visiting four different breweries in the greater Vancouver area. Beer and a meal is included as you explore a variety of different craft breweries on the Washington side of the river.

PORTLAND, OREGON CRAFT BREWERY TOURS ($175)

Thursday, October 31
11 a.m.–4 p.m.
Sunday, November 3
3:30–8:30 p.m.

This four-hour tour includes round-trip transportation from our NanoCon hotel, the Vancouver Hilton, while tasting and visiting four different breweries in Portland. Beer and a meal is included as you explore a variety of different craft breweries here in the city referred to as Beervana.

SCHEDULE AT-A-GLANCE

BYO NANO CON

Pre-Conference NanoCon Boot Camps • Wednesday, October 30, 2019

10:00 AM – 5:00 PM	Starting Up a Commercial Craft Brewery Boot Camp (Day 1)
10:00 AM – 5:00 PM	Hands-On Nano Brewing Science Boot Camp

Pre-Conference NanoCon Boot Camps & Brewery Tours • Thursday, October 31, 2019

10:00 AM – 5:00 PM	Starting Up a Commercial Craft Brewery Boot Camp (Continued, Day 2)
10:00 AM – 5:00 PM	Brewery Financials Boot Camp
10:00 AM – 5:00 PM	Yeast Handling for Nano Brewers Boot Camp
11:00 AM – 4:00 PM	Portland Craft Brewery Tour
5:00 – 9:00 PM	Washington Craft Brewery Tour

NanoCon Day #1 • Friday, November 1, 2019

8:00 – 9 AM	REGISTRATION			
9:00 – 9:15 AM	WELCOME & INTRODUCTION			
9:30 – 10:30 AM	Branding Strategies for Start-Up Nanos	Reliable Yeast Propagation Techniques	Brewery-Specific Cash Flow Strategies	Latest Email Strategies to Boost Business
10:30 – 11:00 AM	COFFEE BREAK & NANO EXHIBITS			
11:00 AM – 12:00 PM	10 Mistakes Pro Brewers Make Impacting Quality	Planning Your Brewery Expansion	Social Media Best Practices for Breweries	Brewery Insurance 101: Protection from Conception to Operation
12:15 – 1:45 PM	LUNCH & NANO TRENDS ROUNDTABLE			
2:00 – 3:00 PM	Events Ideas to Pack Your Taproom Roundtable	Your Biggest Legal Risks as a Brewery	Keys to a Strong Nano Brewery Business Plan	Brewing with Unmalted Adjuncts: From Flaked Oats to Coffee and Beyond
3:00 – 3:45 PM	PACIFIC NORTHWEST NANO BEER BREAK & NANO EXHIBITS			
4:00 – 5:00 PM	Roadmap to Better Brewery Financial Projections	Nano Case Study: One Brewery's Journey from Idea to Reality	Mobile Packaging Do's & Don'ts	Brewery Branding through Taproom Events
5:00 – 6:30 PM	PACIFIC NORTHWEST CRAFT BEER OPENING RECEPTION			

NanoCon Day #2 • Saturday, November 2, 2019

9:30 – 10:30 AM	10 Legal Steps to Take Before Opening your Brewery	Dry Yeast Techniques for Nanos	Leveraging Local Tourism to Bring In More Customers	Understanding Taproom-Specific Accounting
10:30 – 11:00 AM	COFFEE BREAK & NANO EXHIBITS			
11:00 AM – 12:00 PM	NANO TABLE TALKS			
12:15 – 1:45 PM	LUNCH & NANO IDEA-O-RAMA ROUNDTABLE			
2:00 – 3:00 PM	New (and Classic) Pro Hopping Techniques	You're Never Too Small for Human Resources	Creating a Customer-Centric Nano Business	1 Barrel, 5 Barrel, or More? Determining System Size
3:00 – 3:45 PM	PACIFIC NORTHWEST NANO BEER BREAK & NANO EXHIBITS			
4:00 – 5:00 PM	Training Your Taproom Staff	Taproom Draft System Operations & Maintenance	Keys to a Successful Brewery Website	10 Brewery Insurance Mistakes to Avoid
5:00 – 6:30 PM	PACIFIC NORTHWEST CRAFT BEER CLOSING RECEPTION			

Post-Conference NanoCon Brewery Tours • Sunday, November 3, 2019

3:30 – 8:30 PM	Portland Craft Brewery Tour
11:00 AM – 3:00 PM	Washington Craft Brewery Tour

BYO NANO CON

Vancouver, Washington
November 1 & 2, 2019
REGISTRATION

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PRE-NANOCON BREWERY BOOT CAMPS

☐2-Day Brewery Start-Up Boot Camp for NanoCon Attendees (Oct. 30 & 31)	$450
☐2-Day Brewery Start-Up Boot Camp Only (Oct. 30 & 31)	$525
☐1-Day Hands-On Nano Brewery Science for NanoCon Attendees (Oct. 30)	$225
☐1-Day Hands-On Nano Brewery Science Boot Camp Only (Oct. 30)	$275
☐1-Day Brewery Financials for NanoCon Attendees (Oct. 31)	$225
☐1-Day Brewery Financials Boot Camp Only (Oct. 31)	$275
☐1-Day Yeast Management for Nano Brewers for NanoCon Attendees (Oct. 31)	$225
☐1-Day Yeast Management for Nano Brewers Boot Camp Only (Oct. 31)	$275

PRE- & POST-NANOCON CRAFT BREWERY TOURS

* Open to attendees and their guests

☐Thursday, October 31, 11:00 AM – 4:00 PM Portland-area Breweries	$175
☐Thursday, October 31, 5:00 – 9:00 PM Washington Breweries	$175
☐Sunday, November 3, 3:30 - 8:30 PM Portland-area Breweries	$175
☐Sunday, November 3, 11:00 AM – 3:00 PM Washington Breweries	$175

4 WAYS to REGISTER

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802-362-2377

» PLEASE NOTE A SEPARATE REGISTRATION FORM IS REQUIRED FOR EACH NANOCON ATTENDEE »

YOUR NANOCON REGISTRATION INCLUDES:

- » Admission to the conference's full two-day schedule of seminars
- » Two Lunches with Roundtable Programs
- » Nano Exhibits Admission
- » NanoCon Welcome Bag
- » One Year (8 issues) Print Subscription/Renewal to ***Brew Your Own* Magazine**

(Your discounted hotel room needs to be reserved directly with the Vancouver Hilton, go to byo.com/nanocon for more details.)

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☐Credit Card ☐ Visa ☐MasterCard ☐AMEX

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By registering for the conference, I give permission for the free use of my name and photo in any media account of this event. I also certify that I am 21 years of age or older. Cancellation policy: For a refund, less a $100 administrative charge per person, send written notice by October 1, 2019. Refund requests after October 1, 2019 will not be refunded. All refund requests will be processed post-conference. Last Call Discount registration must be received and paid for in full by October 14, 2019.

THE PERFECT CRUSH

by Vito Delucchi

Photo by Charles A. Parker/Images Plus

HOW MILL GAP SETTINGS AFFECT EFFICIENCY

My summer crush began in the warmest months of 2017, shortly after quitting my corporate job to work full-time for MoreBeer! I know, most love stories don't start with a change of occupation. Then again, this isn't a love story, unless of course you count the love to learn more about brewing. Before signing on full-time, I had been working weekends at my local homebrew shop and a frequently asked question was, "What is the ideal gap setting for my grain mill?" On the surface it seems to be an easy, straightforward question with a simple answer.

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

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

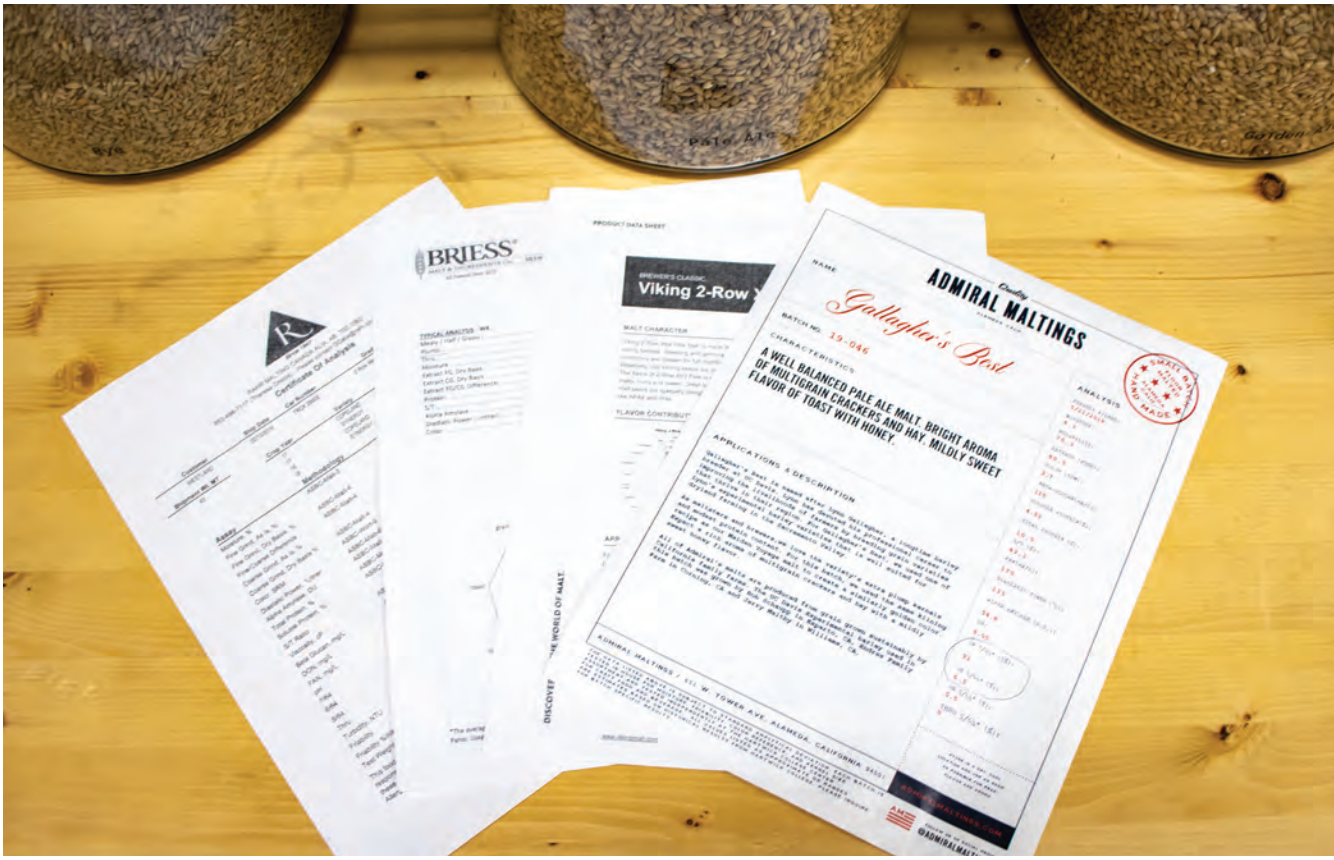


Photo by Vito Delucchi

Malt analysis sheets, also called Certificates of Analysis (COAs), should be available from every maltster and contain a lot of useful information about the malt you are using. In terms of the gap settings when crushing, friability and lot assortment are both critical.

WHY THE CRUSH IS IMPORTANT

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

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

But let's get back to our story, shall we? I was now working full-time in the industry, doing what I loved, and one of the projects I was involved in had me learning more about malts in general. We were working with Viking Malts to develop a new base malt specifically geared towards the North American market. This is when I first learned how to use grain sieves to examine particle sizes on a crush and what all the attributes on a malt analysis sheet (also called a COA or Certificate Of Analysis) meant. If you have never taken a look at one of these sheets, I would recommend doing so. It might not be as sexy as a hop spec sheet but you'll find a lot of important information on them.

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

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

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

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

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

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

Q&A with Curtis Davenport of Admiral Maltings

Curtis Davenport and Vito Delucchi at the Admiral Maltings facility in Alameda, California.

Admiral Maltings was founded in 2017 by two long-time San Francisco brewing industry veterans, Ron Silberstein of ThirstyBear Brewing Company and Dave McLean of Magnolia Brewing Company, along with Head Maltster Curtis Davenport, who has an extensive background in organic farming and small-batch malting. To learn more about the importance of the crush, I sat down with Curtis to get a maltster's point of view.

What should I look for on a COA in regards to milling?
"I would look at friability and kernel size assortment. It's good to look at the COAs and be familiar with the malt, but there is no formula you can gather. Ultimately, it's your observation that matters, but you can look at the COA and understand your observations."

What is friability?
"It's the ability for the malt to be crushed. How much of the kernel was crushed when there was pressure put on it. For low friability you would need a tighter mill gap setting."

What is kernel size assortment?
"It's calculated by counting the weight of kernels in a sample assortment caught on different malt screens. These malt screens are 7/64, 6/64, and 5/64 of an inch. This number will change because barley size changes from year to year and the maltster does not have control over that."

What is the ideal gap setting for a standard crush? *(I had a big smile on my face when I asked this one, but I felt I had to do it for the sake of journalism.)*
"Our standard gap setting is not the same as another brewer's due to our roller sizes. It's really about seeing what is coming out of your mill and adjusting based on that. The best thing to do is run your mill and run a sieve test prior to setting your gap. Or just run a little then look at it and adjust based on what you're seeing."

ON TO THE EXPERIMENTS

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

Photos by Vito Delucchi

A US standard testing sieve has three layers with different-sized screens, from largest gaps to smallest top to bottom, and a pan on the bottom. By methodically shaking the sieves you can calculate the percent of coarse, standard, and extra fine crush results from your mill gap setting.

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

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

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

Example:

#14 + #30 + #60 + Pan = Sum

Then:

#14 / Sum x 100 = percentage

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

Having known the friability and lot assortment (Figure A on page 52) of these malts prior to this test, I originally suspected there would have been a greater variance. To my surprise, the greatest gap (pun intended) in percentages was 7%. Still, that's almost enough of a difference to take you from a "standard" to a "fine" crush (Figure F on page 52) with the same gap setting by simply switching base malts. You can see why brewers are told to "mind the gap."

But it's not just an aphorism for a gap setting, it's about understanding and checking with each batch you brew. I was also surprised at the percentages of fine particles that made it into the pan based on the milling spec sheet (Figure F). But looking at the different crushes (on page 53), I would use some of the ones bordering on the low fine territory. It's really dependent on your system though. A friend of mine who is opening a brewery in Hawaii is putting in a mash filter system. With that type of system you would use an extra fine crush and achieve really high efficiency.

Photo by Vito Delucchi

Lot assortment tests are performed by maltsters placing the grains on top of a stack of four trays with diminishing screen sizes. After shaking the trays, the percent of kernels that do not fall through the 6/64-inch screen make up the lot assortment percent and are considered "plump."

Photo by Vito Delucchi

A visual of the various crushes performed during my experiment crushing base malts from Viking, Rahr, Briess, and Admiral at four different mill gaps.

Figure A: Unmilled Malts

Malt Tested	Friability	Lot Assortment*
Viking - Xtra Pale	92	97
Rahr - 2-Row	92	98
Briess - 2-Row	89	92
Admiral - Gallagher's Best	75	99

* *This represents the percent of grain caught in the 7/64 + 6/64 sieve screen.*

Figure B: 1.25 MM Grind

1.25 MM Gap Setting	#14	#30	#60	Pan
Viking - Xtra Pale	59%	24%	8%	9%
Rahr - 2-Row	60%	23%	9%	8%
Briess - 2-Row	61%	23%	8%	8%
Admiral - Gallagher's Best	56%	26%	9%	9%

Figure C: 1.00 MM Grind

1.00 MM Gap Setting	#14	#30	#60	Pan
Viking - Xtra Pale	40%	34%	11%	15%
Rahr - 2-Row	35%	32%	16%	17%
Briess - 2-Row	40%	35%	13%	12%
Admiral - Gallagher's Best	41%	36%	11%	12%

Figure D: 0.75 MM Grind

0.75 MM Gap Setting	#14	#30	#60	Pan
Viking - Xtra Pale	23%	39%	19%	19%
Rahr - 2-Row	27%	41%	16%	16%
Briess - 2-Row	25%	43%	17%	15%
Admiral - Gallagher's Best	25%	42%	17%	16%

Figure E: 0.50 MM Grind

0.50 MM Gap Setting	#14	#30	#60	Pan
Viking - Xtra Pale	15%	35%	24%	26%
Rahr - 2-Row	13%	37%	24%	26%
Briess - 2-Row	12%	40%	24%	24%
Admiral - Gallagher's Best	19%	36%	22%	23%

Figure F (Admiral milling specs)

Sieve #	#14	#30	#60	Pan
Coarse	70 - 85%	10 - 20%	10%	5%
Standard	45 - 55%	25 - 50%	10%	7%
Fine	30 - 35%	40 - 60%	5 -15%	10%
Extra Fine	10 - 20%	20 - 40%	40 - 50%	10 - 20%

As for the original question of "What is the ideal gap setting for my grain mill?" let's assume we are talking most 2-roller homebrew mills with a 1.25-inch (3.2-cm) diameter roller and you are also using a mash tun with a decent false bottom. I would start with a little over 1.0 mm and go from there. If you don't have feeler gauges you can use a credit card (normally 0.76 mm) to help measure it (or run down to the local auto parts store and buy a set for a few bucks). Ideally, you want to find a highly efficient but not troublesome (meaning it won't cause a stuck mash) crush that works for your brewing system. It's not necessarily going to be solely based on a gap setting either, as the same malt can change from year-to-year, like Admiral's Head Maltster Curtis Davenport mentioned. Similar to how we must adjust hop additions based on alpha acid%, we also need to adjust gap setting based on how the crush comes out of the mill if we want consistency. As long as you are monitoring this step in your process, over time you will develop an eye for it.

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

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

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

AMERICAN BOCK

by Terry Foster

RECREATING THIS HISTORIC STYLE

American bock, you say? Surely, bock is a purely German style . . . right?

Yes, indeed it is, however there was once a style called American bock, which is going to be the focus of this column. But first, we must revisit the history of bock to understand it.

Bock has a long and honorable history, with the original going back at least to the 14th century and perhaps even before that. It was a beer brewed in Einbeck, a town in Lower Saxony just south of Hannover in northern Germany. According to beer author Michael Jackson, Einbeck may well have been "the world's first great center of commercial brewing." Intriguingly, Einbeck had a town brewmaster who would supply equipment and help to individual citizens who had bought malt and hops. I do not know if such an arrangement for beer brewing existed elsewhere. However, I do know that as late as the early 20th century there were traveling cidermakers in Wales. These gentleman would bring equipment to a farmer's premises and press his apples for him and he would presumably oversee the fermentation. But, I digress.

Photo by Shutterstock.com

Photo courtesy of Terry Foster

An Italian-language newspaper advertisement from 1939 for Hull Brewing Co.'s Bock Beer.

HISTORY OF GERMAN BOCK

There are various explanations for the name "bock," but the most commonly held one is that it is a Bavarian corruption of the shortened form of Einbeck. The beer from that town was exported to Munich at least by the 17th century and became popular there. So popular in fact, that the Hofbräuhaus in Munich in 1617 imported a masterbrewer from Einbeck so that the beer could be brewed in Bavaria. Over time several variations of the style appeared on the scene, such as helles bock, dunkles bock, Maibock, weizenbock, doppelbock, and eisbock, both the latter being stronger versions than regular bock. Others were brewed for religious festivals, such as Easter and Christmas and named accordingly. Oddly, few are simply called bockbier. What I call mainstream bocks, that is traditional bock and dunkles bock, are generally brewed at about 6.5% ABV, lightly hopped, and golden to amber in color, but can be much darker. These beers are predominately malt-flavored, often with some roasted malt character, with barely noticeable hop bitterness and are the antithesis of our modern craft-brewed IPAs.

