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NOVEMBER 2014, VOL.20, NO.7

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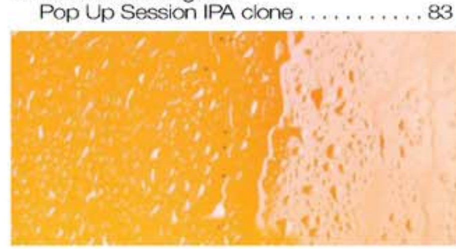

BYO RECIPE STANDARDIZATION

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

Gallons:
We use US gallons whenever gallons are mentioned.

what's happening at BYO.COM

Mead: From Nectar to Nirvana

On page 70 of this issue we take a look at varietal mead. If you want to learn more about making mead in a more general sense this story is a good primer on making the "nectar of the gods." http://byo.com/story1140

A Stroll by the Wandle

Jamil Zainasheff offers a homebrew best bitter recipe "A Bitter to Be Proud Of" with his "Style Profile" column on page 24, but he also came up with another best bitter recipe inspired by Sambrook's Brewing during a recent trip to London. It's online at http://byo.com/story3145

IPA: A Tale of Two Beer Styles

Session IPAs (pages 78–85) are a relatively new breed of IPA. Before those lower-alcohol IPAs became popular, there were two original versions of IPA that captivated the craft beer world. http://byo.com/story921

Pumped Up Toolbox: Projects

The "Projects" column in this issue is a twist on a classic *BYO* project that brought the union of a brewing pump and a toolbox — a portable pump project of prodigious proportions. http://byo.com/story1914

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

Brew Your Own — THE HOW-TO HOMEBREW BEER MAGAZINE

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Volume 20, Number 7: November 2014

Small batch brewing

I enjoyed the small batch brewing article by Josh Weikert in the October 2014 issue of *Brew Your Own*. I think it fit very well with my "Last Call" article on simple brewing in the September 2014 issue: Going smaller also makes it simpler. The only thing I would do differently is not use 1-gallon (3.8-L) carboys as leaving headspace will leave you with less than a full gallon. The WinCo supermarket near my house has 2-gallon (7.6-L) food-grade plastic buckets costing less than $4.50 for bucket and lid. I used one recently to ferment a 1.5-gallon (5.7-L) batch of coconut cider and it worked great.

Steve Ruch
Claypool, Indiana

Brew Your Own *Editor Betsy Parks replies: "Thanks for the suggestions on fermenter size and where to source them, Steve. A slightly larger fermenter is a good idea, especially taking any foaming from fermentation into consideration. Also, thank you again for your 'Last Call' story about simple brewing."*

No-chill brewing

Splendid article on no-chill brewing in the September 2014 issue! I suspect I have a bug in my chill plate or tubing I use from the chill plate to the fermenter. What I wanted to know is whether I can transfer hot wort to a keg and let the keg cool in a kegerator to speed the cooling process, then transfer to a glass carboy to pitch yeast once the wort has chilled in the keg.

Mike Popovec
via emai

Story Author Dave Louw replies: "Hi Mike. Yes, that would probably work. The only thing to watch out for is that as the wort and airspace in the keg cools it will create a vaccum. Kegs are designed for positive pressure, not negative pressure. You have some chance of collapsing the keg due to the negative pressure but I would guess that's unlikely. It's also possible that air will pull in by the seals on the keg. To

contributors

Gordon Strong is the President and highest ranking judge of the Beer Judge Certification Program (BJCP), the organization that certifies beer judges for homebrew competitions and also registers qualifying homebrew competitions. In addition to his Grand Master Level V judge status, Gordon is a three-time winner of the National Homebrew Competition Ninkasi Award and the author of *Brewing Better Beer: Master Lessons for Advanced Homebrewers* (Brewers Publications, 2011). He frequently contributes to *Brew Your Own*.

In this issue, Gordon explores the classic style of the Czech Republic: Bohemian Pilsner. Turn to his story, which starts on page 58, for interpretations from four award-winning homebrewers.

Cary and Brendan Hanson started homebrewing in 2009 and two years later decided to combine their day job talents (graphic designer and e-commerce software developer) to open their business Keg Outlet (www.kegoutlet.com) — an Internet-based store for kegging and fermenting supplies and equipment.

Through their business, Cary and Brendan have had the opportunity to meet many homebrewers as well as professional brewers. The one thing they noticed that everyone agreed on was that controlling fermentation temperature was critical in making great beer. That's where the idea for a "Fermentation Fridge" was born. On page 40 of this issue, the brothers detail how to build a custom fermentation fridge.

Michael Fairbrother is the Founder and Head Meadmaker at Moonlight Meadery in Londonderry, New Hampshire. Michael started making mead at home in 1995. Over the past four years Michael decided to turn his hobby into his career, opening Moonlight in 2010 (which was named for his habit of "moonlighting" as a meadmaker). He boasts more than 50 mead recipes in his repertoire, has been invited by the Robert Mondavi Center at UC-Davis to be a guest lecturer, and was a featured guest speaker at the Australian National Homebrewers Conference this fall. His meads are now available throughout the US and in Australia.

In this issue, Michael makes his *Brew Your Own* writing debut with a story, on page 70, about making traditional mead with single varietal honeys.

be safe I would let it cool to something like 120 °F (49 °C) in the kettle then transfer to the keg and chill the rest of the way. That would be much less likely to create negative pressure issues."

Brewing safety

I do not recall reading in the article about brewing safety in the September 2014 issue of *BYO* about proper, sturdy footwear. Obviously, barefoot is a big no-go. However, sandals, and even canvas shoes, are very dangerous. I watched hot water wick into a canvas sneaker once and the guy had second-degree burns on a good portion of his foot. I use leather in my homebrewery.

Mike O'Brien
via email

Brew Your Own *Editor Betsy Parks replies: "Thanks for writing in, Mike. You bring up a great point that bears repeating — however, it was mentioned in the story. On page 41 the author, Christian Lavender, says: 'I used to brew in flip flops and I can't even remember all the things I spilled or dropped on my feet. After I dropped a carboy and the exploding glass cut open one of my toes, I switched over to boots. Burns and smashed toes are not supposed to be part of the brew day. Go into any commercial brewery and you will see that everyone is wearing some kind of boots with non-slip soles (often rubber boots) and often with steel toes.'"*

Great timing

Perfect timing on the big batch story in the October 2014! Our permits are almost ready, and *Brew Your Own* magazine publishes an article on scaling up to big batches. If that's not fate . . . # craftbeer #hoboken #dreamscometrue

Colby Janisch, Tucker Littleton, and Andrew Brown
902 Brewing Company
Hoboken, New Jersey

Brew Your Own *Editor Betsy Parks replies: "Hi Guys, Congratulations on getting your new brewery off the ground! I'm glad we happened to run the right story at the right time. From your website (http://902brewing.com) I see that you guys have graduated from a 3-gallon (11-L) brewpot to a 15-gallon (57-L) all-grain setup — with more plans to grow. Best of luck riding the craft beer wave and bringing the good people of Hoboken some tasty craft beers. I love hearing about homebrewers who've gone pro and I'll be keeping an eye on you guys on Twitter (@902Brewing) to see how things progress."* BYO

homebrew nation

READER PROFILE:

Brewer: Bradley Shouse

Hometown/State: Mount Orab, Ohio

Years brewing: 4

Type of brewer: Brewer on a budget

Homebrew setup (volume, style, efficiency): Monster Mill, two converted cooler mash tuns, 15-gallon (57-L) electric hot liquor tank, two Bayou propane burners, multiple kettles (15, 11, and 8 gallon/57, 42, and 30 L), and I ferment in a temperature-controlled fermentation chamber. I can brew 10- or 5-gallon (38- or 19-L) batches, usually hitting the standard 75% brewhouse efficiency.

Currently fermenting: Belgian dubbel, Baltic porter, Flanders red, Flanders brown, Russian imperial stout (souring 1 gallon/4 L), and an imperial Oktoberfest.

What's on tap/in the fridge: Citra® blonde ale, harvest ale (100% home grown hops), English mild, and cider for the wife. I'm also bottle-aging multiple barleywines, a Belgian dark strong ale, and a barrel-aged Russian imperial stout.

How I started brewing: I have a tradition to buy myself a birthday present (so I get at least one gift I want), so I ordered the Coopers DIY kit four years back.

A little about the recipe I'm sharing: I've always loved big, strong winter ales. Tröegs Mad Elf has always been wonderful so I thought I could brew this and make it my own. It is a strong beer but the alcohol is well hidden by the long, slow fermentation of the additional sugars. Overall the beer has a lovely light malt flavor, combined with subtle honey and cherry notes, finishing with the Belgian esters complementing and rounding the flavor. It's also a beautiful red color like Mad Elf. A few "tips for success" about the recipe: You should end up with about 6 gallons (23 L) of beer after the addition of the honey and puree. It uses true top cropping yeast so you need a big fermenter. I pasteurized the honey in the oven. Boiling the honey will drive off those delicate honey flavors. I would recommend a 2 qt. (2 L) yeast starter or a 1 gallon (~4 L) starter if you do not have a stir plate. If bottling, condition using Lallemand CBC-1 to ensure proper carbonation.

byo.com brew polls

Do you also make mead?

Yes, frequently 24%

No, but I would like to try 47%

No, I am not interested 29%

reader recipe

Christmas is Cancelled

(5 gallons/19 L, all-grain)

OG = 1.084 FG = 1.017
IBU = 15 SRM = 13 ABV = 10.1%

Original gravity is calculated on brew day additions. The ABV is calculated based on the brew day wort as well as the honey and cherry puree additions.

Ingredients

14.5 lbs. (6.6 kg) 2-row pale malt
3 lbs. (1.4 kg) Best Malz Red X malt (12 °L)
3.2 oz. (91 g) chocolate malt
4.6 AAU Hallertauer Hersbrucker hops (60 min.) (1.25 oz./35 g at 3.7% alpha acid)
1.5 lbs. (0.68 kg) honey (added to fermenter)
2 lbs. (0.9 kg) Oregon sweet cherry puree (added to fermenter)
Wyeast 3787 (Trappist High Gravity) or White Labs WLP530 (Abbey Ale) yeast
Lallemand CBC-1 yeast (if priming)
⅔ cup corn sugar (if priming)

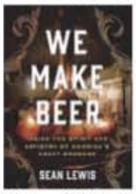
Step by Step

Mash in grain at 154 °F (68 °C) and hold until starch is fully converted, about 1 hour. Mash out at 170 °F (77 °C) and begin recirculation. Sparge with enough water to achieve an appropriate level of wort depending on your boil off rate. Bring to a boil and add your bittering hops and boil for 60 minutes. After the boil, cool to 68 °F (20 °C) and pitch yeast.

Ferment at 68 °F (20 °C). After the initial 24 hours of vigorous fermentation, add the honey (pasteurized, not boiled) to the fermenter. Be prepared for a massive kräusen and have plenty of space in your fermenter for the addition of the fermentables and yeast activity. Allow to ferment another 24 hours and add your sweet cherry puree. After another 24 hours let the fermentation warm up to 74 °F (23 °C). When final gravity is achieved, condition for one week, then add priming sugar and bottle or rack to keg.

what's new?

We Make Beer



On an intensive study of brewing, and later a nation-spanning journey into the heart — and the art — of American beer making, author Sean Lewis found a group of like-minded craftsmen. These brewers weren't afraid to speak their minds, they saw their competitors as cherished friends, they took joy in their work and they sought the same kind of balance in their lives as they did in the barrels they brewed. *We Make Beer* is not just a celebration of American brewing, but of the spirit that binds brewers together. It's about what you can discover in yourself when you put your hands and your heart into crafting the perfect pint. Available at major booksellers.

The Brew Journal

The Brew Journal from Kegs & Code Co. is a traditional solution that brings back the simplicity of logging craft beer recipes with ink and paper. Designed by homebrewers for homebrewers, the layout provides an engaging template to log relevant information during a typical brew day. Includes 13 pages dedicated to reference information including a hop chart, conversion tables, a glassware guide, color and ABV charts. *The Brew Journal* is an innovative yet traditional way of logging your beer recipes and experiments contained in an attractive and durable format. Visit www.kegscode.com to learn more or order yours today.

Real Ales for the Home Brewer

A fully revised and updated second edition of Marc Ollosson's *Real Ales for the Home Brewer* is now available with new tips and recipes. Full of clone recipes based on information supplied by breweries across England and Scotland, this book will get you on your way to making superb real ales. With easy-to-follow instructions, both beginners and seasoned mashers can quickly start brewing classics such as Flowers Original Bitter, Belhaven Sixty Shilling Ale, Whitbread Best Bitter, Castle Eden Ale, Wadworth 6X and Marston Moor Porter. Available at major booksellers.

Sustainable Homebrewing

Co-founder of the country's only cooperatively owned, certified organic homebrew supply store (Seven Bridges Cooperative), Amelia Slayton Loftus has been brewing organic beer since 1995. In her new book *Sustainable Homebrewing*, she shares her expert knowledge on everything homebrewers of all levels need to know to brew delicious, organic beer. Contents include recycling water, using solar energy and achieving zero waste, as well as tips on developing recipes, honing competition skills and a tasting guide to different styles. She also includes more than 30 homebrew recipes. Available at major booksellers.

Palm Springs Air Museum
PROPS
&HOPS
SAT NOV 22, 2014
PALM SPRINGS AIR MUSEUM

calendar

November 1
Motown MASH
Morristown, New Jersey

The Morris Area Society of Homebrewers is hosting Morris County's first homebrew competition sanctioned by the AHA and BJCP. The focus of this competition is to provide valuable feedback to entrants, create a fun experience for judges and volunteers, and help put the New Jersey beer scene on the map. 250 entries in all 23 BJCP categories will be accepted.The entry fee is $8 and entries must be received by November 1. Judging will take place on November 15.
Web: http://mashnewjersey.com/motownmash2014.php

November 15
Butler Homebrew BASH
Butler, Pennsylvania

Organized by the Butler Area Society of Homebrewers, the Butler Homebrew BASH is an AHA/BJCP sanctioned competition. The entry deadline is November 15 and judging will be held November 23. Each brewer will be limited to a maximum of 6 entries and the competition has a 225 total entry cap. The entry fee for this competition is $7 for the first entry and $5 for those thereafter.
Web: www.bash.smythenet.com/bcoem/

November 22
Props and Hops Festival
Palm Springs, California

Held at the Palm Springs Air Museum and shining a light on Southern California craft beer, the 3rd annual Props and Hops Festival in Palm Springs will feature over 40 breweries, a DJ and live music, surrounded by awesome vintage planes. Among other featured activities will be a rare, vintage beer tasting in the sky from inside a vintage airplane and a homebrew competition. The competition entry deadline is November 8 and has an entry fee of $6.
Web: www.palmspringspropsandhopsfestival.com

homebrew drool systems

Flat Brewing Sculpture

Keith Melvill (along with Jeff Paskey, Rob Pearson, and Joe Wallace) • Yucaipa, California

About three years ago at our monthly poker tournament, Rob said his friend had a gravity brewing sculpture, kettles, several kegs, bottling equipment and an immersion chiller for sale for $800. We pooled our winnings and the following weekend brewed our first batches. We soon moved from extract to all-grain and have never looked back. Being in a wheelchair means I couldn't brew alone because I couldn't get to the mash tun. What I needed was a flat brew sculpture. When I suggested this to the others they jumped at it. Turns out no one liked climbing a ladder with 23 lbs. (10.4 kg) of grain.

When we fired up the 90,000 BTU natural gas burners they melted the valves, hoses, everything! I made some heat shields around each burner and a top that guided the heat at the kettle then out the back of the sculpture.

Jeff suggested going with four burners instead of three, that way we could brew two 10-gallon (38-L) batches sequentially. We start the second mash immediately after mashing out the first. This cuts down our brew day by several hours. We can now brew 30 gallons (114 L) in just over the time it used to take to brew 20 gallons (76 L).

The nice thing about brewing with four partners is everything is a quarter of the cost, and brewing turns out to be a social event. We brew about every other weekend and most of the time there are at least three of us there. I think that brewing together is simply more fun, especially since the rule of showing up to brew is to bring a really good beer to drink.

DIACETYL REST

by dawson raspuzzi

One of the most common flaws in the beers brewed by homebrewers who are new to the hobby, particularly in lagers, is diacetyl.

Diacetyl, which has a taste and aroma of butter or butterscotch, is naturally present in all beer during fermentation. Also known as 2,3 butanedione, diacetyl is produced through a chemical reaction outside of the yeast cell when the compound alpha-acetolactate is oxidized by metal ions or dissolved oxygen. It can also be produced from bacteria, most notably *Pediococcus* and *Lactobacilli*.

To avoid diacetyl through bacterial contamination, a consistent cleaning and sanitation routine must be followed. Reducing the naturally forming diacetyl is best done by limiting the beer's contact with oxygen after the start of fermentation (since oxygen causes alpha-acetolactate to convert to diacetyl) and a technique called diacetyl rest — that is, allowing the beer to sit on the yeast a couple of days (or up to a week for lagers) at the end of fermentation and prior to cold crashing, bottling or kegging. At the end of fermentation the yeast will absorb diacetyl into the cell and reduce it enzymatically to 2,3-butanediol. Note that if you plan to rack your homebrew to a secondary fermenter prior to bottling or kegging, the diacetyl rest should be done in the primary fermenter to ensure there is enough yeast to absorb the diacetyl.

The diacetyl rest should be done at the same temperatures as fermentation for ales to ensure a full conversion of alpha-acetolactate to diacetyl, and with enough yeast present to reduce the diacetyl. The diacetyl rest for lagers should be done at similar temperatures as ales, so that means once fermentation is almost complete you will need to bring the temperature up to around 65 °F (18 °C) and hold it there for a few days. This warmer temperature speeds up the conversion of alpha-acetolactate to diacetyl and makes the yeast more active so it is in a better state to convert the diacetyl. Afterwards, gradually allow the beer to cool to the desired lagering temperature. Warming a lager for the diacetyl rest will speed up the process, and since most homebrewers have that ability it is recommended. It is worth noting that most commercial breweries have no way of warming their lagers up to an ale's fermentation temperature prior to cooling and therefore do a diacetyl rest at cooler temperatures — this works but is a slower process.

The diacetyl rest period should begin just prior to the end of active fermentation to ensure that there is still active yeast suspended in the beer to convert the diacetyl. This rest period should begin when your beer is two to five specific gravity points away from the target terminal gravity (or waiting until the bubbles in your airlock have slowed to once a minute or so and the yeast head has collapsed back into the beer).

A diacetyl rest is just as important with ales if you do not want the diacetyl taste in your beer (it is worth mentioning that some brewers like a little diacetyl in certain styles like English bitters or Scotch ales and believe that the buttery notes add complexity). Even if you don't notice the taste of diacetyl right after fermentation, without a rest period your ale could still contain high levels of alpha-acetolactate, which may still be converted to diacetyl later on. Once you have removed the yeast there is no way to get rid of the diacetyl, so you don't want to take that risk.

The rest period will extend the time it takes until you have a finished product, but a little rest and built up anticipation never hurt anybody.

by marc martin

DEAR REPLICATOR, MY WIFE AND I MADE FRIENDS WITH A COUPLE FROM VANCOUVER, B.C. ON THEIR VACATION UP HERE IN ANCHORAGE. LAST JANUARY WE VISITED THEM AND THEY TOOK US TO A NEWLY OPENED BREWPUB, GREEN LEAF BREWING CO. ALL OF THE BEERS WERE EXCELLENT BUT MY WIFE SAID THEY HAD THE BEST STOUT EVER. I WOULD LOVE TO BREW IT IN NOVEMBER AND SURPRISE MY WIFE WITH A COUPLE OF CASES FOR CHRISTMAS.

CHARLES RAGNOL
ANCHORAGE, ALASKA

Green Leaf Brewing Owner Martin Ebadi's father never imagined he would help his son run a brewery. After all, he was a soldier in the Air Force of Iran, a country where the production of alcohol is almost non-existent. Martin's father decided to leave Iran in the mid '90s and brought Martin and the rest of the family to the welcoming country of Canada. There, in North Vancouver, British Columbia, he opened a very successful auto repair garage.

Working with his father, Martin became a skilled automotive technician and gradually took over more control of the business. About 10 years ago, Vancouver started to catch the microbrewery fever that had been sweeping the U.S. Pacific Northwest since the late '80s. Martin discovered how much better great craft beers were than the standard Canadian light lagers. Seeing this as a good opportunity and much more fun than working on cars, he became determined to open a brewery.

Since many Canadians were not familiar with craft beer at the time, Martin knew a location with plenty of pedestrian traffic would be a must. After months searching, he happened upon a vacant lower corner of The Quay Market shopping center. He took the space and placed an order for a new 10-barrel system. As he had no brewing experience, the next challenge became finding a brewer.

As luck would have it, one of the applicants was Bill Herdman, a long-time professional brewer who was bored working for a local company producing beer wort extract. Bill was a great fit and brought with him a world of beer knowledge. He began homebrewing with a friend in 1979. In the '90s he brought two British Columbia breweries up to speed and has been in the industry ever since.

Martin's instinct proved to be correct with both the location and choice of a brewer as he managed to show a small profit after only a few months of operation. His next project will be an outdoor patio overlooking the bay.

This stout is one of his best sellers and is exactly what most consumers expect a stout to be. It is totally opaque with a dense tan head that holds to the bottom of the glass. The nose exhibits notes of chocolate, coffee and roast malt. Heavy bodied, the flavor is neither sweet nor bitter. Hopping levels are just enough to balance the sweetness.

Charles, you can cross the Green Leaf Stout off your Christmas list because now you can "Brew Your Own." For more information about Green Leaf Brewing Co. visit www.greenleafbrew.com. BYO

Green Leaf Brewing Company's Green Leaf Stout clone
(5 gallons/19 L, extract with grains)

OG = 1.057 FG = 1.012 IBU = 36 SRM = 45 ABV = 5.9%

Ingredients
3.3 lbs. (1.5 kg) Coopers light, unhopped, liquid malt extract
1.75 lbs. (0.79 kg) light dried malt extract
8 oz. (0.23 kg) crystal malt (60 °L)
8 oz. (0.23 kg) crystal malt (120 °L)
14 oz. (0.40 kg) chocolate malt (350 °L)
11 oz. (0.31 kg) roasted barley (450 °L)
10 oz. (0.28 kg) Carapils® (dextrin) malt
7 oz. (0.20 kg) flaked barley
10 oz. (0.28 kg) flaked oats
8.5 AAU Northern Brewer hop pellets (60 min.) (1 oz./28 g at 8.5% alpha acids)
4.25 AAU Northern Brewer hop pellets (30 min.) (0.5 oz./14 g at 8.5% alpha acids)
½ tsp. Irish moss (30 min.)
½ tsp. yeast nutrient (15 min.)
White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) or Safale US-05 yeast
⅗ cup corn sugar (if priming)

Step by Step
Steep the crushed grains in 2.25 gallons (8.5 L) of water at 154 °F (68 °C) for 30 minutes. Remove grains from the wort and rinse with 2 quarts (1.9 L) of hot water. Add the malt extracts and boil for 60 minutes. While boiling, add the hops, Irish moss and yeast nutrient as per the schedule. When done, add the wort to 2 gallons (7.6 L) of cold water in the sanitized fermenter and top off with cold water up to 5 gallons (19 L).

Cool the wort to 75 °F (24 °C). Pitch your yeast and aerate the wort heavily. Allow the beer to cool to 68 °F (20 °C). Hold at that temperature until fermentation is complete and then transfer to a carboy and allow the beer to condition for 1 week before bottling or kegging.

All-grain option:
This is a single step infusion mash using 8.5 lbs. (3.9 kg) of 2-row pale malt to replace the malt extracts. Mix all of the crushed grains with 4.75 gallons (18 L) of 171 °F (77 °C) water to stabilize at 154 °F (68 °C) for 60 minutes. Slowly sparge with 175 °F (79 °C) water. Collect approximately 6 gallons (23 L) of wort runoff to boil for 60 minutes. Reduce the 60-minute Northern Brewer hop addition to 6.8 AAU (0.8 oz./23 g) and the 30 minute Northern Brewer hop addition to 3.4 AAU (0.4 oz./11 g) to allow for the higher utilization factor of a full wort boil. The remainder of this recipe is the same as the extract with grains recipe.

Nitro Beers

tips from the pros
by Dawson Raspuzzi

Change the gas; change everything

LOOKING FOR A CREAMIER, FULLER MOUTHFEEL IN YOUR HOMEBREW? MAYBE REPLACING ONE OF YOUR CARBON DIOXIDE (CO_2) TAP LINES WITH A NITROGEN (N_2) BLEND IS THE WAY TO GO. WHERE CO_2 GAS GIVES A SHARPER, PRICKLY BITE TO BEER, NITROGEN IS SMOOTH AND BRINGS OUT A DIFFERENT ARRAY OF SENSATIONS TO YOUR PALATE. PLUS, WHO DOESN'T LOVE SEEING THE CASCADING EFFECT A NITROGEN BEER HAS WHEN POURED INTO A GLASS?

There are obviously pros and cons with nitro. From a visual perspective, a nitrogen head really captures that vision of what head on a beer should look like. It's big, frothy and displays a great texture. The cascading bubbles are certainly a delight to observe and serve as nice foreplay before diving into that first sip. I find these things to be important. The mouthfeel is smooth, pleasant and unencumbered by CO_2 acidity and bite. N_2 allows your palate to discover flavor nuances otherwise hidden by CO_2 sensations.

Aromatically I think nitrogen beers change the ground rules a bit. CO_2 bubbles have a tendency to burst and that can carry volatiles very effectively to your sense of smell. The more aromatically centric a beer is the less I believe it lends itself to nitrogen presentations although I try to avoid speaking in absolutes.

The wort used for each of the beers we serve with nitro is the same and is treated the same from a process standpoint as their CO_2 counterparts. The only recipe difference is the gas blend. N_2 beers are really an N_2/CO_2 blend. Dissolved CO_2 is naturally present after fermentation even if you let it blow off. You need to be cognizant of this residual CO_2. Nothing messes up an N_2 pour like out of spec CO_2 concentrations.

There absolutely are nuances of flavor between beers carbonated with N_2 as opposed to CO_2, and I'm not sure it could be possible to get these two versions of beer to taste the same. For instance, our Milk Stout displays a distinct balance of coffee and chocolate notes. On my palate the Milk Stout Nitro throws more chocolate aromas at me whereas the CO_2 version has a more pronounced coffee element. Nitrogen vs. CO_2 without question shifts that balance around. I think the Sawtooth on nitrogen has a softer more subtle hop character but at the same time there are some delightful cereal and toffee flavors that I feel get enhanced. I always look at these things in terms of each flavor or aromatic note fighting to be recognized; it's clawing its way to the consumer's senses.

"N_2 allows your palate to discover flavor nuances otherwise hidden by CO_2 sensations."

When it comes to big beers like our Wake Up Dead Nitro, which we age for months before we release it for package through our taste panel, you really have to be respectful of what nitrogen does to your ability to taste immaturity. I feel N_2 is less forgiving in that regard than CO_2 is once you get it in the bottle.

For homebrewers, keep it clean, keep it cold and use the right gas mix for dispense. The right gas mix will settle anything down over a rather short period of time as the keg equilibrates. Keep an eye on and control residual dissolved CO_2 after primary; this has a huge effect on pourability. It's easier and better for your beer to add CO_2 rather than having to take it out. However, if you are trying to serve your homebrewed stout to your friends you have a little leeway. After all, no matter how bad you screw up the gas mix initially, once you tap it on a gas blend the mix changes and reaches equilibrium to its new environment rather quickly.

Joe Schiraldi is Vice President of Brewing Operations at Left Hand Brewing Company in Longmont, Colorado. In 2011 Left Hand was the first American craft brewery to release a nitrogen version of a bottled beer. The brewery now bottles three nitrogen beers.

While working as an IT Administrator, Mike Dorneker started homebrewing and fell in love with the process. He graduated from the associate program at Siebel Institute of Technology in 2010 and interned at Metropolitan Brewing before being hired in 2011 as the Master Brewer at Lake Bluff Brewing Company, in Lake Bluff, Illinois. His barrel-aged imperial stout and robust porter have won medals at the United States Beer Open.

Nitro beers add another element of complexity to the beer, giving the brewer a whole new class of beers to play with. Nitrogen gives a more full, creamy body and mouthfeel. That said, with nitrogenated beers there is less perceived hop bitterness and aroma, and I have seen instances where nitro can change a beer from good to subpar.

We serve one of almost every beer we make on nitrogen without making any adjustments to the recipe or brewing technique because you just never know until you try it. We have tried everything from our golden ale all the way to our Imperial IPA. Some worked better than others. I was shocked with how well Skull and Bones, our double pale ale, turned out on nitro. It's a fairly bitter beer but with a nice malty backbone. The nitro really brought out the malty side of the beer and muted the bitterness just enough, making for a delicious surprise. Alternatively, we tried our Honey Badger Golden Ale, which is more bitter than most golden ales and is balanced by sweetness from the honey. The nitro version muted the bitterness and erased the sweetness, leaving a watery, plain, nothing beer. Still, it's fun to see what the beers will taste like side-by-side, nitro vs. CO_2.

