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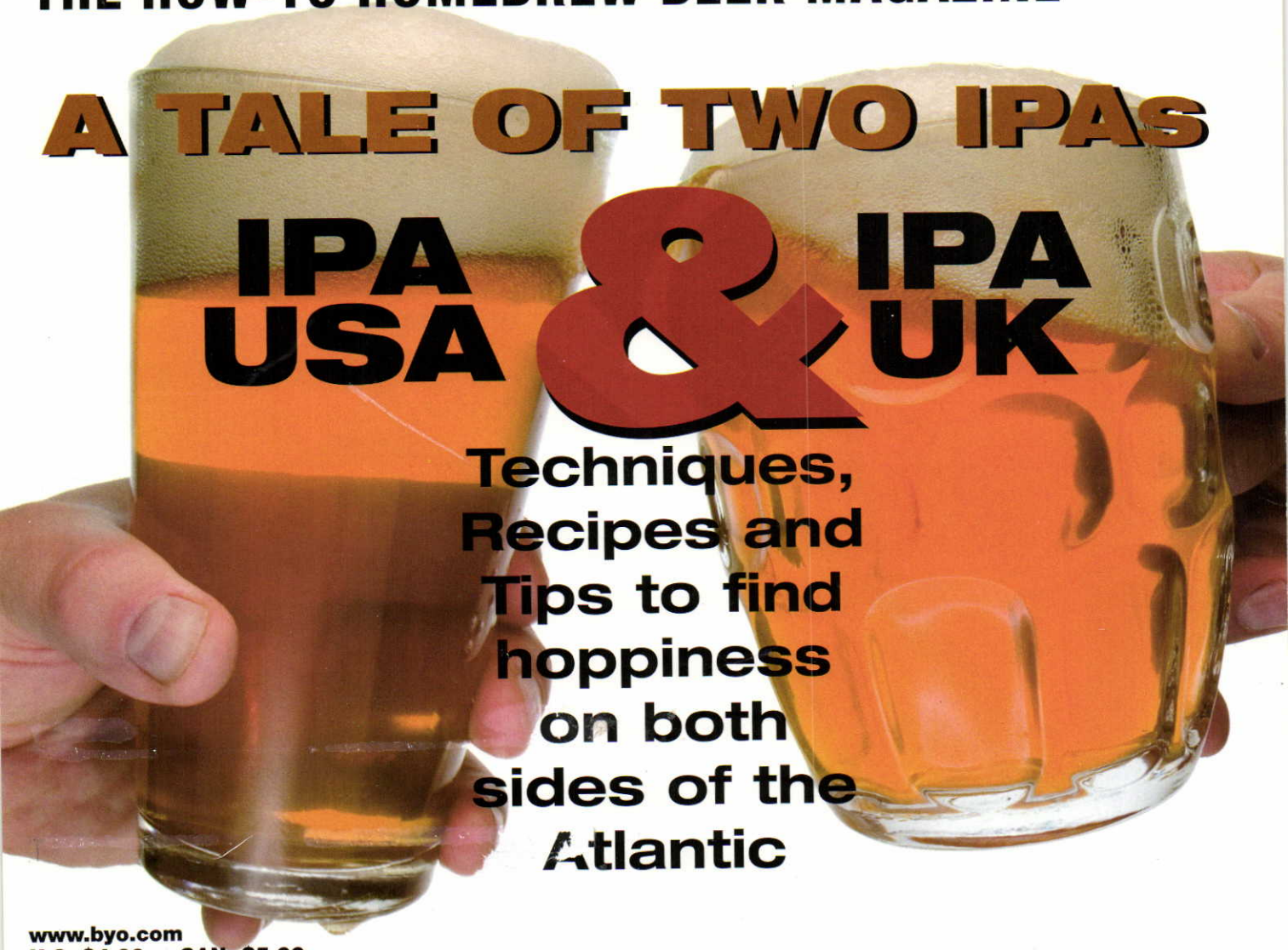
MAY-JUNE 2007, VOL.13, NO.3

THE HOW-TO HOMEBREW BEER MAGAZINE



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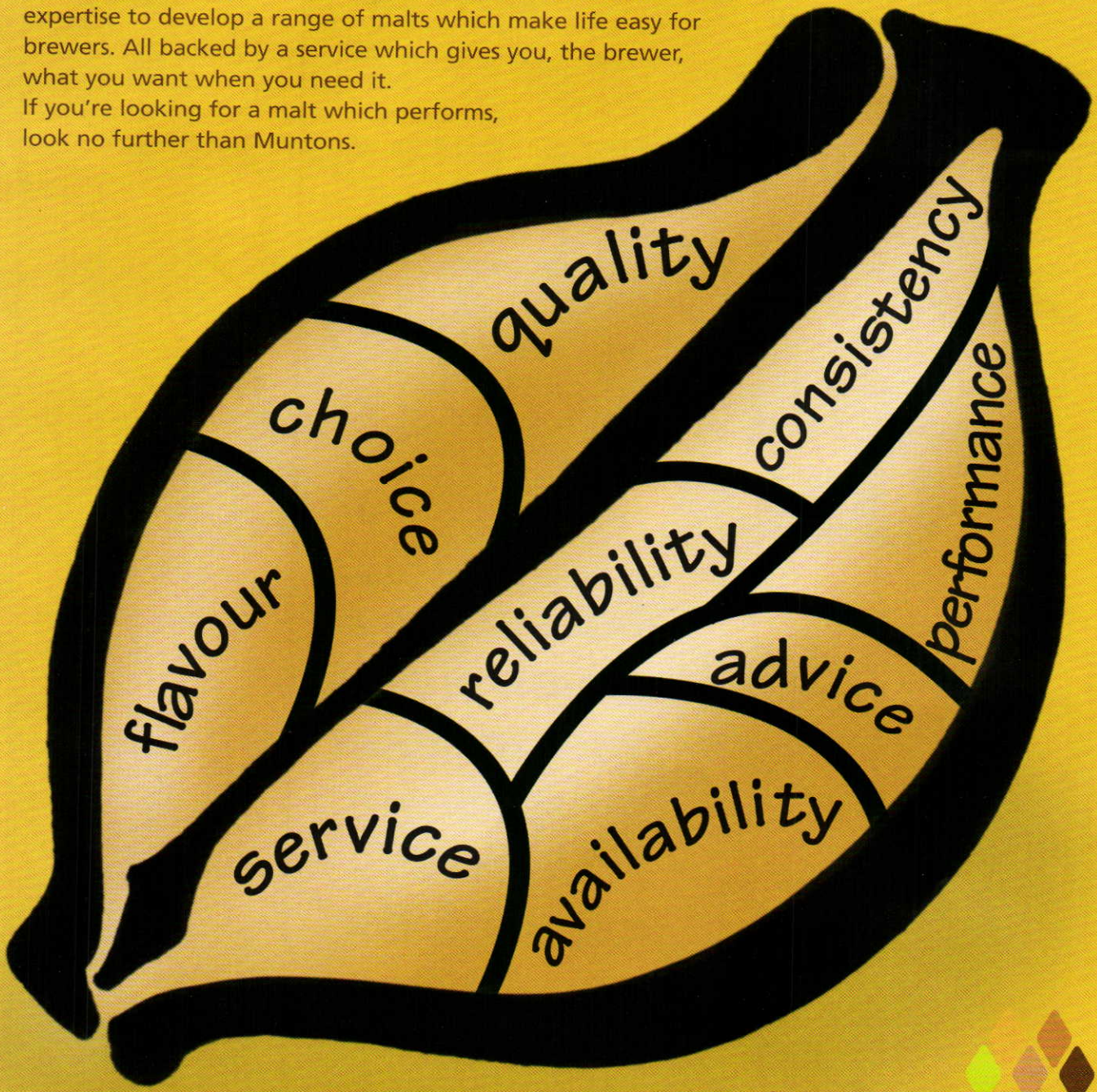

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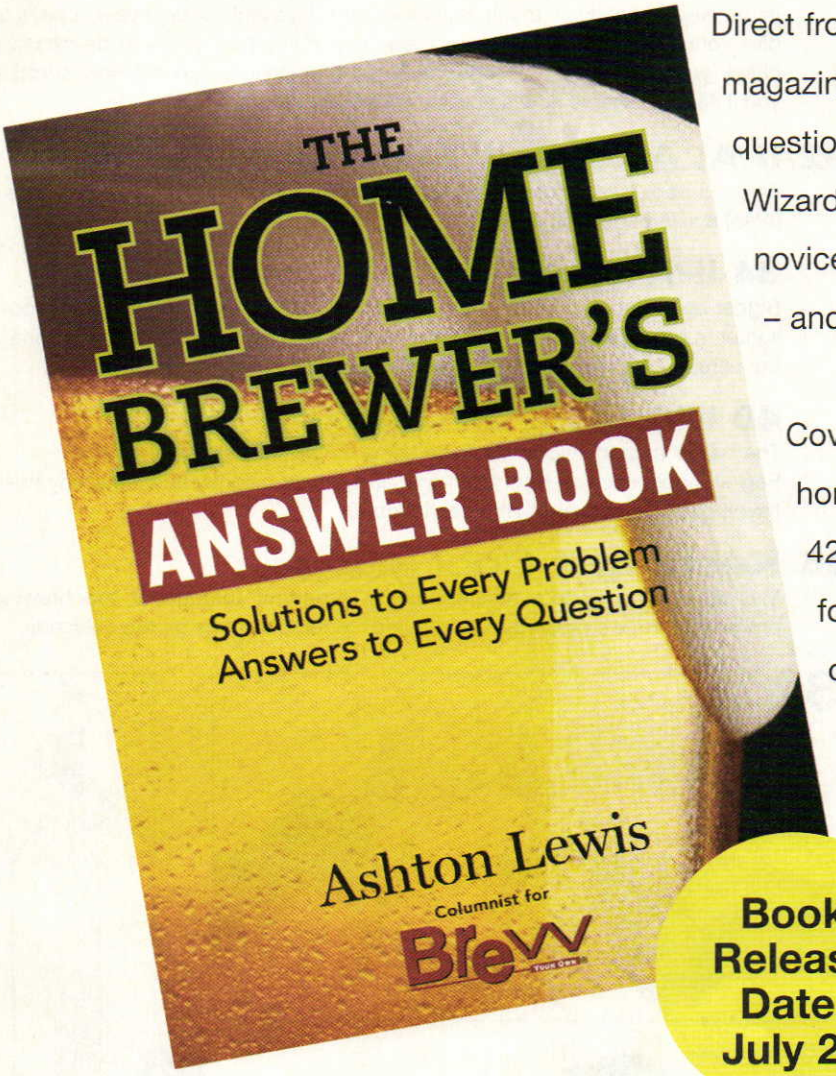

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Volume 13 Number 3

Brew Your Own

THE HOW-TO HOMEBREW BEER MAGAZINE

Departments

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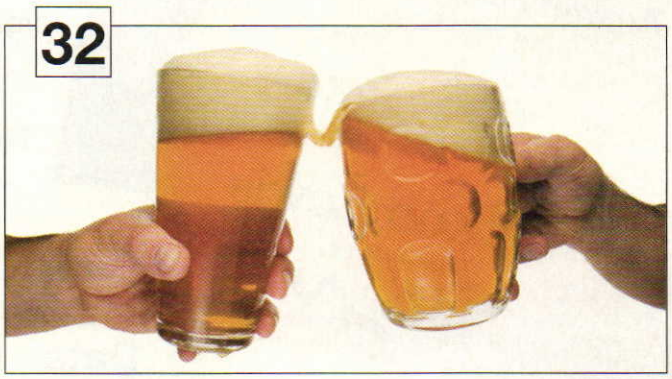
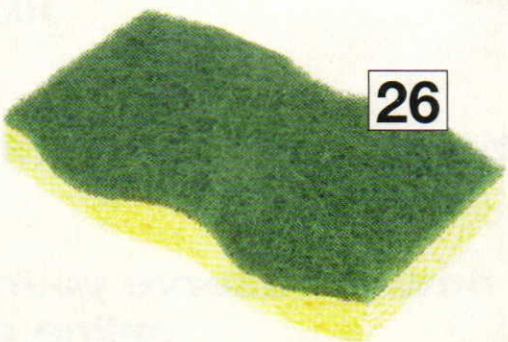
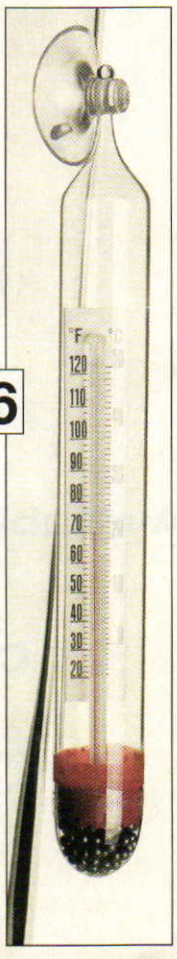
Features







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HERE'S TO BEER

RECIPE INDEX

BYO RECIPE STANDARDIZATION

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

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

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

Hops:
We calculate IBUs based on 25% hop utilization for a one hour boil of hop pellets at specific gravities less than 1.050.

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THE HOW-TO HOMEBREW BEER MAGAZINE

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O-Ring Orientation

In the March-April 2007 Projects column, entitled "The Thrill of the Drill," there is an error regarding the installation of the BrewMometer on the brewpot. The washer should go on the outside of the pot (to hold the O-ring in place and keep the O-ring from getting damaged).

If you followed the instructions in the article, disassemble the thermometer installation and move the washer to the outside. Brew Your Own regrets the error.

Brew Free

As an avid homebrewer, I was severely disappointed and upset when my doctor diagnosed me with celiac disease. The first question out of my mouth was, "Do I really have to give up beer?" Sadly, the answer came back in the affirmative and my life had changed forever. Gone were the days when I could look forward to the smell of grains steeping in my kitchen. My mill would have to sit, unused and covered in grain dust for eternity. Darkness came to my brew closet.

Glenn BurnSilver's article, "Gluten-Free Brewing" (March-April 2007) has rekindled my spirit. I am excited that I can brew gluten-free beer. I am also excited to have a source of information that I can use anytime. Thank you. Please keep it coming. I will soak it up as fast as my liver can soak up the gluten-free beer.

Ian Newhall
via email

Glad you liked Glenn's article. Information on brewing gluten-free beers at home is sparse, but the situation should improve as more homebrewers experiment and share their results. Some further information on gluten-free homebrewing can be found on the Australian podcast Craftbrewer Radio, found at radio.craftbrewer.org (Note: no "www").

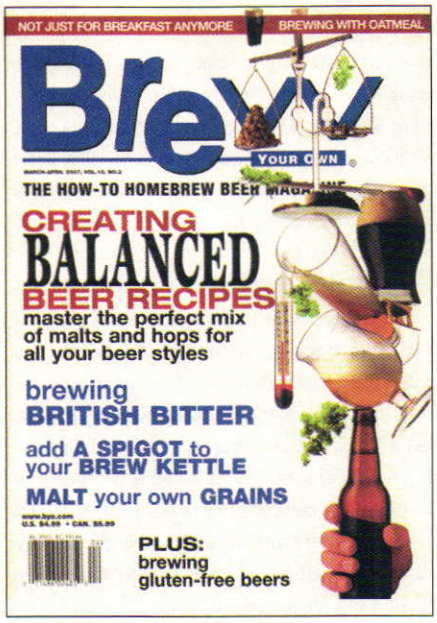
Spunding Search 1

I really liked the article on building a spunding valve (January-February 2007), and of course just have to have one. However, I am having a hard time finding a source for the pressure relief valve.

John "Danger" Skelton
via email

Spunding Search 2

I'm trying to build the spunding valve from the January-February 2007 issue, and



after finally tracking down the Y-adapter, I thought I was set. I was wrong. Could you please tell me where I can get the brass coupling you used to couple your flare disconnect to the pipe-thread y-adapter?

Rick Hogg
via email

Industrial supply stores, such as Grainger (www.grainger.com) or McMaster Carr (www.mcmaster.com) sell pressure relief valves and carry all the fittings and adapters that you need to build a spunding valve.

Scared by Monster Brewing Instructions

I'm a big guy and I like big beers. I was excited to see John McKissack's "21% Alcohol All-Grain Beer" article in the December 2006 issue of *Brew Your Own*. However, after reading the instructions for this monster beer, I was, uh, scared. I had always heard that you should never aerate a beer after fermentation started. In his procedures, McKissack advocates multiple aerations throughout the long fermentation. I'd like to try brewing a big beer like this, but I worry that the oxidation "boogey-man" will get me if I do. Any comments?

Walter Nicholson
Waterloo, Iowa

BYO Editor Chris Colby *responds: "McKissack's unusually big beer (21% ABV) calls for unusual fermentation procedures — procedures that are known to have negative effects in 'normal' beers. When I first read his article, I was skeptical that his methods would work. I received the same feedback*

BETSY PARKS is our new assistant editor at *Brew Your Own*. She graduated from the New England Culinary Institute in Montpelier, Vermont in 1996 before studying journalism while living in Vermont and on Cape Cod.

Betsy enjoys many craft brews – the more local the better. She and her boyfriend enjoy visiting some of their favorite breweries around the region when they can, including Magic Hat, Otter Creek, and Harpoon.

CHRIS BIBLE is a chemical engineer whose love of beer and science intersected when he became a homebrewer nearly a decade ago. Since then, he has been on a quest to not only brew the perfect beer, but to gain a deep, technical understanding of all aspects of the art and science of brewing.

In this issue, Chris writes about the importance of "Keeping it Cool" during the brewing process. His first article for *Brew Your Own* starts on page 46.

TERRY FOSTER wrote the book on English pale ales. Literally. "Pale Ale," from the Classic Beer Style Series (1999, Brewers Publications) retells the fascinating history of this style. He has written about many English beer styles for *Brew Your Own* including stout (September 2006), mild (September 2005), old ale (September 2004) and porter (January 2003). In this issue, on page 40, he discusses English India pale ales (IPAs).

from everyone who reviewed the piece. (Likewise, John tells me that he gets the same reaction from homebrewers when he describes his methods.)

However — for reasons that I don't understand — his beer does not suffer from the flaws it "should" have, given the repeated, vigorous oxygenation steps during fermentation.

Many homebrewers in the Houston area have tried John's beer, including a few high-ranking BJCP judges. All have been pleasantly surprised at how good it tastes. I actually had the pleasure of sampling it when John interviewed me for his podcast (which can be found at www.brewcrazy.com). I was expecting a frightening experience, but found a very big, very boozy beer that was none-the-less extremely smooth and not showing any of the tell-tale 'cardboard' aroma associated with oxidation. (There may have been some Sherry notes in there, but nothing that detracted from the overall presentation.) Likewise, I didn't detect diacetyl or over-the-top fusels, which might have been expected, given the aeration program.

As I mentioned, no one knows for sure why it works. But, it does. Does the yeast gobble up the oxygen "instantly?" Does the long conditioning time bring down the diacetyl level and smooth out the fermentation by-products? Interestingly, it's fairly common in meadmaking to aerate the mead during fermentation. Likewise, in winemaking, sometimes finished wine is purposely aerated (lightly, by racking). If you're interested in brewing a beer like this, forget about the boogey-man . . . and bravely go about making your own monster.

Partial Mash Makeover

One problem I encountered when trying the countertop partial mash procedures (as described in the October 2006 issue) was the inability to smoothly control the way the wort exits the standard spigots that are installed in these coolers. These spigots require you to manually depress the release valve which pretty much results in either a high velocity flow (if fully depressed) or a fine radial spray (if partially depressed).

An inexpensive modification I've made was to remove the standard spigot, open up the hole to 1 ⅛" and install the plastic spigots that are sold with plastic secondary fermentation buckets.

For about $5, one can improve the collection of wort by eliminating the need to keep your finger on the spigot for long periods of time and improve the control of wort flow by installing the plastic spigots used in secondary fermentation buckets.

Carl Hart
Marlborough, Massachusetts

Story author and BYO Editor Chris Colby responds: "Thanks for the information, Carl. The original methods in my countertop partial mash piece were designed to be straightforward and — for simplicity — use only an unmodified 2-gallon (7.6-L) beverage cooler. However, as you note, there are always ways to improve on anything. (See also the changes suggested by readers in the December 2006 Mail column.) Good luck with your partial mashing.

Hydroponic Hops?

I have the equipment to hydroponically grow plants under metal halide spectrum bulbs. I am currently growing a species related to hops. Could I grow hops inside?

Name withheld
via email

You could if you had the space. Standard hop bines grow to over 20 feet (6 m) tall.

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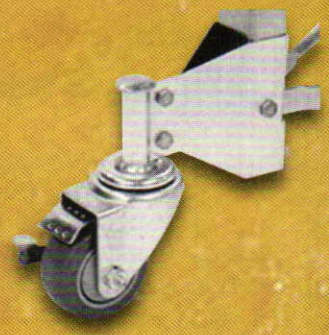

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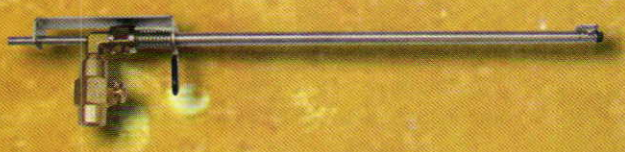

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homebrew PROFILE

Nate Bell • Broken Bow, Nebraska

It was Christmas of 1996. I remember it like it was yesterday. (Insert dream sequence.) I rushed downstairs to see what Santa had brought me — it was a brand new shiny box, with two plastic buckets in it. I was floored, I didn't even know Santa knew I drank!