If we look at the Brewers Association and the Beer Judge Certification Program (BJCP) guidelines there is a slight disparity between the two, since the former gives details for traditional German-style bock, while the latter only does so for dunkles bock. However, the brewing parameters are very similar in both cases and for simplicity I have melded them together:

OG = 1.064–1.074 (15.7–18 °P)
FG = 1.013–1.024 (3.3–6.1 °P)
ABV = 6.3–7.6%
IBU = 20–30
SRM = 14–30

Characteristically, these beers are brewed without adjuncts, as one might expect in Germany. However, the grist contains a proportion of Munich malt and is produced using a decoction mash. The latter is somewhat of a complicated technique as it involves a low temperature start (about 120 °F/ 49 °C), then a removal of part of the mash, which is taken through a higher temperature rest and then to a boil and is added back to the main mash. This step may be repeated once, or even twice, taking the mash through a range of specific target temperatures. It is an approach that apparently came to be used in the days when brewers did not have thermometers and the malt was poorly modified. Nowadays we do have such instruments and the base malts available to us are well-modified and will give good extract yields even with a simple single-temperature infusion mash. So we do not have to bother with the complicated procedure of decoction mashing. Or do we?

Brewers who prefer this approach assert that it results in beers with a more pronounced malt character, which is exactly what is wanted in a bock. At least in part this is due to Maillard reactions during the boiling of the mash, reactions that produce compounds with pronounced malty, caramel, and even savory flavors. In contrast, other brewers go with the view that these sorts of flavors can be obtained without doing a complicated decoction procedure. In this view all that is needed is to select a grist with a proportion of appropriate specialty malts, such as caramel and Munich malts, and allowing sufficient boil time for Maillard reactions to proceed in the boil kettle.

BACK TO AMERICA

Now let me talk about American bock beers, by which I do not mean anything produced by today's craft brewers. What I shall deal with are the bock beers offered by American brewers during the late 19th and 20th centuries. There were quite a number of these, most noticeably Shiner Bock, which dates back to 1913 and was still going as the 20th century ended. One source states that in 1994 Budweiser introduced a beer called Zeigen Bock into Texas to compete with Shiner Bock and followed this in 1995 with Michelob Amber Bock. Genesee Brewing Company still brews a bock that first appeared in 1951. C. Schmidt of Philadelphia still offered a seasonal bock when I came to the USA in 1978. Other brewers who have offered a bock at some stage include Stroh's, Yuengling, Leinenkugel, Augsberger, and Cremo Brewing out of Connecticut.

My brewing colleague, Jeff Browning of Brewport (in Bridgeport, Connecticut) has a complete volume of an Italian-language newspaper published in Meriden, Connecticut in 1939. In this are several advertisements for the beers of Hull Brewing Co., including one splendid full-page ad for its Bock Beer, complete with the image of a goat's head (pictured on page 56). This association with a goat is said to come from "bock" being German for "goat." Whether that is true or not, many brewers over the years have used a goat's head symbol on their bottle labels and in their advertisements, presumably because they thought it indicated that bock was a beer suited to the strong and virile consumer!

Now, many of these American bocks did not match the German versions and were often little more than the brewer's regular lager with added coloring. In other words, they would be only around 5% ABV, would have been brewed with adjuncts like corn grits, and the brewers would not have used decoction mashing (more on that later). Most of those comments are based on anecdotal evidence, but I do have a few concrete numbers to back them up. Shiner Bock comes in at only 4.4% ABV, well below the guidelines given earlier.

I have also had access to a Pabst Brewing Co. laboratory analytical notebook from 1899, which gives data for both a Pabst and a Schlitz bock. There is no indication as to whether either beer was produced with any form of colored or roasted malt, but it seems that the Pabst version was an all-malt brew, whereas Schlitz used some proportion of corn meal in the grist. Pabst Bock had an original gravity (OG) of 1.061 (15 °P) and rang in at 5.5% ABV, whilst that from Schlitz had OG of 1.055 (13.6 °P), was 4.7% ABV, and was quoted as being a colored version of another beer. Curiously, both beers came in at the relatively high final gravity (FG) of 1.019 (4.8 °P), which suggests they tasted quite full-bodied. These beers were a little higher in strength than the same brewers' regular beers, which ran at 4–5% ABV, but neither beer matched up to the requirements for their German relations.

Some other evidence comes from the 1908 edition of Wahl-Henius (*American Handy Book of Brewing and Malting*). This useful piece of history lists analyses of a wide range of beers from both the USA and abroad. However, there is only one entry (from 1905) for American bock beers covering average results for ten Milwaukee bock beers. These show an OG of 1.050 (13 °P), FG of 1.019 (4.7 °P), and 4.3% ABV. So, like those from Pabst and Schlitz, the only match to the parameters for German bocks is in FG.

I should add something about malt adjuncts here. While anathema in Germany, this was a topic under investigation elsewhere in the 1880s as brewing science developed. This topic was looked at in England after an 1880 law freed brewers from using only malt, but the most important area of such research was carried out in the United States. That was because much American malt was made from 6-rowed barley, rather than the 2-rowed varieties used in Europe. The former had a higher protein content than the latter, and this could lead to protein hazes in the finished beer. The solution to this problem was to "dilute" the 6-row malt with low nitrogen adjuncts such as corn and rice. These adjuncts contained starch but no enzymes to hydrolyze the starch; fortuitously 6-row malt had an abundance of enzymes and was capable of breaking down this adjunct starch, as well as its own starch content. It didn't hurt either that these adjuncts were cheaper to use than was malt.

John Siebel and Anton Schwarz were the men most responsible for this development. Both were immigrants — Siebel from Germany and Schwarz from Austria — and both of them founded analytical laboratories — Siebel in 1868 and Schwarz in 1880 — and each of them founded a brewing school in 1882. At first Siebel's school lagged behind that of Schwarz, but it is still in existence as the Siebel Institute of Technology.

It seems that Siebel was interested in all aspects of science, whereas Schwarz had himself been a brewer. Indeed, Schwarz was Editor and Owner of *Der Amerikanische Bierbrauer*, later to become the *American Brewer*, and was apparently very influential in brewing circles. Given this two-pronged scientific approach it is not surprising that the use of non-malt

"Many of these American bocks did not match the German versions and were often little more than the brewer's regular lager with added coloring."

AMERICAN BOCK RECIPES

OLD TIMER'S BOCK

(5 gallons/19 L, all-grain)
OG = 1.060 FG = 1.010
IBU = 35 SRM = 13 ABV = 6.6%

This recipe is our attempt of brewing an American bock similar to that of Hartmann Brewing Co.'s 1904 version.

INGREDIENTS

8.2 lbs. (3.7 kg) Simpsons Best Pale Ale malt
1.5 lbs. (0.68 kg) Simpsons medium crystal malt (65 °L)
3 lbs. (1.4 kg) flaked corn
9.2 AAU Huell Melon hops (60 min.)
(1.5 oz./43 g at 6.1% alpha acids)
SafLager S-23 or White Labs WLP820 (Oktoberfest/Märzen Lager) or Wyeast 2206 (Bavarian Lager) yeast
⅔ cup corn sugar (if priming)

STEP BY STEP

Mix the grains and flaked corn with 5 gallons (19 L) of water to give a mash temperature of 153 °F (67 °C) and hold for one hour. Run off and sparge to collect 5.5–6 gallons (21–23 L) of wort. Add the hops (and any salts, if needed, to give concentrations of 96 ppm Na^+ and 148 ppm Cl^-) and boil for 60 minutes.

Cool to 52 °F (11 °C) and pitch two packets of the yeast or an adequately-sized starter if using liquid yeast. Keep at 50–52 °F (10–11 °C) for two weeks, by which time the gravity should be down to 1.010. Then raise the temperature to 60–65 °F (16–18 °C) for two days for a diacetyl rest (not something Hartmann would have done). Then allow to cool gradually to 31 °F (-0.6 °C) for 20 days and put into the serving tank. Keg or bottle in the usual manner.

X MARKS THE BOCK

(5 gallons/19 L, extract only)
OG = 1.060 FG = 1.012
IBU = 35 SRM = 9 ABV = 6.3%

When formulating an extract version of the all-grain recipe Old Timer's Bock, we had to make some sacrifices due to the large percent of flaked corn in that recipe. As such, this recipe will end up different (the reason for it getting a different name), but still very tasty.

INGREDIENTS

6.6 lbs. (3 kg) Briess CBW® Pale Ale liquid malt extract
2 lbs. (0.9 kg) Briess CBW® Sparkling Amber liquid malt extract
9.2 AAU Huell Melon hops (60 min.)
(1.5 oz./43 g at 6.1% alpha acids)
SafLager S-23 or White Labs WLP820 (Oktoberfest/Märzen Lager) or Wyeast 2206 (Bavarian Lager) yeast
⅔ cup corn sugar (if priming)

STEP BY STEP

Dissolve the malt extracts in warm water to give a final volume of 5.5 gallons (21 L) and then bring to a boil. Once a boil is reached, add the hops (and any salts, if needed, to give concentrations of 96 ppm Na^+ and 148 ppm Cl^-) and then boil for 1 hour.

Cool to 52 °F (11 °C) and pitch two packets of the yeast or an adequately-sized starter if using liquid yeast. Keep at 50–52 °F (10–11 °C) for two weeks, by which time the gravity should be down to 1.010. Then raise the temperature to 60–65 °F (16–18 °C) for two days for a diacetyl rest (not something Hartmann would have done). Then allow to cool gradually to 31 °F (-0.6 °C) for 20 days and put into the serving tank. Keg or bottle in the usual manner.

Photo courtesy of Terry Foster

Now defunct, Hartmann Brewing Co. in Bridgeport, Connecticut, used to brew a couple of American bock beers each year. Brewport attempted to recreate the historic style based on Hartmann's brewing books from the early 20th century.

adjuncts became common practice in the American brewing industry.

HARTMANN BREWING CO.

Along with this development came a new approach to mashing, sometimes called "American infusion" as well as the "American double mash." The adjuncts, along with a portion of the malt, would be mashed separately and then added to the main mash with the rest of the malt, and the whole mash would then be taken through various defined temperature stages by direct heating, often through addition ("under-letting") of very hot water.

So, if American bock beers were not made by decoction mashing, were brewed with malt adjuncts, and did not reach the OGs of German bocks, why should we be interested in brewing them? And does it mean we have to have yet another new style?

Well, I'd argue the interest in brewing them is the same as with any historic style. It's fun! And, no, creating a new style is the last thing we need as far as I am concerned. Indeed, the evidence I have presented so far would suggest that there is no clear understanding of what an American bock should be as we shall see from Hartmann's efforts later on.

Which brings me to the real reason for my interest. Jeff Browning and I have a series of brewing books covering 1904–1916 from Hartmann Brewing Co., an extinct company that brewed just down the road from us. So it will not surprise you that we have been very interested in reviving Hartmann beers.

Hartmann brewed two or three versions of a bock, usually aimed at Easter and Christmastime. The beer brewed each year was quite different, although the basis was pale and caramel malts along with flaked corn. The amount of caramel malt changed widely, from 5% of the grist in 1904 through a range of 3% to 21% in the ensuing years to 1916. The adjunct portion stayed fairly constant at 24%, but from 1914 on a part of that was replaced with corn syrup. What was even more confusing was that the OG was 1.060 (14.7 °P) in 1904 and then declined to 1.053 (13.1 °P). That may have had something to do with the fact that this period was leading right up to Prohibition and expenses were being kept in check.

RECREATING HISTORIC AMERICAN BOCK

As we attempted to recreate an American bock we decided that our version would be based on Hartmann's 1904 brews, which, acording to the records had an OG of 1.060 (14.7 °P) and an estimated 31 IBUs. The pages also indicated the grain bill as follows:

Pale malt 72%
Caramel malt 5%
Corn flakes 23%

Procedure: The flakes plus caramel malt and 25% of the pale malt were mashed at about 152 °F (66.7 °C) for 25 minutes in the "converter" vessel. The remainder of the malt was mashed in at this same temperature and the converter contents added. After 40 minutes the mash was underlet with boiling water to give a rest at 162 °F (72 °C) for one hour, before run off and sparging.

The wort was boiled for 2¼ hours with two separate hop additions *before* boiling and a third with 75 minutes remaining in the boil. Salt was added to the boil at a rate to give concentrations of 96 ppm Na^+ and 148 ppm Cl^-. Note that Bridgeport water is quite soft, with less than 50 ppm total dissolved solids.

The data we have does not include information on the color of the caramel malt, hop varieties, the type of yeast, fermentation temperatures, or FG. Nor does it explain why they made two separate, but identical mashes, with no cooking of the cereal mash. So we had to make some guesses if we were to revive this beer. We opted for a moderately dark 65 °L caramel malt, a lager yeast, and German Huell Melon hops, with the latter being added at the start of the boil (we saw no advantage in first-wort hopping).

Brewport has no cereal cooker and no ability to underlet the mash tun with hot water, so we opted for a straight infusion mash. In addition we opted to use Simpsons Best pale malt as the base because it tends to give a good malty character to the beer. It is also the base malt we carry as our standard and we know well its performance on our equipment.

We also decided this meant that this beer would not be a true re-creation of the original, but we did still stick to the same 1.060 OG. We also felt that just 5% caramel malt was not sufficient (Hartmann also seemed to think this, as they went for higher amounts in later brews). In the end we opted to bump up the caramel malt addition to about 11% of the grist. We also added salt on the assumption that our water supply should be close in mineral content to that used by Hartmann.

On page 58 is the actual recipe, which I have scaled down to 5 gallons (19 L) and adjusted for *BYO*'s standard 65% efficiency, but kept the procedures we used in the brewery. Our Anglo-American-German version of Hartmann's Bock is clearly not a recreation, a replica, or even a clone. As always with old recipes the biggest drawback in brewing something similar is that we could not taste the original. However, we can say that our version does taste pretty good — it is maltier and more full-bodied than you might expect, with the hop bitterness nicely balancing the malt. It is not as rich as a true German bock but it is still a very satisfying drink.

Now, I know that the temperature control indicated by the recipe might be beyond some the capability of some homebrewers. So you might want to change the procedure a little; for example, if you cannot manage the lagering step at about freezing temperature, then a storage time at 40–45 °F (4–7 °C) should still produce acceptable results.

EXTRACT VERSION

It is difficult to match the all-grain recipe with an extract recipe directly because of the quantity of flaked corn required. This requires mashing with pale malt, which means you would have to do a partial mash with flakes, pale malt grain, and the crystal malt to a total of about 7 lbs. (3.2 kg), quite a lot for an extract brew. John Palmer suggests using a high maltose corn syrup for American lagers, which would work well with an amber extract made with a proportion of caramel malt. Unfortunately, although this is available to craft brewers, I have not been able to find it readily available from homebrewing suppliers. You could substitute rice syrup solids for the flakes, as this is fully fermentable, but it is quite expensive — I have seen it offered at as much as $6–8 a pound (~$13–18 per kg). The best and simplest approach I suggest is to use two products from William's Brewing, the first made from base malt and 30% flaked corn, the second from base malt plus both light and dark crystal malts. See the extract version of the recipe we came up with on page 58 more more details on the ingredients.

In conclusion, I will not say that American bock should formally become a new style. What I do say is that what we brewed was an enjoyable drink and simply put it was a good beer and one we shall brew again! BYO

BUILD THIS BREWSTAND

STEEL-FRAMED, CUSTOMIZED RIMS BUILD

by Jacob Burnham

I've often praised homebrewing as one of the few great hobbies that combines the technical specificity of science and the spontaneous creativity of art. As a structural engineer having personally experienced the allure of homebrewing, I've also noticed the specific draw that brewing often has on the technical-minded individual. After all, modern brewing is an industrious process that requires a working understanding of many mechanical devices, process techniques, liquid transfer/routing, and number crunching to get that final intended volume/gravity/ABV. All of these lessons can scale down and start to be learned at the homebrew level; and they can be as complicated as you choose to make them. It is that last sentence that got me into trouble; because it wasn't long after I began homebrewing that I convinced myself that I needed to design my own brewstand.

This desire stemmed from my experiences since starting homebrewing seven years ago, having lived and brewed in five different cities, where each location required me to adjust some small aspect of my routine. I also found myself being too spread out, running back and forth from room to room and inside to outside, which divided my attention and would sometimes result in recipe oversights or the occasional boil-over relocating half of the hop leaves to the outside of the kettle. A brewstand would not only consolidate my area of work on brewday, but the process consistency would allow me to develop consistent recipes and baselines for fine-tuning. This was something I dreamt about for five years until living conditions were such to usher in this new era in my homebrewing.

Photos courtesy of Jacob Burnham

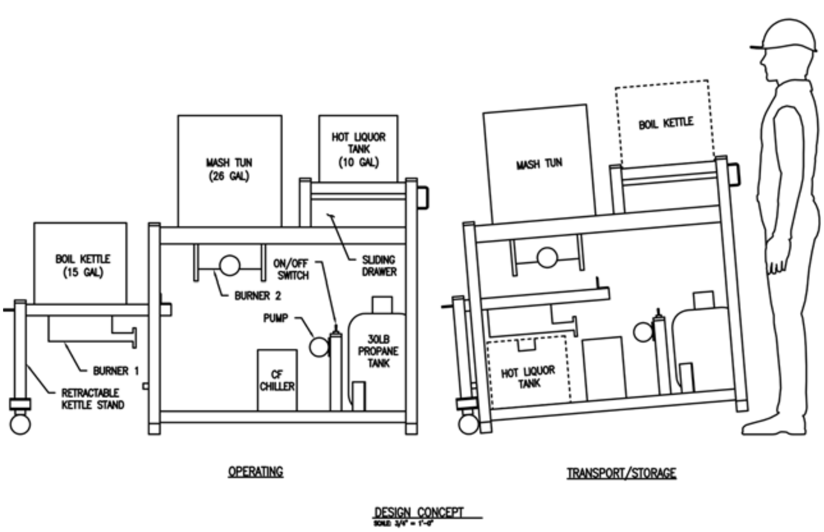
I will say first and foremost that there are numerous brewstands available commercially that are creative, gadgety, and definitely something I wouldn't say no to if somebody offered me one. The goal of this project was not to save overall money. While the final material/equipment take off was just under $3,500, the amount of time spent for design, drafting, and fabrication is definitely not reflected in the final cost (but keep in mind this can be a project that spans many months or even years, so the time investment is spread out). The true goal, like most do-it-yourselfers, was to learn through doing and tailor things to my personal needs. Homebrewers by nature are often very DIY-minded and so, coupled with my engineering background, there was a clash of curiosity and desire that begged the obvious question: How can I not build this?

The very first thing I did was sit down and look at the standard designs of commercial brewstands, noting the features that I did and did not like, in order to develop the conceptual framework for the build. My design would be a steel-frame hybrid 2-tier RIMS (recirculating immersion mash system), as I preferred the eye level operation of lateral systems in tandem with the gravity-fed lautering of tiered systems. I limited my system capacity to 10 gallons (38 L), which would allow me to experiment with multiple carboys/yeasts or to experiment post-fermentation with 5 gallons (19 L) and various dry hops/additives, and still have 5 gallons (19 L) of base beer to go directly to the keg. I also considered that at the homebrew level it becomes more difficult and time-consuming to drink/keg/bottle and give away 10 gallons (38 L) of each batch you brew.

I sized each vessel to accommodate a 10-gallon (38-L) batch of high-gravity beer (15-gallon/57-L boil kettle, 26-gallon/98-L mash tun, 10-gallon/38-L hot liquor tank), since I did not like the commercial standard to use three equal-sized vessels. I mean, why would the hot liquor tank ever need to be the same size as the mash tun? Similarly, I felt the need for three burners was excessive, as liquor could simply be heated in the boil kettle during the mash and pumped to the hot liquor tank (HLT) (essentially a holding tank) just prior to performing the fly sparge/running off from the mash tun to the boil kettle. If the HLT is jacketed I believe there is enough leeway in the range of allowable sparge water temperature to accommodate the heat loss in the holding tank that occurs over the course of the sparge. Economy of materials clearly influenced my preferences, since I feel one of the benefits of DIY projects is to pay less overall money (even if paying far more in time).

