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Brew



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NOVEMBER 2002, VOL.8, NO.7

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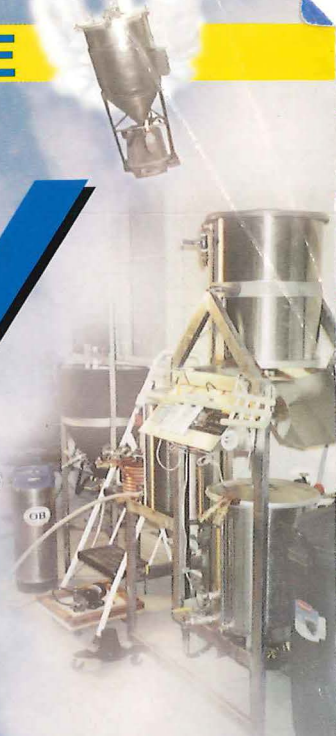


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Switching to kits gave
him time to enjoy a new
kind of round.

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believed that a kit beer
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Roy Bailey - Beer Correspondent
CAMRA's 'What's Brewing' magazine (April 2000)

In Roy Bailey's local Good Beer
Guide Pub, the customers'
reaction was *"uniformly
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and *"most of them
thought it was a full-
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BBC Radio 4 food & drink programme
(July 2000)

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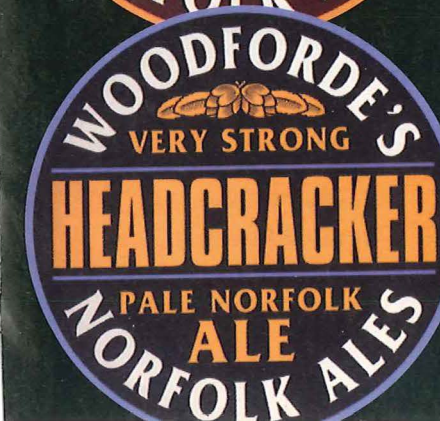
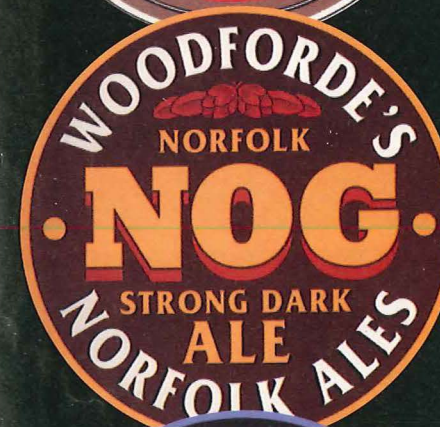
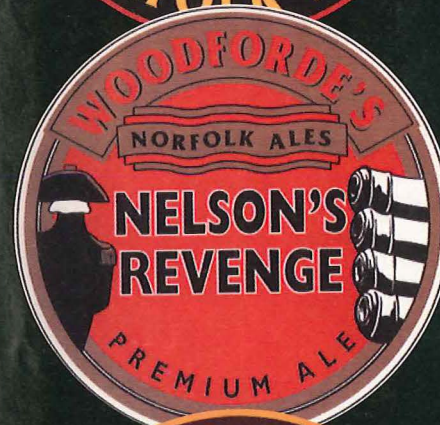
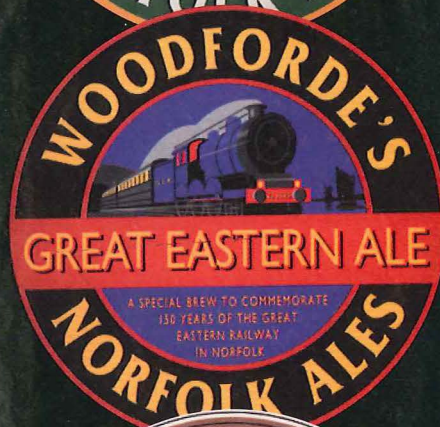
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Departments

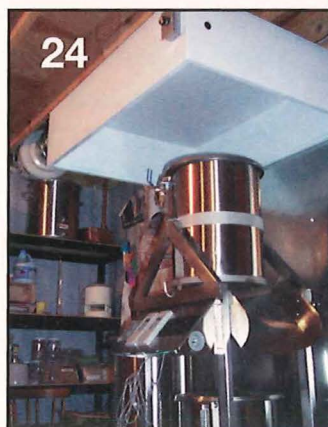
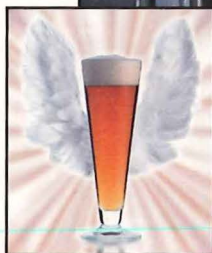
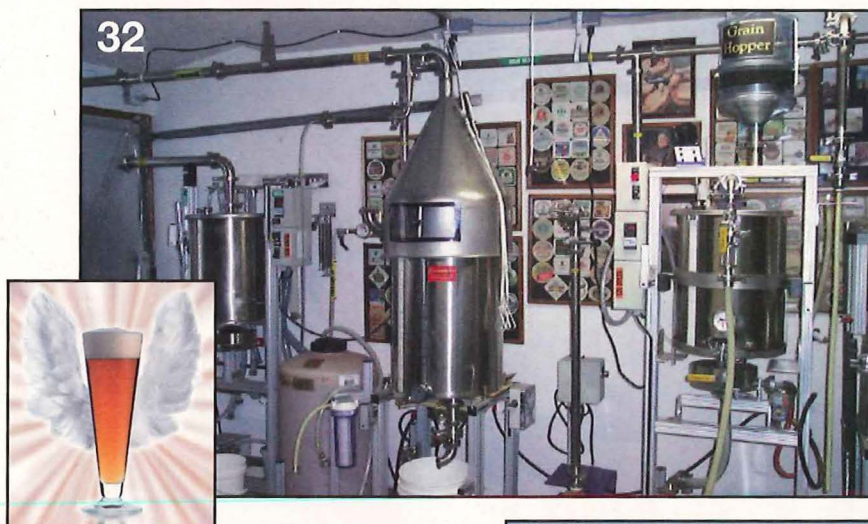
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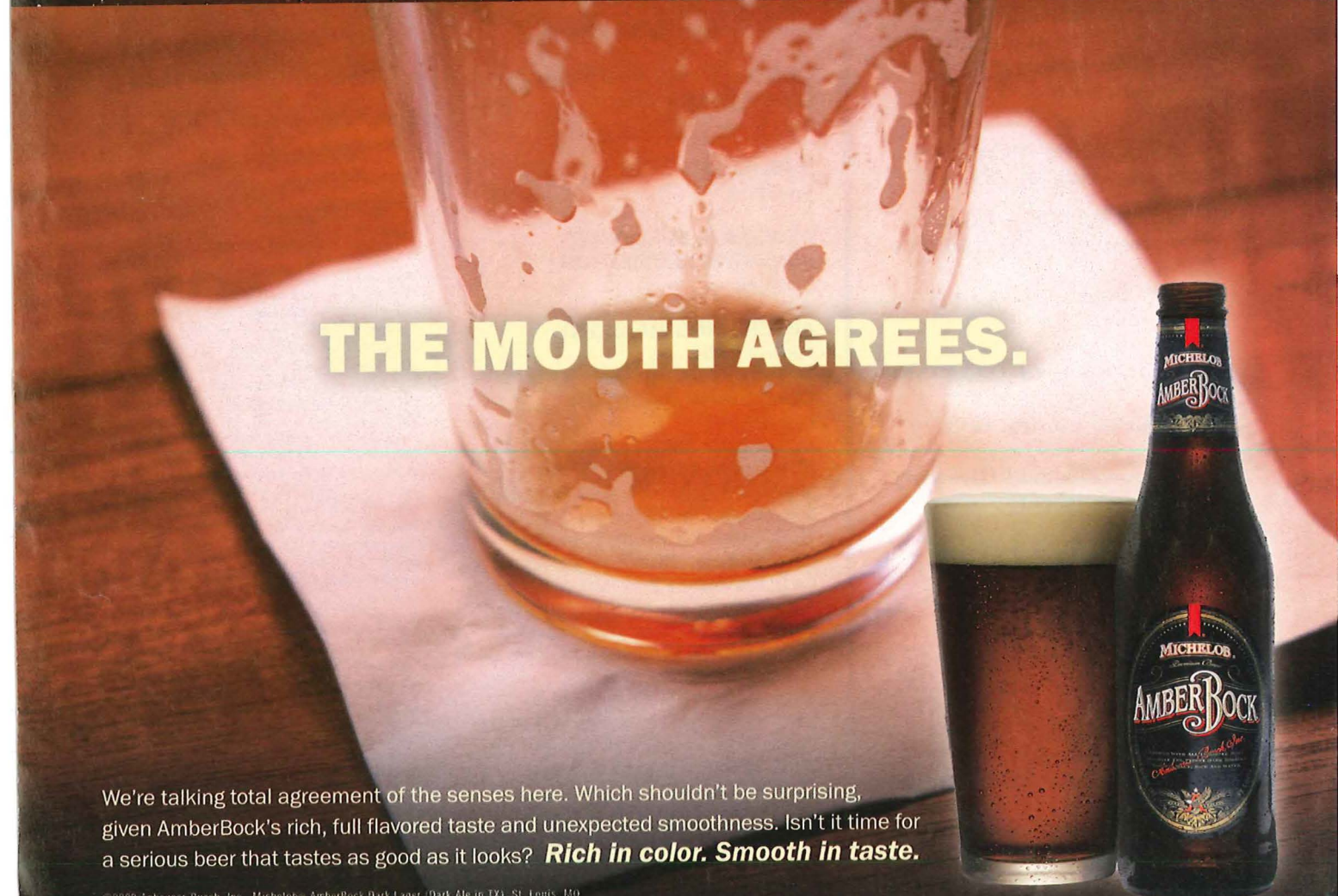


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EDITOR

Kathleen James Ring

MANAGING EDITOR

Chris Colby

ART DIRECTOR

Coleen Jewett Heingartner

TECHNICAL EDITOR

Ashton Lewis

EDITORIAL INTERN

Lauren Rundle

CONTRIBUTING WRITERS

Steve Bader, Thom Cannell, Chris Colby, Horst Dornbusch, Joe and Dennis Fisher, Ashton Lewis, Thomas Miller, Steve Parkes, Scott Russell, Tess and Mark Szamatulski

CONTRIBUTING ARTISTS

Don Martin, Ian Mackenzie, Shawn Turner, Jim Woodward

CONTRIBUTING PHOTOGRAPHER

Charles A. Parker

PUBLISHER

Brad Ring

ASSOCIATE PUBLISHER/ ADVERTISING DIRECTOR

Kiev Rattee

ADVERTISING MANAGER

Michael Pollio

NEWSSTAND DIRECTOR

Carl Kopf

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How to reach us

Editorial and Advertising Office

Brew Your Own

5053 Main Street, Suite A
Manchester Center, VT 05255

Tel: (802) 362-3981

Fax: (802) 362-2377

E-Mail: BYO@byo.com

Advertising Contact

Kiev Rattee

kiev@byo.com

Editorial Contact

Kathleen James Ring

kath@byo.com

Subscriptions Only

Brew Your Own

P.O. Box 469121

Escondido, CA 92046

Tel: (800) 900-7594

M-F 8:30-5:00 PST

E-mail: byo@pcspublink.com

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Volume 8, Number 7: November 2002

Irish Moss and Gravity Drop



I've just read your article on finings ("How Clear is Your Beer?" in the July-August 2002 issue of *Brew Your Own*) and I am now considering using a bit of Irish moss in my brew kettle. Before I go ahead, I would like to know whether Irish moss reduces the specific gravity of the brew, taking into account the fact that it removes proteins.

Francisco Taboas
via email

The specific gravity of your wort may drop a small amount when Irish moss is added. Soluble proteins increase the specific gravity of wort very slightly. (Most of the gravity is, of course, due to dissolved sugars.) Because Irish moss binds proteins, including some that are soluble, it can, as you suggest, decrease your specific gravity. However, the change is almost certainly so small that detecting it with a hydrometer is unlikely.

Mash Lids of Madison County

I would like your input on using a 3/4" oak lid on my mash tun, which is a 15.5-gallon keg with the top cut off. I would like to use white oak and not put any protectant on it. I plan to just rout the underside with a groove to fit the top of the cut-off keg. I thought it would look neat. It would be a two-piece cover with an overlap on the outside to allow the sparge arm to drop in. I brew with oak chips, so I don't mind the flavor (if any) that the lid might impart. Thanks from a cornfield in Iowa.