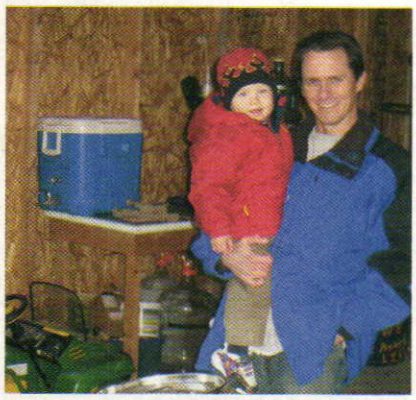
That was during my college years, and the living conditions weren't great. I made a couple kits and don't remember them tasting bad. I do, however, remember cleaning broken glass and beer out of one of our "temperature controlled," "fermentation" closets. I didn't brew again until 2001, when a friend started brewing and I got the bug.

Life intervened again in 2005 when I moved from the homebrew and craft brew rich Kansas City to small town central Nebraska. There I pleasantly discovered that I would have my uncle as a brewing comrade as he had recently gotten into winemaking. Over some wine and beer we decided we should open a homebrew shop and Brew Bums was born (www.brewbums.com).

Because of interest from the shop, we contacted the local community college and taught a class on basic brewing and a class on basic winemaking. We also helped form The Motley Brew Crew (if you ever meet any of us you will understand the name).

As for brewing, last year I switched to all-grain brewing and started entering competitions. I made it to the final round of the National Homebrew Competition in 2006.

Look for me – brewbum – out there on the forums or at events. And always, more cowbell!



Nate Bell and his son Lucas during a recent brew.

Homebrew CALENDAR

May 5
Green Mountain Homebrew Competition
South Burlington, Vermont
Entry deadline: April 20. $6 entry fee. Visit www.mashers.org for details.

May 11 & 12
Brewmasters Open
Alpharetta, Georgia
Entry deadline is May 2, $6 per entry. Visit www.brewmastersopen.com for more information.

May 18 - 19
25th Annual Oregon Homebrew Festival
Corvallis, Oregon
Homebrew competition entries must be received by May 3. Visit www.hotv.org for more information.

June 6 - 9
Aurora Brewing Challenge 2007
Edmonton, Alberta
Entries must be received by June 1. Visit www.ehg.ca for more info, rules and regulations.

June 9
2007 BUZZ Off
West Chester, Pennsylvania
Competition entries accepted from May 13 - 26. Visit www.hbd.org/buzz/ for more information.

reader PROJECT: SIX-KEG BEER DISPENSER

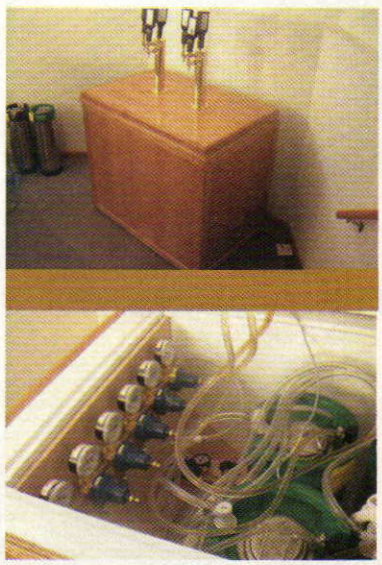
Steve Shawl • Dekalb, Illinois

I have enjoyed brewing (and drinking) beer for about eight years. Early on I began kegging my beer in 5-gallon (19-L) soda kegs, but it always bothered me that I could only sample one at a time. So I finally decided to sit down and design a solution.

I realized the most time and cost-efficient approach would be to modify a chest freezer. I found a 12.8 cubic-foot Frigidaire for $208 and I was on my way! Frigidaire strongly advised against drilling holes in the body of the freezer, so I designed everything to be either freestanding or attached with silicone. Only two 1-inch holes are drilled through the top of the freezer (where there are no critical components) for the dispensing hoses.

Inside I used a 5.0 lb. (2.3 kg) CO_2 bottle with a quick gas disconnect in the line so I can change bottles quickly. For the gas lines, I also chose ¼-inch internal diameter beer line for a really tight fit. I attached six secondary regulators to an open ½-inch Baltic birch plywood box, which is freestanding on the compressor shelf inside the freezer. The individual regulators let me adjust the carbonation and dispensing pressures for individual beer styles and preferences. The Johnson Controls 419A controller is perfect for this application because it allows the freezer to operate at any temperature and is accurate to within one degree.

I placed the whole freezer unit on a 2x6 frame and heavy duty casters to raise it a bit and allow it to be moved easily. Having been a woodworker for more than 30 years, I couldn't resist using quarter-sawn white oak to trim the freezer for a furniture-like effect.



With a little ingenuity, a regular chest freezer can become a homebrew showpiece.

homebrew systems that make you DROOL

Brandon Ledbetter • Fayetteville, Arkansas

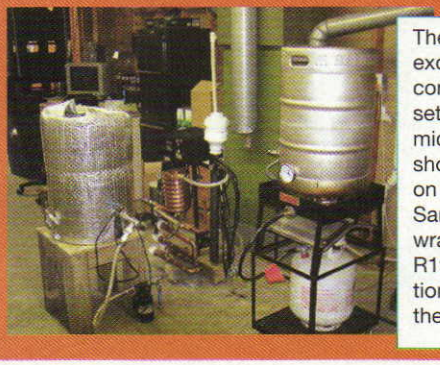
I built this exchanger to regulate my HERMS temperatures. Basically, there are five one-inch copper pipes at the bottom, each has a 4500W water heating element in it that I run at half voltage. (I think it totals around 6000W in the wiring configuration I'm using.)

The heat exchanger water is heated in those pipes and pumped into the outer tube of the Chillzilla counter-flow wort chiller above it (they work so darn well chilling the wort, why wouldn't they work as well heating it up?), which the recirculating wort is counterflowing through.

The white PVC at the top of the down pipe is just a little reservoir for the exchanger water. The heating elements are controlled with an Omega Engineering CN9000A and some big solid state relays, and the temperature is read at the wort outlet of the mashtun.

The pump moves the exchanger water through the tubes and up into the outer coil of the exchanger, which then gets dumped into the reservoir that drops back down into the pump.

It's kind of an expensive setup since it requires two pumps, and a second Chillzilla, but it is capable of bringing the mash from dough-in to 154 °F (68 °C) in less than ten minutes with absolutely no risk of scorching. Not that that's always what you want, but it can.



The heat exchanger & controller setup is in the middle of the shot, mashtun on the left (a Sanke wrapped in R19 insulation), boiler on the right.

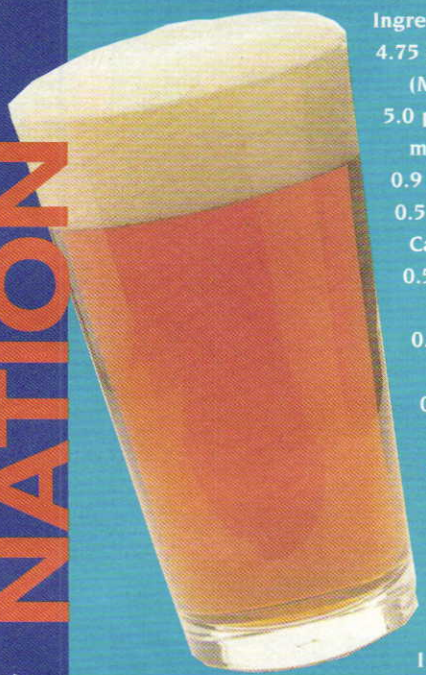
Heating elements are in the horizontal tubes at the bottom, heat exchanger is in the middle, PID controller in the black box, white PVC reservoir above and to the right (the down tube is wrapped in this shot).

reader RECIPE

Christopher Jon Poel • Numazu, Japan

Broken House IPA

OG = 1.062 FG = 1.016 IBU = 62



Ingredients

4.75 pounds (2.2 kg) pale malt (Maris Otter)
5.0 pounds (2.3 kg) Belgian pale malt
0.9 pounds (0.4 kg) Carapils malt
0.5 pounds (0.2 kg) Belgian Caravienna malt
0.5 pounds (0.2 kg) crystal malt (60 °L)
0.5 oz (14.2 g) Burton salts (in mash)
0.5 oz (14.2 g) Burton salts (in sparge water)
0.5 oz (14.2 g) Cascade hops (5.5%) (60 minutes)
1 oz (28.3 g) N. Brewer hops (8.3%) (60 minutes)
1.75 oz (49.6 g) Centennial whole hops (8.8%) (20 minutes)
1 whirlfloc tablet (15 min)
½ tsp yeast nutrient (15 min)
2.25 oz (63.8 g) Centennial whole hops (8.8%) (end of boil)
WLP011 European Ale or Wyeast 1388 European Ale yeast (alternatively WLP001 California Ale or Wyeast 1056 American Ale)
5 oz (141.7 g) DME for priming

Step-by-Step

Mash grains with Burton salts in 15 quarts (14.2 L) of 152 °F water for 70 min. Add 4–5 quarts (3.8–4.7 L) boiling water and heat to raise temp to 170 °F (77 °C) for mash out. Recirculate until wort is clear. Sparge with 170–175 °F (77–79 °C), water with Burton salts. Collect enough wort to end up with 5.5 gallons (20.8 L) in fermenter (approximately 7–7.5 gallons (26.5–28.4 L) in brewpot). Total boil time is 80 min. Boil for 20 min, then add Cascade and Northern Brewer bittering hops. Boil for 40 min and add Centennial flavor hops. Boil for 5 min and add whirlfloc (or Irish moss) and yeast nutrient. Boil for 15 min and turn off heat. Add Centennial aroma hops and steep for 15 min. Whirlpool and cool to 70 °F (21 °C) to pitch starter. Oxygenate/aerate well. Ferment at 68–70 °F (20–21 °C) for 4–5 days. If gravity is near target, transfer to secondary and condition for 2–3 days before cooling to 55 °F (13 °C) or lower. Keep cool for 4–5 days, then let warm back up to room temperature. Prime, and bottle. Condition at room temperature for 2–3 weeks, then in refrigerator for 2–3 weeks.

club PROFILE

Urban Knaves of Grain • Warrenville, Illinois

When people think about Chicago, they think about the Magnificent Mile and deep dish pizzas. The Urban Knaves of Grain (UKG), however, think about the art of brewing great beer, mead and cider at home.

The UKG is the oldest and largest homebrew club in DuPage County, Illinois, a suburban county of Chicago. Chris Campanelli, who lectured on homebrewing in the early 1990's at the Glen Ellyn, Illinois-based College of DuPage, founded the club on April 30th, 1993. The club has grown from 20 people at the first meeting to 70 current members.

Every March we host a homebrew competition called the Drunk Monk Challenge (DMC) at Walter Payton's Roundhouse in Aurora. The DMC is an AHA Sanctioned Competition, a qualifying event for the Masters Championship of Amateur Brewing (MCAB) and a Leg of The Midwest Homebrewer of the Year. It attracts around 500 entries from all over the country, making it one of the largest competitions in the U.S. The DMC includes a special category called the Menace of the Monastery, for beers of monastic descent. These beers are judged hedonistically via discussion between members of a judging team comprised of four people, and led by a head judge dressed in a monk's robe.

Joe Formanek and Rodney Kibzey at the 2006 Drunk Monk Challenge.

We have 21 actively ranked BJCP members that participate in the DMC and other regional and national competitions. Club members conduct BJCP study classes yearly, and some ranked members also organize or proctor local BJCP Exams.

In 1999, we were co-winners of the American Homebrewers Association's Homebrew Club of the Year award and placed in the top ten ever since.

For more information, please visit us online at www.knaves.org.

replicator

by **Marc Martin**

Dear Replicator,

A few months ago a business associate and I went to Los Angeles on a training trip. We are both big fans of microbrewed beers and together have brewed a few batches at our local "brew on premises." We knew that Los Angeles probably wouldn't be a mecca for craft beers like Portland or Seattle, but found five from a site search. We visited all of them during that week but the best by far was Red Car Brewing in the suburb of Torrance. All of their beers were excellent but the Two Rail Pale Ale was our favorite. It is the most well balanced pale ale we have found anywhere. Could you possibly get the recipe for this wonderful beer?

Dave Cooligan and Richard Wilkers
Vancouver, British Columbia

dave and Richard, thanks for this request. My travels frequently take me to southern California and I have visited Red Car Brewing several times. It is one of my favorites and I certainly agree with your assessment of their excellent beers.

I was able to meet with the owners, Bob and Laurie Brandt and get your recipe plus some good background on this unique brewery. This is their seventh year in business, located in a beautiful brick building in downtown Torrance that was originally a telegraph office. The brewery is named for the original rail and electric streetcar line that connected L.A., Ventura, San Bernadino and Riverside Counties from the late 1800's until 1961.

Torrance must be very progressive, because Bob said the town wanted a brewpub in their community so badly that they helped him secure startup capital and made zoning changes.

Bob is the brewer while Laurie handles the restaurant staff training and catering duties. Like many professional brewers, he discovered his passion for brewing as a homebrewer. While he isn't formally trained, he apprenticed at both the Alpine Village Brewery (also in Torrance) and Huntington Beach Brewing Co. in the town of Huntington Beach, California.

The Two Rail Pale ale is not one of their standard beers and is only brewed occasionally. Bob describes this as more similar to a traditional English pale ale. He purposely brews this to be darker and balanced more toward the malt side than American pale ales. Lower than average hopping rates create a malty, copper colored ale that is a great session beer.

I was lucky enough to find this beer on tap for my visit and found it to be as enjoyable as you described. Now it's time for you to "Brew Your Own."

Be sure to visit Red Car next time you're in the Los Angeles area to try some other beers like Motorman Reserve, South Bay IPA and South Loop Porter. Check them out on the Web at www.redcarbrewery.com or call 310-782-0222.

Red Car Brewing Co. Two Rail Pale Ale

(5 gallons/ 19 L, extract with grain)

OG = 1.054 FG = 1.011
IBU = 36 SRM = 13 ABV = 5.6 %

Ingredients

6.6 lbs. (3.0 kg) Coopers light, unhopped, malt extract
0.5 lbs. (0.22 kg) light dried malt extract
9.0 oz. (0.25 kg) crystal malt (60 °L)
2.0 oz. (57 g) chocolate malt
½ tsp. yeast nutrient (15 mins)
6.5 AAU Nugget hops (60 mins) (0.5 oz./ 14 g of 13% alpha acid)
4 AAU Willamette hops (30 mins) (0.8 oz./ 23g of 5% alpha acid)
1.7 AAU Cascade hop pellets (5 mins) (0.3 oz./8.5g of 5.75% alpha acid)
White Labs WLP 002 (English Ale) or Wyeast 1098 (English Ale) yeast
0.75 cup (150 g) of corn sugar (for priming)

Step by Step

Steep the crushed grain in 2.5 gallons (9.5 L) of water at 149 °F (65 °C) for 30 minutes. Remove grains from the wort and rinse with 2.0 quarts (1.9 L) of hot water. Add the liquid and dried malt extracts and bring to a boil. While boiling, add the hops as per the hopping schedule. During the boil, use this time to thoroughly sanitize a fermenter. Add the yeast nutrient after 45 minutes of boiling. Now add the wort to 2.0 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. Transfer to a carboy, avoiding any splashing to prevent aerating the beer. Let the beer condition for one week and then bottle or keg. Allow to carbonate and condition for two additional weeks and enjoy your pale ale.

All-grain option:

This is a single step infusion mash. Replace the malt syrup and dried extract with 10.5 lbs. (4.76 kg) of 2-row pale malt grain. The specialty grains remain the same. Mix the crushed grains with 4.5 gallons (17 L) of 167 °F (75 °C) water to stabilize at 149 °F (65 °C) for 60 minutes. Sparge slowly with 175 °F (79 °C) water. Collect approximately 6 gallons (23 L) of wort runoff to boil for 60 minutes.

Reduce the bittering hop (60 mins) and flavor hop (30 mins) amounts to 0.4 oz (11.3 g) and 0.75 oz (21.3 g) respectively to allow for the higher utilization factor of a full wort boil.

The remainder of this recipe is the same as the extract with grain recipe.

Hop Varieties

Learning the family trees

by Betsy Parks

Golding, Saaz, Cascade...? You may have heard of some of the well-known hop varieties brewers trust to build the characters of their beers, but how do they know which ones to choose? Learning more about hop varieties decodes the mystery of choosing the right hops and can also foster a better understanding of the impact each one has on a finished beer.

Hops exhibit individual characteristics based on their chemistry; but also (much like us) a hop is largely a product of where they're grown and who (or what) their parents are.

Hop growers categorize hops in three ways: as bittering, aroma or dual-purpose. Alpha acid levels determine a hop's bitterness, and the bitterest hops have the most alpha acids. Many classic aroma hops consist of around 3 – 6% alpha acids while the highest alpha acid levels in production bittering hops are around 17%. There are also hops with both high alpha acids as well as pleasing aroma characteristics, often referred to as 'dual purpose.'

Whether bitter or aromatic, though, hop varieties break into somewhat distinctive groups based on where they originate and usually correlate to the types of beers brewed in each respective region. For example, the aforementioned Saaz, which comes from the Czech Republic (and which you may know from drinking the occasional Pilsner Urquell), is considered one of the four "noble hops" of the central European cultivars that are low in bitterness and high in aroma. Saaz or Saazer hops are synonymous with Pilsners and are considered a continental variety. Other varieties in this category include such greats as German Hallertauer, Tettnanger, Spalt and Hersbrucker. Continental hops are typically named for the town or region they came from, like the Saaz region of the Czech Republic.

British varieties, such as Fuggles, Goldings and Brewer's Gold, are sometimes (but not always) named for an individual or institution such as Mr. Richard Fuggle of Brenchley who propagated Fuggles in Kent in the late 1800's. Not surprisingly, traditional English ales use hops like Fuggles and Kent Goldings. Belgium also grows a Goldings variant, Styrian Goldings, which is used in many Belgian beers.

Cascade, Willamette and Mt. Hood are just a few of the many U.S. hops. Many of these new world varieties were originally developed in an effort to duplicate hops that either didn't grow as well in the US. or replace varieties that were susceptible to disease. For example, Mt. Hood was originally developed to recreate German Hallertauer Mittelfruh. In fact, Hallertauer Mittelfruh is a parent to Mt. Hood (as well as others like Liberty and Crystal). But instead of serving as just a substitute, Mt. Hood and its siblings are individual characters, which brewers look to for making great lagers.

It should also be noted that while hops like Hallertauer Mittelfruh don't grow as well in other parts of the world as they do in their native regions, many do. A Golding grown in the U.S. and one from England can have the same genealogy and even the same alpha percentages. Growing conditions can vary, however, which causes differences in the mature hops. Often a hop's name makes it easy to figure out where it's grown – like U.S. Goldings – but that's not always the case.

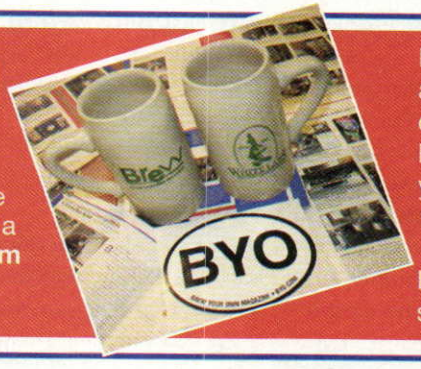
To strengthen your knowledge of hop varieties, focus at first on the types of hops that suit the beers you like to brew. Eventually, you will form a mental catalog of characteristics that you can expand on as you experiment later with different recipes and varieties.

BYO.COM web bonus

Hop Variety Reference Guide
byo.com/referenceguide/hops/

we want you

Do you have a system or a homemade gadget that will make our readers drool? How about a killer recipe or tip? Want to profile your club? Email a description and photos to **edit@byo.com** and experience fame among 100,000+ homebrewers!



If we publish your article, recipe, photos, club news or tip in Homebrew Nation, you'll get a cool ½ Liter German Stein (courtesy of White Labs) and a *BYO* Euro sticker.

Hop To It

Selecting hops is critical for every beer

by Glenn BurnSilver

Hop selection is vital to producing a quality beer. Hops serve several functions, the most important being the impartation of bitterness (from isomerized alpha acids) and flavor and aroma characteristics (from essential oils). Hops come in several forms, including whole hop cones, plugs and pellets. Making the right hop choice — in terms of hop form and hop variety — is important for any recipe, as these professionals will attest.

Jeremy Marshall is the head brewer at Lagunitas Brewing Co. in Petaluma, California. Marshall began his brewing life as a homebrewer, honing his skills for "about eight years" before heading to the University of California at Davis to study the finer aspects of professional brewing. Every spring he throws hop parties with his fellow brewers to select the finest hops for a year of Lagunitas' brews. After testing four or five varieties, "you're pretty much shot. You can't smell a thing," he laughs. He has been creating beers like Lucky 13 Ale and Maximus at Lagunitas for four years.

We purchase all of our hops for the year at once. We're fans of pellet hops, mainly because of storage constraints. We're a small brewery and don't have a big cooler to store all the whole cone hops we would need over the course of a year. Also, the loose structure and the way whole cones are stored allows more possibilities for an attack of oxygen. They will oxidize quicker than a pellet. Pellets are vacuum-sealed and purged and that tends to make them more stable with fewer breakdowns over the course of the year. More breweries are switching to pellet hops now.

When selecting hops for a recipe, I like to say the nose knows. We contract our hops and companies send over samples as whole cones. It's called the brewer's cut, so we have several batches to choose from. We do a hop rub where you rub them up with your hands and smell. Others like to make tea. When I think of hops, in general I divide them into aromatic qualities and bitterness qualities. Bitter qualities I think of for the beginning of the boiling, and aromatic for later in the boil, whirlpool or dry hopping. In the end, we pick the hops with the best organoleptic qualities — that is, the best overall qualities of aroma and bitterness.

At the homebrew store it's basically a packaged thing, so you are at a slight disadvantage. The brewer needs to be somewhat familiar with the variety. Certain characteristics are universal, but there is always a little bit of variation. The homebrewer should always inspect the packaging when buying hops, whether pellets or cones. They can't smell the hops for freshness, so they need to see if the packaging is loose. If so, it may have lost its seal allowing oxygen seepage and the hops won't be as fresh. Pellets are better overall for freshness.