The finer design details and build procedures are broken down into the following steps to provide a general approach that anybody can follow in the design of their own custom brewstand. I will say ahead of time that, due to the iterative steps necessary to converge on final design dimensions, the aid of a computer drafting program (I used AutoCAD) will make your life a whole lot easier. I will explain the stages with regard to my build, but the underlying process of each step will equally apply to your own customized creation.

STEP 1. CONCEPTUAL SKETCH OF UNIT AND FEATURES.

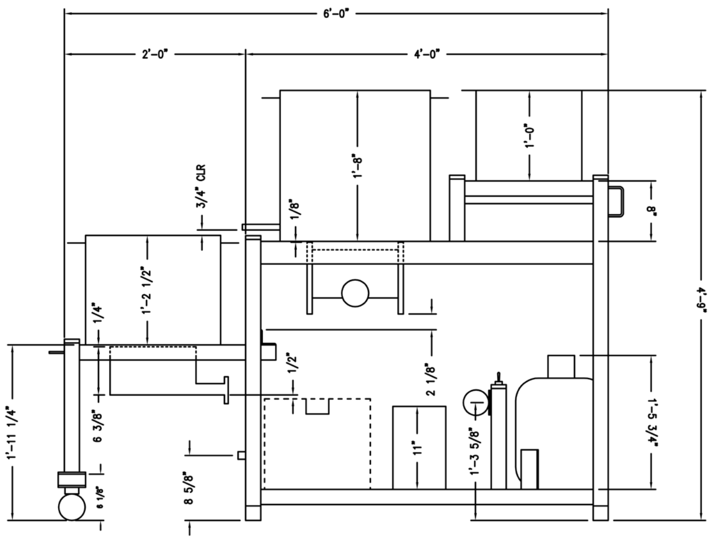


The purpose of this stage is to focus on global constraints (i.e. overall unit length, maximum height of each tier, etc.), which also indirectly determines your level of adjustability. In my case, sketching the initial layout showed me needing a stand that was approximately 6-feet (1.8-m) long. However, my storage space consists of a nominal 8-foot (2.4-m) wide brew shed (which can be seen in the "Equipment Mods" article in the July-August 2019 issue of *BYO*). While the total stand length would technically fit wall-to-wall, it was not practical when considering having to move around it to access shelving/wall-mounted items. Therefore, I moved forward with a design that incorporated a retractable lower tier, which I expanded upon to create a tilt up design for transportation.

Note that steel tends to be pretty heavy. I'm a pretty big guy so I puffed up my chest and said "bring it on" . . . I was wrong (cue chest deflation). In order to comfortably tilt and move the stand as shown in the photo to the left, the kettles need to be removed before transport. The configuration shown is what I utilize for storage, which works very well for consolidation of equipment in my limited space. The clearance/space for the HLT storage was one of the projected constraints from the conceptual stage that governed part of the design (see Step 2). After considerations were taken for brewing process, component layout, and rough overall dimensions, the next step was to acquire the various brewing components for measurement and relative placement.

The last takeaway from Step 1 is to remember that your initial numbers will likely change, but the idea is to give yourself a template and make your concept feasible, leaving enough wiggle room for later necessary adjustments.

STEP 2. COMPONENT MEASUREMENTS AND GEOMETRIC LAYOUT.



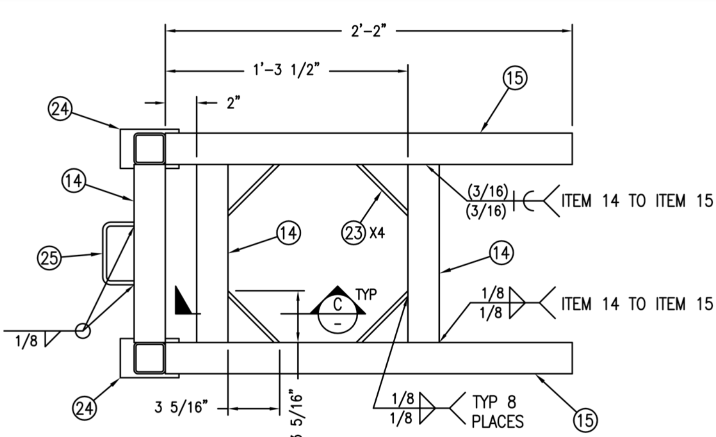
GENERAL ARRANGEMENT
SCALE: 1" = 1'-0"

Once I had specific diameters, heights, and structure member sizes I was able to position items and confidently put numbers to my initial design concept. This process of relative placement within a specified overall constraint "envelope" involves trial and error, as numbers get fine-tuned and problems with initial concepts arise and require a different approach. Drawing and locating the component boundaries to scale is very important; not only to identify interferences, but also to pass the visual test, meaning "does this look right?" For example, I chose to primarily use square ⅛-inch thick tube steel that measured 2-inch x 2-inch (5-cm x 5-cm) cross sections because it looked proportionally better; as opposed to smaller member sizes that could have easily worked from a strength standpoint. I performed a structural analysis of my stand (just for fun, because I'm a nerd, as I knew it was inherently fine) using various software and the maximum member stress came out to 9% of allowable capacity. So, I could have safely used smaller square tube steel, but again, I liked the look of the thicker size. The development from Step 2, more than any other step, will influence the final product; so it's good if you go slow and get it right.

This stage took me over a year, since I partly relied on birthdays and Christmas presents to acquire all of the necessary brewing components, whereby I could then get accurate as-built measurements. I have found that trusting the measurements provided by a website can be a recipe for failure, depending on how much space for adjustability you build into your design. While website measurements are often in the ballpark, if you are dealing with small clearances or tight fit-ups then you need to know the exact numbers (it's a "measure twice, cut once" mentality that will come up again later in this article).

Have fun with the true genesis of your design, and remember that one of the benefits of custom projects is customized conveniences. For example, my layout accommodates a sliding drawer under the HLT (see image from Step 1) that is convenient for putting future hop additions, gloves, or other miscellaneous items on.

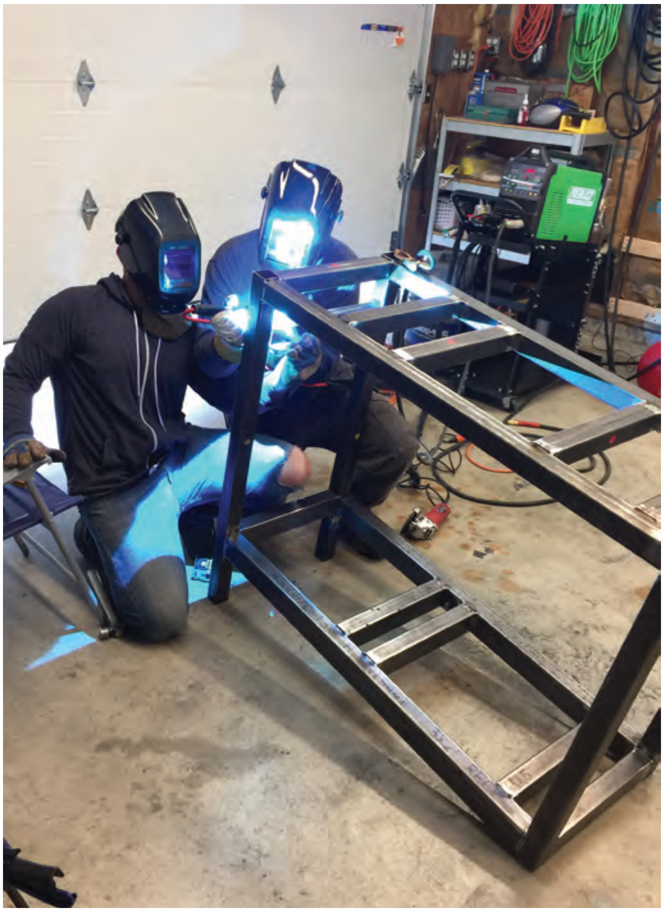
STEP 3. DESIGN DRAWINGS AND MATERIAL LIST.

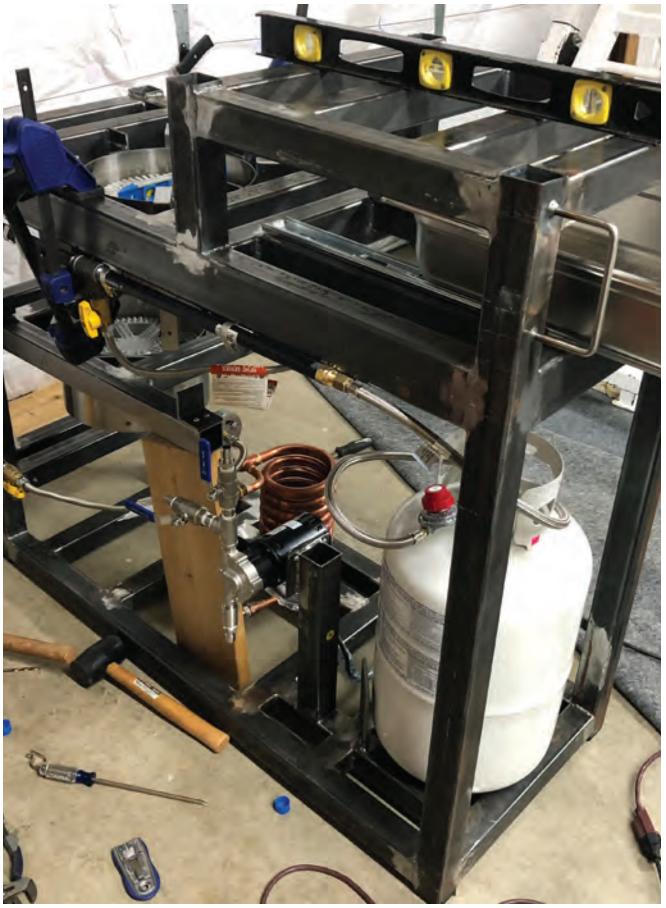


(MOVEABLE WELDMENT – PLAN VIEW)

This image indicates the difference between the layout drawing from the previous step and design drawings. While my layout drawings showed the overall assembly dimensions, these drawings mainly serve to assure the functionality of the build, which influences how things get supported. Design drawings contain all the necessary information to physically build the supporting structure. Design drawings include such items as bubble call outs for specific members, member locating dimensions, and weld callouts. The material list will then contain member cross-sections, lengths, quantities, and material types, as well as quantities and information for required fasteners and miscellaneous items. Following the 2D layout of the stand, I located frame bracing in the 3rd plane (making the design a 3D space frame). These cross members served as members for structural stability, brewing component support, or both. It is at this time that I also routed a gas line to feed my two propane burners and quantified the required parts in my materials list. Prior to material procurement, your design/material/weld details should be checked by either an engineer or experienced individual who understands structural stability and the materials being used.

STEP 4. FABRICATION AND PRELIMINARY FIT-UP.





Once you know all your member lengths for your metal frame, you must determine the quantity of transportable lengths to purchase from a metal supplier, from which your members will be cut. The total length of metal does not equal the total length of metal you order. For those who haven't spent a lot of time building things this may sound like obvious advice, but I guarantee a lot of people have made this mistake. You must lay out exactly which length piece each of your members will be cut from. Organization is the key here because you don't want to cut the wrong members from the wrong purchased pieces.

Depending on your available resources, you may wish to have the supplier or fabricator cut the items for you — to which you want to make it clear as day for them to know how to cut each piece.

For my build, my uncle is a machinist with an at-home metal shop, where I had access to a metal band saw for cutting members to length. If you're unfamiliar working with metal, as I was, it is very helpful to research or have access to a credible resource for metalwork. Machinists are incredibly handy people to know, so try and befriend one. My uncle helped me with miscellaneous other parts of this build, such as milling out notches in lids or drilling holes through hardened steel.

After all of the cuts were made, it was time to begin welding. I was yet again lucky enough to have an extremely valuable resource in the family to aide in fabrication (this work can be hired out otherwise). My father-in-law is a welder with a TIG welding setup and access to Weld Procedure Specifications for the metal types/grades and electrodes that we were using. It took us numerous weekends for fit-up, grinding, and tack welding, followed later by the actual design welds (see photo at top left).

Remember earlier when I mentioned the "measure twice, cut once" philosophy? Well, when you don't abide by that rule, you can run into an instance where we have to cut structural welds because the legs on one end of the frame are an inch (2.5 cm) out of square. We used a reciprocating saw to remove the entire upper part of the frame, cut welds at the bottom of the legs, pulled the legs back into square and re-welded the upper frame. Tensions ran high that day and unfortunately no photo was taken because that's the last thing on your mind after massive failure.

However, with that speedbump behind us and the stand fully welded, I fit-up all the mounted brewing components in their intended mounting locations and matched drilled holes where required (see photo top right).

STEP 5. POWDER COAT AND FINAL ASSEMBLY.

With the frame welded and holes drilled, the final step was finishing. The primary metal option for commercial homebrew stands is stainless steel, whereby a finish is inherently not required. However, in keeping with my economical approach, going with stainless vs. non-stainless steel would have nearly tripled the material cost. Therefore I chose to contrast the brushed stainless of my brew vessels with a flat black powder coated finish on the frame. Powder coating is relatively cheap and offers a high-temperature option that has a listed durability of up to approximately 600 °F (315 °C). While it is not stainless, a black brew stand also has a sharp look to it.

After a few long awaited and satisfying final assembly hours, I had the customized beer makin' machine that I'd been dreaming of for five years. BYO

Photos by Mick Spencer

THE LACTO LOUNGE

A DIY in pursuit of a cleaner kettle sour

by Mick Spencer

Lactic acid-type sour beers (Berliner weisse, Gose, and the like) can be produced by several methods, all of which involve fermentation with at least one bacteria (usually a *Lactobacillus* species) and at least one yeast strain. The bacteria sours the wort or beer by lowering its pH, and the yeast produces all or most of the alcohol. For brevity, I have divided the methods into three subsets, distinguished by when and how the bacteria and yeast are introduced: Co-pitching/staggered pitching, sour mashing, and kettle souring (the focus of this article).

Co-Pitching or Staggered Pitching: This is a broad collection of mixed fermentation methods, which can involve pitching bacteria (*Lactobacillus* and/or *Pediococcus*) and yeast in any order (or together) in a primary and/or secondary fermenter. With co-pitching/staggered pitching, the bacteria normally remains alive throughout the process.

Sour Mashing: In sour mashing, *Lactobacillus* is introduced to the mash after the conversion of starch to sugars and dextrins is complete. The bacteria metabolize some of the sugars present, producing lactic acid and lowering the pH. The resulting sour wort is then typically run off, boiled (killing the bacteria), cooled, and fermented by a yeast strain.

Kettle Souring: Kettle souring involves inoculating a kettle (or other vessel) of wort with *Lactobacillus* to sour the wort. The *Lactobacillus* can come from probiotic drinks or pills, yogurt, fermentation microbe vendors like Wyeast and White Labs, or even from cultures occurring naturally on a handful of base malt. After souring, which can take as little as a day to as long as a week or more, the wort is typically boiled in the same kettle and subsequently cooled and fermented by a yeast strain in a traditional fermenter.

KETTLE SOURING PROS AND CONS

Because the boil stage of kettle souring kills the souring bacteria, the risk of infecting fermenters, siphons, hoses, airlocks, and any other "cold-side" brewery and serving equipment is greatly reduced, in contrast to co-pitching/staggered pitching. (Sour mashing shares this advantage, but its process is somewhat more difficult to control.) In fact, many commercial breweries getting started in making sour beers choose kettle souring for this reason.

Another significant advantage to kettle souring is that it allows the brewer to hop as aggressively as desired in the boil. Most *Lactobacillus* species are very sensitive to hop compounds, which inhibit the souring process. By souring prior to the addition of hops in the boil, this problem is completely avoided.

As with most brewing methods, there are tradeoffs: The pros come with cons. Souring in a kettle comes with two main disadvantages.

First, depending on the kettle design, it can be difficult to keep oxygen and airborne microbes out, which can result in undesirable, oxygen-loving bacteria or wild yeast growing along with the Lactobacillus bacteria pitched. This can especially become a problem if the wort was inoculated with base malt, which can host a variety of microbes.

Second, with most brew kettles, it's difficult to maintain a particular desired temperature for the *Lactobacillus* to work, e.g. 95 °F (35 °C) for *Lactobacillus plantarum* or 115 °F (46 °C) for some other *Lactobacillus* species. This can adversely affect both the time required for souring and the makeup of the active culture.

BUILDING A "KETTLE" SOURING KEG AND ENCLOSURE

As a process-oriented brewer, I had set out to discover a way to keep the advantages of kettle souring, while mitigating or eliminating the disadvantages. I soon realized that excluding oxygen and airborne microbes would be a breeze if I were to use a dedicated Cornelius-type keg as a souring "kettle." The headspace of a wort-filled keg can be purged with CO_2, exactly the same way a keg of finished beer can be purged. This would ensure that no airborne microbes would be introduced and that undesirable microbes already in the wort would be at a disadvantage.

The temperature control challenge could be solved by using FermWrap-type heating elements, controlled by one of the many fermentation temperature control units available. This would optimize the temperature for the particular *Lactobacillus* species being used, putting any other microbes at a disadvantage. But where could I put the controller's temperature probe for accurate temperature readings? It occurred to me that the keg's liquid dip tube would not be needed to serve its normal purpose, and could therefore be converted to a thermowell with a small modification.

I also decided to make a foam box enclosure that could be placed over the keg to provide some insulation, making the heating element's job easier and more efficient.

PARTS LIST

- Ball-lock Cornelius-type keg
- Stainless steel plug (see later for sizing)
- Gas quick disconnect with spunding valve
- 4 polystyrene foam sheets, ¾ x 14½ x 48 inches (2 x 39 x 122 cm)
- Construction adhesive suitable for bonding polystyrene

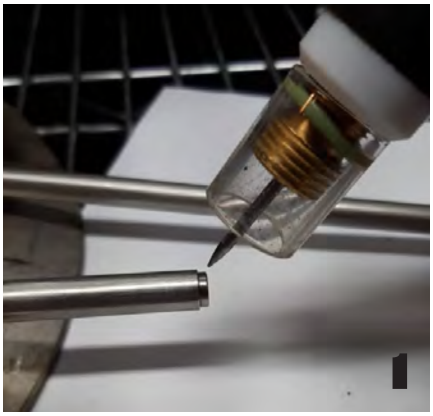
EQUIPMENT FOR OPTIMAL USE OF SOURING KEG

- Temperature controller
- FermWrap-type heating element(s)
- CO_2 setup (cylinder, regulator, tubing, gas quick disconnect)

The build begins with a standard 5-gallon (19-L) ball-lock Corny keg. For my build, I purchased a new Italian model because I always seem to be running out of my existing keg capacity anyway, but a used keg from your collection would work just as well. The first step, modifying the liquid dip tube to serve as a thermowell, is really the only tricky part of the build. That's because it requires soldering or TIG welding. In my case, my friend Dave Naugle helped out. (The pictures accompanying this article show the TIG welded version.) Disassemble the keg, then proceed with the following steps.

1. Construct The Thermowell

Using a Dremel thin kerf cutoff wheel, cut off the end of the liquid dip tube just above or just below the bend (but not "in" the bend), depending on how your dip tube is shaped. The idea is to cut it so that the new length is about half the height of the keg. Square up the cut end with a belt sander. The stainless steel plug should be a sliding fit into the new end of your particular



Top to bottom, turning a dip tube into a thermowell: 1. *Cut the dip tube to about half the length of your keg and insert the stainless steel plug into the tube.* ***2.*** *Solder or TIG weld the plug into the new end.* ***3.*** *Polish the welded/soldered end clean using a file, sandpaper, and finishing with a fine Scotch-Brite pad.* ***4.*** *Your new thermowell.*

If the keg you're using has "permanent" poppets you will need to force the liquid post's poppet out to allow the temperature controller's probe through. This can be done by placing the poppet upright and tapping the head of the poppet with a screwdriver tip and a mallet.

tube. The diameter needed will probably be between $\frac{1}{4}$–$\frac{10}{32}$ inch. It can be made by turning a piece of stainless steel scrap in a lathe, or perhaps cutting from an unthreaded portion of stainless steel bolt. Solder or TIG weld the plug into the new end. If soldering, use silver solder and a small torch. If TIG welding, perform a fusion weld, then file, sand with 120 grit through 400 grit sandpaper, and finish with coarse to fine Scotch-Brite pads. A lathe will make the filing, sanding, and finishing steps much easier. The dip tube is now a thermowell. Note: Detailed soldering and welding techniques are beyond the scope of this article, but the included information should be sufficient for an experienced welder or solderer.