Rod Schumacher
Des Moines, Iowa

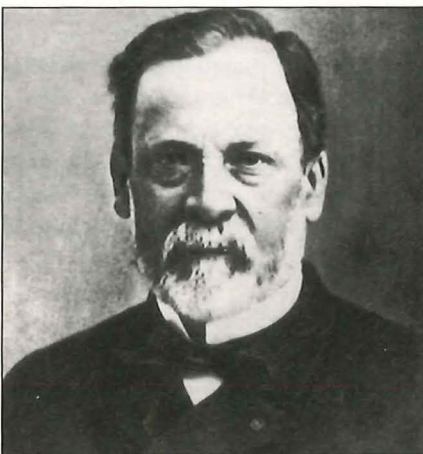
Projects author Thom Cannell responds: "I can't think of a single reason not to do so. Winemakers use aging barrels made from oak, so why not an oak lid for a brewer's mash tun?"

"The only thing I can suggest is maybe making the lid of multiple strips — or perhaps even ripping the pieces, and then assembling the wood grain

up/down/up/down to prevent cupping and warping. Just send us a photo when you're done! Who knows, it might spawn a project or become part of one of our equipment roundups."

Pasteur vs. Crabtree

I'm having trouble squaring a few things. The Pasteur effect states that if one gives a facultative anaerobe (such as yeast) oxygen, it will respire. In the



That blasted Crabtree! His rule trumps my rule when it comes to sweet wort.

absence of oxygen, the organism will ferment. Meanwhile, the Crabtree effect states that if the same organism is in an environment of 0.4% glucose or greater, it will ferment, regardless of the amount of oxygen in the system. Crabtree is supposed to supercede Pasteur in environments of adequate oxygen and high sugar, such as you find in most starting worts. Why is it that if one oxygenates their wort prior to pitching the yeast, the activity of the yeast is vigorous? Is this vigorous respiration or fermentation? Who wins, Crabtree or Pasteur?

Aldo J. Fusaro
Clarendon Hills, Illinois

Crabtree wins. The Crabtree effect suppresses the Pasteur effect when a lot of sugar is present, as it is in wort. Brewer's yeast does respond positively when oxygen is added to cooled wort, but the yeast does not use the oxygen for aerobic respiration. The activity you see is simply vigorous fermentation. Brewer's yeast needs oxygen to build important cell membrane components. When they receive oxygen, they can multiply and ferment vigorously.



Mail

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Some early homebrewing books erroneously state that brewer's yeast aerobically respire early in fermentation. This has even led some brewers to think that aerobic respiration is a phase of fermentation. Under standard brewing conditions, brewer's yeast never respire.

Brown Ale Boo-Boo

I noticed in the latest edition of *BYO* that the recipes for brown ale ("Style Profile," October 2002) are incorrect. I plugged the information into two brewing programs, mainly the Beer Recipator at www.hbd.org, and also ProMash. The amount of extract stated in the recipes is less than half the amount that's needed to hit the specified original gravity.

Herbert C. Gellner
Forestville, Maryland

You're right, the numbers for the last two brown ales — the extract-only beers — are way off. In order to make

five gallons of wort with a specific gravity of 1.044, you'd need over six pounds of liquid malt extract. The recipes only list 3.3 pounds. The recipes were originally formulated in kilograms, but the final two did not get converted to pounds. Sorry!

To correct for the lack of fermentables, but keep the malt ratios the same as in the original recipes, multiply the amount of each malt extract by 2.2. Thus, the Traditional British Brown Ale recipe should list 4.6 pounds of amber malt extract and 2.6 pounds of dark malt extract. The Modern British should list 5.0 pounds of amber extract and 2.2 pounds of dark extract. We'll try not to let that happen again.

Is Bitter Better?

The Bell's Best Brown Ale recipe included in the September *BYO* looks like a beer that I would like to brew. However, I have a couple questions. It looks like the boil is for 45 minutes, not the standard 60-minute boil. Is this

correct? Also, I prefer hoppy beers, which I realize is not the English brown ale style. If I increased the Cascade hops to 8.3 AAU, do you think the bitterness would be more to my liking, or would this take away from the other qualities of the beer? I can't wait to try this one.

David Balducci
Mechanicsville, Virginia

Yes, boil for 45 minutes. And if you like more hops, add more hops. Traditional brown ales are not very bitter but plenty of brewpubs and microbreweries make hoppier browns. And many of them are quite good!

Bell's Best Brown is rated at 30 IBUs, so it is already hoppier than a typical British brown. Instead of adding more hops, you could also try boiling the wort, along with the bittering hops, for 60 minutes instead of 45 minutes. Also, if your brewpot is big enough, a full-wort boil will result in a hoppier beer. ■

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homebrew club

The Hillside Brewers • Rutland, Vermont



The Hillside Brewers of Vermont are chillin' at the neighborhood brew bash.

Brewing was a communal effort for the Babylonian, Egyptian and Inca cultures. And it was a family tradition until the Middle Ages, when production shifted to monasteries (which might explain the increase in religious vocations during that period).

In a hillside neighborhood in Rutland, Vermont, community brewing is still thriving. When I bought my house 10 years ago I was single, and the neighborhood was mostly home to the Greatest Generation.

I started homebrewing in the mid-1990s. It was a solitary activity, just the dog and me. I began using my amateur design skills to develop colorful labels on my PC for my homebrew. The ale was good, but the labels received the most comment. I gave most of the bottled ales away to friends, but never to the neighbors. The neighbors were cordial, but kept to themselves.

Today, I live in the same house with my wife and two-year-old daughter. The neighborhood's demographic composition has changed: Now we live amidst "cohorts," people with families like ourselves. Our "unit" consists of

seven families whose initiation rite into our generation was having kids ages three and younger.

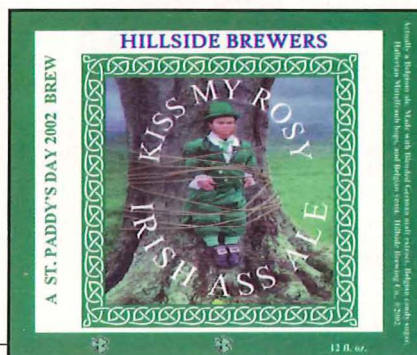
As each of the new families moved in, if they liked beer I would include them on my distribution list. Turns out the guys had all brewed at one time or another. So at our first annual summer neighborhood block party, while enjoying microbrews, we asked, "Why not make the beer ourselves?"

The Hillside Brewers held its first neighborhood brew in late spring, making a batch of red ale from extract for the block party. Instead of limiting the fun just to the male brewers, all the wives and children were invited for a cookout. We were sequestered in the kitchen, protected from the toddler mania outside.

The ingredients arrived a few days before the brew bash from a mail-order firm in California. One of us sanitized the equipment, another watched the 16-quart stainless kettles for boilovers. The wort was cooled outdoors with a copper immersion chiller attached to a garden hose. My daughter, a precocious redheaded two-year-old, helped pitch the liquid yeast into the fermenting bucket. A week later, we gathered again for the ale's transfer to the second-stage fermenter.

Neighborhood brewing is now our favorite pastime. We brew ales for Christmas, the arrival of spring and summer get-togethers. Our brewing is not sophisticated, so it doesn't detract from our enjoying each other's company. It's a welcome antidote to our hectic lives as parents.

—Dick Courcelle



reader recipe

Pumpkin Patch Ale

(five gallons, all-grain)

SG: 1.047–1.050

OG: 1.018–1.020

IBU: 22 ABV: 4%

This is a nice, spicy ale that tastes just like pumpkin pie. It's perfect for Thanksgiving.

Mary Traina

Beer and Winemaker's Pantry
Pinellas Park, Florida

Ingredients

- 6.5 lbs. pale malt
- 1 pumpkin (about 10 pounds)
- 1 lb. crystal malt (60° L)
- 1 tsp. nutmeg
- 1 tbsp. whole cloves
- 1 cinnamon stick
- 1/2 lb. clover honey
- 1 oz. Willamette hops (5.5% alpha acid) (bittering)
- 1 oz. Willamette hops (5.5% alpha acid) (finishing)
- 1 tsp. Irish moss
- Wyeast 1056 (American Ale)

Step-by-step

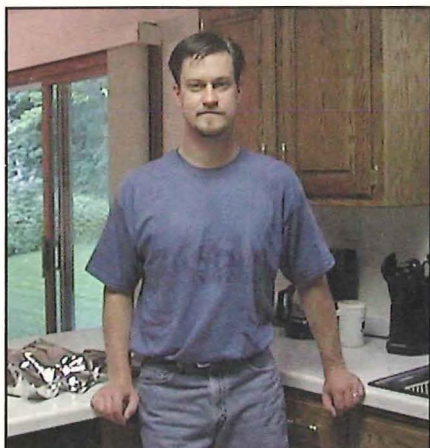
Cook the pumpkin until it is soft (this takes approximately 45 to 60 minutes). Cut and mash the cooked pumpkin into little bits.

Steep the crystal malt and the mashed pumpkin in 1.5 gallons of water at 150° F for about 90 minutes. Strain the pulp from the juice. Now bring the pumpkin juice to a boil.

When the juice is boiling, add the bittering hops and malt. Boil for 45 minutes. Add the nutmeg, cloves, honey, cinnamon, moss and finishing hops. Boil for 15 minutes. Cool the wort, add to fermenter and top off with water. When temperature is approximately 80° F, pitch the yeast.

homebrewer profile

Jeremy Lenzendorf • West Bend, Wisconsin



Lenzendorf takes a study break before enrolling in the Siebel brewing course that he won in a drawing.

When I was twelve, my uncle asked me to help him brew a batch of beer. This was an appealing offer for an almost-teenaged kid. But I have to admit, the big brew day was a bit of a letdown. My uncle is an extract brewer, so there wasn't much for me to do but sit around and watch. Still, from that day on, I day-dreamed about having my own homebrewery. I was intrigued by the idea that I could develop my own recipes and create my own beer. But I never acted on that dream until three years ago, when I finally bought equipment and started brewing my own beer.

In November 1999 my wife and I bought our first house and I began to homebrew in the kitchen. I started with

the typical set-up that you can find in any homebrew shop: a five-gallon glass carboy, a bottle capper, bottle caps, a racking cane, a blow-off tube, a siphoning hose and an airlock. It also came with a how-to homebrew book. I have since brewed a lot of tasty extract ales and some successful all-grain batches, and I read all the homebrew books I can find. I even moved my professional engineering certification exam back by six months so I could attend a "Concise Course in Brewing Technology" at the Siebel Institute.

The Siebel Institute in Chicago, Illinois heightens professional brewers' understanding of their craft. I attended the class on scholarship; my name was selected in a prize drawing this June at the annual National Homebrew Conference in Irving, Texas. I was not present at this conference, but I still won the prize.

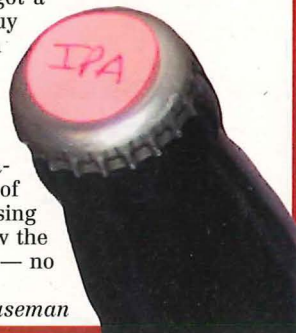
The Concise Course ran from the 16th through the 27th of September. It offers students a solid overview of the commercial brewing process, including such topics as brewing technology, yeast management, beer packaging, brewery engineering, beer styles and precise recipe formulation, quality control and assurance.

Although I admit to cramming to get ready for the course, I'm a pretty relaxed homebrewer. I think you should simply make the best beer you can, enjoy the process, and learn from it to make the next batch even better.

reader tip

THIS IS AN EASY WAY to mark bottles when you've got a number of different homebrew styles in cases. First buy 3/4" round labels; I purchased 1,000 for \$3.95. Note on each label the batch code, date or style. Sometimes I use Microsoft Excel to print out my labels by feeding them into the printer by hand. This works well because I can print smaller fonts on the computer than I can write by hand. This allows me to fit more information on the labels. Then I stick one label on the cap of each bottle after bottling. The biggest advantage to using these labels is that when you drink the beer, you throw the cap and label away. You're all set for the next batch — no more soaking off stuck labels!

—David Houseman



reader recipe

Smoked Maple Porter

(five gallons, extract with grains)

OG: 1.064–1.065 FG: 1.017–1.018

SRM: 100 IBUs: 31 ABV: 5.9%

Ingredients:

10 oz. British chocolate malt
10 oz. U.S. crystal malt (80° L)
5 oz. British peated malt
4 oz. black malt
6.5 lbs. Muntons light DME
8 oz. malto-dextrin
8 oz. maple syrup
9.0 AAU Northern Brewer
(1 oz. @ 9% alpha acid) (bittering)
1 tsp. Irish moss
Wyeast 1968 (Special London) or
White Labs WLP002 (English Ale)
1/2 cup Muntons extra-light DME
2/3 cup maple syrup

Step by step

Bring 1 gal. of water to 160° F, add grain and hold for 30 min. at 150° F. Strain grain into brewpot and sparge with one gal. of 168° F water. Add DME, malto-dextrin, maple syrup and bittering hops. Bring volume to 2.5 gal. Boil for 45 min., add Irish moss. Boil for 15 min., remove pot from stove. Chill wort, strain into fermenter, add water to 5-1/8 gallons. Add yeast when wort has cooled to 80° F. Ferment at 70° F for 5 days, then rack into carboy. Ferment until gravity has been reached and beer has cleared (3 weeks). Prime and bottle. Carbonate at 70° for 3–4 weeks.