The brewpub has a dual regulator system, one for nitrogenating and one for serving. This way I can nitrogenate a single keg and always have one on tap. I can take as many kegs per batch as I want for nitro and carbonate the rest. This can easily be replicated on a small scale for homebrewers.

Since we serve the same batch on both nitro and CO_2 we don't alter the recipes, but if you wanted you could do things like give a recipe more of a malty body/finish to be accentuated by the nitro, or change your mash temperature to give you more non-fermented sugars for a beer that has more body. That extra body will result in a fuller, creamier nitro beer. BYO

Oxygen Quality

Separating the trub, recipe development

help me mr. wizard
by Ashton Lewis

Q TO FOLLOW UP ON YOUR COMMENTS IN THE SEPTEMBER 2014 ISSUE ON FOOD-GRADE CO_2; WHAT ABOUT FOOD-GRADE OXYGEN? I GET BOTTLED OXYGEN FROM MY LOCAL WELDING SHOP, TO AERATE WORT, AND HAVE ALWAYS PONDERED THE QUALITY OF IT.

SAM SCHALLEY
ROCHESTER, MINNESOTA

A There is one very major distinction separating bottled carbon dioxide from bottled gases like oxygen and air, and that is the primary use of the gas. While bottled carbon dioxide has a wide number of industrial-type uses, bottled oxygen and air are sold specifically for use in respiration systems in addition to use in industrial applications. The cleaning requirements, or lack thereof, of these industrial users is far different from those of the buyers of breathing gases. This is why the valves on oxygen and compressed air bottles intended for use in respiration systems are physically different than valves found on cylinders used, for example, in welding. Suffice to say, it is easy to obtain bottles of oxygen and compressed air to use for homebrewing without having to worry about the gas or cylinder.

But this does bring up a good brewing question. What are the practical differences between compressed air and oxygen in the brewery? The one difference that really matters to me is how the source of oxygen affects oxygen solubility. When air is used as the oxygen source in brewer's wort, the solubility of oxygen is about 8 mg/liter or 8 ppm (based on 12 °Plato wort). Changing the oxygen source to pure oxygen increases the oxygen solubility by approximately fourfold. This dramatic difference can negatively affect yeast membranes.

Aside from yeast health, wort oxygen influences the production of nearly all yeast-related aroma compounds present in beer. On paper, one can develop a convincing biochemical argument demonstrating that too much oxygen results in beer that is "too clean" and lacking in aroma, especially those associated with esters. And based on practical experience some brewers find that too much oxygen results in fermentations that stall after a very vigorous start that also tend to throw off lots of acetaldehyde and sulfur. The bottom line is that wort oxygen level plays a very key part in beer flavor development, and is one of those factors that varies with yeast strain and wort properties.

> "... it is easy to obtain bottles of oxygen and compressed air to use for homebrewing without having to worry about the gas or cylinder."

Brewers who successfully use pure oxygen control its delivery into the wort stream during cooling using a variety of methods. The most common method is metering oxygen based on wort flow rate in order to deliver a measured amount to the batch. As long as the oxygen is introduced as very small bubbles, it is safe to assume that nearly all of it is absorbed into the wort. This assumption makes it easy to meter oxygen with a flow meter into a known volume of wort to yield a concentration without verification with an expensive, and arguably unnecessary, oxygen meter.

Pure oxygen can really help out when brewing higher gravity beers

Photo by Charles A. Parker/Images Plus

because the solubility of oxygen from air diminishes as wort gravity increases (for more information on this topic, read up on Henry's Law and how gas solubility in liquid is influenced by the concentration of other gases). Aside from these types of beers, however, I prefer using compressed air for wort aeration because wort simply cannot be over-oxygenated using this method, making aeration one less detail that can go wrong during the brew day.

At Springfield Brewing Company we use dry, oil-free compressed air from an air compressor to supply our wort aeration panel. This panel has a pressure regulating valve, gas rotameter for flow measurement and control, and a sterile filter. I believe the latter feature is pretty important to the practical brewer because compressed air can contaminate wort. And the suitability of a gas for breathing purposes has nothing to do with this particular concern. Since pure oxygen is toxic to most forms of life, I don't get too concerned about oxygen as a potential source of contaminants. So if you decide to use compressed air, consider an in-line sterile filter.

Q

WHAT EFFECT ON THE FINAL PRODUCT DOES PUTTING ALL OF THE WORT FROM MY KETTLE INTO THE CARBOY AS OPPOSED TO REMOVING ONLY THE CLEAR PORTION HAVE? AFTER I CHILL WORT I JUST DUMP EVERYTHING IN AS OPPOSED TO PUMPING OR SIPHONING INTO THE CARBOY. MY FINAL PRODUCT IS USUALLY CLEAR AFTER FERMENTATION AND KEGGING.

KENT REUILLE
WESLEY CHAPEL, FLORIDA

A

Right or wrong, I long ago viewed the production of beer to include many steps where things are modified, separated and moved to the next step of the operation. The malting process, for example, includes barley cleaning before steeping, and includes the removal of rootlets following malt kilning. Go to a hop farm during harvest and you will see equipment that separates leaves and bines from hop cones prior to kilning. Most brewing water is treated using a variety of techniques along the path to make the

water clear, clean and suitable for use in brewing. And even the yeast we use for pitching is often concentrated before use by decanting off the beer resulting from the propagation step. In a nutshell, we seize the opportunity to remove something that is not needed or wanted in the finished beer when the opportunity presents itself.

Now that I have given some background on my way of thinking, it should come as no surprise that I am not a huge fan of the method you describe for no other reason than because trub and hop solids are easy to remove following the boil. But the contrarian will argue that the overall batch yield will improve if this technique is tempered, for example, in the manner you describe. I have no objection on the basis of yield, but I am concerned about the downstream consequences of this method.

My immediate concern is the quality of the yeast crop. If the plan is to crop yeast from this fermentation and pitch it into a subsequent batch you will have to contend with trub and hop solids in the cropped yeast. This concern is more than simply being picky; trub is known to "foul" the surface of the yeast cell wall and the health of cropped yeast is influenced by what settles with it to the bottom of the fermenter.

And my other concern is how the hop solids will affect flavor. One thing that I find pretty useful when contemplating "flavor what-ifs" is to take a sample of the substance in question and taste it. If it does not taste like something that will be beneficial or neutral to beer flavor (filter aids and brewing tools are examples of things that should be flavor-neutral), then it falls on the list of things to remove sooner than later.

Here is an example of how I consider a hop pellet. The aroma is something I want in my beer, unless the hops smell funky (onion/garlic, etc.). So, funky smelling hops may work for early additions because the funky aromas may be removed during the boil. When I taste the hop pellet I get resin, pine, floral, herbal, citrus and bitter flavors that I want in beer. But the longer I ponder the sensation I start to notice astringency on my palate and grassy flavors. And I am thinking these characteristics are of the type I don't want in beer. So I start by selecting hops that smell nice.

I now stand over my whirlpool looking at the mass of green stuff in the center and wonder what would happen if all of this . . . stuff . . . were in the fermentation vessel instead of laying in the center of the whirlpool vessel. Again I wonder how I would harvest my yeast if this mass of hop and protein matter were intermingled with what is normally smooth and creamy yeast awaiting harvest at the bottom of my fermenter, but that's a different question for another day. The trub smells a lot like hoppy wort because it is surrounded by hoppy wort. When the trub is sampled, however, the thing that really hits the palate is astringency. Not real sure I want this in my fermenter; what is the return on my investment? Is it an extra bottle or two of beer per 5-gallon (19-L) batch? That's not a bad proposition, but will the added yield improve, detract or have no influence on the finished beer?

I find this type of thinking to be very useful when thinking about brewing because at the end of the day it's about beer flavor. Even in a commercial brewery, the financial gains can only seriously be considered if process changes geared towards increases in yield have no obvious negative effects on beer flavor.

Although I believe your beer would taste better if you separated your clear wort from hop solids and trub prior to fermentation, you have pinpointed a very real opportunity for improvements in minimizing wort loss. Almost every commercial brewery these days owns whirlpool vessels to facilitate the separation of these solids from wort. A problem that is becoming more and more significant is wort loss associated with high gravity, highly pellet-hopped batches. Whirlpool wort losses are generally higher when wort gravity increases and when hopping rates are increased, and these two factors are becoming increasingly common as the popularity of high-alcohol, highly-hopped beers continues to grow. If this trend holds, brewers will certainly be looking towards technologies to reduce whirlpool losses. Some of the larger lager brewers have been using decanting centrifuges to address this problem, and this technology will most certainly soon spread.

Q WHAT ARE THE BIGGEST CONSIDERATIONS THAT I SHOULD TAKE INTO ACCOUNT WHEN CRAFTING MY OWN HOMEBREW RECIPES?

MICHAEL SCHROTENBOER
KALAMAZOO, MICHIGAN

A Developing new recipes is really one of my favorite things about brewing and I have some fairly strong opinions about this topic. Before I begin with my answer I think it is important to state that there are a few schools of thought about recipe development and that my method and general belief is certainly not shared by all brewers.

The most important target to nail in my view is the original gravity (OG) and I believe that learning how to perform brewing calculations is a prerequisite to recipe development. When I say nailing gravity, this also includes wort volume. So if the goal is to produce 5 gallons (19 L) of wort at 1.048 (12 °Plato), I want 5 gallons (19 L) +/- ~2.5% at 12 °Plato +/- 0.1 °Plato. My reasoning is that OG largely determines alcohol content and influences body and wort volume affects bitterness since hopping is based on batch size. If you miss your volume target you also miss your bitterness target. So job #1 is knowing how to nail those brewing targets.

When I am formulating a recipe I absolutely must have a very clear idea of the finished beer. Some brewers "add a pinch of this and a pinch of that" like a grazer at a salad bar. This method of recipe development is completely foreign to me. I begin with an idea of the beer and build my recipe and

brewing process to support the pint that is in my mind's eye. Since nailing targets is a given in my method of recipe development, the real job #1 is to have a goal in mind.

I think developing the goal is often a major part of the fun and challenge that comes with recipe development. This process includes tasting beer, imagining flavor modifications to the beers being tasted, researching styles, ingredients, recipes published by other brewers and tweaking the flavor of the beer being developed before actually brewing the beer. The thing most consumers don't understand about brewing is that once a recipe is formulated and the wort is made, brewers still have weeks to wait until we know if our creation matches the plan. While there are some opportunities to tweak a batch after brew day, most of the key attributes of the beer have been determined very early in the process. This is why my particular method involves lots of what I call abstraction, where I zone off into my thoughts and transform ingredients and processes into a finished beer.

In order for this process to actually work, you need to have a fair amount of experience that only comes with time. Every time you develop a new recipe you need to somehow fold the process into your mental collection of brewing ideas. Every time you learn something about a beer you taste, this too needs to be added to your mental brewing library.

Once the general goal has been defined and a working recipe is in place I really focus on a few key things before considering the recipe ready to brew. The two biggies to me are balance and drinkability. No matter the style of beer I am contemplating I want a beer that has these two properties. Balance allows all of the ingredients and techniques to be expressed. And if all turned out well the thing I personally prize the most in a beer is drinkability. This is the trait that makes you want another sip and is one of the hallmarks separating the great from the good. BYO

Best Bitter

An authentic English style

style profile
by Jamil Zainasheff

I just returned from a visit to London where I attended the Great British Beer Festival. London has always been a favorite of mine. The city, its people, its history, and its beer make for a wonderful experience. During my previous visits, the beer has always been about either mass-market lager or traditional British ales and it seemed like lager was getting the upper hand. It was getting harder and harder to find real ale and I wondered if the good folks at The Campaign for Real Ale (CAMRA) were possibly fighting a losing battle. However, on this recent visit, I wondered if the tide has begun turning again. Cask ales are on the upswing, but a substantial number of handles are now "American-style" beers. I could still find bitter, but the newest brewers are putting at least some of their focus on American-style pale ale or American-style IPA. Some brewers focus almost exclusively on American and Belgian-style beers, and even the older, more traditional brewers are experimenting with the new breeds of American-grown hops.

I love the fact that more breweries are opening. I love that new brewers are not just focusing on the traditional styles, but instead they are being more experimental. However, just like the massive influx of lagers before, I worry about the pressure of all these new brands on the traditional British beer scene. If everyone starts brewing double IPA with Simcoe® and Amarillo® fermented with California-type ale yeast, then that is too much America in the UK for me. We visited a number of pubs where the majority of the taps were "modern" styles and sometimes there were no traditional styles. I was a little disappointed, as I travel to experience something different, something I cannot find at home. While there are benefits to a smaller world through the Internet and easy travel, I do not want to keep repeating the same drinking experience everywhere I go. I want some cultural differences in beer. So, even though I did taste all of the new beers I came across, I drank more pints of best bitter than anything else.

Best bitter, also referred to as special or premium bitter, is a moderate-strength English ale. It is a beer with plenty of flavor and body, but an ABV in the low 4 percent range. This is the middle ground of the bitter family, and there are a few key differences from other members of the bitter family. Strong bitter (English pale ale) tends to have a fuller malt backbone than best bitter and the appropriate bitterness to balance the additional malt. When you compare best bitter to ordinary bitter, best bitter usually has more malt character and that extra malt character often results in a more balanced beer. This can make the overall impression of best bitter seem less bitter than many examples of ordinary bitter. Cracker and biscuit notes from the malt are also supported by a slight touch of caramel. The hops are often floral, herbaceous, or spicy, but with restraint. The same goes for bittering. Best bitter should be firmly bitter, but the bitterness should not overpower the malt. Balance is important and most examples range from balanced to moderately bitter. The overall impression is all of the flavors in balance. Yes, plenty of malt character and some residual malt sweetness, but balanced with the bittering, hop character, and the esters from fermentation.

In any beer, the base malt plays a

Continued on page 25

> "It is a beer with plenty of flavor and body, but an ABV in the low 4 percent range."

BEST BITTER by the numbers

OG:	1.040–1.048 (10.0–11.9 °P)
FG:	1.008–1.012 (2.1–3.1 °P)
SRM:	5–16
IBU:	25–40
ABV:	3.8–4.6%

Photo by Charles A. Parker/Images Plus

A Bitter to Be Proud Of
(5 gallons/19 L, all-grain)
OG = 1.042 FG = 1.011
IBU = 35 SRM = 9 ABV = 4.1%

Ingredients
8 lbs. (3.65 kg) English pale ale malt
7 oz. (200 g) English crystal malt (75 °L)
5.5 AAU Target hops (60 min.) (0.5 oz./14 g at 11% alpha acids)
3.75 AAU Challenger hops (3 min.) (0.5 oz./14 g at 7.5% alpha acids)
4.25 AAU Northdown hops (3 min.) (0.5 oz./14 g at 8.5% alpha acids)
2.5 AAU East Kent Goldings hops (3 min.) (0.5 oz./14 g at 5% alpha acids)
Irish moss (15 min.)
White Labs WLP002 (English Ale) or Wyeast 1968 (London ESB Ale) yeast
⅓ cup corn sugar (if priming)

Step by Step
I use Crisp Malting's British Pale Ale malt (made from Maris Otter) as my base grain, but other malts of a similar nature should work well. Remember, the bulk of the flavor comes from the base grain, so try to get British pale ale malt. The crystal malt should also be of British origin as it makes a substantial difference. I have had great success with Simpsons and Bairds, but feel free to substitute any high quality malt of a similar flavor and color from a different supplier. My hops are in pellet form and come from the UK via Hop Union or Hopsteiner.

Mill the grains and dough-in targeting a mash of around 1.5 quarts of water to 1 pound of grain (a liquor-to-grist ratio of about 3:1 by weight) and a temperature of 148 °F (64 °C). Hold the mash at 148 °F (64 °C) until enzymatic conversion is complete. Infuse the mash with near-boiling water while stirring or with a recirculating mash system raise the temperature to mash out at 168 °F (76 °C). Sparge slowly with 170 °F (77 °C) water, collecting wort until the pre-boil kettle volume is around 5.9 gallons (22.3 L) and the gravity is 1.035.

Add the bittering hops once the wort is boiling, The total wort boil time is 1 hour. During that time add the Irish moss or other kettle finings with 15 minutes left in the boil and add the last hop additions with 3 minutes remaining. Chill the wort to 68 °F (20 °C) and aerate thoroughly. If you have a nice, fresh package of liquid yeast, you can pitch it direct, although making a 1-liter starter is always a good idea.

Ferment around 68 °F (20 °C) until the yeast drops clear. With healthy yeast, fermentation should be complete in a week or less. Allow the lees to settle and the brew to mature without pressure for another two days after fermentation appears finished. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. Target a carbonation level of 1–2 volumes depending on your packaging. If you are cask conditioning the beer, add priming sugar, any cask finings (gelatin or isinglass), and possibly dry hop with another ¼–½ oz. (7–14 g) of whole East Kent Goldings. Allow the beer to condition in the cask for several days and serve via a beer engine or by gravity feed at 50–55 °F (10–13 °C).

A Bitter to Be Proud Of
(5 gallons/19 L, extract with grains)
OG = 1.042 FG = 1.011
IBU = 35 SRM = 9 ABV = 4.1%

Ingredients
5.4 lbs. (2.4 kg) English liquid malt extract
7 oz. (200 g) English crystal malt (75 °L)
5.5 AAU Target hops (60 min.) (0.5 oz./14 g at 11% alpha acids)
3.75 AAU Challenger hops (3 min.) (0.5 oz./14 g at 7.5% alpha acids)
4.25 AAU Northdown hops (3 min.) (0.5 oz./14 g at 8.5% alpha acids)
2.5 AAU East Kent Goldings hops (3 min.) (0.5 oz./14 g at 5% alpha acids)
Irish moss (15 min.)
White Labs WLP002 (English Ale) or Wyeast 1968 (London ESB Ale) yeast
⅓ cup corn sugar (if priming)

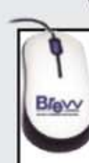
Step by Step
I use an English-type liquid malt extract custom made for my homebrew shop from a 100% Maris Otter malt. Both Muntons and Crisp offer a Maris Otter liquid malt extract as well. It is always best to choose the freshest extract that fits the beer style. The crystal malt should also be of British origin as it makes a substantial difference. I have had great success with Simpsons and Bairds, but feel free to substitute any high quality malt of a similar flavor and color from a different supplier. My hops are in pellet form and come from the UK via Hop Union or Hopsteiner.

Mill or coarsely crack the specialty malt and place loosely in a grain bag. Avoid packing the grains too tightly in the bag, using more bags if needed. Steep the bag in about 1 gallon (~4 liters) of water at roughly 170 °F (77 °C) for about 30 minutes. Lift the grain bag out of the steeping liquid and rinse with warm water. Allow the bags to drip into the kettle for a few minutes while you add the malt extract. Do not squeeze the bags. Add enough water to the steeping liquor and malt extract to make a pre-boil volume of 5.9 gallons (22.3 liters) and a gravity of 1.035. Stir thoroughly to help dissolve the extract and bring to a boil.

Once the wort is boiling, add the bittering hops. The total wort boil time is 1 hour after adding the bittering hops. During that time add the Irish moss or other kettle finings with 15 minutes left in the boil and the last hop additions with 3 minutes remaining. Chill the wort to 68 °F (20 °C) and aerate thoroughly. If you have a nice, fresh package of liquid yeast, you can pitch it direct, although making a 1-liter starter is always a good idea.

Ferment around 68 °F (20 °C) until the yeast drops clear. With healthy yeast, fermentation should be complete in a week or less. Allow the lees to settle and the brew to mature without pressure for another two days after fermentation appears finished. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. Target a carbonation level of 1–2 volumes.

Web extra:



An additional best bitter recipe from Jamil Zainasheff inspired by Sambrook's Brewing in London is available at http://byo.com/story3145 big role in the malt character. British pale ale malt is a key component of any bitter recipe. It provides a background biscuit-like malt character that many people associate with fine British beers. British pale ale malt is kilned a bit darker (2.5–3.5 °L) than the average American 2-row or pale malt (1.5– 2.5 °L) and this higher level of kilning brings out the malt's biscuit-like flavors. A few malt companies (Crisp Malting is one) still produce British pale ale malt from cultivars such as Maris Otter using a traditional floor malting method. The result is malt with a slightly darker color (3.5–4.0 °L) and more flavor than other pale ale malts. It is the malt of choice for many English beer fanatics. British pale ale malt is highly modified and well suited to single infusion mashes and a moderate mash temperature around 152 °F (67 °C) is a good target for this beer style.

If you brew with extract, your best choice is an extract made from British pale ale malt. There are some British-style malt extracts currently on the market made from 100% Maris Otter malt and they are an excellent choice for English beers. If you end up using domestic 2-row malt extract, you might need to compensate with some additional specialty malts such as Munich, Biscuit or Victory®, but use restraint. For a 5-gallon (19-L) batch, add no more than 1 pound (0.45 kg). Adding more tends to make the specialty malt the focus instead of a complement.

While there are some modern examples of best bitter that are quite pale, generally you need to add a touch of caramel character. Even a small dose of crystal malt adds caramel notes as well as body, and helps fill out the malt flavors. The type of crystal malt also makes a difference. Darker color crystal malts add richer colors, as well as some dark caramel, toasty, roasted, and even subtle raisin flavors. Lighter color crystal malts add sweeter caramel notes. The average commercial example has around 5% crystal malt. The maximum crystal malt this style can handle is in the range of 8–10% with a color range of 10–150 °L. A bitter with 10% 150 °L crystal malt may not be cloying, but it can be too intense a flavor for this style. A bitter with all light color crystal malt will tend to lack depth of character.

Some bitter recipes include other specialty malts as well. My favorites are Special Roast, Victory®, Biscuit, and Aromatic, but you can make a fine bitter without them. Commercial recipes range from minimal, low color, specialty-malt additions to considerable amounts of mid-color malts. Some commercial recipes also use a little chocolate or black malt for color. If you take this approach, the amount of highly kilned malt should be small enough that the flavor is not apparent in the finished beer. Use an ounce or two (28–57 g) at most in a 5-gallon (19-L) batch. Specialty malts are a big part of what differentiates one brewer's bitter from another, so feel free to play around with the amounts or types, but just remember that the best commercial examples are quite simple and rely on great quality ingredients and great fermentation.

One of my favorite best bitters on this trip was Sambrook's Wandle. Head Brewer Sean Knight told me that they use pale ale malt made from Maris Otter and about 5% crystal 150 °L. From that, they get plenty of malt complexity and fullness.

While corn, cane sugar, and other adjuncts are traditional in brewing many English beers, I usually omit simple sugar, unless I am brewing a big beer and I need to increase wort fermentability to thin the body. If you are using extract with a very low attenuating yeast strain and have trouble getting it to finish low enough, then replacing some of the extract in your recipe with simple sugar can help. Simple sugars ferment fully, thin the beer, and provide very little in the way of flavor contributions. I have seen recipes that use brown sugar, but do not count on it to add much in the way of flavor. Use it only for thinning the beer. If you want to add brown sugar/caramel type flavors, use caramel malts. Corn and other non-barley adjuncts reduce the overall malt flavors when used in place of the base malted barley. I prefer a bold base malt flavor, so I do not use adjuncts in my best bitter.

While you can find some commercial examples of best bitter brewed with non-English hops, brewers often refer to those beers as American pale ale rather than English bitter. It is really best if you use English hops for this style, such as East Kent Goldings, Fuggles, Target, Northdown, Bramling Cross, Boadicea, Goldings, Progress, Challenger or many others. The bittering level for best bitter is in the range of 25–40 IBUs. You want noticeable hop bitterness, without overwhelming the malt background.

Keep in mind that there are many factors at play in the final impression of bitterness for the drinker. The starting and final gravities, the character malts selected, the type of base malt, the yeast strain, the pitching rate, and even the yeast cell size have an impact on the perceived bittering. For most best bitters, a bitterness to starting gravity ratio (IBU divided by original gravity) ranges between 0.6–0.9, but stick to 0.7–0.8 for the best result. Often there is a hop addition at 60 minutes and an equally sized late hop addition near flameout. The late hop additions might equal an ounce (28 g) for a 5-gallon (19-L) batch. Remember that this is not an extremely hoppy style, so do not go overboard. Traditional cask conditioning can include dry hopping, perhaps ¼–½ an ounce (7–14 g) per 5 gallons (19 L). If you do dry hop this beer, you might need to reduce the late hop additions to keep the hop flavor and aroma in balance.

Much has been written about the high sulfate water of Burton-upon-Trent being a key element in brewing bitters. It is true that water with high sulfate content enhances the sharp, bitter aspect of hops. However, you can easily overdo it, which results in a chalky, metallic, or harsh character. Brewers today brew good bitter with a wide range of water types. In most cases, any water is well suited as is, unless it is on the soft end of the spectrum. If you have soft water, add some gypsum or Burton Salts, but start low, targeting half the amount of sulfate typical of Burton water. Use no more than 1 teaspoon of Burton Salts per 5 gallons (19 L) or no more than 3 grams of gypsum per gallon (4 L). It is always better to add less. While this will not exactly mimic the water of Burton-upon-Trent, it is more than enough to accentuate the hop bitterness. You can add your mineral salts to the mash or, if you are extract brewing, you can add the mineral salts to your kettle. For all other water types, first try brewing this style without any additional mineral salts.

Fermentation creates much of the flavor and aroma in most British beers. "English" yeast strains provide a variety of interesting esters and tend to be low to moderately attenuating, leaving some residual sweetness to balance the bitterness and help fill out the beer. They are also extremely flocculent, which makes them ideal for cask conditioning. Most of these yeasts produce moderate esters at cool fermentation temperatures (less than 65 °F/18 °C) and abundant fruity esters, alcohol notes, and even some spicy notes at high temperatures (greater than 70 °F/21 °C). In general, it is better to start in the middle of this range, letting the temperature slowly rise a few degrees over a couple days. This creates the expected level of esters and keeps the amount of diacetyl in the finished beer at a minimum.

There are a number of excellent English yeast strains to choose from, but the safe choices for this style are White Labs WLP002 (English Ale) and Wyeast 1968 (London ESB Ale). Both of these yeast strains provide a nice ester profile without being over the top. If you like to experiment with different yeasts, try to select English yeasts that have an attenuation percent from the 60s to the low 70s. If you prefer dry yeast, Safale S-04 is a good option.

Serving bitter at cellar temperature, around 50–55 °F (10–13 °C), allows the character of the beer to come out and can improve drinkability. Colder temperatures suppress the beautiful flavors and aromas of this style, so avoid serving the beer below 50 °F (10 °C).