If the keg you're using has posts with "permanent" poppets (i.e. they can't normally be removed for cleaning), you'll need to force the liquid post's poppet out (to allow the temperature controller's probe through later). This can easily be done by placing the post upright on a work surface and tapping the head of the poppet from above with a screwdriver tip and a mallet or hammer. Do not remove the *gas* post's poppet. While you still have the Dremel out, it's also a good idea to cut the keg's *gas* dip tube's length down to about a $\frac{1}{2}$ inch (1.25 cm). This is optional, but the gas dip tube really only has to be long enough to hold the gas O-ring, and shortening it will increase the usable volume in the keg.

As an alternative to building the thermowell, for those not able to do the welding, the liquid dip tube could be removed and replaced with a rubber stopper with a waterproof thermocouple running through it. However, I believe this would increase the risk of oxygen ingress.

2. Construct the Foam Enclosure

With a utility knife, cut the polystyrene foam sheets into five pieces; four 14.5 x 27-inch (approximately 37 x 69 cm) sides and one 14.5 x 16-inch (approximately 37 x 41 cm) top. (14.5 inches/37 cm is the width of the sheets I found, which makes it easy to just cut them to length. Slightly different widths are also common. If yours are different, adjust overall dimensions accordingly. If you cannot find them in your local big box store, they can be ordered online from Menards, model number 1632024.) Repeated light scoring at first, followed by "pushing" down with the knife rather than "dragging" it, helps to cut through without fragmenting the foam. Dry-fit the sides together (upright), and place the top over them; this should look like an upright rectangular box, 16 inches wide x 14.5

Repeated light scoring with a sharp blade, followed by "pushing" down with the knife rather than "dragging" it, helps to cut through without fragmenting the polystyrene foam sheets.

Use construction adhesive to join the sides and then top of your foam insulation enclosure. This insulated box will help maintain a constant temperature for your Lacto *"kettle" keg.*

inches deep x 27.75 inches tall (41 x 37 x 71 cm), with no bottom. An extra pair of hands will be useful here. To help avoid any mistakes, mark each joint with a pencil, ensuring you'll get the right pieces in the right places once you start bonding the joints. Use construction adhesive to join two adjacent sides together, making sure the two sides are at 90-degree angles to each other, and allow to cure. Add the third and fourth sides in the same way. Then, add the top. If desired, cut a small notch in the bottom of one side to allow the heating element and temperature control probe wires to run through. (Personally, I just set the box on top of the wires when in use. The weight of the foam box is negligible.) Note: Make sure your particular keg and spunding valve doesn't exceed 27 inches (69 cm) in height before cutting the enclosure's side pieces to length. If your setup exceeds that height, increase the side pieces' length accordingly.

3. (Re)Assemble The Keg

Reinstall the newly constructed thermowell in the keg. It goes in the liquid "out" opening, just like it did when it was a dip tube. Don't forget to reinstall the dip tube O-ring if you happened to remove it before constructing the thermowell. Next, reinstall the liquid "out" post (sans poppet) onto the liquid "out" opening's threads. You'll notice a hole where the poppet used to be. Don't worry; the keg is still air- and liquid-tight. The hole is where you will later insert your temperature controller's probe and wire. Finish reassembling the rest of the keg as usual.

USING THE "KETTLE" SOURING KEG AND ENCLOSURE

The souring keg and enclosure are fairly straightforward to use. Here's my process:

Clean and sanitize the souring keg just as you would a normal keg. If possible, purge with CO_2 and leave sealed for later use.

On brew day, mash as usual, running off 5 gallons (19 L) (or less) of wort. In a brew kettle, heat the wort to at least 180 °F (82 °C) and hold for at least 8 minutes to pasteurize. Chill the wort to a temperature appropriate for the type of *Lactobacillus* you'll be using. Add lactic acid to acidify the wort to a pH of about 4.5, if desired. This is optional, but it will give the *Lactobacillus* a competitive advantage, improve foam retention, and probably accelerate the souring process.

Using a sanitized siphon, pump, or gravity-fed hose, *gently* transfer the chilled wort to the sanitized souring keg through the lid opening. Avoid aerating the wort. Add your chosen source of *Lactobacillus* to the keg. Seal the lid and purge the headspace with CO_2 (alternately pressurizing via the gas post and burping the keg via the lid's pressure release valve ring), leaving about 20 PSI of pressure in the headspace after purging. The extra CO_2 in the headspace will be slowly absorbed into the wort, but until then it adds extra integrity to the seal.

Wrap the keg with one or two FermWrap-type heating elements, securing them with tape on the ends. Each species of *Lactobacillus* has an ideal temperature (or range of temperatures) for souring. For example, *L. plantarum* works great at about 95 °F (35 °C). Some other species work very well in the 110–120 °F (43–49 °C) range. To sour at 95 °F (35 °C) in ambient room temperature, one FermWrap is sufficient. For higher temperatures, two FermWraps may be needed. Plug the heating element(s) into your temperature controller and insert the controller's probe and wire into the keg's thermowell as far as it will go. Plug the controller into an electrical outlet and set the desired fermentation temperature per the controller's manual. Note: Some temperature controllers (particularly some older analog models) have probes that are too wide to fit into a dip-tube thermowell. Newer, digital models typically have probes that will fit. Three models that I have tested and confirmed will fit are the Johnson A419, the Northern Brewer Dual Stage, and the Keg King MKII.

Install the quick disconnect with spunding valve, set to about 20 PSI on the keg's "gas-in" post, and place the Styrofoam enclosure over keg.

Some species of *Lactobacillus*, known as "homofermentative," never produce any CO_2. Some species, known as "heterofermentative," always produce CO_2. And some oddballs, known as "facultatively heterofermentative" can produce CO_2 under certain circumstances. The *Lactobacillus* species I prefer, *L. plantarum*, is one of these oddballs. Fortunately, when souring wort (which contains ample glucose), *L. plantarum* and other facultatively heterofermentative *Lactobacillus* species produce little or no CO_2. And even the fully heterofermentative species seem to finish souring the wort before producing very much CO_2. That said, I think the spunding valve provides some peace of mind.

When the sourness, as indicated by pH measurement, has reached the desired level (I like a pH of about 3.5 for Berliner-type beers), transfer the soured wort to your brew kettle, add distilled or reverse osmosis (RO) water (more on this below), boil, cool, aerate, and pitch a *Saccharomyces* yeast strain in your "clean" beer fermenter per your usual practices.

VOLUMES, GRAVITY, AND pH

It may have occurred to you, astute reader, that the souring keg limits the volume of wort that can be soured to about 5 gallons (19 L). If you are brewing a 5-gallon (19-L) batch, without much in the way of trub-producing hops, this is not an issue. Simply make sure that the gravity of your pre-soured wort is the original gravity (OG) you'll want after the boil. Then add an amount of distilled RO water equal to what you expect to boil off to the boil kettle. The result is 5 post-boil gallons (19 L) of the wort of the desired OG. Easy.

But what if we want more than 5 gallons (19 L) of wort post-boil? We can take a cue from the "high gravity brewing" technique used by some commercial brewers, but apply it only at the pre-boil (mash and souring) stages. We just make 5 gallons (19 L) of soured wort of a higher gravity that's proportional to the desired final volume of post-boil wort. That may sound complicated, but it's really not. Suppose we want to make 8 gallons (30 L) of post-boil wort, with a gravity of 1.040, or 40 "points." Divide the desired volume (8 gallons/30 L) by the souring keg capacity (5 gallons/19 L) and you get 1.6.

So 1.6 will be our multiplier. Since we want 40 "points" in the post-boil wort, we need 1.6 x 40 points = 64 points, or a gravity of 1.064 for the 5 gallons (19 L) going into the souring keg. Then, at the boil stage, add distilled/RO water. The amount to add will be whatever is needed (3 more gallons/11 L in this case) to reach the total desired post-boil volume, *plus* an amount of distilled or RO water equal to what you expect to boil off.

You may be wondering at this point why we're adding distilled/RO water and not just tap water to increase the volume. The reason is that distilled/RO water has the least impact on the sourness we have worked to achieve, because it barely makes any change to the pH of soured wort. If soured wort were a simple solution of strong acids, we could easily build a model to predict the pH change (increase) to a fair degree of precision. However, soured wort is a complex solution of many compounds and ions buffering against pH changes, and there's no simple model to predict the pH increase caused by dilution. But the good news is that soured wort is very good at resisting pH change by dilution. I recently measured a sample of soured wort at a pH of 3.49. I double the volume by dilution with distilled water, and the pH did not move. When I tripled the original volume by dilution with distilled water, the pH increased to 3.50, which is an insignificant change and possibly nothing more than noise in the measurement.

RECIPES

On the next four pages, please check out three sour beer recipes including a Berliner weisse, a Gose, and an experimental sour. Plus there is even a *Lacto*-fermented hot pepper sauce you can make. A dedicated souring keg, with fermentation temperature control and CO_2 purge capability has tons of potential.

KETTLE SOUR RECIPE

BERLIN SMOOTHIE

(5 gallons/19 L, all-grain)
OG = 1.032 FG = 1.005
IBU = 0 SRM = 3 ABV = 4%

This take on Berliner weisse forgoes any hop additions and incorporates two fruits not often seen together in beer, but it works beautifully. The blueberries and pineapple add a lovely deep claret color that's unclassifiable. The OG above is prior to souring. The FG and ABV include the impact of the fruit addition. The SRM is for the base wort/beer pre-fruit addition.

INGREDIENTS

3.3 lbs. (1.5 kg) German Pilsner malt
3.3 lbs. (1.5 kg) pale wheat malt
4 lbs. (1.81 kg) frozen blueberries
4 lbs. (1.81 kg) frozen pineapple
Distilled water
½ tsp. yeast nutrient (10 min.)
2 Goodbelly StraightShots or 4 Swanson Probiotic *L. plantarum* capsules
White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Mill the grains and dough-in, targeting a mash of around 1.5 quarts of water per pound of grain (3.1 L/kg) and a temperature of 150 °F (66 °C). Add lactic acid as needed to target a mash pH of 5.2. Hold the mash at 150 °F (66 °C) for 60 minutes. Sparge or mashout and lauter with enough water to yield a total volume of 5 gallons (19 L) of wort.

Heat wort to 180 °F (82 °C) in the brew kettle and hold for 8 minutes to pasteurize. Chill the wort to 95 °F (35 °C). Transfer the chilled wort to a sanitized, purged souring keg. *Do not aerate*. Add the Goodbelly shots or the inner contents of the Swanson capsules to the keg. Seal the keg and purge with CO_2, leaving about 20 PSI of pressure in the headspace after purging.

Allow the *L. plantarum* to sour the wort for about 48 hours at 95 °F (35 °C), until the pH drops to about 3.5.

After souring, transfer the wort to a boil kettle and add the amount of distilled water expected to boil off over a 60-minute period. Bring to a boil and boil for 60 minutes, adding the yeast nutrient at 10 minutes remaining.

Turn off the heat and chill the wort to 68 °F (20 °C) or slightly cooler. Transfer the cooled wort to a "clean beer" fermenter and then aerate and pitch the yeast. Ferment at 68 °F (20 °C) until gravity is a few points above terminal.

Thaw and crush the fruit. Rack beer into a secondary fermenter on top of the fruit. Ferment for about a week at 68 °F (20 °C), or until the sugars in the fruit are fermented out.

If bottle conditioning, carbonate the beer to around 2.5 volumes of CO_2. If kegging, carbonate as high as 3.5 volumes of CO_2.

BERLIN SMOOTHIE

(5 gallons/19 L, extract only)
OG = 1.032 FG = 1.005
IBU = 0 SRM = 3 ABV = 4%

INGREDIENTS

3.6 lbs. (1.63 kg) Bavarian wheat dried malt extract
4 lbs. (1.81 kg) frozen blueberries
4 lbs. (1.81 kg) frozen pineapple
Distilled water
½ tsp. yeast nutrient (10 min.)
2 Goodbelly StraightShots or 4 Swanson Probiotic *L. plantarum* capsules
White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Fill the brew kettle with 5 gallons (19 L) of water. Heat to about 160 °F (71 °C). Turn off heat, add the extract, and stir to dissolve. Heat wort to 180 °F (82 °C) in the brew kettle and hold for 8 minutes to pasteurize.

Chill the wort to 95 °F (35 °C) and follow the remainder of the instructions in the all-grain recipe.

TIPS FOR SUCCESS:

If souring in a kettle instead of a dedicated souring keg, flood the kettle headspace (if possible) with CO_2 and cover as tightly as possible. Keep the kettle close to 95 °F (35 °C).

You can add lactic acid to bring the wort pH to about 4.5 or lower before pitching the *L. plantarum*. This will make the job easier for the bacteria and improve foam retention. If you don't have a pH meter, about 8–9 mL 88% lactic acid per 5 gallons (19 L) of wort (starting at 5.2 pH) will be useful and should get you in the ballpark.

Using more *L. plantarum* than called for can also accelerate the souring process. Also, fresher *L. plantarum* will work faster than older *L. plantarum*.

Leaving 20 PSI of pressure in the souring keg's headspace after purging helps ensure positive pressure to keep the keg sealed, as most of the headspace CO_2 is slowly absorbed by the wort. If you do not have a spunding valve, check the keg's pressure periodically and if the souring keg's pressure actually increases (unlikely), bleed some of it off using the pressure relief valve.

The *Saccharomyces* fermentation will be somewhat slowed by the acidity of the wort. This is normal. The yeast is operating under less than ideal conditions (low pH), but will get the job done.

For a more traditional Berliner weisse, hop to 8 IBUs in the boil with any noble hop, skip the fruit addition and the secondary fermentation, and package the beer when it reaches terminal gravity.

KETTLE SOUR RECIPE

RASPBERRY GOSE

(5 gallons/19 L, all-grain)
OG = 1.046 FG = 1.009
IBU = 0 SRM = 3 ABV = 4.7%

The OG is prior to souring. The FG and ABV include the impact of the fruit addition. The SRM is for the base wort/beer: The raspberries will add a beautiful pink/red color that doesn't fit the SRM scale.

INGREDIENTS

4.7 lbs. (2.13 kg) German Pilsner malt
4.7 lbs. (2.13 kg) pale wheat malt
5 lbs. (2.3 kg) frozen raspberries
0.75 oz. (21 g) Indian coriander, freshly ground (15 min.)
0.5 oz. (14 g) sea salt (15 min.)
Distilled water
½ tsp. yeast nutrient (10 min.)
2 Goodbelly StraightShots or 4 Swanson Probiotic *L. plantarum* capsules
White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Mill the grains and dough-in targeting a mash of around 1.5 quarts of water per pound of grain (3.1 L/kg) and a temperature of 150 °F (66 °C). Add lactic acid as needed to target a mash pH of 5.2. Hold the mash at 150 °F (66 °C) for 60 minutes. Sparge or mash-out and lauter with enough water to yield a total volume of 5 gallons (19 L) of wort.

Heat wort to 180 °F (82 °C) in the brew kettle and hold for 8 minutes to pasteurize. Chill the wort to 95 °F (35 °C). Transfer the chilled wort to a sanitized, purged souring keg. *Do not aerate*. Add the Goodbelly shots or the inner contents of the Swanson capsules to the keg. Seal the keg and purge with CO_2, leaving about 20 PSI of pressure in the headspace after purging.

Allow the *L. plantarum* to sour the wort for about 48 hours at 95 °F (35 °C), until the pH drops to about 3.5.

After souring, transfer the wort to a boil kettle and add the amount of distilled water expected to boil off over a 60-minute period. Boil for 60 minutes, adding the coriander, sea salt, and yeast nutrient according to the ingredient list.

Turn off the heat and chill the wort to 68 °F (20 °C) or slightly cooler. Transfer the cooled wort to a "clean beer" fermenter, aerate, and pitch the yeast targeting about 200 billion cells. Ferment at 68 °F (20 °C) until gravity is a few points above terminal.

Thaw and crush the raspberries. Rack beer into a secondary fermenter on top of the raspberries. Ferment for about a week at 68 °F (20 °C), until the sugars in the raspberries are fermented out.

If bottle conditioning, carbonate the beer to around 2.5 volumes of CO_2. If kegging, carbonate as high as 3.5 volumes.

RASPBERRY GOSE

(5 gallons/19 L, extract only)
OG = 1.046 FG = 1.009
IBU = 0 SRM = 3 ABV = 4.7%

INGREDIENTS

5.2 lbs. (2.36 kg) Bavarian wheat dried malt extract
5 lbs. (2.3 kg) frozen raspberries
0.75 oz. (21 g) Indian coriander, freshly ground (15 min.)
0.5 oz. (14 g) sea salt (15 min.)
Distilled water
½ tsp. yeast nutrient (10 min.)
2 Goodbelly StraightShots or 4 Swanson Probiotic *L. plantarum* capsules
White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Fill the brew kettle with 4.95 gallons (18.7 L) water. Heat to about 160 °F (71 °C). Turn off heat, add the extract, and stir to dissolve. Heat wort to 180 °F (82 °C) in the brew kettle and hold for 8 minutes to pasteurize.

Chill the wort to 95 °F (35 °C) and follow the remainder of the instructions in the all-grain recipe.

TIPS FOR SUCCESS:

If souring in a kettle instead of a dedicated souring keg, flood the kettle headspace (if possible) with CO_2 and cover as tightly as possible. Keep the kettle close to 95 °F (35 °C).

You can add lactic acid to bring the wort pH to about 4.5 or lower before pitching the *L. plantarum*. This will make the job easier for the bacteria and improve foam retention. If you don't have a pH meter, about 8–9 mL 88% lactic acid per 5 gallons (19 L) of wort (starting at 5.2 pH) will be useful and should get you in the ballpark.

Using more *L. plantarum* than called for can also accelerate the souring process. Also, fresher *L. plantarum* will work faster than older *L. plantarum*.

Leaving 20 PSI of pressure in the souring keg's headspace after purging helps ensure positive pressure to keep the keg sealed, as most of the headspace CO_2 is slowly absorbed by the wort. If you do not have a spunding valve, check the keg's pressure periodically and if the souring keg's pressure actually increases (unlikely), bleed some of it off using the pressure relief valve.

The *Saccharomyces* fermentation will be somewhat slowed by the acidity of the wort. This is normal. The yeast is operating under less than ideal conditions (low pH), but will get the job done.

For a more tradition Gose, hop to 8 IBUs in the boil with any noble hop, skip the raspberries and the secondary, and package the beer when it reaches terminal gravity.

MANGO HABANERO CHERRY BOMB SAUCE

(Approximately 60 fluid oz. (1.75 L) finished hot sauce)

Though not a beer recipe, this hot sauce made with Lactobacillus*-fermented hot peppers is another use I have for my "kettle" souring keg. It's a cleaner tasting alternative to vinegar-based sauces. The fruit adds sweetness that balances the heat. Use this sauce on eggs, burritos, pizza, or your favorite chip or cracker-like delivery vehicle.*

INGREDIENTS (DAY 1)

4 tbsp. corn sugar
½ Goodbelly StraightShot or 1 Swanson Probiotic *L. plantarum* capsule
48 fluid oz. (1.4 L) spring water or other dechlorinated water
4 oz. (0.11 kg) orange habanero peppers, sanitized, stemmed and quartered
16 oz. (0.45 kg) cherry peppers, sanitized, stemmed and cut into eighths
5 large cloves garlic, sanitized and crushed
Sea salt

INGREDIENTS (AFTER FERMENTATION)

16 oz. (0.45 kg) mango chunks

STEP BY STEP

Pre-Fermentation Process

Stir together the sugar, the Goodbelly or the contents of the *L. plantarum* capsule, and water in a mixing bowl. Add the prepared peppers and garlic. Weigh the mixed ingredients (excluding the weight of the bowl) and add sea salt equal to 3% of the other ingredients' weight, stirring well.