Once you get the hops home and open the package, you can do the same test we do. If you like what you smell, consider using it later in the process. The later you use it, the less you want to use, especially if it is a very pungent variety. If you'd use three ounces for the main boil, try two for the whirlpool and maybe half an ounce for dry hopping. What you smell and what you pick up on will be imparted into the beer. If you smell something you don't like, consider using it at the beginning of the boil. Most of the volatiles will be driven off and you'll just get the alpha acids.

Each year we see new hops being produced strictly for alpha, like Apollo and Summit which are around 18% alpha acids. When formulating a brew, I think it would be nice to get a lot of your IBUs from just a pinch of one of these new hops. In terms of flavor and aroma, it's like I said: your nose knows. If it smells good, use it later in the recipe. Other brewers also consider the merit of using a larger charge of lower alpha hops. They believe it will lead to a more pleasant bitterness.

So much of brewing is steeped in tradition and on the craft side it's all about wild and crazy experimentation. With our staple beers, like our IPA, the hops basically stay the same. We never introduce a new hop variety . But every year we come up with three or four crazy new seasonals that represent 20–30% of our annual production each year. Some we make several times, others we only do once, like Freak Out. We use these beers to play around with the crazy new hops. We tend to pick one hop and make it a focal point. When we did Freak Out, we featured Summit. We're trying to get our hands on some of the newer varieties that are coming out, like Bravo and Apollo, so we're going to be doing more of these Frank Zappa inspired brews. The next one is going to be called Absolutely Free (out in May). I imagine that we'll also feature a brand new hop. We like experimenting with hop varieties we've never played with before. It keeps it fun.

Richard Norgrove, Jr. is head brewer and head of operations for Bear Republic Brewing Co. in Healdsburg, California. Norgrove was a mountain bike fabricator when he started assisting with brewing operations at the Marin Brewing Company. After observing business operations and new tank construction, he thought he should be doing this "in my own backyard." He and his father formed Bear Republic in 1995.

We're currently using pellet hops, for several reasons, mainly storage considerations, packaging and degradation because of the way they are processed. We don't have a lot of storage capacity, plus I prefer pellets for the process and consistency variable. They can be tracked as they degrade over the year so we can make adjustments.

When selecting hops, I look for an aromatic character and bittering elements and how they relate to the aromatic qualities in the late kettle additions. Unfortunately, no one has come up with a mathematical formula, so the brewer has to create his own association with IBUs to aromatic characters. There are a lot of contributing factors to be considered, like kettle boil off, brew volume size, etc.

One of the things that happens a lot on a homebrew scale is that homebrew stores buy a large box of hops and package it themselves. If they don't seal them right or take too long, the hops can oxidize, causing the leaves to turn white. The bittering element will still be there, but the aromatic qualities will be lost. The homebrewer also needs to find the largest pellets they can.

Hops change every year and subtle adjustments have to be made, but we don't really change our recipes, we make slight variations. We use alot of Columbus, which is similar to Tomahawk and Zeus.

I know some brewers are using synthesized oils to get their bitterness. I see the advantage of that, but I like to use real things in my beers.

Other brewers are using high alpha hops to get those IBUs. When you get down to a homebrew level, that can be pretty important. Hops take up a lot of space in the batch and it takes up a lot of your yield. That's why high alpha hops were developed.

We played around a lot last year with Simcoe and all of those beers came out well. But to be honest, I stick with the "Cs": Cascade, Centennial and Columbus . . . and even Chinook.

Extract vs. All-Grain

The facts about filtering and keg conversion

"Help Me, Mr. Wizard"

by Ashton Lewis

What's Better, Extract or All-grain Brewing?

I have only brewed extract recipes (usually with steeped grains) and I have read a number of reasons why all-grain is supposed to be better. Although most concede that extract brewing can yield a very good beer, all-grain is generally regarded as being superior because the brewer has more control over the fermentability of the wort. Having said that, an extract brewer can still control fermentability by either adding sugar (or rice syrup, or corn syrup, etc.) to increase fermentability and lighten the finished beer's body or adding malto-dextrin (or steeping grains such as crystal malt) to decrease fermentability and lead to a more full-bodied, flavorful beer. My question is two-fold: one, are such fermentability adjustments by an extract brewer equivalent to those of an all-grain brewer (which is achieved through the temperature and time at which base malt is mashed), or is there a difference in flavor or some other important characteristic? And two, are there other advantages to all-grain vs. extract brewing (even with grains)? It seems like each side of the divide vigorously defends its position, but are there objective reasons why all-grain is superior? I'm curious if I could be brewing better beer!

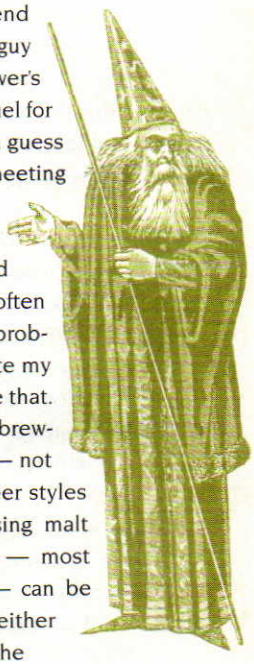
Russ Riley
via email

This is a pretty heavy question because it hits to the foundation of homebrewing. The way I see it, homebrewing is about brewing your own beer. Mashing is certainly part of what almost every commercial brewer does, but there are a few commercial breweries that brew with extract. Some of these breweries have even won medals at the GABF. So in a certain sense, one of the reasons to mash at home is to start with the same basic "raw" materials that commercial brewers use to brew beer. (Of course I put "raw" in quotes because malted grains are greatly altered compared to grains sold as seed or feed.)

Aside from the made from scratch argument, there are some key differences between extract and all-grain brews. You mention several ways that extract brewers can affect the fermentability of wort and these all involve adding something to the extract wort to achieve this goal. In all-grain brewing, a single ingredient, Pilsner malt for example, can be used to produce wort with good fermentability as the basis for a pale lager. The same thing is harder to do with extracts because most extracts are darkened during production. Adding corn or rice syrup to dilute the color and increase the fermentability is clearly not the same as using all-malt for this hypothetical pale lager.

When it comes right down to it, much of the argument surrounding all-grain versus extract brewing comes down to snobbery. Just as home bakers who make delicious cakes and pies from scratch turn their noses up at Betty Crocker cake mixes, some all-grain brewers turn up their noses at extract brews. There is no argument strong enough to combat this type of bias. When it comes to brewing technique I select the method that is most likely to help me reach my brewing objective. That means if I want to brew a very light colored, all-malt Pilsner with a nice grainy dryness, my first thought for brewing method would be all-grain. On the other hand, if I wanted to brew a big chewy stout using a combination of crystal and roasted specialty grains, I would consider both methods to be viable.

A friend once related an encounter with a beer snob that I have never forgotten. One day while working in a brewpub in the San Francisco Bay, a German brewer came in. They had a bock beer on tap and the German brewer was very complimentary of the beer. However, once they began discussing the details of the brewery the German realized that the brewhouse was an infusion set up. His opinion of the bock was instantly changed because he declared that bock beers could not be made with infusion mashing. In his opinion, a bock beer had to be brewed using decoction or step mashing, and of course his preference was for the decoction method. My friend attempted to argue with this guy and used the German brewer's compliments of his beer as fuel for the argument, but as you can guess the debate ended with no meeting of the minds.



Snobs hang their hats on methods and tradition and cannot accept that there is often more than one solution to a problem. I personally do not waste my time arguing with people like that. The most important part of brewing is the finished product — not how you got there. Some beer styles are difficult to replicate using malt extract, while many others — most English ales, for example — can be brewed successfully using either method. If you focus on the merits of the beer in the glass, choose the most appropriate methods to meet your objective and fine tune your own brewing method, I believe you will be happy with your decision, whether all-grain or extract!

Taming Wild Yeasts

I am interested in using wild yeast strains, especially *Brettanomyces* like those used in Orval Trappist and Mo' Betta Bretta. I have been warned that wild yeast can easily contaminate all of your brewing equipment. I live in a small apartment and all of my fermenting and storage of equipment is done in the same office-type storage/supply cabinet. What precautions can I take to still be able to brew "regular" beers and wild brews side by side?

Scott Constanteles
Queens, New York

Most brewers have heard horror stories about wild yeast and

certain bacteria, like *Lactobacillus* and *Pediococcus*, setting up camp in a brewery and contaminating everything in sight. I think these stories originated from times when brewing equipment was very difficult to clean. Wooden vessels, poor valve designs, threaded fittings, open fermenters and the like were commonly seen in older breweries. In this type of environment, it is easy to understand how an unwanted population of microorganisms would be very difficult to expel.

Things are much different when brewing at home. Unlike commercial breweries, homebrewers do not always have multiple batches of beer moving through the brewing process where cross-contamination from one batch is a real possibility, especially if every piece of equipment is not cleaned after every use. If one of the batches contains something bad, like a contaminant, then this can easily and quickly be spread throughout the brewery. Most modern brewery designs have eliminated these problems, but the thought of contamination still scares commercial brewers. At home it is fairly easy to keep batches separated, clean your brewing tools and give them an appropriate dip in a sanitizer before every use.

I can guarantee that you can brew beers containing *Brettanomyces* at home without contaminating all of your brewing equipment and other beers. The key is to practice good sanitation and some common sense. Anything that has a non-porous surface can be cleaned and sanitized and will not retain wild yeast or bacteria. That means you can use glass carboys, metal spoons, etc for all of your brewing and do not need to duplicate your equipment stock. Plastic hoses, buckets, gaskets and wooden barrels are another story, and I would suggest not using these items on both your regular and wild beers. Barrels are a well-known vector for *Brettanomyces* in the wine industry. Once a barrel has *Brettanomyces*, it is nearly impossible to kill off the yeast.

I often view brewing through the eyes of a food microbiologist. Cross contamination is a big deal in food safety and keeping raw foods containing pathogenic microorganisms separated from foods that are ready to eat is crucial. Consumers deal with this issue on a regular basis when raw meat is stored in the refrigerator along with fruits and vegetables and when proper procedures are used, nothing bad happens. The same is true with brewing. If you think I am being too easy going on this issue, read the side of that yogurt container in the fridge next to your yeast culture; it's full of *Lactobacillus*!

First Filter

I just made my first attempt at trying to filter my beer and I think it went terribly! I was using a cartridge filter with a 0.5 micron rating. As I was pushing the beer through the filter it came out much clearer and with less aroma and it basically tasted like water. Before I started the filtration process, I tasted the leftovers from when I got my final gravity reading and it tasted great (except for not having carbonation of course). Is a 0.5 micron rating for a filter too low?

Then I figured I would force carbonate the beer. (I secondary fermented in a 5-gallon (19-L) keg). So as I pressurized the kegged beer, I remembered reading that it helps to rock the keg back and forth while doing this. That's where I think I went wrong! I decided to draw off another glass and see what it looked like – and it was a mess! Will all that sediment drop to the bottom again or now that it is under pressure will it stay suspended in my beer? And if it does drop, how long would that take?

Jared Foote
via email

This story really sounds like a total disaster. Filtration is one of those techniques with many permutations and selecting the right filtration method requires the brewer to define their goals of filtering. Where I work we filter most of our beers and our goal is to make the beers visually brilliant while minimally affecting the flavor. One flavor change that occurs during filtration is that it removes the yeasty flavor associated with unfiltered beers, especially those that are particularly cloudy. I don't consider this a positive or negative thing, it's simply what happens when you remove yeast.

Clear beer can be achieved by using a filter medium with a nominal pore size of around two microns. The most common type of "polish" filter is a cellulose filter sheet impregnated with diatomaceous earth (DE). Different grades of DE are used to change the tightness of the filter sheet. Polish filters have a limited ability to hold yeast and in filtration jargon this trait is called "low sludge capacity." Pretty appealing term, huh? Commercial brewers want to extend the life of sheet filters because they are discarded after they become plugged up with particles. Rougher forms of clarification are usually used before the beer is run through the polish filter to reduce and sometimes completely remove yeast from beer since yeast is mainly what is removed during filtration. Polish filtration removes smaller particles that contribute to haze.

Finally, there are brewers who go one step further and run their beer through a sterile membrane filter. The organisms that spoil beer can all be retained by a 0.45 micron membrane and the beer industry considers filtration using this size membrane as "sterile filtration." Note that membrane filtration is performed on beer that is totally clear because cloudy beer will dramatically reduce the life of membrane filters, which is not good because they are expensive and blinding a filter during a filter run really bites! (The hard part after running through a membrane filter is getting the beer into its package without contamination, but that's another story.)

One thing to know about membrane filters is that there are different types of membranes available on the market and some have pretty nasty properties. For example, some membranes strip color, bitterness and flavor from beer and reduce foam stability and beer viscosity. All of these are important sensory properties. It sounds to me like you used a membrane that does more than remove bacteria, so that was mistake number one and explains why your beer tasted watery.

In my opinion, you do not need a 0.5 micron filter to achieve your goal of clarity. A coarser filter would work fine and you could use one with much more sludge

capacity than a membrane (which has no sludge capacity at all). Wound fiber filters are readily available and can be used in those plastic filter housings commonly used in water filtration. If you want to try filtration again, back off on the porosity and read up on the topic first to give yourself a better chance of success.

As far as your hurried and chaotic method of carbonation, you did not cause any damage that time will not cure. The yeast you roused by shaking your keg will settle out just fine and the pressure in the keg will not hinder this from occurring. I am an advocate of slower carbonation methods at a proper pressure. This prevents over-carbonation but does require a few days of waiting. The next time you decide to filter (or not) and then to force carbonate I suggest taking it slowly and not using the shake and roll method until you have successfully carbonated using a slower method. In other words, chill out Jared!

Keg Conversions

I'm currently hunting around for a used keg or two to convert for my home brewery (legally, of course). My question is, once I find them, I want to drill holes in the kegs required for various weldless gadgets — sight glasses, thermometers and such. I've read that using metal tools on stainless can cause problems with rusting, however, and was wondering what is the best way to drill holes in stainless?

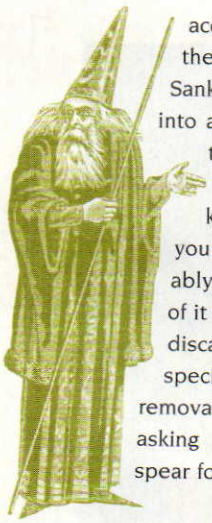
Derek Sherman
New Springfield, Ohio

Forrest Whitesides wrote a nice article in the March-April 2007 edition of *Brew Your Own* (Vol.13, No.2) on drilling holes in stainless steel and aluminum for the installation of weldless fittings into pots used for mashing, boiling and hot water storage and I totally agree with Forrest's advice. In a nutshell, when drilling into metals, especially harder metals like stainless steel, it is very important to use a cutting lubricant, a hard cutting tool and a low drill speed with plenty of pressure.

You are also correct to be concerned about contaminating your stainless steel vessel with metal from other projects. Mild steel filings from other projects can be passed from a tool onto the stainless steel; when the tool is used for cutting or grinding, the mild steel can easily be ground into the surface of the stainless steel and later cause rusting. One easy way to clean up cuts made to stainless steel is to use a file to knock off the high points and then to use an abrasive cloth to polish the area where the hole was cut. I work for a very large stainless steel manufacturer and we use a lot of different abrasives made by 3M in our shop. These abrasives can be purchased in sheets that look pretty similar to the green scrubby pads used in kitchens, but with different degrees of fineness. These types of abrasives can be found at stores carrying welding supplies, such as welding gas supply houses.

When you obtain your legal keg by purchasing it from its owner (a brewery, not a distributor, beer retailer or bar)

make sure that the keg is not pressurized. The easiest way to do this is by attaching a keg fitting to the keg and engaging the fitting into the keg. Most kegs these days have a fitting on the top where gas flows in and beer flows out (the most common style of this fitting used in the US is called a Sanke fitting). After you have relieved pressure in the keg it is safe to begin cutting and drilling.



I have heard tragic accounts of people removing the spear from a pressurized Sanke keg where the spear turns into a projectile. Do not remove the retainer ring holding the spear in place while the keg is pressurized! When you buy your keg you will probably want to cut a hole in the top of it and the spear will likely be discarded. Most breweries have special tools that make spear removal safe and easy. I suggest asking the owner to remove the spear for you to eliminate this task from your keg modification project.

> "The quickest and easiest way of cutting stainless steel is to use a plasma torch. This is not something most people have laying around..."

You didn't ask about cutting the top of the keg off, but you will need to do that to make your keg useful. The easiest and quickest method of cutting stainless steel is to use a plasma torch. This is not something most people have laying around, but if you know a welder, they may be able to help you with that cut. Plasma cuts should be cleaned up like the holes from drilling using a file and then abrasive cloth. If you don't have access to a plasma torch, you can cut the large hole in the top with a reciprocating saw, such as a Sawzall. Drilling several pilot holes on a radius will aid in keeping the hole round when cutting. Clean up the cut with a file or Dremel tool using an appropriate bit followed by some polishing with an abrasive cloth to assure there are no nasty, sharp edges.

BYO Technical Editor Ashton Lewis has been answering homebrew questions as his alter ego Mr. Wizard for the last 12 years. Do you have a question for him? Send inquiries to *Brew Your Own*, 5053 Main Street, Suite A, Manchester Center, VT 05255 or send your e-mail to wiz@byo.com. If you submit your question by e-mail, please include your full name and hometown. In every issue, the Wizard will select a few questions for publication. Unfortunately, he can't respond personally. Sorry!

Schwarzbier

The dark beer with the blond soul

by Jamil Zainasheff

While in Trier, Germany's oldest city, I experienced what my wife would call a "beer moment." I sat at an outdoor café table with my family and drank a Köstritzer Schwarzbier, a fine example of a unique beer style brewed in Germany since the late Middle Ages. As I enjoyed my beer, I wondered about the people of Trier during that time and if they enjoyed this black beer as much as I did.

The first documented mention of Schwarzbier is from 1390, only a short time after the Black Death ravaged Europe. How does a society go through something like that without changing? And what about the Köstritzer Schwarzbierbrauerei, brewing this beer since 1543? Who were their customers? We know historic figures such as Goethe and Bismarck were fans, but what about the average person? Those beer lovers kept a brewery and a style like this going for 700 years despite feast or famine, war or peace.

photo by Jim Witmer

Light Taste, Dark Color

Schwarzbier's aroma can be the same as a pale lager, but the appearance can be almost black. It is one of the darkest of the lagers, ranging from dark brown to almost black – not like a stout, but as close to black as you can get. If you hold a glass of Schwarzbier up to strong light it should be brilliantly clear with ruby highlights.

While dark in color, Schwarzbier ranges from almost no roast character to subtle notes of bitter chocolate and coffee. Despite the use of some highly kilned malt, this is a beer without the astringent notes of stouts. Köstritzer Schwarzbierbrauerei describes their Schwarzbier as, "the black one with the blond soul." If you close your eyes, the aroma and flavor of Köstritzer is very much like a German pilsner. The flavor carries only subtle roast notes, which helps dry the finish.

Another classic example is Kulmbacher's Mönchshof Schwarz. It is a sweeter beer and more on the brown end of the color scale. It has a huge Munich malt character, very much like a Munich Dunkel, yet it also has a touch of chocolate and a drier finish than a dunkel. In the United States, it is common to brew Schwarzbier a little darker, slightly sweeter, and a little bit roastier than both Köstritzer and Mönchshof Schwarz.

Regardless of the level of roasted notes, this is a smooth, easy-drinking, balanced style of beer, with some finishing a bit on the sweet side and others a bit on

SCHWARZBIER by the numbers

OG =	1.046–1.052 (11.4–12.9 °P)
FG =	1.010–1.016 (2.6–4 °P)
SRM =	17–30+
IBU =	22–32
ABV =	4.4–5.4%

(story continued on page 21)

RECIPE

Schwarzbier, American Style

(5 gallons/19 L, all-grain)

OG = 1.051 (12.6 °P)
FG = 1.013 (3.3 °P)
IBU = 30 SRM = 28 ABV = 5%

Ingredients

5.5 lb. (2.5 kg) Munich malt (8 °L)
4.0 lb. (1.8 kg) Pilsner malt (2 °L)
5.0 oz. (142 g) crystal malt (40 °L)
5.0 oz. (142 g) chocolate malt (400 °L)
3.0 oz (85 g) roasted barley (500 °L)
3.0 oz (85 g) Weyermann Carafa® Special II (430 °L)
5.4 AAU Hallertauer hops (60 min.) (1.36 oz./39 g of 4% alpha acids)
2 AAU Hallertauer hops (20 min.) (0.50 oz./14 g of 4% alpha acids)
0.50 oz. (14 g) Hallertauer hops (0 min.)
White Labs WLP830 (German Lager) or Wyeast 2206 (Bavarian Lager) yeast

Step by Step

This recipe makes a slightly bolder Schwarzbier, malty like Mönchshof, but a touch roastier. E.J. Phair Brewing Company in Concord, California (but soon to be downtown Pittsburgh) won gold at the 2005 Great American Beer Festival with a beer based on this recipe.

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 154 °F (68 °C). Hold the mash at 154 °F (68 °C) for 60 minutes to allow for proper grain hydration and enzymatic conversion.

Infuse the mash with near boiling water while stirring or, with a recirculating mash system, raise the tem-

recipe continued on page 20

recipe continued from page 19

perature to mash out at 168 °F (76 °C). Sparge slowly with 170 °F (77 °C) water, collecting wort until the pre-boil kettle volume is around 6.1 gallons (23.1 L) and the gravity is 1.042 .

The total wort boil time is 90 minutes, which helps reduce the SMM (S-methyl-methionine) present in the lightly kilned Pilsner malt and results in less DMS (dimethyl sulfides) in the finished beer. Add the bittering hops with 60 minutes remaining and the flavor hops with 20 minutes left in the boil. Add Irish moss or other kettle finings with 15 minutes left in the boil and add the last hop addition just before shutting off the burner. Chill the wort rapidly to 50 °F (10 °C), let the break material settle, rack to the fermenter, pitch the yeast and aerate thoroughly.