Target carbonation around two volumes of CO_2 for bottled beers and 1–1.5 volumes for keg and cask conditioned beer. BYO

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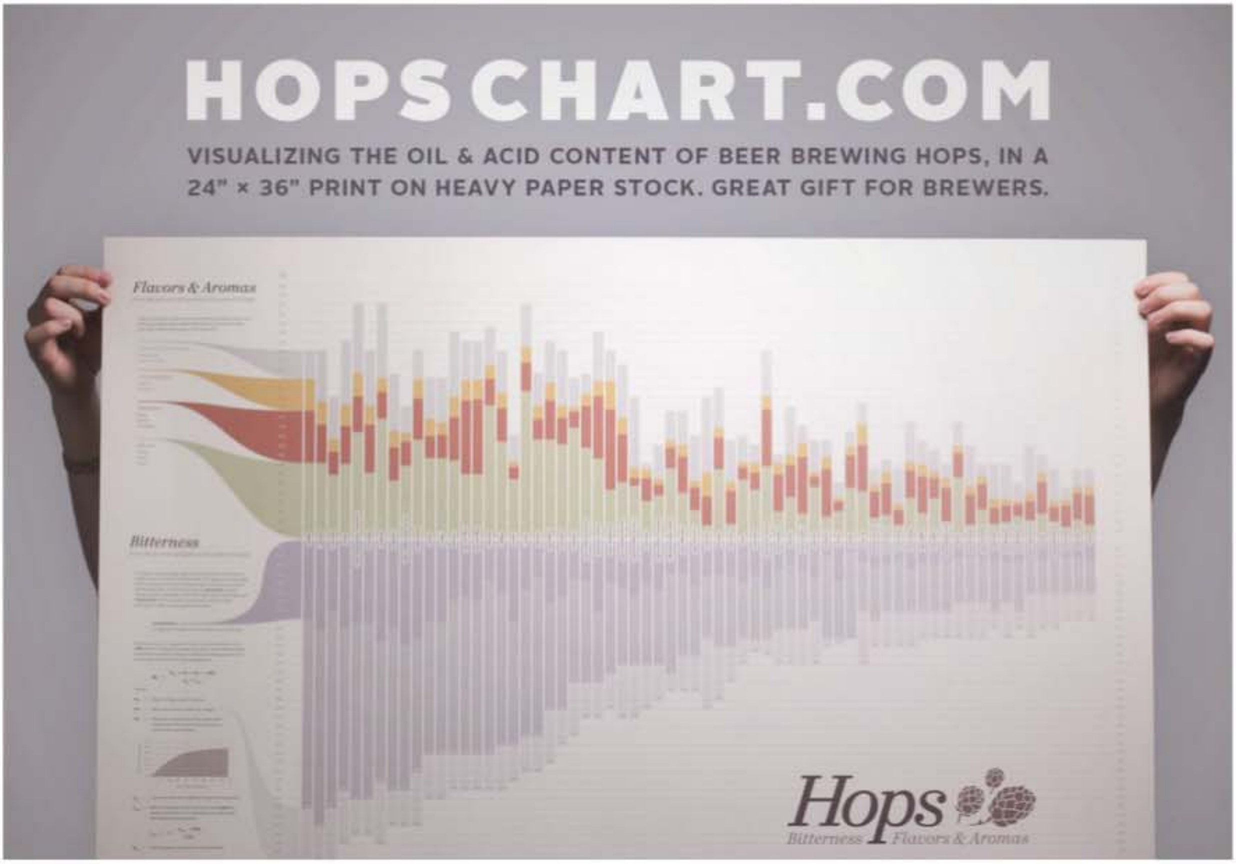
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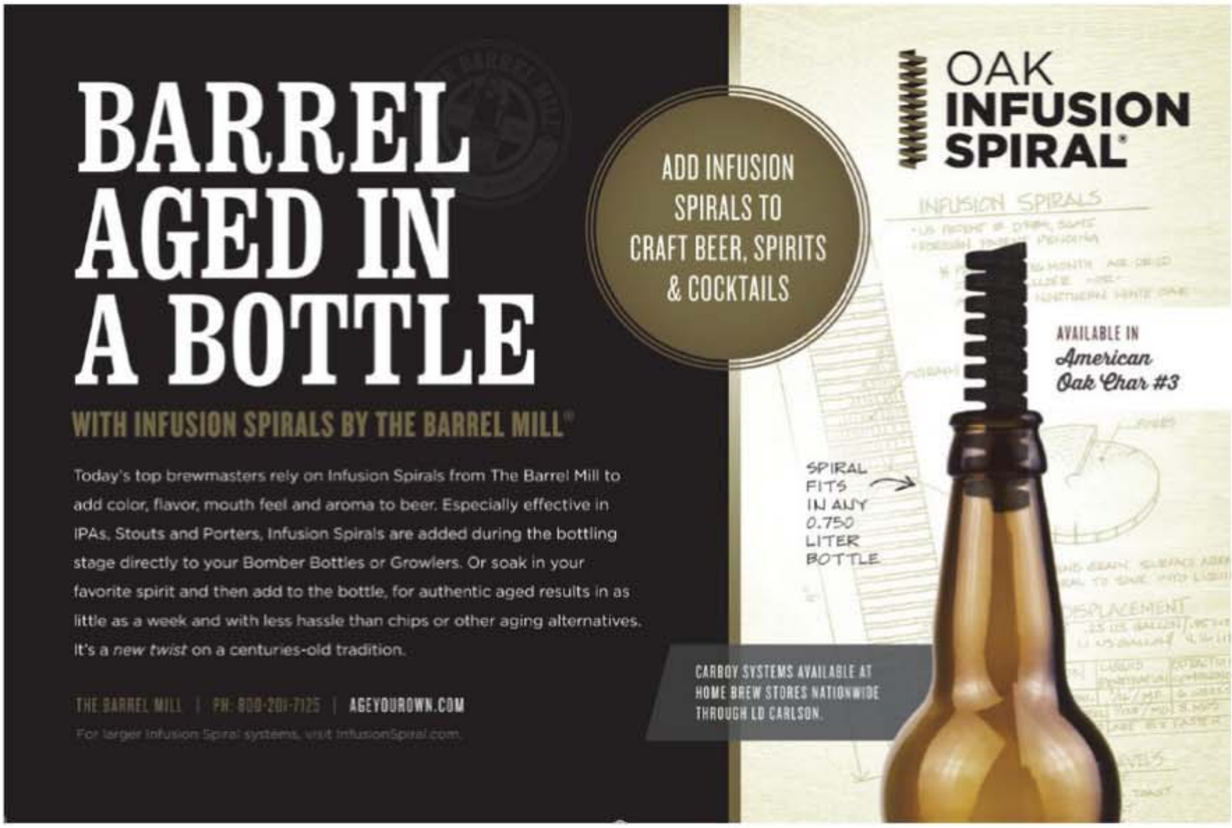
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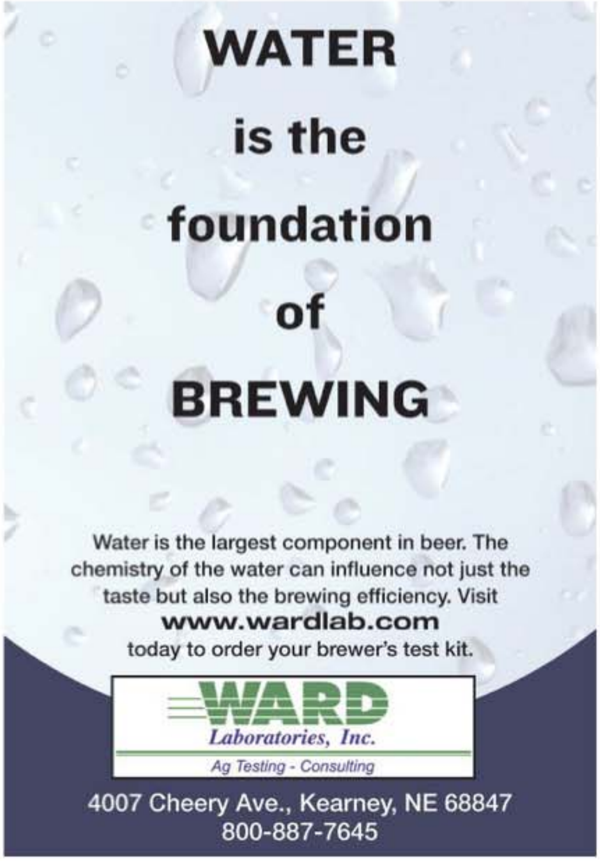
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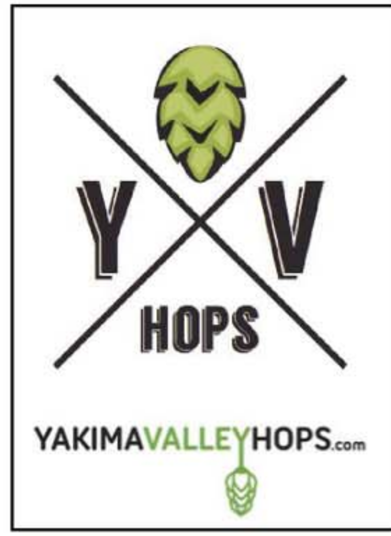
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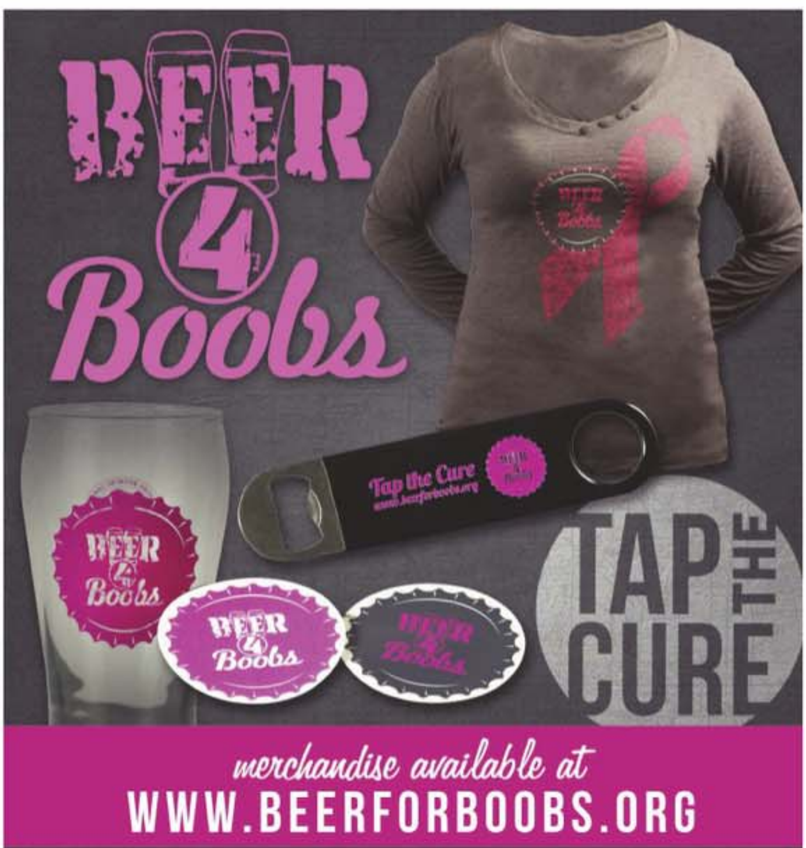
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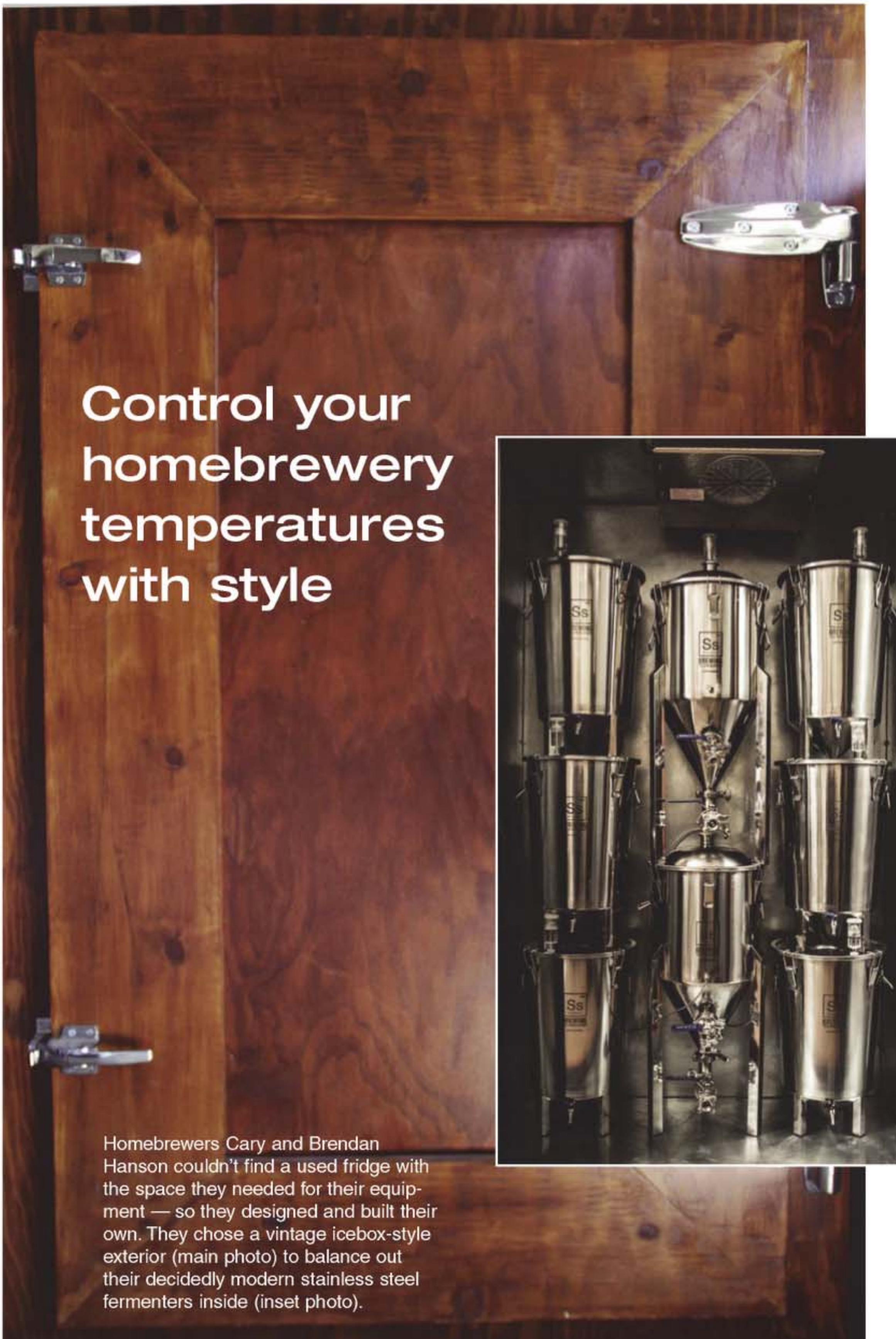
by **Cary and Brendan Hanson**

BUILD a custom BEER FRIDGE

After years of homebrewing, we had dialed in a few recipes that we really liked. However, with each batch we brewed, there was always some variation in the final product. After doing a bit of research and speaking with other homebrewers, it became glaringly obvious that fermentation temperature played a much larger role in the outcome of the beer than we had given it credit for. And so the idea for our fermentation fridge was born.

We initially thought about just buying a standard refrigerator and gutting it like many homebrewers do, but that wouldn't work for our particular homebrewery because we needed more space inside. We also considered using a large chest freezer with a thermostat installed, but that wouldn't work either because we didn't want a top-loading unit; we needed access to the front of the fermenters (our shop, Keg Outlet/kegoutlet.com, had recently partnered with Ss Brew Tech and their stackable stainless steel fermenters, so we wanted to make something that would accommodate a decent amount of these as well as other large fermenters and oak barrels for aging ales). So we came to the conclusion that our structure would need to be custom made.

We loved the look of old antique freezers and ice boxes, so we created specs to design and build something that had that aesthetic. I've gathered our step-by-step process of framing, building, insulating, and wiring this beast to share with other homebrewers. You can follow the specifications of this project exactly and build your own fridge of this size — or — you can use this story as an inspiration to build something uniquely suited to the space and equipment in your homebrewery.



Control your homebrewery temperatures with style

Homebrewers Cary and Brendan Hanson couldn't find a used fridge with the space they needed for their equipment — so they designed and built their own. They chose a vintage icebox-style exterior (main photo) to balance out their decidedly modern stainless steel fermenters inside (inset photo).

Tools and Materials

Tools:

Hammer
Screwdrivers
Electric drill
Drill bits
Circular saw
Miter saw
Staple gun
Sander
Paint brush

Materials:

8-ft. (2.4-m) pieces of 2" x 2" lumber
8-ft. (2.4-m) pieces of 2" x 4" lumber
4-ft. x 8-ft. (1.2 x 2.4 m) pieces of ²³⁄₃₂-inch plywood sheets
8-ft. (2.4 m) pieces of 1" x 10" lumber for door frame
Plastic drop cloths
24-gauge galvanized sheet metal
RTC22 Simpson ties
1.5-inch R-Tech foam insulation
Galvanized nails
Screws
Weather stripping
Rubber casters
Amico silver alloy pull-style latches with strike
Kason reversible 1245 cam-rise hinges with a 1⅜-inch offset
Metallic gray caulk (for interior of fridge)
Brown caulk (Used for outside seams of fridge, something to match the stain color)
2-in-1 stain/urethane
Dual-stage high-voltage digital temperature controller
100W infrared ceramic heat emitter and porcelain lamp with 8.5-inch dome
Copeland 1/3 HP 134A 115V condensing unit
1,000 BTU low profile reach in-style evaporator fan
Copper piping for refrigeration lines
Refrigerant
Electrical wire
Power supply cord
Square electrical box with cover

Step 1: Framing

For the frame, we used 2" x 2" x 8' pieces of wood with RTC22 Simpson Strong Ties and 1¼-inch galvanized nails. These strong ties are made for this size wood and they make it really easy to get your frame set as they hold all the wood strips at right angles (see photo 1). If you're building this, the frame will feel a bit flimsy at this stage, but once you get all the exterior paneling and interior sheet metal installed, it's as sturdy as an oak (see photo 2).

After getting the basic frame built, we attached another piece of 2" x 2" to each interior side of the frame as a backing to mount the interior sheet metal to later. We also added pieces of 2 x 2's to the bottom center, back center and top center for support.

We needed to build the face of the box out a bit more to provide sufficient room to mount the door, so we used 2 x 4's on the front left and right, and 2 x 3's on the front bottom and top face of the frame.

Step 2: Wrap and Panel

After we built the frame we took the measurements of each side and used these measurements to cut all of the panels needed to cover the outside of the fridge. We used 11/32-inch-thick, 4-ft. x 8-ft. (1.2 x 2.4 m) sheets of plywood for the exterior. The door needed to overlap the opening of the fridge by about 1 to 2 inches (2.5 to 5 cm) on each side to allow for weather stripping, so we made sure the opening was smaller than the door by about 2 to 4 inches (2.5 to 10 cm) in both directions.

After getting all of the exterior panels cut to size, we needed to make sure that we had a good moisture barrier in place before installing them. The moisture barrier helps protect the wood against condensation as the fridge temperature fluctuates. You can buy rolls of plastic moisture barrier at most hardware stores. We didn't need all that much, so we just got a couple of heavy plastic drop cloths to use for our moisture barrier.

To install the moisture barrier, simply drape the plastic over the exterior frame and position it so that it wraps the entire box evenly (see photo 3). Use a staple gun to hold the plastic in place if needed. Once the box is wrapped, start mounting your exterior panels to the frame (see photo 4). We used 1¼-inch exterior wood screws for this.

Step 3: The Door

For the door we used the same plywood that we had been using for the exterior of the fridge (19/32-inch-thick sheet) and cut it down to 40.5 inches x 69.5 inches (103 x 177 cm). This would make the size of the door exactly 3.5 inches (9 cm) wider and 2.5 inches (6 cm) taller than the opening of the refrigerator. This overlap was necessary to provide room to attach the sheet metal and weather stripping around the entire door.

Once we had the back sheet of the door cut, we used 1-inch x 10-inch x 8-foot (2.5 cm x 25 cm x 2.4 m) panels to frame and support the door. We cut each of these panels at 45-degree angles, glued them to the back board and secured them with a few small screws (inserting the screws from the backside so they would not be visible from the front, see photo 5, left).

Next, we measured the depth of the exterior of the door with the backboard and the frame, which was roughly 1 3/16-inches (30.1 mm) deep. This measurement is very important when shopping for hinges and latches as door hinges and latches come with and without offsets to accommodate for different door thicknesses. Knowing that our door was about 1 3/16-inches (30.1-mm) thick, and that we needed to add weather stripping, which would compress with pressure, we just added another 3/16-inch to our thickness to give a total of 1⅜-inches (~35 mm).

Once our final door thickness was established, we ordered hinges and latches online. The hinges were wide enough to cover nearly all of the 1 x 10-inch frame on the door. With such a large, heavy door, we wanted to make sure that the hinges we purchased would extend far enough into the door to support the weight, so we chose Kason Reversible 1245 Cam-Rise Hinges with a 1⅜-inch (~35 mm) offset. For the latches, we wanted a pull style latch, but finding one with a 1⅜-inch (~35 mm) offset was a challenge. We ended up finding some Amico silver alloy pull-style latches on Amazon at a good price. The latch handle itself did not have an offset, but the strike was adjustable to about 1.5 inches (3.8 cm), so it would work. We got two of these to install on the top and bottom halves of the door for two reasons: 1. Since the door was so tall we needed to make sure that it sealed well. If we installed just one latch in the center of the door, there was a good chance that the wood would bow over time. All of the pressure holding it shut would be in the middle of the fridge, allowing the top and bottom of the wooden door to bow out, potentially causing leaks. 2. I (Cary) have a 2-year-old, so I wanted to make sure he couldn't get into the fridge and lock himself inside. Installing one of the latches up about 5 feet (1.5 m) off the ground and another only a couple feet off the ground would do the job.

Step 4: Insulating

After the exterior of the fridge was more or less assembled (minus the door), we began insulating the fridge. We used 1.5-inch R-Tech foam insulation, which can be found at many hardware stores. This insulation is the same thickness as the 2 x 2-inch lumber that was used to frame the box and was still exposed on the interior of the fridge. This insulation, when installed, sat flush with everything that was framed out already.

Simply measure all your interior spaces and cut your foam with a utility blade. We cut ours about a ¼-½-inch larger than needed and forced them into the space to ensure tight seals and good coverage (see photos 6 and 7, left).

Step 5: Interior Sheet Metal

The next step was to measure the interior space for installing the sheet metal. We used 24-gauge galvanized sheet metal for the interior walls. This seemed to be a good thickness, but if we were to build it all over again we would recommend going with a slightly thicker gauge for the floor piece to accommodate for large amounts of weight. When the fridge is full of fermenters there is some slight bending in the floor piece from all the weight.

After the interior was insulated with the foam boards, we added a moisture barrier inside as well by just lining the inside walls with the plastic moisture barrier as we had done on the exterior.

Once we had the moisture barrier in place we inserted the sheet metal pieces. We started with the floor piece since we would be standing in there to get all the other pieces in. Next we inserted the back piece (which has 1.5-inch/3.8-cm, 90-degree bends to overlap both side pieces). We then put both sidepieces in, which overlap the back piece that had the 90-degree bends.

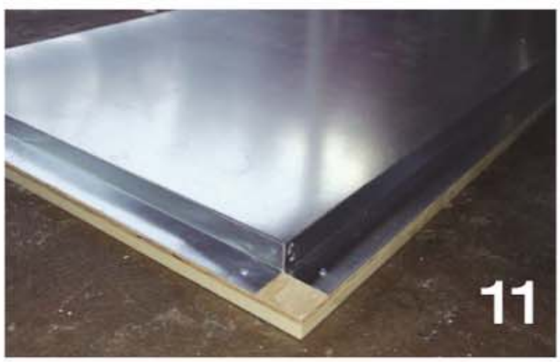
After getting those four pieces of sheet metal in and shifted around to where they were sitting flush we started riveting them into place with 3/16-inch diameter (1/4-inch grip) aluminum rivets. We put the rivets directly into the wood framing behind the sheet metal to ensure that the sheet metal would not move. We put one rivet about every 12 to 18 inches (30 to 45 cm). With the back piece designed to overlap the sidepieces by 1.5 inches this left us the perfect amount of room to drill through both pieces of sheet metal and secure them together with a rivet (see photo 8).

Once all of those were secure we riveted the other four small pieces into place that make up the front inside wall around the door opening. We then installed the top sheet metal with common hex-style sheet metal screws. Since we would later be wiring and mounting an evaporation coil to the top of the fridge, this piece would need to be removable.

Step 6: Staining and Sealing

Once the fridge box and door were completely built, it was time to stain and seal. Staining before mounting the door allowed an even coat of stain to be applied without having to paint over or around the hinges and latches. We chose a 2-1 polyurethane stain and sealer and applied a couple of coats to the exterior of the fridge and both sides of the door (see photo 9, right).

While the stain was drying we masked off the interior of the fridge around all edges and openings leaving about ⅛-inch (3.2 mm) exposed from all corners. We then ran a bead of metallic gray silicone in all cracks, smoothed with a finger and removed the masking tape immediately. This will provide a clean, nearly flawless seal (see photo 10, right).



Step 7: Mounting the Door

After the stain on the door dried, it needed to be insulated. First, we laid a precut piece of sheet metal down on the ground and begin filling it with 1.5-inch foam insulation.

Next, we laid the foam-filled sheet metal piece face down on the backside of the door, centered it and start riveting it into place. We put the rivets closer to the inside edge of the fridge so that when we applied the weather stripping along the exterior edge of the door it wouldn't have to go on top of the rivets (see photo 11, above). We used Frost King 1¼-inch wide x 7/16-inch thick rubber foam weather seal stick tape for the stripping. This is much thicker than our hinge offset allowed for, but we knew that it would compress to nearly nothing with the weight of the door on it.

After the door was finished it was finally time to mount it to the fridge. To do this, we laid the fridge down on its backside (don't attempt to lift something this heavy alone) and set the door on top of the fridge so that we could center and align everything before mounting.

When mounting the hinges to the refrigerator box and the door, we used screws that weren't any longer than the box and door thickness. If you want to build this project or something similar, just measure the thickness of your hinge where the screws will insert, and the thickness of your door and/or box and subtract about ¼-inch — that should give you a screw that will sit deep into the wood without popping through the interior. Next we did the same thing with the latches. At this point the box is nearly complete (see photo 12, left).

Step 8: Installing the Casters

What good is a giant fridge if it can't roll around? After we installed the door, we left the fridge on its back to install four 3-inch rubber casters on the bottom. The casters have a 225-lb. (102-kg) rating (so 900 lbs./408 kg total between all four). You could probably get away with something a little less, but we wanted to go with something that would handle the weight with no problems. You would not believe how much this fridge weighs; without them you would need an army to move it. We used two straight rolling casters in the back, and two swivel casters in the front that have wheel locks to keep from moving once we got the fridge into position (see photo 13, below).


13

> "What good is a giant fridge if it can't roll around?"

Step 9: Heating and Cooling

This is the one step that we couldn't do on our own (well, this and having the sheet metal cut for the interior of the fridge). Good thing my father-in-law is a refrigeration genius and did all the plumbing for us! Before we go further, a word of warning: *Do not*

proceed onto the next steps by yourself if you are not experienced with electrical, plumbing and refrigeration work. Find a friend who is experienced, or a contractor, and have them help you out.

We used a Copeland 1/3 HP 134A 115V condensing unit, and a 1,000-BTU low profile reach in-style evaporator fan for the cooling unit (see photo 14, above). For the heating, we

used a simple 100W infrared ceramic heat emitter and porcelain lamp with 8.5-inch (22-cm) dome. We looked at a number of heating options and decided on this option because it was cheap, would work well, and did not give off any light — allowing us the option to leave beer in bottles or glass carboys inside the fridge without worrying about light exposure.

For the thermostat, we needed a dual stage thermostat that would turn the refrigeration on when it got too hot and would also turn the heat lamp on when it got too cold. We settled on the Control Products TC-9102D-HV dual stage high voltage digital temperature controller (see photo 15, above).

We wired both the heat lamp and the condenser to an electrical box on top of the fridge where it would not be seen. From there we ran the electrical down the interior side-wall of the fridge to the thermostat. This was easy to do because we used screws to put the exterior panels on the fridge, so we just backed the screws out and pulled the side panel off to expose the interior.

After the electrical work was finished we mounted the condenser unit on top of the fridge, drilled holes down through the top for the copper pipes to run from the condensing unit to the evaporator coil, mounted the evaporator coil to the inside top of the fridge and let our refrigeration expert weld the pipes and fill with refrigerant. Again, *do not do any electrical wiring or refrigeration work yourself if you are not experienced* — find someone to help you.

Step 10: Enjoy!

After weeks of work building this behemoth we were anxious to test it out. We plugged it in and it fired right up with no problems. The interior temperature gets from the mid 80s Fahrenheit (~30 °C) (when off) in the summer down to the 60s (~18 °C) within minutes. We haven't tried going much under the low-60s yet because we only brew ales, however we are hoping to try lagering in the fridge this winter for the first time.

One of the main reasons we built this fridge to this size was because of our Ss Brew Tech fermenters. With the unique stacking capabilities of these fermenters we are able to fit a ridiculous amount of beer in this fridge. However, each homebrewery has its own unique space and equipment requirements — you can certainly take the general idea of this project to build a similar fridge to your own specs!

Our next project related to this fridge will be implementing a Raspberry Pi or Brew Pi fermentation temperature controller that will allow us to more closely monitor our fermentation temperatures over time, log data as well as set up fermentation profiles.

For more about our fridge build project, including sheet metal cuts, check out the free ebook on the Fermenter Fridge Build at KegOutlet.com. BYO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by Horst Dornbusch

THE PILS — short for Pilsner or Pilsener — is the northern German adaptation of the world's first-ever blond lager, the original Czech Plzensky Prazdroj, which is more commonly known by its German name of Pilsner Urquell. The Plzensky Prazdroj was first brewed in 1842, in the Bohemian city of Plzen (Pilsen), by the Mestansky Pivovar (Burgher Brewery). This golden-blond Czech Pilsner is rich and mellow on the palate from Pilsen's extremely soft water, Moravia's aromatic malt, and Zatec's (Saaz') floral hops. On the other hand, the German interpretation of this soft and rounded lager is paler, edgy, and more assertive, in part because of the use of spicier, citrusy hops for bittering and the harder German water, which accentuates hop bitterness. To distinguish German-made from Czech-made Pilsners, many German breweries add a middle "e" to the beer's name: Pilsener. This is also in line with strict German grammatical rules, according to which the adjective Pilsner denotes an item from Pilsen, whereas the adjective Pilsener denotes anything that resembles an item from Pilsen but is not from there.

The original Pilsner Urquell was invented by Josef Groll, a Bavarian brewmaster who was hired by the Burgher Brewery with the explicit mission to improve the quality of the local brew, which, according to contemporary records, must have been rather poor. Groll's blond lager owes its

German Pilsener Commercial Examples

Bitburger Premium Pils
Bitburger Brauerei
Bitburg/Eifel, Germany
www.bitburger.de

Heineken Pilsener
Heineken Nederland B.V.
Zoeterwoude, Netherlands
www.heineken.com

König Pilsener
König-Brauerei
Duisburg, Germany
www.koenig.de

Krombacher Pils
Krombacher Brauerei
Kreuztal-Krombach, Germany
www.krombacher.de

Mandarina
August Schell Brewing Co.
New Ulm, Minnesota
www.schellsbrewery.com

Polestar Pilsner
Left Hand Brewing Co.
Longmont, Colorado
www.lefthandbrewing.com

Prima Pils
Victory Brewing Co.
Downingtown, Pennsylvania
www.victorybeer.com

Spaten Pils
Spaten-Franziskaner-Bräu
Munich, Germany
www.spatenbraeu.de

Sunshine Pils
Tröegs Brewing Company
Hershey, Pennsylvania
www.troegs.com

Über Pils
Rogue Ales
Newport, Oregon
www.rogue.com

Warsteiner
Warsteiner Brauerei
Warstein, Germany
www.warsteiner.de

"Northern German Pilseners rank among the palest beers in the world. A brew simply could not get much paler without the use of adjuncts."

