SPECIAL 24-PAGE HANDS-ON GUIDE!

Brew YOUR OWN

SEPTEMBER 2001, VOL.7, NO.7

THE HOW-TO HOMEBREW BEER MAGAZINE

HOMEBREW "U"

LEARN SKILLS BY BREWING:

- No-Boil Kits
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- Partial Mash
- Single Infusion Mash
- Step Mash

PLUS:

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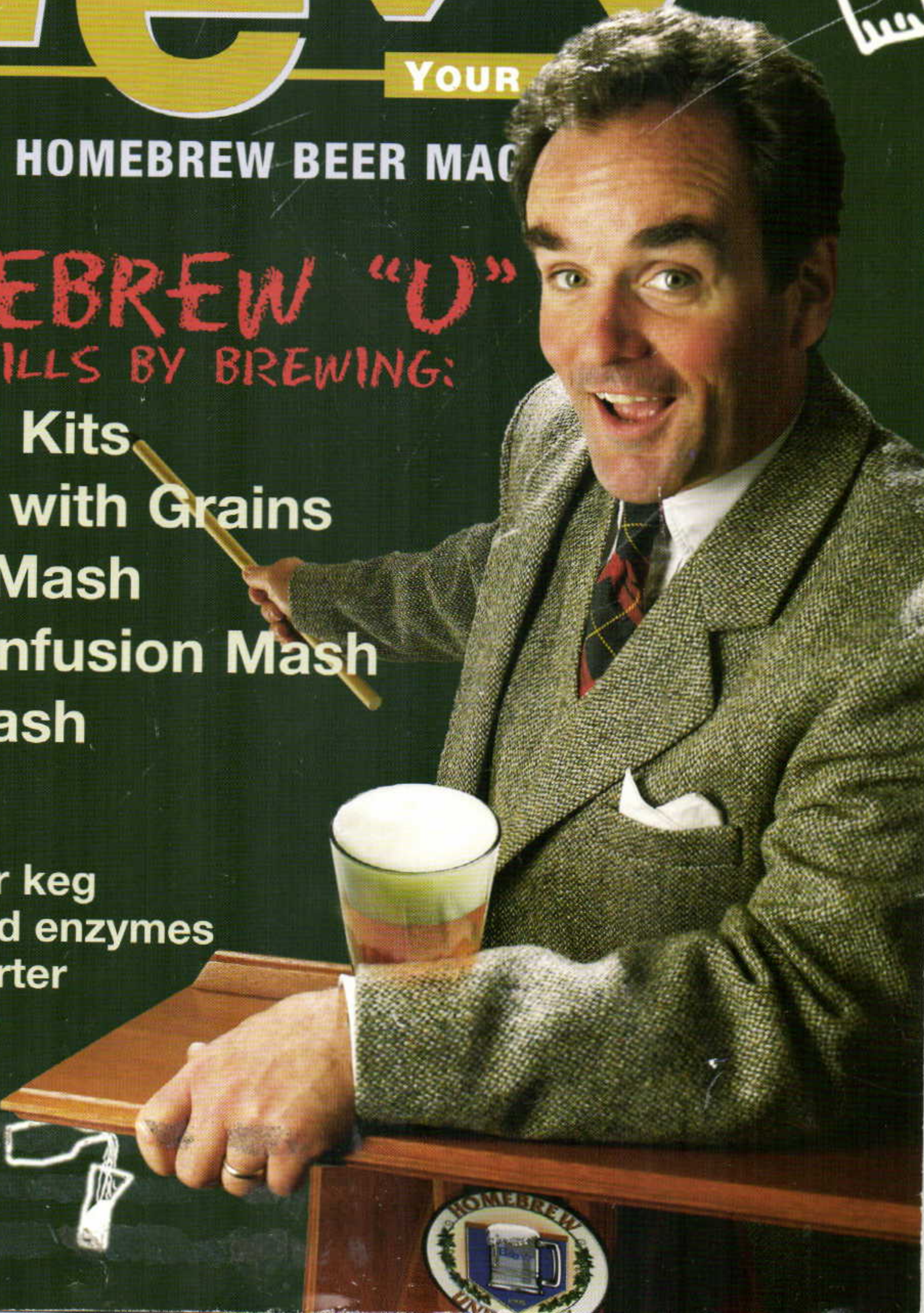

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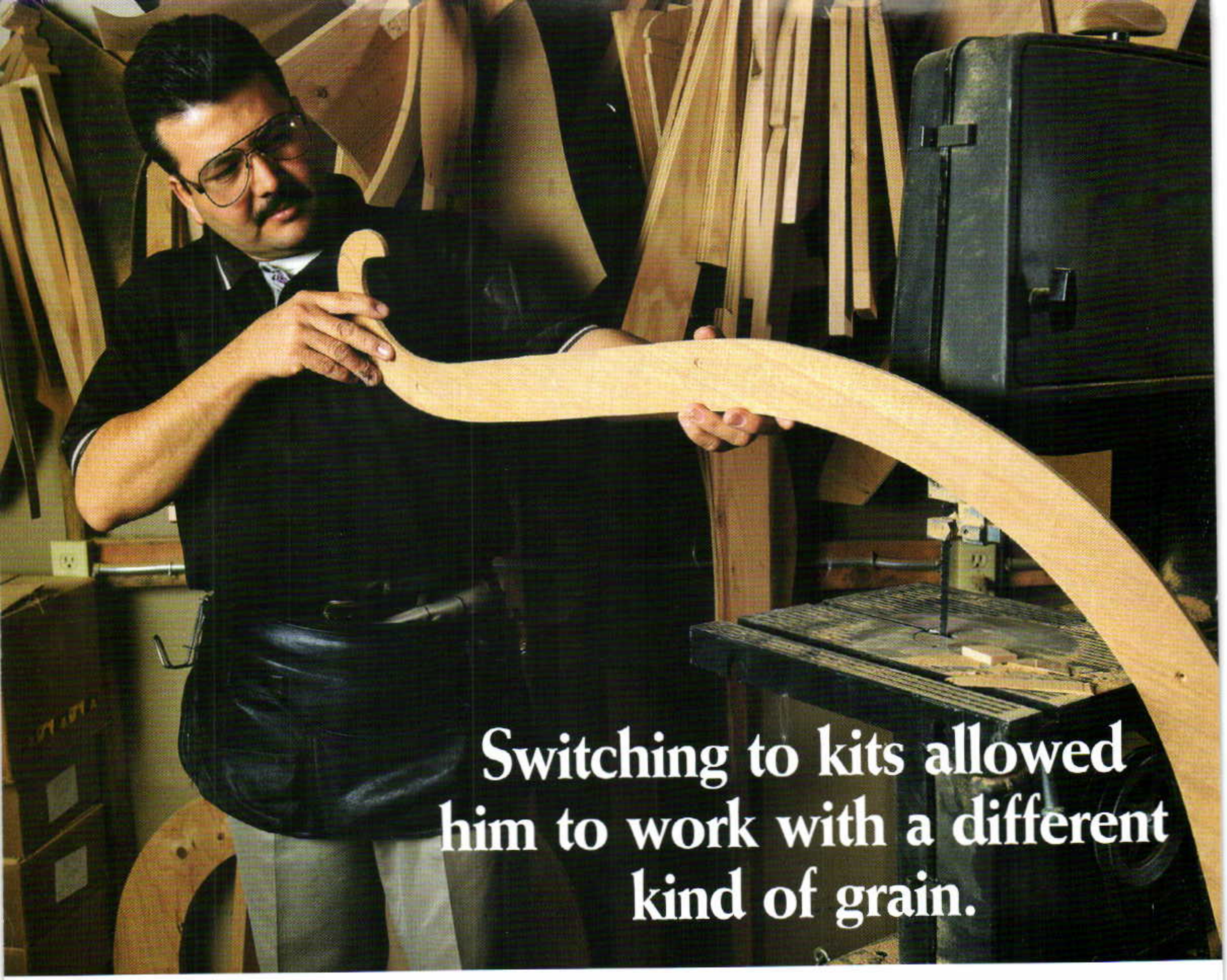

"I wouldn't have believed that a kit beer could be so good"

Roy Bailey - Beer Correspondent
CAMRA's 'What's Brewing' magazine (April 2000)

"It tasted just as good - if not better - than many a pint I've drunk in London pubs."

Richard Neill
'Weekend Telegraph' (April 99)

"It resulted in as good a home-made beer as I have ever tasted"

Maximum 5-point rating in kit review
'Bizarre' magazine (September 99)

This man loves beer and brewing. He's also discovered a talent for crafting fine furniture.

Full grain mash brewing was fine but it was taking up too much of his spare time. So he decided to look for an alternative brewing method that would still provide a satisfying hobby and an equally satisfying brew. The answer was waiting at his local brew store - Smugglers Special Premium Ale, Old Conkerwood Black Ale and Midas Touch Golden Ale - the Premium Gold range of brewkits from Muntons.

Because Muntons use only the finest English 2-row barley and water, the kits give the same quality result you get from full grain mashing - except, it comes in a can, is a whole lot more convenient and frees up more time to do other things.

Since switching to kits our man has never looked back. He's still brewing great beer but Premium Gold means he can see the beauty in other grains.

If you're a slave to full grain mashing, don't be! Switch to Muntons today.

Ask for Muntons Premium Gold at your nearest brew store.

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CIRCLE 23 ON READER SERVICE CARD

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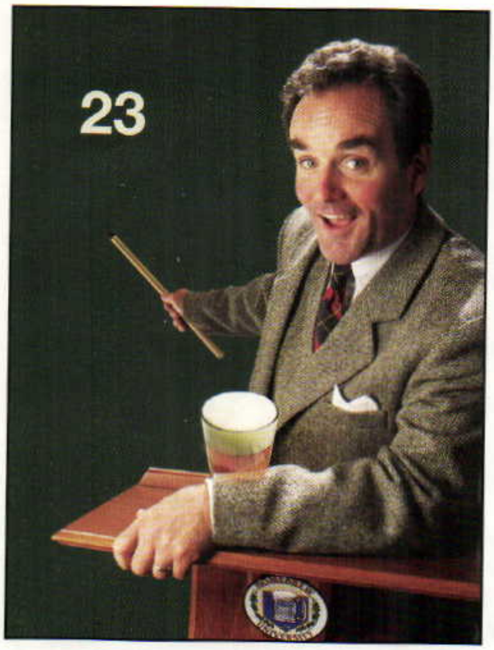
SEPTEMBER



Features

HOMEBREW UNIVERSITY

Check out this month's "Projects" column and learn how to make an old, tired "Corny" keg look and work like new!

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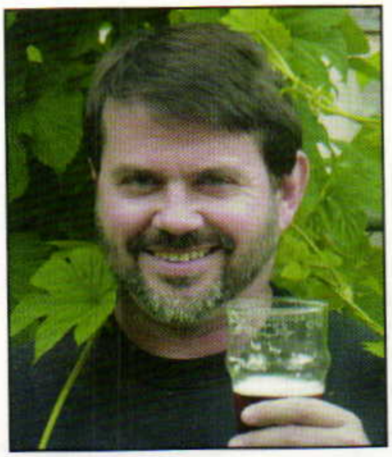
Where to find it

Cover photo: Charles A. Parker/Images Plus

Contributors



OUR NEW "REPLICATOR" columnist, Steve Bader, grew up in rural North Dakota in the wheat-farming community of New Leipzig. True to its German heritage, it's a serious beer-drinking town, complete with its own annual version of Munich's Oktoberfest celebration.

Steve has been a homebrewer since 1989, when he was given a copy of Charlie Papazian's "The Complete Joy of Homebrewing" for Christmas. He started teaching homebrewing classes in 1990 and has taught several hundred sessions in the last 11 years.

In 1992, Steve opened his own homebrew shop, Bader Beer and Wine, in Vancouver, Washington. Since then, he has developed a thick file of "clone" recipes for Pacific Northwest beers. He'll use this experience to help readers "replicate" their favorite beers. His first column appears on page 17.

STEVE PARKES IS THE owner and lead instructor at the American Brewer's Guild, a respected brewing school in Woodland, California. A bona-fide "science guy," Steve graduated in 1982 from Heriot-Watt University in Scotland with a degree in brewing science. He spent several years as a pro brewer in England, producing cask-conditioned beer. He moved to Maryland in 1988 and co-founded the British Brewing Company before heading west to California to launch the Humboldt Brewery in 1992.

Steve is a regular speaker at Institute for Brewing Studies conferences and a judge for the Great American Beer Festival. He's also a frequent contributor to various brewing publications. He lives near Sacramento with his wife Christine, their two kids, Sophie and George, a border collie named Rebus and Velcro the cat.

With the help of Steve, *Brew Your Own* is introducing a new department called "Homebrew Science." It debuts this month on page 51 and tackles the topic of enzymes in the mash.

CHRIS COLBY did quadruple duty this month by writing four of the five excellent articles that comprise our special "Homebrew U" package, which begins on page 23. Written and designed to resemble a typical textbook, "Professor" Colby's Homebrew U curriculum teaches homebrewers a comprehensive set of brewing skills, from the simplest no-boil extract beer to a single-infusion all-grain mash. (Our study culminates with a graduate-level class on step mashing and German helles taught by our technical editor, Ashton Lewis.)

We dreamed up the Homebrew U package months ago, but the idea didn't really come together until we called Chris, a science editor for Holt, Rinehart and Winston in Austin, Texas. He helped us develop our "curriculum," sketched out the slick textbook-style layout ... and then cranked out 12,000 words of information-packed text!

A biology and chemistry major from Augustana College, Chris earned his master's degree in molecular evolution and population genetics from Boston University. Chris also writes the "Techniques" column in every issue of *BYO*. ■

Brew YOUR OWN

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Wizardly Advice

I would like to add something to Mr. Wizard's response to John Husted's question in the May issue (regarding carbonating just a few bottles). The Wizard suggested some excellent ways to work with small amounts of priming sugar, but Husted might also consider giving PrimeTabs a try. These are small, premade corn sugar tablets. The company sent me a free sample a while back, and I found three tablets per 12-ounce bottle to work satisfactorily for my tastes. While I found them to be too tedious to use when filling 50 or so bottles, they might be just the thing when bottling a six-pack.

Mike Lee
Susanville, California

The Wizard responds: "The hardest part about bottle conditioning beer by adding priming sugar to one bottle at a time is weighing out the sugar. PrimeTabs are a good way to make this tedious process more manageable when needed. Thanks for the advice!"

Puffed Wheat

I have a recipe that calls for torrified wheat and am having a hard time finding it. I have seen two different descriptions; it's like oatmeal or it's like puffed wheat. Is there anything more common that I can substitute to give the same effect or should I order some by mail? The recipe I want to brew is an English Cream Stout from the "Style Calendar" *(February 2001).*

David Gates
Victoria, British Columbia

Torrified wheat is made by heating unmalted wheat at high temperatures with dry heat so that it "pops." This is similar to hot-air popcorn except, in the case of wheat, the moisture content is lower than popping corn and the wheat does not "explode" like popping corn. Torrified wheat has a nutty flavor and lends fermentables and foam-positive proteins to beer. Raw (unmalted) wheat can be added to the mash instead of torrified wheat. The only major differences between the two are that raw wheat is harder to mill than torrified wheat and the raw wheat lacks the nuttiness imparted from the torrification process.

Big Brother BYO

I have only been brewing for about six months but I have successfully brewed five batches. Each was great, but one was exceptional. It was a German wheat beer kit that I modified and improved. My next batch of brew is going to be an Irish amber ale. All my batches have been partial mash and I would have made a lot of mistakes if you guys weren't looking over my shoulder. I read many books on homebrewing but your magazine has been my biggest source of information and enjoyment. I owe my success to you! Thanks, *BYO*.

Paul Kinzie
Atlanta, Michigan

Caramel Questions

How do I get a pronounced caramel flavor in my beer? I made some caramel and added it to the wort before the boil. In a second batch, I added it after the fermentation was finished but the flavor still disappeared. Do you know where I could find a caramel extract? The caramel syrups sold in grocery stores are mostly sugar and fermentables.

Mark Yehle
Ashland, Missouri

If you're pouring ice-cream sundae sauce into your kettle, don't! Though caramel sauce tastes great, it contains artificial ingredients that can impede fermentation. Instead, to achieve a pronounced caramel flavor in your beer, use up to one pound of crystal malt (80° to 120° Lovibond) in each five-gallon batch. You could also remove two cups of your wort, caramelize it down to six ounces, swirl a little more hot wort in the saucepan and pour it back into the brewpot.

Black Beauty

I just wanted to say that I brewed the Black Butte Porter clone recipe *(March 2001)* and it turned out great. I think that it is even better than the original. Thanks for the recipe!

Jeff Hertz
Glen Ellyn, Illinois

Counter-Pressure Filler

In the May issue of *BYO*, Thom Cannell's "Projects" column describes how to build an affordable counter-pressure bottle filler. It was an excellent article with easy-to-follow instructions. I have acquired most of the basic materials needed and I am wondering about a piece that seems to be missing. In the instructions, Step 4 reads: "To fill the bottles, replace your regular gas-in keg connection with a common tire chuck." Doesn't the gas line need to go to the keg too? Should it have a T or ball valve instead?

Also, I understand that the gas released from a pressurized bottle will cause a decrease in pressure in the bottle, because the liquid from the keg, which is at a higher pressure, will travel to the bottle in an attempt to equilibrate the pressures. Will the initial pressure in the keg be high enough to

PHOTO BY THOM CANNELL

bottle the whole thing? If the pressure changes in the keg as bottles are filled, won't you end up with different carbonation levels?

William Dunlop
Brandtford, Ontario

Thom replies: "Good question, William.

The connection at the CO2 generator (or high-pressure tank) normally goes from the regulator to a fitting designed to attach to the keg — whether pin-lock or ball-lock — so it can supply appropriate pressure to the keg. It is that 'gas-in' fitting I'm referring to. Replace the keg-side gas fitting with a barb-fitting tire chuck. Or put a T-fitting at the exit side of the regulator, two barb fittings at the T outlets, and separate hoses to the keg's gas-in and a barbed tire chuck. Then adjust the pressure to appropriate levels for carbonation or for dispensing.

As for your other question, there are two different kinds of counter-pressure bottling. One pushes, the other — our system — uses gravity. There should be a slight positive pressure in the keg to assist the first bottle, but (theoretically) the lower discharge point for the bottle is at a point lower than the bottom of the pickup tube in the keg. The keg should drain because of the difference in height. But because a keg is closed it might be necessary to keep 3 to 4 psi in the keg to assist.

You're theoretically dealing with a pressurized container of beer (the keg), whether it became pressurized via CO2 or was naturally carbonated. It should simply drain because of the difference in height between keg and bottle. So keep a bit of positive pressure in the keg and tell us your experience. The purpose is to fill a few bottles. This is not a substitute for normal bottling."

How to Lager?

I've seen different articles in *BYO* about brewing lager. One recommended method is to run a primary fermentation at 50° to 55° for three to six days, followed by secondary fermentation at 45° to 50° F and lagering at 35° to 40° F for four weeks. The other way is to do primary fermentation at 45° F for three days, raise the temperature to 50° F for four more days, conduct secondary fermentation at 50° F, and then lager at 40° F for four weeks. Which is the best way?

Howie "Homebrew" Yost
Mission Hills, Kansas

Both methods, in addition to many others, are used by lager brewers. There is no "best" or "correct" method for all brewers and yeasts. Time and experience will allow you to pick a technique that works for you. ■

Stainless Valve Search

We have had many questions about where to find the stainless-steel tire valves used in our plastic mini-kegs (BYO December 2000). Stainless is difficult to find, but "Projects" author Cannell reports that chrome-plated tire valves are common. "Wanting to make more mini-kegs, I went to a tire shop. While they had no stainless-steel valves, they did have high-quality chrome-plated brass tire valves. Don't give up on the stainless — you might be able to special-order them — but well-cleaned chrome valves make a great substitute."

brewer profile

A Yank Brews in Britain • Marty Cowart, New Market, England

PHOTOS COURTESY OF MARTY COWART

Marty and his canine companion sit in front of his three-tiered gravity-fed homebrewing system.

I AM IN THE AIR FORCE AND STARTED homebrewing in 1998 while I was stationed on Guam. Some friends and I started the "Guam Brew Crew." Now that I live in England, I am slowly developing the English chapter of the good old Brew Crew.

I designed and built my home brewery with the help of an English friend who happens to do stainless-steel welding. I picked up three fifteen-gallon stainless-steel kegs from a local pub supplier and converted them to kettles. Then I found some 1-1/2 inch stainless-steel pipe at the local scrap-yard. The system is a three-tiered gravity-fed set-up. I use two 30,000-BTU burners for the hot liquor tank and the mash tun. I upgraded to a 170,000-BTU burner for the boil kettle. I'm very fortunate to have friends who specialize in metal fabrication.

Brewing outdoors in England is a challenge. I have to watch the weather forecasts, pray they're correct and plan a week ahead. As you can see in the picture *(at right)*, the weather doesn't always cooperate. The problem I have on bad weather days is maintaining the target temperature *(see "Help Me, Mr. Wizard" on page 11)*.

Early in my homebrewing adventures, I was skeptical of stouts, porters and bocks after Terry and Sam, two avid homebrewing friends, gave me a doppelbock for my first sample of homebrew. It was a bit dark, strong and hoppy for my taste back then. Almost five years and 81 home-brewed batches later, I received the March issue of *BYO* and sat down to read "Build a Great Stout."

After reading the article, I decided to go down to the local pub (The Rose and Crown) and sample a pint of Guinness draught. When I tasted it, I thought to myself, "Why didn't I do that years ago?" Since I had brought the *BYO* issue with me, pub patrons and I began conversing about homebrewing and discussing different articles in the magazine, while having a few more samples, of course.

This experience has opened my eyes to dark beers and I plan on trying many new styles. Now that the blinders have been removed and my taste buds have ventured to the dark side of beer, there's no telling what's next on the homebrewing horizon.

Marty monitors his mash temperatures in the cold, rainy English weather.

reader recipe

Mudbone Brown Ale

(5 gallons, extract with grains)
OG = 1.068 FG = 1.018 IBUs = 50

Here is a recipe I recently devised. I wanted a brown, nutty ale and tried several recipes. I played with the grain bill and came up with what my friends call my best brew yet. The roasted barley adds a unique nutty character, and the carapils helps give the brew great body and mouthfeel.

Andy Coppock
Vista, California

Ingredients

1 tsp. gypsum
5 lbs. John Bull light liquid malt extract
3 lbs. dark dried malt extract (DME)
0.50 lb. Victory malt (25° Lovibond)
0.50 lb. roasted barley (300°+ Lovibond)
0.50 lb. carapils malt (1.5° Lovibond)
11.3 AAUs Magnum hops (0.75 oz. of 15.1% alpha acid)
5.6 AAUs Cascade hops (1 oz. of 5.6% alpha acid)
6.1 AAU Kent Goldings hops (1 oz. of 6.1% alpha acid)
1 tsp Irish moss
British Ale Yeast (White Labs WLP005)
2/3 cup corn sugar or 1-1/4 cup DME for priming

Step by Step

Add gypsum to 2-1/2 gallons water, bring to 155° F. Steep grains in 2-1/2 gallons 155° F water for 25 minutes. Sparge with 1/2 gal. 155° F water. Add liquid extract and DME. Add Magnum hops at beginning of boil. Boil 30 min. and add Cascade hops. Boil 20 min. and add Kent Goldings hops and Irish moss. Cool wort and top up with cool water to 5-1/2 gal. Pitch yeast at 68° to 70° F, ferment 7 to 10 days, rack to secondary for an additional 5 to 7 days. Bottle with 2/3 cup corn sugar or 1-1/4 cups DME.

homebrew club

BURP in our nation's capital • Washington, D.C.

PHOTO COURTESY OF BILL RIDGELY

BURP's diverse collection of members gathers for a festive beer-tasting session.

BURP (Brewers United for Real Potables) was started in September 1981 by a small but particularly avid group of homebrewers. With the addition of several energetic leaders, such as Dan McCoubrey — late sports editor at the *Washington Post* — the club grew quickly into one of the premier homebrew organizations in the country. BURP has about 300 members, including a number of couples and many women. BURP meets monthly and each meeting follows a theme, usually a particular beer style or process. The meetings start with an educational session on the style and a commercial tasting, then move on to a competition.

BURP hosts a number of annual events, conferences and festivals, including: The Spirit of Free Beer Homebrew Competition, one of the largest regional competitions in the country; The Mid-Atlantic States Homebrewers Campout (MASHOUT), a regional weekend campout held every August; and the BURP Real Ale Competition and Festival, a celebration of the joys of English-style cask- conditioned ale. For this event, judges from around the country judge 30 to 35 kegs of home-brewed cask ale served on 18 authentic English hand-pull beer engines.

BURP's pride and joy is the Spirit of Belgium Conference. Held every two to three years, it focuses on Belgium and Belgian-style beers and brewing practices. The conference features renowned experts on Belgian beer and brewing (Michael Jackson was the speaker at this year's conference), tastings of rare Belgian beers and American-brewed Belgian-style beers, a Belgian-style homebrew competition and a traditional Belgian banquet and party.