All-grain: Acidify mash water to below 7.2 pH. Mash 10 lbs. British 2-row pale malt and the specialty grains in 4 gal. of water at 154° F for 90 min. Sparge with 5 gal. of water at 5.7 pH and 168° F. Total boil is 90 minutes. Add 7.1 AAU of bittering hops for the last 60 minutes. Add the Irish moss as indicated by the extract recipe.

Tess and Mark Szamatulski
Maltose Express
Monroe, Connecticut

Doppelbock

Top pro tips on the classic German lager

Tips from the pros

by Thomas J. Miller

Doppel is German for double and, although these beers aren't double the strength of a normal bock, their specific gravity is usually above 1.070. Homebrewers who want to take a shot at this classic style need to start brewing now — lagering should take at least three months. This month's professional tips are perfect for getting next year's doppelbock off to a great start!



PHOTO COURTESY OF DAN CAREY

Brewer: Dan Carey is well-known in the microbrewery world. He is the co-owner and brewmaster for the New Glarus Brewing Company in New Glarus, Wisconsin. He earned his bachelor of science degree in brewing science from the University of California at Davis in 1982. He was also valedictorian of the Siebel Institute Course in Brewing Science and Technology (1987). Carey passed the Institute of Brewing Diploma Master Brewer Examination in 1993. He served his apprenticeship at Ayinger Brewery in Bavaria and has operated and constructed numerous breweries throughout the United States. Before founding New Glarus in 1993, he was a production supervisor for Anheuser-Busch, Inc.

The flavor of an excellent doppelbock can be described as clean maltiness. The beer should be quite rich, almost bready. The malt should be dominant. The alcohol character should not be

off-putting; neither should there be any astringency in the beer. In a doppelbock, there is a fine line between getting full flavor, maltiness and drinkability, or missing it altogether.

Good malt is the key to strong beer, so be conscientious of what you purchase. Use a low-protein malt, less than 11.5% protein. European or European-style malts are the best. Munich malt can make up 65% of the base malt. The other 35% should be Pilsner malt (see recipe). Be careful with using too much dark caramel malts, as they have a tendency to be astringent. Lots of people are going to disagree with me on this but, especially with a decoction beer, caramel malt doesn't help the doppelbock.

We do a decoction mash and, because of that, we have a relatively thin mash of 3.5 parts water to 1 part grain. Proper decoction mashing for a doppelbock means something like 15 minutes at 120° F, 20 minutes at 144° F, 20 minutes at 158° F, and then mash-out at 170° F.

When you start sparging, you will get hydrometer readings around 1.070. We stop sparging in the neighborhood of 1.024 (which means the last runnings are heavier than with a normal brew). This gives us a full kettle with a gravity of about 1.060. But, to get to the gravity we need to start fermentation, we need to extend the boil. For a doppelbock we boil 3.5 hours. This yields a gravity of 1.076.

Doppelbock brewers need discipline throughout the fermentation process. First, you'll want a very healthy yeast. Choose a well-attenuating lager yeast that produces low diacetyl. Pitch the yeast at 46-48° F and then allow the beer to free-rise to 52° F until fermentation is complete.

Hold this temperature for a couple of days. Following this schedule will help minimize the production of things like diacetyl, which produces off-flavors. Lager at least three months.

Because the yeast will be required to perform extremely well to ferment all the sugars, make sure you aerate the chilled wort very well. Oxygen is key to helping them do their job.

Here's a recipe that yields five gallons of cold wort after trub separation.

Dan's Doppelbock

(five gallons, all-grain)

OG: 1.076 FG: 1.020 IBU: 22

9 lbs. Munich malt (10° L)

4.75 lbs. Pilsner malt

2 oz. dehusked chocolate malt (400° L)

Saaz, Spalt, Styrian Golding, Hallertau Mittelfrüh or Tettnanger hops

German lager yeast

Mash in at 120° F for 10 minutes. Heat to 144° F and hold for 10 minutes. Remove 1.2 gallons of (thick) mash. Heat this to 158° F. Hold 15 minutes, then heat to a boil. Boil for 15 minutes while stirring. Recombine boiled portion with main mash and stabilize heat at 158° F. Hold for 20 minutes. Remove approximately 1.2 gallons of (thin) mash. Boil 15 minutes while stirring. Return to main mash. Stabilize main mash at 170° F and transfer to lautertun. Recover 7.5 gallons and boil down to 5.7 gallons. Add hops as described above. Cool wort to 46° F, then rack clear wort off cold break. Pitch double the recommended pitch rate. Start the culture the day before in approximately one liter of sterile, aerated wort at 46-48° F until fermentation is noted. Pitch this cooled, aerated wort. Let fermentation free rise to 52° F until complete. Hold at 52° F for two days. Cool to 42° F. Rack off settled yeast. Hold at 42° F for two to three weeks. Cool to 32° F for a minimum of eight weeks. Bottle as normal.

Brewer: Alec Mull has been with Kalamazoo Brewing Company in Michigan since 1999. He was promoted to head brewer in 2001. Kalamazoo's Consecrator Doppelbock won a bronze medal at the 2001 GABF.

Doppelbock is one of my favorite styles, but it is a tough beer to make. You have to pay total attention to many things in order to get it right.

First and foremost, you need to pitch healthy yeast to make a good doppelbock. As a general rule you want to pick a yeast strain that has maltier characteristics, rather than one that is crisp or dry. Bavarian, Bohemian or Munich strains usually work well. I like Wyeast 2124, 2206 and 2308, or White Labs 820, 830, 838 or 920. But almost any healthy lager strain can make a great doppelbock.

It is very important to get the terminal gravity right — I shoot for about 1.020. If your beer ends up above this,

it means you'll have too much residual sweetness. Adding 10 percent caramel malt will help your beer come in with a good terminal gravity.

On the other hand, if your recipe has too much fermentable malt — like Munich and Pilsen exclusively — you'll have too much attenuation, and your beer will ferment down below 1.020. Now you're stuck with a beer that's heavily alcoholic.

Many brewers use too many malts in this style, and their beers are too complex. I recommend using only Munich (50 to 75%), CaraMunich 60°L (10%) and Pils (15 to 40%). Malt is so well-modified these days that you can do a single-infusion mash. A mash temperature of 155° F is perfect. Yes, I said it: A single-infusion mash can and will produce a fine, malty doppelbock.

Malt is the showcase, so hops are a lesser concern. Low- to mid-20s on the IBUs will balance the sweetness. Perle and Northern Brewer are good choices. Avoid hops that leave a footprint,

like Chinook or Centennial or Cascade.

Here is a recipe for five gallons of traditional German doppelbock.

Alec's Doppelbock

(five gallons, all-grain)

OG: 1.088 FG: 1.020 IBU: 22

11 lbs. two-row Munich malt (10° L)
3 lbs. Pilsen malt
2 lbs. CaraMunich malt (60° L)
0.5 oz. Perle hops (7% alpha acids) (add 60 minutes into boil)
0.5 oz. Hallertau hops (4% alpha acids) (add 90 minutes into boil)
German lager yeast

Strike to mash at 155° F. Rest the mash for 60 minutes. Collect runoff slowly until you hit 1.075 gravity. Boil for two hours. Aerate with twice the normal amount of oxygen. Pitch twice the normal amount of healthy yeast. Start fermentation at 50° F and let rise to 55° F near the end of fermentation. Lager near 30° F. ■

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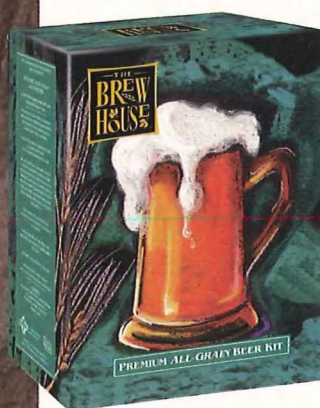
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Brass vs. Beer

"Help Me,
Mr. Wizard"

Birch beer, yeast and brewing with potatoes

Nuts Made of Brass

I am an all-grain brewer and I use a five-gallon Gott cooler as my mash tun. I have a stainless-steel ball valve on the outside of the cooler, which is used to control the flow of the sweet wort. This ball valve is held in place using a rubber washer and a brass nut on the inside of the cooler. My concern is this brass nut being in contact with the sweet wort. I have heard that brass contains lead and therefore should not be used in brewing. Is this true?

Joe Manzi

North Billerica, Massachusetts

Brass is an alloy consisting of the elements copper and zinc — brass contains no lead. Brass, like copper, can be soldered and if lead-containing solders are used, then the "brass fitting" would contain lead.

Brass is commonly used to make water valves and faucets, so you can rest assured you don't have any health risks to worry about. You do have a few options with this nut. The first is to leave it on the valve and not worry. The other option is to replace it with a nut made from another material. Stainless steel and Teflon nuts are pretty easy to come by, especially when they have common threads, such as NPT (National Pipe Thread), that are most likely on the ball valve. Pretty straightforward.

I have a personal beef with brass and wanted to add some meat to this answer. Most brewhouses found in commercial breweries contain metals other than stainless steel and this fact does not

cause any major problems. Even an "all-stainless" brewhouse will have a bit of copper somewhere because copper contributes a small amount of copper to wort and usually contains trace amounts of zinc. These elements fill an important role in fermentation. Copper helps bind volatile sulfur and zinc is a yeast micronutrient. Other metals found in older brewhouses include carbon steel (the type of steel that rusts), brass and bronze. Excellent beers can be made when these metals are part of the "hot side" of brewing — although carbon steel can cause some real problems because it easily releases iron into liquids and is best avoided.

After yeast is pitched, the rules change in my book. Yeast rapidly decreases the pH of wort from about 5.2 to around 4.5 and begins to produce flavor compounds that

are very susceptible to oxidation. Oxygen is not the only element capable of filling the role as an oxidant and metal ions from equipment can and do act as oxidants. In beer the ones to look out for are copper and

iron, because the equipment we use often contains these two elements. Filter sheets and filter powder, such as diatomaceous earth, can carry iron and will contaminate beer being filtered with a very potent oxidizer.

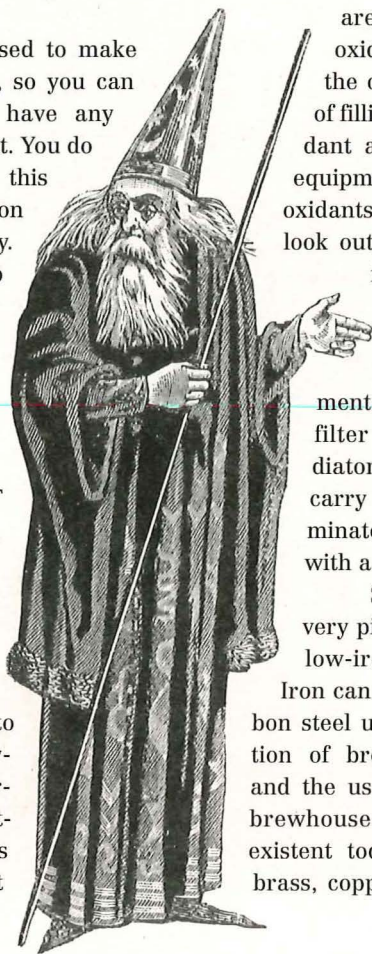
Some brewers are very picky about specifying low-iron filter materials.

Iron can also come from carbon steel used in the construction of brewhouse equipment and the use of carbon steel in brewhouses is virtually nonexistent today. In my opinion, brass, copper and carbon steel

should never touch beer . . . never. In wort, these metallic flavors are absorbed by yeast or react with products of fermentation when wort is fermented. Once fermentation is complete, however, metal ions will make beer taste metallic or oxidize it. When beer comes in contact with these elements, the first thing that becomes apparent is an unpleasant metallic flavor. After a while the beer will begin to taste oxidized if enough metal is present, just like it would if it were in contact with air or oxygen.

This blanket statement really flies in the face of much written about beer. After all, brass is the most common metal used to make beer faucets, and many fittings used in kegging equipment are also brass. The fitting used to tap into a keg is commonly made of chrome-plated brass (the chrome plating really does not last long where it touches beer, and what lies below is plain old brass). The little barbed pieces with nuts used for connecting the keg tap to a beer hose are also made from chrome-plated brass. Chrome is an alloy of chromium and other metals, usually molybdenum. Chrome is not bad, but when it is plated on top of brass and begins to wear the plating comes off and brass is exposed. Some people even use copper tubing to cool beer in a jockey box on its way from keg to faucet.