Ferment around 50 °F (10 °C) until the yeast drops clear. With healthy yeast, fermentation should be complete in two weeks or less, but don't rush it. Cold fermented lagers take longer to ferment than ales or lagers fermented at warmer temperatures. If desired, perform a diacetyl rest during the last ⅓ of fermentation. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. Target a carbonation level of 2 to 2.5 volumes. A month or more of cold conditioning at near freezing temperatures will mellow some of the flavors and improve the beer. Serve at 43 to 46 °F (6 to 8°C).

Schwarzbier, American Style Extract

(5 gallons/19 L, extract plus grains)

OG = 1.051 (12.6 °P)
FG = 1.013 (3.3 °P)
IBU = 30 SRM = 28 ABV = 5%

Ingredients

3.5 lb. (1.6 kg) Munich liquid malt extract
3.0 lb. (1.4 kg) Pilsner liquid malt extract
5.0 oz. (142 g) crystal malt (40 °L)
5.0 oz. (142 g) chocolate malt (400 °L)
3.0 oz. (85 g) roasted barley (500 °L)
3.0 oz. (85 g) Weyermann Carafa® Special II malt (430 °L)
5.4 AAU Hallertauer hops (60 min.) (1.36 oz./39 g of 4% alpha acids)
2 AAU Hallertauer hops (20 min.) (0.50 oz./14 g of 4% alpha acids)
0.50 oz. (14 g) Hallertauer hops (0 min.)
White Labs WLP830 (German Lager) or Wyeast 2206 (Bavarian Lager) yeast

Step by Step

Mill or coarsely crack the specialty malts. Mix well and place loosely in a grain bag. Avoid packing the grains too tightly in the bag; use more bags if needed. Steep the bag in 2 gallons (~8 L) of 170 °F (77 °C) water 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 6.1 gallons (23.1 L) and a gravity of 1.042 (10.48 °P). Stir thoroughly to help dissolve the extract and bring to a boil.

Once the wort is boiling, add the bittering hops. Total wort boil time is one hour after adding the bittering hops. During that time, add the flavor hops with 20 minutes remaining, Irish moss or other kettle finings at 15 minutes, and the aroma hops at shutdown. Chill the wort to 50 °F (10 °C), pitch the yeast and aerate thoroughly. Follow the fermentation and packaging instructions for the all-grain version.

Schwarzbier, Köstritzer Style

(5 gallons/19 L, all-grain)

OG = 1.047 (11.6 °P)
FG = 1.010 (2.7 °P)
IBU = 29 SRM = 24 ABV = 4.8%

Ingredients

8.0 lb. (3.6 kg) Pilsner malt (2 °L)
1.0 lb. (0.45 kg) Munich malt (8 °L)
10.0 oz. (284 g) Weyermann Carafa® Special II malt (430 °L)
5.2 AAU Hallertauer hops (60 mins) (1.3 oz./37 g of 4% alpha acid)
2 AAU Hallertauer hops (20 min.) (0.50 oz./14 g of 4% alpha acids)
0.50 oz. (14 g) Hallertauer hops, (0 min.)
White Labs WLP830 (German Lager) or Wyeast 2206 (Bavarian Lager) yeast

Step by Step

Follow the instructions for the American Style all-grain recipe, lowering the mash temperature to 152 °F (67 °C). The pre-boil kettle volume is still around 6.1 gallons (23.1 L), but the pre-boil gravity is 1.038 (9.6 °P). Boil for 90 minutes, adding hops at times indicated in ingredient list. Ferment at 50 °F (10 °C).

Schwarzbier, Mönchshof Style

(5 gallons/19 L, all-grain)

OG = 1.050 (12.4°P)
FG = 1.013 (3.3°P)
IBU = 30 SRM = 20 ABV = 4.9%

Ingredients

6.0 lb. (2.7 kg) Munich malt (8 °L)
3.75 lb. (1.7 kg) Pilsner malt (2 °L)
4.0 oz. (113 g) crystal malt (40 °L)
3.0 oz. (85 g) chocolate malt (400 °L)
3.0 oz. (85 g) Weyermann Carafa® Special II malt (430 °L)
5.4 AAU Hallertauer hops (60 min.) (1.36 oz./39 g of 4% alpha acids)
2 AAU Hallertauer hops (20 min.) (0.50 oz./14 g of 4% alpha acids)
0.50 oz. (14 g) Hallertauer hops (0 min.)
White Labs WLP830 (German Lager) or Wyeast 2206 (Bavarian Lager) yeast

Step by Step

Follow the instructions for the American Style all-grain recipe. The pre-boil kettle volume is still around 6.1 gallons (23.1 L), but the pre-boil gravity is 1.041 (10.3 °P). Mash at 154 °F (68 °C). Boil for 90 minutes. Ferment at 50 °F (10 °C).

the dry. All Schwarzbiers have far less roast flavors than stouts or porters. These slight roast notes are like dark bitter chocolate, almost coffee-like, but never highly burnt or acrid. The roast also helps dry the finish. The aromas always have some nice bready malt notes and sometimes hints of caramel and noble hops. These are also clean lagers, with no fruit esters or diacetyl.

Hop bittering is moderate and balanced in a way that does not overwhelm the slight residual malt sweetness of the beer.

The Malt

German Munich and Pilsner malts form the bulk of the grist. A mix of about 50% of each contributes the right balance of Munich malty and Pilsner grainy, the base flavors of this style. For a single infusion mash, you might skew the balance a little more toward Munich malt. If you prefer decoction mashing, shift the balance more in favor of Pilsner malt, perhaps as much as 15% either way. If you want to make a beer more like Köstritzer, the grist should be 90% continental Pilsner malt and 10% or less Munich malt. Extract brewers should make every effort to obtain a continental Pilsner extract.

Specialty malts determine much of the character of this beer. Done right, the roasted notes are restrained even though the color is quite dark. The key to getting that rich hue without an acrid, stout-like flavor is using non-bitter dark roasted malt. Although there are a few de-bittered black malts out there, my preference is Weyermann Carafa® Special, a huskless roasted malt. The lack of a husk means far less bitter roasted flavors. Carafa® Special comes in several color levels: Carafa® Special I (340 °L), II (430 °L), and III (530 °L). I prefer the flavor of Carafa® Special II for this style, though the other colors will work fine in a pinch. Weyermann also makes Carafa®, which has a husk and a lot more roasted character, so make sure you're getting the huskless variety. Weyermann also makes Sinamar®, a liquid extract of Carafa® Special, made in accordance with the Reinheitsgebot. It is quite easy to use and provides as good a result as using the grain itself. Just add it to the boil kettle to adjust the color. One ounce (28 g) of Sinamar® in 5 gallons (19 L) of liquid adds 6 SRM of color and little in the way of roasted flavor. The only problem with Sinamar® is that it is a bit harder to find than Carafa® Special.

If you want to make a drier, crisper Schwarzbier similar to Köstritzer, all you need is Pilsner, Munich and Carafa® Special. To brew this style a touch roastier and sweeter, as is common in the United States, a portion of non-fermentable malt is needed. Adding sweetness changes the character of the roasted malts and allows for a slightly higher roast character with less apparent roast bitterness, much like adding sugar to black coffee. Caramel malt around 40 °Lovibond does the trick and CaraMunich® II (45 °L) is a good choice. It adds a bit of caramel flavor and just enough sweetness to fill out the beer. Three to four percent in a five-gallon (19-L) batch is about right. Don't go too

heavy on the crystal malt. Using more than 5% in five gallons is too much. You can use other caramel malts instead, such as US or English-made crystal malts with good results. For the additional roasted notes, a small portion of chocolate malt (no more than 3 to 4%) and roasted barley (no more than 2%) will add that character. That is the limit. Going past that point really puts the beer out of style. The mash temperature for this style ranges from 150 to 154 °F (66 to 68 °C) depending on how crisp you want the finished beer. When making a version similar to Köstritzer, target a lower mash temperature. If making a bigger, bolder version, go with a higher mash temperature to leave the beer with a bit more body.

The Hops

Schwarzbier is not a hoppy style, yet it often has a touch of hop flavor and aroma. Use only German noble hops, such as Hallertauer or Tettnanger, for the late additions. In a five-gallon (19-L) batch, a half-ounce (14 g) addition at 20 minutes and another at flame-out is enough.

A small amount of flavor and aroma from the bittering addition tends to carry through to the finish, so I prefer to bitter with German hops as well. If you wish to use a higher alpha acid hop to reduce the amount of hop matter and cost, Magnum is a good choice.

The Yeast

Schwarzbier can be fermented with any number of German lager yeasts. My preference is Wyeast 2206 (Bavarian Lager) or White Labs WLP830 (German Lager) yeast because of their clean, traditional German lager flavor. Good alternatives to experiment with are Wyeast 2308 (Munich), Wyeast 2124 (Bohemian), White Labs WLP838 (South German), White Labs WLP833 (German Bock) and White Labs WLP820 (Oktoberfest/Märzen) yeast. You will need around 360 billion clean, healthy cells to properly ferment 5 gallons (19 L) of this beer, which is double what you would use for an equivalent strength ale. One package of liquid yeast in a 2.2-gallon (8.3-L) starter, or 2 packages in a 3.5-quart (3.3-L) starter, will result in the right amount of yeast. If you're not making a starter, you'll need about four packages of liquid yeast. If you're using dry yeast, use approximately 0.7 ounce (20 g) of properly rehydrated yeast.

When making lagers, I like to get the wort down to 44 °F (7 °C), oxygenate and then pitch the yeast. I let the beer slowly warm over the first 36 hours to 50 °F (10 °C) for the remainder of fermentation. This results in a clean lager, with very little diacetyl. This is similar in theory to a Narziss fermentation, where the first two-thirds of the fermentation is done cold and the final third is done warmer. In any case, don't rush things. Good lagers take time and ferment slower than ales, especially when fermented cold. Once the beer has finished fermenting, a period of lagering for a month or more at near freezing can improve the beer.

Jamil Zainasheff writes "Style Profile" for every issue of Brew Your Own.

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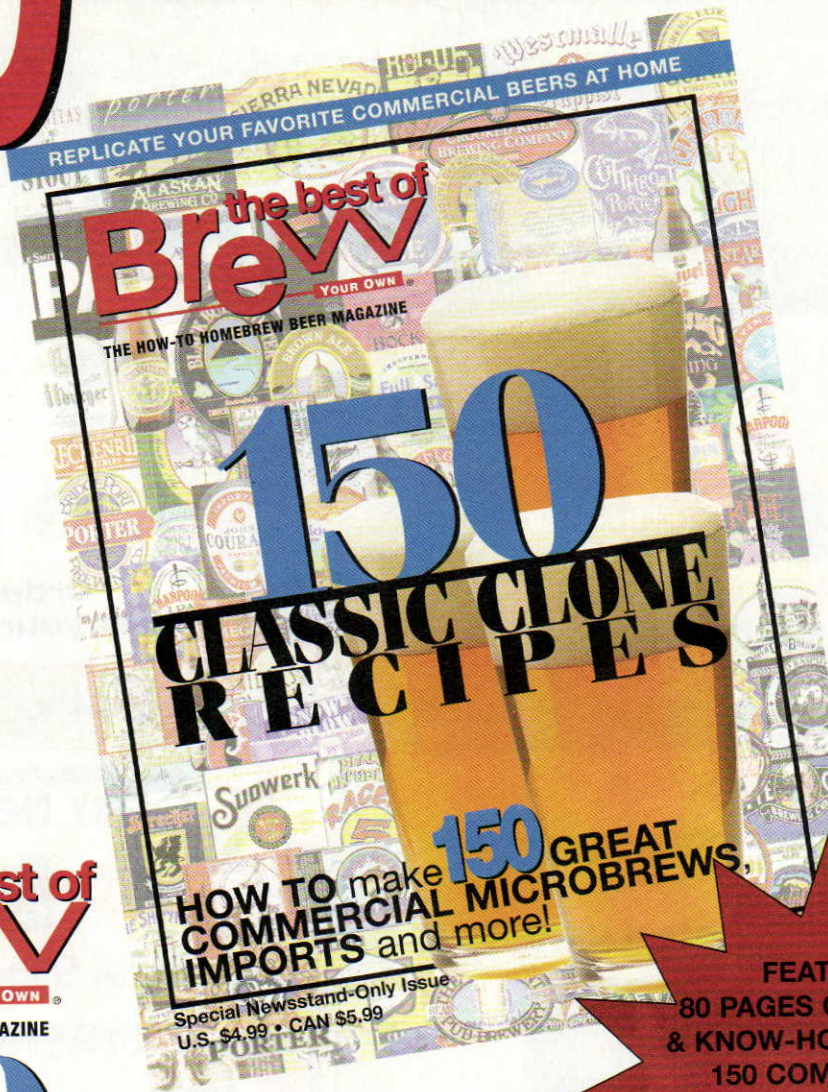

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YEARLY BREWERY CHECKUP

Is that keg clean or dirty? Do I have any Irish moss on hand? Your home brewery likely includes an array of equipment, ingredients and cleaning supplies. Keeping the whole thing organized might seem like a daunting task, but investing a little time and energy just once per year can save you a lot of time and energy at a later date. So, set aside some time, roll up your sleeves and get ready give your home brewery a checkup. You'll thank yourself later . . . most likely with a refreshing beer brewed in your tidily-organized brewery!

Cleaning House

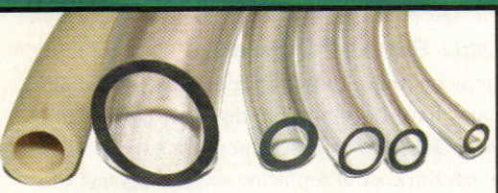
As a homebrewer, you already know the importance of regularly cleaning your equipment. But, did you know that deposits can build up over time, even if you keep your equipment clean? These deposits are collectively known as beerstone (calcium oxalate), which is often not visible to the naked eye. Beerstone can build up inside your kettle or fermenter — anywhere that has been in sustained contact with wort or beer. Furthermore, standard cleansers can't put a dent in this stubborn, scaly build-up. But don't fear! Beerstone can be whisked away by using acid-based cleansers, such as Foaming Acid Cleaner by Spartan Chemicals. You can also check out your local homebrew supply store for an effective beerstone cleaning solution.

Even if you do know the importance of keeping your brewery clean, let's face it, we all get a bit lazy sometimes. Maybe an emptied keg is set aside to be cleaned later. And hey, when was the last time you cleaned your tap lines? Set aside items are easy to forget when doing your routine cleaning, yet bacteria and wild yeast can build up in them. All of these items — kegs, carboys, jugs for yeast starters or whatever you've put off until "later" — can be rounded up and cleaned in one time-saving mass cleaning. A mass cleaning is simply cleaning many pieces of your equipment at once. Doing so saves time, not to mention cleaning solution.

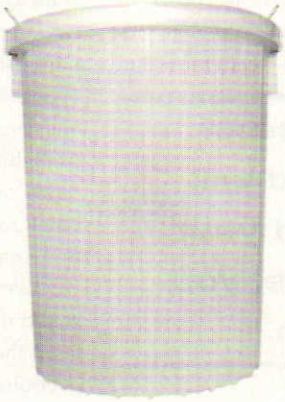
One way to do an economical mass cleaning is to brew a batch of beer, then direct the hot waste water from

by **Kristin Grant**

GIVE YOUR BREWERY THE ONCE-OVER AND GET IT READY FOR A GREAT YEAR OF BEER



Tubing is cheap and can get grungy after a year of brewdays.

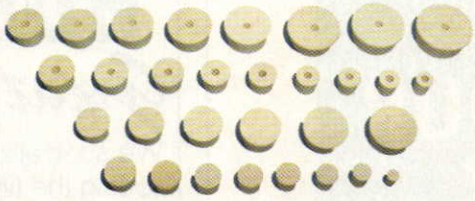


Fermentation buckets eventually begin to smell or get scratched.

Check the expiration date on all your solutons, and be sure to store them

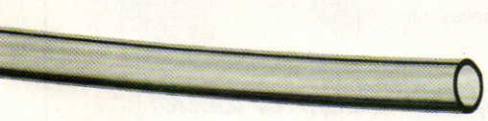
Soft rubber pieces should be replaced if you have suffered contamination.

Stoppers last for years, but can eventually get old and cracked.



Test strips will likely also have an expiration date.

One of the last things your beer touches is your beverage lines. Are they clean?



If foam gets blown out of a fermentation lock, the inside can get fouled.

If you use pH strips often, might an upgrade to a pH meter be worthwhile?

photos courtesy of **Northern Brewer & Hanna Instruments**

your wort chiller into a picnic cooler. Add a cleaning agent — such as PBW, TSP, B-Brite or any good brewery cleaner — and submerge any items to be cleaned into the hot solution. Then, scrub away. A quick soak in hot cleaning solution will make any soil easy to remove and, with a little elbow grease, everything in your brewery can soon be cleaned to a bright shine.

You can clean your fleet of kegs this way — in fact, a Corny keg can be fully submerged in a typical 100-quart picnic cooler — but there is an even easier method to clean multiple kegs. To start, fill one Corny keg with hot cleaning solution. Next, push the solution from keg to keg with CO_2 pressure using a "jumper cable." Before you head out to your garage, note that a jumper cable in homebrewing is merely beverage tubing with "beer out" connectors on each end. Let each keg sit for 5–15 minutes with the cleaning solution inside. When you're ready to clean the next keg, set the CO_2 regulator to about 3 PSI and push the liquid into the empty kegs — up the long dip tube of one keg and down the long dip tube of the next — cleaning them in the meantime! The temperature will drop as you clean more and more kegs, but the solution should be effective down to at least 100 °F (37 °C).

"... if an inexpensive piece of equipment is worn out, and will likely fail and ruin a batch of your homebrew in the near future, you should replace that item."

For an easy way to clean neglected tap lines in a matter of minutes, see the sidebar on page 30.

Parting is Such Sweet Sorrow

As painful as it may be, there comes a time when you should part with items that may have become worn down or "gunked up" over the years. Perform a basic risk assessment on each item in your brewery and weigh the cost of replacing an item against the probability that it will fail. The bottom line is, if an inexpensive piece of equipment is worn out, and will likely fail and ruin a batch of your homebrew in the near future, you should replace that item.

Every brewer has his own level of acceptable risk, but few would risk their beers to scratched up buckets or yucky old tubing if they sat and thought about it. There are many little pieces of equipment or tools you should look at each year. These include your tubing (is it dirty or brittle?), buckets (do they have any smelly stains or cracks?), carboy brushes, bottle brushes, sponges and scrubbies (are they moldy or worn?), cartridges for water filters, stoppers and fermentation locks. For test strips and solutions (such as pH standards), check the expiration dates and think about how they've been stored. Unopened packages stored at

TIME TO UPGRADE?

One nice thing about homebrewing is — once you have a basic brewing system assembled — you can add meaningful upgrades in a piecemeal fashion. Popular upgrades from entry level systems include an immersion wort chiller and a "turkey fryer" setup that includes a large pot and propane burner, for full-wort boils. From there, adding a mash tun, for all-grain brewing, can cost less than $30. (See "Cheap and Easy Batch Sparging" in the Jan-Feb '04 issue.) The big upgrade that many homebrewers make is a kegging system, although this will cost a bit more.

the proper temperature and humidity levels may still be usable. Conversely, if any solution has changed color or thrown a precipitate, this may be a sign that it's no good anymore.

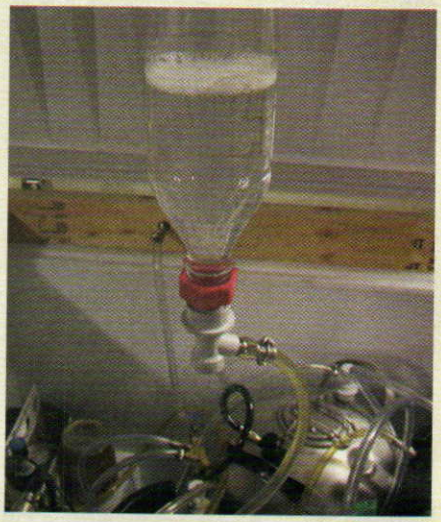
If you are a packrat and cannot bear to throw things away, make sure you clearly separate the old items from the new. This will ensure you don't waste time on brew-day trying to figure out which is which. You don't want to accidentally use old tubing or carboy brushes after you just bought the new stuff!

Stocking Up

Not everyone lives right around the corner from a homebrew shop. If it's a bit of a drive, keeping your home brewery stocked with standard items — gypsum, Irish moss, bottle caps, etc. — will save you the potential frustration of a cancelled brewing (or bottling) day later.

Stocking up on supplies has an array of benefits. First, you don't have to buy a variety of miscellaneous items every time you make a trip to your homebrew store. Second, many supplies or ingredients are cheaper in bulk — and who doesn't want to save a little money? Third, if the trip to the local shop is a long one, you'll have fewer to make during the year. Finally, you won't keep buying Irish moss every time

Clean Your Taps Without the Work



by George Schmidt

So . . . when was the last time you cleaned the lines and taps in your serving fridge or freezer? If you are like many of us, it might have been a while. After all, we bought the setup to reduce the work of serving beer, and cleaning taps is work.

However, clean lines are great for many reasons. They pour better, are more sanitary and they simply taste better. The newer forward-sealing faucets are not a solution; they just prevent the most obvious symptom of mold in a pint. I like to clean my lines between every keg, and I've found a way to do it without all the work. As a bonus, chances are that you already have everything you need to do it yourself.

The carbonator cap is the key. With it, the soda bottle can be used as both the cleaner reservoir and the pressure vessel. The carbonator cap fits into a "gas in" keg connector, so the "beer out" connector on the line to be cleaned must be replaced with the "gas in" connector. The "beer out" connector should be cleaned separately.