BURP members brew at all levels, from extract-only to advanced all-grain. One of our members even built an addition to his house just to brew barrel-sized all-grain batches. Several of our members have built beautiful all-grain systems that rival some of those found in commercial craft breweries. These folks are constantly humbled, though, by one of our partial-mash brewers who routinely wins BURP competitions. ■

Special thanks to BURPer Bill Ridgely for providing this text.

reader tip

I ENJOY CREATING THE LABELS for my new beers almost as much as I like brewing (and drinking) them. I keg and force-carbonate all of my batches and I wanted a way to label my kegs as well as my taps.

I happened across a package of plastic sleeves meant to hold business cards and pressed these into service. They are sticky on the back, so they effectively label my kegs and the taps on the front of my refrigerator. When I brew a new beer, I put two labels into the sleeve on the keg and move one of them to the fridge when the beer is tapped. It really works great!

Debra Ann Cherry
Sugar Hill, Georgia

homebrew calendar

SEPTEMBER 8 AND 9

Tavern Days Celebration, Croton-on-Hudson, New York

A two-day beer-tasting festival held at the Van Cortlandt Manor, home of a 17th-century brewing family, an hour north of New York City. The festival features craft beers from the Hudson Valley as well as food, music, tavern songs and dancing. Historical brewing methods will be demonstrated. Hours: noon to 6 PM. Call (800) 656-1212.

SEPTEMBER 13 TO 16

Mount Angel 36th Oktoberfest, Mount Angel, Oregon

This Bavarian-style folk festival offers Bavarian specialty food, a Biergarten, a Weingarten and a "Microgarten" featuring some of the Northwest's best microbrews as well as four great beers from Munich. Call (503) 845-6882 or go to www.oktoberfest.org.

SEPTEMBER 22

7th Annual California Brewers Festival, Sacramento, California

Offering over 100 microbrews from breweries throughout the West. There will also be live music and local food. Located at the Cesar Chavez Park on 9th and J Streets. Call (800) 754-2261 or go to www.calbrewfest.org.

SEPTEMBER 27 TO 29

Great American Beer Festival, Denver, Colorado

The 20th annual GABF will feature more than 300 microbreweries and 1,200 beer selections. Informative educational booths, food and music. The annual GABF competition runs in conjunction with the festival. The festival is held at the Colorado Convention Center. Call (303) 447-0816 or go to www.beertown.org.

Join the Homebrew Nation! Send your homebrewing stories, tips, recipes and events to edit@byo.com. If we publish your tale, we'll send you our cool new Euro-style BYO bumper sticker.

Looking Back

What I wish I had known as a homebrewer

by Thomas J. Miller

PHOTO COURTESY OF JOHN MAIER

Brewer: John Maier of Rogue Ales in Newport, Oregon. John homebrewed from 1981 to 1987. He took the Siebel Institute long course in 1986 and has worked as head brewer at Rogue for twelve years.

Use a Hopback. If there is one piece of equipment that I really wish I had used as a homebrewer, I would have to say it is the hopback. This is a device used after the boil. We have a stainless-steel screen with a bunch of small holes — big enough to let the wort flow through, but not the hops. Homebrewers could fashion something of similar design, maybe out of a bucket top or perhaps a stainless-steel screen fashioned to fit inside a bucket or a pot. A hopback allows you to get an excellent aroma from the hops without losing some of the aroma characteristics, which might happen if you added the hops at the end of the boil. The longer the hops are in contact with the near-boiling wort, the more aroma is lost. The hopback makes the contact fast and the loss of aroma minimal. It adds tremendously to the brew.

Go Low-Co. I used to use some of the more standard dry-hopping hops like Chinook and Cascade, but I've found that the better finishing hops are low-cohumulone hops. Cohumulone varies between 20% and 65% of total alpha acids, depending on the variety. Some varieties, like Cascade, have higher levels of around 40%. These higher levels of cohumulone impart a harsh bitterness to the beer. Low-cohumulone hops are in the range of 17% to 25% and impart more subtle flavors and aromas, and they add to head retention. I prefer varieties like Horizon and Amarillo.

Mash Short. I would shorten the mash time and only do single-temperature mashes. The way malts are modified these days, I think homebrewers waste their time doing a step mash. We do everything single temperature at Rogue, and 148° to 152° F is the best range. The rest time only needs to be about 45 minutes. Lab tests show that conversion can be reached in seven minutes, but I wouldn't try that. You could try 30 minutes, too. I mean, why extend the brew day?

Brewer: Mark Lupa of Tabernash/Left Hand Brewing in Denver, Colorado. Mark began homebrewing in the early 1980s, then helped to start Tabernash Brewery in 1993. Tabernash merged with Left Hand in 1998.

Transfer with Utmost Care. Transferring the beer is a critical step, and there are two times when you need to be very attentive. The first is when the hot wort is transferred to the lauter tun. It's important to minimize oxygenation at this stage, since it leads to off-flavors.

The second is the transfer of the hopped wort to the cooling vessel. The goal is to get the wort down to fermentation temperature as quickly as possible. You want to reduce the time that organisms other than yeast can work on it. Once the temperature is below boiling, those bad organisms will start going to work.

Monitor pH. I learned it's important to monitor pH during fermentation. This tells us how the yeast is managing. The pH drop is the first effect the yeast has in the fermentation process. A rapid decline in pH in the first days of fermentation is a good sign of healthy fermentation. The general starting pH is between 5.2 to 5.5, then it should drop to between 4.4 and 4.6. Anything below 4.2 means you might have some trouble with the beer. But if the drop isn't low enough, you will not have a complete fermentation. And if it's too slow, other organisms will have an impact.

Regulate Temps. The need for temperature regulation is often ignored because of equipment limitations. The goal is to create the right environment for yeast. If it's too hot — above 60° F for most lagers and above 70° F for ales — you'll get all kinds of by-products, like higher alcohols or fusel alcohols, which can impart a solvent-like and rubbing-alcohol flavor and aroma. If it's too low — below 40° F for lagers and below 65° F for ales — fermentation will be too slow. We regulate lagers at two levels. First we ferment for three days around 50° F, then we drop for several more days between 42° to 44° F. This limits the diacetyl.

PHOTO COURTESY OF BOB DAVIS

Brewer: Bob Davis of the Weyerbacher Brewing Company in Easton, Pennsylvania. Bob started working at the Weyerbacher brewery in September 1991 and became head brewer in 1998. He brewed at home for about five years before "going pro."

Count Yeast Cells. Professional brewing forces you to learn things you never even considered as a homebrewer. Yeast is one example. It's really easy to just grab a packet of yeast and throw it in the fermenter, and then let the little guys do their work. But knowing cell counts and the viability of your yeast is dreadfully important. Being able to do this requires some basic biology and chemistry skills, a microscope with slides, and the ability and patience to count the cells. As a general rule you want to check the cell count throughout fermentation to make sure they are propagating well and are viable, because this guarantees a good fermentation.

Make a Starter. This is helpful whether you count cells or not. However, there are some general rules of thumb. First, a thick slurry always trumps a packet of dry yeast. Second, an active, frothing starter always trumps slurry, which may contain dead, mutated or tired cells.

Watch the Temps. It is often beyond the enthusiasm of most hobbyists to strictly control their fermentation temperatures, but it can be vitally important. Most homebrewers only pay attention to temperature if they are lager brewers, but ale yeasts have preferred temperature ranges as well. Certain ale yeasts give off wacky out-of-flavor-profile esters if permitted too high a primary fermentation temperature, as is evidenced by certain Belgian beers which are fermented in the 80s.

Ignore IBUs. If there is one thing I have learned, it is that IBUs are not the gospel. They are absolutely impossible to duplicate exactly, so there is no point in worrying about doing so. Why? Because your kettle is different from Urquell's, or Bass Brewery's, or wherever. They more than likely get better alpha-acid extraction than you could ever dream of with your home brewery. You'll never know the exact IBUs unless you send your beer to a lab for analysis. Just make the best flavor, aroma, and (above all) the best beer you possibly can, and don't worry about trying to hit a target IBU. ■

Control the Heat

"*Help Me,* **Mr. Wizard**"

Metallic homebrew, calories and excessive ooze

Mr. Wizard

I have recently built a basic three-tier all-grain system out of three converted kegs. I am in the Air Force and currently stationed in England *(see page 7)*. Unfortunately, I must brew outdoors. This time of year the weather is cold, cloudy, windy, wet and rainy, especially during my brewing sessions. I have brewed six five-gallon batches and with every batch I have had a difficult time keeping my target temperature of 152° to 154° F. My temperatures bounce between 145° and 160° F. I usually hold my target temperature for 75 minutes of the 90-minute mash. When the temperature fluctuates, I try to get it back to the target as quickly as possible.

The batches have turned out with a normal OG for their particular style, and they have tasted great. My goal is to constantly improve my brewing techniques and create the best brew possible. Should I be concerned with the temperature fluctuations? If so, do you have suggestions for controlling the temperature?

Marty Cowart
New Market, England

Mash temperature in all-grain brewing has a significant and demonstrable affect on beer flavor. In general, multi-temperature mash profiles with temperature rests between 120° and 160° F will produce more fermentable worts than single-temperature mashes held between 152° and 154° F. In flavor terms, beer produced from highly fermentable wort tends to be drier, crisper and perhaps lighter in body than those made from less-fermentable worts. Concerns about precise temperature control are very real to commercial brewers because the ability to repeat mash temperatures directly affects beer consistency. And consistency is an important key to commercial quality.

When most homebrewers think of quality, we think of the sensory qualities of the beer. Does it taste, look and smell like intended on brew day? If it does, then all is great and we will have a quality brew. However, if you only want to brew that one beer, then you should attempt to be as consistent as possible with your mash temperature, along with every other key variable in the brewing process. On the other hand, if you want to brew a wide assortment of great-tasting homebrewed beer, I would not be overly concerned. It sounds like your mash stays in the desired range for most of the time and when it does cool off you heat it up in a reasonable time frame. I would be more concerned if you were getting the mash too hot and then trying to cool it back down, because that can destroy enzymes.

One easy solution to your problem is to insulate your mash tun. It sounds like you have a stainless-steel mash tun heated by a propane flame. You don't want to insulate the bottom because the vessel would be difficult to heat if the insulation was doing its job and the insulation might burn (unless it is resistant to flame, like rock wool, glass fiber or asbestos). If this were my project I would buy a non-flammable insulation material and insulate the sides of the mash tun and make some type of simple insulated, lid to prevent heat loss from the top. You could probably find these types of materials in your Air Force locker!

Mr. Wizard

One recent afternoon, over a few of our favorite beverages, a friend and I got into a good-natured argument. My friend is a diabetic (and a beer lover) so calorie and nutrition information is very important to him. We were debating just where the calories in beer come from. My friend's opinion is that the alcohol provides the calories, based on the fact that a beer and a shot of liquor are considered equivalent. Having recently read the article on creating low-calorie beers using "Beano" *(April 2001)*, I hypothesized that the majority of the calories in beer must come from unfermented carbohydrates. Please educate us.

Walter Scott
Reisterstown, Maryland

There is really no reason to argue about this because you are both partially correct. An average 12-ounce serving of a "domestic-style" beer contains about 14 grams of ethanol and 11 grams of carbohydrate. In caloric terms this equates to 98 calories from ethanol and 44 calories from the carbohydrate, for a total of 142 calories. The most effective methods of making lower-calorie beer involve reducing the alcohol content, residual carbohydrates or, most commonly, a combination of both. The article on using Beano to make a light beer focused on reducing the residual carbohydrates by increasing wort fermentability.

Mr. Wizard

I recently I made a major brewing mistake. I brewed an IPA, which I

decided to dry-hop. I am a fairly new brewer and I had never dry-hopped before. I needed a weight that would fit into the carboy and hold down the hop bag and unfortunately, my misfiring synapses hit upon the idea of using a nail for this purpose. I washed and sanitized the nail and left the assemblage in the secondary for three weeks. When I bottled, I noticed a metallic aftertaste to the beer. I tried a bottle after a week. It tasted good except for the metallic flavor, which faded after a few drinks.

Do you think it is safe to drink the beer? It tastes okay, but I don't know what chemical reactions may have gone on in the secondary. Or do you think that I should just dump it and learn from the experience?

Lloyd Chatham
Lafayette, Indiana

Whether this beer should be dumped or not is up to personal preference, since the metallic flavor does not present any dangers to your health. The most notable thing about iron in beer is the metallic taste and oxidation. When brewers talk about oxidation, oxygen is usually the first thing that jumps to mind, but oxidation is also caused by metal ions, like iron and copper. Another feature of iron is that it has a positive affect on beer foam. I have heard of brewers intentionally exposing wort to iron for the foam positive results. I think the negative flavor effects outweigh the positive foam effect, but to each his own!

The material of choice for brewing equipment, including hop bag weights, is stainless steel. Although stainless steels are primarily composed of iron, the iron does not leach out of the steel because of the presence of other alloying elements, such as chromium, nickel and molybdenum.

Historically, brewers have used all sorts of materials to build brewing equipment. The list includes copper, wood, aluminum, mild steel (like your nail) and even concrete. Today, almost all beer-brewing equipment, be it brew kettles, valves, pipes or hop bag weights, is made from stainless steel. In the future, I would go to a hardware store and buy some stainless-steel washers or nails and use those instead of the mild-steel version.

Mr. Wizard

I am fairly new to homebrewing. I am trying to use liquid yeast — wit beer yeast, for the second time. The first time it blew the lid off my plastic primary fermenter. This time it's foaming up through the airlock. I have had to clean the airlock several times. I know that by doing this I risk contaminating the beer, but I don't want the lid to blow off again. Any ideas about what's up with this ooze? Should I use less than 5 gallons of wort next time? Is this normal wit beer yeast behavior or should I brew a small starter batch next time?

Julie S. McCrae
via e-mail

I've been brewing for about 5 years. I always have been quite fastidious when it comes to sanitation and my final products are always quite good, which is why I am a bit perplexed about what may or may not be going on in my primary fermenter. I used a new type of yeast on an alt recipe I have made a few times before and the fermentation has been extremely aggressive — so aggressive that it blew the cap off my vapor lock. Is my beer contaminated? Could bacteria cause this? Should I just wait until I move to secondary fermentation? Help!

John Bento
Portland, Oregon

This basic question has come up in the past. It is a question I like to see, because I believe this phenomenon is positive. The foamy ferments are most likely not caused by bacterial contamination. The fact that two nearly identical questions came in at the same time leads me to speculate more homebrewers are pitching enough yeast to witness a "normal" fermentation!

Foam or krauesen volume is a function of several variables. The two most important are yeast strain and the pitching rate of viable and vital yeast. In my experience, weizen and wit beer strains of yeast take the grand prize when it comes to krauesen volume. Normal ale and lager strains seem to have krauesen volumes that are comparable to each other.

In general, increased pitching rate results in a more aggressive fermentation with more krauesen. The caveat to this statement is that the yeast pitched must be viable (alive) and vital (healthy).

The most common type of commercial fermenting vessel these days is the cylindroconical or unitank fermenter. These tanks have a tall, skinny appearance and are designed with sufficient headspace to minimize over-foaming. The standard unitank has a height to diameter ratio of about 3:1 and has between 25 and 30 percent headspace. The headspace is calculated by adding 25 to 30 percent to the working volume. For example, a 5-gallon batch would be fermented in a vessel with a gross capacity of 6.25 to 6.5 gallons.

My point is that commercial brewers anticipate an aggressive fermentation because they really want to use healthy yeast and pitch enough to get a rapid fermentation. They want a rapid fermentation, in part, to minimize the time taken for primary fermentation — after all, time is money. But more importantly, rapid and aggressive fermentation is one of the best ways to reduce the risk of contamination during fermentation. A good pitching rate when using yeast harvested from a previous fermentation is about 250 mL of thick yeast slurry per gallon batch.

A slow, pathetic fermentation takes several days for pH reduction and for alcohol levels to rise. Alcohol and lower pH are two keys to suppressing the growth of bacterial invaders, especially during the early stages of fermentation. Excessive foaming and a big mess in the airlock can certainly cause problems if environmental contaminants begin to grow and make their way into the fermenter.

Another serious problem that can occur with blow-off is that the airlock becomes plugged and either blows off of the fermenter like a rocket or the fermenter breaks, for example if a carboy is used. I personally do not like to see bubbler-style airlocks on fermenters during rapid fermentation. A better device is a large tube with an outside diameter that is the same as the inside diameter of the carboy opening. Make the hose long enough to place the loose end in a small bucket of water and you now have a larger version of an airlock. This style of airlock is much less likely to become clogged and if foam does blow off from the fermentation, you can replace the bucket of foamy water without having to remove the airlock.

Another way to minimize blow-off is to use a larger carboy or to make a smaller batch. I would rather make as much beer as I can get out of my kettle and buy a fermenter large enough to handle the volume, versus allowing my fermenter to dictate my batch size.

On a somewhat related note, many brewers like to have their fermenters foam up enough to skim the top of the foam. Many traditional fermentation systems use some type of skimming. Both Anheuser-Busch and Coors have special methods to remove the "braun hefe" from their fermentations because these companies feel it contributes a coarse and unpleasant bitterness to the finished beer. A foamy fermentation can be a very healthy sign of good beer to come!

Mr. Wizard

What is up with Mr. Wizard's Guinness "GFE" information *(April 2001)*? Where did he hear about this mysterious extract? I think it is a good story, but I am craving a second opinion. I was in London recently and met Roger Protz of CAMRA at a book signing. We spoke briefly over a pint and the subject of Guinness GFE came up. He claims to have heard of it, but did-

n't know of any real documentation. I have friends doubting my beer knowledge. I am distraught. Please point me in the right direction.

Jonathan Surratt
Chapel Hill, North Carolina

I admire your hesitation to buy into the GFE story without a second opinion. However, instead of getting a true second opinion, I will try to shed some more light on the topic. I mentioned GFE, or Guinness Flavor Essence, in the April 2001 issue when answering a question about stout brewing. The short paragraph mentioned, without any references, that Guinness produces a special concentrate for use by breweries who brew Guinness around the world. In essence, GFE is analogous to Coca-Cola's famous ingredient "X."

This is not something I made up nor is it the brewing equivalent of an urban legend. GFE does indeed exist. In Michael J. Lewis' well-regarded book "Stout" (Classic Beer Style Series 11, Brewers Publications), GFE is briefly mentioned on page 61. The technical editor of Lewis' book was Dr. Robert Letters, former Director of Research for Guinness. So far I'm feeling pretty good in the credibility department! I could cite more sources, but these sources may reveal my identity and that simply cannot happen.

Beer is a beverage with a fascinating and romantic history. Modern breweries still hold the traditions of brewing in high regard, but they don't turn a blind eye to modern technology. Brewing literature is full of research on modern alternatives to traditional brewing practices. Continuous fermentation, immobilized cell cultures for accelerated aging, modified isomerized hop extracts and alternative methods of wort boiling are just some of the current topics being explored by brewers around the world. I hope my answer to your question helps you regain your credibility with your friends.

Mr. Wizard

A brewery I once visited mashes every beer at 146° to 148° F. In my opinion, their beers are quite sweet and

uncharacteristic of their respective styles as defined in the BJCP style guidelines. At these lower temperatures beta-amylase is favored. Am I correct? Besides the fact that some of these beers should have slightly higher mash temperatures, why are they so sweet? It works out fine for me since I enjoy sweeter beers but, in general, I thought that lower mash temperatures (148° to 152° F) produced drier, more attenuated beer and temperatures greater than this produced sweeter, more dextrinous beers.

Floyd Bates
Anchorage, Alaska

There are several reasons why a particular brewery makes a lineup of beers that all seem sweet. Some brewers really like crystal malt and can get carried away with it. Another possibility is the particular yeast strain used for fermentation has not completely fermented all of the fermentable sugars. These types of yeast are described as having low attenuation rates. And then there is mash temperature.

I agree with your assessment that a mash that favors beta-amylase activity typically produces drier beers. One exception to this generalization is when the mash temperature is quite a bit lower, say between 140° to 145° F, than the "conversion" temperature range where alpha-amylase is very active. It is possible to have very good beta-amylase activity, where this enzyme has "nibbled" the ends off the starch molecules, and to have very little alpha activity. The result will be a mash with a very high concentration of unfermentable dextrin chains.

If this type of mash were checked with the iodine test it would test positive for starch. It's entirely possible that the 146° to 148° F temperature range is the intended range and the actual temperature is different due to out-of-calibration thermometers.

When I intentionally favor beta-amylase by adding a low temperature rest I always use a second rest in the 154° to 158° F range to ensure complete conversion. *(For more on mash enzymes, see page 51.)*

Usually I would not expect dextrins to add sweetness because they really do not taste sweet. However, if a beer had a high concentration of dextrins you can and will get conversion of the dextrins to simple sugars in your mouth because of amylase enzymes present in saliva. ■

Do you have a question for Mister Wizard? Write to him c/o 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 to questions personally. Sorry!

The Replicator

Harpoon IPA and Slow Elk Oatmeal Stout

by Steve Bader

Dear Replicator,

I recently moved from Portsmouth, New Hampshire to the West Coast and although I have found many new beers to try, I still sometimes miss my Massachusetts favorites. Do you know of any clone recipes for Harpoon IPA?

Matthew Arsenault
Corvallis, Oregon

Harpoon IPA, brewed by the Massachusetts Bay Brewing Company in Boston, is the best-selling beer in the 65,000-barrel brewery. According to head brewer Al Marzi, they have been brewing this IPA since 1992.

Al says this beer is more of a North American IPA than a British IPA. North American IPAs tend to be more bitter and less fruity than the British IPAs. Harpoon IPA has a balanced maltiness with a toasted feel. This comes from the Victory malt, which has a toasted aroma and flavor. Its hop level is around 40 to 45 IBUs, and Al recommends dry hopping this beer with some "floral" aroma hops. (I suggest Liberty, but you could also use Cascade, Hallertau, or Fuggles). Choose a yeast

that promotes fruitiness, but is low in diacetyl and high in attenuation, so this beer doesn't end up too sweet *(my suggestions are in the recipe below)*. The hop bitterness is assertive, yet the maltiness is big enough to balance the beer. IPAs have a higher alcohol level, but they are balanced and drinkable.

For more information go to www.harpoonbrewery.com or call the brewery at (888) HARPOON.

Harpoon IPA
(5 gallons, extract with grains)
OG = 1.060 FG = 1.013
IBUs = 40 to 45

Ingredients

6.6 lbs. Muntons light malt extract syrup
0.50 lb. Muntons light dry malt extract
1 lb. Munich malt
1 lb. Victory malt
8 AAUs Centennial hops (1 oz. of 8% alpha acid)
4 AAUs Kent Golding Hops (1 oz. of 4% alpha acid)
4 AAUs Liberty hops (1 oz. of 4% alpha acid) for dry hopping
1 teaspoon Irish moss
3/4 cup corn sugar for bottling
Bedford British Ale (White Labs WLP006), Burton Ale (WLP023), American Ale II (Wyeast 1272) or Coopers yeast.

Step by Step

Steep specialty grains in about 3 gallons of water at 150° to 155° F for 30 minutes. Remove grains and add malt syrup, dry malt extract and bring to a boil. Add 1 ounce Centennial hops and 1 teaspoon Irish moss and boil for 60 minutes. Add 1 ounce Kent Golding hops for the last 30 minutes of the boil. When done boiling, strain out the hops and add the wort to cool water to fill to the 5-1/2 gallon mark. Add your yeast when the wort is 75° to 80° F and aerate well. Let the beer slowly cool to about 68° F, and ferment until complete (7 to 10 days).

After fermentation is complete, transfer beer to secondary and add 1 ounce of Liberty hop pellets to the beer (this is called dry-hopping). Let these hops sit in the beer for about a week to enhance the hop aroma, then separate the hops from the beer and bottle as usual.

Extract brewing tip: If you are trying to make beers with higher bitterness levels, remember that you must boil a larger portion of the total wort, ideally a minimum of 4 gallons out of a total of 5 gallons. Most extract recipes boil only 3 gallons of wort or less, and with this "thick" syrup, higher levels of hop bitterness are not possible. The compromise with boiling a larger volume of wort is that you need a bigger pot, and you must use a wort chiller before pitching the yeast. While this recipe calls for 3 gallons of boiling wort, I suggest a larger volume to get the proper bitterness.

All-grain option: Replace Muntons malt and dry malt extract with 9 pounds of pale malt. Mash grains together for 60 minutes at 150° to 152° F. Collect enough wort to boil for 90 minutes and have 5.5 gallons yield. Decrease Centennial boiling hops to 1/2 ounce to account for increased hop extraction efficiency in a full boil. The remainder of the recipe is the same as the extract.

Dear Replicator,

I have been looking for a good clone recipe for Slow Elk Oatmeal Stout, brewed by the Big Sky Brewing Company of Missoula, Montana.

Jim Arnold
Auburn, Washington

Here's what Matt Long, brewer at Big Sky, has to say about Slow Elk Oatmeal Stout. "Too many U.S. oatmeal stouts are heavy and bitter. We wanted a stout in the tradition of the British Isles: medium-bodied, very drinkable and smooth. In short, we wanted a session beer. Slow Elk Oatmeal Stout was born in 1995 to satisfy these desires."