My beef with brass is that it is used for all sorts of things that damage beer flavor. I know this firsthand from pinpointing a subtle, but objectionable, metallic flavor in my beers to brass hose barbs or "tail pieces" used in the draft system. The solution was very easy and cheap — I replaced them with stainless-steel tail pieces. After this change my draft beer was fine, but when the beer was kegged, the same bad flavor could be detected. This time I replaced the keg tap with a stainless tap. Stainless taps cost about \$50 com-



pared to the cheap chrome-plated brass versions that sell for about \$18.

I was at a trade show a few years back and a company called "Stainless One" had this really cool demonstration. They had a keg of Sam Adams beer and all of the components of the system were made of stainless steel, right up to the tap. The beer was split into two taps — a stainless tap made by Stainless One and a brass tap normally found in bars all over the country. The sales pitch this company had was non-existent because the flavor difference between the beer poured from the stainless faucet compared to the brass faucet spoke for itself. Beer from the stainless side tasted fine, while the beer on the brass side tasted oxidized.

The point to all of this is that when you start thinking about how beer flavor is affected by the materials you use in the brewery, improvements in flavor often can be made by focusing on your equipment rather than your brewing technique. Although you don't need to

worry about lead from this brass nut, you may find that a flavor improvement can be realized by using a different material.

The Root of the Problem

I recently made a 10-gallon batch of Pilsner and bottled it in two five-gallon Cornelius kegs. I used the triple decoction technique and it tasted great, at least the first keg. I had previously used the second keg for making birch (or root) beer, so the beer in that keg has a hint of birch beer flavor. This is definitely not desirable for a traditional Pilsner. What can I do to improve this batch? I can drink it, but it is not suitable for guests! The more important question is, how do I get the birch beer flavor out of my keg? I have soaked it for 20 minutes with dilute bleach (yes, I know bleach is a no-no) and for 10 days with dilute TSP. I can still smell it. What do you suggest?

*Rich Kragness
Pittsburgh, Pennsylvania*

Ahhh, the old birch-beer beer. This reminds me of a time when I screwed up a beer experiment with the remnants of a root beer experiment. We had three groups in our brewing lab class and each group would brew a beer that had one ingredient or process step changed. The results were assessed both analytically and with sensory evaluation. So, as we tasted the beer from my group, my colleagues began focusing on the odd aroma from the beer. In the end I had to confess that I had tainted the beer keg with root beer!

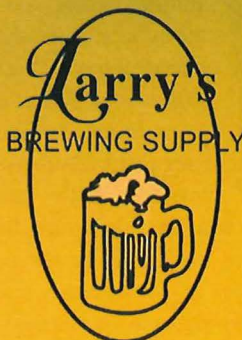
Unfortunately, when beer is tainted with a flavor like root beer, there is nothing that can be done to rescue it. However, several measures can be taken to ensure that the problem will not reoccur.

I learned a lesson because I tried everything imaginable to free the rubber gaskets and o-rings from the pungent odor. I soaked them in bleach, sodium hydroxide and acid. I boiled



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them, steamed them and even let them bake in the hot sun. Nothing worked. Finally, I spent a few bucks and replaced all the rubber parts of the keg and the keg no longer reeked of *eau de root*.

I love root beer and have been serving it to customers for the last five years, but I take a few precautions. For starters, I have a complete set of rubber and plastic components (gaskets, measuring cups, hoses, etc.) that are used only for root beer. I also have kegs that are only used for root beer.

The next precaution is Draconian: The root beer keg is tapped in a stand-alone keg cooler. The reason for not running root beer lines in the same bundle of lines carrying beer is that root beer flavors can actually migrate out of the root beer line and into adjacent beer lines. This seems unbelievable, but it can and does happen. There are special beer lines on the market that are designed to prevent this from occurring, but I don't want to take any chances.

Breweries are not the only places that quarantine root beer. Soda bottlers do the same thing to prevent everything they produce from having that birch root, wintergreen, star anise, licorice and vanilla zip that's known as root beer.

A Cultured Question

OK . . . I think I have finally gotten up the nerve to start my own yeast farm. I want to perpetuate the yeast, but I fear using the spent yeast from the primary fermenter. I'm told that it is better to take the yeast from there, rather than making slants. I have done a little reading on both issues, and I'm hesitant. I'm simply afraid of ruining a batch or two of beer.

My main question is this: After culturing or splitting yeast packets, how do I know how much of the starter culture to add to my beer? I mean, I'll have this half-gallon jug full of wort and yeast, and I want to keep feeding it and splitting it. But is it a cup? How many ounces? I can't seem to get an answer from anyone.

Rob Blanda
Atco, New Jersey

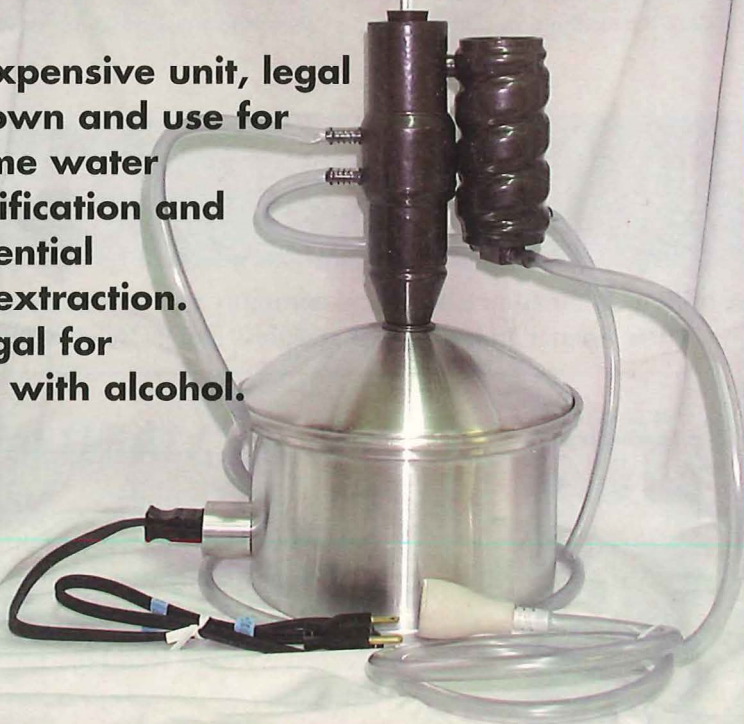
The rule of thumb with propagating yeast is to increase the volume of the starter by approximately ten each time you transfer it. The final transfer is into the fermenter and the increase at this step ranges from about five- to tenfold, depending on the brewery. When I schedule a propagation, I work backwards. For example, five gallons of wort requires about one-half gallon (about two liters) of yeast starter.

When I start from a petri dish (a covered plate containing a solidified growth media), I like to transfer one yeast colony into about 20 mL of wort. After two to three days, I transfer this into 200 mL of wort. After two or three more days, I transfer this into 2,000 mL of wort. Finally, after a final few days of fermentation, the starter is ready for pitching. This is the end of the road for the propagation.

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"Help Me, Mr. Wizard"

Yeast grows a fair amount during fermentation and a normal ale fermentation will typically yield about four times more yeast than is added at the beginning. Lagers tend to produce a little less and a two- to threefold increase is normal for the strain I use. The yeast produced during fermentation is great for re-using because it is available, healthy and easier to use than going through the steps required to grow it. And it is very lively if used shortly (less than seven days) after collection.

What you propose is a bit different. You want to keep your yeast alive and well by continually splitting the culture. I really advise against this practice for a few practical reasons. The first reason is that you will have more yeast than you could possibly use for brewing and will be investing a lot of time, effort and wort into continually splitting the culture. Another problem is sanitation. Every time yeast is transferred from one flask to another there is a risk of contamination. The method

proposed here would increase the odds of contamination to unacceptably high levels. My final objection is mutation. Yeast cultures will mutate over time and change. This is why yeast labs use longer-term storage methods, such as freeze drying (or lyophilization), storage in liquid nitrogen (this requires special equipment and cryoprotective agents), slants and petri dishes. The latter two methods are really not long-term storage methods, but they allow yeast to be stored for a period of months without having to be continually transferred.

I understand your fear of using yeast from the fermenter as the source for your starter, and I agree that it can be a problem because yeast from a fermenter can be contaminated. This is one of the potential problems with re-using yeast in general. When you start a lab culture, the last thing you want is to begin propagating contaminated yeast because the contaminant(s), be they wild yeast or bacteria, will also be

propagated. If you really want to become a yeast farmer, you must learn how to work with microbiological tools, such as slants, petri dishes and loops used to transfer colonies. You also need to learn how to prepare media and sterilize it using a pressure cooker and will need a clean place where you can set up a home lab. (*For tips on culturing from Dr. Chris White of White Labs, see the March 2001 and October 2001 issues of Brew Your Own.*)

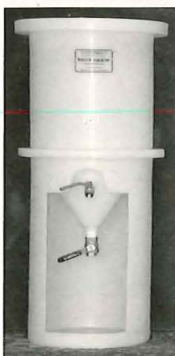
I culture my own yeast and enjoy doing it. I also buy yeast from yeast labs because I do not have the tools for long-term storage. I'll buy a lab culture, grow some on a petri dish and then transfer a colony to a slant for medium-term storage. The bulk of the purchased culture is then propagated to generate enough yeast for a batch of beer. The methods I use allow me to use the yeast held in medium-term storage for about a year and then I buy the same strain from my lab source and start over.

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Mr. Potato Head

I've got a few simple questions about using 'taters for brewing. What, when, why and how?

*Ian "Mr. Potato Head" Williams
Wilmington, Delaware*

Potatoes can certainly be used for brewing beer, just as they can be used to make vodka. I was at a professional brewers meeting several years ago and heard an interesting talk given by a retired brewmaster from the now-closed Lucky Lager brewery in San Francisco. He was giving a lecture about how things were once done in breweries and he talked about some of the special challenges brewers faced during World War II. One such challenge was coping with grain rations. To overcome this problem, Lucky Lager was made for a time using potatoes in place of adjuncts like rice and corn. So brewing beer with potatoes is certainly not a new idea.

Potatoes belong to the nightshade family of plants. Nightshades include tomatoes, eggplants, tobacco and deadly nightshade or belladonna. Nightshades are known for producing alkaloid toxins that act as cholinesterase inhibitors. Cholinesterase is an enzyme involved in neural transmission and cholinesterase inhibitors can cause stupefaction, cramps, loss of speech and even death. Fortunately, tomatoes and eggplants do not contain these toxins in the fruit we eat.

Potatoes, however, can contain significant levels of the alkaloid toxins chaconin and solanin. These compounds are found in minute quantities in all potatoes and contribute to a potato's flavor.

When potatoes sprout or turn green, solanin and chaconin concentrations increase to dangerous levels in the sprouts, leaves and the first few millimeters of the peel. Potatoes begin to sprout when exposed to sunlight and are always kept in the dark during commercial storage to prevent this from occurring. For this reason, we don't hear much about potato-related illness on the news. I point this out because potatoes can sprout at home

and it certainly would be a bad idea to make beer from green potatoes since these toxic compounds are completely unaffected by heating.

Potatoes are rich in starch and can be added to the mash just like any other starchy adjunct. Adjuncts are used to lighten a beer's body and color and can be used to boost the strength of strong beers without contributing much to flavor. In fact, most strong

beers from Belgium are made using sugar as an adjunct. Potato starch has a relatively low gelatinization temperature, ranging from 144–155° F, meaning that potatoes do not have to be boiled like rice and corn before adding them to the malt mash. However, potatoes are very different than cereal grains used in brewing because they contain a lot of water — about 80 percent by weight.

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"Help Me, Mr. Wizard"

So you want to brew a potato beer? I would begin by choosing a recipe that calls for rice or corn as an adjunct grain. The beer does not have to be light, however, since adjuncts are used in beers ranging in color from stouts (bottled Guinness contains a fair amount of adjunct) to very light lagers.

I considered making a potato stout for St. Patrick's day a few years ago, but eventually decided against it. It

makes me wonder if Bud Light had an earlier start as Spud Light — that would explain the whole Spuds MacKenzie era!

Anyhow, armed with a recipe, it's now time to pick the spud for the occasion. The easiest thing to do would be to use dry potato flakes. Make sure you read the label and buy a box containing nothing but potatoes — some potato flakes contain butter or artificial

butter flavors. Dry potatoes can be used as a direct substitute for rice or corn since they all contain about the same amount of water. Dry potato flakes can be added to the mash along with malt and probably should not represent more than about 25 percent of the total weight of grains used in the beer. This is because, like rice and corn, potatoes do not contain amylase enzymes required to convert starch to fermentable sugars during mashing. All other steps in the brewing process remain the same as whatever recipe you have chosen.

You can also start with whole potatoes. Make sure you have potatoes without sprouts — we don't want to end up with a beer that has a greater propensity to cause stupefaction than any other brew! The potatoes should be washed, peeled and then grated. I have this grater attachment that goes on my KitchenAid mixer; it does one helluva job turning potatoes into hash-brown fodder.