German name to the fact that, in those days, Bohemia was part of the German-speaking Austro-Hungarian Empire. "Ur" is German for "original;" and "Quell," for "source," "spring," or "well." The new beer was an instant sensation and, in short order, became a Czech export hit throughout all of Europe. Not surprisingly, almost every brewery in the world soon imitated Pilsner. Even the standard American lager — including, for instance, Budweiser, Miller, and Pabst — are distant adaptations of Groll's Bohemian brew. In Germany, the first indigenous Pilsner-like beer appeared on the market in 1872. It was made by the *Aktienbrauerei Zum Bierkeller* (the "Beer Cellar Corporation"), in the village of Radeberg, near Dresden, the capital of Saxony, a state that borders what is now the Czech Republic. This erstwhile "beer cellar" has since been renamed Radeberger and is now Germany's largest brewing group. Today, with very few exceptions, every one of Germany's roughly 1,300 breweries makes a Pils; and the Pils style holds a more than 50% market share in that country.

Northern German Pilseners rank among the palest beers in the world. A brew simply could not get much paler without the use of adjuncts. Once primarily a specialty of the northern German states, Pilsener is now brewed throughout the entire country, including in Bavaria where the classic indigenous blond lager is Helles. As a rule, Pils interpretations tend to become paler, drier, and bitterer as you move north from the Alps to the sea. The most authentic traditional Pils versions have a distinct, up-front hop kick from as many as 45 IBUs, while many mass-produced modern versions, nowadays, have a much reduced bitterness of as low as 23 IBUs.

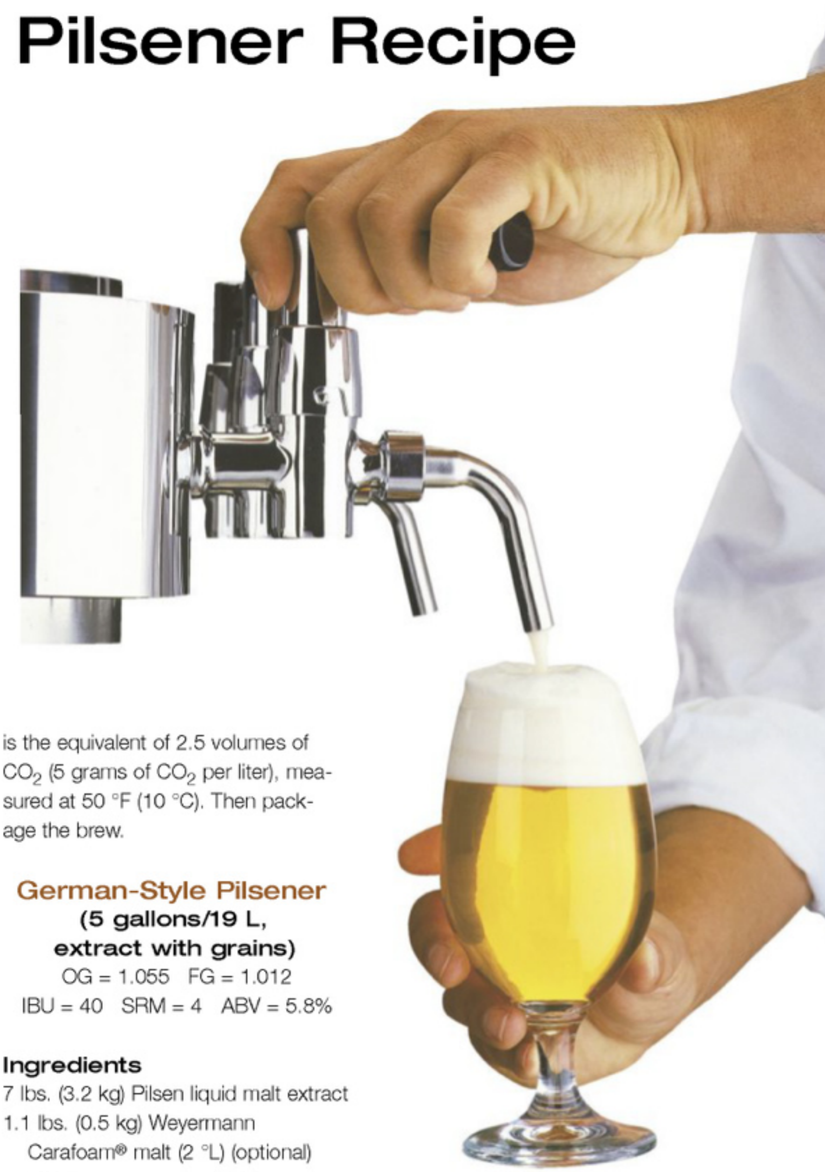
An authentic Pils is always drier, crisper, more attenuated, and more refreshing in the finish than a classic Bohemian Pilsner. It has next to no fruitiness, esters, or diacetyl; and the body is medium. Its effervescence should be spritzy — more so than that of a Bohemian Pilsner — from a generous dose of carbonation of at least 5 grams of CO_2 per liter (2.53 volumes of CO_2), as measured at 50 °F (10 °C). Homebrewers can achieve this effervescence by priming a 5-gallon (19-L) batch with about 7.25 oz. (200 grams or 1 cup) of corn sugar. When a well-lagered Pils is poured correctly — into a tall, tulip-shaped glass, in three increments, slowly, over two minutes — it should have a sturdy, long-lasting head.

Malt

In a simple German lager such as a Pilsener, malt quality is of utmost importance. Therefore, select only the most homogeneous malt from the most malt-aromatic brewing barley varieties. A Pilsener can be made from up to 100% Pilsner malt. However, the recipe on page 53 also calls for 10% Carafoam® for some extra body and mouthfeel. For Pilsner base malt, a brewer has several choices. Virtually any malting company now offers a Pilsner malt, usually with a color of roughly 2 to 2.5 °L. For an extremely pale brew, you can use Weyermann Extra Pale Pilsner Malt, which has an unusually low average Lovibond rating of only 1.5 °L.

Other interesting base malt alternatives are a floor-malted Bohemian Pilsner malt from Weyermann or the recently introduced Barke® Pilsner Malt, also from Weyermann. Barke® is considered one of the "maltiest" two-row barley varieties ever, with some of the best properties for malting and brewing. It has a relatively large and

German Pilsener Recipe



German-Style Pilsener

(5 gallons/19 L, all-grain)

OG = 1.055 FG = 1.012
IBU = 40 SRM = 4 ABV = 5.8%

Ingredients

10.2 lbs. (4.6 kg) continental Pilsner malt (2 °L)
1.1 lbs. (0.5 kg) Weyermann Carafoam® malt (2 °L)
6 AAU Tettnang hops (80 min.) (1.5 oz./43 g at 4% alpha acids)
5.2 AAU Spalt hops (30 min.) (1.3 oz./37 g at 4% alpha acids)
2.6 AAU Hallertauer Mittelfrüh hops (5 min.) (0.6 oz./17 g at 4.25% alpha acids)
White Labs WLP830 (German Lager) or Wyeast 2124 (Bohemian Lager) yeast
⅔ cup corn sugar (if priming)

Step by Step

This is a multi-step infusion mash. Mash in at 122 °F (50 °C). Rest 30 minutes. Raise temperature to 144 °F (62 °C). Rest 20 minutes. Raise temperature to 162 °F (72 °C). Rest 20 minutes. Raise temperature to 172 °F (78 °C) for the mash-out. Transfer mash to lauter tun. Recirculate. Sparge to pre-boil gravity of about 1.042, assuming 1.5 gallons (5.7 L) evaporation during subsequent boil. Boil for 90 minutes. Bitter hop at 10 minutes into the boil; flavor hop at 60 minutes; aroma hop at 85 minutes. After the boil, verify OG in kettle. Add water if too much evaporation occurred. Chill the wort down to the top of the selected yeast's temperature range. Aerate the wort thoroughly. Maintain transfer temperature until primary fermentation is vigorous. Pull temperature down slowly to the bottom of the selected yeast's temperature range. Rack at terminal gravity. Reduce temperature to about 34 °F (1 °C), or lower. Lager at least eight weeks (12 weeks is better). Prime the beer with a total of 4 oz. (112 g) of corn sugar. Technically, this is the equivalent of 2.5 volumes of CO_2 (5 grams of CO_2 per liter), measured at 50 °F (10 °C). Then package the brew.

German-Style Pilsener

(5 gallons/19 L, extract with grains)

OG = 1.055 FG = 1.012
IBU = 40 SRM = 4 ABV = 5.8%

Ingredients

7 lbs. (3.2 kg) Pilsen liquid malt extract
1.1 lbs. (0.5 kg) Weyermann Carafoam® malt (2 °L) (optional)
6 AAU Tettnang hops (80 min.) (1.5 oz./43 g at 4% alpha acids)
5.2 AAU Spalt hops (30 min.) (1.3 oz./37 g at 4% alpha acids)
2.6 AAU Hallertauer Mittelfrüh hops (5 min.) (0.6 oz./17 g at 4.25% alpha acids)
White Labs WLP830 (German Lager) or Wyeast 2124 (Bohemian Lager) yeast
⅔ cup corn sugar (if priming)

Step by Step

Crush and steep the optional Carafoam® in a nylon or muslin bag for about 30 minutes in approximately 2 qts. (~2 L) of water, at roughly 160 °F (70 °C). Raise and rinse the bag with 2 cups (~0.5 L) of cold water. Do not squeeze the bag. Dissolve about 7 lbs. (3.2 kg) of liquid malt extract in the steeping liquid plus enough water to bring the OG of the mix to approximately 1.042, assuming a 1.5 gallons (5.7 L) evaporation rate during a 90-minute boil. Bring to a boil and proceed as for the all-grain batch.

German Pilseners tend to become paler, drier and bitterer (as high as 45 IBUs in some places) as you travel north from the Alps to the sea. The color of German Pils is paler than its Czech counterpart, Bohemian Pilsner, as well as drier, crisper and more attenuated.

homogeneous kernel diameter ("plumpness"), good germination potential, superior diastatic power, and low beta-glucan levels, as well as excellent extract yield and attenuation potentials.

The bittering hop for Pilsener must be assertive but not harsh or excessively citrusy. The grapefruit-like Cascade, for instance, would be totally out of place in a Pils. Instead, traditional German Tettnanger is an ideal bittering choice for Pils because it has a slightly lemony aspect and a mild touch of hay. Significantly, Tettnanger has a relatively low percentage of harsh-tasting cohumulones (only about 22–28% of total alpha-acids). Compare that to Cascade, which weighs in at a hefty cohumulone value of 33–40% of total alpha-acids. For reference, one of the highest concentrations of cohumulone in hops is in Brewers Gold at 40–48% of total alpha-acids.

Low cohumulone levels are especially important in the highly drinkable, high-IBU Pils, which requires a slightly astringent yet still pleasant bitterness. In addition, high cohumulone levels have a detrimental effect on head retention. In a classic German Pils, therefore, which requires a strong, creamy-white head as a style-defining characteristic, cohumulones are the least desirable alpha-acids.

The hop selected as a flavor variety in our recipe is the almost Saaz-like German Spalt. The hop fits a Pils perfectly, because it has not only a very low cohumulone content (only 22–29% of total alpha-acids), but also has a substantial amount of fragrant humulene oil (about 20–30% of total oils). For comparison, Cascade has a humulene content of only 8–13% of total oils. Humulene has strong aromatic qualities, which manifest themselves in an herbaceous bouquet and a spicy, woody, almost coriander-like flavor. Fortunately, humulene also has a high boiling point of roughly 210 °F (99 °C), which allows brewers to preserve this hop's etheric aromatics in late additions to the boil, and in the hot whirlpool.

As an aroma hop, I selected the classic German "noble" Hallertauer Mittelfrüh. It, too, has a low cohumulone content of only 18– 28% of total alpha-acids, while it has a truly high humulene content of about 45–55% of total oils for a long lingering hop note in the finish.

Yeast

The key to a clean, crisp tasting Pilsener is a clean, crisp fermenting lager yeast strain. Two of the best choices for this beer style include Wyeast 2042 (Danish Lager), which attenuates well and produces a well-rounded profile that, as the Wyeast website states, "accentuates hop characteristics." Its optimum fermentation temperature is 46–56 °F (8–13 °C). The other good choice is White Labs WLP830 (German Lager Yeast), which the White Labs website describes as, "one of the most widely used lager yeasts in the world." Its optimum fermentation temperature is 50–55 °F (10–13 °C).

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The hop choices for brewing a German Pilsener should be amongst the "Noble" category. Some choices include German Tettnanger, German Spalt and Hallertauer Mittelfrüh (shown above). Hallertauer hops are named for the area of Bavaria where they are grown.

minute rest at 144 °F (62 °C), as well as a 20-minute rest at 162 °F (72 °C). The mash-out temperature should be 172 °F (78 °C). Lautering should be slow and last for more than an hour. The conventional boil time for a Pils is 90 minutes to ensure the complete evaporation of dimethyl sulfide (DMS), which tends to be more prevalent in Pilsner malt than in other. The bittering, flavor, and aroma hop additions happen after 10, 60, and 85 minutes into the boil, respectively. (For more information about step mashing, visit http://byo.com/story1415)

In the tank, the pitching temperature for the yeast should be at the top of the temperature tolerance of the selected yeast. Aeration should last at least 90 minutes. Once the yeast shows signs of vigorous fermentation, the tank temperature should be lowered gradually (by perhaps 2 °F or 1 °C per hour) to the bottom working temperature of the selected yeast to minimize the production of fermentation byproducts. At terminal gravity, rack the brew, and lager it at a temperature of about 34 °F (1 °C) or lower. Lager the brew unfiltered on the remaining yeast in suspension for at least eight weeks (12 weeks is better). At this stage, the yeast will absorb scrub residual oxygen, as well as many of its metabolic byproducts. Specifically, a long lagering period gives the yeast a chance to reduce buttery-tasting diacetyl enzymatically to more palatable, vanilla-like acetoin; and to reduce any residual acetaldehyde (green-apple flavor) to simple ethanol alcohol. Once properly lagered, condition the brew either with CO_2 or with priming sugar and package it.

The Process

In the 19th century, all Pilsener mashes were decoctions. Given the quality of most modern malts, however, this is no longer necessary. In a traditional German brewhouse, the mash takes place in the brew kettle at a very low viscosity at a liquor-to-grist ratio of perhaps 3.5:1. This is a metric measure meaning approximately 3.5 liters (0.925 gallons) of liquor per 1 kg (2.2 lbs.) of malt; or 0.42 gallons (1.68 quarts) of liquor per 1 lb. of malt. This is a much thinner mash than is customary for most British-, Belgian-, or American-style ales. The mash-in liquor in a batch of German brew can amount to an equivalent of up to 80% of the net kettle volume of wort after the boil.

In step mashing, steam-heated jackets (or other heating mechanisms used for boiling the wort) provide the heat required to raise the mash temperature in the kettle from one step to the next, and finally to the mash-out temperature. The mash is then slurry-pumped from the kettle to the lautering tun. Homebrewers would use a ladle for this. Next, the initial run-off is recirculated in the lauter tun until clear. Finally, the wort is run off into the kettle, which was rinsed, while the wort was recirculating. German-style lautering usually takes place without sparging, that is, the run-off continues until the grain bed is almost dry. Instead of sparging, German brewers then "re-mash" the grain bed once, twice, or even three times using what is called a *Nachguss* (literally "after-pour"), until the desired pre-boil kettle gravity is reached.

If your equipment does not permit such a German-style transfer of the mash from the kettle to the lauter tun, you can mash-in the British way, into the mash-lauter tun with conventional sparging. However, try to keep the mash viscosity as low as your equipment allows.

While many brewers have made tasty Pilsener interpretations with a single-step mash at perhaps 148 °F (64 °C), with a 30- to 40-minute rest for optimum beta-amylase activity, a multi-step mash schedule provides additional assurance that all essential malt compounds are optimally degraded. A good mash-in temperature for a step-mash is 122 °F (50 °C) for a 30-minute rest, followed by a 20-

Extract and Steeping Options

Because of the simplicity of the grain bill, use roughly 7 lbs. (3.2 kg) of any commercial Pilsner liquid malt extract (LME) for an extract brew. Mathematically, the exact amount of LME depends on the extract's percentage of fermentable sugars. This value varies from one producer to another. The precise calculation for the replacement of 8.07 lbs. of malt — in a 5-gallon (19-L) batch with an original gravity (OG) of 1.048 — with an LME containing 75.5% sucrose, is 6.95 lbs. (3.12 kg). This is a nominal value, which is safely rounded to 7 lbs. (3.17 kg — or just round to 3 kg) Then steep the optional, crushed Carafoam® in a nylon or muslin bag in perhaps 2 quarts (~2 L) of water, at roughly 160 °F (70 °C), for about 30 minutes. Raise the bag out of the kettle and rinse it with 2 cups of cold water. Do not squeeze the grain bag to prevent extracting excess tannins from the grain husks. Use this "malt tea" as part of the liquor required to dilute the malt extract. Bring the thinned extract — at the correct original gravity — to a boil and proceed as you would for the all-grain batch.

Brewers, who wish to skip the steeping process, can simply purchase unhopped Weyermann® Bavarian Pilsner LME, which is already made from a decoction mash of Pilsner and Carafoam® malts. BYO

Related Links:

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http://byo.com/story552

• Classic American Pilsner is a much bigger beer, in terms of flavor and aroma, than today's mainstream American Pilsners. Like your grandpappy's Pilsner, this is a rich malty and hoppy beer.
http://byo.com/story2424

• Looking for more great Pilsner (or Pilsener) recipes? Check out the BYO.com recipe archive for a collection of *Brew Your Own*'s favorite Pilsners from the past:
http://byo.com/pilsner?start=20

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https://byo.com/european-pale-lager

Image by Charles A. Parker/Images Plus

BOHEMIAN PILSNER

by Gordon Strong

Brewing the classic pale lager of the Czech Republic

What's in a name? That which we call a rose by any other name would smell as sweet.
~ William Shakespeare, Romeo and Juliet

The pale, bitter, hoppy lager known best to American homebrewers as Bohemian Pilsner and typified by the classic example Pilsner Urquell is also called Czech Pilsner, Czech Premium Pale Lager, *Svetly Lezak*, *Svetle Specialni Pivo*, or simply Pilsner. But why does it have so many names? The answer depends mostly on who you are, where you live, and what exactly you are drinking.

Like most words formed from a city or place name with an –er ending, Pilsener refers to beer that resembles that from Pilsen (the German name for the Czech city of Plzen), and Pilsner is a shorter form of the same word. Plzen is a large city in Bohemia, the western region of the modern Czech Republic in central Europe. Bohemia is a historical country, although the name is Latin (the Czech name is Cechy). Bohemia, Moravia, and Czech Silesia form the modern Czech Republic.

Within the Czech Republic, beers are often referred to by color and strength. Pale beer of 11–12 °P (OG 1.044–1.048) is called *Svetly Lezak* (pale lager), while the 13 °P and stronger beer (1.052 SG and up) is called *Svetle Specialni Pivo* (pale special beer). Czech beer is almost always bottom-fermented lager beer.

While the term Pilsner is widely used around the world for pale lager beer, the name is often bastardized from its original meaning. For example, consider Miller Lite, which is labeled "A Fine Pilsner Beer" even though it bears little resemblance to its namesake. Pilsner Urquell (a German phrase meaning "original source of Pilsner") was the first Pilsner-type beer, and has been brewed since 1842. The Czech name for this beer is *Plzensky Prazdroj*.

Czechs won't call a beer Pilsner unless it's actually brewed in Plzen, and only Pilsner Urquell is brewed there. So it's ironic that the name of the beer style that has become the basis for the most widely produced beers of today isn't actually used in its country of origin, except to describe a single (although exemplary) commercial product. Used in comparative discussions, the style is often called Bohemian or Czech Pilsner (or Pilsner) to differentiate it from German derivatives and the modern worldwide pale lager styles.

The Beer Judge Certification Program (BJCP) has called the style Bohemian Pilsener since at least 1997, but is changing the name in the 2014 guidelines to Czech Premium Pale Lager out of respect for the usage in its country of origin, and to more accurately reflect the direct translation into English of its name. However, brewers and beer drinkers should understand all the names that might be associated with commercial products. For our purposes we'll refer to it as Pilsner for the rest of

Bohemian Pilsner Commercial Examples

Budweiser Budvar
Budějovický Budvar,
Ceske Budejovice, Czech Republic
www.budvar.cz

Gambrinus
Plzensky Prazdroj
Plzen, Czech Republic
www.pilsner-urquell.com

Golden Pheasant
Pivovar Zlaty Bazant
Hurbanovo, Slovac Republic
www.zlatybazant.sk

Krušovice Imperial
Královský Pivovar Krušovice
Krušovice, Czech Republic
www.krusovice.cz

Nomad
Great Divide Brewing Co.
Denver, Colorado
www.greatdivide.com

Piercing Pils
Dogfish Head Craft Brewery
Milton, Delaware
www.dogfish.com

Pilsner Urquell
Plzensky Prazdroj
Plzen, Czech Republic
www.pilsner-urquell.com

Samuel Adams Noble Pils
Boston Beer Company
Boston, Massachusetts
www.samueladams.com

Schell's Pils
August Schell Brewing Co.
New Ulm, Minnesota
www.schellsbrewery.com

Shiner 101 Czech Style Pilsner
Spoetzl Brewery
Shiner, Texas
www.shiner.com

Staropramen Lager
Pivovary Staropramen
Prague, Czech Republic
www.staropramen.cz


Image courtesy of Hopunion LLC

Classic Bohemian Pilsner is traditionally brewed with Czech Saaz hops. Saaz is the German pronunciation of *Zatec*, which is the name of the town in the northwest corner of the Czech Republic where noble Saaz hops have been grown for more than 700 years.

the story.

Aside from the superb Pilsner Urquell, Gambrinus and Budweiser Budvar (called Czechvar in the United States) are good commercial examples of Bohemian Pilsner.

Attributes of Bohemian Pilsner

Bohemian Pilsner is actually a quite simple beer, but made with some of the finest ingredients used in brewing. The traditional beer uses Czech Saaz (*Zatec*) hops, Moravian Pilsner malt, very soft water (low mineral content), and Czech lager yeast. Decoction mashing and a long, cold fermentation are traditional. The ingredients and process yield a highly-hopped and bitter beer that is very smooth and lacking in harsh bitterness, despite a high IBU level.

The Czech malt gives a bready-rich malty flavor and produces a gold-colored beer that is darker in color and richer and fuller in flavor than a German-type Pilsner. The Saaz hops are often spicy, but related Saazer-type (sometimes called "Noble") hops are often used. The bitterness level is high, generally 30–45 IBUs, but the apparent bitterness is often lower than a German-type Pilsner because of the soft water, clean bitterness, and malty-full finish.

The malt and brewing process can sometimes produce a very light buttery diacetyl quality. Diacetyl should never be more than a pleasant background character in this style. If present in a beer at low levels, diacetyl should not be considered a fault, but I don't think brewers should manipulate their process to try to obtain noticeable diacetyl. The beer is complex enough without it.

The beer should not be sweet, but a substantial malty palate is desirable since it serves to support and enhance the hop presentation. To avoid being sweet, the beer should be well-attenuated and dry. However, since the ideal water is quite soft and has very little sulfate content, the finish seems fuller. The body is a bit more dextrinous than a German Pilsner, so the beer may seem a touch heavier but still should be drinkable in quantity.

Homebrewing Bohemian Pilsner

As with my past style review articles, for recipes I turned to four award-winning homebrewers with proven success in brewing Bohemian Pilsner: Randy Scorby of Bend, Oregon, Ted Hausotter of Baker City, Oregon, James Golovich of Richland, Washington, and Michael Agnew of Minneapolis, Minnesota. All four homebrewers are also high-ranking BJCP judges.

As I mentioned earlier, Bohemian Pilsner depends heavily on proper ingredients and a process that allows the ingredients to be featured. My homebrewing experts agree, with all of them emphasizing the region-specific character of the ingredients and general freshness as key control points. However, once you have the fundamentals of the style down, there is room for interpretation, and the homebrewers I spoke to offered some interesting ideas and alternatives for other aspects under the homebrewer's control.

The expert homebrewers all identified hops as the most critical component, but they also offered advice on malt, mashing, yeast, fermentation, and lagering.

Hops

To brew a traditional Bohemian Pilsner, the obvious hop choice is Czech Saaz, and many brewers insist on them. However, there is a bit of leeway; the key to substituting Czech Saaz is to stick with the profile of Saaz's spicy character.

Ted Hausotter is very picky about his hops and loves Czech Saaz for this style, but he will use them only when the quality is sufficient. Sourcing fresh, well-kept Czech Saaz hops can be difficult at times, and US-grown Saaz is not a good substitute for him. When he can't source Czech Saaz, he likes Sterling (also a favorite of mine), which has a higher oil content and alpha acids than Czech Saaz, and can often be found fresher in the US. He recommends a mixture of Saaz and Sterling for the best balance of classic Saaz character and fresh hop intensity from the Sterling. He likes to get the bulk of his IBUs from a first-wort hop addition (read more about first wort hopping at http://byo.com/story2958). Michael Agnew uses Sterling exclusively, as he believes it has a perfumy, floral character with a hint of interesting citrus.

Randy Scorby prefers to avoid the traditional bittering addition, and uses late additions to reduce the chance of hop-derived harshness and emphasize the flavor and aroma dimension. He chooses Saaz hops for traditional reasons. James Golovich uses a clean Magnum bittering addition, saving the traditional Saaz for finishing. He believes the higher-alpha Magnum hops allow him to limit the hop matter in the beer, which also reduces harshness. Ted Hausotter also mentioned using Magnum for bittering as an alternative for the same reason.

James Golovich stressed the importance of knowing how your brewing system responds to different hop levels. Knowing what hop utilization to expect is critical to hitting the right balance in this type of beer. Simply throwing in tons of hops like making an IPA isn't the right answer.

Fresh hops with the Saaz-like char-

Continued on page 66

Award-Winning Bohemian

Bohemian Pilsner

Recipe by Randy Scorby, Bend, Oregon
(5 gallons/19 L, all-grain)

OG = 1.051 FG = 1.015
IBU = 42 SRM = 4.2 ABV = 4.8%

Randy was the runner up Best of Show at the 2014 Central Oregon Homebrewer's Organization Spring Fling in Bend, Oregon with this recipe.

Ingredients

5 lbs. 14 oz. (2.7 kg) Weyermann pale ale malt (3 °L)
3 lbs. 14 oz. (1.8 kg) Weyermann Pilsner malt (2 °L)
7.4 oz. (210 g) Weyermann pale wheat malt (2 °L)
4.5 AAU Czech Saaz hops (30 min.) (0.8 oz./23 g at 5.6% alpha acid)
8.4 AAU Czech Saaz hops (20 min.) (1.5 oz./43 g at 5.6% alpha acid)
5.6 AAU Czech Saaz hops (10 min.) (1.0 oz./28 g at 5.6% alpha acid)
8.4 AAU Czech Saaz hops (3 min.) (1.5 oz./43 g at 5.6% alpha acid)
Wyeast 2278 (Czech Pils) yeast (2 qt./2 L starter)
¾ cup corn sugar (if priming)

Step by Step

Two or three days before brew day, make the yeast starter, aerating the wort thoroughly (preferably with oxygen) before pitching the yeast.

This is a single decoction mash, for more on decoction mashing see http://byo.com/story1409. On brew day, mash in the malt at 132 °F (56 °C) in 15 qts. (14 L) of water, and hold this temperature for 10 minutes. Pull a thick decoction and hold at 154 °F (68 °C) for 20 minutes, then boil the decoction for 10 minutes. Return the decoction to the main mash and hold at 154 °F (68 °C) until conversion is achieved. Recirculate until clear, fly sparge with 168 °F (76 °C) water until 6.5 gallons (25 L) of wort is collected. Boil the wort for 75 minutes, adding hops at times indicated. Chill the wort and pitch the starter of yeast; the wort temperature should be no higher than 50 °F (10 °C) when pitched. Ferment at 48 °F (9 °C) until desired final gravity is achieved. Lager for 4–6 weeks at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes CO_2.