This beer comes in around 3.9 percent alcohol by weight. The oats in the recipe give the beer a special smoothness that is not normally found in this kind of stout. ■

For more information, call (800) 559-2774 or go to www.bigskybrew.com.

Slow Elk Oatmeal Stout
(5 gallons, extract with grains)
OG = 1.055 FG = 1.016 IBUs = 20

Ingredients

6.6 lbs. Coopers light unhopped malt syrup
1.5 lbs. crystal malt (80° Lovibond)
4 oz. black patent malt
6 oz. chocolate malt
6 oz. flaked oats
6.25 AAUs East Kent Golding hops (1.25 oz. of 5% alpha acid)
1 teaspoon Irish moss
2/3 cup corn sugar for bottling
London ESB Ale (Wyeast 1968) or English Ale (White Labs WLP002) or Muntons dry yeast

Step by Step

Steep specialty grains in about 3 gallons of water at 150° to 155° F for 30 minutes. Remove grains, add malt syrup and bring to a boil. Add 1.25 ounces Kent Golding hops and 1 teaspoon Irish moss and boil for 60 minutes. When done boiling, strain out hops and add the wort to cool water in a sanitized carboy. Fill carboy to the 5-1/2 gallon mark. Add your yeast when the wort is 75° to 80° F and aerate well. Let the wort cool to about 68° F over the next few hours and then ferment at 66° to 70° F until fermentation is complete (7 to 10 days).

All-grain option: Replace Coopers malt extract with 7.5 pounds of pale malt. Mash grains together for 60 minutes at 155° F. Collect enough wort to boil for approximately 90 minutes and get a 5.5-gallon yield.

Decrease boiling hops to 1 ounce (5 AAUs) to account for increased hop extraction efficiency in a full boil. The remainder of the recipe is the same as the extract.

Have a recipe request? Send it to the Replicator at edit@byo.com.

Kölsch and Porter

Ale from Köln, porter from London

by Tess and Mark Szamatulski

In the fall, brewers realize that summer has taken its toll and they are dangerously low on homebrew! We have chosen a light Kölsch to ferment in cool September weather and a robust porter to take the chill out of October evenings.

KÖLSCH-STYLE ALE

OG = 1.040 to 1.048 FG = 1.008 to 1.013 IBUs = 16 to 30 SRM = 3.5 to 5 ABV = 4.0 to 5.0%

Kölsch is the beer that put the German city of Cologne (Köln) on the map. Kölsch is the only beer in the world that has "protective appellation" and is recognized by the German government. This means that the name Kölsch can only be used for beers that are brewed in Cologne.

Kölsch is an ale that is fermented at the lower end of ale temperatures (between 55° to 62° F), then lagered at 34° to 45° F to reduce fermentation byproducts. The well-balanced Kölsch pours into the glass as a brilliant straw-gold beer topped with a tightly-beaded head. The aroma is soft and subtle with a hint of fruity hops leading to a clean, crisp flavor and a dry, lingering finish.

Style Guidelines

The guidelines for Kölsch do not allow for much variation. The light, fruity hop aroma is from German noble or Czech Saaz hops. There should be no or very low maltiness. There should be no diacetyl because after fermentation this beer is lagered, rendering it smooth and clean. There is a slight hint of fruitiness because it is fermentated at low-end ale temperatures.

The beer is brilliantly clear, very pale to light gold. A stark white, long-lasting head stays until the end with lace clinging to the glass. The palate is round and soft with just a slight hop fruitiness and a subtle dry finish. There is a low to medium bitterness.

Hops, Malt and Yeast

It is very important to use German hops for brewing a true Kölsch. Use Tettnang, Perle or Hallertau for bittering, and Spalt, Tettnang and Hallertau for flavor and aroma. The only exception, Czech Saaz, can also be used.

Some Kölsch brewers use 100 percent pilsner or two-row pale malt in the grist, while others use as much as 20 percent wheat malt. The wheat is used for head retention, mouthfeel and to add to the body of the beer. An addition of a small amount of German Munich malt will provide a subtle maltiness to the Kölsch. For extract brewers, use Muntons extra-light DME with up to 20 percent dry wheat malt extract. The reason for using the British brand is for lightness in color. The best choice of yeast is Kölsch (Wyeast 2565) (ferment at 60° F) or German Ale (White Labs WLP029).

KÖLSCH-STYLE ALE

(5 gallons, extract with grains)
OG = 1.047 to 1.048 FG = 1.010 to 1.011 SRM = 3 IBU = 23 ABV = 4.7%

Ingredients

4 oz. German crystal malt (2.5° Lovibond)
4 oz. Munich malt
4 lb. Muntons extra-light dry malt extract
1.5 lb. Muntons wheat dry malt extract
5.4 AAUs Tettnanger (1.25 oz. of 4.3% alpha acid) (bittering)
1 AAUs Spalt (0.25 oz. of 4% alpha acid) (flavor)
1 AAUs Czech Saaz (0.25 oz. of 4% alpha acid) (flavor)
1 tsp. Irish moss for 15 minutes
1 AAUs Spalt (0.25 oz. of 4% alpha acid) (aroma)
1 AAUs Czech Saaz (0.25 oz. of 4% alpha acid) (aroma)
Kölsch (Wyeast 2565) or German Ale (White Labs WLP029) yeast
1-1/4 cup Muntons extra-light DME

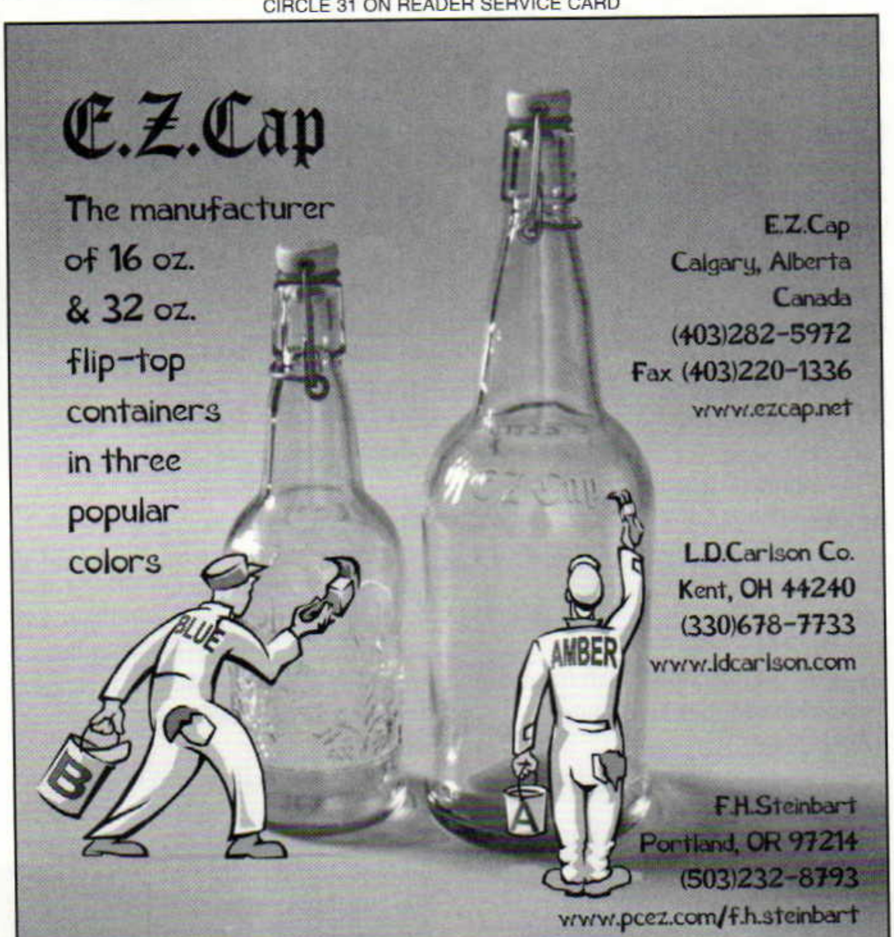
2001
THE YEAR IN BEER

JANUARY:
Baltic Porter & German Pilsner
FEBRUARY:
Cream Stout & American Dark Lager
MARCH:
Oktoberfest & American Brown Ale
APRIL:
British IPA & Old Ale
MAY:
Dunkelweizen & English Bitter
JUNE:
Fruit Ale & Belgian Strong Dark Ale
SEPTEMBER:
Kölsch & Robust Porter
OCTOBER:
Celebration Ale & Pale Lager
NOVEMBER:
Strong Scotch Ale & Vienna Lager
DECEMBER:
English Barleywine & Doppelbock

Step by Step

Bring 1 gallon of water to 155° F, add crushed grain and hold for 30 min. at 150° F. Strain the grain into the brewpot and sparge with 1/2 gallon of 168° F water. Add the dry malt extract, dry wheat malt extract and the bittering hops.

Bring the total volume in the brewpot to 2.5 gallons. Boil for 45 min., then add the flavor hops and Irish moss. Boil for 13 min., then add the aroma hops. Boil for 2 min., then remove from the stove. Cool wort for 15 min. Strain



into the primary fermenter and add water to obtain 5-1/8 gallons.

Add yeast when wort has cooled to below 80° F. Oxygenate-aerate well. Ferment at 60° to 62° F for 7 days, then rack into secondary (glass carboy). Ferment until target gravity has been reached and beer has cleared (approximately 5 weeks). Prime and bottle. Carbonate at 70° to 72° F for 3 to 4 weeks. Store at cellar temperature.

Partial-Mash Option: Acidify the mash water to below 7 pH. Mash 2.25 lbs. German two-row pilsner malt and the specialty grains in 1 gallon of water at 122° F for 30 min. and then at 149° F for 90 min. Sparge with 1.5 gallons of water at 5.7 pH and 168° F. Then follow the extract recipe, omitting 1.75 lbs. of Muntons extra-light DME from the boil.

All-Grain Option: Acidify the mash water to below 7 pH. Mash 7.5 lbs. German 2-row pilsner malt, 1 lb. German wheat malt and the specialty grains in 3 gallons of water at 122° F for 20 min. and then at 149° F for 90 min. Sparge with 4.5 gallons of water at 5.7 pH and 168° F. The total boil time is approximately 60 min. Add 4.4 AAUs of bittering hops for the last 60 min. of the boil. Add the flavor hops, Irish moss and aroma hops as indicated by the extract recipe.

ROBUST PORTER
OG = 1.050 to 1.065 FG = 1.012 to 1.016 IBUs = 25 to 45
SRM = 30+ ABV = 4.8 to 6.0%

Porter originated in London, England as early as the 18th century. It was popular at that time to mix three beers to create an "Entire." The Entire consisted of an old, well-vatted or stale brown ale, a new, fresh brown ale and a pale ale. It was too time-consuming for the publican to pull from three casks for one pint of ale, so a new beer was created that mimicked the blended beers. This beer became so popular with the porters working in the Billingsgate and Smithfield markets that the name "porter" took hold. This style made its way across the ocean to America and into the heart and mug of our own George Washington.

Style Guidelines

There are two types of porters, robust and brown. Brown porter has a softer flavor and lower gravities. Robust porter is a hearty dark ale with complex roasted malt and hop character. We will only refer to the robust style of porter in this article. A roasted malt-grain aroma reminiscent of coffee or chocolate should be apparent. The hop aroma is low to moderate. Diacetyl and fruity esters are moderate to none. The color is dark brown to black with garnet highlights. The beer should be clear and the head retention should be moderate to good. Depending on the combination of grains in the malt bill, IBUs and attenuation, the flavor may finish from dry to medium-sweet. Robust porter is medium to full-bodied with moderate to low carbonation.

Hops, Malt and Yeast

Our recipe is for an American-style robust porter but you can easily substitute English ingredients and make an English-style porter. An American porter could use Nugget, Centennial, Chinook, Northern Brewer or Cascade hops for bittering, and in some beers a small amount (not over one-half ounce for a 5-gallon batch) of Cascade, Willamette or a combination for flavor (if flavor hops are used). Usually aroma hops are not used, but if the brewer desires, he or she can use up to one-half ounce of Willamette or Cascade hops for aroma.

Use a U.S. two-row as the base malt. Specialty grains include chocolate, crystal, black, British brown malts and small amounts of roasted barley (1 to 6 ounces per 5-gallon batch). For extract brewers, British malt extract or U.S. brands such as Alexanders or Briess (light) can be used as the base malt. Malto-dextrin is sometimes added for body and mouthfeel.

There is a wide variety of yeast strains used to ferment this style. For American porters, try American Ale (Wyeast 1056) or Northwest Ale (Wyeast 1332). Some English strains can also be used to ferment American versions with much success.

AMERICAN ROBUST PORTER

(5 gallons, extract with grains)
OG = 1.062 to 1.063 FG = 1.017 to 1.018
SRM = 93 IBU = 38 ABV = 5.8%

Ingredients

10 oz. U.S. chocolate malt
8 oz. Belgian cara-Munich malt
8 oz. U.S. crystal malt (60° Lovibond)
4 oz. British black patent malt
2 oz. roasted barley
4 lb. Alexander's pale malt extract syrup
3.75 lbs. Muntons extra-light dry malt extract
6 oz. malto-dextrin
11.5 AAUs Northern Brewer (1.25 oz. of 9.2% alpha acid) (bittering)
1.25 AAUs Cascade (1/4 oz. of 5% alpha acid) (flavor)
1.25 AAUs Willamette (1/4 oz. of 5% alpha acid) (flavor)

1 tsp. Irish moss
American Ale (Wyeast 1056) or California Ale (White Labs WLP001)
1-1/2 cup Muntons extra light DME

Step by Step

Bring 1 gallon of water to 160° F, add crushed grain and hold for 30 min. at 150° F. Strain grain into the brewpot and sparge with one gallon of 168° F water. Add the DME, malt extract syrup, malto-dextrin and bittering hops. Bring the volume in the brewpot to 2.5 gallons. Boil for 45 min., then add the flavor hops and Irish moss.

Boil for 15 min., then remove the pot from the stove. Cool wort for 15 min. in an ice bath or with a wort chiller. Strain into the primary fermenter and add water to obtain 5-1/8 gallons. Add yeast when wort has cooled to below 80° F. Oxygenate-aerate well. Ferment at 70° to 72° F for 7 days, then rack into secondary (glass carboy). Ferment until target gravity has been reached and beer has cleared (approximately 3 weeks). Prime and bottle. Carbonate at 70° to 72° for 3 to 4 weeks. Store at cellar temperature.

Partial-Mash Option: Acidify the mash water to below 7.2 pH. Mash 1.5 lbs. British two-row pale malt and the specialty grains in 1 gallon of water at 150° F for 90 min. Sparge with 1.5 gallons of water at 5.7 pH and 168° F. Then follow the extract recipe, omitting 2 lbs. of Muntons extra-light dry malt extract from the boil.

All-Grain Option: Acidify the mash water to below 7.2 pH. Mash 10.33 lbs. British two-row pale malt and the specialty grains in 4.25 gallons of water at 154° F for 90 min. Sparge with 5 gallons of water at 5.7 pH and 168° F. The total boil is 90 min. Add 8.1 AAUs of bittering hops for the last 90 min. of the boil. Add the flavor hops and Irish moss as indicated by the extract recipe. ■

Tess and Mark Szamatulski are the owners of Maltose Express in Monroe, Connecticut. All recipes are adapted from their books "Clonebrews" (Storey Publishing, 1998) and "Beer Captured" (Maltose Press, 2000).

By Chris Colby with Ashton Lewis and Horst Dornbusch
Illustrations by Don Martin

first edition

HOMEBREW university

contents

Brew Your Own
THE HOW-TO HOMEBREW BEER MAGAZINE

HOMEBREW 101:
BREWING A NO-BOIL MALT EXTRACT BROWN ALE

Vocabulary

cleaning
sanitizing
wort
malt extract
aeration
fermentation
specific gravity
patience
priming
racking

New Skills

cleaning
sanitizing
aerating
fermenting
priming
racking
bottling

Equipment list

large pot or kettle
large spoon
dial thermometer
plastic fermenter
airlock
hydrometer
racking cane
plastic hose
bottles
bottle caps
bottle capper

Objective: Brew a brown ale with the least amount of effort and equipment

A new homebrewer is often both exhilarated and bewildered by his or her new hobby. Although a successful first batch is thrilling, a brewer may not understand the point of each step in the procedure. And, if he'd like to change a few things the next time he brews, he may not know what the consequences will be. That's where Homebrew 101 comes in.

In Homebrew 101, I'll guide you through the steps of brewing a typical first beer recipe *(see the box on page 28)*. I'll tell you what's really important when brewing this beer, and what your beer will be like if you alter key steps. I'll also point out errors beginning homebrewers often make and tell you how to avoid them. In subsequent Homebrew U articles, we'll comment on the changing equipment and techniques needed for brewing beer with more and more complex techniques.

Our Homebrew U curriculum takes a hands-on approach to the hobby. Through five "classes" that revolve around recipes and step-by-step instructions, we'll help homebrewers acquire a comprehensive set of skills — techniques you can use whether you brew with extract or grains (or both).

This course is meant to supplement, but not to entirely replace, your favorite homebrew book. You may need your brew book to get detailed instructions for some of the steps listed in the procedure. We also try to explain why each step is performed. Armed with this knowledge, Homebrew U graduates — no matter how they chose to brew — will be well-informed about their brewing decisions.

The beer we'll brew for this course is a brown ale. Brown ales — such as Newcastle and Pete's Wicked — are dark, malty beers. To brew our brown ale, we'll use only malt extract and a minimum of equipment beyond what can normally be found in a kitchen. You probably have a large pot (be sure it can hold at least three gallons of water), and you can visit any homebrew supply shop to buy a five-gallon plastic fermenter and lid, an airlock, a racking cane, a hydrometer and bottling supplies. *(For a complete equipment list, see box at left).* Putting together this beer will only take a few hours; this is much faster than it takes to brew an all-grain beer.

Cleaning and sanitizing

There are many kinds of brewers, from extract brewers making their beer in five-gallon buckets to commercial brewers making their beer in multi-story fermenters. The skills these brewers need and the procedures they use vary substantially. However, there are two skills that every brewer needs, no matter what size brewery they brew in: *cleaning* and *sanitizing*.

Cleaning and sanitizing your brewing equipment is the first step listed in the procedure on brew day. Your brewing equipment needs to be as clean and as free from biological growth as possible. The only organism you want growing in your fermenter is yeast. Growth of other organisms in *wort* can spoil the resulting beer. Contaminated beer may turn out sour or develop other off flavors. It can smell like baby diapers. In addition, the beer may gush when opened or your bottles may explode. *(For a quick guide to common beer contaminants, see page 26.)*

To clean your equipment, you'll need a special solution that's made for brewing equipment *(see the box on page 25)*. Make up the solution, grab a scrub brush and clean all the surfaces you can reach. Run your cleaning solution through your racking cane and fermentation lock. After cleaning, rinse the equipment. When you're done, visually inspect your equipment, especially those surfaces that will contact the *wort*. If you see any dirt or residue, repeat your cleaning procedures. Don't rely on your sanitizer to take care of any surfaces that are not spotless — it doesn't work that way. You'll need your equipment to be as clean as possible for the sanitizer to be effective.

To sanitize, soak any equipment

that will touch wort in sanitizing solution. Be sure to run sanitizing solution through your racking cane and fermentation lock and let it sit there for the same amount of time your bucket is soaking. When you're done, rinse the equipment.

The final step is prevention. Don't take this the wrong way, but you may be the biggest threat to your beer! Every day, you pick up bacteria and yeasts from every surface you touch. You transfer these microorganisms to every surface you touch subsequently. On brew day, you handle malt extract and grains. You may also touch brewing equipment that wasn't completely cleaned after your last brewing session. All these things may be harboring strains of bacteria or yeasts that can live in your wort.

So don't touch any surface that will touch wort (the inside of buckets, submerged parts of racking canes). In addition, wash your hands often while brewing. When you're done, clean your brewing equipment thoroughly and wipe down all surfaces that may have gotten spattered, like your kitchen counters and stovetop.

No-boil wort preparation

After cleaning, the next steps in the procedure involve preparing the wort. To make our wort we'll use *malt extract*, a condensed form of wort. Malt extract is available in many different forms, including light and dark, hopped and unhopped, liquid and dry. We'll mix light, hopped malt extract (in liquid form) with dark, unhopped malt extract (in dry form). This mixture will produce the right amount of bitterness and color for our brown ale. If malt extract is "hopped," it means hops are already in the wort; hops give beer bitterness. Bitterness can be expressed in various ways *(see page 31)*.

We'll make our wort by dissolving malt extract in hot water and steeping for 15 minutes. Most brewers boil their wort. But here, with our all-extract beer, there is really no need to. With this type of beer, you may even make better beer by not boiling your wort.

To dissolve the malt extract, heat 2 gallons water to 170° F in a large pot. Turn off the heat and add the malt extract. You can heat the can of extract so it pours more easily by placing it in a sink full of hot tap water. Stir the extract into the water. Your spoon should be clean, but it does not need to be sanitized. Once the extract is dissolved, check the temperature with your dial thermometer. If it is below 160° F, raise the temperature to this point. If you overshoot your temperature mark, don't worry. It won't affect the outcome. Let this mixture sit for 15 minutes at 160° F or higher, then proceed to the next step.

One of the primary reasons for boiling wort is to kill microorganisms. But, raising the temperature of wort to 160° F should kill all the bugs in your wort. And, since the wort used to make malt extract was probably boiled

To make this "no-boil" beer, you simply dissolve malt extract in hot water in a big kettle.

Use a dial thermometer to hold the extract-and-water mixture at 160° F or higher for fifteen minutes.

cleaning: the process of making an object free from dirt or other impurities

sanitizing: killing all, or greatly reducing the number of, microorganisms on an object

wort: unfermented beer

malt extract: a thick syrup or dry powder made from malted grains; a pre-made, condensed form of wort

aeration: dissolving oxygen into cold brewing water so that the yeast will multiply quickly

Choosing the right cleaners and sanitizers

It takes two steps to get your brew equipment ready: cleaning and sanitizing. For both steps, you'll need special chemicals that you can buy at any homebrew shop or mail-order outlet. You often mix a powder with water to make a solution.

When cleaning your brewing equipment, it's best to avoid using soap. Soap residue can interfere with head retention in beer. Two popular alternatives to soap are TSP (tri-sodium phosphate) and PBW (Powder Brewery Wash), but there are many other options and brands.

Bleach is a cheap sanitizer. 2-1/2 tablespoons of bleach in 5 gallons of water makes an effective solution. Be careful when using bleach: It can corrode stainless steel (if that's what your brewpot is made of) and can be absorbed by plastic, leading to off-flavors. If you use bleach, and many homebrewers do, rinse thoroughly.

Another common sanitizer is iodophor. Just 1 ounce in 5 gallons of water makes a great sanitizing solution. When used in low concentrations it does not need to be rinsed.

For more information, ask at your homebrew store, check out a mail-order catalog or go to these Web sites:
www.ecologiccleansers.com
www.fivestarchemicals.com

Extra Credit!

A quick guide to some common beer contaminants

MICROBES ARE EVERYWHERE, AND sometimes they get into our beer, no matter how meticulously you keep things clean. They are critters that thrive in the presence of alcohol and the absence of oxygen. Their metabolic by-products destroy the biological stability of your homebrew and usually cause clouding, excessive sedimentation, and a revolting taste, which gets worse over time. When your beer tastes really lousy, is unusually cloudy or gushes like crazy, in spite of your best brewing efforts, chances are that your potentially delightful beverage caught one of these common brewery bugs.

Pediococcus cerevisia makes beer cloudy and gives it a sour, buttery, diacetyl taste. Yet, in gueuze and other Belgian beers, this bacterium is added deliberately to increase acid levels.

Lactobacillus, as the name implies, produces lactic (sour milk) acid. Cloudiness and excessive sedimentation are also "gifts" of this rod-like critter. One version of bacterium, ***Lactobacillus delbrückii***, can be found in several Belgian beers such as gueuze, lambic and sour brown ale, as well as in Berliner Weisse. Some strains also produce diacetyl.

Wild yeasts come in endless varieties. They are "wild" only because brewers think so. There are only two categories of yeast that are not wild and make beer: *Saccharomyces cerevisia*, the warm- and top-fermenting variety that is used to make ales, and *Saccharomyces uvarum*, the cold- and bottom-fermenting variety that makes lagers. All other yeasts turn most beers into yuck.

Wild yeasts tend to make beer cloudy, cause a soupy sedimentation, and give the beer a weirdly aromatic taste with harsh and unpleasantly bitter overtones. Again, the Belgian brewers are the deviants of the lot. They use the wild *Brettanomyces bruxellensis* to produce the classic sweaty "horsehair" character of many Belgian gueuzes, lambics and sour browns. The sourness comes from the lactic-acid bacteria *pediococcus* and *lactobacillus*.

Finally, if your bottles foam and gush uncontrollably upon opening, it's probably because of ***fusarium***, ***aspergillus*** or ***rhisopus***. These are mold-like, parasitic fungi that contaminate the barley in the field. Very wet weather (flooding) causes fungal problems and the fungus will stay in the soil many seasons after the flood. They are very difficult to eradicate. These fungi contain peptides that promote the reversal of the dissolution of carbon dioxide (CO_2) in your brew. This result is the formation of large, fast-escaping CO_2 bubbles around miniscule particles in your beer.