Fermentation Process

Transfer ingredients to souring keg. Seal the keg and purge with CO_2, leaving about 20 PSI of pressure in the headspace after purging.

Allow the *L. plantarum* to ferment the pepper mixture for about 3 days at 95 °F (35 °C) or about a week at room temperature, shaking/swirling the keg daily.

Post-Fermentation Process

Transfer the pepper mixture to a blender and blend until most of the seeds are no longer whole. Pour the contents into a pot and bring to a boil. Reduce heat and simmer until liquid is reduced by about 50%. Transfer to the blender and purée along with the mango chunks. Transfer to the kettle and heat to at least 180 °F (82 °C) and hold for at least 8 minutes. Bottle in sanitized bottles or jars and refrigerate until use.

TIPS FOR SUCCESS:

If fermenting in a container other than a dedicated souring keg, flood the container headspace (if possible) with CO_2 and cover as tightly as possible. Keep the container close to 95 °F (35 °C).

Leaving 20 PSI of pressure in the souring keg's headspace after purging helps ensure positive pressure to keep the keg sealed.

If you do not have a spunding valve, check the keg's pressure periodically and if the souring keg's pressure actually increases (unlikely), bleed some of it off using the pressure relief valve.

Don't worry if your souring keg's thermowell doesn't reach all the way down into the pepper mixture. It will still measure the temperature well enough.

This recipe makes a fairly thick, "toothy" sauce that can be poured very controllably without a "shaker" bottle insert. For a thinner sauce, you could skip the "simmer until reduced" step, but you'd need a blender larger than the typical 2-qt. (2-L) size, or would have to split the final purée step into two stages.

This recipe can easily be scaled up, with all ingredients scaled proportionally, as there is plenty of room in the souring keg. However, the purée steps would have to be split into multiple stages.

As written, the recipe makes a sauce with a "medium" or "medium-plus" heat. For a hotter sauce, increase the habanero peppers and decrease the cherry peppers, while holding the total weight constant. For a smokier, less "citrusy" sauce, substitute red Fresno peppers for the cherry peppers. Finally, try other fruits (raspberries work well) as a substitute for some or all of the mango.

This recipe can be adjusted for heat, consistency, or flavor. One adjustment I have made is substituting raspberries for some of the mango (pictured above).

KETTLE SOUR RECIPE

DANNY'S REDRUM RUOS

(5 gallons/19 L, all-grain)
OG = 1.046 FG = 1.011
IBU = 5 SRM = 13 ABV = 4.6%

The deep red-garnet color from this beer came to existence for a homebrew club Halloween-themed party. While the color could still be achieved with a less malty base grain, it is supposed to add to the fun of the beer. Be sure to go light on the cinnamon, you don't want to overpower the fruit character . . . think more a berry jelly on toast with a crisp snap from the acidity and hint of cinnamon.

INGREDIENTS

9 lbs. (4.1 kg) Best Malz Red X malt
1 lb. (0.45 kg) pale wheat malt
1 oz. (28 g) roasted barley (300 °L)
3 lbs. (1.4 kg) frozen raspberries
3 lbs. (1.4 kg) frozen strawberries
½ cinnamon stick (0 min.)
5 oz. (21 g) dried hibiscus flower (secondary)
1.3 AAU Cascade hops (60 min.)
  (0.2 oz./6 g at 6.5 % alpha acids)
½ tsp. yeast nutrient (10 min.)
2 Goodbelly StraightShots or 4 Swanson Probiotic
  L. plantarum capsules
White Labs WLP001 (California Ale) or Wyeast 1056
  (American Ale) or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Mill the grains and dough-in targeting a mash of around 1.5 quarts of water per pound of grain (3.1 L/kg) and a temperature of 150 °F (66 °C). Add lactic acid as needed to target a mash pH of 5.2. Hold the mash at 150 °F (66 °C) for 60 minutes. Sparge, or mash-out and lauter with enough water to yield a total volume of 5 gallons (19 L) of wort.

Heat wort to 180 °F (82 °C) in the brew kettle and hold for 8 minutes to pasteurize. Chill the wort to 95 °F (35 °C). Transfer the chilled wort to a sanitized, purged souring keg. *Do not aerate*. Add the Goodbelly shots or the inner contents of the Swanson capsules to the keg. Seal the keg and purge with CO_2, leaving about 20 PSI of pressure in the headspace after purging.

Allow the *L. plantarum* to sour the wort for about 48 hours at 95 °F (35 °C), until the pH drops to about 3.5.

After souring, transfer the wort to a boil kettle and add the amount of distilled water expected to boil off over a 60-minute period. Bring to a boil and boil for 60 minutes, adding the hops, cinnamon, and yeast nutrient according to the ingredient list.

Turn off the heat and chill the wort to 68 °F (20 °C) or slightly cooler. Transfer the cooled wort to a "clean beer" fermenter, aerate, and pitch the yeast targeting about 200 billion cells. Ferment at 68 °F (20 °C) until gravity is a few points above terminal.

Thaw and crush the strawberries and raspberries and place in the bottom of secondary fermenter. Using 1 qt. (1 L) of water, make a hot tea with the dried hibiscus flower. Add the tea with flowers to the bottom of a secondary fermenter. Rack beer into the secondary on top of the strawberries, raspberries, and hibiscus tea. Ferment for about a week at 68 °F (20 °C), until the sugars in the fruit have fermented out.

If bottle conditioning, carbonate the beer to around 2.5 volumes of CO_2. If kegging, carbonate as high as 3.5 volumes.

DANNY'S REDRUM RUOS

(5 gallons/19 L, extract only)
OG = 1.046 FG = 1.011
IBU = 5 SRM = 13 ABV = 4.6%

Beets are added to the extract version simply to replace the red hue contributed by the Red X malt in the all-grain version. You could add them before souring, but I added the beets to the boil instead to maximize color extraction.

INGREDIENTS

4.2 lbs. (2.36 kg) extra light dried malt extract
1 lb. (0.45 kg) Munich dried malt extract
2 medium beets, processed (10 min.)
3 lbs. (1.4 kg) frozen raspberries
3 lbs. (1.4 kg) frozen strawberries
½ cinnamon stick (0 min.)
5 oz. (21 g) dried hibiscus flower (secondary)
1.3 AAU Cascade hops (60 min.)
  (0.2 oz./6 g at 6.5 % alpha acids)
½ tsp. yeast nutrient (10 min.)
2 Goodbelly StraightShots or 4 Swanson Probiotic
  L. plantarum capsules
White Labs WLP001 (California Ale) or Wyeast 1056
  (American Ale) or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Fill the brew kettle with 4.95 gallons (18.7 L) water. Heat to about 160 °F (71 °C). Turn off heat, add the extract, and stir to dissolve. Heat wort to 180 °F (82 °C) in the brew kettle and hold for 8 minutes to pasteurize.

Follow the souring instructions from the all-grain recipe. After souring, transfer the wort to a boil kettle and add the amount of distilled water expected to boil off over a 60-minute period. Boil for 60 minutes, adding the hops, beets, cinnamon, and yeast nutrient according to the ingredient list.

Turn off the heat and chill the wort to 68 °F (20 °C) or slightly cooler. Transfer the cooled wort to a "clean beer" fermenter, aerate, and pitch the yeast targeting about 200 billion cells. Ferment at 68 °F (20 °C) until gravity is a few points above terminal.

Follow the remainder of the all-grain instructions.

– Recipe by Dave Green

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WEDNESDAY, MARCH 25, 2020

INSIDER TOUR OF DENVER-AREA CRAFT BREWERIES - You'll tour – and taste – at four different craft breweries in the Denver area during this pre-event optional offering. You'll have the opportunity to meet brewers and ask questions in addition to sampling their beers. Includes a beer-pairing meal. A great way to kick off your BYO Boot Camp experience and check out some of Denver's thriving craft beer scene.

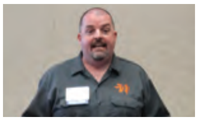
THURSDAY, MARCH 26, 2020 DENVER BOOT CAMPS

Each Boot Camp will run from 9:30 a.m. to 5 p.m. and is limited to just 35 people. Your Boot Camp will include lunch as well as a post-Boot Camp Colorado Beer Reception with local craft breweries pouring samples to wrap up your full day.

TROUBLESHOOTING HOMEBREW FAULTS & FIXES – ***with Ashton Lewis*** – Join *Brew Your Own*'s Mr. Wizard and Technical Editor Ashton Lewis as he walks you through the potential minefield of beer flaws and faults homebrewers can face. You'll learn how to troubleshoot – and fix! – your own homebrews with Ashton who has helped thousands of homebrewers over the last 20+ years troubleshoot common and not-so-common beer problems as *BYO*'s Mr. Wizard. You'll have a chance to experience many faults first-hand to better recognize them later. Plus as a special bonus, bring in your own troubled homebrews and Ashton will use your beer as a live example walking the class through the thought process as he figures out what might have gone wrong with your homebrew and what you can do to fix the problem moving forward.

ALL-GRAIN BREWING ESSENTIALS – ***with John Palmer and John Blichmann*** – Designed for intermediate to beginner homebrewers getting into all-grain brewing, this full-day workshop will cover all you need to know to successfully make great homebrews using all-grain brewing both with traditional and newer techniques. *How To Brew* author John Palmer and equipment guru John Blichmann will take you hands-on through the full all-grain process from milling, mashing, and sparging before going into the boil. You'll get to know the equipment, techniques, and ingredients first-hand and learn all-grain brewing by doing in a small-class environment. They'll also cover newer homebrew all-grain techniques such as Brew-in-a-Bag and No Sparge in addition to traditional mash methods and some advanced tips as well.

RECIPE FORMULATION ESSENTIALS – ***with Brad Smith*** – Learn the best ways to jump into creating your own signature recipes and understand the keys to developing a specific grain bill, hop schedule, and ingredient proportions to meet your homebrewing goals. Brad Smith, owner of Beersmith software and a *Brew Your Own* Contributing Writer, has helped thousands of homebrewers design their own beer recipes and now you'll learn first-hand from this recipe building expert how to use both artistic and scientific approaches to beer design to end up with the beer you had envisioned in your glass. You'll explore ingredients, techniques, and even your own brewing system during this practical boot camp that will get you on the right path to craft your own recipes for better beers at home. Please note Brad will also be offering an advanced recipe design workshop on Saturday as well.



CIDERMAKING – ***with Jason Phelps*** – Join professional Cidermaker Jason Phelps to learn all the steps you need to know to successfully craft your own hard cider, both still and carbonated, at home. Jason has taught many hobbyists about making hard cider in addition to making it himself at his New Hampshire Cidery every day. He'll have you roll up your sleeves and take you through the process of crushing, pressing, fermenting, all the way to bottling. You'll learn how to choose apples and get to know cidermaking equipment and the tests you need to run on your cider.

ADVANCED ALL-GRAIN TECHNIQUES – ***with Gordon Strong*** – Pull out the mash tun and get ready to learn advanced all-grain techniques hands-on with *Brew Your Own* "Style Profile" Columnist, book author, and President of the Beer Judge Certification Program, Gordon Strong. Gordon will walk you through a world beyond straight infusion mashing with keys to mastering step mashing, sour mashing, and decoction mashing. Plus you'll learn about playing with mash thickness and other ways to control your all-grain wort production. Please note this workshop will also be offered on Saturday as well.

ADVANCED YEAST TECHNIQUES – ***with Dr. Chris White*** – Join Dr. Chris White of White Labs as he discusses how to master different yeast-related techniques including harvesting yeast, figuring cell counts, the dos and don'ts of repitching including steps such as yeast washing, building up a proper yeast starter, storing your yeast samples, and much more. Here's your chance in a full-day seminar format to learn about getting the most from your yeast from one of the true leaders in the beer yeast field.

ADVANCED HOMEBREW HOPPING TECHNIQUES – ***with Dave Green*** – Join *Brew Your Own*'s Dave Green as he explores when and how to add hops to create awesome hop-forward brews. You'll explore the basics of hop biology (and why it matters to us!); techniques and timing of hop usage including mash hopping, boil hopping, whirlpool/knockout hop stand additions, and dry hopping; hop varietal choice strategies including hop pairing/blending; evaluating hops including hands-on hop rubbing and sensory training; and practical usage techniques including hop extracts, boil-hops "management" (bags, filters, free addition), and water adjustments for hoppy beers. By the end of the full day Dave will make sure you are making informed hops decisions and getting the most out of your hops – and into your glass!

FRIDAY, MARCH 27, 2020 BONUS BOOT CAMP SEMINARS, 9:15 A.M. TO 5 P.M.

We are adding a third bonus day to our normal event schedule based on feedback we've received from past attendees who wished they had a chance to learn from all our assembled speakers beyond their Boot Camp workshops. So for 2020, we've scheduled a full day of seven different seminars led by our cast of brewing all stars who will share their knowledge with you on their area of expertise. It will be a full day packed with great tips and techniques from the best in the industry so get ready to learn. Plus you'll have even more time to check out the latest homebrew gear and ingredients with our Boot Camp sponsors located right in the meeting area.

9:15 A.M. – 10 A.M.
Brad Smith on Recipe Design

10:15 A.M. - 11 A.M.
Dr. Chris White on Yeast Propagation for Homebrewers

11:15 A.M. – NOON
Ashton Lewis on Avoiding Brewing's 5 Biggest Mistakes

NOON TO 1 P.M.
Lunch

1:15 P.M. – 2 P.M.
Gordon Strong on Evaluating Homebrew Like a Beer Judge

2:15 P.M. – 3 P.M.
John Blichmann on Layout Designs for Homebreweries

3:15 P.M. – 4 P.M.
John Palmer on Brewing Water Demystified

4:15 P.M. – 5 P.M.
Kara Taylor on Yeast and Fermentation Myths Busted

TURNING PRO & COMMERCIAL BREWERY START-UP: THREE-DAY BOOT CAMP

– *with Steve Parkes* – By popular demand, we're expanding our past two-day Brewery Start-Up Boot Camp to three full days to better cover more material in more depth for you. When you register for this class you will attend it for Thursday, Friday, and Saturday unlike our other offerings.

Opening up a commercial brewery is a far cry from just ramping up the amount of beer you brew. Steve Parkes, who has trained hundreds of pro brewers as lead instructor and owner of the American Brewers Guild, will walk you through the steps, planning decisions, and keys you need to know if you want to open a successful commercial craft brewery. Learn from his decades of expertise and wide range of experience to help you better achieve your goals of turning pro. Over three full days Steve will guide you in depth through all the various elements you'll have to know for the next big step toward starting a craft brewery.

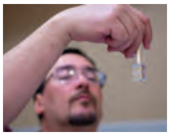
SATURDAY, MARCH 28, 2020 DENVER BOOT CAMPS

Each Boot Camp will run from 9:30 a.m. to 5 p.m. and is limited to just 35 people. Your Boot Camp will include lunch as well as a post-Boot Camp Colorado Beer Reception with local craft breweries pouring samples to wrap up your full day.

ADVANCED RECIPE FORMULATION – ***with Brad Smith*** – Take your recipe creations to the next level by dialing in the specific grain bill, hop schedule, ingredient proportions, and water treatments to meet your brewing goals. Brad Smith, owner of Beersmith software and a *Brew Your Own* Contributing Writer, has helped thousands of homebrewers design their own beer recipes and now he's ready to get in-depth on the details of beer design so you end up with the beer you had envisioned in your glass. You'll explore ingredients, techniques, and understanding your own brewing system during this boot camp designed for advanced homebrewers that will help you craft your own recipes for better beers. This workshop can be taken in combination with Brad's Recipe Formulation Essentials class on Thursday that offers more of an introduction to intermediate and beginning brewers to the concepts of writing your own recipes.

ADVANCED YEAST LAB – ***with Kara Taylor*** – Join White Labs' Laboratory Operations Manager Kara Taylor for some hands-on yeast lab work to develop skills you can bring back home to help you make better beer. Learn how to accurately count yeast using a microscope, culturing yeast, using slants, harvesting yeast, washing and reusing yeast, propagation and determining growth rates, and more. Here's your chance to learn hands-on what you may have read in books and magazines, or listened to in seminars, and Kara's the perfect teacher to lead you through the world of yeast using lab equipment you can source for your home use.

HANDS-ON HOMEBREW SCIENCE – ***with Ashton Lewis*** – Get hands-on with pH meters, refractometers, slants and loops, stir plates, centrifuges, and other brewing science gear with *BYO* Technical Editor and Mr. Wizard Columnist Ashton Lewis. Ashton will walk you through how to best use scientific gear at home to help you improve the quality of your beer. You will have the chance to understand not only how to use and care for the equipment properly, but also how to take the results and put that data into action to produce better beer in your glass. This workshop will focus only on those pieces of equipment suitable – and affordable – for your homebrewery.



BREWING WATER ADJUSTMENTS – ***with John Palmer*** – Water is the least understood ingredient when making great beer. John Palmer, who literally wrote the definitive book on the subject, *Water: A Comprehensive Guide for Brewers*, will help take the mystery out of water's role in brewing and how to make better beer as a result. You'll learn how to read water reports, understand flavor contributions, and how to adjust your brewing water to make different styles of beer. You'll leave with not only an understanding of the chemistry concepts of brewing water, but also the practical how-to aspects of getting the most from from this critical brewing ingredient.

MEADMAKING – ***with Jason Phelps*** – Interest in mead is on the rise throughout North America. Now you can learn all the steps you need to successfully craft your own homemade meads. Join professional Meadmaker Jason Phelps as he takes you through the keys to making a great mead at home including key techniques, yeast selection, fermentation strategies, and more. Learn how to select and work with different honey varieties as well as best practices for adding ingredients such as fruits and spices to your mead.

ADVANCED ALL-GRAIN TECHNIQUES – ***with Gordon Strong*** – Pull out the mash tun and get ready to learn advanced all-grain techniques hands-on with *Brew Your Own* "Style Profile" Columnist, book author, and President of the Beer Judge Certification Program, Gordon Strong. Gordon will walk you through a world beyond straight infusion mashing with keys to mastering step mashing, sour mashing, and decoction mashing. Plus you'll learn about playing with mash thickness and other ways to control your all-grain wort production. Note: This Saturday workshop is a repeat of the Thursday class and is offered twice due to its popularity.

HOME CHEESEMAKING – ***with Pamela Zorn*** – You make your own beer so now it's time to learn how to make your own cheese to pair with it! Pamela Zorn has been teaching people how to make their own cheese for years from her Colorado cheesemaking retail shop. You'll learn hands-on how to craft soft cheeses as well as be introduced to the world of making your own hard cheese plus understand the keys to making great cheese from a variety of different kinds of milk. Get ready to roll up your sleeves with this full-day introduction to the fun world of home cheesemaking – a perfect fit with your homebrewing!

SUNDAY, MARCH 29, 2020

INSIDER TOUR OF DENVER-AREA CRAFT BREWERIES

You'll tour – and taste – at four different craft breweries in the Denver area during this post-event extra offering. You'll have the opportunity to meet brewers and ask questions in addition to sampling their beers. Includes a beer-pairing meal. A great way to wrap up your BYO Boot Camp experience and check out some of Denver's thriving craft beer scene.

Three-Day and Two-Day Registration Options Available.
Full Event Details Available at: BYOBootCamp.com

Photo by Charles A. Parker/Images Plus

ICE, ICE, CIDER

by Jeremy Olsen

Crafting a sweet apple treat

I had my first encounter with ice cider in a seminar at the 2014 Homebrew Con and made my first batch that fall. At the time, there wasn't much information about it in the homebrewing world and I could only find one commercial example locally. Today I am consistently judging excellent examples in competitions and local cideries are starting to produce more and more ice cider. With a little work and effort, as a homebrewer you can make excellent ice cider.