Bohemian Pilsner

Recipe by Randy Scorby, Bend, Oregon
(5 gallons/19 L, partial mash)

OG = 1.051 FG = 1.015
IBU = 42 SRM = 4.2 ABV = 4.8%

Ingredients

4 lbs. 14 oz. (2.2 kg) Weyermann pale ale malt (3 °L)
7.4 oz. (210 g) Weyermann pale wheat malt (2 °L)
3.3 lbs. (1.5 kg) Pilsner liquid malt extract
4.5 AAU Czech Saaz hops (30 min.) (0.8 oz./23 g at 5.6% alpha acid)
8.4 AAU Czech Saaz hops (20 min.) (1.5 oz./43 g at 5.6% alpha acid)
5.6 AAU Czech Saaz hops (10 min.) (1.0 oz./28 g at 5.6% alpha acid)
8.4 AAU Czech Saaz hops (3 min.) (1.5 oz./43 g at 5.6% alpha acid)
Wyeast 2278 (Czech Pils) yeast (2 qt./2 L starter)
¾ cup corn sugar (if priming)

Step by Step

This is a single step infusion mash. Mash the grains at 155 °F (68 °C) in 7 qts. (6.6 L) of water. Hold at this temperature for 60 minutes. Collect 2.25 gallons (8.5 L) of wort. Add water to make at least 3 gallons (11 L) of wort. Boil the wort for 75 minutes, adding hops at times indicated. Add the liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate wort and pitch yeast, the wort temperature should be no higher than 50 °F (10 °C) when pitched. Ferment at 48 °F (9 °C) until desired final gravity is achieved. Lager for 4–6 weeks at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes CO_2.

Bohemian Pilsner

Recipe by Randy Scorby, Bend, Oregon
(5 gallons/19 L, extract only)

OG = 1.051 FG = 1.015
IBU = 42 SRM = 4.2 ABV = 4.8%

Ingredients

6.6 lbs. (3 kg) Pilsner liquid malt extract
6 oz. (170 g) light dried malt extract
4.5 AAU Czech Saaz hops (30 min.) (0.8 oz./23 g at 5.6% alpha acid)
8.4 AAU Czech Saaz hops (20 min.) (1.5 oz./43 g at 5.6% alpha acid)
5.6 AAU Czech Saaz hops (10 min.) (1.0 oz./28 g at 5.6% alpha acid)
8.4 AAU Czech Saaz hops (3 min.) (1.5 oz./43 g at 5.6% alpha acid)
Wyeast 2278 (Czech Pils) yeast (2 qt./2 L starter)
¾ cup corn sugar (if priming)

Step by Step

Add the dried malt extract and half of the liquid malt extract to enough water to make at least 3 gallons (11 L) of wort. Boil the wort for 75 minutes, adding hops at times indicated. Keep some boiling water handy and do not let the boil volume dip below 3 gallons (11 L). Add the remaining liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to the fermenter and top up to 5 gallons (19 L). Aerate the wort and pitch the yeast; the wort temperature should be no higher than 50 °F (10 °C) when pitched. Ferment at 48 °F (9 °C) until desired final gravity is achieved. Lager for 4–6 weeks at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes CO_2.

Pilsner Recipes

Bohemian Pilsner

Recipe by Ted Hausotter, Baker City, Oregon
(5 gallons/19 L, all-grain)
OG = 1.055 FG = 1.014
IBU = 42 SRM = 4 ABV = 5.5%

Ted has won several awards for this recipe, the best of which was second place Best of Show at the Masters Championship of Amateur Brewing (MCAB) in 2000.

Ingredients

10 lbs. 3 oz. (4.6 kg) German Pilsner malt (2 °L)
13.6 oz. (0.39 kg) German Vienna malt (3.5 °L)
4.5 oz. (128 g) German pale ale malt
3 AAU Czech Saaz hops (FWH) (1.0 oz./28 g at 3% alpha acid)
4.2 AAU US Sterling hops (FWH) (0.6 oz./17 g at 7% alpha acid)
3 AAU Czech Saaz hops (10 min.) (1.0 oz./28 g at 3% alpha acid)
7 AAU US Sterling hops (5 min.) (1.0 oz./28 g at 7% alpha acid)
3 AAU Czech Saaz hops (1 min.) (1.0 oz./28 g at 3% alpha acid)
9.8 AAU US Sterling hops (1 min.) (1.4 oz./40 g at 7% alpha acid)
Wyeast 2124 (Bohemian Lager) or White Labs WLP830 (German Lager) yeast (2 qt./2 L starter)
¾ cup corn sugar (if priming)

Step by Step

Two or three days before brew day, make the yeast starter, aerating the wort thoroughly (preferably with oxygen) before pitching the yeast.

This is a single step infusion mash. On brew day, mash in the malt at 155 °F (68 °C) in 16 qts. (15 L) of water, and hold at this temperature for 60 minutes. Recirculate until clear, sparge with 168 °F (76 °C) water until 6.5 gallons (25 L) of wort is collected. Boil the wort for 75 minutes, adding hops at the times indicated. Chill the wort, aerate, and pitch the yeast. Ferment at 50 °F (10 °C). Lager for 4–6 weeks at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes CO_2.

Bohemian Pilsner

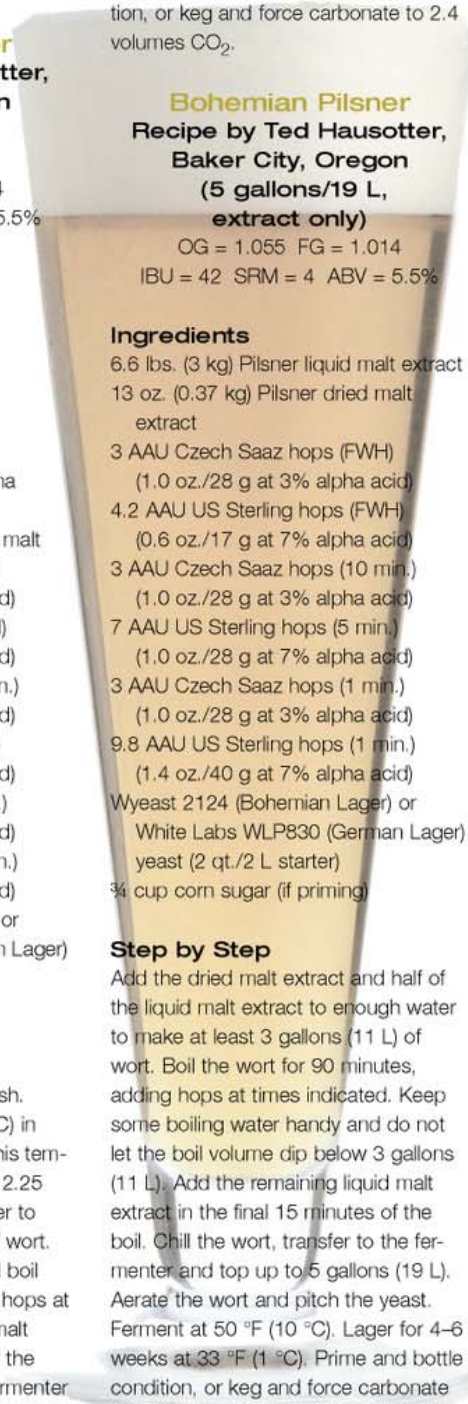
Recipe by Ted Hausotter, Baker City, Oregon
(5 gallons/19 L, partial mash)
OG = 1.055 FG = 1.014
IBU = 42 SRM = 4 ABV = 5.5%

Ingredients

3.3 lbs. (1.5 kg) Pilsner liquid malt extract
2 lbs. (0.91 kg) Pilsner dried malt extract
1 lb. 10 oz. (0.74 kg) German Pilsner malt (2 °L)
13.6 oz. (0.39 kg) German Vienna malt (3.5 °L)
4.5 oz. (128 g) German pale ale malt
3 AAU Czech Saaz hops (FWH) (1.0 oz./28 g at 3% alpha acid)
4.2 AAU US Sterling hops (FWH) (0.6 oz./17 g at 7% alpha acid)
3 AAU Czech Saaz hops (10 min.) (1.0 oz./28 g at 3% alpha acid)
7 AAU US Sterling hops (5 min.) (1.0 oz./28 g at 7% alpha acid)
3 AAU Czech Saaz hops (1 min.) (1.0 oz./28 g at 3% alpha acid)
9.8 AAU US Sterling hops (1 min.) (1.4 oz./40 g at 7% alpha acid)
Wyeast 2124 (Bohemian Lager) or White Labs WLP830 (German Lager) yeast (2 qt./2 L starter)
¾ cup corn sugar (if priming)

Step by Step

This is a single step infusion mash. Mash the grains at 155 °F (68 °C) in 4 qts. (3.8 L) of water. Hold at this temperature for 60 minutes. Collect 2.25 gallons (8.5 L) of wort. Add water to make at least 3 gallons (11 L) of wort. Stir in the dried malt extract and boil the wort for 90 minutes, adding hops at times indicated. Add the liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate the wort and pitch the yeast. Ferment at 50 °F (10 °C). Lager for 4–6 weeks at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes CO_2.



Bohemian Pilsner

Recipe by Ted Hausotter, Baker City, Oregon
(5 gallons/19 L, extract only)
OG = 1.055 FG = 1.014
IBU = 42 SRM = 4 ABV = 5.5%

Ingredients

6.6 lbs. (3 kg) Pilsner liquid malt extract
13 oz. (0.37 kg) Pilsner dried malt extract
3 AAU Czech Saaz hops (FWH) (1.0 oz./28 g at 3% alpha acid)
4.2 AAU US Sterling hops (FWH) (0.6 oz./17 g at 7% alpha acid)
3 AAU Czech Saaz hops (10 min.) (1.0 oz./28 g at 3% alpha acid)
7 AAU US Sterling hops (5 min.) (1.0 oz./28 g at 7% alpha acid)
3 AAU Czech Saaz hops (1 min.) (1.0 oz./28 g at 3% alpha acid)
9.8 AAU US Sterling hops (1 min.) (1.4 oz./40 g at 7% alpha acid)
Wyeast 2124 (Bohemian Lager) or White Labs WLP830 (German Lager) yeast (2 qt./2 L starter)
¾ cup corn sugar (if priming)

Step by Step

Add the dried malt extract and half of the liquid malt extract to enough water to make at least 3 gallons (11 L) of wort. Boil the wort for 90 minutes, adding hops at times indicated. Keep some boiling water handy and do not let the boil volume dip below 3 gallons (11 L). Add the remaining liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to the fermenter and top up to 5 gallons (19 L). Aerate the wort and pitch the yeast. Ferment at 50 °F (10 °C). Lager for 4–6 weeks at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes CO_2.

Award-Winning Bohemian

Bohemian Pilsner

Recipe by James Golovich, Richland, Washington
(5 gallons/19 L, all-grain)
OG = 1.052 FG = 1.010
IBU = 37 SRM = 3.6 ABV = 5.6%

James won Best of Show at the 2008 Grant County Fair with this recipe.

Ingredients

9 lbs. 14 oz. (4.5 kg) Weyermann Pilsner malt (2 °L)
13.8 oz. (0.39 kg) Weyermann Carafoam® (dextrin) malt (2 °L)
5.8 AAU Magnum hops (60 min.) (0.5 oz./14 g at 11.5% alpha acid)
3.6 AAU Saaz hops (30 min.) (1 oz./28 g at 3.6% alpha acid)
3.6 AAU Saaz hops (10 min.) (1 oz./28 g at 3.6% alpha acid)
1 oz. (28 g) Saaz hops (0 min.)
White Labs WLP833 (German Bock Lager) or Wyeast 2487 (Hella Bock)* yeast (3 qt./3 L starter)
¾ cup corn sugar (if priming)

Step by Step

Two or three days before brew day, make the yeast starter, aerating the wort thoroughly (preferably with oxygen) before pitching the yeast.

This is a single step infusion mash. On brew day, mash in at 155 °F (68 °C) in 15 qts. (14 L) of water. Hold at this temperature for 60 minutes. Raise the mash temperature to 170 °F (77 °C) for five minutes then recirculate. Run off the wort and sparge with water hot enough to keep the grain bed around 170 °F (77 °C). Collect 6.5 gallons (25 L) of wort. (Check that the final runnings do not drop below SG 1.010.) Boil the wort for 90 minutes, adding hops at times indicated. Chill the wort, aerate, and pitch the yeast. Ferment at 48–50 °F (9–10 °C) for three to four days, then finish off at 54–56 °F (12–13 °C). Lager for four to six weeks at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes of CO_2.

Bohemian Pilsner

Recipe by James Golovich, Richland, Washington
(5 gallons/19 L, partial mash)
OG = 1.052 FG = 1.010
IBU = 37 SRM = 3.6 ABV = 5.6%

Ingredients

3.3 lbs. (1.5 kg) Pilsner liquid malt extract
1 lb. (0.45 kg) Pilsner dried malt extract
3 lbs. 4 oz. (1.5 kg) Weyermann Pilsner malt (2 °L)
13.8 oz. (0.39 kg) Weyermann Carafoam® (dextrin) malt (2 °L)
5.8 AAU Magnum hops (60 min.) (0.5 oz./14 g at 11.5% alpha acid)
3.6 AAU Saaz hops (30 min.) (1 oz./28 g at 3.6% alpha acid)
3.6 AAU Saaz hops (10 min.) (1 oz./28 g at 3.6% alpha acid)
1 oz. (28 g) Saaz hops (0 min.)
White Labs WLP833 (German Bock Lager) or Wyeast 2487 (Hella Bock)* yeast (3 qt./3 L starter)
¾ cup corn sugar (if priming)

Step by Step

This is a single step infusion mash. Mash the grains at 155 °F (68 °C) in 6 qts. (5.7 L) of water. Hold at this temperature for 60 minutes. Collect 2.25 gallons (8.5 L) of wort. Add water to make at least 3 gallons (11 L) of wort. Stir in the dried malt extract and boil the wort for 90 minutes, adding the hops at the times indicated. Add the liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to a fermenter and top up to 5 gallons (19 L). Aerate the wort and pitch the yeast. Ferment at 48–50 °F (9–10 °C) for three to four days, then finish off at 54–56 °F (12–13 °C). Lager for four to six weeks at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes CO_2.

Bohemian Pilsner

Recipe by James Golovich, Richland, Washington
(5 gallons/19 L, extract only)
OG = 1.052 FG = 1.010
IBU = 37 SRM = 3.6 ABV = 5.6%

Ingredients

6.6 lbs. (3 kg) Pilsner liquid malt extract
8 oz. (0.23 kg) Pilsner dried malt extract
5.8 AAU Magnum hops (60 min.) (0.5 oz./14 g at 11.5% alpha acid)
3.6 AAU Saaz hops (30 min.) (1 oz./28 g at 3.6% alpha acid)
3.6 AAU Saaz hops (10 min.) (1 oz./28 g at 3.6% alpha acid)
1 oz. (28 g) Saaz hops (0 min.)
White Labs WLP833 (German Bock Lager) or Wyeast 2487 (Hella Bock)* yeast (3 qt./3 L starter)
¾ cup corn sugar (if priming)

Step by Step

Add the dried malt extract and half of the liquid malt extract to enough water to make at least 3 gallons (11 L) of wort. Boil wort for 90 minutes, adding hops at times indicated. Keep some boiling water handy and do not let the boil volume dip below 3 gallons (11 L). Add the remaining liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to a fermenter and top up to 5 gallons (19 L). Aerate the wort and pitch the yeast. Ferment at 48–50 °F (9–10 °C) for three to four days, then finish off at 54–56 °F (12–13 °C). Lager for 4–6 weeks at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes CO_2.

(*Wyeast 2487 (Hella Bock) is a limited release strain)

Pilsner Recipes

Bohemian Pilsner

Recipe by Michael Agnew, Minneapolis, Minnesota (5 gallons/19 L, all-grain)

OG = 1.058 FG = 1.017
IBU = 41 SRM = 3.3 ABV = 5.6%

Michael won Gold in 2010 in the National Homebrew Competition (NHC) with this recipe.

Ingredients

11.5 lbs. (5.2 kg) German Pilsner malt
6.8 oz. (0.19 kg) dextrin malt
5.4 AAU Sterling hops (60 min.) (0.9 oz./26 g at 6% alpha acid)
6 AAU Sterling hops (30 min.) (1.0 oz./28 g at 6% alpha acid)
3.6 AAU Sterling hops (10 min.) (0.6 oz./17 g at 6% alpha acid)
1.0 oz. (28 g) Sterling hops (0 min.)
Wyeast 2001 (Urquell Lager) or White Labs WLP800 (Pilsner Lager) yeast
¾ cup corn sugar (if priming)

Step by Step

Two or three days before brew day, make a yeast starter, aerating the wort thoroughly (preferably with oxygen) before pitching the yeast.

This is a single decoction mash, for more on decoction mashing see http://byo.com/story1409. On brew day, mash in the malt at 122 °F (50 °C) in 18 qts. (17 L) of water, and hold this temperature for 15 minutes. Raise temperature to 148 °F (64 °C) and hold this temperature for 15 minutes. Raise temperature to 155 °F (68 °C) and hold this temperature for 60 minutes. Decoct ⅓ of the mash, boiling it for 10 minutes. Return the decoction to the main mash to hit mashout temperature of 169 °F (76 °C). Recirculate until clear, fly sparge with 168 °F (76 °C) water until 6.5 gallons (25 L) of wort is collected. Boil wort for 90 minutes, adding hops at times indicated. Chill wort, aerate, and pitch yeast. Ferment at 55 °F (13 °C) for 14 days. Lager for 30 days at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes CO_2.

Bohemian Pilsner

Recipe by Michael Agnew, Minneapolis, Minnesota (5 gallons/19 L, partial mash)

OG = 1.058 FG = 1.017
IBU = 41 SRM = 3.3 ABV = 5.6%

Ingredients

3.3 lbs. (1.5 kg) Pilsner liquid malt extract
2 lbs. (0.91 kg) Pilsner dried malt extract
3 lbs. (1.36 kg) German Pilsner malt
6.8 oz. (0.19 kg) dextrin malt
5.4 AAU Sterling hops (60 min.) (0.9 oz./26 g at 6% alpha acid)
6 AAU Sterling hops (30 min.) (1.0 oz./28 g at 6% alpha acid)
3.6 AAU Sterling hops (10 min.) (0.6 oz./17 g at 6% alpha acid)
1.0 oz. (28 g) Sterling hops (0 min.)
Wyeast 2001 (Urquell Lager) or White Labs WLP800 (Pilsner Lager) yeast
¾ cup corn sugar (if priming)

Step by Step

This is a single step infusion mash. Mash the grains at 155 °F (68 °C) in 6 qts. (5.7 L) of water. Hold at this temperature for 60 minutes. Collect 2.25 gallons (8.5 L) of wort. Add water to make at least 3 gallons (11 L) of wort. Stir in the dried malt extract and boil the wort for 90 minutes, adding hops at the times indicated. Add the liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to a fermenter and top up to 5 gallons (19 L). Aerate the wort and pitch the yeast. Ferment at 55 °F (13 °C) for 14 days. Lager for 30 days at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes CO_2.

Bohemian Pilsner

Recipe by Michael Agnew, Minneapolis, Minnesota (5 gallons/19 L, extract only)

OG = 1.058 FG = 1.017
IBU = 41 SRM = 3.3 ABV = 5.6%

Ingredients

6.6 lbs. (3 kg) Pilsner liquid malt extract
1 lb. 2 oz. (0.51 kg) Pilsner dried malt extract
5.4 AAU Sterling hops (60 min.) (0.9 oz./26 g at 6% alpha acid)
6 AAU Sterling hops (30 min.) (1.0 oz./28 g at 6% alpha acid)
3.6 AAU Sterling hops (10 min.) (0.6 oz./17 g at 6% alpha acid)
1.0 oz. (28 g) Sterling hops (0 min.)
Wyeast 2001 (Urquell Lager) or White Labs WLP800 (Pilsner Lager) yeast
¾ cup corn sugar (if priming)

Step by Step

Add dried malt extract and half the liquid malt extract to enough water to make at least 3 gallons (11 L) of wort. Boil the wort for 90 minutes, adding hops at times indicated. Keep some boiling water handy and do not let the boil volume dip below 3 gallons (11 L). Add the remaining liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate the wort and pitch yeast. Ferment at 55 °F (13 °C) for 14 days. Lager for 30 days at 33 °F (1 °C). Prime and bottle condition, or keg and force carbonate to 2.4 volumes CO_2.

Web extra:

Try another take on Bohemian Pilsner using only Sterling hops and 2-row Pilsner malt (extract option included) at http://byo.com/story3043 acter seem to be the key, but there are several approaches for reaching the desired bitterness level. All agreed that substantial bitterness is a requirement; most were around 40 IBUs, which could reflect the expectations of competition judges for a hop-forward beer. Magnum is an acceptable bittering choice, but any hopping method should favor clean bitterness and flavor. The choice is likely dependent on how prominent a late hop character the brewer desires.

Malt

If you only choose one malt, good quality continental Pilsner malt is all you really need to brew a traditional Bohemian Pilsner. However, there are certainly options as far as adding other grains to your lineup. Some brewers play with the grain bill to achieve complexity, even if the grist isn't traditional. For example, Randy Scorby uses a combination of German Pilsner and pale malts, along with some wheat malt for head retention. Ted Hausotter uses mostly Pilsner malt, but adds various amounts of Vienna, wheat malt, and pale malt for complexity. Both James Golovich and Michael Agnew use German Pilsner malt, but with additional malt for dextrins (dextrin malt or Carafoam®). Czech malts can be difficult to source as a homebrewer, so staying within the general region and selecting high-quality German malts seems to be a workable solution, even if it does take a bit of tinkering to enhance malt complexity and body (in conjunction with the mash schedule).

Mashing

Bohemian Pilsner was historically always brewed with a decoction mash, and some commercial and homebrewers still mash their Pils this way. Randy Scorby uses a decoction mash to get a richer, more complex malt character, as well as improving clarity. He feels it is a key factor for success in the style, but he doesn't use a long boil in the decoction to keep it from picking up too much color and caramel-like flavors. However, Michael Agnew uses a more intensive combination step and decoction mash schedule, while both Ted Hausotter and James Golovich use a single infusion mash at 155 °F (68 °C) to favor dextrin formation. All are choosing either mash techniques or grain bills to get the necessary body for the beer. (For more about decoction mashing, visit http://byo.com/story1409.)

Yeast

It seems that almost any malt-forward yeast strain will do, and traditionally this style is brewed with a bottom-fermenting lager strain. Bohemian Pilsner is a little fuller and has more fermentation-derived compounds than its German cousin, and as I mentioned earlier, a small amount of diacetyl is ok. Randy Scorby uses Wyeast 2278 (Czech Pilsner). Ted Hausotter uses a malty German lager yeast (Wyeast 2124, the classic Weihenstephan 34/70 strain). James Golovich uses White Labs WLP833 (German Bock), another malt-forward choice (and my personal favorite lager yeast). Michael Agnew uses Wyeast 2001 (Urquell Lager) yeast, a hard-to-find but traditional choice.

Fermentation

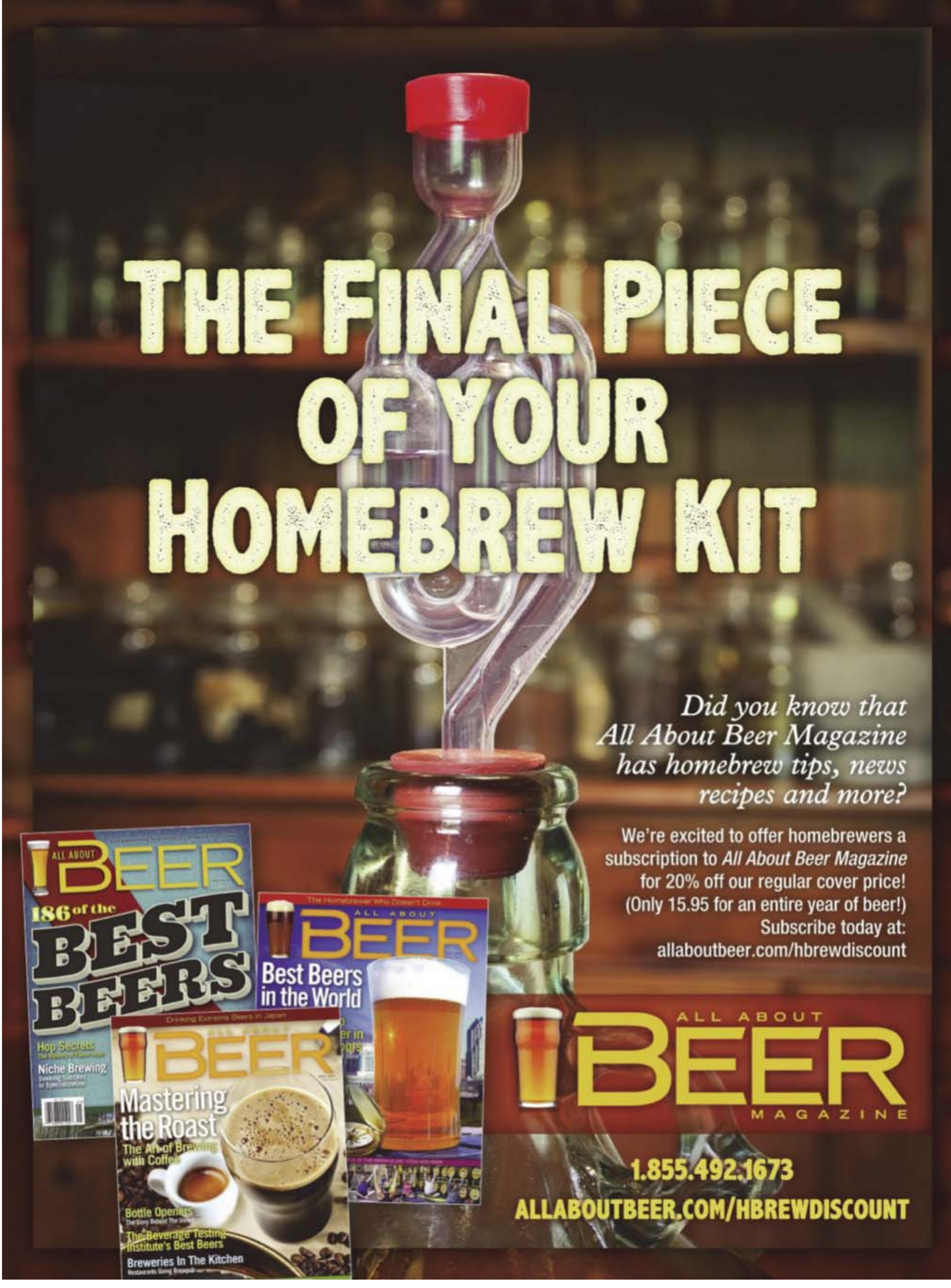
Fermentation temperature is very strain-dependent, however you can count on a cooler ferment, and the ability to control your temperature is key. James Golovich recommends pitching yeast cool (45 °F or 7 °C), then letting it warm up to 48–50 °F (9–10 °C) before finishing it off at 54–56 °F (12–13 °C). Michael Agnew stresses the need for temperature control to keep the fermentation temperature cool and steady. Randy Scorby likes to keep fermentation temperature in the 48–50 °F (9–10 °C) range, but mentions that a higher pitching rate is needed with the lower fermentation temperature. He also adds a diacetyl rest, although the other brewers don't mention the need for it. Some yeast strains, including the Czech strains, can produce higher levels of diacetyl. The German strains mentioned are typically cleaner, as well as producing less sulfur, so they are unlikely to need a diacetyl rest. To perform a diacetyl rest, raise the temperature of your beer up about 10 °F (6 °C) at the end of primary fermentation and hold it there until the fermentation is complete and the diacetyl is undetectable.

Water

None of the brewers mentioned their water profiles, but I think this was because they felt the water choice was obvious, not because it isn't important. They are all high-ranking BJCP judges, so I know they all understand that traditional Plzen water is very soft, and they very likely used that same profile when brewing their beers. The low ion water is critical for producing a highly bitter beer without any associated harshness or clashing sulfur character. I've found that sulfur in beer (whether from water that has a high calcium sulfate content, or from yeast-derived fermentation byproducts) tends to clash with the classic Saazer-type hops that are key to this style. The best advice for water is to use soft, low ion content water, and to avoid adding any calcium sulfate (which some brewers might try to do because they've been told that it "accentuates the hops"). If you have very hard water, consider diluting or completely substituting your water with distilled water or reverse osmosis (RO) water.

Lagering

A classic Bohemian Pilsner needs a lagering period at near-freezing temperatures for at least a month, and some brewers recommend longer. Michael Agnew says to "not skimp on the lagering time," recommending a full four weeks at 33 °F (1 °C). I totally agree; too many competition beers have a yeasty or sulfury flavor from not dropping the yeast completely, and not finishing a proper lagering schedule. Ted Hausotter thinks the peak flavor is at 6–8 weeks, allowing sufficient time for lagering to smooth the flavors. Average-strength pale beers don't have an extended shelf life, so consuming these beers when fresh is best (although not at the expense of fully lagering the beer). The smooth, clean flavors so characteristic for the beer style cannot be fully appreciated with a distracting yeast character. BYO



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the FORCED FERMENT test

Photos and story by **Michael Dawson**

A forced ferment is a test used by many professional brewers and brewery labs to determine the minimum final gravity possible from a freshly-made batch of wort.

By diverting a sample of wort from the main batch and causing it to undergo a rapid fermentation — through some combination of overpitching, elevated temperature, and/or agitation or stirring — brewers can anticipate the final gravity (FG) well ahead of time and plan for the late stages of fermentation and beyond with greater certainty, all while the main batch is still approaching high kräusen. Obviously this is important for a commercial brewery, since speedy and efficient turnaround in the brewhouse and cellar is desirable. It is used to check consistency in commercial brewhouse operations, specifically enzymatic action in the mash. It's also important because by knowing the final gravity, the brewer can tell if the fermentation is finished, or if it has stalled prematurely. Chilling a tank when it is stalled, but when there is still fermentable sugar left in the beer, is bad for a packaging brewery and can lead to spoilage or overcarbonation in the bottle.