Contaminations are almost always airborne, and they happen in the best of breweries. There is no cure for beer infections. Down-the-drain is the only remedy for the beer, and exposure to high heat (such as boiling) is the most effective means of making your equipment usable again. On a good note, none of these beer infections cause humans to get sick. They just make us sad from the loss of a fine batch.

—Horst Dornbusch

before it was condensed, there is no reason to boil it a second time. There are also a few benefits to *not* boiling an all-extract wort. For one thing, the wort will darken less if less heat is applied to it. This is important since you are instructed to heat a concentrated wort, then dilute it to working strength in the fermenter. The more concentrated the wort, the more it darkens as heat is applied. In addition, boiling the wort will drive off any hop volatiles present in the pre-hopped malt extract. These compounds, when present, give beer the aroma of hops.

Wort cooling and aeration

Another benefit of no-boil wort preparation is that less wort cooling is needed compared to worts that have been boiled. Wort needs to be cooled before yeast is pitched. If yeast is pitched into hot wort, the heat can kill or stun the yeast. Different yeast strains prefer different temperatures, but for this beer, the wort needs to cool to at least 72° F. In this procedure, the wort is cooled by adding the hot, concentrated wort to cold water in the plastic fermenter.

The cold water serves another purpose besides cooling. If you shake the water bottles vigorously for several seconds *(see box on page 28)*, oxygen will dissolve into the water. This is called *aeration*. Your wort needs oxygen so that the yeast can multiply quickly after they are pitched. Beers made from inadequately aerated wort may suffer from a sluggish fermentation. And the yeast will give off compounds, called esters, which can make the beer smell like bananas.

So, you should aerate your cold brewing water as much as possible. Should hot wort be aerated, too? No. Aerating hot wort can instantly darken the wort. More importantly, beers suffering from "hot-side aeration" may go stale faster. Only aerate cold water or cold wort when brewing. After adding your wort to the cold water in your fermenter, check the temperature with a sanitized thermometer. If the temperature is below 72° F, pitch the yeast.

Fermentation

Next to cleaning and sanitation, the most important step in brewing good beer is conducting a good *fermentation*. A good fermentation will proceed quickly and yield a beer free from odd flavors and smells. Encouraging yeast growth by running a good fermentation is also an anti-contamination measure. Yeast growth changes wort conditions and protects against growth of many other microorganisms. And beers made from good fermentations finish at an appropriate *specific gravity*. Specific gravity measures the density of a liquid compared to water, which is 1.000. More on this later.

A weak fermentation can lead to a beer with a high final gravity. Beers like this are too sweet. Also, unfermented sugars in the beers can support bacterial growth in the finished beer. In order to run a good fermentation, you need to understand yeast. By choosing brown ale for our first beer, we've hedged our bets. Brown ales are supposed to be a bit sweet. So, even if your fermentation doesn't go exactly as planned, your beer will still be all right.

Yeast are microscopic fungal organisms. In brewing, they consume the components of wort, primarily the sugar maltose, to obtain energy. The energy obtaining process they use is called fermentation. Different types of fermentation are named for their breakdown products, what the cell converts the sugar into. The type of fermentation yeast use gives off carbon dioxide and ethanol as by-products and is called ethanol fermentation. The carbon dioxide and ethanol given off by the yeast during fermentation give beer two of its most desired characteristics: fizz and kick. But, minor fermentation byproducts given off by yeast, such as esters, also play a large role in the taste and aroma of beer.

Pitch enough yeast

In the procedure, you are instructed to pitch 2 to 4 packets of dried yeast. You need to pitch this much yeast because pitching too few yeast cells means the yeast have to multiply many times before there are enough of them to ferment the wort. Beers made from underpitched worts start slower and finish fermenting at a higher specific gravity. Both of these situations encourage growth of microorganisms. Beers made from underpitched worts also have more esters than beers from adequately pitched worts.

Pitch healthy yeast

You are also instructed to proof the yeast in the procedure. Proofing yeast is something done by both bakers and brewers who use dried yeast. The dried yeast is placed in warm water before it is used. The warm water quickly rehydrates the yeast cells and brings them back to functionality. Pitching the dried yeast directly into the wort is not as effective at quickly reviving them. Once proofed, the yeast should not sit in water for long. Read the instructions on your yeast packet — different yeast strains have different proofing times. Prolonged storage in water can lead to osmotic shock, a state where the yeast cells are having trouble pumping water out of their cells because it is diffusing into them too quickly.

Try a little patience

Once the wort is in the fermenter and the fermentation lock is on, it's time to wait. If you aerated the wort sufficiently and pitched enough yeast, everything should be fine. You should see signs of fermentation within 24 hours, sometimes much sooner.

A common complaint of beginning homebrewers is that their fermentation never started or was delayed. Sometimes, they're right. If they did not pitch enough yeast or aerate their wort, it may take a few days for fermentation to start. However, the fermentation may have gone fine and they just don't know it. It's not uncommon for bucket fermenters to seal incompletely. Fermentation can be taking place while little or no activity is seen in the airlock. So try a little *patience*. The best course of action is to assume the fermentation went well and wait until three days before your planned bottling day. Check your specific gravity each of these three days. If the gravity is low (below 1.020) and doesn't

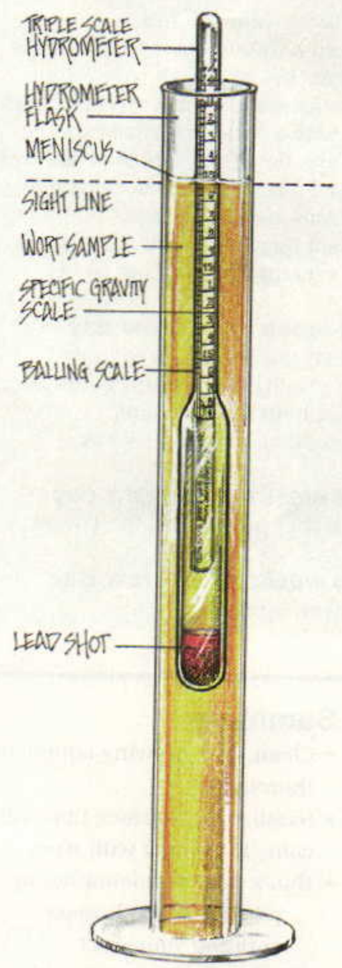
fermentation: the process by which yeast convert sugars in wort to ethanol and carbon dioxide, resulting in a drop in the wort's specific gravity

specific gravity: the density of a liquid compared to water; original gravity is measured before fermentation and final gravity is measured when fermentation is complete

patience: the state, quality, or fact of being calm and unhurried

priming: adding a small amount of sugar to beer before bottling to restart fermentation and create carbonation

racking: siphoning your beer from one container to another



Homebrewers measure the specific gravity of wort with a hydrometer. Place a sample in a cylinder and gently drop in the hydrometer. Be sure to read along the bottom of the meniscus.

Brown Ale

OG 1.048 • FG 1.016
IBU depends on malt extract

3.3 lbs. of liquid malt extract (light, hopped)
2.75 lbs. of dried malt extract (dark, unhopped)
2 to 4 packages of dried ale yeast
PrimeTabs

1 day before brew day
Clean and sanitize six 2L (or four 3L) soda bottles.
Fill the soda bottles with water and refrigerate overnight.

On brew day
Clean and sanitize equipment.
Heat 2 gallons water to 170° F.
Shut off heat.
Stir in malt extract.
Heat mixture to 160° F.
Hold at 160° F for 15 minutes.
Shake water bottles.
Add aerated water to fermenter.
Pour hot wort into cold water.
Swirl wort to mix evenly or stir with a large, sanitized spoon.
Take the temperature of the wort with a sanitized thermometer.
Proof and pitch yeast.
Seal fermenter and add airlock.
Ferment for 7 days at 68° F.

1 week after brew day
Test gravity for three days.
If gravity is constant, bottle beer.
Let bottles sit at room temperature for 1 week.

2 weeks after brew day
Refrigerate bottles for 1 week.

3 weeks after brew day
Beer is ready.

Summary

- Clean your brewing equipment thoroughly
- Sanitize any surface that will come in contact with wort
- Run a good fermentation by:
  - pitching enough yeast
  - aerating your wort
- Check specific gravity with a hydrometer
- Bottle and enjoy your beer!

change, you're ready to bottle.

To test the specific gravity, you'll need a clean, sanitized measuring cup, your hydrometer and a test cylinder. You can buy special cylinders for this, but I just use the plastic tube the hydrometer came in. Open your bucket fermenter and scoop out about 3 to 4 ounces of wort. Seal the fermenter immediately. Pour the wort into the cylinder and read the gravity. (Your hydrometer will come with detailed instructions.) Discard the sample.

Bottling your batch

To bottle your brown ale, you need to clean and sanitize 54 twelve-ounce bottles. You also need to clean and sanitize your plastic hose and *racking* cane. This is a rigid plastic tube that bends at the top. You use it to siphon or "rack" beer from one container (your fermenter) to another (your bottles).

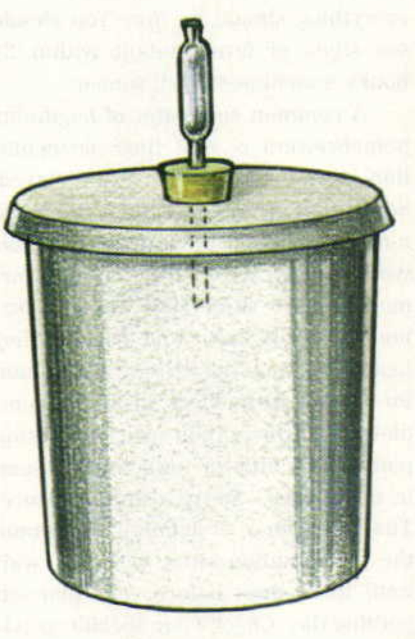
You don't really need to sanitize your bottle caps, just be sure not to touch the side of them that will be facing the beer. If you choose to sanitize them, boil them for 15 minutes.

The next step is *priming* your beer. This means adding a small amount of fermentable sugar, usually corn sugar, to the batch. This "wakes up" the yeast and starts a renewed fermentation in the bottle, and the resulting carbon dioxide carbonates your beer.

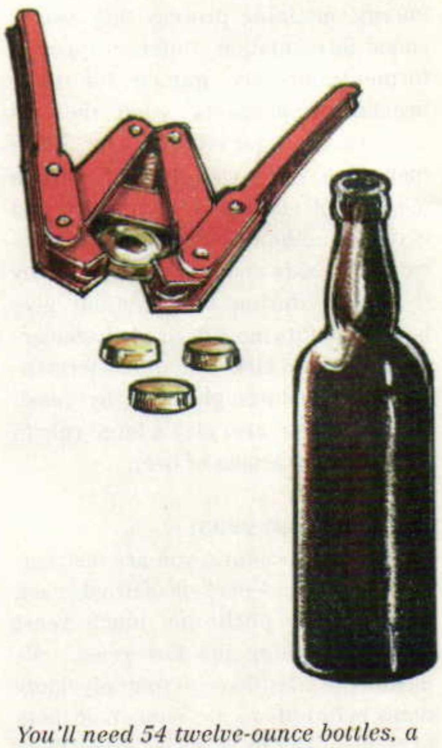
The simplest way to prime beer is to use PrimeTabs, which are premeasured corn-sugar tablets. You can buy these at many homebrew shops. Drop 2 to 5 PrimeTabs in each bottle, depending on the level of carbonation you want (3 is a safe bet). Once all the bottles have been primed, rack the beer into each bottle. Leave behind the dregs at the bottom of the bucket.

To start a siphon, attach a sanitized plastic hose to your racking cane (at the top, near the bend). Put the fermenter on a table or stool so it's higher than your bottles. Fill the hose and cane with water, making sure there are no air bubbles. Put the racking cane in the beer and the hose in a little bucket. When you take your thumb off the hose, the water will flow out of the tube and start the siphon. Once beer is flowing through, fill your bottles! Pinch the hose to stop the beer each time you switch bottles. Leave about an inch of headspace in the neck of each bottle. Crimp the caps and you're done!

—Chris Colby



Ferment your beer in a five-gallon plastic bucket with a lid and airlock.



You'll need 54 twelve-ounce bottles, a bottle capper and some caps.

Extra Credit!

Foreign Language 101

Do you speak beer? The world of brewing is filled with foreign phrases and weird words. This mini-glossary offers plenty of cool-sounding words you can use to impress your friends and sound like a pro.

Biersteuergesetz: The beer-tax law in Germany that governs the taxation of beer and the methods and processes of malting and brewing.

Braun hefe: The brownish yeast and trub layer that accumulates at the top of the fermenter.

Brauer Geschwür: Translates roughly to "brewer's tumor," an unfortunate accumulation of fat around the midsection of many brewers.

Bung juice: British slang for beer.

Chondrus crispus: Scientific name for Irish moss, a red seaweed that is sometimes added to the last few minutes of the boil. It helps clear the beer by causing haze-forming substances to coagulate and settle.

Drauflassen: A method of yeast propagation that involves doubling the wort volume after a few days.

Drop fass: Process used by some brewers in which beer is dropped into a small buffer tank, or fass, as it is transferred from the primary to lagering in order to strip out some sulfurous aromas.

Firkin: A cask for beer with the capacity of a quarter-barrel.

Fob: A term used to describe beer foam during bottling or kegging.

Glattwasser: Last wort or last runnings during the sparge.

Grant: Small cylindrical vessel fitted with drain cocks. Used for draining and inspecting the mash when it is transferred from the mash tun to the lauter tun.

Gyle: A portion of unfermented wort added to finished beer for conditioning and raising alcohol content.

Isinglas: Collagen protein from the swim bladders of certain fish used for beer clarification.

Keiselguhr: Diatomaceous earth used for beer filtration.

Kraeusen: A stage of fermentation when a big, rocky head of foam appears on the surface of the wort. Wort at this stage can be used to kraeusen other batches in a later stage of fermentation to carbonate and condition the beer. Also, adding young fermenting wort to a fully fermented lagering wort to create a secondary fermentation.

Lager: German for "to store." A generic term for any beer produced by bottom-fermenting yeast. True lagers are matured (lagered) in cold storage rooms for one to three months and sometimes longer, but modern methods complete aging much more rapidly.

Lautering: The process of separating the sweet wort from the spent grains with a straining apparatus. From the German word "lauter," which means to clarify.

Lauter tun: From the German word for clarify. A large vessel fitted with a false slotted bottom and a drain spigot, in which the mash is allowed to settle and the sweet wort is removed from the grains by straining.

Lickspigot: Obsolete British slang for an alehouse keeper.

Liquor: Brewers' term for water used for brewing.

Nachgusse: Wort collected after sparging begins, when the wort gravity begins to taper off.

Pin: Half a firkin.

Sauermalz: Sour malt, malt treated with naturally produced lactic acid prior to kilning and used to lower mash pH.

Shive or spile: A circular shaped wooden bung for casks, or a small hole in the wooden bung of a cask, into which the publican or cellarman inserts a wooden peg to control the escape of gas.

Sparging: The process of spraying the spent grains of the mash with hot water to retrieve the leftover malt sugars.

Spindle: A term for a hydrometer, or the act of taking the specific gravity of wort or beer with a hydrometer.

Spund or bung: A closure used to close off a beer vessel, traditionally a wooden keg or barrel.

Trub: Suspended particles caused by the precipitation of proteins, hop alpha acids and tannins during the boiling and cooling stages of the wort.

Ullage: Synonym for headspace. The empty space between the liquid and the top of a bottle.

Vorderwurze: First wort collection.

Vorlauf: Wort recirculation before wort collection.

Wort: The sugar solution obtained by mashing the malt and boiling in the hops before it is fermented into beer.

Some of these definitions are reprinted with permission from the "Dictionary of Beer and Brewing" (Brewers Publications, 1998). Brewers Publications is a division of the Association of Brewers in Boulder, Colorado. Call (303) 447-0816 or go to www.beertown.org.

HOMEBREW 201:
BREWING A PALE ALE WITH SPECIALTY GRAINS

Vocabulary

specialty grains
kilning
crystal malt
pellet hops
alpha acids
liquid yeast
secondary fermentation
yeast starter
flocculation

New Skills

making a yeast starter
steeping specialty grains
boiling pellet hops
conducting a secondary fermentation

Equipment list

nylon grain bag
nylon hop bags or large tea balls
2L or 3L soda bottle
glass carboy
fermentation locks

Objective: Learn how to use specialty grains, pellet hops and liquid yeast to brew a West Coast pale ale.

In Homebrew 101, you learned how to brew a beer the simplest way possible using the least amount of special equipment. In Homebrew 201, you'll learn how to use steeped grains, pellet hops and liquid yeast to modify an extract beer to closely match a popular style of pale ale. Brewing with specialty grains, your own choice of hops and liquid yeast takes a few additional pieces of equipment and some added work. However, using the techniques described here, you can modify an extract-based beer to brew virtually any style of beer you want.

We'll examine the recipe and procedure for brewing a West Coast pale ale recipe *(see page 33)*. Pale ale is one of the most popular styles of ales for homebrewers. The best pale ales are refreshing beers in which the flavor of malt is balanced by the hop bitterness. West Coast pale ales have more color and more hop bitterness and flavor than their East Coast (or British) counterparts. Full Sail Ale (from Hood River, Oregon) and Red Seal Ale (from Mendocino County, California) are two excellent examples of this style.

In our recipe, we'll add some sweetness and color with the use of crystal malt. In addition, we'll boost the level of hop bitterness and flavor from the hopped malt extract by adding additional hops to our wort. And finally, we'll pick a liquid yeast strain that gives us that clean, neutral fermentation character found in most American pale ales.

Specialty grains

When brewing extract-only beer, you must find a malt extract formulated to yield your desired style of beer. When brewing an extract beer with specialty grains, you can start with a base of light malt extract. From this starting point, you can add flavors, aromas and colors to your beer by adding one or more *specialty grains.*

Specialty grains are any grain that is not a base grain. So, what's a base grain? Base grains are the grains — usually lightly kilned malted barley or malted wheat — that provide the bulk of the fermentable sugars in a beer. Specialty grains are darker grains that are added to beer in smaller quantities. Although they add a small amount of fermentables, the flavor, aroma and color of these grains are the main reasons they are added to beers. There are many different kinds of specialty grains. Adding them singly or in combination yields a large range of possible flavors and colors.

There are two basic types of specialty grains, those that have been prepared by stewing and those that have been produced by roasting. Stewing and roasting are two ways of adding heat to darken the grain. The process of heating malted grains in the malting process is called *kilning.* Stewed grains are heated such that the liquid inside them cannot escape. In contrast, roasted grains are heated so they are dried quickly. The upshot is that in the center of a stewed grain most of the starch has been converted to sugar. In a roasted grain, the center of the grain is mostly starch. The most common types of stewed grains are *crystal malts.* Common roasted grains include chocolate and black patent.

We'll use crystal malt in our beer. Different crystal malts are kilned to different degrees. The more kilned the malt is, the darker the color. The color of a crystal malt is usually expressed in degrees Lovibond (°L). For our pale ale, any crystal malt from 30° to 40° L will suffice. *(For more on grain color, see page 36.)*

You can steep large amounts of stewed grains in an extract beer. Although some brewers load their beers up with specialty grains, most homebrewers try to keep specialty grains under 10 to 15 percent of the total grain bill. You should limit the amount of roasted grains that you steep. The starch in roasted grains can create a haze in your beer that can serve as a source of growth for bacteria. Using less than 5 percent roasted grains in an extract beer is a good rule of thumb. In order to use larger amounts of roasted grains, you need to mash the grains. *(See Homebrew 301 and 401 for more details.)*

Using specialty grains

Specialty grains must be crushed before they are steeped. Most homebrew stores either sell crushed grains or have a grain mill and will crush the grains for you. To do it yourself, simply use a rolling pin and a fairly light touch. You want to crack the grain and open the husk, but not pulverize it.

Specialty grains should be steeped at temperatures in the range that base malts are mashed. This range is usually 150° to 158° F. If you steep the grains at higher temperatures — for example, if you boil them — you risk extracting too many tannins from the husks. A beer with too many tannins will taste astringent.

To steep the specialty grains, place the grains in your nylon grain bag. If the bag has a drawstring, close it. If not, tie off the end of the bag. Heat 3 gallons of water to 160° F, then turn off the heat. Place the grain bag in the water. (This should drop the temperature a couple of degrees.) You can tie the bag's drawstring to the handles of your pot or use string to tie the bag to the handles. This will keep part of the bag out of the liquid and make it easier to pull out. Stir the water a few times while you steep, and stir the water one final time before you remove the grain bag. Stirring will cause water to flow through the bag and release colors and flavors from the grain.

After the grains have been steeped, pull them out and set them in the sink. The grains will be hot, so be careful. It's a good idea to take a small kitchen strainer and remove most of the "floaties" left in the water. The floaties are mostly husk parts. If boiled, the pieces of husk will surrender their tannins and lead to astringency. Don't worry if you can't get them all; a few stray husk pieces won't hurt your beer. The strainer should be clean, but don't bother sanitizing it, as you will boil the wort later.

Once you're done steeping the grains, it's time to add the extract and proceed towards the boil. During the boil, you'll further alter the flavor of your base malt extract by adding hops.

Hop varieties

Your local homebrew shop probably has a large variety of hops. To a beginning brewer, the variety can seem overwhelming. However, after reading a few recipes, you'll start to see some patterns emerge.

Hops come in three basic forms: leaf hops, plug hops and *pellet hops*. Pellet hops are the most convenient and most widely used form of hop among homebrewers. Pellet hops are made by compressing shredded hop leaves into small, cylindrical pellets. We'll use this form of hops in our West Coast pale ale.

Although there are a large number of different varieties of hops, you can use the country of origin as a guide to what type of beers to use it in. British hops, such as Fuggles and East Kent Goldings, go well in bitters, porters or other beers traditionally brewed in the region. Hops from the European continent, such as German Hallertau or Czech Saaz, go well in continental lagers such as helles or pilsner. Here in the U.S., craft brewers frequently use Cascade or Chinook, which are grown in the Pacific Northwest.

We'll load up our pale ale with Cascade hops. Cascade has a citrus-floral smell that is prominent in most West Coast pale ales, including Sierra Nevada (the quintessential West Coast pale ale). Not all brewers use hops from their own country. Budweiser, the largest-selling beer in the United States, advertises the use of European hops in its beer.

Regardless of what region they come from, hops are rated for their bittering strength. Bittering strength is given in percent *alpha acids*. Many homebrewers use high alpha-acid hops early in the boil to provide bitterness and lower alpha-acid hops later in the boil to provide flavor and aroma. Lower alpha-acid hops provide less bitterness, but often have better flavor and aromatic properties than the high-

specialty grains: malted barley or other grains used to add flavor, color, and aroma to beer, usually more highly kilned than base grains

kilning: the heating of malted barley or other grains during malting to dry the grains; kilning also darkens the color and alters the flavor and aroma of the grain

crystal malt: a stewed specialty grain that adds a sweet taste and amber color to beers

pellet hops: pellets made by compacting parts of the hop flower

alpha acids: the compounds that account for bitterness in hops; often expressed as a percentage of the weight of the cones

liquid yeast: brewer's yeast suspended in a liquid media (instead of dried)

secondary fermentation: settling stage for beer; little actual fermentation takes place

yeast starter: a small amount of wort, made before brew day, in which yeast cells multiply to numbers great enough to pitch into a regular batch of beer

flocculation: when yeast cells clump together and sink to the bottom of the carboy; this happens toward the end of fermentation

Extra Credit!

Getting the Most (and Best) Out Of Your Steeping Grain

1. Always steep specialty grains in the brewing liquor *before* adding the malt extract. This way the hot liquor will not yet be saturated with sugars, and the extraction of the grain flavors will be more efficient.

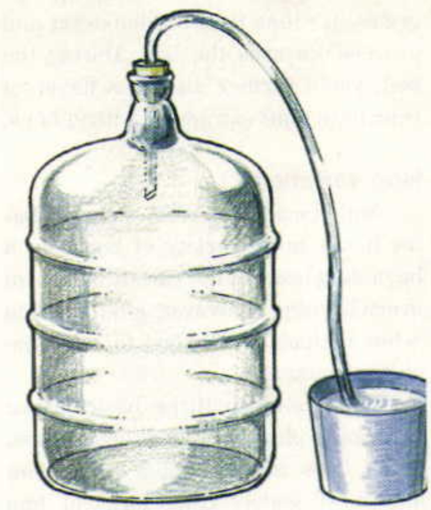
2. Since steeping produces fewer sugars than does mashing and sparging, it makes a smaller contribution to your wort's gravity. Most grains, when steeped, yield about half as much sugar as they would when mashed. But as a practical matter, because of the relatively small amounts of grain, the gravity change from steeping can be ignored. Your beer is not likely to be outside the style guidelines because you added steeped grain.