Any size soda bottle can be used. I really do clean between every keg, and a single line does not need much cleaner. For one serving line I use a 24 fl. oz. (710 mL) plastic soda bottle. For cleaning an entire setup, a 2-L bottle would be helpful.

To start, fill the bottle no more than three-quarters full with liquid, making sure to leave enough headspace to pressurize. Screw on the carbonator cap, and pressurize the bottle with CO_2. I disconnect the other kegs and dial the regulator up to about 30 PSI for this. Then, switch the bottle to the line to be cleaned, hold the bottle upside down and open the tap. The pressure in the headspace will push the bottle's contents into the beer lines. Close the tap to stop the flow. To clean a line, I push a bottle of hot tap water, followed by beer line cleaner (such as BLC), which I let soak for 5-minutes. I finish with a rinse of sanitizer. (I use Star San.)

Cleaning one line with the carbonator bottle takes about 10 minutes, and I can do all four of my lines in about 15 minutes. As a bonus, there are no kegs or tubing to clean and dry when the process is finished. Using the carbonator bottle is so fast and easy that you can have clean lines for every keg, without all the work.

you visit your homebrew store because you can't remember how much you have left. You'll know you have plenty!

Stocking up does have a few drawbacks, though. First and foremost is the upfront cost. You'll need to shell out a few bucks up front, but remember that you should theoretically be spending less cash later in the year. Secondly, if your planning turns out to be more ambitious than your schedule allows, you may have stocked up on some items that go unused. Deciding whether to stock up on "the usual suspects" is much easier if you have a predictable brewing schedule.

So, let's say you've decided to stock up. When you go to your local homebrew store, you'll want to pick up these commonly used items: Irish moss or whirlfloc, water salts, Campden tablets, bottle caps . . . but what about ingredients? When thinking about stocking up ingredients, you should keep in mind a few rules of thumb. The key to stocking up effectively is determining what ingredients you will use over the next year and what their shelf life is. Stored properly — in your freezer in an oxygen-barrier pack — a supply of hops will easily last an entire year. Malted grains will stay fresh for up to a year if stored in a cool, dry place. (Crushed grains, however, will go stale in a matter of weeks.)

For extract brewers, liquid malt extract will stay fresh for about three months. Dried malt extract will keep for about eight months, if kept sealed away from moisture.

Lastly, liquid yeast has a relatively short window of freshness. Make sure to check the expiration dates on the packages when purchasing your yeast. Fresh liquid yeast has a shelf life, if refrigerated, of about four months. Dried yeast stores significantly longer — a refrigerated, unopened pack can last a year or two.

You should label all your ingredients with the date purchased. Use a marker to ink the date right on the package, unless the ink can flow through and contact the ingredient. If so, purchase a cheap pad of labels at your local office store. By doing so, you'll never have to wonder how old something is. In fact, you can use up the ingredients in the order of the expiration dates to reduce waste. With a few minutes of labeling after each trip to the homebrew store, you can be confident your ingredients are fresh, and will not ruin a batch of your brew.

You can add other activities to your yearly brewery checkup, if you'd like. For example, you may want to plan your brewing schedule, which will also help you determine what ingredients to stock up on. By simply mapping out when you'll have time and when you want certain beers to be ready — for example, stout for St. Patrick's day, Octoberfest in October or your special sure-to-be-award-winning porter for your club's homebrew contest — you can lay out a tentative brewing plan for the year. In any case, now that you've given your equipment a good cleaning, replaced your worn-out items and stocked up on ingredients, you've got nothing left to do — nothing, that is except to start brewing.

Kristin Grant wrote "Cookie in a Glass," about using oatmeal in brewing, in the March-April 2007 issue.

IPA:

A TALE OF TWO BEER STYLES

photo by charles a. parker/images plus

IPA USA&UK

Long a favorite of homebrewers, IPA is a big, flavorful beer, full of hop character.

We've all heard the story of IPA before. Originally it was an export beer, a strong pale ale brewed with extra hops to act as preservatives during the long journey from England to the British troops in India. Fast forward to the 1980's in the United States. Here, craft brewers picked up on English pale ales and started brewing their own versions with American hops.

In the two articles in this package — "IPA UK," by Terry Foster and "IPA USA," by Chris Colby — we present the classic English style and it's younger American cousin. Both brews share a lot of similarities and overlap in many style parameters, to the extent that some commercial examples may be hard to categorize (even if they are easy to drink). However, clear-cut examples of both sub-styles exist, too.

Differences between the two beers can be summarized this way: Although both kinds of IPA are malty, English IPAs generally show more biscuity or nutty malt character and are less highly attenuated. American IPAs are usually stronger and hoppier, but many classic American examples are lighter in color and are better attenuated than median British examples. English IPAs show a more estery yeast profile than their American counterparts, which are usually fermented with "clean" ale yeasts. In both cases, the hops are the star of the show. Classic English hops such as Kent Goldings may be showcased in an English-style IPA, while citrusy Amercian hops — especially Cascade — are frequently on center stage in an American IPA.

Whichever style you decide to brew, English or American — or a hybrid, taking your favorite elements from each — get ready for a flavorful and-richly rewarding pint.

usa INDIA PALE ALE

photo courtesy of sevenpack.net

by **Chris Colby**

"When in doubt, use more hops."
John Maier (Rogue)

Here in the Unites States, there is a long-standing practice of borrowing ideas from other countries and putting an American spin on them. American-style pizza, for example, can trace its ancestry back to a flat, baked-bread dish called pizza in Naples, Italy. American India pale ale (IPA) is likewise a descendent of India pale ale, a once-popular beer brewed in Britain. American IPA is generally stronger and hoppier than its English progenitors, but frequently has a lighter color and malt profile.

The Wide World of Water

You can make a great American IPA from water with a variety of mineral compositions. Some are brewed from soft water — water with very few dissolved minerals. Others are brewed from harder waters, with abundant calcium and sulfate ions.

One ion that should not be present in large quantities is bicarbonate. Bicarbonate raises mash pH and dulls the hop character in beer. For pale versions of IPA, the level of bicarbonate should be under 50 parts per million (ppm); for amber versions, it can be as high as 100 ppm. If your water has more bicarbonate than this, add distilled water to dilute the level to an acceptable point. In contrast, calcium ions lower mash pH (through their reaction with phosphates). For an IPA, your level of calcium should — at a minimum — exceed the level of bicarbonate. Beyond that constraint, levels anywhere in the 50–250 ppm range will work well.

Sulfate levels can likewise vary over a wide range — anywhere from 0 to 350 ppm. Sulfate ions accentuate the hop character in beer, and if you really want them to bring out the hops, make sure they exceed 150 ppm.

Calcium and sulfate can be added to your brewing liquor by adding calcium sulfate (in the form of gypsum). If you need to add calcium, but don't wish to boost your sulfate levels, use calcium chloride instead. Dilute the bicarbonate with distilled water first, if needed, then add back any calcium or sulfates you require. As with any beer, treating your brewing liquor overnight with one Campden tablet per 20 gallons (76 L) will eliminate any chlorine or chloramines.

If mucking with water chemistry calculations isn't your thing, don't worry. Try brewing a batch with your local water. If it turns out fine, then you don't need to worry about it. If, however, your hop bitterness seems coarse and the beer seems blah (or even soapy), altering your water will be required.

A good plan for extract brewers is to use soft or distilled water when making their American IPA, supplemented by 0–2 tsp. gypsum per 5 gallons (19 L) of brewing liquor. The extract itself will have minerals dissolved in it, so there is no need to make elaborate plans to alter your water's chemistry.

Make Mine Malty

The focus in an American IPA is on hops, but malt plays an important supporting role. When making an American IPA, it's important to understand what the word "malty" means — and some confusion exists among homebrewers.

Malt flavor comes from malt — specifically from the husks of malted grains. At the end of malting, malted grains are kilned (heated) and this develops colors and flavors that

Something BORROWED. Something BREWED.

dissolve into the wort during mashing and end up in your beer. The more malt you use in a recipe, the maltier the beer. Likewise, up to a point, the more highly-kilned a malt is, the maltier it will be. Vienna and Munich malts are frequently cited as exhibiting the classic malty flavor, whereas less highly-kilned malts (such as Pilsner malt) show less malt character. Dark malts, including most specialty malts, are kilned to the point where they show more roast character than malt.

However, adding more malt usually correlates with another variable — a higher final gravity (FG). If all other variables are held to be the same, a beer with more malt will also have a higher FG. And here's where the confusion comes in. Some homebrewers confuse malty (the character that comes from malt) with sweet or viscous (the characters that increase with higher FG). But, the two are theoretically independent. You can brew a malty beer that is dry if you use a lot of malt, but achieve a high level of attenuation. Converse-ly, if you brew a beer with less malt and achieve a low level of attenuation, you could brew a thicker beer with relatively little malt character. This distinction is important when brewing an American IPA.

Malt Choices

When making an American IPA, the most straightforward choice of base malt is a domestic 2-row barley malt. But, you have other options. English pale malt (~2 °L) or pale ale malt (~3 °L) will also work well. German Pilsner malt (~1.8 °L) can also work. Blending two or more base malts can add a bit of complexity.

Most American IPAs contain between 2.5–10% crystal malt with a color rating of 20–60 °L. Darker crystal malts yield a more raisin-like, plum-like or roasty character, which is more often found in English-style ales. Many American IPAs also contain up to 20% Munich malt, to boost the malt character of the beer. You could also use Vienna malt to achieve the same thing. Other malts — including biscuit malts and amber malts — can be used in small amounts and still yield a distinctly American IPA. Too much of these, however, will give an overly biscuity or nutty flavor which is more appropriate to an English-style IPA.

Although American IPAs are often bigger than English IPAs, they are not always darker or that much heavier. The focus really is on the hops in this style and plenty of classic American IPAs are fairly light in color and well-attenuated. See, for example, Stone IPA or Full Sail IPA. Of course, it's a big country — with a correspondingly large number of interpretations of the style — and some American IPAs show a solid amber color and a fair amount of sweetness. Sierra Nevada's Celebration Ale is one example here, although this beer also doubles as a holiday beer. And, of course, there are plenty of beers in the middle. Anchor's Liberty Ale is a light amber — about the same color as their steam beer — with a fairly dry finish for an all-malt beer. If you're going to brew an American IPA, I recommend plenty of "research" with these beers and other great American IPAs.

Hops Yield Happiness

Hops are, without question, the focus of any IPA. Good IPAs have a nice balance between hop bitterness and hop flavor and aroma. When you taste a well-brewed IPA, you taste hops up front, through the "mid-palate" and into the aftertaste.

IPA USA by the Numbers:

OG = 1.056–1.075 • FG = 1.010–1.016
IBU = 45–70 • SRM = 5–16 • ABV = 6–8%

Brewers often divide hops into bittering hops and aroma hops. The idea is that bittering hops are added early in the boil, boiled for a relatively long time and give the beer most of its bitterness. Aroma hops are added later in the boil and, while they yield some bitterness, they are mainly supposed to add flavor and aroma that would boil away if the hops were boiled longer.

In an American IPA, there are many approaches to hopping. Some are brewed with a big dose of bittering hops added early and some late hops added to round out the flavor and aroma. Others are brewed with enough hops added near the end of the boil that most of the IBUs are actually obtained from the "aroma" hops. Still others are brewed with numerous hop additions, making any attempt to conceptually divide the hops into a bittering portion and a flavor/aroma portion futile. Each method of hopping has its pros and cons.

"Traditional" Hopping vs. Other Types of Hopping

"Traditional" hopping — with bittering hops added early, then flavor aroma hops added near the end — is widely practiced because it gives the biggest "bang for your buck" and results in the fewest problems in the brewhouse. If you pick a nice, high-alpha variety to add for your bittering hops and then throw in some aroma hops at the end, you'll need fewer hops overall to reach your target bitterness. This saves money in terms of how much you pay for the hops and, for commercial brewers, how much wort is lost due to being absorbed into the hops. Also, with less hop "gunk" in your kettle, getting the wort from the kettle to your fermenter can be easier. And finally, alpha acids and the essential oils that convey flavor and aroma aren't the only compounds in hops. As with most plant material, they also contain tannins. Methods of hopping that involve using more hops to obtain less bitterness run the risk of being overly grassy or — in extreme circumstances — excessively tannic or vegetal.

Proponents of adding hops throughout the boil claim that this method gives a hop character you can't achieve with a "bookend" approach of adding some early and late, but none in the middle. In practice, great commercial examples of IPAs made using both approaches exist. Homebrewers interested in IPA will most likely try both approaches and decide for themselves which is more suited to their tastes.

The Wide Variety of, uh, Varieties

When choosing your hops for an American IPA, you have numerous options. Most of these beers show a citrusy, "American" character found in the "C hops" — Centennial, Chinook, Columbus and, especially, Cascade. In most, more than one hop variety is chosen and, for this reason, almost every hop imaginable has shown up somewhere in an American IPA. American brewers are also quick to try new hops and recently-released varieties such as Amarillo and Simcoe are finding favor at many breweries. In addition, there are always new varieties being released. (Summit, a new high-alpha variety, is generating some interest. One new hop I have tried and liked is Nelson Sauvin, a hop from New Zealand.)

Clean Ale Yeast

American IPAs typically show a clean fermentation profile and any of the American ale yeast strains available to homebrewers — including Wyeast 1056 (American Ale), Wyeast 1272 (American Ale II), White Labs WLP001 (California Ale), White Labs WLP051 (California V Ale) and Fermentis US-05 (formerly US-56) yeast — are a good choice. You can also use English ale strains that are only moderately estery.

For 5 gallons (19 L) of beer, a 2–3 qt. (~2–3 L) yeast starter should do the trick. Make your starter wort at SG 1.030–1.040 and aerate the starter well. Adding a pinch of yeast nutrients to the starter is also a good idea.

Wort Production

American IPAs range from fairly dry to full-bodied. The level of attenuation that all-grain brewers achieve in their beer will depend both on the grain bill and the mash procedures. Almost all American IPAs are brewed using a single infusion mash.

If you are shooting for a fairly dry IPA, formulate your recipe with domestic 2-row pale malt, fewer specialty grains and mash at the low end of the saccharification range. Domestic 2-row malts are enzyme rich and a 60 minute mash at around 150–152 °F (66–67 °C) will yield a wort with the right amount of fermentability for a well-attenuated version of the style. You should not need to use adjuncts or step mashes to achieve more fermentability for a "fairly dry" IPA. These beers are drier than many full-bodied ales, but not as dry as "lawnmower" beers such as cream ale or American Pilsner.

If you are aiming for a less attenuated version of the beer, include more specialty malts in your recipe and mash at a higher temperature. Mash temperatures around 154–156 °F (68 –69 °C) will lead to more viscous beer. Using English pale malts, which have less diastatic power, and opting for a shorter mash rest can also decrease your fermentability. You can mash for as little as 20 minutes, but you should use an iodine test if you do. A negative result (no color change to purple or black) will mean there are not enough starches in the wort to be a problem.

The fermentability of the wort made by extract brewers will depend mostly on the malt extract they choose. For a sweeter version, most English-style malt extracts will work well. American light or pale malt extracts are usually a bit more fermentable.

For a more highly-attenuated extract IPA, extract brewers have a couple options. One option is to perform a partial mash at around 150–152 °F (66–67 °C). The combined wort from the partial mash and dissolved malt extract will exhibit a fermentability in between the two. You can also use the enzymes from the partial mash to work on any available carbohydrates in the extract wort. To do this, just make a partial mash as you normally would. While the partial mash is resting, dissolve your malt extract and heat it to 150–152 °F (66–67 °C). Run off the partial mash wort and combine it with the malt extract solution. Hold this combined wort at 150–152 °F (66–67 °C) for about 15 minutes. If there are degradable carbohydrates in the malt extract, the enzymes from the partial mash will work on them, yielding a more fermentable combined wort. Extract brewers can also use prepared amylase enzyme, available at many homebrew shops, for this purpose. Extract brewers should not increase their fermentability by adding corn sugar. This works, but yields a less malty wort than is desired for this style.

BYO.COM web bonus

More American IPA recipes for extract, partial-mash and all-grain brewers.

Boiling

The biggest difference between boiling an IPA wort and boiling a wort for a "regular" ale is that there are more hops in an IPA wort. Once the boil is over, the wort will need to be separated from the hop "sludge" at the bottom of the kettle.

All-grain brewers will likely want to boil their wort for 90 minutes. This will allow enough time to reduce the wort volume such that the proper original gravity is reached. It will also be long enough to develop a nice hot break and provide enough time to boil the hops. During the boil, hops will cling to the kettle above the liquid line. Take a spoon and knock these back into the kettle periodically — they aren't doing you any good if they aren't being boiled in the wort.

The pH of your finished beer will have an effect on the hop character. At higher pH values, the beer will be more bitter, but the bitterness with have a harsh edge to it. During the boil, you can "prime" your beer to reach a final pH that is conducive to a pleasing hop bitterness by adding a little calcium to your boil — around 0.5–1 tsp. of gypsum or calcium chloride per 5 gallons

AS AMERICAN AS IPA

Roswell IPA

(5 gallons/19 L, all-grain)

OG = 1.070 FG = 1.014

IBU = 60 SRM = 8 ABV = 7.2%

Golden colored and highly-attenuated, with just enough malt to serve as a framework for the hops. Solid, clean hop bitterness fades into a moderate amount of hop flavor and aroma.

Ingredients

13 lbs. 9 oz. (6.15 kg) US 2-row pale malt
11 oz. (0.31 kg) Vienna malt
5.0 oz. (0.14 kg) crystal malt (30 °L)
14 AAU Magnum hops (60 mins)
(1.0 oz./28 g of 14% alpha acids)
3.75 AUU Centennial hops (15 mins)
(0.38 oz./11 g of 10% alpha acids)
0.75 oz. (21 g) Cascade hops (5 mins)
0.75 oz. (21 g) Cascade hops (dry hops)
0.5 oz. (14 g) Amarillo hops (dry hops)
1 tsp. Irish moss (15 mins)
0.5 tsp. calcium chloride (optional)
Wyeast 1056 (American Ale), White Labs WLP001 (California Ale) or SAFALE US-05 (formerly US-56) yeast
(3 qt./~3 L yeast starter)
0.75 cups corn sugar (for priming)

Step by Step

Prepare 12 gallons (45 L) of brewing liquor with bicarbonate below 50 ppm and calcium around 75 ppm. (Adding 3.5 tsp. of gypsum to 12 gallons (45 L) of soft water will get you there.) Add a Campden tablet the night before you brew to get rid of chlorine compounds. Mash grains at 152 °F (67 °C) in 18 qts. (17 L) of water. Rest for 60 minutes, then mash out to 168 °F (76 °C). Recirculate wort for 20 minutes, then collect around 7.0 gallons (26 L) of wort in your kettle. Keep your sparge water hot enough that the grain bed temperature remains at 168 °F (76 °C). Boil wort vigorously for 90 minutes, adding hops at times indicated. (As an option, add 0.5 tsp. calcium chloride at the beginning of the boil.) Knock any hops that cling to the side of your kettle back into the boiling wort. Cool wort and transfer to fermenter. Aerate thoroughly and pitch sediment from yeast starter. Ferment at 68 °F (20 °C) until primary fermentation ends. (This should take about a week.) Rack to secondary fermenter. If you are going to bottle your beer, let it sit for 3–4 days, add the dry hops and let the beer sit for another 3-4 days, then bottle it. If you are going to keg your beer, let the beer sit in secondary until it clears substantially (7–10 days), then keg and dry hop.

Lots of things can affect the level of hop bitterness, hop flavor and hop aroma in an IPA. When your beer is finished, taste it critically and make note of the level of bitterness, hop flavor and hop aroma in your brewing notebook. The next time you brew this beer, or any hoppy beer, use your observations as a guide to making any needed adjustments in recipe or procedures.

Extract option:

Reduce the amount of 2-row malt to 3.0 lbs. (1.4 kg) and add 5 lb. 10 oz. (2.6 kg) Briess light dried malt extract. "Steep" (actually partial mash) grains at 152 °F (67 °C) in 6.0 qts. (5.7 L) of water. In your brewpot, combine "grain tea" and hot water to make at least 4.0 gallons (15 L) of wort, stir in malt extract and hold at 152 °F (67 °C) for 20 minutes. Boil wort for 60 minutes. Cool wort, transfer to fermenter, top up to 5 gallons (19 L) with water, aerate, pitch yeast and follow remaining all-grain instructions.

(19 L) will help if you have been brewing IPAs with a coarse edge to the hop bitterness.

At the end of the boil, most all-grain brewers will empty their kettle by opening a ball valve near the bottom of the vessel. Hop screens installed inside the kettle will hold the break material and hop sludge back and let the wort through. For brewers without hop screens, there are a couple options.

One option is to take a stainless steel "chore boy" and place it around the inlet end of your racking cane. Another option is to cool the wort and let the hop debris settle for an extended period of time. If you cool with an immersion chiller, simply let the cool wort sit (with the cover on the brewpot) for an hour or two, then siphon the wort off the top into a fermenter. Or, you can run chilled wort from a counter-flow chiller into a sanitized bucket and let it settle there before racking to a fermenter. Yet another option is use a funnel fitted with a screen. To do this, cool your wort first with an immersion chiller, then transfer the beer through the (sanitized) funnel into your fermenter. The screen should catch most of the hop debris. Use a sanitized spoon to keep the screen from getting plugged. (If you're brewing alone, you can rack the beer and clamp the outlet end of the racking cane to the funnel.)

For extract brewers, there two other considerations when boiling — wort thickness and volume. The more dense your wort is, the fewer iso-alpha acids will be extracted. In addition, there is a maximum amount of iso-alpha acids that can be extracted by boiling hops in wort. So, if you're boiling a doubly-thick wort on your stovetop, and then diluting it, you are limiting your bittering potential in two ways — first by boiling in a thick wort and second by dilution. There are a couple ways to overcome, or at least partially overcome, this obstacle.