A relatively new cider style, ice cider or *cidre de glace* originated in Quebec in the early 1990s. It has quickly developed into the provincial specialty, earning in 2014 a designated geographic protection, which regulates commercial production of ice cider.[1]

Made by freeze concentrating apple cider prior to fermentation, ice cider is the cider equivalent of ice wine — sweet and thick with complex layers of flavor. There are two different freezing methods utilized to produce the concentrated apple cider must needed for fermentation. It should not be confused with apple-jack, which is typically "jacked" by freeze distillation or the additional of alcohol after fermentation, lending a completely different flavor profile and mouthfeel.

CRYOCONCENTRATION VS. CRYOEXTRACTION

Cryoconcentration is the most common method of freeze concentrating the apple cider, accounting for 90–95% of all commercial production. It is also the method used for homebrewing due to its ease for anyone who does not have a cider orchard in their backyard. Through this method, apples are harvested at peak maturity and pressed just like they would be for traditional cider production. On the commercial scale, the juice is stored until winter temperatures drop below freezing, when at that time the juice is moved to outdoor tanks and allowed to freeze solid in the natural cold of winter. It can take a month or more to fully freeze, with the natural day/night temperature fluctuations creating freeze/thaw cycles that help separate the water crystals from the sugar.

Once frozen, it is moved to a warmer area and slowly thawed as the initial runnings are collected. The freezing point for apple sugars are lower than water, so upon thawing the sugar-concentrated juice will thaw first and drain off, in effect separating the sugar from the water, which remains as ice. Quebec commercial producers typically will stop the thaw process when the specific gravity of the collected run off is between 30–35 °Brix (1.129–1.154 SG) (by Quebec ice cider definitions, the starting gravity must not be any lower than 30 °Brix/1.129 SG). The regulations also stipulate that all freezing must be done by natural cold and not artificial refrigeration, the residual sugar of the final product must be at least 140 gm/L, and producers cannot add any sugars to artificially boost the gravity.[1]

Additionally, Quebec commercial producers of ice cider must cultivate at least 50% of the apples in their own orchard, and all picking, pressing, and fermentation must occur on-site.[2]

The second freeze concentration method is **cryoextraction**, which involves pressing frozen apples. Cortland apples, commonly used for cryoextraction, if not picked, will hang on the tree into winter, slowly dehydrating due to the sun, wind, and cold. Once temperatures drop below 14 °F (-10 °C) for a couple of days in a row, the apples are picked, crushed, and pressed immediately. Other apples that do not stay on the tree are picked in the fall and frozen whole in large totes until it is cold enough outdoors to crush and press. Producers can control the starting gravity of their must by intentionally pressing the apples at warmer or cooler temperatures — even a change of just a few degrees will result in a different sugar-to-water ratio extracted from the apples. Colder apples will result in lower volumes with a higher sugar concentration of the must.

Though more time-consuming and resulting in a lower extraction percentage compared to cryoconcentration, cryoextraction produces a distinctly more complex flavor profile, with some caramel, toffee, and cooked apple flavors that develop during the extended hang time on the trees. On the other hand, ice ciders produced by cryoconcentration tend to produce ice ciders with brighter, fresh apple flavors.

While most cider styles benefit from the use of cider-specific apples, it is preferred to use table or hand apples for ice cider. The high tannin and acid levels of traditional bitter sharp and bitter sweet cider apples become even more concentrated in an ice cider, giving you a finished cider that is severely unbalanced. Cortland, Macintosh, Sparten, and Empire are common varietals used in Quebec, along with some new varietals bred specifically to hang on the tree until harvest, being ideal for cryoextraction.[3] I have had very good luck with the drinking blends produced by my local orchards — there is just enough acid and tannin to balance, but it doesn't become overwhelming when freeze concentrated.

MAKING ICE CIDER AT HOME

Start by sourcing your fresh juice. I recommend calling local orchards to inquire about bulk purchase or checking out your local farmers market in the fall. As in sourcing any fresh fruit juice, it is critical that the cider is unpasteurized — UV pasteurized cider is perfectly fine and will ferment with any commercial yeast pitch, but pasteurized juice with added potassium sorbate or sodium benzoate will not ferment. Commercially-produced shelf-stable apple juice or frozen concentrate will not give you the depth of flavor you are looking for in an ice cider — I have done trials with these in the past, but wasn't happy with the results. This would be the time to add pectic enzyme if you want, although I have not found it necessary to produce brilliantly clear ice cider. Do not sulfite the fresh cider at this point — the freeze concentration will also concentrate the sulfites into the run off, which will produce a tasty apple drink that is quite unfermentable, in my experience.

Pour the juice into a sanitized bottling bucket, carboy, or other vessel, leaving a couple of inches (~5 cm) of head space to allow for expansion during freezing. I use my 10-gallon/38-L bottom outlet mash tun from Stout Tanks and it works perfectly for this, but a bottling bucket with a spigot would work too. I recommend propping up the back to allow for rapid draining of the must as it melts. The key is draining liquid as it melts — this will give you the best extraction volume. Do not use a regular bucket and plan on intermittently pouring out the melting must as it will be very difficult

Photos courtesy of Jeremy Olsen

Making ice cider requires freezing the apple juice. In my experience, it can take a week or more to freeze 10 gallons (38 L) solid. Doing this in a vessel with an outlet at the bottom makes collecting the thawed juice easier.

Collect the concentrated juice as it melts and check the gravity regularly so you can halt collection when the sugar concentration of the juice reaches your gravity.

to hit your target gravity by collecting the juice in larger portions like this.

After transferring the juice to your vessel, loosely cover with a lid or aluminum foil. You do not want to seal it, especially if using a glass carboy, as this may cause the vessel to break as the juice turns to ice and expands. Move it to somewhere that it will freeze and leave it until the juice is frozen solid. I find the 10 gallons (38 L) of cider in my kettle takes at least a week at 20 °F (-7 °C) in an upright freezer. The trick is to make sure the center is frozen solid — if it isn't, you will quickly have run-off of unconcentrated juice. Sanitize your collection container and slowly begin the thaw process. If using a carboy, place upside down over a collection bucket, making sure there is clearance for it to drip down and collect without filling up over the mouth of the carboy. Additionally, I have found wrapping my tank in blankets helps insulate and slow the thaw. My best extractions have taken between 18–24 hours.

Under ideal conditions, at a maximum you will collect 20% of the thawed volume you began with. Start checking the gravity with a refractometer once you get close to this volume, making sure to stir well prior to your measurement to prevent stratification of the must causing false gravity readings. A refractometer is key here given the overall low volumes of the concentrated must making it difficult to use a hydrometer. Stop the collection based on the original gravity (OG) of your must (note that the actual volume will vary based on the gravity of your starting cider and efficiency of the cryoconcentration process). If you overshoot, no worries, just freeze and thaw a second time. What remains behind is nearly all ice with very little sugar. It is not worth the effort to melt and refreeze this, you will get an extremely small amount of additional concentrated must.

Shoot for a starting gravity between 1.129–1.154. It is possible to go up to 1.180 and still be able to ferment with the right yeasts. Ice ciders with starting gravities above 1.154 can benefit from barrel aging as the wood-derived tannins will help bal-

ance the higher residual sweetness. Once the run off is complete, measure the pH and sulfite to 50 ppm. I would recommend waiting until you are done with the run off to sulfite as you don't want to over-sulfite based on an expected volume that wasn't achieved. Given the cold temperatures of the run off and high gravities, I have never had any issues with wild yeasts starting to ferment during the collection phase.

Once collection of the concentrated juice is finished, oxygenate and add yeast nutrients. I prefer Fermaid O and generally shoot for a slightly lower amount than would be added to a mead of a similar gravity. Apples are naturally low in yeast assimilable nitrogen (YAN) so you need some yeast nutrient, but you don't want to encourage too rapid or vigorous of a fermentation.

White wine yeasts work well for ice cider and I have had good luck with 71b, D21, D47, and Wyeast 4184 (Sweet Mead) yeast. Many Quebec producers also use Champagne yeast, although on a home level Champagne yeast will be more challenging to use and get the fermentation to stop at the desired time.

Warm the must to fermentation temperature and temper the rehydrated yeast with small amounts of the must before pitching. Ferment at the low end of the selected yeast's temperature range. I ferment in my basement, which is around 60 °F (16 °C) in the winter. If you do not have a naturally cool location, then a temperature-controlled fridge/freezer will be required. The fermentation of ice cider is cool and slow. For commercial producers, a 6–8 month fermentation is typical, while on the homebrewing scale, I have found my fermentations are complete within a month or two.

There may be a lag period of several days before you start to see signs of active fermentation. A good rate of fermentation would be a drop of two gravity points a day. As ice cider should have a residual sugar of at least 140 g/L and ABV of 9–13%, this cool fermentation is key to stopping it when it has reached the desired gravity. The best way to control your fermentation speed is to carefully manage the temperature — you can always drop the temperature of your fermentation a couple of degrees if it is going faster than desired. Patrick Fournier at Vignoble Et Cidrerie Coteau Rougemont in Rougemont, Quebec, shared with me another method he uses to slow fast ferments if cooling doesn't work, which is to rack off the lees during fermentation. This effectively removes nutrients from the must and will slow the fermentation.

Start checking your gravity daily once you are about 10 points higher than your desired finishing gravity (a residual sugar of 140 g/L equates to a FG of 1.056). I have found that final gravities 1.060–1.070 are ideal for what I am looking for in my own ice ciders. Don't fear the high final gravity — you're not making a saison. Given the relatively small volumes of fermenting ice cider on the homebrew

ICE CIDER
RECIPE

ICE CIDER
(5 gallons/19 L)
OG = 1.144 FG = 1.061
ABV = 10.9%

INGREDIENTS

10 gallons (38 L) fresh-pressed, unpasteurized apple cider
7.5 grams Go-Ferm
6 grams Fermaid O
6 grams Lalvin 71B yeast
Sulfite

STEP BY STEP

Pour the juice into a sanitized bucket or carboy and freeze until the juice is completely frozen solid. Once frozen, move the juice to a warmer location that will result in a slow thaw. Sanitize a collection container and collect the concentrated juice, checking the gravity with a refractometer once close to 20% of the juice has thawed and been collected. When the gravity of the collected juice reaches about 1.144, stop collecting the juice (should be about 2 gallons/7.6 L in my experience). You can continue thawing juice and checking the gravity to see if you can collect enough to make a small batch of a more sessionable ice cider as well.

Making sure to give the juice a good mixing, measure the pH and sulfite to 50 ppm accordingly. Oxygenate and add Fermaid O, shooting for a slightly lower amount than would be added to a similar gravity mead.

Warm the must to fermentation temperature and temper the rehydrated yeast with small amounts of the must before pitching. Ferment cool at the low end of the yeast temperature range. A good rate of fermentation would be a drop of two gravity points a day. Start checking your gravity daily once you are about 10 points higher than your desired finishing gravity.

Crash cooling to 25 °F (-4 °C) and adding sulfite should stop your fermentation. The cider should drop clear in 2–3 weeks, but if not you may need to rack 2–3 times or add a clarifying agent of your choice.

Once brilliantly clear, sulfite one more time to 50 ppm, bottle, and let age for a couple of months to help the flavor and acidity mature and mellow.

scale, I recommend using a refractometer to limit volume loss during gravity checks. I use the EasyDens by Anton Paar that only requires a few milliliters per reading. I think this would be a very good application for a floating hydrometer, such as a Tilt hydrometer. I have never had enough volume to leave a standard glass hydrometer in my fermenter.

Crash cooling to 25 °F (-4 °C) and adding sulfite should stop your fermentation. I have had good luck with my ice cider dropping clear in 2–3 weeks at 25 °F (-4 °C). You may need to rack 2–3 times or add a clarifying agent of your choice if not brilliantly clear. Due to the nature of the slow fermentation, the yeast and haze proteins will drop, resulting in a brilliantly clear product. Commercial producers often sterile filter, but I have not found a need for filtration or other clearing agents in home production. If you end up with a stuck fermentation that is a little sweet, or you miss your desired final gravity and it ends up too dry, save this for blending. It makes the perfect back-sweetener for other ciders or cyser. Or save to blend with other batches of ice cider. I often make several batches every fall, and definitely notice some differences between early and late season batches. Blending is your friend and will really help get the acidity and sweetness just right.

Once brilliantly clear, sulfite one more time to 50 ppm, bottle, and let age for a couple of months to help the flavor and acidity mature and mellow. If you have them, 375 mL clear Bordeaux or Bellissima bottles are perfect for showcasing the rich, dark golden color of your ice cider.

Ice cider has its own Beer Judge Certification Program (BJCP) category, C2D and I refer you to those guidelines for the BJCP style description. At the time of writing, the BJCP guidelines require the entrant to specify the starting gravity, the final gravity or residual sugar, and alcohol level. Ice cider is the only cider category to require such entry specifications, although this may change with future guideline updates.

Ice cider has quickly become my favorite bottle to pull out at tasting events or when having friends over for dinner. It is sweet, with just enough acidity and tannin to balance the sweetness and not come across as cloying. It pairs well with desserts, blue cheeses, or standing alone as an after-dinner aperitif.

In my conversation with Fournier, his recommendation for crafting an excellent ice cider is to "balance the sugar and acidity. Alcohol should be the third wheel." I couldn't agree more. Ice cider is an exercise in balance — sweet but not cloying, a perception of alcohol but not a booze bomb. BYO

REFERENCES

[1] https://cidreduquebec.com/en/the-cider/quebec-ice-cider-designation/

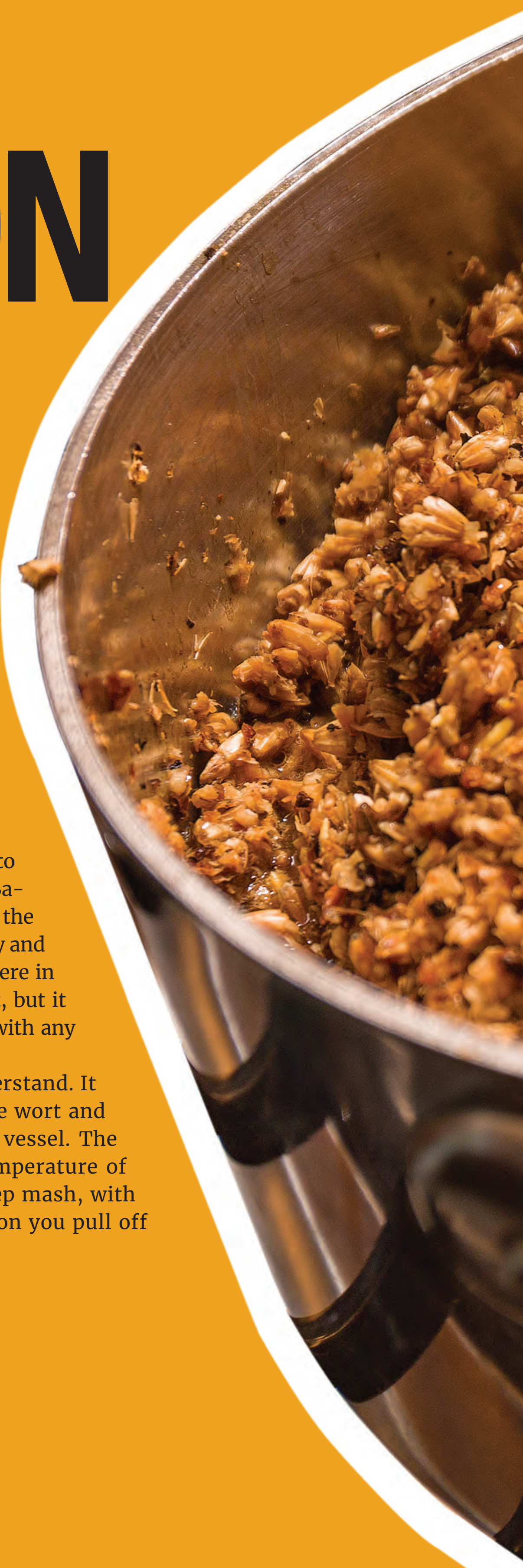
[2] https://corridorcanada.ca/resource/le-cidre-de-glace-delectable-fusion-du-terroir-et-de-lhistoire/?lang=en

[3] https://goodfruit.com/ice-cider/

THE DECOCTION MASH

by Brad Smith

The methods and madness of decoction



Decoction mashing has both a mystic and feared quality to it. Purists imagine achieving perfection in the ultimate Bavarian or Bohemian lager. The more pragmatic of us fear the time-intensive triple decoction with its grueling brew day and extended mess. Like most things, the truth lies somewhere in the middle. Decoction mashing is not done without cost, but it can also add a unique character to beer that is difficult to replicate with any other method.

The foundation of the decoction technique is not hard to understand. It is a method for heating your mash by extracting a portion of the wort and grains from the mash and bringing them to a boil in a second vessel. The boiling mixture is then added back to the mash to raise the temperature of the mash as a whole. It is most often done as part of a multi-step mash, with decoction used for each step after the first. By varying the portion you pull off and boil you can accurately control the temperature for each step.

Photos by Charles A. Parker/Images Plus

Pull your decoction fraction from the thickest part of the mash, or use a strainer to pull the decoction portion from the mash.

Decoction is most closely associated with European lagers, though it can also be done with ales. In particular, many of the Bavarian and Bohemian beer styles were traditionally made using decoction, though the practice spread to other breweries around the world.

The decoction method provides a rich, bready maltiness beer drinkers closely associate with German lagers, and also excellent wort clarity that likely aided in development of the first light-colored lagers. There are some additional technical benefits that we'll cover in more detail shortly. The downside of decoction is mainly in terms of time. It takes substantially longer than a simple infusion mash, especially if you want to perform the traditional triple decoction mash.

HISTORY OF DECOCTION

Decoction has its roots in ancient brewing techniques. While it's hard for many of us to imagine life before cell phones, the thermometer is a fairly recent invention, as is modern brewing science. Daniel Fahrenheit invented the alcohol thermometer in 1709, but it was not widely used until much later. Similarly we had little scientific understanding of the subtleties of the malting process, mash enzymes, or what temperature ranges were best for mashing. As a result, the malts used were often undermodified (lacking the digestion of cell walls during germination) and the mash process itself involved a lot of convoluted steps.

Going back to medieval times, Mika Laitinen's recent book *Viking Age Brew: The Craft of Brewing Sahti Farmhouse Ale* describes the ancient farmhouse process of brewing beer. Beer was made locally, with local ingredients, usually in the same location it was consumed. It was mashed in wooden vessels, as metal was expensive and often rare. Hot stones were added from the fire to a wooden mash tun to heat the water and grain.

Since neither the temperature nor process was well understood, the mash temperature would slowly be raised by adding more stones over a period of hours until it reached boiling, and there was no separate boil stage. This long process had advantages for converting the often undermodified malts as lower temperature stages allowed time for cell wall digestion and phosphate release needed for sugar conversion. The wort was then lautered, often over a filter bed with herbs or spices to infuse flavor, and then fermented either open or with reharvested yeast.

As brewing moved from home to commercial settings, a dizzying variety of mash techniques were developed. Most were quite complex by modern standards, as brewers struggled to make enough fermentable sugars to produce good beer. Georges Lacambre describes in his 1851 book, *Traité Complet de la Fabrication des Bières*, some insanely convolut-

While heating the decocted portion up to a boil you want to stir it constantly to reduce the chance of scorching the grains at the bottom of the pan.

ed Belgian brewing practices of the time involving five vessels, baskets, pans, strainers and "eight to ten strong brewers" to manage the whole process. Multi-step mashes, perhaps derived from the ancient mash process, were quite common though the method for heating and boiling the wort had evolved.