3. Prepare grains for steeping by first placing them in a strong plastic bag. Then use a rolling pin to crack them. Do not fine-mill specialty grains, because finely milled malt is hard to contain in a steeping bag and particles end up in the wort.

4. After cracking, place the grains in a muslin or nylon bag and immerse them in about two gallons of cold water. Heat the water slowly until you can detect bubbles rising in the kettle. This should take at least half an hour, at which point the brewing liquor should be at about 70° to 80° F. Do not boil your specialty grains!

5. Lift the muslin bag out of the kettle and rinse it with about one cup of *cold* water. Do not use hot water or squeeze the bag; this would extract starchy residue.

6. After removing the grains from the kettle, bring the brewing liquor to a boil. Remove the kettle from the burner to add the extract. This prevents scorching as the thick extract sinks to the bottom. Stir gently to distribute the extract evenly. Then adjust the volume and bring the mixed wort to a boil. —*Horst Dornbusch*



During the primary, when activity is vigorous, use a blow-off tube instead of an airlock. One end goes through a stopper, the other into a bucket of water. The water keeps bacteria from going up the hose and into your carboy.

alpha hops. In beer recipes, the amount of hops required is often given in AAU (alpha acid units). AAUs are the alpha-acid rating of the hop times the weight of the hops in ounces. To calculate how many ounces of hops you need for a recipe, divide the value of AAU given by the alpha-acid rating of the hops. For example, if you need 12 AAU of hops and you choose hops with a 4% alpha acid rating, you need (12/4) = 3 ounces of hops. Bitterness also can be expressed in terms of International Bitterness Units (IBU), a more complex measurement.

Boiling hops

Bitterness is affected by the AAUs of the hops and the length of time the hops are boiled. The longer hops are boiled, the more bitterness is extracted from them. Another major factor that influences how much bitterness gets extracted from hops is wort concentration. The more concentrated a wort is, the less bitterness gets extracted from the hops. To counteract this, we are adding hops to our base of hopped malt extract. If we used an unhopped extract, we'd have to add considerably more hops to get the level of bitterness we desire.

Pellet hops turn into a green sludge when they are boiled. You need to ensure this mess doesn't get transferred to your kettle. One way of doing this is by enclosing the hops in a nylon bag or tea ball. Both will keep large hop particles from diffusing into your beer, but tea balls have the advantage of being heavy enough to submerge the hops. Often, hops in nylon bags will float on top of the wort.

It's important not to fill the bag or ball more than one-quarter to one-thirds full. When boiled, the hops will take on water and expand. If they are too constrained, they will pack into a tight ball. Only bittering molecules from the outside of the ball will diffuse into the beer. Molecules in the middle will be trapped, leading to inefficient use of the hops. At the end of the boil, remove the hops and set aside to cool.

Conducting the boil

Heat the steeping water to a boil. Once the water starts boiling, turn off the heat and add the malt extract. Turn the heat back on until the wort begins to boil. Often, wort will foam a lot at the beginning of the boil. A couple quick stirs with a clean spoon should calm the foaming down. If it doesn't, lower the heat until the foam subsides.

Add the first charge of hops right after the wort comes to a boil. These hops will boil for an hour and add to the bitterness of the hopped malt extract. You can tie the hop bag or tea ball to the handle of your pot.

Try to maintain a vigorous, rolling boil. If your wort is only simmering, cover the pot partially with its lid. If the wort is boiling fine, leave the cover off. Never cover the pot completely no matter how weak the boil is. There are compounds in the wort that need to boil off or they will add off-flavors or aromas to your beer.

Add the second charge of hops with 15 minutes left in the boil. When the boil is over, remove the hops and turn off the heat. As in Homebrew 101, add cold, aerated water to your bucket fermenter, then pour in your wort.

Choosing yeast

You need to plan ahead when you use *liquid yeast*. There are not enough yeast cells in liquid yeast containers to pitch directly into 5 gallons of beer. So, you must build a *yeast starter*. For 5 gallons of average-strength beer — like our pale ale — you will need about 1/2 gallon (approximately 2L) of yeast starter. At ale fermentation temperatures (68° to 72° F), it takes about 3 days for enough yeast to grow in a starter this size. This preparation time is the major disadvantage of using liquid yeast. There are, however, many advantages to using liquid yeast.

Liquid yeast comes in a wide variety of strains for dozens of different beer styles. Since liquid yeast grows in a yeast starter immediately before being pitched, it takes little or no time for it to adapt to new surroundings. Dry yeast, in contrast, goes from being desiccated to soaking in hot water to swimming in cool wort. It takes the yeast some time to adapt to the wort before it can start moving wort sugars across its cell membrane.

American ales are usually cleaner than their British counterparts, containing fewer esters. For our beer, we'll use Wyeast 1056 or White Labs WLP001. These yeasts yield a beer with very little "ale nose," which focuses more attention on the flavor and aroma from the malt and hops.

Making a yeast starter

A yeast starter is just a small batch of beer. The yeast in this beer multiply to numbers great enough to pitch into the next larger size batch of beer. You can make a starter for 5 gallons of beer by adding 4 to 5 ounces of dried malt extract (light, unhopped) to 2L of water. Boil the extract for 15 minutes, cool, and pour into a sanitized bottle. Cap the bottle and refrigerate the yeast starter overnight.

You can aerate the yeast starter well by shaking the next day. Then, remove the cap, affix an airlock and leave it out at room temperature to warm up. Once the starter warms to room temperature, pitch the yeast and keep the starter at room temperature (around 72° F degrees) for two to three days. On brewing day, after you have checked the temperature of the wort, the entire yeast starter can be pitched.

Secondary fermentation

After fermenting for a week, our procedure calls for a *secondary fermentation*. The term secondary fermentation is a bit of a misnomer as it implies that fermentation begins again. In fact, the bulk of the fermentation for our ale will have finished in the first 3 to 4 days. After that, the yeast finish off the few remaining fermentable sugars and begin dropping out of solution. This is called *flocculation*.

Secondary fermentation is really just a settling stage. The fermented beer is racked off the layer of dead yeast from the primary fermentation. Yeast and other particles still in suspension are allowed to settle out. Removing the beer from the yeast ensures that it doesn't pick up any off-flavors from these materials.

To conduct the "secondary fermentation," clean and sterilize a glass carboy and a racking cane. Rack the beer from your primary fermenter (bucket) to your secondary fermenter (carboy). Splash the beer as little as possible to avoid oxidation. When racking, keep the end of the cane beneath the surface of the beer in the carboy. One benefit of a glass carboy is that you can see what's going on with your beer!

After secondary fermentation is finished, bottle the beer as you did in Homebrew 101. The only difference is that you will be bottling out of your secondary fermenter instead of your primary. Your beer should be a little clearer as a result of the secondary fermentation. In Homebrew 301, we'll learn a slightly more advanced procedure for bottling. —*Chris Colby*

Summary

- Specialty malts add color and flavor to beer
- By boiling hop pellets you can add hop bitterness, flavor and aroma to your beer.
- A yeast starter is a good way to grow a pitchable amount of liquid yeast.
- A secondary fermentation can lead to a clearer beer.

West Coast Pale Ale

OG 1.048 • FG 1.015
IBU over 25 (depends on extract)

3.3 lbs. of liquid malt extract (light, hopped)
2.75 lbs. of dried malt extract (light, unhopped)
0.50 lb. crystal malt (30° to 40° L)
10 AAU Cascades hops (bittering) (2 oz. hops at 5% alpha acid)
5 AAU Cascades hops (flavor) (1 oz. hops at 5% alpha acid)
1 bag of Wyeast 1056 or 1 vial White Labs WLP001
PrimeTabs

4 days before brew day
Make yeast starter
Refrigerate yeast starter

3 days before brew day
Shake yeast starter
Bring to room temperature
Pitch yeast and affix airlock

1 day before brew day
Clean, sanitize, and rinse 4 2L soda bottles with warm water
Fill the soda bottles with water and refrigerate overnight

On brewing day
Heat 3 gallons of water to 160° F
Steep crystal malt for 30 minutes
Strain out floaties
Bring water to boil
Stir in malt extract
Bring wort to boil
Add bittering hops
At final 15 minutes, add flavor hops
Shake refrigerated water bottles
Add water to primary fermenter
Add hot wort to fermenter
Pitch yeast starter
Ferment for one week

1 week after brewing day
Rack to secondary fermenter

2 weeks after brewing day
Check gravity with hydrometer
Bottle beer when gravity is constant for three days
Leave bottles at room temperature for 1 week, then refrigerate for 1 week

3 weeks after brewing day
Beer is ready

HOMEBREW 301:
USING A PARTIAL MASH TO SUPPLEMENT EXTRACT

Vocabulary

partial mash
base grains
full-wort boil
wort chiller
aeration stone

New Skills

partial mashing
conducting a full-wort boil
using a wort chiller
aerating with an aquarium pump
batch priming

Equipment list

large kitchen strainer
8-gallon kettle
wort chiller
aquarium pump and aeration stone
bottling bucket

Objective: Learning how partial mashing allows you to brew a beer in which some of the fermentables come from grain

In Homebrew 201, you learned how to alter a malt extract beer by using grains, hops and liquid yeast. We'll continue along that path in Homebrew 301. Here I'll show you how to create a wort with a substantial percentage of its fermentables from malted barley. Making a *partial mash* of base grains improves the flavor of extract beers. I'll also show you how changes in some brewing procedures require compensating changes in other procedures. And of course, you'll need a few new pieces of equipment — a bigger brew kettle to hold the entire volume of wort, a device to quickly chill your hot wort to pitching temperature, and an aquarium pump and aeration stone to add oxygen to the wort.

In Homebrew 301, we'll focus on brewing a British style of beer — porter *(see page 37 for the recipe and step-by-step procedure)*. Porters are dark, malty beers that first were brewed in London as early as the 18th century. Stout evolved from porters, and many porters have a slight bite from dark roasted grains, though not to the degree that stouts do. The hop bitterness in porters is well-balanced with the maltiness, with neither predominating in most examples of this style. Redhook's Blackhook Porter and Sierra Nevada Porter are two excellent U.S. porters. Samuel Smith's Taddy Porter is an English porter that is widely available in the States.

In this recipe, we'll supplement the malt extract we use with sugars from a partial mash. In mashing, the starch in the center of malted grains is broken down into its constituent sugars. Along with the *base grains*, which will supply most of the fermentables from the partial mash, we'll add some roasted specialty grains. We'll also learn the advantages of boiling our entire wort, and the changes we'll have to make in our equipment and brewing procedures as a consequence.

Partial mashing

In our porter recipe, approximately 2/3 of the fermentable sugars will come from malt extract. The remaining 1/3 will come from grains. Mashing is a simple process, but one that is often made to seem overly complex in some homebrewing texts. The essence of mashing is simply soaking crushed grains in water. As the grains soak, the water dissolves the starch in the grains. Enzymes from the grain attack the starch and chop it up into its building blocks, sugars. Once the starch is fully converted, the sugars are rinsed from the spent grains.

As far as starch-conversion goes, a partial mash works exactly like a full mash. However, since less grain is used in a partial mash, handling the soaking and rinsing of the grains is simpler and requires no special equipment beyond a mesh grain bag and a measuring cup. Performing a partial mash is very similar to steeping specialty grains. Gaining some experience with partial mashing often encourages brewers to go on to try making an all-grain beer.

Performing a partial mash

In a partial mash, you want to steep the grains in a volume of water sufficient to cover them completely, but not leave a lot of excess volume. For our porter we'll steep 2 pounds of pale malt, plus the specialty grains, in 2 gallons of water. This is a thinner mash than most full mashes, but that won't adversely affect our beer.

To begin the partial mash, gather the crushed grains and place them in the nylon bag. Although we will be holding the temperature of the mash at 150° F, we need to heat the water to 160° F to start. This is because the temperature of the mash will drop once the grains, which are at room temperature, are added to the liquid. Once the grain bag has been submerged for a couple minutes take the temperature of the water in the pot. As with the steeped specialty grains, you should shut the bag and tie it to the handles of your brew pot.

Try to hold the temperature as

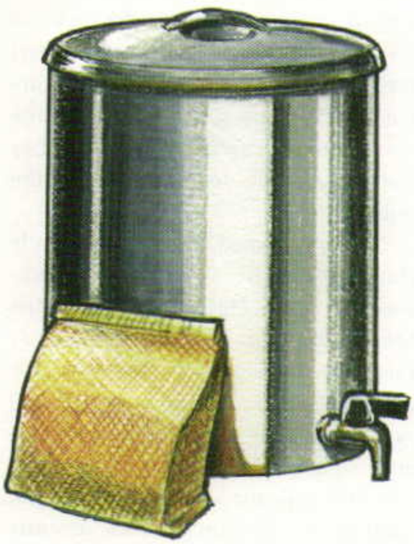
close to 150° F as possible for 1 hour. To adjust the temperature of the partial mash, add heat or cold water as necessary. When changing the temperature, add only a little bit of heat or cold water, then stir and retake the temperature. It's easy to overshoot your temperature mark, especially when heating.

As you heat a pot, it takes time for the heat to travel through the metal and equilibrate. Thus, if you heat the mash continuously until the thermometer reads 150° F, then turn off the burner, the temperature will keep rising as heat from the pot is transferred to its contents. To avoid this, heat in short bursts, stir while heating, and wait a couple of minutes before checking the temperature again. It's not going to hurt the beer if it takes you a little while to adjust the temperature, so be patient.

Rinsing the grains

After an hour, take a large kitchen strainer and lift the bag out of the water. Let the liquid drain into your pot. If possible, balance the strainer over the pot. If you can't do this, have a friend hold it. Open the drawstring or untie the bag and expose the grains. Take a measuring cup and ladle water from the pot over the grains. The water will run through the grains and fall back into the pot. Keep doing this for 5 minutes or so. The idea here is to rinse as much of the sugars from the grains as possible.

Once you're done rinsing the grains, use your small kitchen strainer to remove as much solid matter as feasible. Don't spend more than 5 minutes doing this. Once the large solid materials have been removed, add the liquid (wort) to your large brew pot. (Before you do, give it a taste. Mmmm . . . malty!) Your strainers should be clean, but they do not need to be sterilized since the wort will be boiled after they are used.



You'll need a large brewpot, one that holds at least eight gallons of liquid, to conduct a full-wort boil. Many come equipped with ball valves for draining wort from the pot.

Full-wort boil

In your large brewpot — it should hold at least eight gallons of liquid — combine the wort from the partial mash with water to make 5.5 gallons. Bring this to a boil, then add the malt extract. Although our target is 5 gallons of wort, we need more wort initially because some liquid will evaporate during the one-hour boil. The amount that evaporates is dependent on the amount of heat applied to the kettle. If you're boiling on the kitchen stove, the evaporation may be minimal; if you're using a propane burner, it may be considerable.

Boiling 5 gallons of wort is a large task for most home stoves. A gas stove can probably bring this volume of wort to a rolling boil. An electric stove may have problems developing more than a sustained simmer. Also, the amount of time it takes for the wort to come to a boil may be quite long. You may wish to begin heating the additional water while you are performing the partial mash. If your kitchen stove is having trouble boiling this volume, close the lid partially. Another option is to move your home brewery to the backyard and use a propane burner for the boil.

Two benefits of boiling the entire wort are increased hop utilization and less wort darkening compared to boiling a concentrated wort. When brewing a beer using a *full-wort boil*, you need to add fewer hops to get the same level of hop bitterness. This is because

partial mash: a small mash that adds fermentables and grain flavors and aromas to an extract beer

base grains: malted grains that supply the bulk of the fermentables in an all-grain beer; base malts are kilned less than most specialty grains

full-wort boil: a procedure in which you boil — get this — the full wort; boiling the entire wort leads to better hop utilization and less wort darkening, but requires a method to quickly chill the wort after it has been boiled

wort chiller: a device used for quickly cooling wort after it has been boiled

aeration stone: a porous device, often made of stainless steel, through which air is pumped; the air is diffused into small bubbles which help aerate the wort

Extra Credit!

Grain Color 101

Grain color units are based on a standard of comparison created by J. W. Lovibond in 1883 and adopted by the American Society of Brewing Chemists. So North American maltsters list the color ratings of their grains in °L (degrees Lovibond). But beer color is usually expressed in °SRM (Standard Reference Method). In theory, 1° Lovibond of grain color equals 1° SRM of beer color for 1 lb. of grain in 1 gal. of water. In many texts, °L and °SRM are used interchangeably.

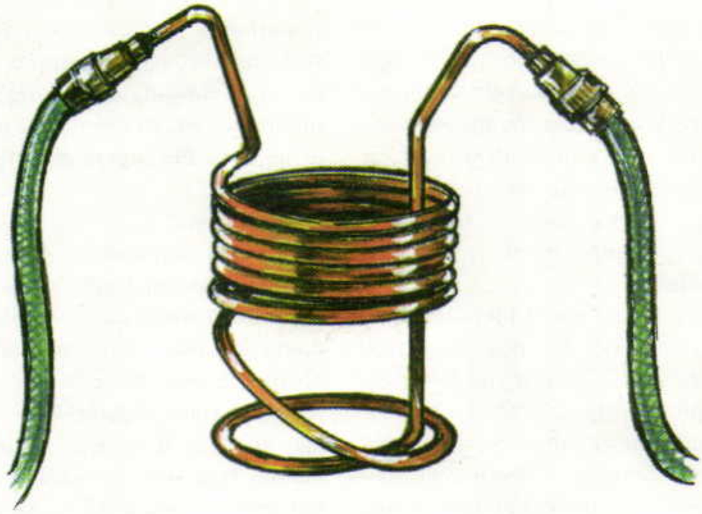
Here are a few typical values for different grains: A carapils malt may be as blond as 1.5 °L, while a European pils may come in at 2 °L. British pale ale malt is usually around 3.5 °L. A typical mid-range Munich malt weighs in at 10 °L. Crystal malts are usually sold in 40 °L, 60 °L, 80 °L and 100 °L versions, but go as high as 180° L. Most chocolate malts are about 450° L and black patent malts may rate 500 °L or higher.

To compose a grain bill of any color value from different grains, look up the color ratings for each grain, multiply the Lovibond rating in °L for each grain by its weight in pounds and add these products into one sum. Once you divide this sum by the net kettle volume of wort (in gallons), you have an approximate Lovibond/SRM color rating of the finished beer. Here is the nominal mathematical formula that allows you to determine the relative proportions of each grain:

$$\frac{(°L1 \times lb1) + (°L2 \times lb2) + (°L3 \times lb3)}{VKnet}$$

where:
(1, 2, 3) are the grains
(°L1, °L2, °L3) are the Lovibond ratings of these grains
(VKnet) is the net kettle volume of wort (in gallons, end of the boil)

Since wort color is also affected by the extraction efficiency of your system and by the mashing process you employ, your actual beer color will be at least 10% lower than this mathematical predictor, for pale beers. It will be much lower for dark beers. —*Horst Dornbusch*



You can't pour five gallons of hot wort directly into a glass carboy, so you need to cool it quickly with a submersible wort chiller. This is a coil of copper tubing attached to garden hose. You dunk the copper into your hot wort, turn on the cold tap water, and swirl gently as the water runs through the coil and cools your wort. If you brew inside, you'll need an adapter to attach the hose to your sink.

more hop bitterness is extracted in more dilute worts. With a full-wort boil, you can also brew beers that are much lighter in color than beers brewed with from a concentrated wort. In thicker worts, the sugars carmelize much easier, darkening the wort. This difference in color won't be very visible in our porter, of course.

Another change that a full-wort boil will bring is the inability to pour the wort directly into the fermenter. (Pouring boiling wort into a glass carboy, for example, could crack the glass.) With no cold water to dilute the wort and bring down the temperature, you will need to cool the wort first. Then, given the large volume, it's more convenient to simply siphon the wort to the fermenter.

This drawback, however, has a hidden benefit. Since siphoning the wort to a fermenter leaves behind material on the bottom of the kettle, you don't need to keep your hops in a bag or tea ball. The hop debris will settle to the bottom of the kettle during cooling. The clear wort can then be siphoned off the hop material and hot break, the proteins, lipids and other compounds that coagulate in the boil.

Cooling your wort

There are several ways to cool wort. One way is to place the kettle in a sink or bathtub full of cold water and ice. The drawback of this method is that you need to lift a large volume of near-boiling hot liquid. Needless to say, this can be a bit dangerous. You can avoid the potential hazard of spilling 5 gallons of hot wort by chilling it on the stovetop with a submersible *wort chiller*.

A submersible wort chiller is a spiral of copper tubing. This tubing is submerged in the wort and cold water is run through it. Heat from the wort transfers to the cold water and is carried out. The speed of cooling and the eventual temperature the wort reaches depends on the temperature of the cooling water.

You can speed chilling by gently whirlpooling the wort. If the submersible wort chiller is left undisturbed, the wort next to the copper coils will quickly cool. However, the wort farther away from the coils will cool much more slowly. The wort will move somewhat in that cold wort will sink and warmer wort will rise. But, starting a whirlpool will greatly enhance the amount of hot wort passing by the copper coils and greatly enhance your cooling rate.

If you move your submersible wort chiller in a circular motion, you will start the wort moving. As the wort moves by the cool chiller, it cools. Hot wort is prone to hot-side aeration, so try not to agitate it unduly. Induce a slow, steady swirling motion by moving the wort chiller in a circle. Repeat this motion every five minutes.

The wort chiller is usually sterilized by submersing it in the wort for the final 15 minutes of the boil. During this time, there is no water flowing through it. In fact, it's best not to connect the tubing until after you have turned off the heat to the kettle. A logistical note: Connecting the tubing to your sink faucet will probably require an adapter, since most wort chillers are threaded to screw onto a garden hose connector.

Aerating the wort

Performing a full-wort boil necessitates one other change in your brewing procedure; you need to aerate your wort once it is cool. In Homebrew 101 and 201, we simply added cold, aerated water to our concentrated wort to aerate it. Now we can't do that, because our wort is already at working strength. Adding water would dilute it.

One of the simplest ways to aerate cooled wort is by using an *aeration stone* attached to an aquarium pump. Most aeration "stones" used in brewing are actually made of stainless steel. Air is pumped into the stone, where it is forced out through hundreds of tiny holes. Air from the aquarium pump should be filtered, so you are not pumping airborne microorganisms into your wort. Most homebrew shops sell aeration kits that include the stone and a HEPA filter. Since the aeration stone and the tubing leading to it will touch the wort, you must sanitize both before you aerate.

You can aerate your wort while it is siphoning into your fermenter. Just put the aeration stone in the fermenter and run the aquarium pump as you are siphoning. By the time your fermenter is filled, the wort should have enough oxygen. If you'd like, you can run the pump for another five or ten minutes. However, keep an eye on the wort so the bubbles from the aeration stone don't make the wort foam over.

Bottling the entire batch

After the porter ferments for a week or so in your primary fermenter, and then settles for another week in your secondary fermenter, it's time to bottle. We'll do things a bit differently this time. Instead of priming each bottle individually with PrimeTabs, we'll use batch priming in a bottling bucket.

To bottle this way, you need to siphon your wort from your secondary fermenter into a sanitized bucket. Try to minimize the amount of splashing when you transfer the beer. You don't want to oxidize the porter.

For 5 gallons of beer, use a sanitized spoon to stir a solution of sugar water into your beer. Make the sugar water by boiling 3/4 cup of corn sugar in 2 cups of water. Boil for 15 minutes, then cool the solution to about room temperature and stir it into the wort. Now, siphon the beer into bottles and cap them as before. The sugar water works just like the PrimeTabs; it provides a new source of fermentable sugar, which causes fermentation in the bottle and creates carbon dioxide.

After a week at room temperature, put the bottles in the fridge for a week. Then, invite some friends over and impress them with your newfound brewing skills.

So that's how to make a partial mash. In Homebrew 401, we'll move up to full mashing and brew an all-grain beer. A full mash works just like a partial mash, but you will need get some added equipment and learn a few new skills to handle the larger volume of grains required. — *Chris Colby*

Summary

- Partial mashing with grains adds more control to your extract homebrew.
- A full-wort boil increases hop utilization but requires that the wort be cooled.
- A submersible wort chiller can cool wort quickly
- Aerating cooled wort with an aquarium pump and stone is simple and effective.