These potato strings can be directly added to the mash, just like dried potatoes, because of their low gelatinization temperature. When using fresh potatoes you have to compensate for their high water content by using about five pounds of fresh potatoes for every pound of rice or corn called for in the recipe. This fact alone probably explains why the potato has never been a real popular ingredient for beer and why most vodkas no longer use potatoes as an ingredient. ■

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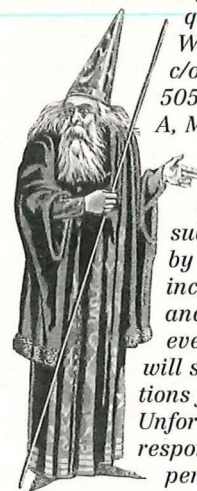


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Beers Cloned

Midas Touch and Winter Palace Wee Heavy

The RepLiCator

by Steve Bader



Dear Replicator,

We have a wonderful brewery in Lewes, Delaware called Dogfish Head Brewery. They make Midas Touch, the beer that inspired my entrance into homebrewing, and I thought I might want to try to make this beer myself. I would appreciate any help you could offer towards supplying a clone recipe. I guarantee you won't be disappointed in tasting this fine ancient ale.

Ty Ming
College Park, Maryland

This beer was inspired by residue found in drinking vessels that are believed to be from the actual tomb of King Midas. (For more information, see the University of Pennsylvania Museum Website at www.museum.upenn.edu/Midas/intro.html.) Some secrets of the beverage, dated to around 700 BC, were revealed by the new methods of molecular archaeology. The residues inside the vessels belonged to a "Phrygian cocktail," which combined grape wine, barley beer and honey mead. Starting with the ancient chemical evidence, Dogfish Head Brewery "recreated" a marvelous golden elixir, truly touched by King Midas.

I spoke to Sam Calagione, brewer at Dogfish Head Brewery, about how they make this beer, and it is far from the normal beer. Midas Touch is a high-alcohol beverage with a relatively light body, the floral aroma of the

Muscat grape juice and a hint of spiciness from saffron.

The brewery first mashes pale malt to get approximately 60 percent of the total sugars in this beer. They then boil the wort, adding another 20 percent of the sugars as honey at the end of the boil. Since this is a recreation of an ancient recipe, they use saffron in place of most of the hops.

Saffron is an expensive spice with a delicate aroma and a slight yellow color. Sam said they decided to add a very small amount of Willamette hops to this beer.

After the wort and honey is cooled, they add the final 20 percent of the fermentable sugars as a white Muscat grape juice. This brings the original gravity to about 1.075–1.080.

You can get more information about the Dogfish Head Brewery at <http://www.dogfish.com/> or call (302) 684-1000.

Dogfish Head Midas Touch

(5 gallons, extract with grains and adjuncts)

OG = 1.078 FG = 1.010 IBUs = 10 ABV = 9.0%



Ingredients

- 3.3 lbs. Briess light malt extract syrup
- 1.5 lbs. Briess light dry malt extract
- 3 lbs. honey (do not boil)
- 2 lbs. Alexander's Muscat grape concentrate (do not boil)
- 0.5 teaspoon dry saffron (boil 15 minutes)
- 2.5 AAU Willamette hops (bittering hop) (0.50 oz. of 5.0% alpha acid)

2.5 AAU Willamette hops (flavor hop)

(0.50 oz. of 5.0% alpha acid)

1 tsp. Irish moss

White Labs WLP500 (Trappist)

or Wyeast 3787 (Trappist) yeast

0.75 cup of corn sugar (for priming)

Step by step

Heat 2.5 gallons of water to a boil, add malt syrup and powder and return to a boil. Add Willamette hops, Irish moss and boil for 60 minutes. Add 0.50 ounce of Willamette hops and the Saffron for last 15 minutes of the boil. Add honey at the end of the boil after you turn off the heat. Let stand for 5 minutes to sanitize the honey.

Strain out the hops, add wort to two gallons cool water in a sanitary fermenter, then add the Muscat concentrate and top off to 5.5 gallons. Cool the wort to 80° F, aerate the beer and pitch your yeast. (For a high-gravity fermentation such as this, be sure to make a yeast starter.) Allow the beer to cool to 68–70° F, and ferment for 10 to 14 days. Bottle your beer, age for three to four weeks and enjoy!

All-grain option

Replace the light syrup with 6.0 lbs. two-row pale malt. Mash your grains at 155° F for 45 minutes. Lower the amount of bittering hops to 0.4 ounces.



Dear Replicator,

This request involves the worst kind of emergency — a beer emergency! My wife and I have been enjoying microbrewed beers for a number of years, and began homebrewing around one year ago. Several months ago, we got a sampler from the Paper City Brewery in Holyoke, Massachusetts. My wife fell in love with the Winter Palace Wee Heavy. I've tried a number of wee heavy recipes, but can't seem to get close to this. Can you help?

John Combs
Haughton, Louisiana

The Replicator to the rescue! More powerful than a rolling boil. Faster than a counter-flow chiller. Able to clean carboys with a single scrub. Wait . . . that must be another superhero!

I talked to brewer Jason Dunson-Todd at Paper City Brewery about this relatively new addition to their lineup of beers. Wee Heavy is a Scottish ale beer style that is normally above six percent alcohol by volume. This beer has the signature Scottish ale flavor of heavy malt with relatively low bitterness levels (under 25 IBUs). This beer is all about the malt. You taste malt from the first sip to the last swallow, with very little hop bitterness to get in the way! The color is a beautiful dark amber, and this is a potent beer at about 7.5 percent alcohol.

Jason said that they use only two malts, pale for the sugar and a small amount of roasted black barley for just a bit of color. Paper City also uses only Cascades for the bitterness in this beer,

and do not use any aroma hops!

To make this beer, pay close attention to aeration. This will allow the yeast to bring the ending gravity down to the high teens, so that your beer is not too sweet. Paper City uses a private strain of yeast that produces a fairly low ending gravity. While low final gravities are not traditional for this style of beer, it works for them. I would recommend the yeasts listed in the recipe to replicate their results.

You can get more information about the Paper City Brewery at <http://www.papercity.com> or by calling them at (413) 535-1588. ■

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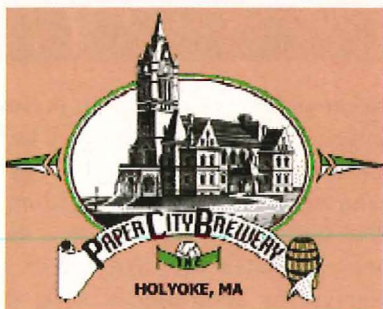
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5053 Main Street, Suite A
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Paper City Winter Palace Wee Heavy

(5 gallons, extract with grains)

OG = 1.075 FG = 1.018 IBUs = 24-25 ABV = 7.5%



Ingredients

9.9 lbs. Coopers light malt extract syrup
1 lb. pale malt
4 oz. roasted black barley
8.3 AAU Cascade hops (bittering hop)
(1.66 oz. of 5.0% alpha acid)
1 tsp. Irish moss

White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) yeast
0.75 cup corn sugar (for priming)

Step by step

Steep the crushed crystal malt in three gallons of water at 150° F for 30 minutes. Remove grains from wort, add malt syrup and bring to a boil. Add Cascade (bittering) hops, Irish moss and boil for 45 minutes.

When done boiling, strain out hops, add wort to two gallons cool water in a sanitary fermenter, and top off with cool water to 5.5 gallons. Cool the wort to 80° F, heavily aerate the beer and pitch your yeast. As with any high-gravity beer, your results will greatly improve if you make a yeast starter.

Allow the beer to cool over the next few hours to at least 68–70° F. Cooler fermentation temperatures, from 60–65° F, will yield a cleaner, more traditional finish. Bottle your beer, age for two to three weeks and enjoy!

All-grain option

Replace the light syrup with 13 lbs. British two-row pale malt. Mash all your grains at 156–158° F for 60 minutes. Collect enough wort to boil for 90 minutes and have a 5.5-gallon yield.

Lower the amount of the Cascade boiling hops to 0.75 of an ounce to account for the higher hop extraction rate of a full boil. The remainder of the recipe is the same as the extract.

Schwarzbier

The dark lager with the smooth taste

Styl^e profile

by Horst D. Dornbusch

SCHWARZBIER by the numbers

OG	1.044–1.051 (11–12.75° P)
FG	1.008–1.012 (3–4° P)
SRM.....	26–30
IBU.....	22–26
ABV.....	4.1–5%

Schwarzbier is to lager what stout is to ale. This is the quickest and easiest way to understand the true nature of this beer style. Schwarzbier is German for black beer. As such, it is a darker version of the Bavarian dunkel. The schwarzbier style originated in southeastern Germany. Among the best-known of today's commercial versions are the Kloster Mönchshof Schwarzbier from the Franconian city of Kulmbach, in northern Bavaria, and the Köstritzer Schwarzbier from the Thuringian spa town of Bad Köstritz, not far from Germany's cultural capital of Weimar.

Schwarzbier is very opaque. Its color ranges from solid black to almost deep sepia, depending on the choice and quantity of black malt in the grain bill. But unlike British-style dark ales, this German-style black lager does not display the roasted grain flavors and aromas found in most stouts. Schwarzbier also leaves next to no perception of diacetyl or fruitiness on the palate. Instead it produces very mild, almost bittersweet, notes of chocolate, coffee or vanilla. Like most traditional German lagers, schwarzbier has very little nose and up-front bitterness. Considering its dark color, schwarzbier is unusually clean tasting. It has a rich, malty, faintly nutty-sweet middle, but the sweetness is never cloying or overpowering. The beer is moderately to well attenuated. The finish is dry, but never harsh or acrid.

A prehistoric beer style

It is a little-known fact that schwarzbier is the oldest European

beer style for which we have hard, scientific brewing evidence. It is also a well-kept secret that, from today's perspective, Kulmbach is probably the place with the longest uninterrupted brewing tradition in the world. The oldest evi-

dence of brewing in Kulmbach comes from an amphora-shaped crock that was discovered in a prehistoric burial site seven miles west of Kulmbach in 1935. The grave dates from around 800 BC and belongs to the so-called Hallstadt culture. The crock is now in the Beer Museum in Kulmbach. On the inside of the crock, scientists identified residues of crumpled, blackened barley bread — the standard raw material of ancient Germanic brews. Because the beer made from such toasted loaves would be dark, too, we can reasonably assert that the Hallstadt crock contains residues of an ancient ancestor of the schwarzbier!

Bestowing the title of the world's oldest, still-active brewing center to Kulmbach may come as a surprise to most people. We know that the Sumerians, who lived during the Stone Age in what is now southern Iraq, started making beer at least 4,000 years earlier than did the Germans. The Sumerians eventually taught the art of brewing to the Babylonians, who, in turn, taught it to the Egyptians. And by the time Caesar, the Roman conqueror, had his fling with the Egyptian Queen Cleopatra, he found a thriving brewing industry up and down the Nile. However, when Islam became the dominant religion in the Middle East about seven centuries later, the breweries in the region had to shut down because the Koran demands total sobriety.

No such calamity befell the Kulmbach brewers. The oldest documentary evidence of modern beer brewing in Kulmbach is a reference in

RECIPES

Medieval Cloister Schwarzbier

(5 gallons, all grain)

OG = 1.048 FG = 1.012

SRM = 30 IBU = 24 ABV = ~ 4.6%

Ingredients

5.5 lbs. Pils malt (<2° L)
1.0 lbs. Munich malt (10° L)
1.0 lbs. Munich malt (20° L)
1.0 lb. Briess CaraPils (1.5° L)
1.0 lbs. caramel malt (60° L)
or Weyermann CaraMunich III (53–60° L)
2 oz. Weyermann dehusked Carafa II (375–450° L)
5.4 AAU Hallertauer (bittering) (1.2 oz. of 4.5% alpha acid)
0.5 oz. German noble hops, such as Hallertauer (flavor)
0.5 oz. German noble hops, such as Hallertauer (aroma)
Wyeast 2206 (Bavarian Lager) or White Labs WLP830 (German Lager) yeast
1 cup corn sugar (for bottling)

Black Gold Schwarzbier

(5 gallons, all grain)

OG = 1.046 FG = 1.010 SRM = 27

IBU = 24 ABV = approx. 4.6%

Ingredients

6.5 lbs. Pils malt (<2° L)
2.0 lbs. Munich malt (10° L)
0.5 lb. Briess CaraPils (1.5° L)
1.0 lbs. caramel malt (60° L)
or Weyermann CaraMunich III (53–60° L)
1.5 oz. Weyermann dehusked Carafa II (375–450° L)
5.4 AAU Hallertauer (bittering) (1.2 oz. of 4.5% alpha acid)
0.5 oz. German noble hops, such as Hallertauer (flavor)
0.5 oz. German noble hops, such as Hallertauer (aroma)

Wyeast 2206 (Bavarian Lager) or
White Labs WLP830 (German
Lager) yeast
1 cup corn sugar (for bottling)

Step by Step

Use a step-mash schedule of 30 minutes at 122° F, 30 minutes at 146° F and 30 minutes at 156° F. Finally, raise the temperature to 170° F for the mash-out. Sparge slowly for about 90–120 minutes. Boil between 90 and 120 minutes. Add the bittering hops about 15 minutes into the boil, the flavor hops about 30 minutes before shut-down and the aroma hops about 15 minutes before shut-down. Heat-exchange, aerate the wort and pitch your yeast. Ferment in the 50–60° F range, slightly above the standard temperature for lager fermentation. Primary fermentation should be finished in two weeks. When the beer is virtually still and has reached the final gravity, rack it to your secondary fermenter for lagering.