Unfortunately I could not find a definitive time or location for the invention of decoction mashing. The technique became commercially popular in Bavaria and Bohemia regions, but most of the techniques we now recognize as "traditional" decoction techniques were likely developed in the 1800's. Pilsner Urquell is the first brewery cited to use decoction methods, and it was established around 1840. The great German breweries we associate with decoction were all established after that date.

Though the lack of thermometers and well-modified malt are often cited as a reason behind decoction, very likely the momentum of "tradition" played a larger role. In fact, by the 1800s both well-modified malts and thermometers were available. The significant advantage of decoction mashing is that it provided a very repeatable process to achieve a multi-step mash at precise temperatures and also it was simpler than some of the convoluted multi-step mash procedures that preceded it. Also as the technique was perfected, it resulted in highly fermentable wort of improved clarity, which was critical for the development of the lighter-colored European lager styles it is so closely associated with. Light lagers were also a mid-1800s invention, as darker ales dominated commercial beer production prior to that date.

In examining the history of decoction mashing, it is indeed hard to separate the technique from the development of lightly-colored lagers. Pilsner Urquell, released in 1842, is widely cited as the first commercial pale lager, though many dark lager styles predate it. It was followed quickly by the release of a wide number of lager styles we associate with Bavaria and Bohemia. By 1870, lagers made up 97.9% of the production in Bohemia.[1] With the development of rail transportation and refrigeration, the light lager craze spread across the globe, becoming the most popular beer style worldwide in the late 1800s. Despite the American craft beer revolution, Pilsner is still the dominant beer style by a wide margin both inside and outside the US.

THE ADVANTAGES AND DISADVANTAGES OF DECOCTION

Before we dive into the fine details of decoction mashing, let's discuss some of the advantages and disadvantages of decoction. First, we need to acknowledge that decoction mashing breaks some of the modern fundamental rules of mashing. Yet, breaking these rules turns out to also be a key to the method's success.

For example, when I learned all-grain brewing, I was taught to never raise the temperature of the mash above 178 °F (81 °C) or I would risk extracting tannins. However, decoction does exactly that — in fact it brings a portion of the mash to a boil multiple times! How can this be? Well it turns out that temperature is

After the decoction fraction reaches a boil, mix it back in with the primary mash to raise it to the desired temperature. This is done up to three times if performing a triple decoction.

not the critical factor driving tannin extraction and in fact the pH, particularly during the sparge, drives most of the excess tannin extraction. The pH in a decoction mash does not rise high enough to promote excessive extraction of tannins.

The other obvious oddity is direct heating of the decoction itself. Most homebrewing systems are designed to avoid directly heating the mash tun to avoid scorching or darkening the grains. Instead they use infusions of hot water heated separately or a recirculation method to avoid directly heating the grains. However, in decoction we extract a portion of the mash to a separate vessel and bring it to a full boil with direct heat. This does risk scorching the grains, so care must be taken to constantly stir the decoction, however this direct heating is also responsible for developing much of the malty character we associate with decoction.

A unique malty finish to the beer is a critical advantage of decoction. While single-infusion mash brewers often attempt to replicate this effect using melanoidin malt, it is difficult to achieve the exact decoction flavor. Directly heating a portion of the grains to boiling creates melanoidins, which are a major color/flavor compound in the malts via a Maillard reaction. This slightly darkens the malt but also produces a slightly higher content of high molecular weight polymers that contribute maltiness and body to the finished beer. Munich malts, which are a large part of the grain bill for many Bavarian beer styles, have a high melanoidin content that is enhanced by decoction.

Boiling a portion of the mash also helps to break down the cellular walls in the grains. This releases additional enzymes and substrates from the endosperm into the mash, which generally results in slightly higher overall conversion rates and fermentability in a decocted beer. Breaking down proteins in the cellular walls of the grains may also contribute to enhanced clarity in the finished beer.

Clarity is another advantage of the decoction method. As a portion of the mash is decocted and boiled, the proteins in the wort tend to coagulate and fall out. For a triple decoction mash, three different boils may be used giving a portion of the wort three chances to eliminate some of the protein. Reducing the protein remaining can result in much clearer wort and a clearer finished beer.

The only disadvantages of decoction mashing are the added complexity in terms of equipment and time. To perform a decoction you generally need a separate mash vessel with a heat source to bring the decocted portion of the mash to a boil, in addition to the original mash tun, which still needs to be able to maintain its temperature during long decoction steps.

Aside from the added equipment, decoction can easily add several hours to your brew day depending on how many stages you use. Each decoction must be drawn off, measured, slowly heated to a boil while constantly stirring, and then mixed back into the main mash to complete each step. A complex triple decoction can easily turn into an all-day affair.

VARIATIONS IN DECOCTION

Before you start a decoction mash you need to select a mash schedule. Since decoction is a technique you could apply to any mash step, it could be used with any step mash profile. The traditional approach is a triple decoction, though obviously a single or double decoction involves a lot less work. When counting steps, the first step is typically reached using a simple infusion of hot water, so a triple decoction actually involves four mash steps, with three separate decoctions after the initial mash-in. You might want to start with a single decoction initially as it is much easier than a triple decoction.

The Triple Decoction

The triple decoction is the traditional approach most brewers associate with Bavarian and Bohemian brewing. The first step is done by adding hot water to the grains in a simple infusion step to achieve a lukewarm temperature of about 99 °F (37 °C). The modern term for this step is called an acid or phytase rest, and it is known to slightly lower the mash pH. Typically it is held for only 20 minutes or so (however, in practice, about two-thirds of the mash stays around this temperature much longer as the first decoction is being heated up).

The first decoction is pulled and used to raise the temperature of the mash to around 122 °F (50 °C) for the second step. While heating the decocted portion up to a boil you want to stir it constantly to reduce the chance of it scorching. The modern term for this is called a protein or beta-glucan rest. It was done to help break down proteins and assist developing enzymes to help mash undermodified malts. However, modern malts are all highly modified, and a protein rest using modern malts can actually reduce protein levels enough to harm the final head retention and body of the beer. As a result, modern brewers typically will skip the protein rest for most barley-based beers and only add a protein rest if brewing beer with a large percentage of protein-rich adjuncts like wheat, flaked barley, oats, or rye. The protein rest typically lasts around 20 minutes.

A second decoction is pulled and used to raise the temperature for the main starch conversion step. This step, which could be anywhere in the 148–156 °F (64–69 °C) range, is where long starch sugar chains are broken down into shorter sugar molecules that are fermentable. This is the main mash step you typically perform in a much shorter single step mash, and will last anywhere from 30 to 80 minutes.

A third decoction is pulled to raise the temperature for the mash-out step and is performed at a mash temperature of around 168–180 °F (76–77 °C). This step slows enzyme activity and also decreases the viscosity of the mash and wort, which will aid in lautering. Typically this is a short step, only 5–10 minutes before you go directly into your lautering process.

While the triple decoction is the standard most closely associated with Bavarian and Bohemian beers, there are alternatives that take less time and still achieve most of the character of a triple decoction.

The Double Decoction
A double decoction is identical to the triple decoction, except that it skips the first decoction and first mash stage (the acid/phytase rest). Instead, the first infusion of water is used to initiate the protein rest, and then two decoctions are performed to reach the starch conversion and mash out steps. However, since you are not performing the first decoction (which aids in overall efficiency), many brewers will alter the main starch conversion step to choose a slightly lower mash temperature to compensate. For example, they might perform the starch conversion step at 148 °F (64 °C) instead of 152 °F (67 °C). Done properly, a double decoction will retain most of the character of a triple decoction, while cutting the mash time by at least a third.

Single Decoction
The single decoction typically eliminates the later decoction "mash-out" step but preserves the protein rest and main starch conversion step. So you would start by infusing hot water to reach your short protein rest step, and then perform a single decoction mash to reach your main starch conversion step. So only one decoction is performed for this two-step mash.

Many modern brewers don't want to thin the beer with a protein rest, due to the fact that modern malts are all highly modified, and instead will target a higher temperature range for the first step. Often this is just below the typical starch conversion range — around 144 °F (62 °C). Then the decoction is performed to reach a step temperature near 155 °F (68 °C) for the main conversion. This gives you a mash schedule similar to the high/low two-step mash schedule often used with lagers and results in a high attenuation and clean finish on the beer.

Schmitz Process Decoction
The Schmitz process is a homebrew variant of a single decoction that still develops the desired malty character of the decoction without as much effort as a full triple decoction. It is typically done on a stovetop or in another large mash vessel where you have direct heat available.

The Schmitz process can be thought of as a "reverse" decoction. You start by using either an infusion or direct heat to bring the mash temperature up to 150 °F (66 °C), stirring to avoid scorching. Next you let the grains settle to the bottom and instead of pulling the thickest part of the mash off, you actually pull the hot liquid from the top of the mash and collect it in a separate vessel to the side. Now you actually take the thick grain mash and slowly bring it to a boil for 15 minutes, stirring constantly to avoid scorching. Boiling the grain breaks down cell walls and adds color and malty complexity.

Next you need to cool the boiled mash down, stir in the liquid you set aside earlier and continue to mash at around 150 °F (66 °C) until starch conversion is complete.

LET'S DO SOME MATH

Though we've covered the basic decoction process, there are some additional details like how much water to use and how to determine the fraction of mash to pull that are important when performing any of the previously mentioned decoction mash techniques.

While traditional infusion mashes are typically done at a relatively thick ratio of around 1.5 quarts/lb. (3.1 L/kg), it is not uncommon for decoction to use water-to-grain ratios that are as high as 1.9–2.4 qts./lb. (4–5 L/kg). The additional water can reduce the chance of scorching when heating the mash, and was used in many older decoction schedules, but you need to carefully consider what will fit in your mash tun as well as the volume of your separate boiler. Ratios below 2 qts./lb. (4.2 L/kg) are more commonly used and more manageable for brewers.

The first mash step is reached via hot water infusion, just as you would do for a traditional infusion mash. Calculating the water temperature for the infusion step can be done using your brewing software or an online infusion calculator, and you merely heat the water needed to reach the first step temperature and then mix in your grains.

For the decoction steps, you will need to calculate the volume of mash you need to pull and boil. Typically this is expressed as a fraction of the total mash volume. It is best to pull from the thickest part of the mash-grain mixture for each decoction. To get an approximate fraction to pull you can use brewing software or the following equation from Marc de Jong, *Homebrew Digest*:

$$\text{Fraction} = (TS - To)/(TB - To - X)$$

For the equation, ***fraction*** will be the fraction of the total mash volume we are going to decoct and boil. All temperatures are in degrees Celsius. ***To*** is the starting temperature of the mash. ***TS*** is the temperature of the target step we are moving to next. ***TB*** is the boiling temperature, which is 100 °C unless you are working at high altitude. Finally, ***X*** is a factor to compensate for your equipment thermal losses. Typically 10–18 °C is a good number. Use X=14 °C as a starting point, but you can adjust this up if your step temperatures come in too high, or down if your step temperatures are too low.

Here is an example of a decoction with the equation above, using 4 °C (7 °F) for environmental loss.

To = 60 °C
TS = 72 °C
TB = 100 °C
X = 4 °C
Fraction = (72-60)/(100-60-4) = 33%

SOME CLOSING DECOCTION TIPS

At this point, I've covered everything you need to know to perform your first decoction, but here are a few summary tips to make sure your decoction is a success:

- Plan ahead and make sure you

have allotted extra time in your brew day for performing your decoction and also the additional cleanup needed.

- Ensure that you have the extra equipment needed including a separate vessel and heat source to bring the decocted portion to a boil, along with tools (large ladles or small pots and gloves) to safely move large volumes of hot wort around.
- Choose your decoction schedule in advance. For your first decoction, a single decoction or Schmitz process decoction is usually best.
- Determine your water-to-grain ratio up front when calculating the first infusion step, and make sure you have enough volume for both water and grain in your mash tun.
- Calculate the fraction of the mash you are going to decoct at each step in advance, and have a method for measuring the volumes as you pull the decoctions.
- Pull your decoction fraction from the thickest part of the mash (you can use a ladle for a small system, or a pot with a long handle or something similar for a larger home system).
- Have a way to maintain the main mash at a steady temperature while you are decocting the separate portion. Often a mash cooler works well for maintaining a steady temperature.
- When bringing your decoction to a boil, stir it continuously to avoid scorching the mash on the bottom of the boil pot.
- Be very careful moving around hot pots and transferring large volumes of boiling hot mash. It is very easy to get burned, so use gloves and ladle the mash back and forth, or perhaps using a small pot rather than trying to dump hot mash directly between vessels.
- You can use small volumes of hot or cold water to adjust the step temperature if you don't precisely hit your target temperatures.
- When the mash is done, you lauter, boil, chill, and ferment your beer just as with any traditional beer, so don't make changes outside of the mashing process to your regular routine.

CONCLUSION

While some brewers do see decoction mashing as a real chore, it can be fun to get a few friends together and make a day of it and try something new. The precise malty but clean finish you get from a decoction mash is nearly impossible to duplicate using other methods. Decoction is a great way to add something special and unique to your beer, and is appropriate for a wide variety of European beer styles. I hope you enjoy your first decoction and the unique beer you've made! BYO

REFERENCE

[1] Pasteur, Louis, *Studies in Fermentation*, 1879. English translation reprinted 2005 Beerbooks.com ISBN 0-9662084-2-0 p10. Citing *Moniteur de la Brasserie*, 23 April 1871.

BY DREW BEECHUM & DENNY CONN

RECIPE DESIGN

Our six philosophies to beer construction

This time around we're talking about recipe design, how you think about it and approach it. No, we're not giving you any "rules" for recipe design . . . we're not those kinda guys! We're going to talk about how you think about designing a recipe — the philosophy of design — not tell you what goes into it. We want to help you figure out how to approach recipe design. Knowing how you think about a recipe will help you focus on what the recipe should be. Exercising recipe mindfulness improves your brewing execution and reduces your number of "failed" recipes.

Broadly speaking, there are two ways to design a beer recipe. You can use the bottom-up approach: Look at your ingredients to decide what to make. Alternatively, you can use the top-down approach: Start with how a beer tastes (physically or conceptually) and figure out how to get there. Both of those methods have their own merit. Sometimes you come across a stray pound of Galaxy™ and need to figure out what to do with it! (If this happens to you, call us.) Other times you think, "I want a bright, citrusy pale ale."

Usually recipe design goes like this: "What do I want to make? IPA it is!" Then you look at the ingredients you have on hand and they don't quite fit the bill. But you have a little of this and little of that, you plug it into your recipe software, and at least the numbers look right! You brew it and then probably think, "Hmm . . . that didn't work. Maybe next time I should just go out and buy the correct ingredients."

You have fallen prey to the common pitfalls: Too much stuff and not enough understanding of ingredients, processes, and style. You're shooting in the dark and your beer suffers for it.

Over the years, we've identified a few types of recipe design.

1. More is Better
2. What Have I Got?
3. Tweaking Another Recipe
4. Every Beer Tells a Story
5. The Roadmap
6. Less is More

Let's look at each of them.

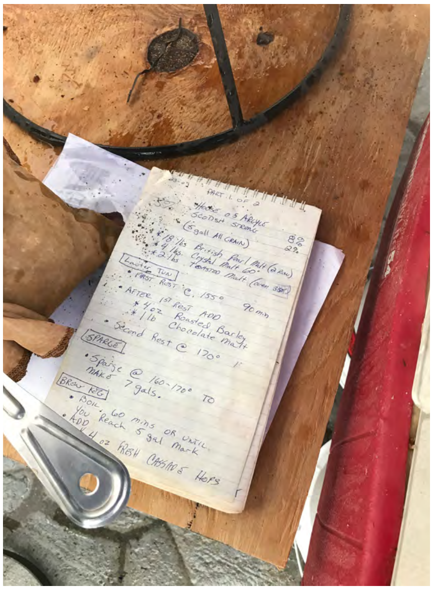
MORE IS BETTER

OK, let's be honest . . . who hasn't done this? And if you answer "not me," then you may be the only one! This is especially common in newer brewers. You're so excited by the world of ingredients out there that you want to try them all. And you're so anxious to try them that you can't wait to add some of them to one batch and others to another. You want the world and you want it NOW! (insert Jim Morrison/Doors reference . . . what, you're not that old?) This is an example of the bottom-up approach.

Let's look at a "more is better" recipe. You start with some pale malt as a base. Then add some Vienna malt for depth. Maybe a bit of melanoidin malt for richness. You need wheat for head formation, and of course, some carapils for body. You think, "every recipe I see has crystal 60 in it, so I'll throw some of that in." A little brown malt for color, and some Munich malt because who doesn't like Munich? Seven different hops will add complexity, and then you age it in a Hungarian goulash barrel (don't ask!) just because you can. And you end up with a muddled mess. There is no direction, no point, to the beer. It's just a bunch of ingredients thrown together.

Remember, more is not necessarily better, but neither is less. Use whatev-

Exercising recipe mindfulness improves your brewing execution and reduces your number of "failed" recipes.



Specialty grains should have a purpose in every recipe you design.

er it takes to make the beer you want, but understand why every ingredient is in there and what it brings to the beer party in your glass.

WHAT HAVE I GOT?

A variation on the "more is better" theme is the "what have I got?" method. Sometimes also known as the "kitchen-sink recipe," this is when you decide to clean out the grain bins, throw it all together and see what happens. It may work, or it may not. In the immortal words of Dirty Harry, "are you feeling lucky?" The upside is that at least your grain bins are empty and you can start over collecting ingredients. And make no mistake; you can make a really good beer like this. You just won't know until after you've made it.

And if you don't take really great notes — you'll never make it again! Although sometimes that might be the point.

TWEAKING ANOTHER RECIPE

You can use a previous recipe of yours, or one from a friend or book, and try tweaking it to make a different beer. This isn't a bad place to start, assuming that the recipe you're tweaking is sound. You need to decide that for yourself, or talk to someone who's made the recipe before. At this point, Denny would like to implore you . . . make the recipe exactly as written before you start tweaking. If you don't, then you probably have no idea what that beer is like (brewed on your system) and what you may want to change. Yeah, we know that almost none of you will do that, but for Denny's sake, at least THINK about it!

When you tweak a recipe, it's important to change only one thing at a time so you can realistically assess the changes you've made. Before you do anything, think about how your tweak will affect the base recipe. The answer might even be, "I don't know, but I want to find out how this hop works in there." That's valid. But just don't change two hops at the same time!

EVERY BEER TELLS A STORY

This is one of Drew's favorite ways to design a beer. Beers like his Cookie Celebration Ale, Saison Guacamole, and even the dreaded Clam Chowdah Saison. It's a great opportunity to use locally- or home-grown ingredients to make beers that have a personal connection to them.

The thought process is pretty simple — what's the story and how does that work in a gustatory fashion. Before the Cookie and Chowdah beers were pretty straightforward translations. What goes in an oatmeal raisin cookie? (One of Drew's favorites for his favorite dog.)

The Chowdah was a bit harder because we object to the idea of chucking a cream-based soup in our beer. (Not that that stops a number of breweries out there.) Instead, that beer was designed to emulate the aspects of what makes chowder, chowder. . . potatoes lent a creamy silky mouthfeel; thyme, bay leaves, and pepper corn, the herbaceous quality; and finally the clams? Well, they gave the brininess! (And yes, you could just use salt water.) Break it down.

For things non-culinary, you need to break down the aspects that make the story work. When doing a beer in memory of the late Hunter S. Thompson, Drew used poppy seeds, mushrooms, hemp seed, Jack Daniels, and Coca-Cola to riff on Hunter's legendary drug consumption. (Think about it for a few minutes.)

Find a story and let it guide you!