Porter

OG 1.048 FG 1.014 IBUs 26

3.75 lbs. dried malt extract (light, unhopped)
2 lbs. pale ale malt
3/4 lb. crystal malt
1/2 lb. chocolate malt
1/4 lb. black patent malt
9 AAU Fuggles hops (2 oz. of 4.5% alpha acid)
Wyeast 1968
3/4 cup corn sugar for priming

4 days before brew day
Make yeast starter
Refrigerate yeast starter

3 days before brew day
Aerate starter
Pitch yeast to starter

On brewing day
Heat 2 gallons of water to 160° F
Steep all grains for 60 minutes
Hold temperature at 150° F
Rinse grains with hot water from brew pot
Strain out "floaties"
Add 3.5 gallons of water to mash water
Bring the 5.5 gallons of water to a boil
Stir in malt extract
Bring wort to boil
Add bittering hops
Cool wort with wort chiller
Siphon cooled wort to fermenter
Aerate wort with aquarium pump, stone and filter
Pitch yeast
Ferment for one week

1 week after brew day
Rack beer to secondary

2 weeks after brew day
Test specific gravity with hydrometer for 3 days
Bottle beer when gravity is constant
Condition at room temperature for 1 week
Refrigerate for 1 week

3 weeks after brew day
Beer is ready

HOMEBREW 401:
BREWING AN ALL-GRAIN SCOTTISH ALE

Vocabulary

all-grain brewing
single-infusion mash
fearless
sparging
propane cooker
mash tun
recirculation
lauter tun

New Skills

single-infusion mashing
recirculation
sparging

Equipment list

mash-lauter tun
propane burner
sparge arm

Objective: Brew an all-grain Scottish ale from malted barley

In Homebrew 101 through 301, we brewed extract-based beer with various modifications. In Homebrew 401, we'll switch gears and brew a beer in which the fermentables come entirely from malted barley. This is called *all-grain* or *full-mash brewing*. We'll perform a ***single-infusion mash***, the simplest kind of full mash.

Although our mash works on the same principles as the partial mash, the increase in the amount of grain used requires us to alter our procedures slightly. In Homebrew 301, we put our entire grain load in a mesh bag. We later lifted this bag out of the brew pot, leaving behind wort. In all-grain brewing, the "grain bag" stays in place and you move the wort out of it. For this, you will need some additional equipment — most importantly an 8-gallon kettle, a propane cooker and a mash-lauter tun *(for more on mash-lauter tuns, see page 40)*.

Advantages and Disadvantages of All-Grain Brewing

Brewing beer from a full mash takes significantly more time than brewing an extract beer. Some of the extra time comes from added steps in the procedure, such as the mash, recirculation, run-off and sparge. (Don't worry, I'll explain these terms later.) Other blocks of time are needed to heat the larger volumes of water needed to brew an all-grain beer. You also have to clean the additional equipment used in brewing an all-grain beer.

Although it takes more time, there are many advantages to brewing "from scratch." All-grain brewers can manipulate the conditions of the mash to make their wort exactly as they want it. They can, for example, adjust the fermentability of the wort, a topic we'll discuss in more detail in Homebrew 501. Beer made from a more fermentable wort will be dry. In general, an all-grain brewer can make a wort that will ferment to a lower specific gravity than an extract brewer can. A less fermentable wort yields a beer that finishes sweeter. We'll brew a sweet beer — a Scottish ale — in this course. *(See page 39 for the recipe and procedure.)*

In the long run, brewing all-grain beers is more economical. When you buy malt extract, you are paying not only for the malted barley, but the expense of mashing the grains, separating the wort from the husks, and condensing the wort into extract. So, malted barley grains cost about half as much as an equivalent amount of malt extract. Of course, the start-up cost for brewing an all-grain beer can be substantial. At a minimum, you need a mash-lauter tun to hold the grains.

A homebrewer contemplating switching to all-grain brewing may be intimidated by the amount of information out there. Homebrewing books and online homebrewing forums are filled with talk of appropriate mash thicknesses, stepped temperature regimes, pH and mash efficiencies. These are all important theoretical considerations. However, in most cases a practical brewer can brew without worrying about all these variables. And keep in mind that, although there are many varieties of stepped-temperature mashes, many commercial brewers and homebrewers use a single-infusion mash for their beers. For your first all-grain beer, you should be *fearless* — just jump right in. Remember, you're soaking grain in hot water, not performing brain surgery.

Scottish ales are big, malty brews. The yeasts used in brewing Scottish ales are not very attenuative, which means they drop out of solution earlier than other ale yeasts. Because of this, they leave more residual sugar in the finished beer. Scottish ales have little hop bitterness, and usually no hop flavor or aroma.

Heating the Water

Although some of the later steps may be intimidating to a first-time all-grain brewer, an all-grain brew day starts with a simple task — heating water. When mashing, you need a large volume of hot water to mash the grains. About an hour later, you will need another large volume of water for rinsing the grains, or *sparging*. In all, you will need about 10 gallons of hot water to brew 5 gallons of beer.

If you begin heating all your water first, you can clean and set up your brewing equipment while it heats. Having a reserve gallon or two of cold or room-temperature water will come in handy on brewing day. Likewise, having a reserve gallon or two of boiling, or near boiling, water will also come in handy.

Heating all the water needed for an all-grain batch can literally take hours on a kitchen stove, especially an electric stove. Most all-grain brewers eventually switch to a *propane cooker* to heat their water and boil the wort. These cookers will greatly decrease the amount of time it takes to heat water and will give you the power to bring your full wort to a nice, rolling boil.

Mashing In

To begin the mash, or to mash in, you combine the 9 lb. 3 oz. of grains with about 3 gallons of 170° F water. To do this, place the crushed grains in your mashing vessel, the *mash tun*. With a large measuring cup or a beer pitcher, add hot water to the grains. Stir the mash each time you add water to break up clumps of grain. These clumps can form a ball that seals liquid away from their dry core. Having dried clumps in your mash will lower the amount of fermentables you extract from the grain. It may also add starch to your beer.

As you ladle water onto the grains, work quickly. As you are working, heat is escaping from your mash into the environment. You don't need to rush, but work at a steady pace. Once there is enough water in the mash tun to barely cover the grains, take the mash temperature — it should be close to 158° F. If the temperature is higher than 158° F, stir in cool water from your reserve until the temperature sinks to 158° F. When you stir in this water, make sure to stir the mash enough that the temperature is even throughout the mash.

If the temperature is less than 158° F, stir in water from your boiling water reserve until the temperature rises to 158° F. Be sure to stir well. Once your mash temperature is right at 158° F, look at the water level in your mash tun. If there is about an inch of water (or more) above the top of the grains, put the cover on your mash tun. If there is less than an inch of water on top of the grains, add 170° F water until there is. This will raise the temperature, but not by much. You don't need to stir this water in. The inch of water on top of the grains will be mostly absorbed during the mash as water continues soaking into the grain.

The mash

At this point, seal your mash tun. If you are mashing in a modified picnic cooler, shut the lid. If you are mashing in a brew-pot or modified brewpot, put on the cover and insulate with towels or a mash-jacket. Let this mash sit for an hour. If your mash tun is insulated well enough, the temperature should stay roughly constant. It may drop a few degrees, but that's nothing to worry about. While the grains are mashing, heat 2 gallons of water to the boiling point.

A lot occurs in the mash. Hot water soaks into the center of the grains and dissolves the starch. Starch is a large molecule found in great abundance in the barley kernels. Starch molecules are chains of simpler sugars. The seed stores sugars that are needed to fuel early growth of the plant. The starch is cut up by enzymes, called amylases, present in the grain. The starch molecules are gradually reduced to smaller sugar molecules, mostly maltose. *(For a complete rundown on mashing enzymes, see "Homebrew Science" on page 51.)*

Although a lot is going on in the mash, the brewer doesn't need to do anything. If you'd like, you can stir the mash occasionally. You may increase the efficiency of mash by doing this, but you will also lose heat every time you open the mash tun. If you do open it, you will need to stir in boiling water to boost the temperature back up to 158° F. If you just let the mash sit for an

all-grain brewing: a brewing technique in which all of the fermentables come from malted barley grains; also called full-mash brewing

single-infusion mash: a type of mash in which hot water is mixed with crushed grains; the mash is maintained at one temperature, in contrast to step mashes, in which the mash is rested at two or more temperatures

fearless: a state of mind marked by a lack of tension, unease or trepidation

sparging: adding hot water to the top of a grain bed to replace the wort that's being run off

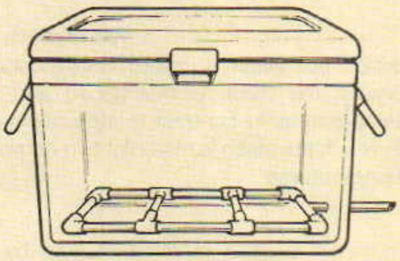
propane cooker: a burner, designed for outside use, that runs on propane; propane cookers deliver many more BTUs than kitchen stoves do

mash tun: the vessel that malted grains are mashed in

recirculation: a step in which wort is drained from the grain bed and reapplied to the top of the grain bed, for the purposes of clarifying the cloudy wort

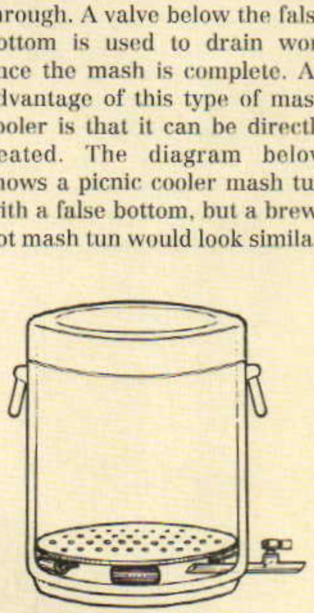
lauter tun: a vessel in which wort is separated from the spent grains

Many ways to mash your malt



Most homebrewers use one of two arrangements for mashing grains and draining the wort. One set-up involves modifying a picnic cooler to hold a framework of copper pipes on its bottom *(see diagram above)*. The copper pipes are cut with slots that allow wort to flow through but are too narrow for the grain. The pipes channel wort outside the cooler. A valve allows the homebrewer to control the flow of wort out of the cooler when draining the wort. Picnic coolers are well insulated and can hold the mash at a steady temperature for the entire duration of the mash.

The second common type of mash tun is a large brew pot with a "false bottom" inserted. The false bottom sits an inch or so above the kettle's floor and is perforated, so the grain stays behind but the wort can flow through. A valve below the false bottom is used to drain wort once the mash is complete. An advantage of this type of mash cooler is that it can be directly heated. The diagram below shows a picnic cooler mash tun with a false bottom, but a brewpot mash tun would look similar.



hour, you can be cleaning brewing equipment used in later stages. In any case, you will need to heat the water used to rinse the grains — the sparge water — towards the end of the mash.

The mash-out

After an hour of mashing, open your mash tun and take the mash temperature. Note this in your brewing notebook. Then, raise the temperature of the mash to 168° F. To do this, stir in the boiling water a few cups at a time. Take the temperature each time. Once you reach 168° F, seal the mash tun again and wait for 15 minutes. Boosting the temperature to 168° F will make the sugary wort less viscous, and easier to drain from the grain bed. You can skip this step if you'd like. Due to limitations of their equipment, many brewpubs do. But, it can increase the amount of fermentables you extract from your grains and stop the enzymatic action in the mash.

Recirculating

In Homebrew 301, we rinsed the grains in the grain bag and used a kitchen strainer to remove "floaties," husk pieces and other large particulates from the grain. With a full mash, you reverse these two steps. First, the wort is recirculated through the grain bed until it clears. During recirculation, the floaties get trapped in the top layers of the grain bed. After recirculation you proceed to the run-off and sparge, when clear wort is drained from the grain bed.

To begin *recirculation*, open the valve on your *lauter tun*. For most hombrewers, the lauter tun is the same vessel as the mash tun. In a few breweries, however, brewers mash in one vessel, then transfer the mash to a separate vessel for rinsing the grains, or lautering. Once you open the valve, cloudy wort should start flowing. Collect this wort in a large measuring cup or beer pitcher. Once the container is full, pour this wort on top of the grain bed. As you continue recirculating, you will notice the wort clearing. For a 5-gallon batch of beer, about 20 minutes of recirculating the wort is usually sufficient.

While recirculating, you want the wort to drain from the grain bed at a rate of about three quarts every five minutes. (Two quarts is 64 oz., about the volume a pitcher of beer holds. At 3 quarts per 5 minutes, a beer pitcher should fill in a little over 3 minutes.) At this rate, at the end of twenty minutes you will have recirculated the entire volume of wort in the grain bed. The wort should now be clear of large husk pieces and large grain particles. To control the rate that the wort drains, you will need to adjust the valve on your mash tun frequently.

The run-off

Once the recirculation period is over, continue draining the wort from the grain bed. However, this wort should go to the brew kettle. You can begin heating the wort as you collect it, but don't bring it to a boil. During the run-off period, you should be draining wort at about 2 quarts per five minutes or slightly less. The run-off period will be relatively short; it ends when the liquid level in the lauter tun falls to the level of the grain bed. Once the grain bed is about to be exposed, it's time for the sparging.

The sparge

During sparging, you continue running off clear wort as you did before. However, you add hot water to the top of the grain bed at the same rate as wort is being drained off. As a result, as you collect the remainder of your wort there will always be a little water on top of the grain bed.

There are a couple different ways to add sparge water. You can ladle a quart or two of water on top of the grain bed when the level gets low. Alternately, most homebrew stores sell sparge arms. Sparge arms are like little lawn sprinklers for your mash. Hot water drains from a container (often the homebrewer's bottling bucket) through nylon or plastic tubing to the sprinkler. The rate of water can be adjusted either by opening or closing the valve on the bottling bucket or by partially clamping the nylon tubing leading to the sprinkler.

The sparge water should be heated

A sparge arm is like a little sprinkler that sprays water over the mash.

to between 160° F and 170° F. The heat from the sparge water keeps the temperature of the grain bed up. At higher temperatures the thick, sugary wort will flow freely through the grain bed. As the grain cools, the flow of wort slows. At temperatures higher than 170° F, tannins could be leached out of the grains. So, avoid overheating your sparge water. If the water is significantly cooler than 170° F, it may slow down the drainage of your wort.

Remember to keep checking the rate at which the wort is draining. You should be collecting wort at a rate of about 2 quarts every 5 minutes. As you continue collecting wort, the valve may become progressively blocked with small particles from the mash. If the rate of wort drainage drops too low, or stops altogether, open the valve all the way for a few seconds until the flow resumes. Then slowly close the valve to the proper flow rate.

It can be difficult to get the wort to drain at a constant rate. You will probably need to fiddle with the valve quite a few times. As long as your rate is in the right ballpark, you'll be fine. If you finish collecting your wort in less than 45 minutes, you've gone too fast. If it takes over an hour and a half, you're going too slow. Once you've collected six gallons of wort, shut the valve off.

Boiling, cooling and fermenting

You will finish brewing this beer as you did the beer in Homebrew 301. You will boil and cool the entire wort. The cooled wort will be siphoned to your fermenter and aerated. However, you will notice a few differences when handling an all-grain wort.

We'll start the boil with 6 gallons of wort, more than before. There are two reasons for this. First, with a propane cooker you can supply more heat to the wort. This added heat will increase the evaporation rate compared to the evaporation rate from boiling the wort on your stovetop. In our one hour boil, we will reduce our wort from 6 gallons to just over 5 gallons.

Second, we expect a larger hot break from an all-grain wort than from an extract wort. Very soon after the boil commences, you will see little light-colored flakes in your wort. This is the hot break. The hot break is little clumps of coagulated proteins and lipids. This material will settle to the bottom of the kettle while the beer is cooling. If all goes well, there will be five gallons of clear wort sitting atop a few quarts of break material. This clear wort will be siphoned to the fermenter, leaving behind as much of the break material as feasible. In an extract wort, the hot break was already left behind in the process of making an extract (although procedures for making extract vary). Therefore, we expect less break material from an extract wort.

That's Homebrew 401. You learned that a single-infusion mash is an easy way to make wort. In Homebrew 501 we'll tackle a step mash and make a helles lager. —*Chris Colby*

Summary

- It takes a lot of water to brew an all-grain beer, so start heating it early.
- When mashing in, stir water into the crushed grains.
- Mash for an hour.
- Recirculate for 20 minutes.
- Run off wort from grain bed, begin sparging just before grain bed is exposed
- For a 5-gallon batch, collect 6 gallons of wort

Scottish ale

OG = 1.055 FG = 1.020 IBU = 22

9 lbs. pale ale malt
2 oz. chocolate malt
1 oz. roasted barley
6.25 AAU of Fuggles hops (1.25 oz. of 5% alpha acid)
Wyeast 1728 (Scottish ale)
3/4 cup priming sugar

4 days before brew day
Make yeast starter
Refrigerate yeast starter

3 days before brew day
Aerate starter
Pitch yeast

On brewing day
Heat 10 gallons of water to 170° F
Mix 3 gallons of 170° F water with the crushed grains
Allow grains to mash for 1 hour
Boil 2 gallons of water (from the remaining 7 gallons at 170° F)
Raise temperature of mash to 168° F by adding boiling water
Allow grain bed to set for 15 minutes
Recirculate wort for 20 minutes
Prepare 4 gallons of sparge water at 170° F
Run-off and sparge wort at rate of 2 quarts every 5 minutes
Collect 6 gallons of wort
Bring wort to boil
Add bittering hops
Cool wort with wort chiller
Siphon cooled wort to fermenter
Aerate wort
Pitch yeast
Ferment for one week

1 week after brewing day
Rack to secondary fermenter

2 weeks after brewing day
Test beer with hydrometer
Prime and bottle when gravity is constant for 3 days
Condition for 1 week
Refrigerate for 1 week

3 weeks after brewing day
Beer is ready

HOMEBREW 501: BREWING A HELLES LAGER USING A STEP MASH

Vocabulary

helles lager
drinkability
lightly kilned malt
step mash
starch-conversion rest
lauter tun

New Skills

step mashing

Equipment list

lauter tun

helles lager: "helles" or pale lagers are the most popular beer in Bavaria. They are noted for their pale, straw color, delicate malt flavor, balanced bitterness and piney hop aroma

drinkability: buzz-word coined by big domestic brewers. Beers with drinkability are characterized by low diacetyl, high wort fermentability and moderate bitterness. These beers show their flaws and are considered more difficult to brew than big styles like stout and barleywine

lightly kilned malt: malt that has been dried at cool temperatures and received a final "cure" temperature around 180° F to minimize malt color and flavors produced by browning reactions, especially the Maillard reaction

step mash: mash conducted at several temperatures to optimize the activity of the active enzymes in a brewer's mash. Step mashing is accomplished by directly heating the mash vessel or by adding small amounts of hot water to the mash

Objective: Brew a German-style helles lager using step mashing

Through each course at Homebrew U, we have learned how to take more control over the wort-production stage of brewing. In Homebrew 501, we will harness the potential of the enzymes beta and alpha amylase and use these biological tools to produce a highly fermentable wort from a grist bill primarily comprised of lightly kilned malt. The result will be a crisp and refreshing German-style *helles lager* with high *drinkability*.

Single-infusion mashes, such as the mash we performed in Homebrew 401, work well with beer styles that are not known to be "dry." The Scottish ale that we brewed in Homebrew 401 is a great example of a beer best brewed using the infusion mash technique. In some beer styles, however, more than one mash temperature is required to coax the naturally present enzymes in malt to behave in such a way to maximize both fermentability and extraction efficiency.

In beer-geek lingo, we would say that helles wort has a high fermentability, perhaps around 80 percent. This means the beer would start at 12° Plato (this equates to an OG of 1.048) and finish at 2.4° Plato (a bit less than 1.010 FG). A Scottish ale wort has a lower degree of fermentability, perhaps as low as 70 percent. It might start at 15° Plato (1.060 OG) and finish at 4.5° (1.018 FG). °Plato is another way of expressing specific gravity; it's based on the percentage of dissolved solids, such as sugar, in the wort.

To use *lightly kilned malts* to their full potential, a *step mash* is required. A step mash is one in which the temperature is gradually "stepped up" over time at progressively higher rest temperatures. To perform the step mash in Homebrew 501, you will need a mash tun that can be heated with a propane burner or electric heating element. It should not have a false bottom or slotted pipe like the combined mash-lauter tun we used in Homebrew 401. We'll explain why a bit later.

We'll use a step mash to brew a crisp and refreshing beer style with great drinkability, a German helles lager. This style of beer is typically light in color, has an assertive, yet balanced hop bitterness and a subtle hop aroma from the use of traditional German hop varieties like Tettnang and Hallertau.

The mash rests

In our step mash, we are going to mash over a temperature range spanning from 131° F to 158° F for a total of 90 minutes, not including the time required for heating. In a step mash, the time spent at each different temperature is called a "rest."

There are two types of rests commonly used in step mashing. The most common is the rest named for the enzyme substrate acted upon at a certain temperature. For example, the *starch-conversion rest* occurs around the optimum temperature for alpha amylase of 158°F and the protein rest occurs around the temperature optima of several proteolytic enzymes.

Sometimes brewers want to slowly heat the mash. You will find that this technique is very difficult to control. This is also hard for commercial brewers to control since most mash vessels are designed to heat at about 1.8°F per minute. An easy way to decrease the heating rate is by adding intermediate rests. For example, if you want to slowly heat your mash from 140°F to 149°F, you can simply add a short rest around 145°F. In fact, you may want to modify the mash profile described above to include such a rest. I'll discuss why this sort of rest is important later.

In Homebrew 401, we had a single rest at 158° F. At this temperature there is little beta-amylase activity because this high temperature causes rapid denaturation of beta amylase *(for a detailed discussion of mashing enzymes, see "Homebrew Science" on page 51)*. Wort produced by infusion mashing at this high temperature has decreased fermentability. For our helles, we want to produce a very fermentable wort and need as much help from beta amylase as possible.

Barley starch and the action of beta and alpha amylase

There are two types of starch found in barley: amylose and amylopectin. Amylose comprises roughly 25 percent of the starch content but the bulk is amylopectin. Amylose is a straight-chain molecule made exclusively of glucose molecules that are chemically linked with a bond called an "alpha 1-4 bond." Amylose has two features that are important to brewers. The first is that it is soluble in hot water without requiring "gelatinization." This means that it is soluble at temperatures less than 140° F, the gelatinization temperature of barley amylopectin.

The second key feature of amylose is the absence of branches caused by the alpha 1-6 bond. Beta amylase attacks starch from the reducing end of the starch and continues to munch its way down the molecule, producing a maltose molecule with each bite, until it runs into an alpha 1-6 bond. Beta amylase is called an "exo-enzyme" because it attacks from the end of the molecule. Since amylose contains no alpha 1-6 bonds, beta-amylase can convert almost all of the amylose found in malt into maltose.

Maltose is the principle fermentable sugar found in wort and over 95 percent is produced by beta amylase. For this reason, beta amyalse is known as "the fermentability enzyme."

Amylopectin does contain alpha 1-6 bonds and it is these bonds that make amylopectin a branched molecule. Amylopectin can be drawn as a tree, and the trunk of the tree is the one and only reducing end of the molecule. The tips of all of the branches are referred to as non-reducing ends. The significance of this is that amylopectin has only one spot where beta-amylase can bind to starch and produce maltose. This reaction does not last long because of the large number of branch points in amylopectin.

Amylopectin has another feature that makes it more difficult to degrade than amylose, and that is its crystalline structure. As amylopectin is heated this crystalline structure begins to "melt" or gelatinize and the starch becomes soluble. Gelatinization of barley amylopectin begins to occur around 140°F. When starch is gelatinized it absorbs water and becomes very thick. This is why starch from wheat flour or corn starch thickens gravy and stir-fry.

This is where we really need the help of alpha amylase. Unlike beta amylase, alpha amylase is an endo-enzyme and randomly breaks alpha 1-4 bonds from the inside of the molecule. Using the tree analogy, alpha-amylase is like a tree removal guy using a chain saw to cut a big tree into several medium-sized pieces. With every cut, a new trunk is created and beta-amylase can latch onto the trunk (a reducing end) and do its thing until it runs into another alpha 1-6 branch.

The take-home message from this is that we get a more fermentable wort when beta and alpha amylase work together. And the best way to accomplish this is with step mashing.

Alpha amylase rapidly decreases the size of amylopectin. In doing so, it reduces mash thickness, creates more spots for beta-amylase to act upon and is responsible for changing the result of the iodine test from positive to negative. Alpha amylase is known as "the liquefaction enzyme" because of its dramatic effect on mash thickness. An iodine test is an easy way to see if all of the starch has been converted to sugar in the mash. You can buy an iodine kit at almost any homebrew store.

Raising the mash temperature

The most common method used to heat step mashes in a commercial brewery is with an external application of heat, usually though a steam jacket. In the old days flame heat was common, but steam is much cooler than direct flame and it is easier to control the rate of temperature change.

When applying heat directly to the outside of a mash vessel, the mash must be stirred to ensure even heating. Uneven heating results in temperature fluctuations throughout the mash and defeats the purpose of attempting to accurately control mash temperature. At home, we can heat our mash either with an electrical element or flame from a propane burner or gas range.

starch-conversion rest: confusing name describing the rest around 158° F. The name implies that this rest is the only time that starch is converted to smaller carbohydrates. This is not true, as beta amylase catalyzes the degradation of starch at much lower temperatures. The name comes from the fact that the mash is "converted" from testing iodine-positive to iodine-negative around the temperature optimum of alpha amylase

lauter tun: specialized vessel used to separate wort from spent grains. Step mashing and decoction mashing typically use a separate vessel for wort separation because these mashes are stirred while being heated in the mashing vessel. A lauter tun is essentially a vessel equipped with a screen and a valve located below the screen. Most lauter tuns also have some sort of sparging device

Extra Credit!

What's happening in the mash?

131° F: mash solids are wetted, amylose begins to dissolve and beta amylase begins producing maltose.

140° F: amylopectin begins to gelatinize, alpha amylase begins to reduce the size of starch molecules and beta amylase continues its activity.