Start the lagering period by gradually reducing the brew's temperature by about 2° F per day. Eventually, get the temperature down to at least 38° F, at which point all yeast activity stops. If possible, drop your beer's temperature to 28° F, the lagering temperature preferred by German brewers. Lager your schwarzbier for at least four weeks.

Rack the schwarzbier before priming and bottling. Then let the packaged beer rest at about 40° F (4° C) for about a month to mellow out. Serve it at around 45° F (8° C).

Medieval Cloister Schwarzbier (5 gallons, partial mash)

OG = 1.048 FG = 1.012 SRM = 30
IBU = 24 ABV = ~ 4.6%

Ingredients

4.5 lbs. Bierkeller plain light or
Weyermann Bavarian Pilsner
malt extract
2.0 lbs. Munich malt (10° L)
(or 1.5 lbs. of Bierkeller or
Weyermann amber extract)

1.0 lb. Briess CaraPils (1.5° L)
1.0 lbs. caramel malt (60° L)
or Weyermann Cara Munich III
(53–60° L)
2 oz. Weyermann dehusked Carafa II
(375–450° L)
5.4 AAU Hallertauer hops (bittering)
(1.2 oz. of 4.5% alpha acid)
0.5 oz. German noble hops, such as
Hallertauer hops (flavor)
0.5 oz. German noble hops, such as
Hallertauer hops (aroma)
Wyeast 2206 (Bavarian Lager) or
White Labs WLP830 (German
Lager) yeast
1 cup corn sugar (for bottling)

Black Gold Schwarzbier

(5 gallons, partial mash)
OG = 1.046 FG = 1.010 SRM = 27
IBU = 24 ABV = ~ 4.6%

Ingredients

6.5 lbs. Bierkeller plain light or
Weyermann Bavarian Pilsner
malt extract
2.0 lbs. Munich malt (10° L)
(or 1.5 lbs. of Bierkeller or
Weyermann amber extract)
0.5 lb. Briess CaraPils (1.5° L)
1.0 lbs. caramel malt (60° L) or
Weyermann Cara Munich III
(53–60° L)
1.5 oz. Weyermann dehusked
Carafa II (375–450° L)
5.4 AAU Hallertauer hops (bittering)
(1.2 oz. of 4.5% alpha acid)
0.5 oz. German noble hops, such as
Hallertauer hops (flavor)
0.5 oz. German noble hops, such as
Hallertauer hops (aroma)
Wyeast 2206 (Bavarian Lager) or
White Labs WLP830 (German
Lager) yeast
1 cup corn sugar (for bottling)

Step by Step

Place the caramel, dextrin and Carafa II malts in a muslin bag. Steep the Munich malt, if used, by itself in a separate muslin bag. Immerse the bag(s) in three gallons of cold water. Heat slowly to about 170° F. Turn off heat. Lift bags, rinse with 4–5 cups of cold water, and discard. Add extract

and stir. Bring to a boil and follow the remaining brewing instructions from the all-grain recipes.

Medieval Cloister Schwarzbier (5 gallons, extract only)

OG = 1.048 FG = 1.012 SRM = 30
IBU = 24 ABV = ~ 4.6%

Ingredients

4.5 lbs. Bierkeller dark malt extract
2.0 lbs. Bierkeller or Weyermann
amber extract
1.0 lbs. Coopers, John Bull, or
Alexander's stout extract
5.4 AAU Hallertauer hops (bittering)
(1.2 oz. of 4.5% alpha acid)
0.5 oz. German noble hops, such as
Hallertauer (flavor)
0.5 oz. German noble hops, such as
Hallertauer (aroma)
Wyeast 2206 (Bavarian Lager) or
White Labs WLP830 (German
Lager) yeast
1 cup corn sugar (for bottling)

Black Gold Schwarzbier (5 gallons, extract only)

OG = 1.046 FG = 1.010 SRM = 27
IBU = 24 ABV = ~ 4.6%

Ingredients

5.0 lbs. Bierkeller dark malt extract
2.0 lbs. Bierkeller or Weyermann
amber extract
0.5 lbs. Coopers, John Bull, or
Alexander's stout extract
5.4 AAU German noble hops, such as
Hallertauer (bittering)
(1.2 oz. of 4.5% alpha acid)
0.5 oz. German noble hops, such as
Hallertauer (flavor)
0.5 oz. German noble hops, such as
Hallertauer (aroma)
Wyeast 2206 (Bavarian Lager) or
White Labs WLP830 (German
Lager) yeast
1 cup corn sugar (for bottling)

Step by Step

Stir all malts into at least three gallons of water. Bring to a boil and follow instructions for hopping, fermenting, lagering, and bottling from all-grain recipes.

a charter letter from 1174, written by the Bishop of Bamberg. Another document dating from 1349 confirms that, by that time, local Augustine monks were already operating a complete brew house in their cloister. Though we have no clear evidence of brewing activity in Kulmbach proper between 800 AD and 1174 BC, there are scattered archaeological finds from other parts of Bavaria, as well as written records of Germanic brewing, for much of that period. These strongly suggest that the practice of brewing, once learned, was never forgotten by the Germanic tribes.

It is likely that the fourteenth-century monks of Kulmbach brewed ales instead of lagers. Lager brewing took hold in Bavaria only in the sixteenth century. However, the Kulmbach brew house is significant for our topic because it served as the original source of the now classic Kulmbacher Kloster Mönchshof Schwarzbier. Hence the brew's name, which literally translates to "black beer from the monks' courtyard cloister."

The cloister brewery of Kulmbach was secularized in 1791, and its schwarzbier is now made by the Kulmbach A.G. brewing conglomerate. The Kloster Mönchshof is brewed to an original gravity of almost 1.050 and it finishes at roughly 1.011. This gives the beer an alcohol-by-volume level (ABV) of 4.9%. The Kloster Mönchshof Schwarzbier has a lingering hop after-taste that is well balanced on the palate by a strong, dark maltiness.

The Köstritzer Schwarzbier Brewery lies to the east of Kulmbach, in the neighboring state of Thuringia. That brewery was founded in 1543. The Köstritzer Schwarzbier is a bit heftier than the Kloster Mönchshof Schwarzbier and is today the biggest seller among all the German dark lagers. It has a slightly bitter-toasty to chocolatey middle that is almost edgy, followed by a smooth, rounded after-taste that lingers gently in the dry finish. The Köstritzer starts at a relatively low original gravity of barely 1.046 and finishes low, too, at about 1.008. So the beer still has an ABV of 4.8%.

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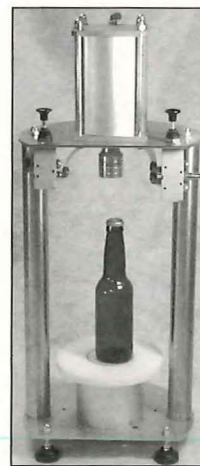
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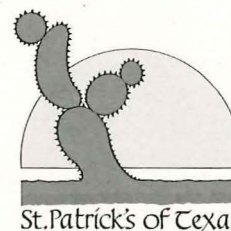
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commercial schwarzbiers are made mainly by Japanese breweries. Asahi, Suntory, Kirin and Sapporo all make black lagers. Another interesting black lager is the Xingu Black Beer from Cervejaria Colonia in Brazil.

Several North American microbreweries, too, have started to take an interest in this venerable lager style, as evidenced by the fact that German-style schwarzbier is now one of the cat-

egories judged at the Great American Beer Festival (GABF). (Schwarzbier is Category 25.)

In 2001, twenty-two schwarzbiers competed for honors at the GABF. The gold went to Squatters Pub Brewery in Salt Lake City, Utah for its Black Forest Schwarzbier. John Harvard's Brew House of Wayne, Pennsylvania, took the silver with its Springfield Schwarz Beer. Another Salt Lake City brewery,

the Uinta Brewing Company, captured the bronze with a schwarzbier named King's Peak.

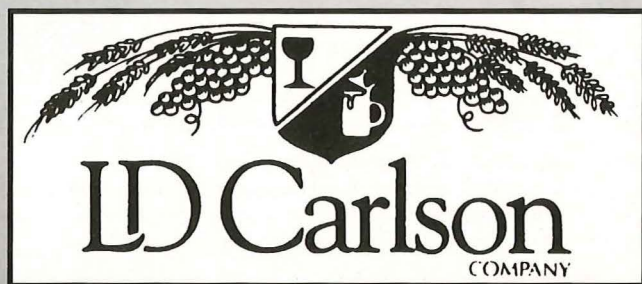
Schwarzbier ingredients

The foundation grain for schwarzbier is German Pils malt, a pale malt with a color rating below 2° L. The schwarzbier's color comes from generous portions of Munich malt and the addition of some roasted malt. Here is a rough guideline for the composition of a generic schwarzbier grain bill: Use about 20–30% Munich 10–20° L, 10 percent caramel 60° L, and about 1–1.5 percent black malt of up to 488° L. The remaining half (or more) is Pils malt. If you prefer a more full-bodied beer, you can also add about 5 percent dextrin malt, such as Briess CaraPils, and reduce the amount of Pils malt accordingly.

As for the black malt, you must make your selection very carefully. Black malt is the critical variable that can ruin your schwarzbier. Never use black (patent) malts that are designed for robust, British-style beers, because they impart an intense toasty-roasty flavor that is not proper for a schwarzbier. If you can taste strong, roasted notes in a schwarzbier, the beer will not taste authentic.

Remember, in a schwarzbier — just as in a Bavarian dunkel — the requirements for color and flavor are at odds with each other, yet both must come from the same grain source. You need to get the darkness from the grain into the beer while keeping the toastiness out!

The best way to accomplish this tricky objective is through black grains that have been malted specifically for dark lager making. The ideal roasted malt (röstmalz) is the dehusked version of Weyermann Carafa I, II or III. Carafa I has a nominal color rating of 300–375° L; Carafa II, of 375–450° L; and Carafa III, of 450–488° L. Depending on how "schwarz" you want your schwarzbier to be, choose your color weapons. Any one of these malts will do, but I find that Carafa II gives you the best color bang with the least roastiness for your homebrew buck. If you cannot obtain the dehusked



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Weyermann product, use ordinary black patent malt, but the taste of your brew will not be quite as authentic.

For a partial-mash schwarzbier, substitute the Pils grain with light lager or Pilsner malt extract. You might even substitute the Munich grain with amber Munich-style malt extract. Then steep the specialty grains. With the disappearance of Ireks malt extracts from the market, the homebrewer has really only two choices for authentic German extracts: Bierkeller malts in the 1.5-kilogram can and Weyermann malt extracts in the 15-pound Jerry pack. For a partial-mash schwarzbier, Bierkeller plain light or Weyermann Bavarian Pilsner are suitable malt extract brands.

For extract-only brewers, schwarzbier represents a real challenge, because there appears to be no pure schwarzbier extract on the market. The dunkel (dark) malt extracts from Germany are not dark enough, and the stout extracts from Britain, Australia, and the United States are too roasty-toasty. The best way out of the dilemma — but it is a compromise — is to brew the schwarzbier from a mixture of mostly German plain dark extract for maltiness, some German amber malt extract for depth, and some plain stout extract for the needed "schwarzness."

Use roughly the following proportions: 60 percent Bierkeller plain dark, 20 percent Weyermann Bavarian amber or Bierkeller amber, and 20 percent stout extract, such as John Bull, Coopers, or Alexander's. Yes, the stout extract goes against the grain, but it's probably the best we can do. Using this method achieves some of the required color values. However, the color comes at the expense of authenticity because of the burnt stout flavors.

As for hops and yeast, there are no surprises. Any German or American-grown noble hops, other than the highly aromatic Saaz, will work. Ferment your schwarzbier with a standard Bavarian lager yeast such as Wyeast 2206 (Bavarian Lager) or White Labs WLP830 (German lager) yeast. ■

Horst Dornbusch's next "Style Profile" column will examine oatmeal stout.