But what about us homebrewers? Many brewing software programs calculate an anticipated FG for homebrew batches based on the apparent attenuation range for yeast strain, typical fermentability of grains and sugars, and the mash regimen used for each batch. But as we know, a lot can happen between grain and glass.

For all-grain brewers, a forced ferment test can provide deeper insights into your system and process: An unexpectedly high FG in a forced ferment test indicates too many unfermentables in the wort, either as a result of mash temperature or incomplete saccharifcation, and a hint that it may be time to recalibrate your thermometers. A forced ferment that finishes with a lower FG than the main batch may be a sign of fermentation issues in the main batch, such as underpitching or O_2 deficiency.

With a forced ferment test, extract brewers can get a grip on the maximum fermentability of their chosen liquid or dried malt extract on their equipment, which can help improve consistency and repeatability.

For homebrewers of all methods, a forced ferment can answer questions about — and help remedy — stuck fermentation issues, as well as possibly saving some time and final yield by eliminating the need for some hydrometer samples late in the fermentation.

A forced ferment started on brew day can help a homebrewer anticipate any stutters or stops with the main batch; for example, when using a saison yeast strain that is known for taking breaks mid-fermentation. If a fermentation stalls, pulling a sample from the fermenter and performing a forced ferment test will determine if the fermentation is truly stuck, or if the main batch just needs a little encouragement — perhaps in the form of warmer temperatures, additional yeast, a bit of O_2, or just more time.

Knowing what FG reading to watch for means knowing that fermen-

Step One: Collect a sample of fresh wort from your main batch of beer (before the yeast has been pitched).

Step Four: Measure the final gravity of the sample, record the results and discard the sample (do not add it back into your main batch of beer).

tation is done, and not having to wait for a hydrometer reading to stabilize in real time over the course of days, or trying to guess by watching kräusen or airlock bubbles. That means a lot less sanitizing and cleaning of a beer thief and/or stopcock, and — ideally — less volume lost to hydrometer samples. It also means that you'll know exactly the point when your batch is ready for its next step, whether secondary, lagering, or packaging.

Should I Do a Forced Ferment Test?

You'll have to answer that for yourself. If, like me, an FBI profiler would say of you that your airlock-sniffing habit is likely to escalate, you are probably a likely candidate. Although beer geeks, large-batch brewers, and the technically minded might find a lot to love, conducting a forced ferment test is not necessary in order to successfully brew, ferment, and enjoy a batch of your own beer. Homebrewing only needs to be as simple or complicated enough to give you enjoyment.

Take the guesswork out of final gravities

Step Two: Pitch your yeast into the sample.

Step Three: Ferment the sample. A stir plate set to a low speed will help agitate the wort.

Performing a Forced Ferment at Home

Please read through all steps before starting! Maintaining excellent sanitation practices are a must, since contamination of the sample with wild yeast or spoilage bacteria can skew the readings. Here are the steps:

1. Collect a sample of fresh wort from the main batch.

Because the end goal of a forced ferment is to measure the gravity, the sample you pull from the main batch of wort has to be big enough for a hydrometer reading (see top photo on page 68) — say, approximately 1 to 2 cups (250 to 500 mL).

After the boil is finished and the wort is cooled, decant the wort sample into a sanitized container with roughly 50% headspace — a flask, Mason jar, or similar vessel will work fine — and cover the container loosely with sanitized foil or lid.

2. Inoculate the wort sample.

Here you'll need to make a choice — inoculate the forced ferment sample at the same rate as the main batch, or inoculate at a much higher rate (5–10x) than the main batch.

A higher pitch rate will yield the fastest test result in the shortest amount of time; this approach is called for by many forced ferment protocols (like this one by Wyeast Laboratories: www.wyeastlab.com/he-brew-qc.cfm). To do this on a homebrew scale, add 15 mL (approx. 1 tablespoon) of yeast slurry from a starter culture, or 3 grams (approximately 1 teaspoon) of dried yeast per cup of sample wort. The liquid and/or fermented starter wort from a liquid slurry may lower the SG of the sample by 0.001–0.002 or so.

Pitching at the same rate as the main batch is probably more manageable for most homebrewers, since there is less potential for wort dilution and less handling required, therefore less opportunity for contamination of the sample; this simpler method is also used successfully by the lab staff in at least some commercial breweries. With this approach, just wait to collect the forced ferment sample until after the main batch is aerated/oxygenated and the yeast pitched.

3. Ferment the sample.

Move the inoculated sample to a warm spot (75–80 °F/24–27 °C) to encourage rapid fermentation. If you have a stir plate, this is a great time to use it — set to low speed and let it whirl (see the bottom photo on page 68). If you don't have a stir plate, agitate the flask or jar frequently by shaking or swirling.

4. Measure the gravity of the sample.

After 24 to 48 hours, the forced ferment sample will have reached final gravity. Allow the yeast to settle, then measure gravity with a hydrometer (see top photo on this page). Once you have recorded the target FG for your batch, the forced ferment sample can be discarded. BYO

SINGLE VARIETAL MEAD MAKING

How to Highlight Different Honeys

by **Michael Fairbrother**

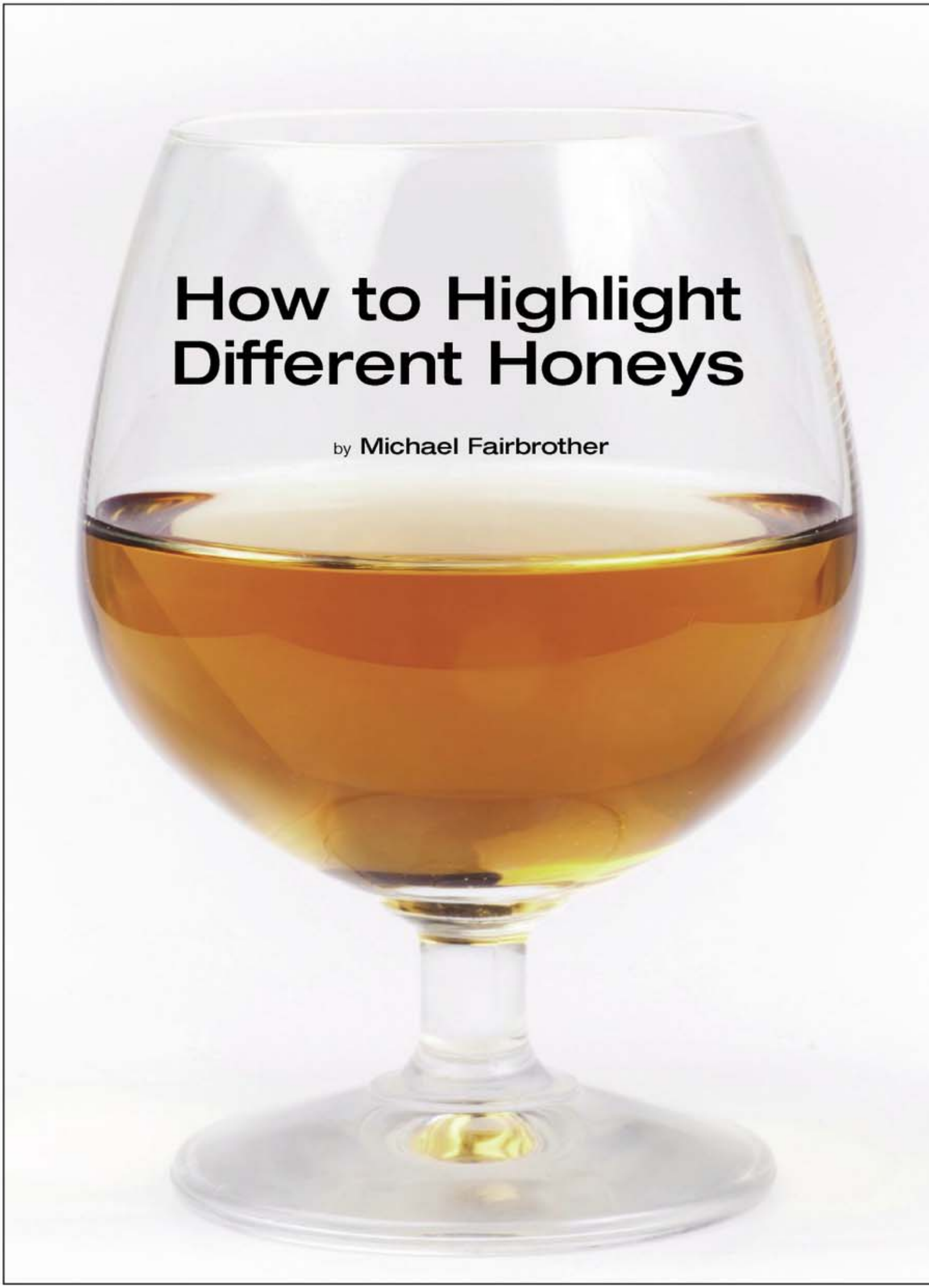


Image by Istockphoto.com

In its simplest form mead is a fermented beverage made from honey and water. The key to making fantastic meads is your honey, so don't think of honey as a generic ingredient — it's so much more.

Honey is a complex mixture of sugars, flavors from the pollen as well as trace enzymes, minerals, vitamins, and amino acids. The majority of the honey found in grocery stores is Wildflower honey, which is a blend of different honeys made with the goal of producing honey that is consistent in flavor and color. This type of honey is not the same as the Wildflower (or other varietal) honey you can find from a local beekeeper, which isn't likely to be a blend, and will differ based on time of year harvested, rainfall, and the types of flowers the bees visit. Store-bought honey is fantastic for making melomel (meads made with the addition of fruit); however I highly recommend using a single varietal honey, which is a type of honey derived predominantly from the nectar of one flower, for making traditional meads.

Varietal Honey

Bees are efficient; they fly to the closest flower sources possible looking for nectar. So when a beekeeper places a hive in a given field and harvests the honey after the bloom, the result is that flower's varietal honey. The color, flavor, and even aroma of a particular variety of honey may differ depending on the nectar source of flowers visited by the honeybees. The colors may range from nearly colorless to dark brown (see the photo below), the flavor may vary from delectably mild to distinctively bold, and even the aroma of the honey may be mildly reminiscent of the flower.

There are more than 300 unique types of honey available in the United States alone, each originating from a different floral source. As a general rule, the flavor of lighter colored honeys is milder, and the flavor of darker colored honeys is stronger. Varietal honeys can be compared to varietal wine in terms of annual climactic changes. The same flower blooming in the same location may produce slightly different nectar from year-to-year depending upon temperature and rainfall (bees don't go out looking for nectar when it's raining). To locate specific varietals of honey available near you, try visiting the National Honey Board's Honey Locator website, http://www.honeylocator.com

Making Varietal Mead

Other than the honey, the other key elements to making a good single-varietal mead (or any mead for that matter) are water, nutrients, yeast, and yeast health.

Water is as critical as the honey selection, using spring water or other water that is free of chlorine and bacteria is essential. If you have very hard water consider diluting a percentage of your water with distilled or reverse

Image by Charles A. Parker/Images Plus

The color, flavor and aroma of different honey varietals can vary wildly depending on the flowers the honeybees visited when gathering nectar. As a general rule of thumb, honeys with lighter colors have milder flavors, while darker colored honeys tend to have stronger flavors.

Varietal Honey Choices

Some of the honey varietals that I like to use for meadmaking include: Tupelo, Orange Blossom, Star Thistle, Cranberry, Almond, Brazilian Peppercorn, and Arizona Pecan Blossom. As with many ingredients, the more honey you buy the better the price break you can negotiate, even on a small scale. You can expect to pay more than $8 per pound for honey. I purchase the majority of the honey for Moonlight Meadery from Dutch Gold in Pennsylvania and they have been very helpful to us as we have grown.

I am not a fan of Buckwheat or Pumpkin Blossom honey, and I also can't say that I am overly thrilled with Heather Blossom honey either. These varietals of honey tend to taste extremely earthy when they are fermented. I have customers at the meadery who absolutely adore that earthiness, but for me it's a bit challenging — it's really up to you as a mead maker to decide what you like.

Here is a list of some of the most common honey varietals you may be able to buy near where you live, and my thoughts on using them for mead making:

Alfalfa: A white or extra light amber-colored honey. It has a mild flavor and aroma that is reminiscent of beeswax. It's OK for meads, but not extremely popular.

Almond: A great candidate for making into mead. It is light in aroma and its flavor has a slight nuttiness. Almond honey is one of our meadery's most requested single-varietal meads, and also my mother's personal favorite.

Arizona Wild Mountain Pecan Blossom: This is a deep, dark honey with lots of malt-like character, which may appeal to homebrewers. It ferments into a wonderfully rich mead that will have the color of a brown ale and taste distinctive and delicious.

Avocado: This honey is dark amber in color with notes of caramelized molasses. It is a robust flavored honey with a little bit of nut character.

Blackberry: A light colored honey that finishes with a nice floral note. It is excellent for making into mead and leaves a hint of the berry note.

Basswood: A very light colored honey, identified as water white. Basswood is fantastic for making meads and has an herbal note with a clean finish.

Blueberry: The aroma of Blueberry honey is reminiscent of green leaves with a light citrus note. The honey has a moderately fruity flavor that finishes with a light buttery note. It is well suited for making into mead.

Buckwheat: A very dark honey, which when raw tastes like a cross between molasses and malt. When it is fermented out in a mead . . . well that's another story; it is (how do I put this) very pungent and dominated with earthy notes. I personally find the aromas overwhelming in a mead, but some people like it.

Cranberry: The color of Cranberry honey is medium to dark amber, with a slight red tint. Berry notes are also evident. It has a deep complexity when fermented out, and the berry notes fade a bit, but it is quite delicious in a mead.

Orange Blossom: Put this varietal in your "must make mead with" list. Orange Blossom has strong citrus notes that are fantastic in mead. It is very light in color and has a citrus-like character. I prefer to make Orange Blossom honey into a semi-sweet mead.

Raspberry: Another very light honey that works great in meads. There are not as many berry notes in Raspberry as Blackberry honey, but it is light and it finishes clean with little need for acidity adjustments.

Star Thistle: Light to extra light amber in color, with the slightest greenish cast. It has some anise notes in aroma and flavor, and it makes for a wonderful mead.

Tupelo: Light amber in color, with a complex floral, herbal note. When fermented, Tupelo has a spicy finish that is very distinctive. Tupelo is extremely expensive honey that is very difficult to come by in large quantities, however.

Varietal Mead Recipe

Single Varietal Mead
(5 gallons, 19 L)
OG = 1.108 FG = 0.998
ABV = 15.7%

This is a traditional mead recipe that is perfect for showcasing a single varietal honey. Experiment with small (1 gallon/3.8-L) batches before you scale up to a 5-gallon (19-L) batch to find and invest in the varietal honey you like the best.

Ingredients
15 lbs. (6.8 kg) varietal honey
~3.75 gallons (14 L) water
4.5 tsp. Go-Ferm
2.5 tsp. Fermaid K yeast energizer
Fining agent (optional)
Potassium sorbate (optional)
2 packets (10 g) Lalvin Narbonne 71B-1122 dry yeast

Step by Step
Brew Day:
Clean and sanitize all of your fermenting equipment.

Fill a sink or cooler with hot tap water and soak the honey container(s) to make the honey easier to pour. I don't recommend using boiling water, just be patient. If your honey is crystallized, don't worry — all raw and natural honey crystallizes over time, with the exception of Tupelo blossom honey, especially in colder temperatures. Soaking the honey container in hot water will turn it back into liquid form. Fill the fermenter with 3 gallons (11 L) of room temperature water.

Pour honey into the fermenter along with the room temperature water. Take half a gallon (~2 L) of warm water (110 °F/43 °C) and carefully pour a small amount into each empty honey container. Replace container covers and shake to dissolve remaining honey, save every drop of that honey — it takes a bee its entire life to make 1⁄12 of a teaspoon. Place a ½ cup (118 mL) of the warm water/honey mix in a measuring cup (to be used for preparing the yeast) and pour the remaining dissolved honey into the fermenter. Top up with additional water as needed to achieve a volume of 5 gallons (19 L), saving space for the yeast of course. The mixture is now called the must. Stir the must until all honey is dissolved and well mixed. This may take 5 to 15 minutes, possibly longer.

Prepare the Yeast:
Add 4.5 tsp. of Go-Ferm to the ½ cup (118 mL) of warm water/honey mix. Let the mixture cool to 104 °F (40 °C) then add the active dried yeast. Let stand for 20 minutes. Slowly (over 5 minutes) add equal amounts of must (honey/water) to be fermented to the yeast slurry. Watch the temperature difference. Do not allow more than 18 °F (10 °C) difference between the must and the yeast slurry. Atemperate as necessary. After 15 minutes (yeast should begin to foam), stir well to mix the yeast into a slurry. Pour the yeast slurry into the fermenter. Seal the fermenter with a sanitized airlock and locate the fermenter in an area that is 65 °F (18 °C). Fermentation should start within 24 hours.

First One to Two Weeks:
Sanitize all equipment used to stir the must for each nutrient addition. Please note that adding nutrient and stirring may cause the mead to foam over, extreme care must be taken to do this slowly, a slow stir before adding the nutrient will allow the release of residual CO_2. Add ¾ teaspoon yeast energizer/nutrient mix 24 hours after fermentation begins. Add ¾ teaspoon yeast energizer/nutrient mix 48 hours after fermentation begins. Add ¾ teaspoon yeast energizer/nutrient mix 72 hours after fermentation begins.

Secondary Fermentation:
When fermentation stops and the specific gravity as measured by a hydrometer is stable (has not changed over the course of several days), it is ready to transfer into a secondary fermenter. Sanitize your fermenter and siphoning equipment. Carefully siphon the mead into the fermenter. Leave as much sediment as possible in the primary fermenter. Let the mead clarify in the secondary fermenter for three months. You may wish to add a fining agent such as isinglass to facilitate clearing, and/or potassium sorbate to prevent further fermentation.

Bottling Day:
Sanitize all of your siphoning and bottling equipment and bottles. Carefully siphon the mead to a bottling bucket. I recommend this mead be made still, but if you wish to carbonate it you would add priming sugar at this point. Fill and cap bottles like you would any beer you were making. Bottles may be consumed two weeks after bottling or kept and aged for six months or more to achieve superior flavor.

Photo courtesy of National Honey Board

osmosis (RO) water.

As with brewing, the yeast you use will make all the difference to the mead you make. I would avoid using Champagne yeast as it tends to dry out the mead too much. My go-to yeast strain for mead making is Lalvin Narbonne 71B-1122 dry yeast, which I use commercially for everything we make at Moonlight Meadery in Londonderry, New Hampshire. As a home mead maker I have also had success with Lalvin ICV D-47 dry yeast. You also have many good choices on mead yeast from White Labs, and Wyeast, including White Labs WLP720 (Sweet Mead/Wine Yeast) and Wyeast 4184 (Sweet Mead) or 4632 (Dry Mead).

Healthy yeast and temperature control are essential for running a clean mead fermentation with less chance of off-flavors or the production of higher alcohols (fusels). Honey does not have the same amount of yeast assumable nitrogen (YAN) as you would find in malt or fruit, which is important as the yeast needs this to stay viable throughout fermentation. When making mead, it is also essential to add the yeast nutrients over the course of several days. This process can be as simple as taking the total amount of nutrients needed for the batch and dividing into four parts, adding one portion of nutrients every 24 hours until they are gone. This process is known as "staggered nutrient additions" and provides the key nutrients to the yeast cells during their growth phase. Think of it as giving the new generations of yeast what they need when they need it. I also use a slightly different method at the meadery, which is a little simpler (and good for making multiple large batches), where I add the last nutrient addition at the 72-hour mark, instead of at 30% depletion of sugar. As you become a more experienced meadmaker, you can experiment with nutrient additions to find what works best for you.

I prefer to use Fermaid K (yeast energizer) and Go-Ferm (an organic yeast nutrient) for adding the additional nutrient requirements of the yeast during mead fermentation. An alternative to Go-Ferm is diammonium phosphate (DAP). All of these nutrients should be available at your local homebrew or home winemaking supplier. The choice of what to use is up to the mead maker; as long as the yeast have nitrogen and oxygen they will continue in the growth phase. Once the yeast cells have grown, get out of the way and let them do what they do best — ferment sugar into ethanol.

Tip: When adding yeast nutrients to your must (unfermented mead) you want to start off by pulling a ½ cup of the must, mix the nutrient blend, then SLOWLY add it back to the fermenter. Once the nutrients are added then begin to slowly stir the must to release the main portion of the CO_2 gas. After the foaming subsides you can begin to

Photo by Aaron Lee

Damian Magista of Bee Local in Portland, Oregon, pours some single-varietal honey. Damian manages more than 30 bee hives scattered around the city of Portland.

Photo by Aaron Lee

Damian uses his honey to experiment with single-varietal meads. Just like the honey itself, the resulting meads vary in color, which is due to the nectar of the flowers the bees visited.

stir more vigorously. Mix the must well enough to introduce plenty of oxygen into the fermenting must.

Mead Methodology

Most of the traditional mead recipes that I make, especially when making a varietal mead, follow this ratio: 1 part honey, 3 parts water. Using that ratio, it's easy to scale down or up a batch as needed. This should get you in the range of a 1.120 starting gravity (SG). In a recent mead experiment I sourced 3 lbs. (1.4 kg) of 60 different types of honey, added 1.5 quarts (~1.5 L) of water, and made several different varietal meads. An experiment like this is a good way to put all those 1-gallon (3.8-L) growlers you have collected to work as mini-fermenters, as single varietal honey is expensive. It's also a great way to make sample batches of mead with different varietals of honey to find the ones you like. In my base recipe on page 74, find the honey you like best and follow the directions to make a full 5 gallons (19 L).

For a "regular" sized batch (5 gallons/19 L) of mead, you will need (at minimum): A 6-gallon (23-L) food-grade fermenter with a lid and airlock (what you use to brew beer is fine), a 5-gallon (19-L) secondary fermenter (a glass or PET carboy), 15 lbs. (6.8 kg) of a varietal honey (see the sidebar on page 73), a clean water source (see what I said earlier about water), yeast nutrients, your chosen yeast, a calibrated hydrometer setup, a siphon, and of course your cleaning and sanitizing agents of choice. The meadmaking process is more akin to making wine than beer — no boiling – so you can leave your brewpot to the side for this project.

Viva Varietal

The complexity of making single varietal mead is much like making fine wine — choose a good honey source and keep the meadmaking simple to let the honey character shine through. Source the best, most interesting honeys and with a clean fermentation, the proper nutrients, cleanliness and patience, you can make a world-class mead that will express the nuances of your honey. BYO

Session IPA CLONES

by **Steve Bader**

Photo by Charles A. Parker/Images Plus

It is no secret that the best-selling craft beer style category in the USA is IPA. We have a variety of official IPA beer styles, including British IPA, American IPA and imperial IPA. Add to that double IPA and Black IPA (or Cascadian Dark Ale). We are even starting to see variations like white IPA, rye IPA and Belgian IPA. All of these IPA styles and sub styles have two distinct characteristics in common, however: #1) high hop flavor and bitterness, and #2) a higher alcohol content, typically from a low of 5.5% to up to over 10%, with the majority of them in the 7% range.

What is the downside with all of the numerous IPA styles? Because of the higher alcohol content, you frequently can't drink more than two pints without looking for a pillow. Out of this dilemma came a new unofficial IPA beer style called "session IPA," a highly hopped pale ale that is low in alcohol.

Doesn't "Session IPA" sound like just an over-hopped American pale ale? Well, no, they are not quite the same. The simplest way to describe the difference is that while the alcohol content of a session IPA and an American pale ale is about the same, the hop flavor would be described as more "intense" than an ordinary pale ale. Notice that I did not say the hop flavor is more "bitter" than a pale ale. Calculated IBUs are often probably somewhat similar when comparing the two styles side by side, but hop flavor and aroma is more intense with a session IPA. (Read more about session beers in the sidebar on page 80.)

I contacted three US commercial brewers making session IPAs, for their take on brewing this new "style."

Jack Harris, the Co-owner and brewer at Fort George Brewery in Astoria, Oregon describes a session IPA as, "A beer that would be intensely aromatic with hops, full-flavored (not thin or watery), low in alcohol and low in hop bitterness. It is sort of the hoppy part of an IPA without the puckering bitterness."

Mitch Steele of Stone Brewing Co. in Escondido, California calls session IPA, "A way for craft beer drinkers to enjoy an intensely hoppy beer at a lower alcohol level."

Sean Lawson of Lawson's Finest Liquids in Warren, Vermont says Session IPAs are, "A low alcohol IPA with as much body and mouthfeel as you can insert, and then the hops are layered on heavily with a minimal amount of bittering from the boiling hops." Sean's Super Session IPA is brewed with a single hop, and he uses a different variety of hop each time.

Replicate craft beers lower in alcohol but bigger in taste

Session-Style Hops

So, how do you make the hop profile of a beer more "intense" without adding bitterness? A relatively new hopping method called "hop bursting" is used. Hop bursting is generally a method where the vast majority of the hop bitterness comes from a combination of very late kettle and whirlpool additions. This isn't necessarily all that different than traditional late hopping, however, when "hop bursting," brewers add much more late hops and relatively little first- and middle-boil additions. Additional hop aroma can also come from dry hopping in the fermenter. A variation on hop bursting is when the brewer uses only a very small amount (around 5%) of the hops that are added in at the beginning of the boil to reduce foaming. *Brew Your Own*'s Mr. Wizard has an article from the July-August 2012 issue (http://byo.com/story2519) with more information about "hop bursting." From this article, *BYO*'s "Style Profile" columnist (and the Founder of Heretic Brewing Co. in Fairfield, California) Jamil Zainasheff had this comment about hop bursting: "Long ago I ran across a few commercial beers that were massively late hopped and had little or no bittering charge. The aroma wasn't anything more than you would expect from dropping in massive amounts of hops near the end of the boil, but the bittering had a 'softer' character. It seemed to me at the time that boiling hops for a longer time not only resulted in more isomerized hop acids, but a harsher bittering the longer you boiled them. By switching to a shorter boil and a greater quantity of hops, you got a softer bittering and more hop character because you tossed in lots of late hops."

The key to brewing this kind of beer seems to be the hopping methodology that is unusual by standard brewing practices. I think Jack Harris said it best: "Use an unreasonable amount of hops in the fermenter, even at the expense of loss of beer volume." For more about hop bursting, as

Continued on page 85

What is a "Session" Beer?

You may have heard the term "session" beer, and know that they have a low ABV. But how low does a beer need to go to be considered "session"? Well, that depends on who you ask.

Session beers are not tied to any one beer style, but like "extreme" beers they signify what you can expect when drinking one. In very loose terms, a session beer is one that is lower in alcohol but still packs the flavor you expect from craft beer (as opposed to, for example, a "light" beer). The advantage to the low ABV being that you can enjoy a session beer at lunch without worrying about blowing that conference call in the afternoon, or you can enjoy a couple of session beers on a hot summer afternoon without having to worry about napping through the family dinner.

So how low in alcohol exactly does a session beer have to be? The definition is actually still being defined (or up for debate, depending on who you ask). This makes sense, at least in the US, considering this is a new trend in the American craft beer world and even the definition of craft beer is still being edited every year or two. Many beer experts agree that session beers should be no higher than 4.5% alcohol (including longtime drinks writer Lew Bryson who writes The *Session Beer Project* blog). Others say 4.0% should be the cut-off, and of course, other brewers are pushing the "style" limits in the other direction. For instance, Founders All Day IPA Session Ale clocks in at 4.7% ABV and Sierra Nevada's Nooner Session IPA is 4.8% ABV. For those who like the higher ABV, fear not; *Beer Advocate* defines the allowable alcohol limit of session beer at 5% ABV. For homebrewers, there are no hard and fast rules. Just keep the ABV under 5% (or less) and you can call it sessionable.