The best solution is to perform a full-wort boil, even if have to make your wort in shifts — for example, by boiling two separate 2.5-gallon (9.5-L) worts and combining them. A partial solution to the problem is to use the "extract late" method, in which your wort is boiled at working strength, followed by a late addition of extract to hit your target gravity. (See the October 2004 and December 2005 issue for more.)

Fermentation and the Finish Line

American IPAs are fermented and dry-hopped just as English-style IPAs are. An American twist on serving American IPA, developed by Dogfish Head, is to push it through a filter of hops (called a Randall).

This hoppy beer, favored by American beer geeks, arrived in our glasses via a circuitous route. Originally, IPA was an English beer, brewed for export to India. Now, thanks to adventurous brewers in the USA, it's as American as apple pie — or, at least, as American as pizza.

Chris Colby is the Editor of Brew Your Own.

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INDIA PALE ALE

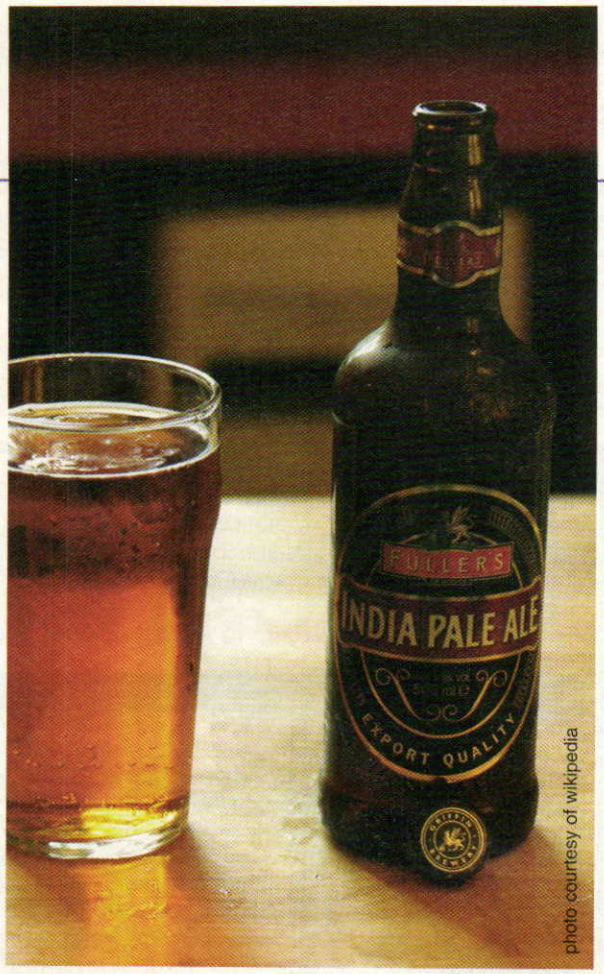


photo courtesy of wikipedia

by **Terry Foster**

Many people think that India Pale Ale (IPA) originated in Burton-on-Trent in England, but it didn't! It was first brewed by George Hodgson in London in the eighteenth century, and only began to be brewed in Burton almost twenty years into the nineteenth century. It is true, however, that it was the Burton Brewers — notably Bass and Worthington — who brought it to perfection and brewed it on a grand scale. Now the great British Empire no longer exists, India is its own master and very few Englishmen have any concept of the style. A handful of English microbreweries do produce creditable versions, but these are hard to find. Much more widely available are "IPAs" from certain regional brewers that are no closer to real IPA than mainstream American lagers are to Pilsner!

In fact, these days I think of IPA as more of an American brew. The craft brewing movement in the United States took pale ale and IPA to its heart right from its early days in the 1980's. However, they nearly always tried to brew IPA in the spirit of the original and to the standards by which it was first produced. And interestingly, some of the "innovations" of US craft brewers aren't really that new — Bass was using American hops in the Burton IPA heyday of the second half of the nineteenth century! In this article, I'll explore how to brew the classic English India Pale Ale.

Brewing and Breadth

IPA is sometimes seen as a one-dimensional brew, because it is above all else a hoppy beer. However, other flavors from both yeast and malts play a part in its palate. Given this — and the wide range of hops available to us — it is possible to achieve quite wide variations in flavor.

Water

There were several reasons why IPA took off as soon as the Burton Brewers got into the act. One of the major reasons is that the water in Burton was particularly suited to the brewing of this style of beer. It didn't come from the Trent, of course, but from deep wells. This water is very high in total dissolved solids, containing mainly calcium, magnesium, and sulfate ions, as well as bicarbonate and chloride ions. The bad news is that it is just about impossible to take another water with differing salt contents, and adjust it so that it

The beer that LAUNCHED a THOUSAND SHIPS

matches Burton water exactly. The good news is that you don't have to!

Originally, the reason why Burton water was so good for brewing IPA was that it was perfect for mashing a brew made from only 2-row pale malt. In those days, such malts would have been somewhat undermodified, and it was essential to control the mash pH in order to get good conversion of the malt during mashing. The very high levels of calcium and sulfate ions in the water would have done just that. Modern 2-row pale malts are of much better quality, and are more uniformly well-modified. Yet they contain plenty of enzymes to do the conversion job, so brewers have less to worry about when it comes to mash pH.

It is all too easy to get lost in the maze of deciding what is a suitable water treatment program for your water, in order to make it suitable for mashing a particular malt. In fact, the only problem you are likely to have is if your water is alkaline — that is, it is high in bicarbonate ions. If that is the case, the best approach is to check your mash; if it is above pH 5.5, add gypsum (calcium sulfate), 1 tsp (5 g) at a time until you get down to the desired pH 5.2–5.5 range. Boiling your water before mashing will also help, by precipitating calcium carbonate.

In extract brewing, you do not need to worry about water treatment. This has already been done for you by the manufacturer during the mashing stage of the malt extract production process. It is, however, just as well if you boil the water first to remove carbonate, as this ion can "cloud" hop flavor, making it flabby and not clean.

Whether you are an all-grain or extract only brewer, there is another argument for adding gypsum to your brewing water. This is that the sulfate ion helps to ensure that you get clean, sharp hop bitterness in the final beer. This is the approach I take myself, since I have a water supply low in dissolved solids. But, with similar water, Jeff Browning at Bru Rm@Bar in New Haven, here in Connecticut, produces excellent IPA (and pale ale) with no water treatment whatever. For 5 gallons (19 L) of extract beer, add no more than 1 tsp (5 g) of gypsum.

IPA UK by the Numbers:
OG = 1.065–1.070 • FG = 1.012–1.016
IBU = 40–60 • SRM = 8–14 • ABV = 6.9–7.1%

Malt

For all-grain brewing the selection of malt should be obvious — it's ale, it's pale, so we need only one base malt. And given its origin, that should be English 2-row pale malt, surely. Indeed, I like to use Maris Otter pale malt even though it gives a slightly lower extract yield than other pale malts, as it gives a good background nuttiness to the beer. Other English 2-row pale malts still work pretty well, though.

Mashing is fairly straightforward; you should go for a slightly high temperature to give the beer a little body. I like 153–155 °F (67–68 °C), but a degree or two lower is not crucial.

When it comes to extract brewing, several manufacturers offer pre-hopped IPA extracts, which offer a quick and easy route to a quite decent IPA. But most of the fun of this beer comes from playing with the hops, so I prefer to use a plain, unhopped pale extract, made from 2-row malt. Use one designed for pale ale or IPA, or just the palest ale malt extract you can get, avoiding those with adjuncts if possible. A few shops sell malt extract made from Maris Otter and that is perfect for this beer.

It is well to remember the old saying about IPA, namely that it is only pale in comparison to the very dark porters and stouts that were popular when IPA was first produced. That means that you can in fact use a little colored malt in this beer, with crystal malt being the best option. It isn't really traditional, since it wasn't available until around a hundred years after George Hodgson first started shipping pale ale to India. However, I think it adds a hint of extra complexity to IPA.

Use only one of the paler crystal malts (20 to 40 °L), at around 5% of the malt total. That means a maximum of a

(continued on page 43)

ship-shape IPA RECIPES

Burton-on-Housatonic IPA

(5 gallons/19 L, all-grain)

OG = 1.070 FG = 1.014
IBU = 60 SRM = 9 ABV = 7.3%

Ingredients

14 lb. 2 oz. (6.4 kg) 2-row pale malt (made from Maris Otter)
0.5 lb. (0.28 g) crystal malt (40 °L)
16.1 AAU Northern Brewer hops (90 mins)
(2.3 oz./65 g at 7.0 % alpha acid)
1.0 oz (28g) East Kent Goldings hops (10 mins)
1.0 oz (28g) East Kent Goldings hops (0 mins)
1.0 oz (28g) East Kent Goldings hops (dry hops)
White Labs WLP023 (Burton Ale) yeast
1 cup corn sugar (for priming)

Step by Step

Use a single-step infusion mash at 153–155 °F (67–68 °C) for 1–1.5 hours. Sparge one hour, with water no hotter than 175 °F (79 °C), until run-off reaches SG 1.010–1.012. Boil 90 minutes, with bittering hops added after the first foamy head subsides. Adjust wort volume with cold water, and cool to about 70 °F (21 °C). Pitch with yeast starter, and allow to ferment. By 5–7 days, final gravity should have been reached; rack into a secondary fermenter. If you will be bottling, add dry hops at this stage. One to two weeks later, rack again, prime with corn sugar, and rack into keg or bottles. If you keg your beer, add dry hops at this stage.

The beer should be ready to drink after conditioning for a week or so. It will keep for months if kept cool, and you have been careful to avoid aeration during racking.

Burton-on-Housatonic IPA

(5 gallons/19 L, extract with grains)

OG = 1.070 FG = 1.014
IBU = 50+ SRM = 12 ABV = 7.3%

Ingredients

1.5 lb. (6.4 kg) Maris Otter pale malt
0.5 lb. (0.28 g) crystal malt (40 °L)
1 lb. 14 oz. (0.85 kg) Muntons Light dried malt extract
6.6 lb. (3.0 kg) Muntons Gold India Pale Ale liquid malt extract kit
16.1 AAU Northern Brewer hops (60 mins)
(2.3 oz./65 g at 7.0 % alpha acid)
1.0 oz (28g) East Kent Goldings hops (10 mins)
1.0 oz (28g) East Kent Goldings hops (0 mins)
1.0 oz (28g) East Kent Goldings hops (dry hops)
White Labs WLP023 (Burton Ale) yeast
1 cup corn sugar (for priming)

Step by Step

In a large kitchen pot, heat 3.0 qts. (2.8 L) of water to 165 °F (74 °C). Place the crushed grains in a steeping bag and steep in this water for 60 mins. Hold steeping temperature around 154 °F (68 °C). Heat 1.5 gallons (5.8 L) of water to a boil in your brewpot. Add "grain tea" from steep to your brewpot. Hold grain bag over brewpot with a large colander and rinse grain bag with 1.5 qts. (~1.5 L) of hot water (at 170 °F/77 °C). Add dried malt extract and bring to a boil. Boil 60 minutes, adding hops at times indicated. Stir in liquid malt extract at end of boil and let steep for 15 minutes with the brewpot lid closed. (If the liquid extract is hopped, it will give you more bitterness.) Cool wort, top up to 5 gallons (19 L), aerate and pitch yeast. Follow the instructions for fermentation and dry hopping in the all-grain recipe.

Haldane's Select IPA

by Chris Colby

(5 gallons/19 L, all-grain)

OG = 1.062 FG = 1.011
IBU = 51 SRM = 12 ABV = 6.5%

Light copper colored, fairly dry and nicely balanced with "earthy" English hops. An English-style IPA with a couple eccentricities.

Ingredients

8.25 lbs. (3.7 kg) pale ale malt (3 °L) (preferably malted from Maris Otter barley)
5.25 oz. (0.15 kg) crystal malt (60 °L)
3.0 oz. (85 g) biscuit malt
0.33 oz. (9.3 g) chocolate malt
2.0 lbs. (0.91 kg) cane sugar
12.5 AAU Kent Goldings hops (60 mins)
(2.5 oz./71 g of 5% alpha acids)
0.75 oz. (21 g) Fuggles hops (15 mins)
1.5 oz. (43 g) Fuggles hops (dry hop)
Wyeast 1028 (London Ale) or White Labs WLP026 (Premium Bitter) yeast
0.75 cups corn sugar (for priming)

Step by Step

Mash at 153 °F (67 °C) in 11 qts. (10.4 L) of brewing liquor (with 150–200 ppm calcium ions and less than 100 ppm bicarbonate.) Collect about 4.5 gallons (17 L) of wort, add 2.0 gallons (7.6 L) of water and boil wort for 90 minutes. Add hops at times indicated in ingredient list. Add cane sugar with 15 minutes left in the boil. Ferment at 70 °F (21 °C). Add dry hops in the secondary fermenter or in your keg.

half-pound (0.23 kg) in a 5-gallon (19-L) brew, added with the pale malt if you are working with all grain. In the case of extract, pre-steep the crystal malt in hot water at 160–170 °F (71–77 °C).

Hops

The heart and soul of IPA! The original brews were very highly hopped; in the nineteenth century, with no refrigeration available, and a 6-month voyage to India from England, it was the preservative powers of hops that were most important to the brewer. High addition rates were used — up to as much as 10–12 oz. (280–340 g) per 5 gallons (19 L)! There were no high alpha-acid hops then, and the hops would often deteriorate during storage without refrigeration. This makes it difficult to know what bitterness levels were in terms of IBU, but calculations would suggest something around the 100 IBU maximum. This bitterness would have decreased somewhat during long storage and shipping before drinking, which is why we nowadays go for a target of 60 IBU maximum.

When making an English-style IPA, you should not concentrate on bitterness alone, for the originals surely had significant hop flavor and aroma, as late hopping, and dry hopping were regular practice in the nineteenth century. Both are also practiced with IPA by modern craft brewers (some with multiple additions throughout the boil), and I recommend that you do the same. Late hopping, that is, addition within the last twenty minutes and perhaps after the heating is turned off, should be fairly generous (1–3 oz./28–85 g), as late hopping does not always work consistently on a small scale.

Dry hopping is easy to do if you are going to keg the beer. If not, it

can be done in the fermenter; as we do at Bru Rm@Bar (although the dry hops are only added after the kräusen has subsided). This is fine if you use an open fermenter, but can be dangerous if you use a glass carboy, especially if your fermentation lock or blow-off tube is so narrow that it can easily become blocked with the hops. In fact, with a carboy, dry hopping is best done in the secondary. Whether during fermentation or in the keg, use a sterilized, tightly tied hop bag, with a sterilized weight attached to it.

But what hops? Classically, of course, it should be English Goldings throughout, as that was the finest hop available in England 200 hundred years ago. I have certainly used it to advantage in my IPAs. But there is no reason to limit yourself, English Fuggles, Target, Challenger or the new dwarf hop, First Gold, all work very well. Many American-grown varieties — notably Cascades, Columbus, Chinook, Northern Brewer, Amarillo and Willamette — work well in IPAs and are not unheard of in English brews. I know of one commercial brewer who likes German Hallertauer, and also from Europe, Styrian Goldings are excellent as a finishing hop. Just be very careful of very high alpha-acid hops (above 10% alpha), as these can sometimes give quite a harsh bitterness in the beer.

A good plan is to use a moderate high alpha, such as Target or Northern Brewer for bittering (90-minute boil), and one of the lower-alpha aroma hops for finishing and dry-hopping. There is also a lot to be said for using several different aroma hops, especially if you want to make additions at more than one time during the boil. For dry hopping, East Kent Goldings work very well, and remains my favorite.

With the possibility of using so many different varieties at several different points in the brewing process, there is good potential for experimentation, and for producing a whole range of interesting IPAs, none of which will be one-dimensional!

Yeast and Fermentation

Burton IPA was brewed in the famous Burton Unions. Many homebrewers practice a blow-off system in fermentation, and many of them think that this is similar to a Union system. It most definitely is not. In Burton, the fermentation was carried out in regular open vats for the first 2–3 days. The fermenting wort was then transferred ("cleansed") into a battery of large casks, which were water-cooled by means of internal pipes. As fermentation continued, the beer overflowed, by means of swan neck pipes into a common shallow trough where it was separated from the yeast and returned to the

casks. This whole system was called a Union and it permitted the Burton brewers to use a powdery, non-flocculent yeast. This meant that they could achieve high attenuation, which was important for a beer that was to travel long distances in warm conditions. They didn't want vigorous in-cask fermentation occurring in a ship's hold anywhere between Liverpool and Calcutta!

Such a system is not practical for the homebrewer, and can easily lead to contamination of the beer. Besides, as far as I know, the original yeast strain (which might well have been a mixture of strains) is not available to us. White Labs WLP023 (Burton Ale) yeast, however, gives an excellent IPA, with good attenuation and some estery character. Their WLP005 (British Ale) also works well, as does Wyeast 1098 (British Ale) and 1028 (London Ale), both of which attenuate well, with only a hint of fruitiness.

IPA worts should be fermented at moderate temperatures. Try to keep them at 65–70 °F (18–21 °C). Higher temperatures can lead to loss of bitterness and hop aroma, as well as ester production, which can dull the hop character at high levels. If you are bottling, dry hopping is best carried out in a secondary stage, after the first racking. It may take up to three weeks to get the full hop flavor from the dry hops.

The IPAs from Burton brewers were conditioned warm, in the hold of a ship. However, as a modern homebrewer, do not be tempted to use a hot conditioning stage. The temperature program that historical IPAs endured was a constraint, not anything the brewer planned or desired. One to three weeks of conditioning — at or slightly below fermentation temperatures, while dry hopping — should be all the conditioning your IPA requires.

Terry Foster wrote about stout in the September 2006 issue of BYO.

KEEPING it COOL

a FIELD GUIDE to TEMPERATURES on the COLD SIDE

by **Chris Bible**

Keeping your cool during brew day will certainly enhance your enjoyment of the brewing process. Keeping your beer cool when it matters most can greatly enhance the overall quality of your beer. Measuring and controlling the temperature of your mash and wort on brew day is important, and has been written about extensively in the homebrew literature, but temperature continues to plays a role throughout the life of beer. In this article, I'll present a "field guide" to the important temperatures on the cold side of brewing. This will include the reasons for hitting or maintaining various temperatures during wort cooling, wort aeration, fermentation, lagering, carbonating, storage and enjoyment.

Wort Cooling

The purpose of wort cooling is to precipitate the cold-break material — which is formed when proteins and polyphenols (tannins) come together — and to prepare the wort for aeration. The idea here is to bring the wort temperature down to the desired yeast-pitching temperature as quickly as possible.

Cold-break precipitate usually begins to form at a temperature of about 140 °F (60 °C). Although there is nothing that a brewer needs to do when the wort drops to this temperature, simply observing the formation of the cold break material can confirm that the cooling process is proceeding.

When cooling your wort, quicker is better because many types of bacteria and wild yeasts would dearly love to make a meal of your lovingly-prepared wort. Bacteria can take up residence in your wort once it drops below lethal temperatures. It is best to minimize the time that the wort temperature is in the range in which bacteria can multiply quickly — for many wort-spoilers, this means the 90–120 °F (32–50 °C) range. Since quicker cooling is better, the cooling water that is used to cool the wort via a heat-exchanger (e.g. counter-flow chiller or immersion coil) or

immersion should be as cold as possible. If you do anything active during your cooling procedures (such as adding ice or swirling your chiller), this is the range where your actions would be most helpful. However, keep in mind that most homebrewers cool their wort faster than commercial brewers because we brew on a much smaller scale.

> "Keep your beer cool when it matters most."

Wort Aeration

Wort aeration is the act of introducing oxygen into the cooled wort. This can be done by injecting oxygen or air into wort using a pump or compressed air source, or agitation of the wort to increase surface area in contact with air. The purpose of this step is to provide optimal conditions for yeast growth during the fermentation process. The temperature at which wort aeration occurs is important because the solubility of oxygen in wort decreases with increasing temperature. The graph on page 49 shows the effect of temperature on oxygen solubility in water.

Cooler wort can hold more dissolved oxygen, so it is advantageous for the wort to be as cool as possible during this step of the process. Note that the solubility of oxygen may play a role in your decision of how to cool your wort and pitch your yeast when making a lager. Some sources instruct homebrewers to cool their wort to 75 °F (24 °C), pitch their yeast, then cool the fermenting beer to lager temperatures once fermentation is evident. Other sources advocate chilling the wort all the way to fermentation temperatures. In the latter case, you could potentially dissolve around 25% more oxygen into your wort by cooling the wort down to 50 °F (10 °C), compared with cooling to 75 °F (24 °C).

Fermentation

Fermentation is the biochemical conversion of fermentable sugars in the wort to ethanol, CO_2 and flavor compounds by the action of yeast. The purpose of this step is to turn wort into beer. The fermentation process involves complex interactions of biological, chemical and physical factors. Factors such as wort temperature, wort pH, yeast nutrient availability to the yeast cell, dissolved oxygen content, etc. all interact and play a role in the fermentation process.

The role of temperature in the fermentation process is related to how temperature affects yeast metabolism. When yeast metabolize sugars at higher temperatures, metabolism occurs more quickly, and more flavor compounds will be produced than at lower temperatures. The finished beer will contain increased levels of fusel alcohols, esters, lactones, organic acids and sulfur compounds. These additional flavor compounds may or may not be desirable, depending upon the style of beer. If yeast metabolize sugars at a lower than optimal temperature, a sluggish or incomplete fermentation may result. Residual sweetness in the finished beer will likely be higher than desired.

Optimal fermentation temperatures depend upon the specific strain of yeast in question. In general, the optimal fermentation temperature range for ale yeasts is 59–68 °F (15–20 °C). The optimal fermentation temperature range for lager yeasts is 39–54 °F (3.8–12 °C). For yeast strains that ferment German wheat beers or Belgian-style ales, the fermentation characteristics may vary a great deal depending on temperature. For these, knowledge of the individual strain is often needed to get the best results.