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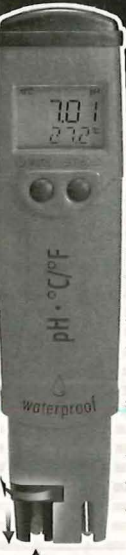
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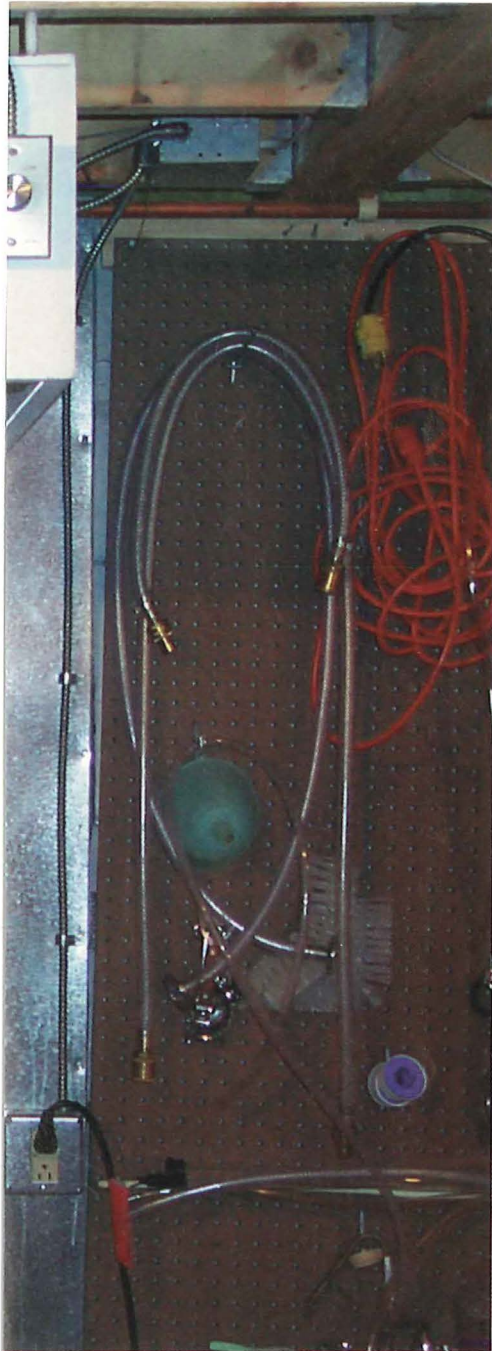
How to safely **PLAN** and
INSTALL a **GAS-FIRED**
BREWING SYSTEM in your
HOME. The first step:
Hire an expert. The last step:
Fire up the kettle and brew
indoors all year round!



I FEEL A LITTLE GUILTY

in the winter, when I'm brewing inside the microbrewery and it's a chilly 60 degrees here in California. Meanwhile, my brethren in the Northeast are trying to make a 5-gallon batch outside in sub-freezing weather. In California, brewing indoors is a convenience. In other places, it's a necessity.

Building an indoor brewery is a dream for many homebrewers. It's also a big challenge, and in this article I hope I can teach you enough to understand some of the most serious problems. It's beyond the scope of this article to give you all of the necessary skills to engineer an indoor brewery yourself. It is not the things you understand that



Above: The brewing system at Downtown Joe's in Napa, California, where author Colin Kaminski works. It's an enclosed system with a combustion chamber. Left: A homebrew system that'll be fired by propane piped in from outside, with an exhaust hood and fan.

will get you in trouble, but the things that didn't even cross your mind. When I say I recommend something, I really mean it. Cutting corners is risky.

If you undertake building a brewery indoors, you must first consult an expert (such as a licensed gas engineer) and get him to sign off on your plans. This may not be as hard as it sounds. Simply make a detailed sketch and an engineer will study it, make suggestions and sign the bottom. The usual fee in California for this is \$100 to \$150 per hour, and if there are no changes, it can be done in under two hours. This may vary from state to state, but this approach can work if you are an experienced do-it-your-

selfer who has worked with gas before.

If you don't have the skills, don't even think about building a brewery yourself. Hire contractors and let the pros do the job. You should also talk to the local gas company about the building codes in your state. In some states, for example, the gas company won't hook up your system unless it was built by a licensed propane-gas installer.

If you are ambitious, you can do your own calculations. Start at the gas supply and finish at the top of the flue. At every place in between, specify the material and size used. Then cross-reference each calculation to the "Gas Engineers Handbook" with a page number or table number. If you used any correction factors, list the correction factors and the place in the handbook where you found it. This is a lot of work, but will save money in the long run and give you the experience and satisfaction of designing a gas system from scratch. Once again, do not install a gas system without having a licensed engineer sign the plan or consulting a gas company! I have designed many gas systems and I would never consid-

er running a gas system inside without an engineer's approval.

You should be able to find a copy of the "Gas Engineers Handbook" at the local library. A good example of a problem that's covered by this text would be joining a flue from one appliance with the flue to another, or connecting the flues from three burners in your brewhouse. An hour with a good text will help avoid a potentially dangerous situation.

I have chosen to talk only about gas-fired breweries because that is where the danger is most acute. If you undertake an electric-fired brewery make sure you know an electrician very well, as making high-current connections takes much care and the risks of fire and electrocution are great.

Seven things to consider

There are many things to think about when designing a brewery. Here are the key things that will be of interest to you and your contractor: effluent, heat, gas supply, exhaust venting, make-up air, water vapor and carbon-monoxide detection.

Effluent

If you have the space and resources it would be a great idea to make a sloped floor and install a drain. Then you can just hose things down. I have found a slope of 0.125" per foot works adequately. If the floor is small a slope of 0.25" per foot can be used for quicker runoff. If you are in a basement, this could be a problem and may involve a pump. Still, it is a convenience I would highly recommend.

Carefully consider the things you may wish to put in your drain. Most drains are plumbed with black ABS plastic pipe. If you sterilize with lots of hot water then you can easily melt this pipe. CPVC is a beige-colored PVC designed for use with hot water and is cheaper than cast iron, but cast iron would be best.

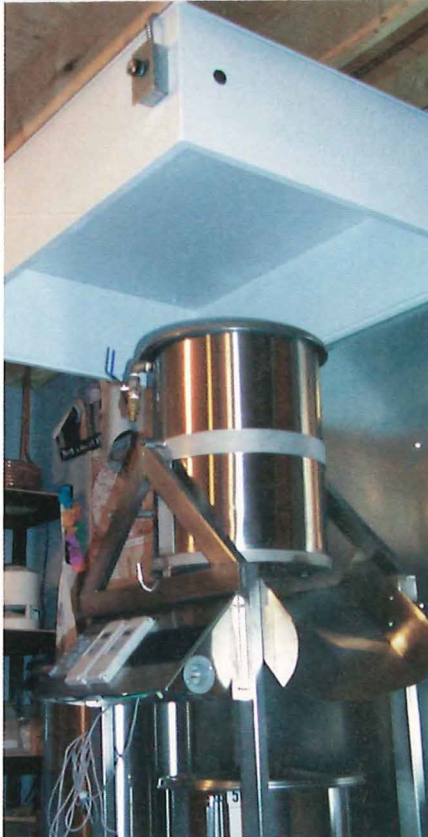
If you are not putting in a floor drain then you will have to install a sink large enough to clean up your kettles and fermenters. If this is in your basement then a pump may be required to get your effluent up to the sewer level. Otherwise you will have to take things outside to clean.

Since the batch size for a home brewery is small, effluent is a fairly simple problem to solve. For larger breweries it is often the most important consideration when choosing a building site.

Heat

To achieve a vigorous boil, your burners must generate a considerable amount of heat. It's important to put the heat where you need it, while protecting surfaces that are flammable.

Much of the heat will be carried away by the air. The rest of the heat is radiated as infrared light. This infrared heat will radiate from the burner and kettles. Again, it is very important to protect anything flammable from this source of heat. Infrared heat (like visible light) dissipates with the square of the distance, so you only need to protect the surfaces that are near to the burners, like the back wall and the floor. Many homebrewers use 400,000 to 600,000 total BTUs in their indoor breweries. For this amount of heat and an enclosed system (see



A restaurant-style hood with exhaust fan, vented to the outside, carries away water vapor from the boil and carbon dioxide created by burner combustion. A heat-protective sheet is behind the system.

below), most reference books recommend a distance of 12 to 18 inches between the burners and anything combustible. You should allow even more distance if your system has open flames. These are minimum recommendations; check with an expert.

Often people use WonderBoard and then cover it with a fire-proof material. WonderBoard is a concrete board that comes in thicknesses of one-quarter inch and one-half inch. WonderBoard is not a final surface, so you must install tile or another fire-proof and water-proof substance on top of it. The construction is similar to what is used behind a wood-burning stove. There are other choices available and each of them requires the gas burner to be spaced a certain distance from the surface.

You may also want to consider the ceiling. While we will make every effort to vent the steam from the kettle, there still can be a considerable amount of steam condensing on your ceiling. If you have sheetrock with flat latex paint, you could have some long-term water damage. If nothing else, I would

use gloss paint as it is better suited to water exposure and it is easier to clean. A more ambitious solution is to attach a pipe to the lid on the kettle and run the pipe to the outside. If you choose this method it is important to make sure the condensate cannot drip back into the boil, because the steam carries off undesirable flavors.

Gas supply

You will need to get gas to your brewhouse. There are two options: pipe in natural gas from the city supply or pipe in propane from the main tank outside your house. Do not use a refillable propane tank in an indoor brewery: It is against building code and dangerous. This is very important! The vent hole can and does release propane if the diaphragm ruptures.

When bringing gas inside, make sure you have a large-enough pipe to carry your gas. In any run of pipe there is a pressure drop due to friction of the gas against the walls of the pipe. It is common to design a gas-delivery system to allow not more than 0.3 to 0.5" water column (0.011 to 0.018 pounds per square inch) of pressure drop. Water column is a measure used for very low pressures, like gas-line pressure, and is the standard when dealing with natural gas. A 0.5-inch Schedule 40 pipe will not carry enough gas to burn three 200,000 BTU burners. For complex runs the number and type of fittings is also important. In the "Gas Engineers Handbook" there are tables that give you correction factors for fittings and pipe runs. When in doubt, use the next-largest pipe size.

For an example of the kind of math involved, to run a single 200,000-BTU natural gas burner with a run of 10 feet, you would need 0.75" diameter pipe. For a 20-foot run you would need 1" diameter pipe. You also need to add a calculation for the added friction of the fittings.

In order to run a pipe for propane, you would need 0.5" pipe for 10 feet, 0.75" pipe for 20 feet and 1" pipe for 100 feet in order to supply a 200,000-BTU burner. If you are running three 200,000-BTU burners, then you would need 1" pipe for a 10-foot run and

1.25" for a 100-foot run. This is not to be considered a recommendation, because your city codes and installation will be different. A plumber will know about proper leak checking and hanging methods. Unless you have been trained as a plumber, I don't recommend you install this yourself.

These numbers are given so you can get a feel for the size changes and are not intended to be prescriptive. Look up your system in a plumbing text to calculate the needs for your system, then hire a plumber to check your work and install it. With multiple appliances hooked up to a gas system, you start at the appliance furthest from the meter and work backwards to calculate the total gas demand on each section of pipe. In this way you can calculate a tapered pipe system that will supply all of your appliances.

This is a good place to mention that propane gas is heavier than air and can pool in a basement. Pools of explosive propane gas are very dangerous. Building codes may prohibit the use of propane in any room with a portion below grade to prevent explosions. If water cannot run to the outside, then propane won't either. Also, water can collect in basements and can put out pilot lights, causing gas to leak from the pilot. I would shut off any pilot lights when not in use or install a pilot sensor to shut off the gas if the pilot light goes out. Most cities have a code that sets the minimum height a pilot light can be above the floor to avoid flood waters from putting them out.

Exhaust venting

There are two main ways to rid the space of exhaust gases: a hood or an enclosed burner with a flue. The issue of make-up air is important for both types of systems and is discussed later.

Exhaust gases need to be vented correctly because the CO₂ (carbon dioxide) is an asphyxiant, meaning it will displace the oxygen from the room, causing you to suffocate. Since we burned O₂ (oxygen) to make the CO₂, that leaves even less oxygen in the room. Incomplete combustion creates carbon monoxide (CO), a very dangerous poison and neurological toxin.

Nitrous oxides are released as well. You don't want any of these gases in your home.

Hoods with exhaust fans

The first method we will talk about is installing a hood with an integral exhaust fan above the brewery. This is called a forced-air system. If you have ever been inside a restaurant kitchen, you have seen an exhaust hood above the stoves and grills. Hood manufacturers have detailed specifications in their product selection guides. You will need to know your BTU output, as well as the size of your brewery footprint. It's a simple matter to select a hood and exhaust fan. A hood also will remove the steam from the kettle.