– Dawson Raspuzzi

Fort George Brewery Suicide Squeeze IPA clone

(5 gallons/19 L, all-grain)

OG = 1.044 FG = 1.008
IBU = 48 SRM = 6 ABV = 4.7%

Ingredients

8.4 lbs. (3.8 kg) 2-row pale malt
0.25 lbs. (113 g) crystal malt (40 °L)
0.5 lbs. (226 g) flaked oats
2.7 AAU Mosaic™ hop pellets (60 min.) (0.25 oz./7 g at 11.0% alpha acids)
8.3 AAU Mosaic™ hop pellets (15 min.) (0.75 oz./21 g at 11.0% alpha acids)
6.5 AAU Citra® hop pellets (15 min.) (0.5 oz./14 g at 13.0% alpha acids)
2 oz. (56 g) Mosaic™ hop pellets (0 min.)
2.5 oz. (71 g) Mosaic™ hop pellets (dry hop)
0.25 oz. (7 g) Citra® hop pellets (dry hop)
½ teaspoon Irish moss (30 min.)
Wyeast 1968 (London ESB) or White Labs WLP002 (English Ale) or Lallemand Windsor Ale yeast
⅔ cup corn sugar (if priming)

Step by Step

This is a single step infusion mash, mashing at 154 °F to 156 °F (68 to 69 °C) to create a fuller-bodied beer. Mix all the crushed grains with 3.5 gallons (13 L) of 170 °F (77 °C) water and stabilize the mash at 156 °F (68 °C) for 60 minutes. Raise your mash temperature to 165 °F (74 °C) and sparge with enough 175 °F (79 °C) water to collect approximately 6 gallons (23 L) of wort. Boil this wort for 60 minutes. Add the first hop addition of Mosaic™ at the beginning of the boil primarily as a foam inhibitor. Add the Irish moss for the last 30 minutes. With 15 minutes left in the boil, add the second Mosaic™ and first Citra® hop addition. At the end of the boil, insert a wort chiller and begin cooling your wort. As soon as you begin chilling your wort, add 2 oz. (56 g) of Mosaic™ hops, stirring them in the wort while you are cooling the wort. You would like to have these hops in the wort with the temperature between boiling and around 150 °F (66 °C) for close to five minutes. When you have cooled the wort to about 80 °F (27 °C), you can strain the wort into a fermenter. Aerate the wort and pitch the yeast. Ferment at 70 °F (21 °C). When fermentation is complete, rack the beer off the trub, and add the remaining dry hop additions of Mosaic™ and Citra®. Allow the beer to absorb the dry hop flavors for about four days. Bottle or keg as normal.

Fort George Brewery Suicide Squeeze IPA clone

(5 gallons/19 L, extract with grains)

OG = 1.044 FG = 1.008
IBU = 48 SRM = 6 ABV = 4.7%

Ingredients

3.3 lbs. (1.5 kg) Briess unhopped Pilsen liquid malt extract
2 lbs. (0.9 kg) Briess light dried malt extract
0.25 lbs. (113 g) crystal malt (40 °L)
0.5 lbs. (226 g) flaked oats
2.7 AAU Mosaic™ hop pellets (60 min.) (0.25 oz./7 g at 11.0% alpha acids)
8.2 AAU Mosaic™ hop pellets (15 min.) (0.75 oz./22 g at 11.0% alpha acids)
9.7 AAU Citra® hop pellets (15 min.) (0.75 oz./21 g at 13.0% alpha acids)
2 oz. (56 g) Mosaic™ hop pellets (0 min.)
2.5 oz. (71 g) Mosaic™ hop pellets (dry hop)
0.25 oz. (7 g) Citra® hop pellets (dry hop)
½ teaspoon Irish moss (30 min.)
Wyeast 1968 (London ESB) or White Labs WLP002 (English Ale) or Lallemand Windsor Ale yeast
⅔ cup corn sugar (if priming)

Step by Step

Steep the crushed grain in 2.5 gallons (9.5 L) of water at 155 °F (68 °C) for 30 minutes. Remove the grains from the wort. Add the malt extracts and boil for 60 minutes. Add the first hop addition of Mosaic™ at the beginning of the boil primarily as a foam inhibitor. Add the Irish moss for the last 30 minutes. With 15 minutes left in the boil, add the second Mosaic™ and first Citra® hop addition. At the end of the boil, insert a wort chiller and begin cooling the wort. As soon as you begin chilling the wort, add 2 oz. (56 g) of Mosaic™ hops, stirring them in the wort while you are cooling the wort. You would like to have these hops in the wort with the temperature between boiling and around 150 °F (66 °C) for close to five minutes. When you have cooled your wort to about 80 °F (27 °C), you can strain the wort into a fermenter and top off to 5 gallons (19 L). Aerate the wort and pitch the yeast. Ferment at 70 °F (21 °C). When fermentation is complete, rack the beer off the trub and add the remaining dry hop additions of Mosaic™ and Citra®. Allow the beer to absorb the dry hop flavors for about four days. Bottle or keg as you normally would.

Tips for Success:

Flaked grains such as flaked oats (as used in this recipe) or flaked wheat can provide extra mouthfeel, which can help balance a beer with higher hops and lower alcohol. Flaked grains technically should be mashed, or partial mashed to convert the starch. In the extract with grains version of this recipe, the grains are steeped at 155 °F (68 °C). This will not convert the starch in the grains, but it will still increase the mouthfeel (but may also leave some haze behind.)

Lawson's Finest Liquids Super Session IPA clone

(5 gallons/19 L, all-grain)

OG = 1.050 FG = 1.017
IBU = 47 SRM = 5 ABV = 4.3%

Ingredients

8.6 lbs. (3.9 kg) pale ale malt
1 lb. (0.45 kg) Carapils® (dextrin) malt
6 oz. (170 g) crystal malt (10 °L)
6 oz. (170 g) Munich malt (10 °L)
2.5 AAU Amarillo® hop pellets (60 min.) (0.25 oz./7 g at 10% alpha acids)
5 oz. (142 g) Amarillo® hop pellets (0 min.)
3 oz. (85 g) Amarillo® hop pellets (dry hop)
½ teaspoon Irish moss (30 min.)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) or Lallemand BRY-97 or Safale US-05 or Mangrove Jack's M44 (US West Coast) yeast
⅔ cup corn sugar (if priming)

Step by Step

This is a single step infusion mash, mashing at 158 °F (70 °C) to create a fuller-bodied beer. Mix all the crushed grains with 3.5 gallons (13 L) of 170 °F (77 °C) water and stabilize the mash at 158 °F (70 °C) for 60 minutes. Raise the mash temperature to 165 °F (74 °C) and sparge with enough 175 °F (79 °C) water to collect approximately 6 gallons (23 L) of wort. Boil the wort for 60 minutes. Add the first hop addition of Amarillo® at the beginning of the boil primarily as a foam inhibitor. Add the Irish moss for the last 30 minutes. Turn off the burner and remove the pot from the heat source. Now add 5 oz. (142 g) of Amarillo® hops, and stir to mix in. After about three to four minutes, begin using your wort chiller to drop the temperature of the wort to pitching temperature. This addition is a bit tricky, but the goal is to have the large amount of hops in your wort for about 5 minutes after the wort has finished boiling, but prior to cooling below around 150 °F (66 °C). This extracts a small amount of hop bitterness, and a large amount of hop flavors. When you have cooled the wort to about 80 °F (27 °C), you can strain the wort into a fermenter. Aerate the wort and pitch the yeast. Ferment at 68–70 °F (20–21 °C) to help hold the aromatics in the beer. When fermentation is complete, rack the beer off the trub and add the remaining dry hop addition of Amarillo®. Allow the beer to absorb the dry hop flavors for about four days. Bottle or keg as normal.

Lawson's Finest Liquids Super Session IPA clone

(5 gallons/19 L, extract with grains)

OG = 1.050 FG = 1.017
IBU = 48 SRM = 5 ABV = 4.3%

Ingredients

3.3 lbs. (1.5 kg) Briess unhopped light liquid malt extract
2.1 lbs. (0.95 kg) Briess light dried malt extract
1 lb. (0.45 kg) Carapils® (dextrin) malt
6 oz. (170 g) crystal malt (10 °L)
6 oz. (170 g) Munich malt (10 °L)
2.5 AAU Amarillo® hop pellets (60 min.) (0.25 oz./7 g at 10% alpha acids)
5 oz. (142 g) Amarillo® hop pellets (0 min.)
3 oz. (85 g) Amarillo® hop pellets (dry hop)
½ teaspoon Irish moss (30 min.)
Wyeast 1056 (American Ale) or White Labs WLP001 (California Ale) or Lallemand BRY-97 or Safale US-05 or Mangrove Jack's M44 (US West Coast) yeast
⅔ cup corn sugar (if priming)

Step by Step

Steep the crushed malts in 2.5 gallons (9.5 L) of water at 155 °F (68 °C) for 30 minutes. Remove the grains from the wort. Add the malt extracts and boil for 60 minutes. Add the first hop addition of Amarillo® at the beginning of the boil primarily as a foam inhibitor. Add the Irish moss for the last 30 minutes. Turn off the burner and remove the pot from the heat source. Now add 5 oz. (142 g) of Amarillo® hops and stir to mix in. After about three to four minutes, begin using your wort chiller to drop the temperature of the wort to pitching temperature. This addition is a bit tricky, but the goal is to have the large amount of hops in your wort for about five minutes after the beer has finished boiling, but prior to cooling below around 150 °F (66 °C). This extracts a small amount of hop bitterness, and a large amount of hop flavors. When you have cooled your wort to about 80 °F (27 °C), you can strain the wort into your fermenter. Top off to 5 gallons (19 L) then aerate your wort and pitch your yeast. Ferment at 68–70 °F (20–21 °C) to help hold the aromatics in the beer. When fermentation is complete, rack your beer off the trub, and add the remaining dry hop addition of Amarillo® hops, and allow the beer to absorb the dry hop flavors for about four days. Then bottle or keg as you normally would.

Boulevard Brewing Co. Pop Up Session IPA clone
(5 gallons/19 L, all-grain)

OG = 1.042 FG = 1.010
IBU = 41 SRM = 5 ABV = 4.2%

Ingredients

8.25 lbs. (3.7 kg) British pale ale malt
0.25 lbs. (113 g) amber malt
4 AAU Australian Topaz hop pellets (60 min.) (0.25 oz./7 g at 16.0% alpha acids)
2.5 oz. (70 g) Cascade hop pellets (0 min.)
1.5 oz. (42 g) Citra® hop pellets (0 min.)
1.5 oz. (42 g) Mosaic™ hop pellets (0 min.)
1 oz. (28 g) Amarillo® hop pellets (dry hop)
1 oz. (28 g) Cascade hop pellets (dry hop)
0.25 oz. (7 g) Citra® hop pellets (dry hop)
0.25 oz. (7 g) Centennial hop pellets (dry hop)
½ teaspoon Irish moss (30 min.)
Wyeast 1098 (British Ale) or White Labs WLP007 (Dry English Ale) or Safale S-04 or Mangrove Jack's M07 (British Ale) or Lallemand Nottingham Ale yeast.
⅔ cup corn sugar (if priming)

Step by Step

This is a single step infusion mash, mashing at 154 °F to 156 °F (68 °C to 69 °C) to create a fuller bodied beer. Mix all the crushed grains with 3.5 gallons (13 L) of 170 °F (77 °C) water and stabilize the mash at 156 °F (68 °C) for 60 minutes. Raise the mash temperature to 165 °F (74 °C) and sparge with enough 175 °F (79 °C) water to collect approximately 6 gallons (23 L) of wort. Boil the wort for 60 minutes. Add the first hop addition of Topaz at the beginning of the boil. Add the Irish moss for the last 30 minutes. Turn off the burner and remove the pot from the heat source. Add the first Cascade, Mosaic™ and Citra® hop additions and stir to mix in. After about three to four minutes, begin using your wort chiller to drop the temperature of the wort to pitching temperature. This addition is a bit tricky, but the goal is to have the large amount of hops in the wort for about five minutes after the wort has finished boiling, but prior to cooling below around 150 °F (66 °C). When you reach about 80 °F (27 °F), strain the wort into a fermenter. Aerate the wort and pitch the yeast. Ferment at 68 °F (20 °C). When fermentation is complete, rack the beer off the trub, add the remaining dry hop additions of Cascade, Centennial and Citra®, and dry hop for four days. Bottle or keg.

Boulevard Brewing Co. Pop Up Session IPA clone
(5 gallons/19 L, extract with grains)

OG = 1.042 FG = 1.010
IBU = 41 SRM = 5 ABV = 4.2%

Ingredients

3.3 lbs. (1.5 kg) Briess light unhopped liquid malt extract
2 lbs. (0.9 kg) Briess light dried malt extract
0.25 lbs. (113 g) amber malt
4 AAU Australian Topaz hop pellets (60 min.) (0.25 oz./7 g at 16.0% alpha acids)
2.5 oz. (70 g) Cascade hop pellets (0 min.)
1.5 oz. (42 g) Citra® hop pellets (0 min.)
1.5 oz. (42 g) Mosaic™ hop pellets (0 min.)
1.0 oz. (28 g) Amarillo® hop pellets (dry hop)
1.0 oz. (28 g) Cascade hop pellets (dry hop)
0.25 oz. (7 g) Citra® hop pellets (dry hop)
0.25 oz. (7 g) Centennial hop pellets (dry hop)
½ teaspoon Irish moss (30 min.)
Wyeast 1098 (British Ale) or White Labs WLP007 (Dry English Ale) or Safale S-04 or Mangrove Jack's M07 (British Ale) or Lallemand Nottingham Ale yeast.
⅔ cup corn sugar (if priming)

Step by Step

Steep the crushed amber malt in 2.5 gallons (9.5 L) of water at 155 °F (68 °C) for 30 minutes. Remove the grains from the wort. Add the malt extracts and boil for 60 minutes. Add the first hop addition of Topaz at the beginning of the boil. Add the Irish moss for the last 30 minutes. Turn off the burner and remove your pot from your heat source. Add the first Cascade, Mosaic™ and Citra® hop additions and stir to mix in. After about three to four minutes, begin using your wort chiller to drop the temperature of the wort to pitching temperature. This addition is a bit tricky, but the goal is to have the large amount of hops in the wort for about five minutes after the wort has finished boiling, but prior to cooling below around 150 °F (66 °C). When you reach about 80 °F (27 °F), strain the wort into a fermenter. Aerate the wort and pitch the yeast. Ferment at 68 °F (20 °C). When fermentation is complete, rack the beer off the trub, add the remaining dry hop additions of Cascade, Centennial and Citra®, and dry hop for four days. Bottle or keg.

Photo by Molly Kinne/Tapdancerblog.com

"Session" IPAs are popping up in commercial craft breweries all over the United States. The new style is lower in alcohol than regular IPA, but has a bigger body and more hop aroma than a traditional American pale ale. The key to these beers is using late hop additions.

Session IPA Commercial Examples

All Day IPA
Founders Brewing Co.
Grand Rapids, Michigan
www.foundersbrewing.com

Day Time Ale
Lagunitas Brewing Co.
Petaluma, California
www.lagunitas.com

Easy IPA
Flying Dog Brewery
Frederick, Maryland
www.flyingdogbrewery.com

Go To IPA
Stone Brewing Co.
Escondido, California
www.stonebrewing.com

Hop Session Ale
Otter Creek Brewing
Middlebury, Vermont
www.ottercreekbrewing.com

well as whirlpool hops and late addition hops, which are also often employed when making session IPAs, read Dave Green's story from the March-April 2013 issue of *BYO* at http://byo.com/story2808.

One of the problems that large-scale brewers have with late hopping methods is that when they finish boiling their wort, because of the size of 10-barrel to a few hundred-barrel brewing systems, it can take a very long time — 30 to 60 minutes — to cool the beer, and any late hop additions will continue to extract more of the harsh hop flavors in the 30 minutes or longer that it takes to cool the beer, not to mention additional time sitting in a boiling vessel if they are whirlpooling to help with hot break separation. As a homebrewer, typically brewing 5- to 10-gallon (19- to 38-L) batches, you have the advantage of being able to cool your beer at the end of the boil very quickly in comparison. Using an immersion wort chiller, typically you should be able to drop the temperature of your beer from boiling temperature to somewhere around room temperature in a 5 to 10 minute timeframe, thus having more control over how much of the more harsh hop flavors are extracted after flameout.

Session IPA At Home

Session IPA is a beer style that embodies the spirit of homebrewing perfectly. This is because for now, since it is not recognized by the Beer Judge Certification Program (BJCP) as an official style, the rules are just guidelines, and a great deal of variation of methodology is completely acceptable when brewing this type of beer.

Starting on page 81 are three session IPA commercial clone recipes. Hop IBU numbers when using this hop bursting method will vary for homebrewers, so the IBU numbers on the recipes could vary by 20% to 30%. *Brew Your Own* states in their recipe standardization (on page 2), "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," so that is what these recipes reflect. Your results could vary, so don't get hung up on the numbers. BYO

Build a BETTER Homebrew PUMP

Modify a centrifugal pump for better wort control

by **Christian Lavender**

There's nothing more frustrating on brew day than flipping your new shiny magnetic driven pump on and nothing happens. You might have hot water waiting to mash-in or your wort is ready to transfer to the boil kettle, but you can't seem to get anything to move. The pump is on and you can hear it spinning away. What gives? Did you set the pumps up to flow in the right direction? How about position? How about height in relation to your brew kettle or mash tun? Are the pumps self-priming? There's a lot to these little homebrew power pushers and with a few modifications, your pump can be doing double duty.

Bleed Valve and Throttle Assembly

Most affordable homebrew pumps on the market are not self-priming, which means that air is the enemy. The pump manufacturers state that "the pumps need to be positioned below the level of liquid for the input in order for the pumps to prime." Speaking from many years of experience with these types of pumps, they don't play nice all the time.

The pump will be full of air and that air needs a place to go. Adding a simple bleed or relief valve can help you release some of the trapped air in the pump chamber. The pump head must be filled with liquid before it will pump properly, so bleeding out the air will allow the pump to get going. It helps to run a tube from your bleed valve down into a bucket or reservoir to catch any small amounts of liquid during pressure relief. The additional outlet also comes in handy for gravity samples during the mash, sparge and final runoff to the fermenter and back flushing your system with cleanser. See Figure 1 on page 90 for a basic centrifugal magnetic drive pump with bleed and throttle valve.

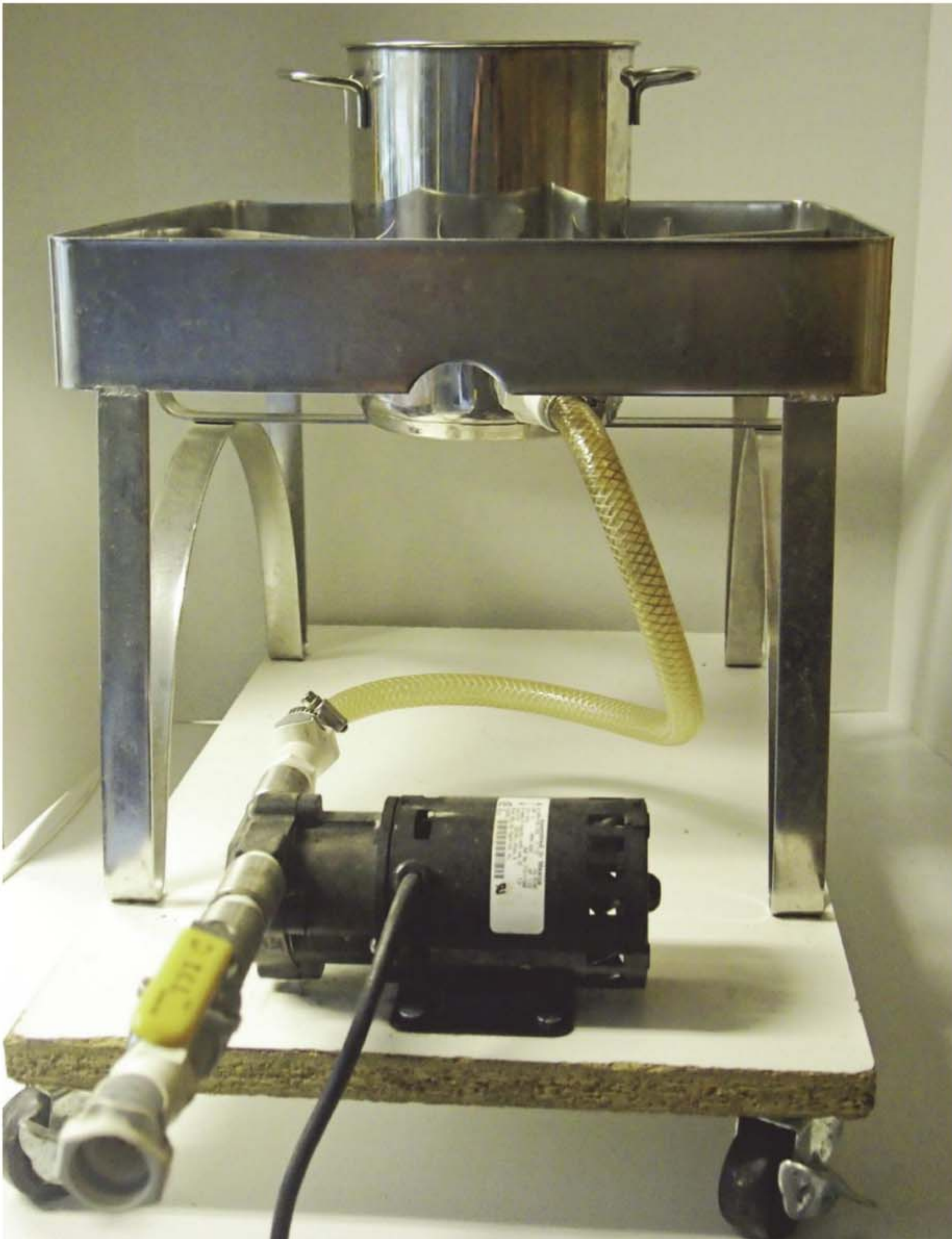


Photo by Terry Foster

Adding a bleed valve to the discharge port allows air pockets out that might be trapped in the pump head. The flow regulating throttle valve is placed on the outlet also. This becomes especially paramount during sparge and transfers that need to be low flow to reduce agitation. It is not recommended to put the throttle valve on the wort-in port. This can cause cavitation because your pump will be trying to push more than it receives, creating a vacuum. Cavitating air pockets in your pump head can cause your pump motor stress and possibly lead to a shorter lifespan.

Advanced Two Pump Design

In a two pump all-grain homebrew system you have the ability to move all liquid from start to finish using pump power. Figure 2 on page 90 shows a sample schematic of a 10-gallon (38-L) system using two pumps for hot water transfer, mashing in, recirculation, sparge, final runoff transfer through a plate chiller and finally to the fermenter. The pumps, in conjunction with four 3-way ball valves, move the entire brew day along without the need to move hoses.

Hot water flows in from the hot liquor tank (HLT) and is then pumped through a 3-way ball valve on PUMP 1 and out to the mash lauter tun (MLT). After the mashing process is completed, the wort is recirculated through the same pump with a twist of the 3-way ball valve on PUMP 1. After recirculation is complete, the sparge process begins. The 3-way valve on PUMP 1 is set back to allow hot water to flow in from the HLT to the MLT's sparge arm/assembly. (Using the Blichmann Auto-Sparge or the Ultimate Sparge Arm can give you even more control over your flow rates.)

The bottom 3-way valve on the MLT is set to divert runoff into PUMP 2 and out to the boil kettle. After the sparge and lautering process winds down and you have boiled your wort, the PUMP 2 bottom valve is switched to allow flow from the boil kettle out to the plate chiller and finally into a closed fermenter. Not

Continued on page 92

Popular Homebrew Pumps

March, Chugger, and Steelhead centrifugal pumps are the most common pumps used by homebrewers. Any specific reason why? Yes. They are magnetic driven, which allows you to put a ball valve after the pump to slow down flow without taxing the motor. If you are looking to pump or transfer finished beer after fermentation you need a self-priming pump.

So, what does self-priming mean? A pump that is not self-priming does not suck air and must be fed liquid via gravity before it will begin to pump. The pump head and lines must be full before the pump is started. This is why the configuration of the pump head is so important. A pump that is self-priming will pump air and therefore can create a suction that will pull liquid from a kettle.

Other pumps that can be used by homebrewers for various liquid transfers include sous vide pumps, submersible pumps and pond/fountain pumps.

Pump head port configuration

Inline Style – The most common port configuration for homebrew transfers. Liquid takes two 90-degree turns, so this can cause cavitation and lower flow rates than the center inlet models.

Center Inlet - Liquid enters from the front port and immediately enters the pump impeller making it easier to prime. This port configuration helps prevent cavitation issues and achieves higher flow rates with the larger diameter inlet.

Figure 1: Basic Centrifugal Magnetic Drive Pump with Bleed and Throttle Valve

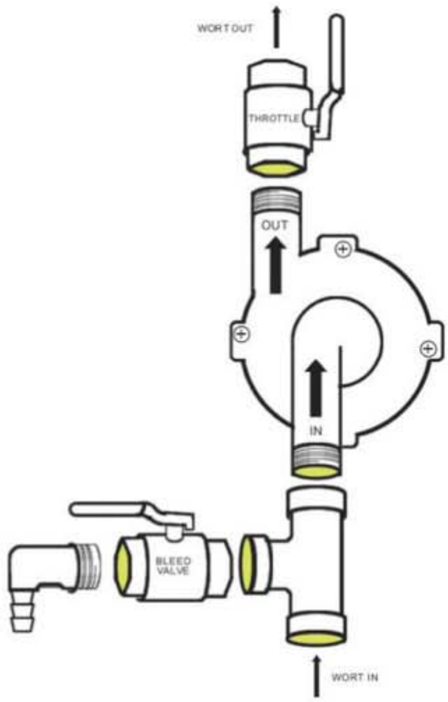


Figure 3: Four Possible Pump Head Configurations

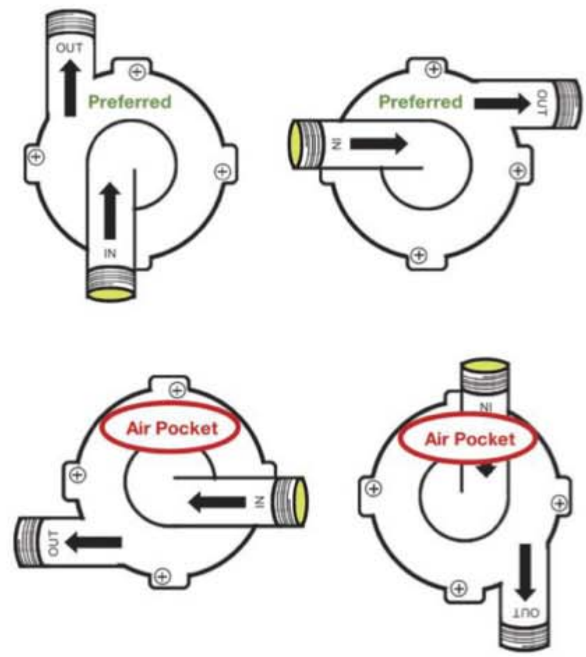
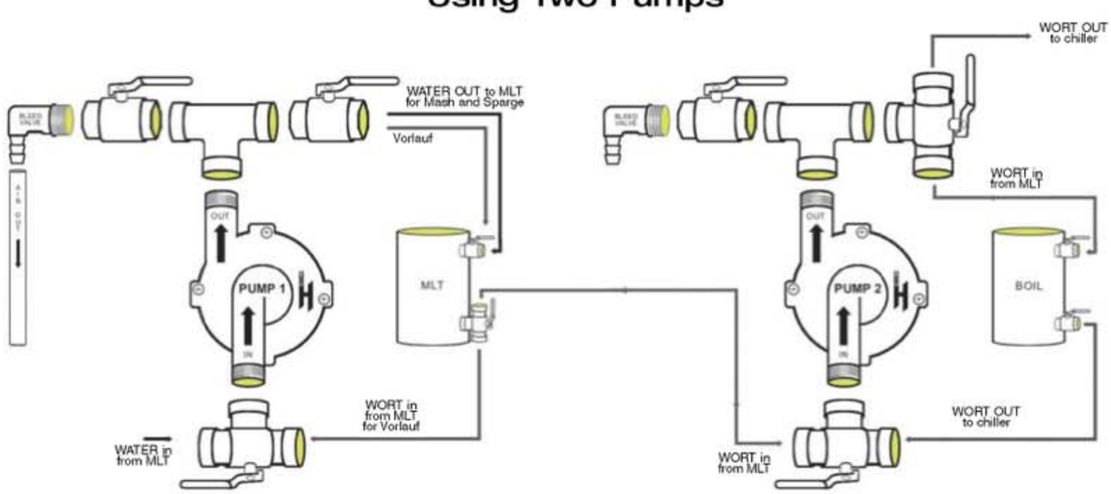


Figure 2: A 10-gallon (38-L) System Using Two Pumps



With two well-positioned pumps and 3-way ball valves connected to an all-grain system, a homebrewer can move all of the brewing liquid in a batch of beer from start to finish.

Pump Maintenance Tips

- Take pumps apart after every brew and do a hot soak in Powdered Brewery Wash (PBW) cleaner for 30 minutes.
- Scrub each part of the pump with a brush.
- Spray the parts with sanitizer, air dry and then reassemble.
- (Optionally) Recirculate hot cleaner and sanitizer through the assembled pump for 20-30 minutes.
- Oil pumps yearly with 4-5 drops of (3-in-one) SAE20 weight non-detergent oil in the labeled oil holes.

Pump Control

Not all homebrewers have big fancy control panels to power their pumps, but there are a few devices that can provide some quick control and hands free operation.

Pedal Foot Switch - Simply plug the foot switch into your electrical outlet, and then plug your pump into the pedal. Step on pedal once to activate pump and step again to deactivate.

Remote Switch – Plugs into grounded electrical outlet. Remote button turn the pump on or off.

DISCLAIMER: ELECTRICITY CAN BE DANGEROUS Always use a ground fault circuit interrupter protected power source when using any electrical devices around your homebrewery to avoid the risk of shock.

only is there no disconnection of hoses in this pump design, but the system remains "closed" during the final transfer to the fermenter. Closed transfers are considered the safest for minimizing exposure of bacteria and wild yeast.