140° to 149° F: The "ramp" when beta and alpha amylase work together to make a highly fermentable wort

149° F: beta amylase begins to fade out because of denaturation, alpha amylase becomes more active and starch continues to dissolve into the wort.

158° F: more starch dissolves and alpha amylase is at its fastest rate. Any starch extracted during this temperature is reduced in size by alpha amylase and "conversion" is completed.

169° F: mash-off stops enzyme activity and reduces wort viscosity prior to wort collection.

Extra Credit!

The protein rest no more

The protein rest is a temperature rest in the mash around 121° F where protein degradation was long thought to occur. But research conducted over the past two decades casts doubt on the significance on the protein rest. Dr. Michael Lewis' group at the University of California at Davis originally stirred up controversy and debate among brewers in the early 1980s when they published data showing an initial peak in protein content in the mash, followed by a decrease in high molecular weight protein fraction. No increase in lower molecular weight fractions was recorded.

If protein-degrading enzymes attack proteins during the protein rest, one would certainly expect to see a decrease in large molecules and a related increase in smaller molecules. Lewis' group concluded that the initial peak in protein content was due to proteins going into solution, like amylose, and the decrease in the high molecular weight fraction over the course of the mash was caused by denaturation, not enzymatic activity.

The same studies produced data showing an increase in amino acids, agreeing with the notion that some proteolytic activity is present. The enzyme carboxy-exo-peptidase was attributed to the increase in amino acid content. This enzyme is an exo-enzyme and can produce a lot of amino acids without significantly altering the size of a protein.

As the initial shock of this research faded, other research groups repeated the experiments and obtained data that agreed with that of Dr. Lewis. Many breweries changed their mash profiles based upon these studies. It is widely held that most of the proteolytic activity occurs during malting and that this enzyme group is denatured during kilning. Protease activity during malting is extremely important and many measures of malt modification, such as the Kolbach index, are based on proteins.

Today, many brewers refer to the rest at 121° F (50° C) as the beta-glucanase rest" because there is active beta-glucanase present in malt. Some beers, especially those made using raw barley, benefit from a beta-glucanase rest because beta-glucans can cause real problems during wort separation and beer filtration. — *Ashton Lewis*

Whatever you choose to use, try to keep the heat low and the gentle stirring constant to prevent rapid, uncontrolled heating and scorching.

The intermediate temperature rest mentioned earlier may come in handy during the heating steps. For starters, it gives you a minute to allow the mash temperature to equalize so you can get a good temperature reading. The intermediate rest also slows the rate of heating. When trying to produce a very fermentable wort this helps a bunch, especially in the 140° to 149° F range, because it gives more time for beta and alpha amylase to work together.

An alternative method for mash heating is to add boiling water to the mash. If you choose to use this method, add small volumes at a time and use plenty of stirring to minimize hot spots in the mash. To heat this mash from 131° F to 140° F will require about 54 fluid ounces of water at 208° F. The mash becomes thinner after each heating step and the volume of water required to change the mash temperature by 9° F increases. The last heating step to mash-off will require 142 fluid ounces of 208° F water and the total amount of water in the mash will have increased from 3 gallons at mash-in to 5.6 gallons. While a thinner mash increases extraction efficiency (yield), it also makes enzymes more sensitive to temperature. Many brewers steer clear of this method for this reason.

The mash out

Once the starch-conversion rest is completed and the iodine test is negative, we will mash out as we did in Homebrew 401. If you are heating by adding water, it will take slightly more water to raise the temperature to 169° F than it did for the infusion mash.

After raising the temperature to 169° F, the mash is ready for transfer to the *lauter tun*. We must use a separate lauter tun for this beer, because you will be stirring the mash quite a bit. It's problematic to do a lot of stirring in a combined mash-lauter tun, because the false bottom gets clogged. Also, the screen interferes with even heating.

Grain to Extract and Back!

Here is a radical thought: The only real difference between extract and all-grain brewing is convenience, since the liquid or dry extract brewer merely buys what the all-grain brewer makes himself. To switch your recipes from all-grain to extract and back again, all you really need to know are a few simple and approximate conversion rules. Homebrewing does not need to be serious!

Rule One

The average liquid malt extract contains about 20 percent water and 80 percent solids, while dry extract (as the name implies) contains virtually no moisture. This is the basic rule of thumb from which all other conversions follow.

Rule Two

Therefore, 1 pound of liquid extract contains the rough solids equivalent of 1.2 pounds of milled, two-row, malted grain. Or, conversely, 1 pound of two-row grist can be substituted with 0.83 pounds of liquid extract, while 1 pound of dry extract contains the rough solids equivalent of 1.46 pounds of milled, two-row, malted grain. Or, again conversely, 1 pound of two-row grist can be substituted with 0.68 pounds of dry extract.

Rule Three

1 pound of liquid malt extract contributes about 8.75 °Plato (1.035 specific gravity degrees) to 1 gallon of water, or 1.75 °P (1.007 SG) to 5 gallons of water. One pound of dry malt extract contributes about 11.25 °P (1.045 SG) to 1 gallon of water, or 2.25 °P (1.009 SG) to 5 gallons of water.

Rule Four

Now do your own math!

— *H.D.*

Prior to transfer, cover the false bottom of your lauter tun with hot water to prevent creating an airlock beneath the mash. Try to minimize splashing during transfer, as splashing can darken wort and cause oxygen pick-up. It's important to let the mash settle in the lauter tun before beginning wort recirculation. Ten to fifteen minutes is a typical lauter rest time.

Collect the wort as you did in Homebrew 401. Recirculate for 20 minutes to achieve good clarity. Then run off the wort off at about 2 quarts every 5 minutes. This is an important time to be patient, as an overly aggressive collection rate can result in a stuck mash bed. A stuck mash does nothing but cause stress and prolong a relaxing brew day. Begin sparging just before the grain bed is exposed and collect 6 gallons of wort.

The boil and beyond

We will use a 60-minute boil for our helles. Three hop additions impart a balanced hop character. Hop bitterness is accentuated in dry beers, so the hopping rate is kept at 20 IBUs. After the boil, cool the wort using the method described in Homebrew 401.

After cooling, it's time for wort aeration, yeast pitching and fermentation. We want to produce a clean lager and will ferment between 50° and 55° F. After fermentation is complete, rack to a secondary fermenter and age in the secondary for two weeks at 40° F to produce a clear beer. Clarification will continue in the bottle and our helles will be ready for consumption three weeks after bottling. —*Ashton Lewis*

Summary

- Highly fermentable worts are best produced when beta and amylase are allowed to work together.
- A step mash with several temperature rests work well for these types of beers.
- Make sure when raising the temperature of a mash, you stir the mash well so the mash temperature is uniform.

German-style helles lager

OG = 1.048 FG = 1.009 IBUs = 20

7.5 pounds lightly kilned malt (pilsner malt or lager malt)
0.25 pounds Briess Cara-Pils malt
2.75 AAU Tettnang bittering hops (1/2 ounce at 5.5% alpha acid)
2.75 AAU Tettnang flavor hops (1/2 ounce at 5.5% alpha acid)
2.25 AAU Hallertau, Mount Hood or Liberty aroma hops (1/2 ounce at 4.5% alpha acid)
Wyeast 2124 (Bohemian Lager) or White Labs WLP830 (German Lager)

4 days before brew day

Make 2-liter (68 ounce) starter wort with an OG of 1.048 using dry malt extract
Cool starter, aerate and add yeast

On brewing day

Note: This beer style benefits from soft water. Purchase 10 gallons of distilled water (not spring water) and add 1 gram of calcium sulfate to each gallon jug of water. This will give us about 50 ppm of calcium in the water and no carbonates.

Mix 3 gallons of 143° F water with the crushed grains. The mash temperature should be 131° F.
Allow mash to rest at 131° F for 20 minutes.
Raise mash temperature to 140° F.
Allow mash to rest at 140° F for 30 minutes.
Raise mash temperature to 149° F over a time period not less than 5 minutes. This gives us a ramp of no more than 1.8° F per minute.
Allow mash to rest at 149° F for 20 minutes.
Raise mash temperature to 158° F.
Allow mash to rest at 158° F for 20 minutes.
Check for starch conversion using the iodine test. If the test comes up negative (no blue or black color in the wort sample) go to next step. If the test is starch positive, extend rest until you get a negative test.
Raise mash temperature to 169° F.
Gently transfer mash to lauter tun.
Recirculate wort for 20 minutes.
Begin collecting wort at the rate of about 12 ounces per minute (roughly 2 quarts every 5 minutes).
When top of grain bed becomes visible (but not dry), begin sparging with 169° F treated brewing water.
Maintain about 1 to 2 inches of sparge water on top of the grain at all times during wort collection.
Collect 6 gallons of wort.
Bring wort to boil.
Add bittering hops at boil.
Add second hop addition 30 minutes after start of boil.
Add last hop addition 55 minutes after start of boil.
Stop boiling 60 minutes after start of boil.
Cool wort with wort chiller.
Siphon cooled wort to fermenter.
Aerate wort.
Pitch yeast starter.
Ferment for 7 to 10 days at 50° to 55° F or until specific gravity is below 1.012.
Rack beer to secondary fermenter and decrease temperature to 40° F and hold at 40° F for 2 weeks.

About 3 weeks after brew day

Prime and bottle beer when specific gravity is constant for three days.

Condition for 1 week at room temperature
Refrigerate for 2 weeks

6 weeks after brew day

Beer is ready

A mash paddle can be used to stir the grains in the mash tun, which you need to do frequently to make our helles lager. Many homebrewers use spoons or little canoe paddles, but you can make or buy a fancy one.

Continuing Education

Want to continue your Homebrew U studies? Here are just a few of the excellent reference books you can peruse. And, of course, keep reading BYO!

Brewing Quality Beers: The Home Brewer's Essential Guidebook by Byron Burch (Joby Books, 1992). Covers procedure, ingredients, equipment and advanced techniques.

Brewing the World's Great Beers: A Step-by-Step Guide by Dave Miller (Storey Publishing, 1992). Includes recipes and tips and a solid introduction to homebrewing.

Brew Ware: How to Find, Adapt and Build Homebrewing Equipment by Karl F. Lutzen and Mark Stevens (Storey Publishing, 1996). Includes step-by step instructions for many handy do-it-yourself projects, from a full-blown RIMS to hopbacks, carboy carts and wort chillers.

Clone Brews: Homebrew Recipes for 150 Great Commercial Beers by Tess and Mark Szamatulski (Storey Publishing, 1998). All recipes come with extract, partial-mash and all-grain options. A complete collection of the classic styles. Includes a brief discussion on how to evaluate your favorite beer's head, color, aroma, taste and body before cloning it.

Dave Miller's Homebrewing Guide: Everything you Need to Know to Make Great-Tasting Beer by Dave Miller (Storey Publishing, 1995). Overview for homebrewers of all levels. Step-by-step procedure, water, mashing and yeast. Touches all the bases, covers all the steps in 38 chapters.

Designing Great Beers: The Ultimate Guide to Brewing Classic Beer Styles by Ray Daniels (Brewers Publications, 1996). Part One gives an overview of the brewing basics, while Part Two covers the full spectrum of styles in depth, with stats on style guidelines and much more.

Home Brewing: The CAMRA Guide by Graham Wheeler (Camra Books, 1993). A comprehensive how-to book that teaches beginners to experts how to brew ales, stouts, lagers and wheat beers from kits, extract and all-grain.

Michael Jackson's New World Guide to Beer by Michael Jackson (Running Press, 1988). As the title states, this is a comprehensive history of and guide to the world's greatest beers. Jackson takes you through every beer-producing country from Czechoslovakia to Tasmania.

New Brewing Lager Beer by Gregory J. Noonan (Brewers Publications, 1996). This book for homebrewers and microbrewers is an excellent guide to producing high-quality, all-grain beer with an emphasis on lagers. It starts with an in-depth look at barley and finishes with a chapter devoted to equipment.

Pale Ale: History, Brewing, Techniques and Recipes by Terry Foster (Brewers Publications, 1999). This is the second edition of "Pale Ale," the first book in the Classic Beer Style Series. This handy, how-to book gives a character profile of the style, along with information on brewing equipment and procedures. Other books in this popular 15-book series include: Mild Ale, Brown Ale, Kölsch, Altbier, Barley Wine, Stout, Bock, Scotch Ale, German Wheat Beer, Belgian Ale, Porter, Vienna-Märzen-Oktoberfest, Lambic and Continental Pilsener.

Principles of Brewing Science: A Study of Serious Brewing Issues by George Fix, Ph.D. (Brewers Publications, 1999). Explore the science of making great beer with this intensely technical study that combines chemistry, biochemistry and thermodynamics. This book covers beer flavor, fermentation, oxidation, bacteria, wild yeast and malting chemistry.

Seven Barrel Brewery Brewer's Handbook by Gregory Noonan, Mikel Redman and Scott Russell (G.W. Kent, 1996). Seven Barrel is a craft brewery in New Hampshire. For novices as well as the expert all-grain brewer, this book covers everything from malting to mashing and more. Includes off-beat recipes for extract, partial mash and all-grain brews such as "fillmimug wheat" and "thistle bog ale."

The New Complete Joy of Homebrewing by Charlie Papazian (Avon Books, 1991). A fun how-to guide to making beer the way you like it. From the basics of homebrewing to beer appreciation.

Using Hops: The Complete Guide to Hops for the Craft Brewer by Mark Garetz (Hop Tech, 1994). Dedicated entirely to the subject of hops. Chapters include hop history, the plant, varieties, bittering and aroma and growing your own hops, among other hop topics.

Plotting OG

How to calculate gravity with a graph

by Chris Colby

Table 1

Extract Potential of Grains and Adjuncts
(in gravity points per pound)

Wheat malt	37
Pale malt	36
Munich malt	35
Biscuit malt	35
Crystal malt	30-33
(darker malts have lower values)	
Chocolate malt	29
Black patent malt	25
Roasted barley	25
Dried malt extract	45
Liquid malt extract	38
Corn syrup	37
Molasses	36
Honey	33

Ever looked at the ingredients in a recipe and wondered what the original gravity of the beer would be? Ever wanted to brew a beer of a certain specific gravity and wondered how much malt you'd need?

There are formulas for calculating the expected original gravity from a list of ingredients (and vice versa). *(See "Brew by the Numbers," November 2000.)* But solving these equations can be tedious for some homebrewers. Fortunately, there's another quick way to calculate specific gravity from a list of ingredients. You can use this graphical method to help you formulate recipes, modify recipes or figure out what OG to expect from a list of ingredients. This method also works in reverse — you can calculate how much malt you will need to hit a desired OG.

Single malt extract

To calculate the OG of a beer brewed with a single type of malt extract, you need to know three things: the weight of your extract, its extract potential and the volume of your wort. Extract potential is a measure of how much extract or soluble solids can be extracted from a given weight of a particular ingredient. The extract potentials of common ingredients are given in Table 1 *(at left)*. Using this information — and a graph like Figure 1 *(see below)* — you can quickly estimate your beer's expected original gravity.

In Figure 1, the amount of ingredients per unit volume (in pounds of malt per gallon of wort) is plotted versus "gravity points." Gravity points are the decimal part of a specific gravity. For example, a barleywine with an OG of 1.090 would have 90 gravity points per gallon. Lines are plotted on the graph that reflect the extract potential for dried and liquid malt extract.

To calculate the OG of a single-extract beer, locate the point on the x-axis (the horizontal axis) that corresponds to the amount of malt per gallon of wort you have. Trace a line straight up from that point until it intersects the plotted line of the extract potential of your malt extract. Then trace a line from this point horizontally until it crosses the y-axis (the vertical axis). The value at that point on the y-axis is your OG in gravity points.

Here's an example. Suppose you had 6 lbs. of dried malt extract to make a 5-gallon batch of beer. First you find the point on the x-axis that corresponds to 6 lbs. of DME in 5 gallons of beer. That point is (6/5) = 1.2 pounds malt/gallon of wort and is shown with a circled one. Next, trace a line straight up until you intersect the line that represents the extract potential of dried malt extract. In Figure 1, the point where the two lines intersect is labeled with a circled 2. Finally, trace a line horizontally to the y-axis and read the value for OG. This point is shown with a three. The value is 55 — so using 6 lbs. of DME to brew 5 gallons of beer should yield a beer with an original gravity of 1.055.

Multiple malt extracts

Most brewers use more than one source of malt when they brew. Extract brewers, for example, may mix dried and liquid extract to make a wort. When brewing with multiple sources of fermentables, you simply repeat the procedure for each ingredient, then add the results together.

Let's say you want to brew 5 gallons of beer with 6 lbs. of DME and 3.3 lbs. of liquid malt extract. In the previous example, we found that 6 lbs. of DME yielded an OG of 1.055 for a 5-gallon batch. Now, we need to find out the gravity points expected from 3.3 lbs. of liquid malt extract. In Figure 1, point 4 corresponds to (3.3/5) = 0.66 lb./gallon of liquid malt extract. A line drawn vertically intersects the liquid malt extract line at point 5. A line drawn horizontally from that point intersects the y-axis at point 6. The value at point 6 (24) corresponds to the gravity points from using 3.3 gallons of liquid malt extract in 5 gallons of beer.

The final step is adding the two partial gravities together. In this case, 55 plus 24 equals 79. So, the original gravity of the beer would be 1.079.

Single, mashed malt

When you use only malt extracts, or adjuncts that don't need to be mashed, you need to know the weight

Figure 1 Calculating Gravity from Amount of Malt

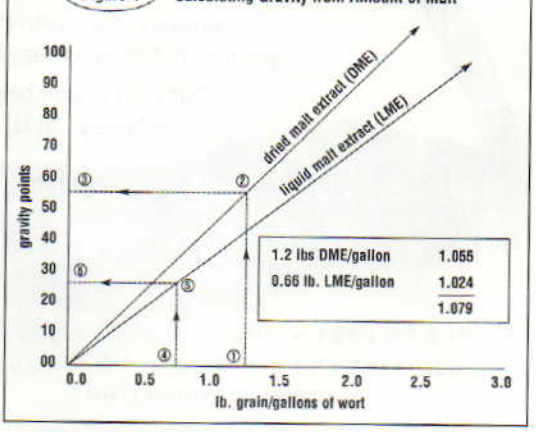
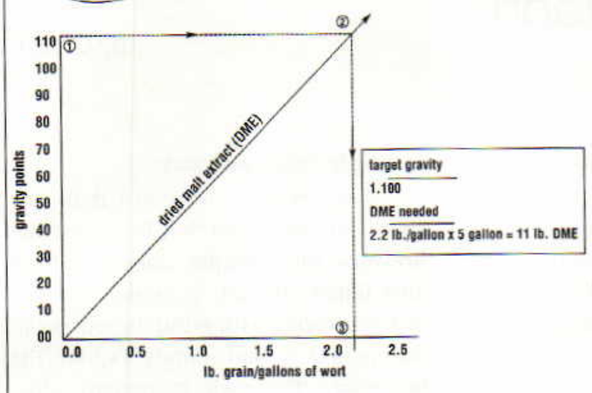


Figure 2 Calculating Amount of Malt Needed to Reach Target Gravity



and extract potential of your ingredients. All-grain brewers also need to know their extract efficiency. If you give several all-grain brewers 10 pounds of pale malt, each beer will likely have a different OG because each system has different efficiency or "brewhouse yield." These differences could result from different mash tuns, mashing procedures, water sources or many other factors. A brewer whose efficiency is high might brew a 5-gallon batch with a gravity of 1.065. Another brewer might end up with a 1.040 beer.

Different brewers express extraction efficiency in different ways. There is "points per pound per gallon" and the percent of the maximum amount of fermentables that could have been extracted. You can use either way with the graphical method of calculating OG.

If you know your efficiency in points per pound per gallon, you would construct your extract potential line in the following way. Let's say your efficiency is 30 pt./lb./gallon; in other words, one pound of malt in one gallon yields a wort with an original gravity of 1.030. Find the point on the x-axis that represents 1 pound per 1 gallon. Trace a line up to 30 — the amount of points you get for one pound of malt in one gallon of wort — and make a point.

To make a line using this point, you need another point. This point on the graph should represent the amount of gravity points you would receive from another quantity of malt. Let's pick an easy example; if you had no malt, you would get no gravity points. In other words, using zero malt means your beer is water. Water has a gravity of 1.000 (zero gravity points). So, your line will be drawn from (0,0) to 1 lb./gallon and the SG equivalent of your extract efficiency. In our example the second point would be (1,30).

If your extract efficiency is expressed as a percentage, convert it to "points per lbs. per gallons" by multiplying your percentage by the extract potential of the grain. For example, the extract potential for pale malt is 38 pt./lb./gallon. If your extraction efficiency is 80%, your efficiency in pt./lb./gallon is (0.80 * 38) = 30 pt./lb./gallon.

Once you have your own extract potential line plotted, calculate original gravity as before. Pick a spot on the x-axis that corresponds to the amount of malt you have. Move up until you intersect your plotted line representing the extract potential of your malt in your brewery. Then, move over until you cross the y-axis — and there's your gravity.

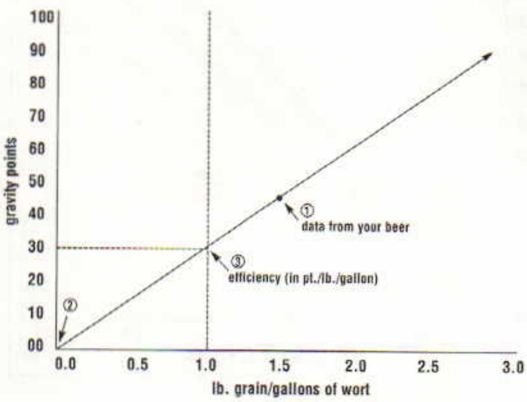
Grains, extracts and adjuncts

To calculate the gravity of a beer made from a mix of ingredients, find the amount of gravity points contributed by each and add them together. You can lump together sources with the same or similar extract potentials. For example, if you use 8 lbs. of pale malt (36 pts./lb./gallon) and 1 lb. of Munich (35 pts./lb./gallon), count it as 9 lbs. of pale malt.

Target gravity

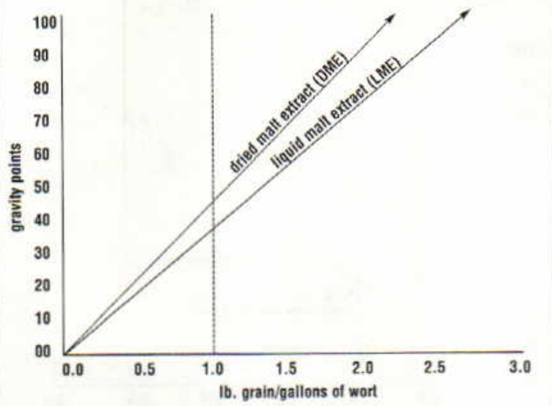
You can reverse this method and calculate how much of a certain type of ingredient you'd need to hit a target OG. Let's say you want to brew a barleywine with DME with a starting gravity of 1.100 — how much extract would you need? To calculate this, start at 110 on the y-axis (labeled 1 on Figure 2) and trace a line over to the DME line. From this point, labeled 2, drop the line down to the x-axis. The value where this line crosses the axis, labeled 3, is the amount of extract per gallon you would need. Multiply this number (2.2) times the total gallons in your batch. If you brewed a 5-gallon batch of barleywine, you'd need (2.2 * 5) = 11 lbs. of DME to attain a gravity of 1.100.

Figure 3 Calculating Extract Efficiency



You can still use the graph even if you want to mix ingredients. For example, let's say you want to brew the same barleywine with an all-grain base and added extract. You could decide to make 70 points come from the grains and 30 points come from malt extract. Determine how much

Figure 4 Gravity Points vs. Amount Malt per Gallon



used, the OG and wort volume. The best beers to pick are ones made almost entirely out of pale malt, with no extracts or adjuncts and few specialty grains. If less than 5 percent of your recipe is crystal malts or other lightly kilned specialty malts, your estimate will be close.

Plot a point from the amount of grain used per gallon and the gravity achieved. Draw a line from this point to (0,0). Where the graph passes 1 on the x-axis is your efficiency in points per pound per gallon for that beer.

Let's say you brewed 5 gallons of pale ale with 7.5 lbs. of pale malt (1.5 lbs. per gallon) and your original gravity was 1.045. Plot a point at (1.5, 45) and draw a line from the point to zero. As shown in Figure 3, the line crosses 1 — which represents 1 pound per 1 gallon — at 30. Thus your efficiency is 30 pts./lb./gallon. When using the graph to calculate efficiency, be accurate when calculating the pounds of ingredient per gallon of wort. Be sure to use the volume of wort you actually ended up with in your calculation, not the amount of wort you planned on.

If you are an extract brewer, you can also plot your "efficiency" and see the actual number of points per pound per gallon you are getting from your malt extract. If you actually get, say, 35 pt./lb/gallon when using a specific brand of liquid malt extract, adjust your graph accordingly the next time you use that malt extract.

grain you need to make 70 points, and how much extract you need to make 30 points, and there's your recipe.