Conditioning (Lagering)

Lagering is the storing of bottom-fermented beer at cold temperatures. The purpose of this is to enhance the finished

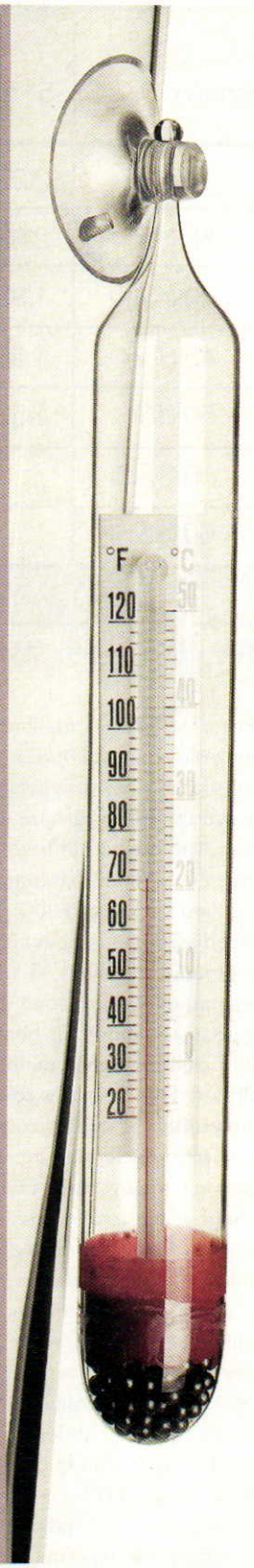


PHOTO BY CHARLES A. PARKER/IMAGES PLUS

Table 1: Combined Effects of Temperature and Pressure on CO_2 Content of Beer

Temperature (°F/°C)	5 PSI	10 PSI	15 PSI	20 PSI	25 PSI	30 PSI
30 (-1)	2.23	2.82				
35 (1.7)	2.02	2.52	3.02			
40 (4.4)	1.83	2.30	2.75	3.19		
45 (7.2)	1.66	2.08	2.51	2.94		
50 (10)	1.50	1.90	2.30	2.70	3.10	
55 (12.8)		1.75	2.12	2.47	2.83	3.18
60 (15.6)		1.62	1.95	2.27	2.60	2.92

Values in table are volume CO_2/volume beer

> "By understanding how temperature affects finished beer quality, brewers will ensure that the quality of their beer is as high as possible."

beer's flavor profile by "mellowing" and "smoothing-out" its taste. It also helps to settle out proteins, polyphenols and tannins that contribute to chill haze in the finished beer. The term "chill haze" is used to describe the haze which is formed when beer is chilled to 32–36 °F (0–2 °C). This haze will redissolve as the beer is warmed to a temperature of about 68 °F (20 °C). The temperature at which conditioning or lagering occurs is important because the removal of chill-haze compounds is best accomplished if the beer is as cold as possible. Solubility of these compounds decreases with decreasing temperature and maximum removal will occur if the beer is held at the lowest possible temperature for a time long enough for the precipitated material to settle out.

The ideal time and temperature for conditioning beer varies with the beer style. Ales may benefit from conditioning for 2–3 weeks at a temperature of 59–68 °F (15–20 °C). Lager styles such as Octoberfests may be conditioned for several months at 30–33 °F (-1.1–0.5 °C), and doppelbocks may be conditioned for a year or more! Greg Noonan, in his book "New Brewing Lager Beer" (1996, Brewers Publications), recommends that a dextrinous beer from a decoction mash be conditioned 7–12 days for each 2° Plato (roughly 0.008 increments in specific gravity) of the original wort.

Carbonating

Carbonating beer is the process of allowing carbon dioxide (CO_2) to dissolve into beer under pressure. This can be accomplished by force-carbonating with CO_2 or adding fermentable sugars or young, fermenting beer (kräusening) to induce a renewed fermentation in a closed vessel.

The temperature at which carbonation occurs is important because the solubility of carbon dioxide in beer is directly related to the temperature and pressure of the beer. Carbon dioxide is more soluble in beer at lower temperatures. The table above shows the effect of temperature and pressure on the equilibrium solubility of carbon dioxide in beer.

Generally speaking, beers that are to be consumed at lower temperatures are usually more highly carbonated than beers intended to be consumed at higher temperatures.

Packaging and Storage

Packaging is defined as bottling, kegging or putting beer into a cask, and "storage" is defined as placing beer into the best environment to preserve quality. Temperature is of minimal importance during packaging, but is very important during storage.

It is better to store beer at cooler temperatures. Cooler storage temperature will lead to slower oxidation, slower alteration of flavor profile and generally extend a beer's shelf life. Conversely, higher storage temperature leads to faster oxidation, faster alteration of flavor profile and generally decreased beer shelf life.

Homebrewed beer does not have to endure the rigors of shipping and potential poor treatment that can occur in stores where beer is sold. If you can store your homebrew at refrigerator temperatures (or colder), it will have close to the maximum theoretical shelf life, compared to commercial beers. (This assumes that the homebrew is not contaminated.) At a minimum, properly-stored, normal-strength beers can stay fresh for about 8 months; stronger beers can benefit from the preservative power of alcohol and some may keep for many years.

Enjoying the Beer

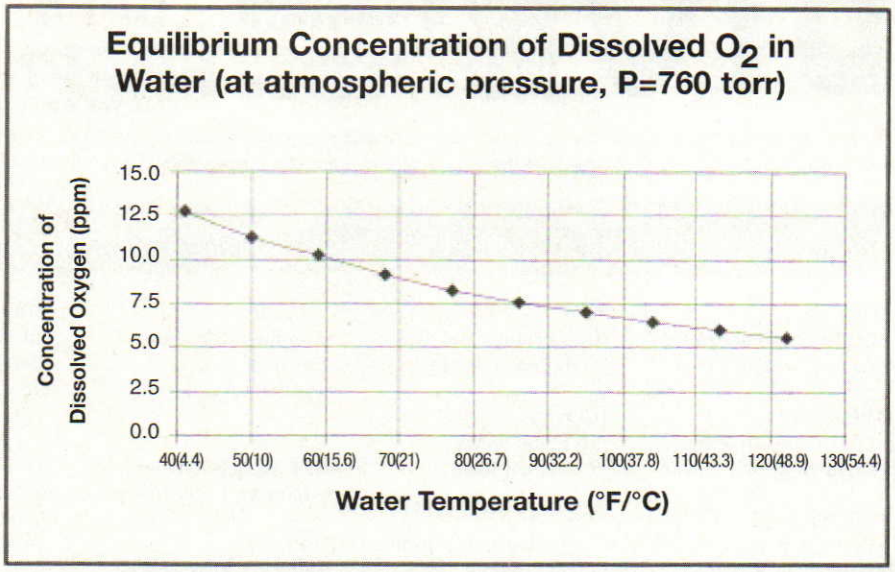
The role of temperature in the enjoyment of beer is very apparent to every beer drinker. At lower temperatures, beery increases, the rate of carbon dioxide release decreases, volatile flavor and

odor compounds are released less quickly and there is less overall flavor intensity. Ideal serving temperatures vary for different beer styles, but in general a temperature range of 48–52 °F (9–11 °C) is ideal for most lagers, wheat beers and lambics, while a slightly warmer temperature range of 50–60 °F (10–16 °C) is ideal for most other ales.

Summary

Keeping your cool when it counts is very important in the beer making process. Temperature is an important variable at almost every step, but your beer spends much more time on the "cold side" than your wort does on the "hot side." By understanding how temperature affects finished beer quality, and by controlling this single variable, brewers will ensure that the quality of their beer is as high as possible.

Chris Bible is a chemical engineer. This is his first article for Brew Your Own.



As the temperature of water — or wort, which is mostly water — decreases, the amount of oxygen that can dissolve into it increases. For homebrewers, this means that better cooling paves the way for more thorough aeration or oxygenation of their wort.

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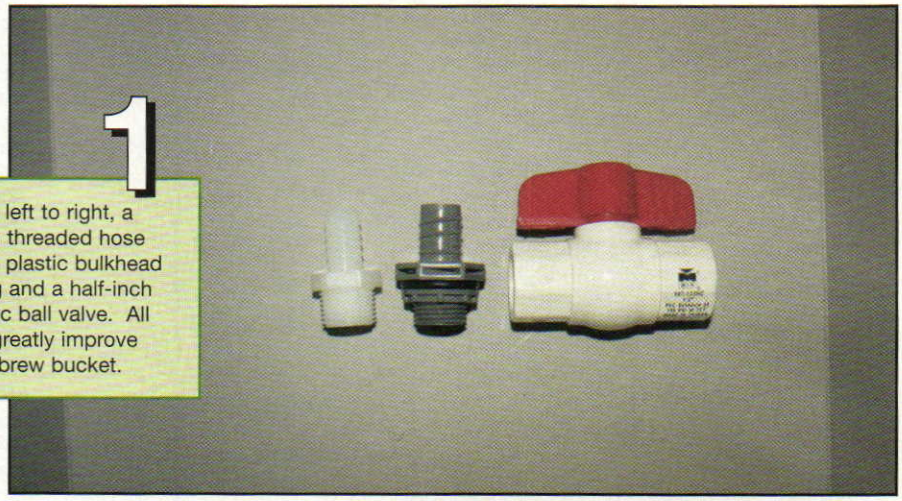
Pimp My Bucket

It is easy to make plastic fantastic

Story and photos by Forrest Whitesides

When it comes to choosing a primary fermenting vessel for your carefully planned and executed recipes, plastic buckets are often at the bottom of many homebrewers' lists. Buckets are widely regarded as inferior to glass carboys for a number of reasons: you can't see what's going on during fermentation, airlock activity is hit-or-miss due to a lack of an airtight seal, interior scratches could lead to contamination, the lids are difficult to remove, etc.



1

From left to right, a nylon threaded hose barb, plastic bulkhead fitting and a half-inch plastic ball valve. All can greatly improve your brew bucket.

There are, however, also some compelling reasons to use plastic. It is much lighter than glass and handles rapid temperature changes without cracking. More importantly, if you drop a plastic fermenter, the worst that can happen is a big mess. A dropped glass carboy, on the other hand, can be very dangerous and may result in nasty cuts or trips to the emergency room. (The next time you visit your favorite online homebrew forum, ask about glass carboy horror stories.) Plastic buckets are also easy to clean because you can reach in and wipe down the interior. Plus, it's easy to take gravity and tasting samples with such a wide opening compared to the thin neck of a glass carboy. They are also pretty darn cheap.

But while the pros and cons of plastic buckets are fairly evenly split for most brewers, a few simple and inexpensive modifications can eliminate a few of those negatives and make buckets an attractive option for primary fermenters. By adding an airtight, easy to remove lid and a plastic ball valve, the lowly bucket gains a lot of utility and gets a real boost in street cred, and it looks cool.

PARTS LIST

- A 6.5-gallon (25-L) brewing bucket (if starting from scratch)
- Gamma Seal lid
- ½-inch plastic ball valve
- ½-inch plastic bulkhead fitting
- ½-inch nylon threaded hose barb
- Teflon pipe tape
- Bucket lid grommet or rubber stopper with hole (if starting from scratch)

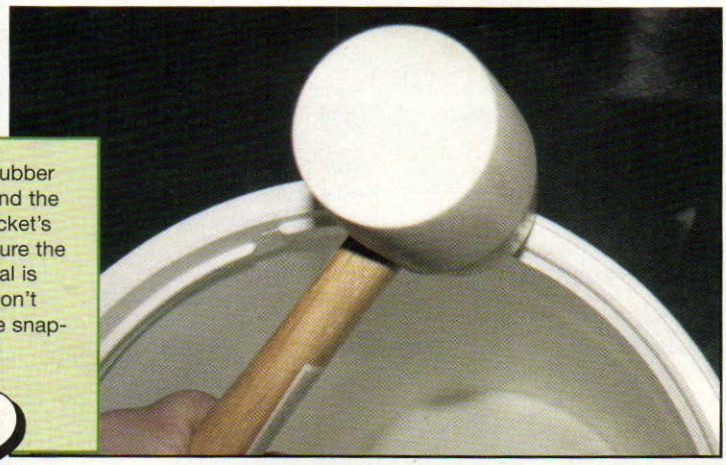
Necessary Components

Gamma Seal lids are widely available online and cost about $8 plus shipping. The other items are readily available at your local homebrew or hardware store. The ball valve and hose barb fitting can be found in the plumbing department, while the bulkhead fitting (grey plastic) will be found in the outdoor electrical wiring section near the waterproof switch boxes.

You'll need a drill and bits capable of making a ½-inch and ⅞-inch hole. A rubber mallet and Dremel tool are also handy, but aren't required.

Make it Airtight!

The stock lid that comes with the standard brew shop bucket can be . . . not so effective. These lids generally do not sit totally flush on the bucket, leading to small leaks during fermentation. This



2

Tapping a rubber mallet around the edge of bucket's rim will ensure the Gamma Seal is tight, but won't damage the snap-on base.

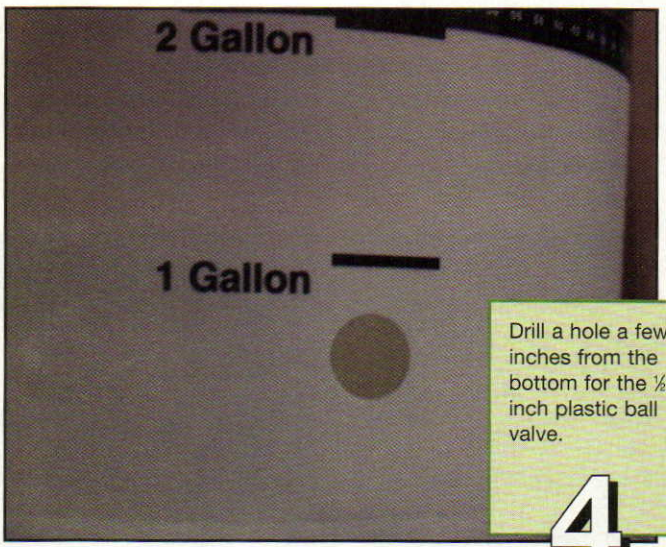
3

A half-inch hole drilled into the lid of the bucket serves as the airlock hole.

doesn't cause sanitation problems, but it does dramatically reduce or totally negate the frequency of bubbles going through the airlock. Many brewers use the rate of bubbling through the airlock as a way to measure the progress of primary fermentation. On top of being relatively leaky, stock lids are also notoriously difficult to remove.

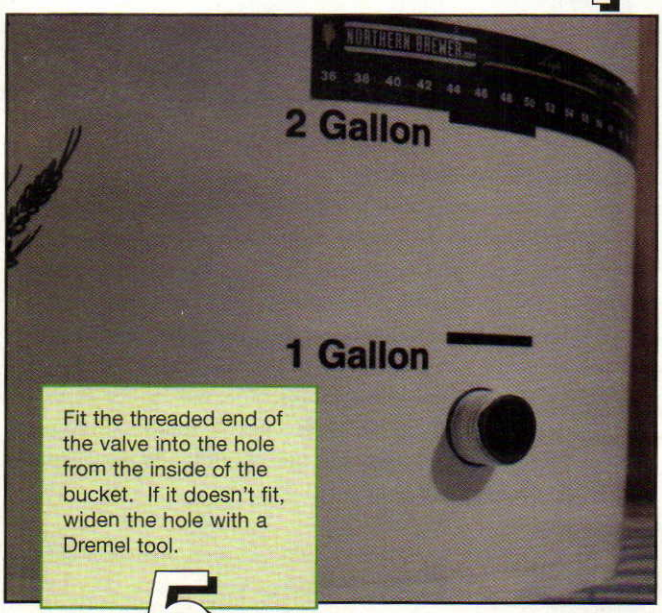
Enter the Gamma Seal lid, which comes in two pieces: the snap-on base and the screw-in lid. To install, press the base onto the rim of your bucket until it sits flush. Press down hard all the way around the base to insure a tight seal. If you have a rubber mallet, lightly tap along the top edge of the base. Using a mallet will guarantee a tight fit without damaging the base.

The Gamma Seal was not designed for homebrewing, so the lid does not have a hole for an airlock. No problem. Drill a ½-inch hole in the lid wherever you prefer. Now, if you're converting your old bucket, hijack the rubber grommet from the lid and slip it in the hole you drilled in the Gamma Seal lid. If this is a new project, use a tapered stopper with a hole, or a new bucket lid grommet (available at some brewing supply and hardware stores).



Drill a hole a few inches from the bottom for the ½-inch plastic ball valve.

4



Fit the threaded end of the valve into the hole from the inside of the bucket. If it doesn't fit, widen the hole with a Dremel tool.

5

Screw the ball valve into the bulkhead by hand until it is snug, being careful not to over tighten.

6

Ball Valve

Using a bottling bucket as a primary fermenter is nothing new; homebrewers have been doing it for years. But a ball valve adds a little something extra in the form of more precise flow control, a sturdier contruction than bottling spigots, and the ability to use screw-in attachments (such as a hose barb or quick disconnect fitting). The biggest advantage of a ball valve on your buck-

et is that you can forget all about racking with a cane and siphon. Just open up the valve and let gravity pull your sweet brew to the secondary fermenter or bottling bucket. Keep in mind, however, that long-term storage (months) of beer in a plastic bucket may lead to oxidation.

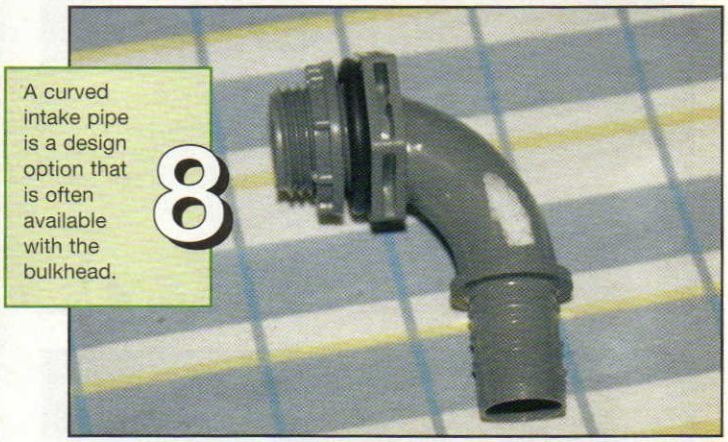
First, mark a dot about 1.5 to 2 inches (3.1 to 5.1 cm) up from the bottom lip of the bucket with a permanent marker. By setting up the valve at this height, the trub and yeast that settle out during fermentation will be below the valve's intake and won't be disturbed when the beer is racked. If you want maximum wort-saving efficiency (at the expense of clarity), mark the hole a little lower. Now drill a ⅞-inch hole, using the dot as the center point.

Unscrew the nut and remove the rubber O-ring from the bulkhead fitting. Wrap the bulkhead's threads with a generous amount of teflon pipe tape. From inside the bucket, insert the threaded end of the bulkhead through the hole. If the hole isn't quite large enough, widen it with a Dremel tool with a sanding drum.

With the threads through the hole, slide the O-ring over the threads and push it flush with the bucket. Screw on the nut and tighten it until the O-ring gets slightly flattened. Do not over tighten. When the bulkhead is installed, wrap the threaded end of the nylon hose barb with pipe tape and screw it into either end of the ball valve. Now screw the ball valve into the bulkhead until it is snug. Hand tighten only. Plastic is more delicate than brass or stainless steel. Too much torque will break the threads. Given the low cost of a bulkhead fitting (about $2.50), it's a good idea to buy an extra just in case. Be sure to test the integrity of the ball valve by filling the bucket at least half way and letting it sit with the valve closed for about half an hour to check for leaks.

Before and after each use, it's a good idea to break down the valve and soak it in a sanitizing solution. Taking a few minutes to sanitize the parts helps mitigate potential contamination. Most ball valves have a threaded end (called a Dutchman) that must be "broken" with a very large wrench the first time. This should be done PRIOR to mounting it on your bucket. Once you disassemble the valve, reassemble it hand-tight, then attach to the bucket with this end out. Cleaning becomes easy — close the valve, unscrew the Dutchman, drop out the ball and flush.

Add a stick-on thermometer and the bucket is ready to go with all the pros and very few of the cons of plastic. No longer will you wonder if fermentation has started (or finished), and your racking cane will gather dust as you let gravity do the work for you. Additionally, sampling will be simple thanks to the large, easy-to-open lid.



Design Alternatives

As with just about any DIY project, parts substitutions are practically unlimited. A Gamma Seal lid is a required part, but they are available in a wide array of colors to suit your brewing attitude or match your official brewhouse logo and color scheme.

The ball valve components, on the other hand, are considerably variable. For starters, the grey plastic bulkhead fitting is also available with a longer, curved intake pipe, making for an excellent dip tube with no added work. Or, you could use a spigot designed for bottling buckets, but this requires a larger-diameter hole than specified in this project.

Forrest Whitesides writes the "Projects" Column in every issue of Brew Your Own. *He is also a big fan of any Belgian-style brews.*

Fermentability

How low do you want to go?

by Bill Pierce

Advanced all-grain brewers strive to exercise enough control over their brewing so they can manipulate their ingredients and techniques in order to achieve the qualities they desire. For example, once a brewer gets to know his (or her) system, hitting his target original specific gravity (OG) consistently is often a goal.

The final gravity of your beer depends on your original gravity, fermentability of the wort and action of the yeast.

Somewhat more difficult — but just as important — is achieving a desired finishing specific gravity (FG). This affects several major characteristics of beer, including the alcohol content, mouthfeel and the perceived sweetness. Beers with a lower FG are less viscous and are generally perceived as less sweet; the opposite is true of beers with a higher FG. Beers with a greater difference between the OG and FG have higher alcohol content and are said to be more highly attenuated, that is they have greater fermentability.