THE ROADMAP

This is how Denny usually approaches a recipe. He "tastes" the beer in his head and tries to break down the component flavors, then figure out what ingredients he needs to get those flavors in the beers. He imagines what every component will add to the beer as he builds it up in his mind. The main rule here is "if you don't know why something is there, leave it out!" This is how his Bourbon Vanilla Imperial Porter recipe came about (see page 101 for Denny's Bourbon Vanilla Porter recipe). He wanted to make a beer to give to friends for Christmas. Normally that would be a barrel-aged something or other, but time was short and he didn't have a barrel anyway! So he thought about what a Bourbon barrel might bring to a porter. The first two things he thought of were Bourbon (DUH!) and vanilla notes from the wood. OK, maybe not vanilla like you get from vanilla beans, but it sounded good. He brewed a couple batches of the base porter to make sure it was going to work, then started working on the vanilla and Bourbon additions. (By the way, Denny is big on brewing test batches until he gets the beer he has in his mind.) The beer turned out to be a hit not only with his friends, but also with the thousands of homebrewers who have made it in the years since its inception.

> **"Whatever you do — don't go crazy with your choices. That's how you get things that are unfocused."**

LESS IS MORE

We started with the school of more is better, so it only makes sense that we end with its philosophical opposite. We think ultimately, this is where brewers drift over time. Denny's philosophy of leaving out things of unknown impact is a loose way of saying, "use the least things needed." But some folks really like structure.

The big one on the internet is the Single Malt and Single Hop methodology. The rule is there in the name. We often see a number of posts about, "I'm making a SMaSH pale ale with XYZ hops." So many in fact, that it often feels like that's the only thing homebrewers can think of! But look throughout brewing history and you'll see a number of beers that fit the SMaSH profile – the classic being a solid Pilsner. Think about it — it's a good Pilsner, properly mashed and then boiled classically with Saaz hops. That's kinda it. You can make a classic English barleywine with a ton of Maris Otter and a long boil.

But if that's too restrictive for you, Drew has a notion called Brewing on the Ones. It's less restrictive than SMaSH, but the idea still remains — use only one base malt, one crystal malt, one hop, etc. Whatever you do — don't go crazy with your choices. That's how you get things that are unfocused. In the brewing world, this almost becomes a default because most breweries aren't going to store 30 different types of malt used in weird quantities. You can see lots of beers in the wild that follow this principle — the classic pale ale, a hefeweizen, a Belgian tripel, etc.

Here's the thing — you don't have to hew religiously to any of these philosophies. Fanatical "Drewids" aren't going to hunt you down for putting a second roast malt in your stout recipe. Denny's not going to demand to see the map before he pulls over his mash tun. Mix, match, choose, but above all else be aware of what you're using and why you're using it!

Now that we've looked at how you think about designing recipes, it's time to look at how you tweak an existing recipe and evaluate the changes you've made. But we're out of space, so that will have to wait until the next issue's column!

BOURBON VANILLA IMPERIAL PORTER

(5 gallons/19 L, all-grain)
OG = 1.086 FG = 1.028
SRM = 45 IBU = 32 ABV = 7.8%

INGREDIENTS

12 lbs. (5.4 kg) 2-row pale malt
2.5 lbs. (1.13 kg) German Munich malt (10 °L)
1.5 lbs. (0.68 kg) brown malt
1.25 lbs. (0.57 g) chocolate malt (350 °L)
1 lb. (0.45 kg) crystal malt (120 °L)
0.5 lb. (0.23 kg) crystal malt (40 °L)
9.8 AAU Magnum hops (60 min.) (0.65 oz./18 g at 15% alpha acids)
2.4 AAU East Kent Goldings hops (10 min.) (0.4 oz./11 g at 6% alpha acids)
½ Whirlfloc tablet (5 min.)
Wyeast 1450 (Denny's Favorite 50 Ale) or SafAle US-05 yeast
⅔ cup corn sugar (if priming)

STEP BY STEP

Mash at 155 °F (68 °C) using 23.6 quarts (22.2 L) of water for 60 minutes. Lauter as you normally would. Bring wort to a boil. Total boil time is 70 minutes with the first hop addition 10 minutes into the boil and the second hop addition during the final 10 minutes. Add the Whirlfloc with 5 minutes remaining.

Chill the wort down to yeast-pitching temperature, aerate heavily, and pitch a sufficient starter (or 2 packets) of yeast. Ferment around 66 °F (19 °C).

When fermentation is complete, split 2 vanilla beans lengthwise. Scrape all the seeds and "gunk" from them and add it to the fermenter. Chop the beans into 2–3 in. (5–7.5 cm) long pieces and add them, too. Leave in secondary for 10–14 days, then taste. You want the vanilla to be a bit on the strong side since it will fade. If the vanilla flavor is adequate, rack to bottling bucket or keg and add approximately 375 mL (1.6 cups) of Jim Beam Black Bourbon. You don't need to use an expensive Bourbon, and you don't want to add a lot. The beer shouldn't scream "BOURBON!" at you. You should have an integrated flavor of the chocolatey porter, vanilla, and Bourbon. This beer does not benefit from extended aging. I prefer it within a few months of brewing. The FG should be in the mid-high 20s, so don't worry about trying to get it lower.

BOURBON VANILLA IMPERIAL PORTER

(5 gallons/19 L, partial mash)
OG = 1.086 FG = 1.028
SRM = 45 IBU = 32 ABV = 7.8%

INGREDIENTS

6.25 lbs. (2.8 kg) light dried malt extract
2.5 lbs. (1.13 kg) German Munich malt (10 °L)
1.5 lbs. (0.68 kg) brown malt
1.25 lbs. (0.57 g) chocolate malt (350 °L)
1 lb. (0.45 kg) crystal malt (120 °L)
0.5 lb. (0.23 kg) crystal malt (40 °L)
9.8 AAU Magnum hops (60 min.) (0.65 oz./18 g at 15% alpha acids)
2.4 AAU East Kent Goldings hops (10 min.) (0.4 oz./11 g at 6% alpha acids)
½ Whirlfloc tablet (5 min.)
Wyeast 1450 (Denny's Favorite 50 Ale) or SafAle US-05 yeast
⅔ cup corn sugar (if priming)

STEP BY STEP

Place the crushed Munich and brown malts in a large muslin bag. Mash at 155 °F (68 °C) using 9 quarts (8 L) of water for 45 minutes. Add crushed chocolate and crystal malts to a separate muslin bag. After the 45-minute mash is complete, add the specialty grains. Steep for 15 minutes. Remove both grain bags and rinse with hot water. Top off kettle to about 6 gallons (23 L). While the heat is off, stir in the dried malt extract, stir until all the extract is dissolved. Bring the wort to a boil. Total boil time is 70 minutes with the first hop addition 10 minutes into the boil and the second hop addition during the final 10 minutes. Add the Whirlfloc with 5 minutes left.

Chill the wort down to yeast-pitching temperature, aerate heavily, and pitch a sufficient starter (or 2 packets) of yeast. Ferment around 66 °F (19 °C). Follow the remainder of the all-grain instructions.

FORCED CARBING

Don't take this ingredient for granted

We take great care in selecting our ingredients but we make almost no distinction as to the quality of our carbon dioxide (CO_2) and the precision with which we use it. Carbonation plays a significant role in developing the mouthfeel, aroma, flavor, and presentation of the beer. CO_2 is also weakly acidic, so it can affect the pH of the final beer. For this column I'll be focusing on the bottled form of carbon dioxide that many of us buy from a local homebrew shop or gas shop. So let's take a little time to understand the intricacies of this ingredient to help us maximize our time, effort, and investment in every beer we brew.

CO_2 is a handy and often-used tool by brewers to move liquids around (racking), flushing the oxygen from storage vessels (purging), and of course the most important — providing CO_2 to force carbonate kegged beer. Carbonating a keg is something I always see questions about. While it is a very simple concept there are a few things to keep in mind and a few errors in the way we are taught. So let's start this journey by learning about some of the traps we may fall prey to.

OUR HANDY CO_2 CHART

The first thing we are taught is to find a reliable CO_2 chart that will guide us through the forced carbonation process. The two main variables found on these charts are temperature and pressure. Often our kegerators are set to a certain temperature, so the temperature is often a fixed setting. The pressure from the CO_2 tank can be changed rather easily thanks to our regulators, so often we will adjust the pressure in the keg to adjust the carbonation level of the beer. Therefore, for most brewers, the pressure on the beer is the control point . . . in other words, the thing that gets adjusted to get our desired level. When we line up the beer's temperature with the keg's pressure we assume to find the carbonation level.

So the first major decision we need to make when we are ready to package the beer is: What carbonation level am I seeking for this beer? As an aside, I have noticed that the CO_2 levels over the last 10 years have been creeping up. Beers styles that were commonly 2.6 are 2.8 now. But I digress — many homebrewers may be running several kegs on one regulator. So if your kegerator is run on one regulator you may be left with doing a "best-fit" carbonation level . . . one that will work for all beers you have on tap. But for those more invested brewers, having multiple regulators allows you to have simultaneous kegs running at various carbonation levels. Something to think about!

My suggested CO_2 levels:

- Cask ales: 1.5 to 2.0 volumes
- Ales: 2.3 to 2.6 volumes
- Lagers: 2.4 to 2.6 volumes
- Highly carbonated beers: 3.0+ (Note: Champagne is 6.3 and requires a special bottle.)

The carbonation chart will guide us to a specific pressure to set our regulator based on the gauge found on said regulator. This is where we may run into potential problems with the CO_2 chart. You may not actually get the desired volume you were looking for when you pour your beer. Let's look at some of the considerations not listed on a standard CO_2 chart. One source of error is the difference between the gauge's pressure and something called absolute pressure. We read gauge pressure as the difference (or delta) in pressure

If you're a brewer that likes to carbonate from the bottom of the keg, unitank, or serving vessel, then that different contact point affects the gauge pressure too.

Photo by Laura Schott

Multiple regulators allow brewers to carbonate and maintain kegs in their kegerator at different levels while also utilizing CO_2 as tool.

between atmospheric and the keg pressure. But carbonation levels only care about absolute pressure, which is the difference between a vacuum and the keg pressure. To get absolute pressure we need to add 14.7 psi (100 kPa) at sea level to our chart (this should already have been incorporated into the chart though). Atmospheric pressure drops roughly 0.5 psi (3.5 kPa) every 1,000 ft. (305 m) gained in elevation. So in Denver you need a full 3 psi (21 kPa) over the chart to get your beer to your carbonation level.

If you're a brewer that likes to carbonate from the bottom of the keg, unitank, or serving vessel, then that different contact point affects the gauge pressure too. This "bottom up" approach to forced carbing can help speed things up, but we also need to increase pressure to account for the head pressure resulting from the weight of the beer. As a result, you'll need an additional one psi (7 kPa) for every 28 in. (71 cm) of beer above the carbonation point.

Another source of error is the alcohol. Alcohol has a different CO_2 solubility than water. The standard CO_2 chart was measured with the alcohol at 4.8% ABV. As we move away from this alcohol level the chart becomes less and less accurate. This would be a good place for a curve fit equation but I have always used a liner assumption of 0.32 psi (2.2 kPa) per % alcohol above 4.8%. This is really accurate if we are close to 4.8%. At around 10% it needs some further correction.

Finally, the residual starches and sugars change carbon dioxide's solubility so we need a final gravity correction as well. Our carbonation chart was made with the assumption that the FG is 1.015. As we move away from this number, solubility of CO_2 also changes.

PRESSURE CORRECTNESS

So how do we convert a chart to an equation? Fortunately, beer guru AJ deLange has done a great job of working this out for us already using Henry's Law:

$$P_{absolute} = [(V + 0.003342)/(0.01821 + 0.090115e^{-(T-32)/43.11})] - 14.7$$

P = Pressure (in psi)
V = Volumes of CO_2 (1 volume = 1.96 g/L)
T = Temperature (in °F)

This equation simply allow us to come close to the CO_2 chart data. But for those serving beer at high elevation, serving a big honker of a beer, carbonating from the bottom of a tank, or serving a super dry or super high FG beer, you may consider taking these into consideration.

$$P_{altitude} = (A/1000) \times 0.53049$$

Where A is altitude in feet is our elevation correction.

$$P_{alcohol} = (AVB - 4.8) \times 0.32$$

Where ABV is alcohol by volume is our alcohol correction.

$$P_{head} = H/28$$

Where H is our height in inches from the carbonation point to the top of the beer is our height correction.

$$P_{starch} = (FG - 1.015) \times 5$$

Where FG is the final gravity is our residual sugar correction.

If we put these all together we end up with our master carbonation equation you could set up in a spreadsheet:

$$P_{corrected} = P_{absolute} + P_{altitude} + P_{alcohol} + P_{head} + P_{starch}$$

This equation can be improved if we make some curve fitting equations (such as the alcohol factor) for some of our corrections but in practice it works very well as is.

As an example, the kegerator is 40 °F (4 °C) and I want 2.8 volumes (5.5 g/L) of CO_2 in my beer. My elevation is 1,000 ft. (305 m), the beer's ABV is 5.5%, the carbonation point is 30 in. (76 cm) down in the tank, and the final gravity reading is 1.009. Plug it into my spreadsheet and I find my $P_{absolute}$ is 15.4 psi (106 kPa), $P_{altitude}$ is 0.53 psi (3.7 kPa), $P_{alcohol}$ is 0.22 psi (1.5 kPa), P_{head} is 1.07 psi (7.7 kPa), and P_{starch} is -0.03 psi (-0.2 kPa), meaning I need 17.2 psi (119 kPa) of gauge pressure to hit my desired carbonation level. Note that the pressure in the CO_2 line will not equal the pressure on the top of the tank. Don't use head space pressure here.

A final point to consider is if an air stone is added, often to the bottom of the keg/unitank, we insert a pressure drop called the wetting pressure. Fortunately it is pretty easy to measure the wetting pressure of our stone: Hook up your stone to CO_2 and set the gauge to 0. Immerse your stone in water then slowly increase your pressure until you see bubbles start to form on the stone. This is your wetting pressure that should be added to the equation. Note: If your stone becomes clogged, your wetting pressure will change. This measurement is also a good way to check your cleaning methods.

FORCING A FORCED CARBONATION?

Now that we have our desired pressure we quickly realize that CO_2 takes some time to dissolve into solution. As many of us do, we then try all the tricks to speed up this carbonation process. You'll find folks who will roll the keg, rock the keg, hook up the CO_2 to the beverage-in side and burp the keg, run over-pressure (very high pressure for a day or so) . . . all of these methods have advantages and disadvantages.

Anyone that has force carbonated before knows that dissolving the gas from the surface down through the top of the beer is the slowest method. Its rate is proportional to the surface area of the top of the beer and the volume of the beer. A short flat tank is the fastest. When we fill a corny keg completely full, it is very hard to carbonate from the top because there is very little surface area.

Adding an airstone at the bottom of the keg can help speed things up. This has the advantage of increasing the surface area of the bubbles and lowering the carbonation point lower in the keg helps give the bubbles more contact time before they rise to the surface. This would require a designated carbonation keg though for those brewers with multiple kegs and require added cleaning.

The other methods of shortening the carbonation time also come with disadvantages. The first is over-pressuring

. . . cranking up the pressure for a set time frame then lower it to serving pressure when fully carbed. Over-pressuring the keg runs the risk of over-carbonation. Setting a reminder on your phone can be a helpful way to remember, and be sure to be safe rather than sorry — it is very difficult to lower the carbonation level of a keg once over-carbonated.

Another method popular in the homebrew world is shaking or rolling the keg to increase surface area. This may speed things up, but it also stirs up all of the sediment our aging process has removed. Some fining agents work much better the first time they settle than the second time, making a once clear beer cloudy after agitation.

Partial List of CO_2 Contaminants

Water
Rust
Oils
Benzene
Toluene
Nitrogen Oxides — NOx
Ethanol
Acetaldehyde (apple)
Sulfur Dioxide (rotten eggs)
Dimethyl Sulfide — DMS (corn)
Iso-Amyl (banana)

THE SOURCE OF OUR CO_2

There are many ways to create CO_2, but in the US the dominant methods are recovering CO_2 from an industrial process that would normally be vented to the air. Industrial plants create CO_2 from processes that produce hydrogen or ammonia from natural gas, coal, or other hydrocarbons as well as all processes that use yeast to make ethanol.

CO_2 is purified after capture and divided into different grades. For brewing we use food-grade CO_2. Food-grade can be used for most applications we brewers need CO_2 and most local gas shops only offer this grade (since they have a single system to bottle CO_2). But even food-grade CO_2 comes with contaminants. The one that bothers me the most is benzene. Benzene is an aromatic hydrocarbon often found in CO_2 from petroleum processing. It is usually undetectable but some people are sensitive to the headache it can cause.

Many breweries and taprooms install CO_2 filtration on the CO_2 supply. A CO_2 filter usually has a particle filter, a water trap, an activated carbon stage, sulfur removal stage, and finally another finer particle filter. Homebrewers could install an inline CO_2 filter to their systems as well, but they aren't that cheap, usually around \$150–\$200. One addtion that doesn't cost as much and can easily be added to a draft system is a sterile filter. Adding a sterile filter to the end of lines can protect the gas system from getting back-contaminated by accidental backflows of beer.

Special thanks to Dinesh Padir for help with understanding natural logarithms in this work. He is a physicist, homebrewer, and all around good egg. BYO

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LAST CALL

BY BRUCE GIFFORD

LIFE'S A SYMPHONY

Sweet rewards found in Cologne

I'm sitting onstage in Cologne, Germany, spring of 2005, finishing a concert of American composers' music (which honestly, I don't think the Europeans really wanted to hear but clapped politely for nonetheless). As usual, the duration of the concert combined with the hot stage lights and my position as Principal (first chair) French Horn of the Utah Symphony left me hot, sweaty, and stressed out. As we exited the stage, there were some oddly dressed "waiters" with circular serving trays handing us these tall, cylindrical glasses that looked like props from Star Trek. It was cold, delicious beer!

I wasn't really into beer back then. I knew wine pretty well, and being a native Texan I made a terrific margarita, but beer was my dad's drink, and the smell of Bud Light cans in the trash in Texas summer heat isn't the best introduction to the world of beer.

On this, our big, one and only tour of Europe we were scheduled to play 13 cities in 15 days in Slovenia, Germany, and Vienna. I got to see beautiful hops fields coming up, and as much great beer as we could all find in the limited time we had, but none was better than that first amazing Kölsch.

On our one day off in Germany, the horn section took a train, from Regensburg, to Tiefenried to meet the maker of our instruments, Engelbert Schmid. We of course took the wrong train, he had to come pick us up, and we toured his shop and went to lunch at a tiny inn where he was friends with the owners. We naturally all had a beer, and he laughed at us when we asked for seconds. "You're all going to be asleep!" he admonished, probably hoping we would be buying more equipment.

Being a crazy, obsessive musician type, I got back to America and learned all I could about beer and homebrewing . . .

Being a crazy, obsessive musician type, I got back to America and learned all I could about beer and homebrewing through various books and tons of magazines (like this one). I grew seven varieties of hops, and brewed many types of beers, leaning towards Kölsch of course, pales, English beers, IPAs, and the occasional Belgian golden ale. Several years went by and I increased my library and brewing experience.

My story takes a turn however, when an ominous tingling started in one hand, then the other. My neck had decided to grow extra bone in very inappropriate places. I ended up with three surgeries and three sets of hardware, but the pain only got worse. During that time, my frontal sinus became completely occluded, requiring five surgeries and a complete obliteration to fix. I had to eventually quit performing and realize that I was disabled as I could not lift any significant weight and was in constant pain. It was also painful not being a part of something I worked so hard to succeed at since I was 10 years old.

Needless to say, with the hoisting of heavy tanks of propane and hauling a keg full of wort around; brewing was completely out of the realm of possibility for me. I gave it up for a long time. Then one day while browsing the internet, I saw Blichmann Engineering had coils for heating, and I realized that I could eliminate the major heavy lifting if I retrofitted my brew keg and improvised a tier system. Brewing was no longer impossible!

It might seem like a small thing to most people, but for me, regaining the ability to brew feels like getting a small piece of my life back. The first beer I'm going to brew . . . you even need to ask? A frosty, well cold-conditioned German-style Kölsch! BYO

To find two of Bruce's favorite Kölsch recipes visit: byo.com/recipe/kolsch-two

Photo by Bruce Gifford

One of the many crisp, clean German beers enjoyed over the course of my tour through Slovenia, Germany, and Vienna.