Pump Position

There are many different ways to design your brewery and the previous example I mentioned was just one way to go. In that example the pumps would be mounted horizontally to a brewing rig or table below the vessels in order to help pump priming as the manufacturers suggest. The preferred pump head orientation is having the inlet on the bottom and the outlet on the top. Mounting the pump head on its side works too, but make sure the outlet is on the right side and the inlet is on the left. Mounting the pumps in the opposite configurations will cause air pockets and pump cavitation. See Figure 3 on page 90 for preferred pump head configurations.

In the end, pump head orientation is not something to get hung up on. The pumps should work in any position they are mounted with the use of a bleed valve. Making sure the position of the pump is below the liquid needing to be moved is more important.

The pump head material that most non self-priming models come with is Polysulfone (a tough and durable thermoplastic) with a maximum operating temperature of 250 °F (121 °C) (a great choice for homebrewing). The stainless steel heads run at the same max out temperatures and are made of food-grade metals that can withstand caustic chemicals. They can be effectively sanitized and are more common among professional brewers. Weigh the pros and cons of different models and choose what works best for your setup and budget.

Related Link:

- If you're ready to automate your all-grain brew day, considering using a RIMS (Recirculating Infusion Mash System) or HERMS (Heat Exchanger Recirculating Mash System). http://byo.com/story1325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Stuck Fermentations

Troubleshooting common fermentation problems

by Terry Foster

Let's start with two pieces of useless advice. The first came from a doctor who, when I was in my fifties, diagnosed a fractured foot and told me I should have done it when I was 17. The second is to tell you that with all-malt worts you shouldn't have stuck fermentations, which is very little help when that is exactly what you have and you want to know what to do about it.

What is a stuck fermentation?

Brewers generally use the term "stuck fermentation" to mean a fermentation that started normally, but then stopped at a gravity significantly higher than the targeted gravity. But I think I should include in this discussion fermentations that either have not started, or have started very slowly, since these are fermentations that have "stuck" right from the beginning.

Some of the causes of these problems may be similar or at least closely related, but the means of getting fermentation satisfactorily under way may be different, so I shall deal with them separately.

Non-starting fermentations

These are generally the result of one or more of the following causes:

1. Yeast quality: The sample used was too old or had been mishandled, and just contained few or even no viable cells. If a starter had been made, this lack of viability would have been obvious prior to pitching, and a fresh sample could then have been used for pitching. The answer is to re-pitch with a fresh starter (more on this later).

2. Lack of nutrients to promote growth: This is generally not a problem with all-malt worts, but can be so if high proportions of sugars (those not derived from malt) or non-malt adjuncts (such as rice or corn) are used. In that case, adding ammonium phosphate-based nutrients or proprietary nutrients such as Servomyces from White Labs will help, although these should probably be added along with a fresh yeast starter.

3. Insufficient oxygen dissolved in the wort: Yeasts need oxygen in order to permit sufficient growth of new cells, which are what are going to do the work of fermentation. If fermentation hasn't started at all, then try aerating or oxygenating it again, and preferably re-pitch with a fresh batch of yeast. Whatever your technique may be (splashing, using an aeration device, or direct oxygen with a carbonation stone), make sure you have sufficient oxygen in the wort when you pitch your next brew.

> "Some of the causes of these problems may be similar or at least closely related, but the means of getting fermentation satisfactorily under way may be different . . ."

4. Wrong temperatures: If you pitched into wort above 90 °F (32 °C) then you may have drastically reduced yeast viability, or perhaps even killed the yeast off completely. If the wort was too cold, then that too can cause problems with initial growth. If you pitch an ale yeast strain into wort below 50 °F (10 °C) its growth will be at best sluggish, and it may even give up the ghost entirely. In that case you need to bring the wort temperature up to 65–70 °F (18–21 °C) and then re-pitch with a fresh, active yeast sample. Do pay close attention to the supplier's recommendations for pitching and fermentation temperatures for the yeast strain you are using. Good brewers are those who can brew a particular beer to a consistent quality,

and control of fermentation temperature is important in achieving consistency. Temperature-controlled conical fermenters are available to the homebrewer, although at some cost; simpler solutions, such as a heating band or an insulated box heated by a bulb can be quite effective in this regard.

5. Not enough yeast pitched: This will generally result in a very long lag time before fermentation is visible (that is CO_2 bubbles can be seen on the surface. And by long lag time I mean more than 12 hours). It is true that in such cases, assuming none of the earlier problems are the cause, that fermentation will probably get under way eventually, and many homebrewers are content to leave it at that. In most instances the resulting beer will be disappointing for a number of reasons. The first is that wort sitting around at ambient temperatures is an inviting target to beer spoilage organisms; remember that if you encourage them once they may spoil not only the present brew but also later ones! The second is that if the yeast has to struggle in the early stages it may not perform properly as the fermentation gets under way. It may, for example, produce too many esters for the style, and it likely will not handle reduction of diacetyl so that the finished beer has too high a concentration of that chemical and an overly buttery taste. Also the yeast may be too tired to give the desired level of attenuation, so that the beer is overly sweet. This is not an easy problem to solve, for you are unlikely to have a fresh starter on hand to re-pitch the wort, and it will take a day or two to prepare one. Nevertheless, pitching a fresh starter is the best way to go. While you are preparing the starter, make sure the wort is kept tightly covered (with an airlock in case fermentation does start); if you are using an open fermentor all you can do is pray!

6. Very flocculent yeast: Some yeasts, even when healthy and pitched in sufficient amounts — will flocculate so readily that fermentation will be slow to start and will be sluggish. Some brewers approach this by frequent rousing of the sediment in the fermenter, and that can sometimes work. This is essentially what happens with the traditional Yorkshire Stone Square fermentation system, where the yeast is continually pumped from the bottom of the vessel back to the top of the beer. At least one English beer that I am familiar with is fermented in this manner, and the result is that it has a significant concentration of diacetyl, a flavor that is by no means to everybody's taste.

Just to pull this together, if you have a fermentation that doesn't start or is very slow to do so, you have a serious problem and in most cases the only way out is to add a fresh, active yeast starter. Even that may not work if your wort has picked up unwanted organisms while sitting there virtually unprotected while you prepare the new starter. The latter may finally get a good fermentation going, but those devilish bacteria or wild yeasts will be waiting in the wings to spoil the beer. Every brewer should hold it to be an act of faith to pitch a sufficient quantity of active yeast into properly aerated or oxygenated wort. To me that means preparing a starter, for that will not only give sufficient yeast it will also prove that your sample is viable. How big a starter? Well that is a separate topic and one that I dealt with in the "Techniques" column from March-April 2012. Or you can check at www.mrmalty.com, which will easily allow you to calculate how much pitching yeast you need.

Stuck fermentations

The yeast was pitched and it took off satisfactorily, and then a day or so later everything seems to have stopped, with no more CO_2 being evolved. You immediately think you have a stuck fermentation and wonder what to do about it. The very first thing to do is to ask yourself whether it really is a stuck fermentation. Just because the airlock isn't bubbling doesn't mean nothing is happening. It might just be that you have a sluggish fermentation, which is often the case with high gravity worts, for example. Or, conversely it may have been a very rapid fermentation that reached completion more quickly than you bargained for. Or perhaps there has been a sharp temperature drop, and all you need to do is bring the fermenter into a warmer place. One thing is certain, however, and that is that you must check beer gravity before bottling or even kegging to avoid development of excessive pressure in that final container. If the gravity is the same on three consecutive days, and is in the target zone for finishing, then you are safe to bottle.

But suppose you have taken a gravity reading (take care to remove all gas from the sample) and you get a result greater than a third of the original gravity? Remember, that in most beers you would be looking at a finishing gravity about 15-30% of the original gravity. If this was an all-grain brew it's possible that you mashed at too high a temperature and have too high a level of non-fermentables. If that is the case there is not much you can do about it, you just have to accept it and resolve to take more care when you do the next mash. The only real way to determine if you have a true stuck fermentation is to do a forced fermentation by taking a sample, pitching with an excess of yeast and fermenting warm, then measuring the final gravity and checking it against the gravity of the wort in the fermenter. That's not too practical for the homebrewer, so you have to assume that you do have a stuck fermentation and need to take some action.

If the yeast has given up the ghost it could be that there was insufficient yeast nutrient present in the original wort, or that the yeast has flocculated very rapidly. It would therefore seem that a good solution would be to add some more nutrient and to rouse the yeast thoroughly, a remedy that many brewers espouse. In fact, rousing at this point may cause all sorts of oxidation problems, as well as increasing the concentration of diacetyl in the beer, without actually doing anything to improve attenuation.

What we need to add is some fresh yeast that can pick up the baton from the tired cells and complete the race. But just tossing in more yeast is unlikely to work, because there is no oxygen present to help yeast growth, but there is sufficient alcohol present to "poison" the yeast and reduce its vitality. Instead, the yeast must be in active, vigorous growth phase when it is added to the beer. And that means (yes, you've guessed it) adding a fresh starter. This technique is called kräusening.

Starter directions

If you have space, I suggest you make a 2-quart (2-L) starter for a 5-gallon (19-L) batch (10-15% kräusen is normal for the traditional method). If you do not have the space in your fermenter, a 1-quart (1-L) starter will usually work too, but a larger number of active yeast cells is better. Normally for a starter you would decant the liquor before pitching the sediment to the wort. You can do that here but since you want to add the yeast at full kräusen I think it is preferable to add all the liquid in the new starter.

Take 4 oz. (113 g) of dried malt extract (DME), and add water to a total of 1 quart (1 L), and stir until the DME is dissolved. Add a pinch of yeast nutrient and boil the solution for 20 minutes, then top up with boiled water as necessary and cool to about 70 °F (21 °C). Aerate thoroughly (oxygenation is better) and pitch with a fresh yeast sample; if you have a stir plate keep the pitched wort continuously agitated. Maintain at room temperature until it is fermenting vigorously (the so-called high kräusen stage), then add this starter to the beer. For best results the beer should have been left in the fermenter during this time so that much of the dissolved CO_2 will have escaped.

Note that if your new yeast comes in a "smack pack" it can be added directly from the pack without smacking if you wish. However, it is preferable to smack it to break the inner pack and allow the yeast to become active in the pack, and then add its contents to the starter solution so that you get as much growth and as many active cells as possible in the starter.

Note also that some brewers prefer to use very lightly hopped wort to make a starter, usually at 10-15 IBU, which in this case would amount to a maximum of 1 gram of hops at 5% alpha acid. BYO

Ice (Bock) Beer

The science of crystallization

by Chris Bible

Eisbock is a style of beer that is characterized by a strong, malty, rich, warming aroma and flavor profile. Eisbock beers are produced by allowing an already-strong doppelbock to partially freeze. The ice crystals that form are then removed and the liquid component that remains contains the concentrated alcohol and flavor compounds that were in the entire volume of beer prior to freezing.

To make a good eisbock, it is important to have a good understanding of how ice crystals form, and to be able to effectively manage crystal formation within the beer.

Crystal formation

According to *Chemical Engineers' Handbook* (*8th Edition*), ice crystals, the solid state of water, form in beer when the temperature is lowered to the freezing point. The freezing point of beer is always lower than that of water because of dissolved solids and ethanol; this relationship is known as a colligative property. When the intermolecular attractive forces between water molecules is greater than the vibrational energy within the molecule, the individual water molecules join together and form an orderly, bonded structure, as is illustrated in Figure 1 (below, right).

There are two steps involved in freezing; nucleation and crystal growth. Nucleation occurs when solid water particles begin to form. Crystal growth follows as the number of water molecules associated with this nucleation site increases. In order for crystal growth to occur, water molecules move from the liquid bulk to the surface of the growing crystal; this is known as diffusion. Incorporation is the term used to describe how water molecules that diffuse to the surface of the crystal are added to the growing lattice of water molecules. This process can be seen when a water droplet lands on a cold glass surface.

Crystal nucleation and crystal growth rate

Nucleation and growth rate are the two defining parameters within the overall crystallization process (Perry's *Chemical Engineers' Handbook, 8th Edition*). Figure 2 (page 100) shows a generalized time/temperature relationship for the crystallization process as it occurs within a pure water system, and provides a description for what is happening at specific points within the process.

> "The freezing point of beer is always lower than that of water because of dissolved solids and ethanol . . ."

Nucleation describes the initial formation of ice within liquid at the molecular level. Other molecules then attach to this "core" of solids and form crystals. In order for crystal growth to progress, the temperature of the bulk solution and surfaces crystal nuclei may contact must be cold enough to prevent water molecules from leaving the lattice structure. The number of water molecules required to form a stable crystal nucleus has been estimated to be about 100. Scientists studying nucleation summarize the rate of crystal growth as follows:

$$B0 = Bss + Bcc + Bci$$

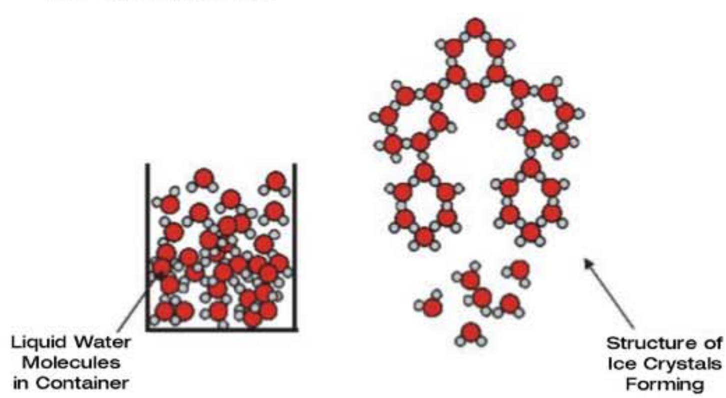


Figure 1: Ice Crystal Formation

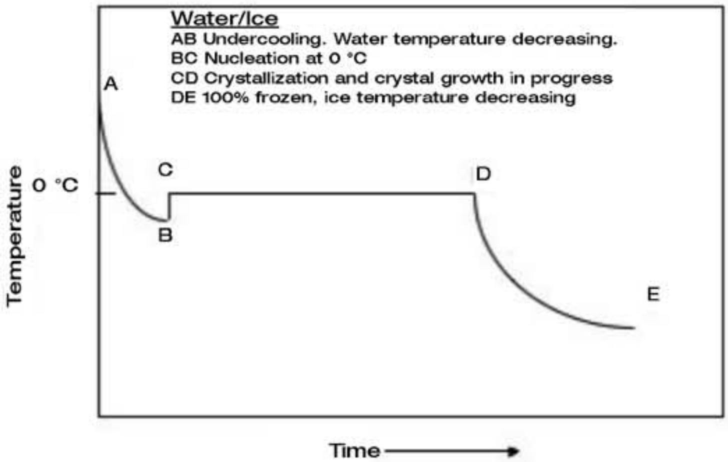


Figure 2: Water Crystallization Curve
(Source: University of Guelph Dairy Education Book Series)

Where:
B0 = the net number of new crystals formed in a unit volume of liquid per unit of time
Bss = the primary nucleation rate due to the thermodynamic driving force
Bcc = the rate of nucleation due to crystal-crystal and crystal-container contacts
Bci = the rate of nucleation due to crystal-impeller contacts

In simple terms, the rate of crystal growth is influenced by temperature, collisions between growing crystals and the wall of the container and collisions between growing crystals and an impeller that may be used to mix the freezing system.

Crystal growth rate and crystal size

Ice crystals grow in layers as water molecules diffuse from the bulk solution and incorporate into the growing lattice, and the growth rate is limited by the diffusion rate of liquid water from the bulk solution to the crystal surface. Crystal growth rate is generally independent of crystal size.

Nucleation rate and crystal growth rate is explained by:

B0 = ksb

Where:

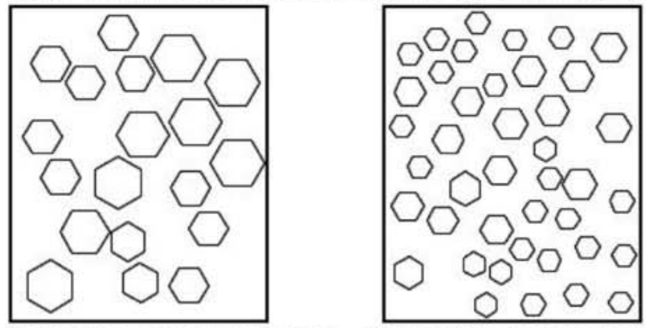
B0 = the net number of new crystals formed in a unit volume of liquid per unit of time

k = dimensional coefficient specific to the material
s = crystal saturation extent (mass of total system - mass of crystals present)
b = experimentally derived constant

This model suggests that nucleation rate slows as more water molecules are incorporated into crystals. This makes intuitive sense, as it becomes easier and easier for a water molecule to find a crystal and attach as the number of already-existing crystals within the system increases. It is generally more thermodynamically favorable for a water molecule to attach to an existing crystal than to begin to form a new nucleation site.

Ice crystal size is dependent on the freezing rate. More specifically, a high freezing rate results in more small ice crystals than does a low freezing rate. This is why flash freezing of fruits and vegetables, for example, causes less tissue damage associated with ice crystal growth than does freezing in a relatively warm freezer. Rapid cooling of beer and the subsequent freezing of water results in a greater number of small crystals as compared to a slower process resulting in fewer, but larger crystals. The practical consideration to take away from this is that larger crystals are easier to remove from the beer and the slow freezing approach is likely better for making ice beer than rapid freezing (see Figure 3, right).

Figure 3: Effect of Freezing Rate on Crystal Size



Slow freezing = fewer, larger crystals   Fast freezing = many smaller crystals

Practical considerations

A primary practical consideration when making an ice beer as a homebrewer is the legality of actually freeze-concentrating the beer by removal of water. There are many different opinions and discussions about this that can be found on the Internet, but the United States Alcohol and Tobacco Tax and Trade Bureau provides specific discussion about this in their "ATF Ruling 94-3," which can be viewed here: www.ttb.gov/rulings/94-3.htm. Legal considerations aside, important considerations when making ice beer are:

1) Make a very "clean" beer for use as your ice beer starting point. Concentrating the alcohol and flavor compounds by "icing" the beer will concentrate off-flavors in the beer.

2) Place the beer into a vessel from which it will be easy to separate the ice from the remaining liquid. A Corny keg, bucket fermenter, or a conical fermenter with a removable top will be easier to work with than a glass carboy.

3) Control the rate of freezing in order to obtain larger, easily removed ice crystals. Do this by:

a. Controlling the temperature external to the vessel to be below the freezing point of the liquid, but not too cold. Larger temperature differentials increase the rate of cooling, so try to err on the side of having the temperature be just cold enough to freeze the liquid in a reasonable amount of time. If you are using a corny keg, try a temperature of 0 to 10 °F (-18 to -12 °C), and check on the beer after about 10–12 hours by gently shaking the keg and listening for the sound of ice crystals scraping against the keg. Let trial-and-error be your guide with this.

b. Although you may need to shake the keg to listen for the presence of ice crystals, avoid excessive agitation of the container of beer during the freezing process. Agitation increases primary nucleation rate and therefore crystallization rate within the system. If faster freezing with correspondingly smaller crystals is desired, shake the container of beer when the ice crystals initially begin to form in order to increase the number of "nucleate" crystals. If you desire larger, more easily-removed crystals, avoid agitation of the container of beer during the freezing process.

4) After the ice is removed, the high concentration of alcohol and other residual sugars may make it challenging to carbonate the beer by bottle conditioning. If you choose to bottle-condition your beer, consider adding fresh, healthy yeast. Force-carbonation, of course, is always an option.

Making an ice beer presents several unique technical and procedural challenges to a homebrewer. Understanding the science of crystallization can help a brewer develop good post-fermentation practices to manage the ice crystal growth rate and ice-removal process. The reward for properly managing these post-fermentation operations is an ice beer that has the rich and intense flavors and aromas that make it something truly special. BYO

References:

1) Green, Don W. (editor), Perry's Chemical Engineers' Handbook, 8th Edition, 2007, pp. 18-39 - 18-48
2) University of Guelph Dairy Education Book Series: http://www.foodsci.uoguelph.ca/dairyedu/freeztheor.html
3) Alcohol and Tobacco Tax and Trade Bureau ATF Ruling 94-3: http://www.ttb.gov/rulings/94-3.htm

Toolbox Pump

Give your pump portability

projects
by David Sandy

Cooling your wort in a timely matter could make the difference between a crisp, hoppy ale or a sour, infected mess.

I'm sure a lot of brewers can remember a time when they had to lug a near-boiling pot of almost beer into their sink or bath tub and add what seemed like endless bags of ice into the tub to cool their wort. After doing this myself I knew there had to be a better way and that's when I decided to invest in a plate chiller and a pump. Since I didn't have a dedicated brewing area, I wanted to come up with an easy and portable cooling station being that half the year I brew in my kitchen and the other half I'm in my backyard. I came across the "Pumped up Toolbox" article from the October 2009 *BYO* and thought that was the perfect solution for me — well, after I put my own spin on it.

For this project I used an old metal toolbox. The toolbox has multiple valves on in the front so you could use this system simply as a pump for transferring wort or whirlpooling after the boil without pumping unnecessary gunk through the chiller, or you can also easily add other components like a hopback without modifying anything. You can also use the pump to clean and back flush the plate chiller to insure that there's no gunk left in it. I opted not to hardwire a switch for the pump onto the box since I'm not experienced with wiring electrical components and decided to just buy a $12 outlet switch, which works great.

"Since I didn't have a dedicated brewing area, I wanted to come up with an easy and portable cooling station . . ."

The only potential problem with the design is the chance the pump could overheat and fail due to the closed-in nature of the toolbox. This is easily remedied by leaving the lid open while the pump is in use, or installing a small computer fan or two into the sidewalls of the toolbox to pull hot air off the pump and blow cool air into the box when the pump is in use. As a caution, when I would start whirlpooling the pump would seize up and stop working for no apparent reason. After some testing I realized at near-boiling temperature there are air bubbles at the bottom of my kettle and it will start to cavitate my pump and cause it to stop working. So the solution I found was to restrict the flow of liquid out of the pump by about 40% and to slowly open the valve as the wort cooled over the next few minutes. With this technique I don't have any problem pumping liquid.

Tool List:
Power Drill
Crescent wrench
Pliers
⅞-inch drill bit
1½-inch drill bit

Parts List:
Toolbox, minimum of 22 inches (56 cm) in length
Plate chiller
Pump
(3) ½-inch stainless steel tees
(2) ½-inch mini ball valves male/female
(3) 2-piece ½-inch ball valves
(3) 1.5-inch nipples
(1) ½-inch 90 degree male/female stainless steel elbow
(2) ⅝-inch male hose barb
5 Female garden hose thread (GHT) to ⅝-inch barb
4 Male cam lock "type F"
2 "Big C" cam locks for every tube you make.
1 foot (30 cm) large ½-inch ID x ¾-inch OD silicone tubing (More tubing is needed for more disconnect hoses.)
5 feet (1.5 m) ⅝-inch ID vinyl hose
Gilmour brass one-way shutoff
Hose clamps
Ground fault interruptor
Belkin power switch
2 Gilmour metal quick connector set with overmold
Teflon tape

1. ASSEMBLE HARDWARE TO PUMP OUTPUT

For this first step you are going to need your pump, ½-inch ball valve, two nipples, tee, mini ball valve and a ⅝-inch hose barb. Assemble hardware to pump output as it is pictured. One suggestion I have is to use a liberal amount of Teflon tape when tightening your valves and tee to make it easier to set them at the correct orientation and make them tight enough not to leak. Leave the tubing off until the end so you can cut the correct size.

2. PLATE CHILLER ADJUSTMENTS

Fasten the tee and hose barb to the wort input of your plate chiller. Cut about one foot (30 cm) or so of vinyl tubing and slip a GHT barb over each end of the tube. Screw this tube onto the exit water output of the chiller. Make sure to use hose clamps on all sides of all tubing for this project unless you want hot wort shooting everywhere. If you have any trouble slipping the hose over the barbs you could dip the tube in boiling water briefly and it should sufficiently soften the tube so you can slide it over the barb.

3. CUT HOLES IN TOOLBOX

Line up the pump input to the side of the toolbox and the tee to the face of the toolbox. Mark each spot and cut the two holes. I used a 1½-inch drill bit for these holes but you could use as small as ⅞-inch if your measurements are precise. Next you are going to want to line up the wort output side of the chiller to the right inside of the toolbox. Use a ⅞-inch drill bit for the wort output and the 1½-inch bit for the water input. Drill holes to mount the chiller inside the box, line up the tee to the face of the box, mark that spot and cut the hole. Fasten the chiller to the box with your nuts and if you want a more polished look make sure to line up both tees so the valves on the face of the toolbox will be even.

4. MOUNT THE PUMP

Gather the tee, mini ball valve, elbow and cam lock so you can assemble the air purge valve. After that is assembled you are going to mount the pump to the box by fastening the purge valve to the input of the pump and the ball valve to the tee on the face of the toolbox. If you drill 7/8-inch holes the pump shouldn't need to be screwed to the base of the box. Cut an appropriate size piece of silicone tubing (or other high temperature rated hose) so that you can connect the two hose barbs. Next, fasten a cam lock to the wort output, also fasten the garden hose shut off valve and the GHT quick disconnect to the water input on the chiller.

5. ATTACH QUICK DISCONNECT

Take the vinyl hose that is connected to the water output on the chiller and line up the other end to the back of the toolbox, making sure not to kink the line too much. Mark that spot, cut a hole and screw on your quick disconnect. The hole I cut on my box was too big and I used a floor and ceiling plate ring to hold the quick disconnect in place. Cut a 1½-inch hole in the back of the box to feed the power cord through. If you are using a metal toolbox, use electrical tape or whatever you think would work best so that the sharp edges of the toolbox don't scrape away the housing of the power cord.

6. ASSEMBLE OTHER QUICK DISCONNECTS HOSES

Use the remaining vinyl hose to make two quick disconnect hoses. The first hose will have a GHT barb on one end and a male GHT quick disconnect screwed into the GHT barb on the other end. This hose is going to connect your garden hose to your plate chiller. The second hose is just going to have a GHT quick disconnect screwed into a GHT barb that is fastened to one end. This tube is going to be used as your cooling water exit line. Lastly you are going to want to make a few silicone cam lock quick disconnect hoses so you can move water or wort around. Simply cut the high temperature rated tubing to your desired length, slip a "big C" quick disconnect over each end and fasten with hose clamps. One last safety reminder, being that you'll be using electricity and water in such a close proximity <u>you are definitely going to want to plug your pump into a ground fault interrupter</u> so you don't electrocute yourself.

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last call
by Michael Berrios

Homebrew Rivalry

Identical twins with identical hobbies

> "However, by the end of the brew we realized something. We realized that we were both very passionate about brewing beer and demanded perfection."

My identical twin brother, Jay, and I have been rivals since we were young; from sports to school to girlfriends, and even barbecue'n. There was this one time when we were both into grilling ribs and each of us thought that we had the best ribs on the planet. After a long night of "sampling" we got on the subject of bbq'n and the argument got heated. So we decided to have a "rib off" that our entire family would judge to decide once and for all who was the grill master. Because this argument almost erupted into a fist-fight we decided that the loser of the competition would be banned from cooking anything on the grill for the rest of their life. This bet has not taken place yet, but I have to admit that I might have bitten off more than I can chew.

As you can see, my brother and I have always been very competitive, but when we both got into home-brewing the competition really picked up a notch and sometimes things could boil over.

It all started seven years ago when I was surfing the Internet. Back then I was notorious for having a few cheap, American lagers and then buying crap I didn't need like the Perfect Pancake® maker and the Slap Chop. I even bought a Cherokee tomahawk (I watched the movie The Patriot so many times that I decided I needed one). The tomahawk is currently collecting dust in my man cave where it has sat, unused, since its purchase. Anyway, one night I was in the mood to buy something and I stumbled upon a Mr. Beer kit. It made my computer screen glow and not just an ordinary glow but a mesmerizing, "buy me, you will never regret it" kind of glow. So I did.

I got the kit and tried a couple of batches that tasted like bacteria-infested pond water. However, my brother, who I was living with at the time, saw what I was trying to do and decided he wanted to take a stab at it. We brewed a few batches together that turned out much better but heads collided too many times and we decided to go our separate brewing ways. And so, the homebrew competition among us began.

After a short time brewing extract batches Jay went to a 3-gallon (12-L) all-grain system, I topped that with a 5-gallon (19-L) all-grain system. He would brew beers that were between 5-7% ABV, I would make my beers well above 11%. He went from bottles to kegs and I did the same.

For a long time we brewed separately and when we met up would discuss how each of our own beers were better then the other person's.

Eventually the time came to reunite as brewing partners once again as we planned to brew a collaborative Easter beer for our family. When we came together to brew this beer, the brew day was angry and got heated on many occasions.

We brewed "He who has Risen Rye Lager," brewed with Holy Water but the day almost turned out like Cain and Abel. As we brewed we sampled many different brews and voices were raised and pushing and shoving took place. However, by the end of the brew we realized something. We realized that we were both very passionate about brewing beer and demanded perfection. When Easter came around we tried our collaboration creation and it tasted heavenly! I believe this is because of the secret ingredient that we added (besides Holy Water) . . . Rivalry! BYO


Photo courtesy of Michael Berrios

Michael Berrios (left) and his twin brother Jay (right) at the 2013 National Homebrew Conference.