By the numbers

Unfortunately, there is no easy formula for predicting the finishing gravity and the fermentability of a beer; there are only some very general rules of thumb. For example, beginning brewers are told to expect the FG points to be approximately one-quarter of the OG points. According to this rule of thumb, a beer with an OG of 1.048 will finish at about 1.012 (because one-fourth of 48 is 12).

The relationship between the OG and FG is called the apparent attenuation (AA) and the formula for it is:

$$AA = [(OG - FG) * 100]/OG$$

If a beer has an original gravity of 1.056 and a final gravity of 1.014, the apparent attenuation is 75%:

$$AA = [(56 - 14) * 100]/56 = 0.75$$

The attenuation is "apparent" (as opposed to "real") because it does not take into account the lower density of ethanol (specific gravity 0.07893) compared to water (SG 1.000).

The determination of real attenuation is more complex. It requires accurately weighing a sample of beer (to a resolution of 0.01 g), distilling off (at a lower boiling point than water) the ethanol, adding water to achieve the original weight of the beer and finally measuring the specific gravity. For an approximate formula for typical homebrew gravities, the OG and FG values must first be converted to °Plato). Then, the formula is:

$$\text{Real attenuation (RA)} = [(OG_{(°P)} - ((0.8114 * FG_{(°P)}) + (0.1896 * OG_{(°P)}))) * 100]/OG_{(°Plato)}$$

If we use the approximate conversion of specific gravity to °Plato as specific gravity points divided by four, the result for our example OG of 1.056 (14 °P) and FG. of 1.014 (3.5 °P) is a real attenuation of 60.8 percent:

$$RA = [(14 - ((0.8114 * 3.5) + (0.1896 * 14))) * 100]/14 = [(14 - (2.84+2.65))*100]/14 = 60.8$$

The major reason for difficulty in predicting and controlling the attenuation of a beer is that the factors are rather complex and subtle. However, that does not make it impossible to do so. Armed with information about the ingredients and brewing techniques that affect fermentability, you can learn to greatly influence the outcome with regard to this important aspect of your beer.

Ingredients are the key

Two very important determinants of final gravity are grain (or extract or sugar) and yeast selection. Pale base malts and adjunct grains produce the most fermentable wort (wort that may ferment to an apparent attenuation of 70–80%), while darker specialty malts contribute to less fermentable worts. Caramel and crystal malts will yield wort that only ferments to 40–60% apparent attenuation. With dark roasted malts, this may be as low as 25%. On the other hand, simple brewing sugars have very high attenuation. In the case of table sugar (sucrose), the apparent attenuation can be more than 95%.

Due to the manufacturing process, malt extract is usually less fermentable than mashed grains. The apparent attenuation can vary in the range of 50–75% depending on the brand and color. If you brew with extract and wish to accurately predict fermentability, it's worth consulting your supplier or the manufacturer for the typical value.

Yeast suppliers will give the range of apparent attenuation that a strain typically exhibits. The numbers are based on the assumption that all-malt worts — made from pale malt and only a small percentage of darker specialty malts — are being fermented. Additionally, they assume adequate pitching rates and aeration, as well as fermentation in the recommended temperature range. Some highly attenuative dried ale strains can achieve an apparent attenuation of 80% or more, while the least attenuative liquid strains can be in the low 60% range.

Inside the mash

Beyond the selection of ingredients, fermentability is largely a matter of controlling the mashing process. During

mashing, the crushed grain is mixed with water to hydrate the proteins and starches and dissolve any sugars already present. Whether in a single temperature rest or during multiple steps, the starches are gelatinized (transformed to a semi-liquid state) and acted upon by various malt enzymes to convert them to sugars of varying complexity.

The two most important enzymes are alpha-amylase and beta-amylase. Alpha-amylase randomly breaks the long chains of starch molecules into smaller pieces. Beta-amylase works on the ends of the pieces and produces maltose, an easily fermentable disaccharide (sugar molecule in two parts), and so-called "beta limit dextrins." The degree of complexity of the sugars is what determines those that can be metabolized by the yeast, thus contributing to fermentability, and those that will remain in the finished beer.

These processes and enzymes are dependent upon the temperature, which is why controlling the mash temperature is so important for all-grain brewers. There are additional, somewhat less significant factors, which we will examine later.

A matter of degrees

In order for the enzymes to function effectively, the starches first must be gelatinized. For barley, this occurs at a temperature range of 140–149 °F (60–65 °C); the range for wheat is 136–147 °F (58–64 °C). Some other adjunct grains (corn and rice, for example) have higher gelatinization temperatures, which is why they must be used in either flaked (pre-gelatinized) form or boiled in a separate cereal mash. Beta-amylase is active at the same temperature range as barley gelatinization (140–149 °F/60–65 °C). At higher temperatures, it quickly begins to be denatured and is much less effective. Alpha-amylase begins to work at 140 °F (60 °C), but is most effective in the range of 149–158 °F (65–70 °C), above which it too begins to be denatured.

Note that there is some overlap in these temperature ranges, which allows for considerable manipulation of the mash schedule. Beta-amylase, which is more active at a lower temperature range, produces less complex and more fermentable sugars. Alpha-amylase, which is more active at a higher temperature range and produces more complex, less fermentable sugars.

You may sense a general trend emerging: lower mash temperatures favor beta-amylase, which results in higher fermentability, while higher temperatures favor alpha-amylase, resulting in less fermentable wort. But the starches must be gelatinized (and beta-amylase activity is partially dependent on alpha-amylase activity). Accordingly, there is a minimum temperature of about 148 °F (64 °C) at which gelatinization has occurred and alpha-amylase becomes sufficiently active. Likewise, beyond a maximum temperature of around 158 °F (70 °C), neither enzyme is effective for very long.

For the single temperature infusion mashes, a temperature of 148 °F (64 °C) will produce more simple sugars and a more fermentable wort, while a rest at 158 °F (70 °C) will result in more complex sugars and less fermentable wort. There is also a temperature that tends to equalize the effect of both alpha- and beta-amylase, which is why many single infusion mash recipes recommend a temperature rest at 152–153 °F (66 °C). This attempts to strike a balance between the enzymes and produces wort of "average" fermentability. Actual mashes performed under test conditions show a decrease in apparent attenuation of more than 6% between wort mashed at 148 °F (64 °C) and 158 °F (70 °C).

Although not strictly necessary with modern malts, it may sometimes be desirable to do a step mash, in order to maximize efficiency (the extraction of total sugars, as opposed to fermentability) and the effectiveness of both alpha- and beta-amylase. Popular step mashes often include rests at 140 °F (60 °C) and 158 °F (70 °C), the bottom and top of the active temperature ranges for both enzymes and the minimum temperature for barley starch gelatinization.

Beyond temperature

While the mash temperature is clearly the most important factor in controlling fermentability, there are others. The time for the rests during mashing also affects fermentability. Modern well-modified and highly enzymatic malts are known for their quick conversion of starches to sugars. Tests prove that the great majority of starches are converted in the first 5–10 minutes as they are hydrated and gelatinized and brought to the correct temperature. This has led some brewers to conclude there is little benefit from mashing for a much longer period of time. However, conversion does not tell the entire story. There is evidence that beta-amylase takes somewhat longer to work than alpha-amy-

FERMENTABILITY FACTORS

FINISHING GRAVITY	PALATE	GRIST	MASH SPECIFICS	FERMENTATION
Low	Dry	-Pale Malts -Corn & Rice Adjunctions -Simple Sugars (e.g. dextrose)	-Low Mash Temps (148-150° F) -Longer Mash (60-90 min.) -Thinner Mash (1.5-2.0 qts./lb.)	-More Attenuative Strain of Yeast -Aerate Well Post-Boil -Higher Fermentation Temp in Range
High	Sweet	-More Specialty Grains -More Unfermentable Sugars (e.g. lactose)	-Higher Mash Temp (155-158° F) -Shorter Mash (30 mins. or less) -Thicker Mash (1.09 qts./lb.)	-Less Attenuative Strain of Yeast -Lower Fermentation Temp in Range

lase. Therefore a longer rest (up to 90 minutes) will encourage greater fermentability, although the effect seems to be much less than that of the temperature itself. Common conversion rests for mashing with modern malts are 30–60 minutes.

Additionally with multi-step mashes, varying the difference in times between the beta- and alpha-amylase-favoring rests will change fermentability slightly. If you are seeking more fermentable wort it may be worth increasing the beta rest and decreasing the alpha rest time.

A minor factor is the mash thickness, the ratio of water to grain. There are limits, however. The grain becomes fully hydrated at a water/grain ratio of about 1.0 quart per pound (2.1 L/kg), which should be considered a minimum, and the enzymes become too dilute and less effective at more than about 2.0 qts./lb. (4.2 L/kg). Within this range the effects of the mash thickness on fermentability are believed to be small, and other considerations such as mash tun capacity, ease of mixing and stirring, and ease of increasing the temperature should take precedence.

One final issue is the mash pH. Research has shown that beta-amylase is favored at a somewhat higher pH (~5.5) than alpha-amylase, which has an optimum pH of 5.0. This might suggest increased fermentability with a higher mash pH, but in general, as long as the mash pH is within the recommended range of 5.2–5.6 there are no problems.

Not the least is the yeast

Yeast management and fermentation procedures also affect the FG a brewer achieves. Every good brewer knows the importance of pitching a sufficient population of healthy yeast. The classic ale pitching rate for commercial breweries is one million cells per milliliter of wort per °Plato. However, there is some anecdotal evidence from Belgian brewers that slight underpitching (up to 25% less than the optimal population) can actually increase fermentability. The problem is that very few homebrewers have the ability to accurately count yeast. Given the consequences of severe underpitching, it is better to err on the side of pitching more yeast than needed than too little.

Ensuring that the wort is well-aerated when the yeast is pitched can increase attenuation. Optimal aeration involves more than merely stirring the wort or shaking the fermenter. An aeration or oxygenation system is a good investment. (See the December 2005 installment of the Advanced Brewing column for more information.)

Increasing fermentation temperature can also increase attenuation by increasing yeast metabolism. However, warmer fermentations also increase the production of various flavor compounds and that may or may not be appropriate for the style being brewed. One possible method of achieving higher attenuation, while overcoming this problem is gradually increasing the temperature as fermentation begins to subside.

Bill Pierce writes the Advanced Brewing column in every issue of Brew Your Own.

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brewer's log

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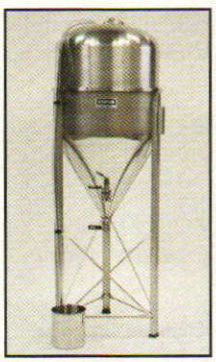

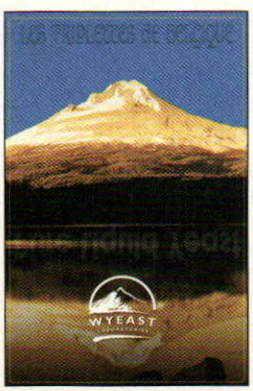

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Last Call

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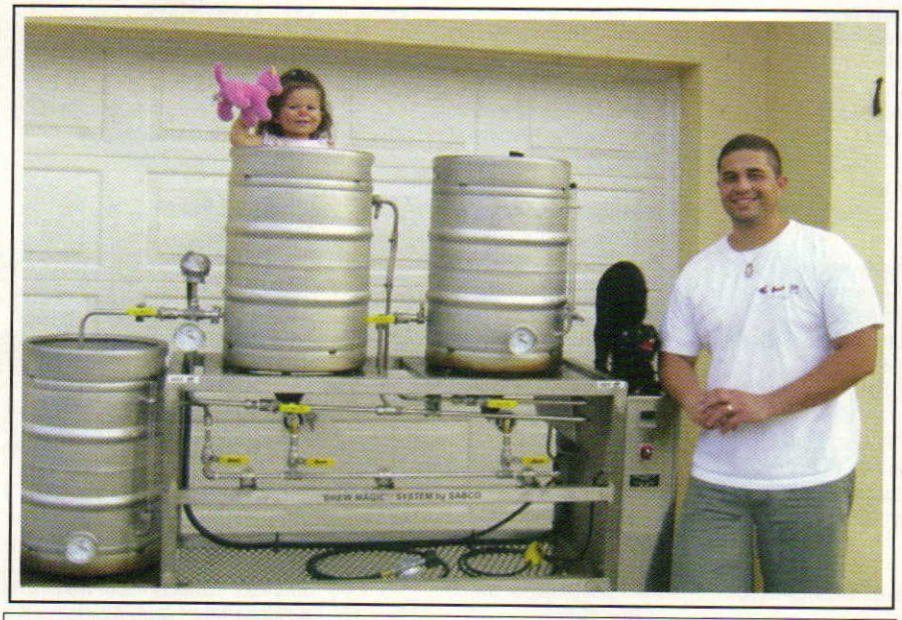
Giving bad luck a good name

by Joe Cruz • Guam

Has anyone had one of those bad days when no matter what you did, nothing went right? This is my story about how no matter what kind of bad day you're having, it can always get worse.

I'm a Marine and homebrewer living on the island of Guam. I've been brewing for approximately 5 years and never get tired of this hobby (just like the rest of you). I ordered a Brew Magic commercial unit from Sabco a few months ago and it finally arrived at customs. This is where my problems started.



Joe Cruz and his daughter almost never had the chance to see his Brew Magic setup thanks to a string of bad luck. He named his home brewery in honor of the experience.

Island customs said they were going to hold my Brew Magic hostage until I paid a 4% sales tax — I fought with them for a week before I paid the charge! Then, when I went to pay the tax, the lady behind the counter (who I dealt with over the phone) looked at me as I handed her my credit card and said "you're not going to like this." Because I was using a credit card, they had to charge me another 4% on the taxed total.

Well, after going through the hassle with the tax and customs, a whole new adventure arose. The delivery guy called from five miles away and said he was almost to my house, but broke down on the side of the road. I had to call the company and reschedule another drop off for later that day. Not a problem, I thought, because they said they would deliver it that day, no matter what.

The delivery company had to transfer my Brew Magic onto a second truck after the first truck returned (with my Brew Magic) from being towed. So what do you think happens next? The second truck supposedly has a heart attack and doesn't make it past the company gate before it breaks down.

But even then, do you think this real life Charlie Brown gets a break? I called the delivery company around 2:30 p.m. to see what's up only to hear that the company is holding a funeral service for truck #1 and truck #2 on Sunday. I said "you got to be kidding me." The man replied, "Hold on a second," and all I heard was yelling and cursing back and forth between him and one of his drivers. He got back on the phone and said, "I've got a third truck," to which I replied, "What, did it catch on fire?" He laughed and told me not to worry, that he would get my Brew Magic to me in about 20 minutes.

> "...he looked at me with a serious look and said, 'Do you have a forklift where you live?' I told him, 'yeah, I keep it next to the lawnmower.'"

When I met the lift truck at the base gates, we both parked. As I signed in the one guy the company sent, he looked at me with a serious look and said, "Do you have a forklift where you live?" I told him, "Yeah, I keep it next to the lawnmower." He laughed, as did a bunch of other people waiting in line to get base passes. I led him through the base gates and he followed me to my house, which is only about a mile and a half away from the gates, and it felt like eternity as I recalled his comment about the fork lift. When we finally arrived at my house, he backed the truck up into my driveway, got out and looked at me again with that concerned look on his face and said, "My lift gate is broken, how can we get it off?" I lost it. I started laughing like Tom Hanks when the bathtub fell through the floor in the movie "Money Pit." I think I scared the driver, because he asked me if I was all right – again with that concerned look in his eye – and I lost it even more. Usually my wife has some kind of comment to say, but I think she saw the crazy look in my eye as I went to get a hammer so I could break open the crate on the truck.

Well, in the end, we carried the Brew Magic off the truck and into the garage, and I gave the driver a tour of my home brewery – and even taught him a little about brewing. But with all the bad luck I was having, I felt like a black cat was circling my house, so that's where my brewery got its name, Black Cat Brewery. But in the end I've found that bad luck can make good beer.

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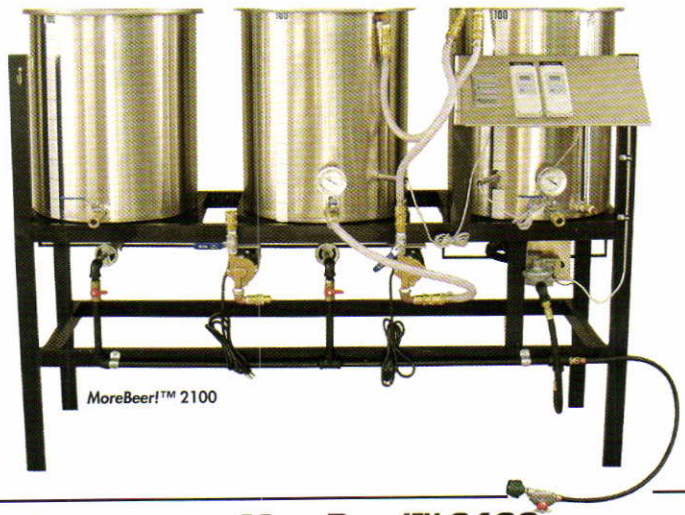
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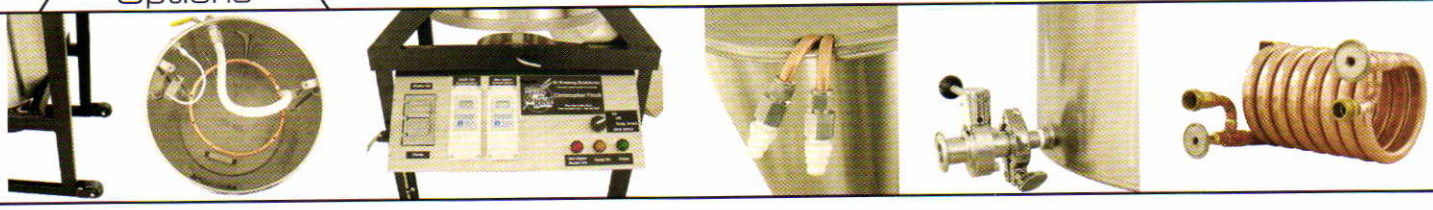

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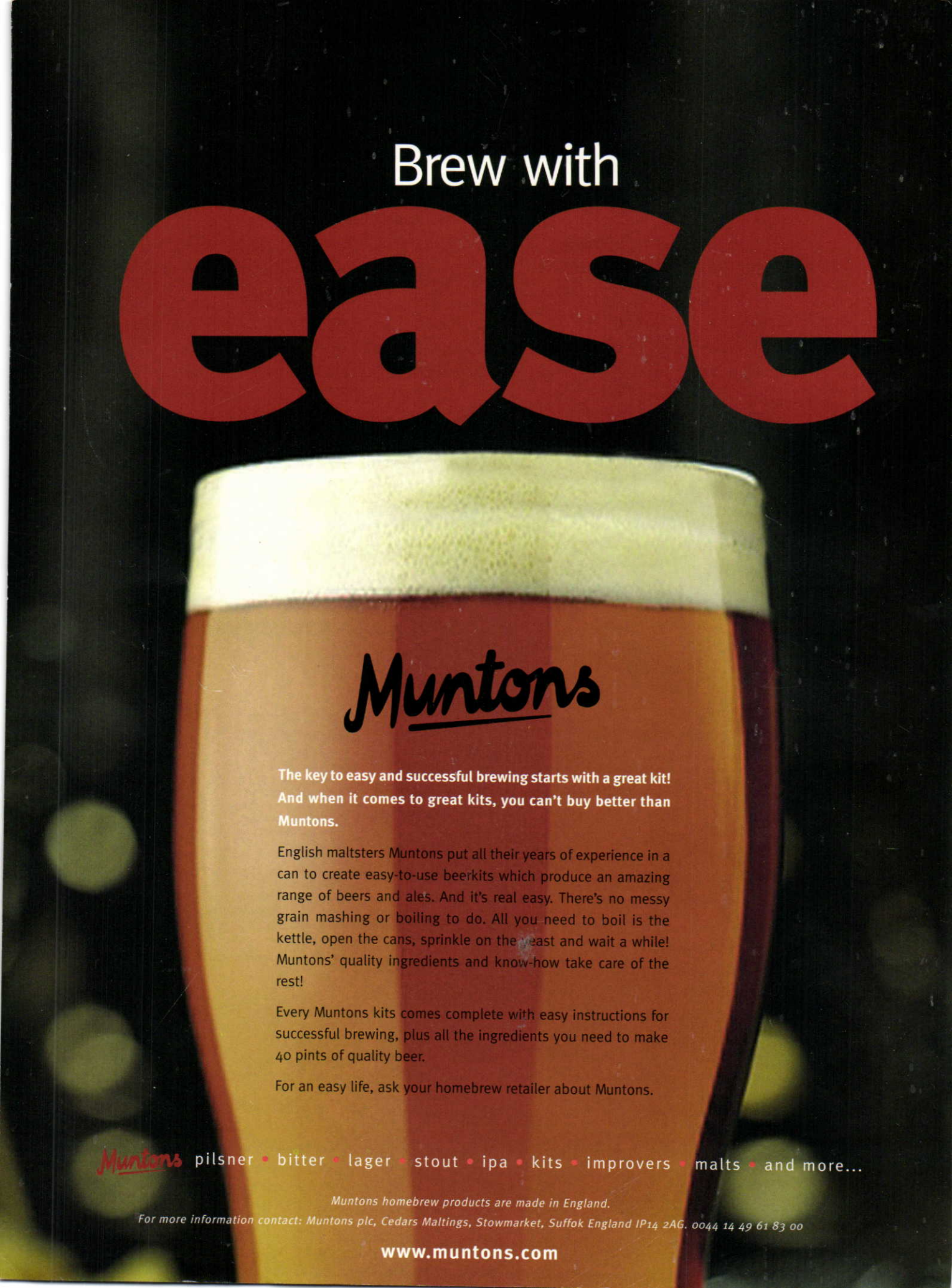
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