Calculating efficiency

All-grain brewers will have one final use for the graph — calculating extraction efficiency. Pick a beer for which you know the amount of grain

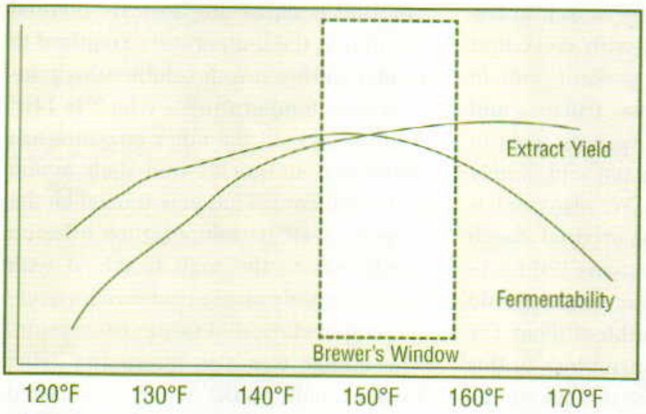
Try it yourself

Figure 4 *(at left)* is a blank graph that you can photocopy and use in your brewing notebook. The curves for dried malt extract and liquid malt extract are supplied. Hopefully, it will save you some time calculating and let you spend more time brewing. ■

Enzyme Time

What do enzymes do in the mash?

by Steve Parkes



This chart shows the temperature range for an infusion mash. Within the "window," between 145° and 158° F, a great deal of control over wort fermentability is exerted.

What's going on in the mash?

Many homebrewers find this question confusing, which is hardly surprising, since many commercial brewers don't appear to truly understand it either! It is important to think of the mash as two distinct operations: conversion of the solid malted barley into a liquid extract, and recovering that sweet "wort" from the spent grains.

This article will discuss mashing enzymes, which convert the starch in malt into soluble sugars. By understanding and manipulating enzyme activity, an all-grain brewer can control the fermentability of his wort.

What are enzymes, anyway?

First and foremost, enzymes are proteins. They are a specific type of protein with an important role. They catalyze biochemical reactions, which means that they enable a reaction to occur quickly and at the temperature of living organisms. They act on small molecules to join them together and make them larger, they take large molecules and break them up into smaller ones, or they rearrange molecules into something different.

Each biochemical reaction is catalyzed by a very specific enzyme. For example, maltose is created by joining two glucose molecules, and this is done by a specific enzyme. A different enzyme is responsible for breaking the maltose back into two glucose molecules. Maltose also can be created by breaking a two-molecule chunk off a long chain of glucose molecules — and this is done by yet another enzyme!

Being a protein, enzymes are made of several thousand different amino acids (selected from the 20 naturally occurring amino acids) joined together. This chain is then folded and coiled to form a specific shape. This shape is suited to the specific job the enzyme must do, and so it is important. However, the shape is relatively fragile and can be damaged by excessive heat or agitation, or chemical attack, which will render the enzyme unable to catalyze a reaction. This is called "denaturing" the enzyme and once the structure is destroyed, rarely can the enzyme be renatured.

The molecule the enzyme acts on is called the "substrate" and the enzyme is usually named after this substrate, with the letters "ase" added (beta glucanase acts on beta glucan, and alpha amylase is one enzyme that acts on amylose, a component of starch). The rate at which a reaction occurs is affected by temperature, and enzymes catalyze reactions more quickly as temperature increases. But they also are denatured by heat, and reach peak activity just before they are destroyed.

Mashing Enzymes from A to B

In a brewer's mash we are concerned with the activity of two main enzymes, alpha and beta amylase.

Alpha amylase is the enzyme responsible for breaking large, complex, insoluble starch molecules into smaller, soluble molecules. It is stable in hot, watery mashes and will convert starch to soluble sugars in a temperature range from 145° to 158° F. It requires calcium as a co-factor.

Beta amylase is the other mash enzyme capable of degrading starch. Through its action, it is the enzyme largely responsible for creating large amounts of fermentable sugar. It breaks starch down systematically to produce maltose.

Beta amylase is active between 131° and 149° F. But like all enzymes, its activity reaches a peak, declines, and then drops precipitously as temperature increases. The rate is also dependent on the amount of enzyme present. It takes time for all of the enzyme to be destroyed, but what is still intact works very quickly. So as the mash temperature approaches 149° F, beta amylase is operating at its fastest rate but it is also being denatured.

This may seem trivial, but at these higher temperatures the denaturation is so rapid that the enzyme is mostly gone in less than 5 minutes. Also, in a homebrewer's mash tun, where the grain may be poured into very hot water, the exposure to very high heat for the few seconds before the mixture becomes homogenous may work to destroy the fragile enzymes.

This means that, in a practical sense, the manipulation of beta amylase activity can be utilized to control the fermentability of the wort. If the mash is allowed to "stand" at a temperature that favors the action of beta amylase, then a greater proportion of the sugars extracted from the malt will be maltose and hence the wort will prove more fermentable.

In my commercial breweries, I

found that changing the mash temperature from 149° to 156° F raised the beer's terminal gravity from 1.008 to 1.014. This is a significant difference.

What these Enzymes Do

Both of these enzymes act in consort to degrade barley starch to produce a range of sugars present in wort. Below a certain temperature (145° F), alpha amylase activity is low and so the large starch molecules remain insoluble. Above a certain temperature (149° F), beta amylase is denatured significantly, limiting the amount of fermentable sugars that can be extracted into the wort. This leaves a small "window" where a brewer can operate and have influence over the types of sugars that end up in the wort. A lower temperature results in a wort that is more fermentable but may yield slightly less, while a higher temperature will yield less fermentability but increased extract efficiency.

The thickness of the mash has a similar, albeit less dramatic, influence over yield and fermentability. A thicker mash offers protection to the more fragile enzyme, beta amylase, and so increases fermentability, whereas a thinner, more watery mash favors a higher extract. After these enzymes have acted on the barley starch in the mash tun we are left with wort that contains around 15 percent simple sweet sugars like glucose, fructose and sucrose. Most of these were present in the malt in the first place and simply dissolved into the wort. We also are left with larger pieces of the original starch molecule known as dextrins (20 to 35 percent), which popular belief would have contribute to mouthfeel. They are probably not large contributors to this perception in beer, however, but can be rapidly attacked by amylases in the mouth to yield glucose and hence a sweet flavor. The remaining extract is maltose (and a little maltotriose), and since the primary source of maltose is the action of beta amylase it is apparent how important control of that enzyme's activity must be in a mash.

A paper written by Professor E.J. Manners at Heriot-Watt University in Scotland in 1974 proposed that there is only one enzyme brewers need to concern themselves with when mashing, and that is alpha amylase. He pointed out that at the temperature required to render barley starch soluble (the gelatinization temperature – which is 140° F in barley), all the other enzymes are denatured so quickly that their action is insignificant. That may indeed be the case in a single-temperature infusion mash, where the malt is mixed with hot water only once to achieve an overall temperature that favors conversion. The author was also discussing using English pale malt, which is malted specifically with this type of brewing in mind. In their book "Brewing," published 21 years later, Dr. Michael Lewis and Dr. Tom Young proposed that it is in fact the consorted effort of beta and alpha amylase, working together within a narrow temperature range, that has a far greater effect on the final beer, due to its role in determining the wort's fermentability.

While many enzymes are denatured by heat and agitation, American two-row malt contains such an enormous surplus of the two main enzymes that their activity will have an impact prior to their demise in the mash.

The role of mash pH

Mash pH is another factor that affects the activity of the various enzymes. A mash carried out using distilled water ends up with a pH in the region of 5.8 to 6.0. The presence of enough calcium ions in the water causes the mash pH to drop down into the 5.5 to 5.6 range. Additional calcium ions can drive the pH down to 5.2, where we get within optimal conditions for the two main mash enzymes. pH in the optimal range also helps to insulate the enzyme a little from the effects of temperature.

Protease enzymes are still an area of controversy among brewing scientists. Historically, brewers from a British pedigree have dismissed the action of enzymes that break down and solubilize potentially harmful proteins in the mash. Understandably, since it was discovered that with a variety of denaturation temperatures, even as high as 144° F, virtually no protease enzyme would survive to be effective in an infusion mash. Likewise, a well-modified, highly kilned British malt is unlikely to contain much in the way of protease enzymes in the first place. Research at the University of California at Davis in the 1980s, focusing on protease activity in the mash, concluded that so little of the protease enzymes survive kilning in modern malts that the presumed benefits of a "protein rest" were more likely due to physical factors regarding protein solubility than enzymic factors.

However, there is strong evidence that some protein degradation is occurring, namely the enzymes responsible for the production of additional amino acids in the wort. Amino acids are a vital yeast nutrient and so when high levels of adjuncts are used, additional amino acids can be a big benefit. Low temperature rests may even double the amounts of amino acids in the wort. In an all-malt wort this can lead to a surplus of amino acids and affect beer flavor and negatively affect a beer's microbiological stability. Textbooks continue to discuss the action of protease enzymes that break down large proteins into smaller ones, however, in a temperature range of 122° to 140° F. "The Practical Brewer," published by the Master Brewers Association of the Americas, states that there is just as much proteolysis in mashing as there is during malting, and numerous other texts discuss the degradation of complex proteins into polypeptides and peptides. The larger soluble breakdown products of the big proteins in barley are responsible for enhancing foam and palate fullness and cause haze, while the smallest provide yeast nutrition.

Beta glucanase enzymes are important because of the negative effects beta glucan can have on beer quality and processing in a commercial brewery. Beta glucan is a gummy carbohydrate and it can dramatically increase the viscosity of both wort and beer. This increased viscosity will lead to dramatic problems with wort separation and beer filtration.

Neither of these issues is likely to trouble homebrewers since wort separation just takes a little longer and few homebrewers feel the need to filter their beer. This enzyme helps break down large beta glucans into much smaller ones, making them less problematic. It is active in low temperature mashes to a limited extent.

Phytase is an enzyme that converts phytic acid (an enormous source of phosphates) in barley into free phosphates, which are vital in the malting process as enzyme co-factors and have a vital role in pH regulation. It is almost wholly denatured by kilning in a modern malt but in an extremely under-modified, lightly kilned malt, and using a decoction system, this enzyme may be a factor in bringing the mash pH into line.

Lipoxygenase is another enzyme of interest to brewers. Speculation that this enzyme may have an important role in beer staling has kept the brewing scientists embroiled in friendly arguments for the last several years. Proponents claim it causes the oxidation of lipids in the mash to produce stale flavor precursors in beer, while opponents argue its relevance and influence. Either way, it's not something a homebrewer should be concerned with. ■

The "Brewer's Window" graph that appears on page 51 is adapted from the book "Brewing" by Dr. Michael Lewis and Dr. Tom Young.

Temperature Rests in the Mash

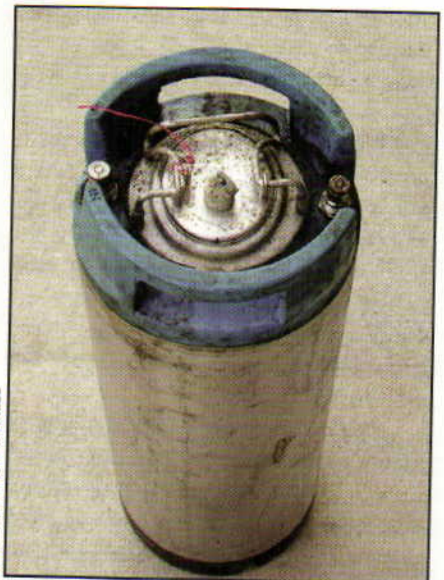
113° to 122° F	protein and beta glucanase rest
144° to 149° F	fermentability rest
158° to 167° F	extract rest
172° F	mash-off temperature

If your malt is well-modified, and in this day and age the majority of commercial malt is extremely well-modified, it is preferable to eliminate the first rest and go straight to the rest at 144° to149° F. Most of the protein will have already been degraded, along with the beta glucan, in the malthouse. And the protease and beta glucanase enzymes are largely denatured in the kiln.

Save a Keg

How to refurbish old beverage kegs

by Thom Cannell



PHOTOS BY THOM CANNELL

An everyday dirty, grimy, gooey beverage keg, waiting to be rescued.

It only takes an hour of work to make an old keg look this new.

You've decided to switch from bottles to kegs. Now what? The obvious first step is to obtain a keg. If you buy a new keg or choose one that's been refurbished by a pro, this primer will tell you how to keep it in tip-top condition over time. If you find a really nasty one — like the one I bought — this article will tell you how to fix it up.

There are many different types of kegs. Beer kegs, the kind you see at parties, are used exclusively for holding beer. They have locking devices built into the keg valves so the average consumer can't open them (you need a special tool). "Beverage kegs," usually used for syrup and soda pop, have tops that are easy to remove. This makes them the container of choice for most homebrewers.

Beverage kegs generally come in two varieties — pin-lock kegs, which were designed for the Coca-Cola company, and the ball-lock style employed by everyone else. The names come from the style of inlet and outlet attachments. Pin-lock kegs have pins and a twist-on locking system, while ball-lock kegs use a simpler snap-on connection.

Bob Sulier of Sabco Industries, a company that sells both new and refurbished kegs, says the vast majority of calls he receives concern ball-lock kegs. Ball-lock kegs are easy to find and therefore more common among the homebrew crowd. Pin-lock kegs are a bit tougher to locate, mostly because the Coca-Cola company tends to scrap its old kegs instead of selling them. You might find some that have been discarded, for example, by a bottling plant in your area.

Whether ball-lock or pin-lock, most of these so-called "Cornelius" kegs originally contained concentrated beverage syrup that was dispensed under high pressure and mixed at the soda fountain. They range in size from 2.5 to 10 gallons, though the 5-gallon size is most common. Expect to discover ancient syrup in any old "Corny" keg you purchase, and expect that syrup to have permanently flavored any part that's not made of stainless. These parts can be replaced and we will explain this a bit later.

Step One: Finding the Keg

A friend says he has a line on used kegs "for a couple of bucks each." It sounds like a good deal, until you see them. They're nasty and gooey, rusty and dented. Should you buy or pass?

Small dents on the body, the cylinder, generally don't mean much. If a tank has a crease, a place where the metal has folded sharply, it's only good for the shredder. Bent entry or exit ports, whether pin-lock or ball-lock fittings, might mean you cannot attach your hoses. A dent around the keg lid might mean it will never seal properly.

If the dents in the cylinder are truly minor, it's no problem. You should be able to straighten keg fittings if they are only a few degrees off-kilter. And a dented lid or sealing surface may respond to a few gentle taps with opposing hammers. But once metal is severely dented, the metal is stretched and can never be perfectly flat. If this is the case, don't hesitate to say "no thanks" to your friend.

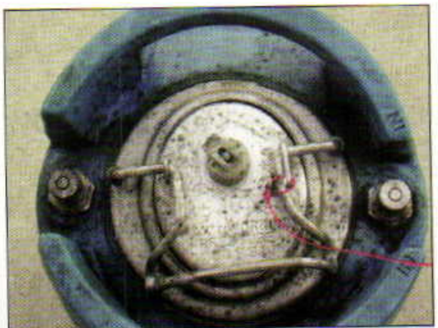
However you obtain your keg, remember one point of homebrewing ethics: Keeping a beer keg from last night's party and calling the deposit your "purchase fee" is illegal. Plus, it imposes a big financial burden on the breweries and liquor stores that need to replace them.

Step Two: Cleaning the Keg

You'll have a hard time finding a keg that's much dirtier than mine, but they are out there. The first step is to clean the outer surface with a good cleaning solution, like PBW (Powder Brewery Wash) or Simple Green. A brush or nylon scrub pad will remove most of the junk. Once the sides, top and fittings are as clean as you can get them, its time to start disassembling the keg.

Step Three: Flush the Inside

Remove the lid by pulling up on the bail. Flush the keg with hot water a few times to remove any remaining syrup. Add some cleaning solution — PBW or your favorite — and slosh it



The typical ball-lock beverage keg uses a simple snap-on connection system.

The pin-lock beverage keg uses pins and a twist-on locking system.

around. Then soak and scrub until the inside is pristine.

Step Four: Remove the Fittings

Remove the male keg fittings and toss them into some cleaning solution. This process is no more difficult than removing a spark plug from your lawnmower. For ball-lock fittings, you need a 7/8-inch deep socket and socket wrench. For pin-lock fittings, a 13/16-inch socket can be modified with special cuts to accommodate the pins. You can make your own socket with a Dremel tool or buy one from a homebrew supply store that carries keg parts and tools.

Next, remove the short gas dip tube and the long beer dip tube. The gas dip tube may be made of nylon or stainless steel. (You may want to replace a nylon tube, since it absorbs soda flavor.) Toss the short gas dip tube into the cleaner and run cleaner through the beer dip tube until you're sure it is clean. You may need a special dip tube brush to remove debris. (You can find a dip-tube brush at any homebrew supply shop that sells keg parts.)

Step Five: Scrub and Scrub

Clean all the surfaces of the keg, inside and out, with a scrub brush and your cleaning solution of choice. Pay particular attention to the places where the male keg fittings will seat. Use a toothbrush to clean all the crevices. Next, clean the male keg fittings, especially the inner threaded portion and seating surface. Check for nicks or bumps. If the bottom of the fitting is severely distressed or the threads are messed up, replace it. Many homebrew supply shops carry replacement fittings for kegs *(see the sidebar on page 58).*

Don't worry too much about mistaking which fitting is which; the gas-in fitting of ball-lock kegs has a slot in the lower tightening nut. Pin-locks use two pins on the gas side and three pins on the beer side. If your lid has a gas relief valve you might want to replace it to remove any remaining odors. It should simply unscrew or unbolt. A note: Just on principal, you probably should replace all gaskets when you first rehab your keg. You shouldn't need to replace them again unless something springs a leak.

Step Six: Pretty Little Poppets

Male fittings have poppet valves to permit gas or beer to move into or out of the keg. Make sure you've run some cleaner through the seating surface by gently pushing down on the center of the fitting until it depresses. This may cause the poppet to push completely out. Don't worry if it does, just be sure to line it up with the center hole when tightening onto the keg.

You'll only need to replace the poppet valve if you find a leak. Pressure-test your keg at 25 to 50 pounds per square inch (psi) before its first use. To do this, attach your gas-in hose and pin-lock or ball-lock connection and pressurize the keg. This is exactly the procedure you'll use when carbonating your beer, and you want to find any leaks before your precious homebrew enters the keg.

If you find a leak, press the leaking poppet out from the top, and press a new one gently in from below. The new poppet may not stay in the housing. Don't worry, just center it up when screwing the male fitting back on.

Step Seven: The Sugar Test

Fill the keg with iodophor solution. If there is any remaining sugar or starch it will reveal itself by turning into visible black specks or streaks on the surface. If you see any streaks, scrub some more!

Step Eight: Sanitize the Keg

If you clean with PBW, as I do, neutralize the cleaner and sanitize at the same time by spraying or filling with StarSan. If you use another cleanser you'll still need to sanitize your keg

To remove ball-lock fittings, you need a 7/8-inch deep socket and wrench.

To remove pin-lock fittings, you need a modified 13/16-inch deep socket.

Remove the short gas dip tube with a wrench and toss it in the cleaner. If it's nylon, replace it.

You should replace every part that's not made of stainless steel when you first rehab your keg.

before using. Regardless of what cleanser you decide to use, sanitize and let all of the parts air dry, then reassemble. All you need to do now is give your keg a final pressure test at 25 to 50 psi.

Step Nine: Admire Your Keg

It's shiny, it's sparkling, and this is absolutely the same nasty keg we started with. The entire process of cleaning and refurbishing one keg took me about an hour. In just a few more minutes, you could probably do four. So don't let kegs that are merely dirty prevent you from making your homebrewing experience much simpler. Instead of waiting weeks for your beer to condition, have it ready in just two days. ■

Thom Cannell, a veteran automotive writer and editor, writes the "Projects" column in every issue of Brew Your Own. He lives in Lansing, Michigan.

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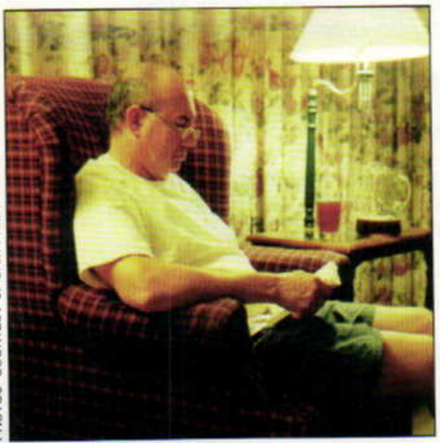
Mug Unplugged

Explore the quiet side of homebrewing

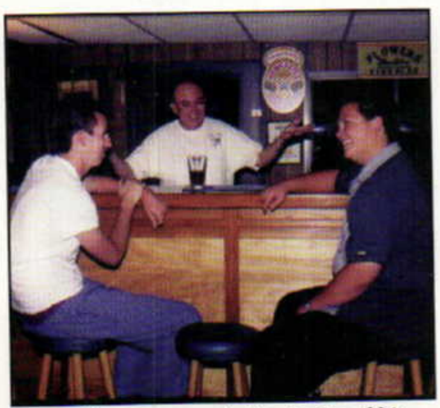
Sam Piper
Laguna Hills, California



PHOTOS COURTESY OF SAM PIPER

Sam relishes his quiet time while sipping a glass of his homebrew.

After clearing the teenagers out, Sam is at peace in his temple of brewing.



Sam offers some pals the fruits of his relaxing labor in his cellar pub.

There is a social aspect to brewing and there is a personal part, what I call "the quiet side." This is the time one spends alone with beer, whether that time is in the brewery, reading a brewing journal or sitting up with a book and a homebrew at night. I look forward to and treasure such times.

Joseph Campbell talks about the need for a sacred place of your own. A sacred place is where you go to spend a little time doing whatever it is that brings you bliss and connects you to the center of the universe. For me, my sacred place is the brewery, and whether I am making beer or bottling or washing equipment, I am content to be there and work my craft. When I need to get away, this is where I go.

I usually brew on Friday evenings, setting up the night before so that I can come home, take off the monkey suit, add a few gallons of hot tap water to my grist and *voilá*! I'm at the first step, 120° F and ready for a sandwich. Sometimes I have radio or music in the background, sometimes I work alone with my thoughts. As I work, the daylight fades to dusk, then dark, while neighbors on the street come home from work. Brutus, the cat next door, will mosey in for a scratch. Maybe Scott from down the street stops by to talk, and before you know it I am totally relaxed, it is dark outside, the wort is chilling, crickets are singing, and I feel content with myself and the world. It is a good ritual.

One night I came home to brew and there was my son Joshua, age 18, with two friends, working on some project in the garage with the radio blaring head-banger music. At our house we have the convention that whoever has the TV or radio on first gets to complete their show, unless the World Series, Star Trek or the lunar landing is on another channel. But when I found my temple so defiled with profane activities, you can imagine my disappointment. I just wanted to turn around and evaporate.

But this was my temple. And I told them so. My words were, "Boys, in ten minutes I am making beer and this becomes a sacred place. You are welcome to stay, but the music changes and you have to remove your stuff from the altar." I got a couple of funny looks, but no argument.

I first discovered the quiet side of brewing as a new brewer. I have a custom of sitting up alone at night with a book and a beer. I read a little, think a little, sip a little — I call it "putting the day away." After I started making the beer I drink, putting the day away took on a whole new dimension. It is very satisfying for me to look at a beer in a mug and know that I made it. I feel connected to the drink, connected to my grandfather who made beer for 50 years, connected to a community of people who share a sense of beauty, wonderment and effort about beer.

When I first started brewing I kept a row of bottles along the back of the fridge, just like my grandfather did, and I bought a glass pitcher. And just like grandpa, I'd pour two beers into the pitcher and set it on the floor next to my chair. I now have kegs and pour straight into my glass, but I still love to see beer in a pitcher and use one whenever I have company.

And sometimes at night it's easy to pretend I'm in a real pub, nursing down a porter, shedding the freeway, the kids and just getting in touch with myself again. It's a moment that wants to linger. "Inkeeper, over here, pull me another, please." ■

Sam Piper has been brewing for 14 years and is a member of the Barley Bandits Homebrew Club. He lives and brews in Orange County, California.

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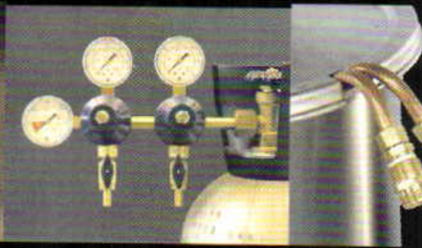

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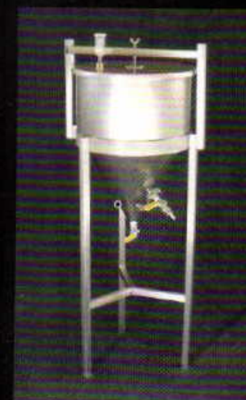

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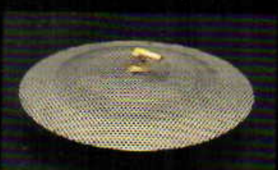

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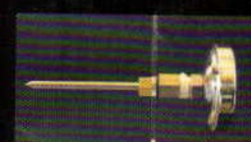

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