If we have a perfect combustion, the gas is converted to CO₂ and water vapor. Because the gas is very hot it will rise towards the hood. The top of the hood will be connected to a flue and the fan inside the hood will force the exhaust outside.

You may be able to find a hood in a used restaurant-equipment store. They usually don't have specifications with them. I would highly recommend finding the manufacturer and researching any used hood before you buy it.

When venting with a forced system it is important to ensure there is enough air entering the room to replace the air leaving the room. A very dangerous situation can result if your hood lowers the pressure in the house enough that the other appliances can't sufficiently vent their gases. It is possible to pull the exhaust gas from your furnace or hot-water heater right back down the flue. This is called "negative pressure" and it creates a dangerous situation. We will talk more about this in the section on make-up air. It is a bad choice to rely on a window or any other closable opening. In fact it does not satisfy building code and will be denied by your planning commission. It may be necessary to separate the brewery room from other gas appliances and this may be wise whether it is required or not.

Enclosed combustion

The second method we will talk



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about is enclosing the burners and directly venting the exhaust to the outside. This is basically making a box around the burner, and making sure that the box has sufficient air coming in the bottom and a place for the exhaust to come out the top and go up a flue. The most critical part of this is the configuration of the combustion chamber. A flue is a pipe, like a chimney, that uses natural convection to exhaust the burned gas (look above your gas-fired water heater for an example). It is important to make the kettle seal perfectly against this enclosure so exhaust gases cannot escape through the sides of the vessel into your breathing space. Braided fiberglass rope can be used for this seal and other products are available in shops that sell woodstoves. This is more complicated, but in the long run I believe it has some interesting advantages.

A flue works by relying on the heat generated by the burner to make the pressure in the flue lower than the

pressure in the room. One to 5 Pascals of pressure difference are needed in order to provide a flow up your flue, depending on the inside and outside temperatures. This is called the "draft" or "draw." This very small difference (only 0.00015 to 0.00073 psi) is just enough to keep the room free of exhaust, but it is so slight that it is easily disrupted. One Pascal is just enough to float a 2.5" square piece of paper.

There are two general causes of the flue not drawing. The first is that the pressure in the flue becomes too positive. The second is that the room becomes too negative. We'll look at them separately.

One way the flue can become too positive is by sizing the flue too small or having other restrictions in the flue, such as elbows. There needs to be a rise right after the burner before there can be any horizontal runs. This is often called connector height. It needs to be at least 18" to 36", depending on the flue construction and burner size.

A plumbing text will have charts to allow you to calculate this. Another good resource would be flue-pipe manufacturers' catalogs.

Sometimes it is unavoidable to have horizontal runs in a flue system. In that case, it is important to have a slight rise in the horizontal run. This allows any condensation to flow back to the burner. It is helpful to think of the flue as flowing gas up and water down to avoid causing any places that may puddle water and cause rust. Your system must not have too much horizontal piping. The rule of thumb is no more horizontal length than vertical length. Flue calculations assume you are going to install two elbows. If you need more elbows consideration must be made for the added resistance.

The flue must terminate above your roof. Different towns have different requirements for flue height as related to pitch of your roof and distance to windows. You cannot terminate a flue at the side of the building.



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The proper flue cap is important in order to keep downdrafts (and small animals) from entering your flue, especially in areas of high wind. I was once in a glider in a downdraft that was moving at 3,000 feet a minute!

If the flue gets filled with debris there will be increased resistance. Make sure to keep your flue clean. If you notice soot building up, check to make sure the flame is burning correctly. A yellow flame is oxygen deprived, inefficient and creates soot.

The final way the pressure can become too high in the flue is if the flue gases get too cold before they exit the flue. It is important to make sure the exhaust is hot enough. In order for your flue to work at a variety of flame settings, you need to make sure the flue is well-insulated. Never use single-wall flue pipe. A double- or triple-wall flue will insulate the flue gasses and will also make a surface that is safer to touch. Do not wrap anything around the flue as insulation. Always support the ducting correctly.

Masonry chimneys have a very large amount of thermal mass. Until the whole chimney heats up, the venting will be poor. Also, the combination of the condensing water vapor and the combustion products can leave an acidic residue that will eat the grout from around the stone or brick. It is not unheard-of to have a chimney collapse if it is used to vent a gas appliance. You can install a liner inside the chimney if you really need to use it. Don't vent in an unlined chimney! Not ever!

If the flue is too big for the burner or the flame height is too low, the velocity in the flue can become too low to vent properly.

If for some reason you need to slow down the velocity of the flue, there are barometric dampers for this purpose. They look like a "T" and are installed in the flue at the connector near the burner. They work by sensing the pressure difference between the room and the flue. They draft some room air up the flue to cool it down and raise the pressure in the flue. They work by counteracting too much draft, which can ruin burner efficiency and dangerously overheat the flue.

Make-up air

All of the gas appliances in your home must be considered when designing an indoor brewery. If you pull lots of air up one flue and there is not sufficient air to replace it, then you will be pulling fumes down another flue — or it will make the pressure in the room so low the flue won't vent at all. Even your clothes dryer causes a large displacement of air.

Modern home design seals all available entrances for air ingress in order to lower the cost of heating and air conditioning. This creates a situation in which there is not enough air to burn even small appliances. It is common practice to install a heat exchanging vent in order to allow fresh air into the space. A large amount of information is available on "sick building syndrome," you may wish to study it. Any gas-fired brewing equipment you install will make this more important. Even if your home is older, often the doors and windows have been sealed very well and can create some of these same problems. We are going to require a huge amount of air to combust our fuel so venting is required.

This is where make-up air comes into play. It is not acceptable to just open a window when you light the burner. I highly recommend you install a permanent vent designed for your system. There are vents available that sense the pressure inside a room and open when needed. This is the best method as it helps keep the heat inside when the brewery is not in use. They are expensive, however. The simplest vents are screened holes in the wall.

There are gas-fired make-up air vents that pre-heat the incoming air. They are available in a range of sizes.

If you are using a hood, the make-up air system needs to be rated for at least as much air flow as your exhaust fan. It is wise to make it a little larger by 5% to 10%.

If you are using enclosed combustion, then you need to consult the "Gas Engineers Handbook" for the vent size. You will need to know the size of the room you are using. If you have two rooms adjoined with an opening that cannot be closed then you may be able



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to add the other room into the calculations. The tables specify when an adjoined room can be included into the room volume calculations. Most of the rooms we are likely to use for a brewery are going to be too small to rely on room air alone and make-up air vents will need to be installed. You will need to have one vent in the top of the space and one vent in the bottom of the space. If you have exhaust fans or a clothes dryer in the space, the vents will need to be larger — or better yet, build a wall separating the brewery from the other equipment.

As an example: In a confined space ventilated with a horizontal vent, you need 1 square inch of vent space for every 2,000 BTUs of your burner. If you are using louvers, then you de-rate this number by the area covered by the louvers when open. As a rule of thumb you may assume only 20% to 25% of the area is open with wood louvers and 60% to 75% is available with metal louvers. If a screen is used it must be of a

minimum mesh of 0.25 inch. Check any louvers for proper operation regularly.

Water vapor

If you install a hood then water vapor is carried out with the gas. But if you use an enclosed burner, the vapor from the boil must be dealt with separately. If you are making a 20-gallon batch, 2 gallons are going to evaporate from the boil. Venting the two gallons outdoors is important or the water can damage your home. If you do this with a fan you must add this air to your make-up air requirement, or you may make the flue inoperative and leave carbon monoxide in the room.

The wort must boil vigorously for the beer to taste good. This helps to remove DMS from your beer. DMS is a chemical compound that is often described as "cooked corn." Venting the steam from the kettle while getting good air flow will take some experimentation. In a large brewhouse the kettle is vented with its own flue and

an opening is provided to bring in room air. The kettles at the brewery where I work have a small door in the top and we leave it cracked about 6 inches. We also have a small trap that keeps any condensation from dripping back down into the boil.

It is imperative to keep the condensate from reentering the boil, because it will dilute the wort and contribute to off-flavors. While this is very easy to do in practice, it does take some playing with the steam flue size and height and the air-intake opening size. As a rule of thumb, the longer the steam flue, the larger the diameter. When it is working correctly you will see the steam being pulled away from the kettle and up the flue. When the brewery is not too steamy and the kettle boils vigorously, you have succeeded.

Carbon monoxide meters

Carbon monoxide (CO) is a very dangerous, invisible and odorless gas. More than 450 people will die this year



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from CO poisoning. Many more will suffer neurological damage.

For about \$80 you can buy a carbon-monoxide meter at your local hardware store. The meters are not absolute and the law only requires they pass very simple tests. With this said, I highly recommend installing one in your brewing environment. Don't trust the readings, as they are notoriously inaccurate, but if the alarm sounds:

1. Make sure it is the carbon-monoxide detector and not the smoke alarm, then shut off your burners.
2. Check to see if anyone in your house is experiencing symptoms.
3. If they are, get them out of the house immediately and seek proper medical attention.
4. If no one is feeling symptoms, ventilate the home with fresh air and turn off all potential sources of CO.
5. Have a technician inspect your fuel-burning appliances and chimneys to make sure they're operating correctly.

The symptoms of acute CO poisoning are headache, nausea, weakness, dizziness. It can also be fatal. The symptoms are sometimes confused with the flu or food poisoning. CO poisoning can cause long-term problems such as cognitive impairment, mood changes, personality changes, visual problems and hearing problems. Most people recover from CO poisoning within 9 to 12 months, but it is not uncommon to find people with symptoms persisting for 15 years or more.

Even very low amounts of CO for a long period of time can be extremely hazardous. High levels of CO poisoning cause immediate symptoms that are very recognizable. Low exposures for long periods can cause long-lasting symptoms that are harder to recognize and can be permanent.

When choosing a meter it is important to not choose one strictly on price. Look for the Underwriter Laboratories mark with the phrase "Single Station Carbon Monoxide Alarm."

Brew safely

Brewing is an obsession to some of us. It is important that in our quest to make the best brew we don't sacrifice our health or the safety of our families. If you brew indoors, hire an expert and check often for separated flues, proper burner combustion and clogged make-up air vents.

With an indoor brewery, you can brew in any weather. While it is a big undertaking, it also is rewarding and a beautiful showpiece for your home. ■

For further reference see the "Gas Engineers Handbook." This is the book that most local building codes are based upon. We also highly recommend "Carbon Monoxide Toxicity" by David G. Penney. Special thanks to Penney and the other experts who carefully read this article for accuracy.

Colin Kaminski works at Downtown Joe's in Napa, California and designs homebrew systems for Beer, Beer and More Beer.

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JIM NIELSEN LONGMONT, COLORADO

The Brew Room

"A place for everything and everything in its place." That's what I was always told as a kid. Apparently, Jim Nielsen heard the same thing. And it looks like he listened. Jim's brew room sports his favorite decor — stainless steel — and stores almost everything he needs in an organized fashion. A pegboard (at left) holds hoses, funnels and other miscellaneous items. The rack allows wet items to drip dry and keeps the equipment within arm's reach. Three stainless shelves hold his specialty grains, cleaning chemicals and some empty kegs. Three stainless-steel tables and a cabinet provide both work space and storage. A two-tub sink makes keg cleaning easy.



PHOTOS BY JAMES NIELSEN

The center of Jim Nielsen's homebrewery is a three-tiered system from Beer, Beer and More Beer (B3). He opted for every bell and whistle that was offered and "some that had yet to be invented." His brewery is all-stainless and is controlled by the two digital controllers on the front of the rig. By using these controllers, he can "set it and forget it" and maintain a constant mash temperature within one degree Fahrenheit. All the connections that need to be sterilized have a stainless tri-clover

fitting. These can be disassembled, cleaned and boiled in water for sterilization. Jim also got a 12.2-gallon conical fermenter from B3 and a 20-gallon glycol-jacketed stainless conical fermenter from a friend. Jim's equipment resides in his brew room (which his wife, strangely, calls the laundry room). Stainless-steel shelves and a pegboard wall help Jim keep everything organized. Next to the brew room is Jim's Tavern and Pub Club. Jim's bar features a modified 10-cubic-foot chest freezer that holds six of his beers on tap.



Jim, his brewing sculpture and his brew buddy

Jim's customized brewing rig was the first of the "Pro Series" to come off the B3 assembly line. The all-stainless homebrew system features three 14-gallon pots — all with tri-clover butterfly valves — that serve as his mash and lautertun, hot liquor tank and brew kettle. In this shot, happy Jim hangs out with his rig, his stainless conical fermenter (at left) and his dog and brewing pal, Dee.



Big brew machine

A closer look at his rig, showing kettles, connections and two digital controllers. Jim also has an oxygen stone and a sight gauge that can be connected with two tri-clover "T" joints. When shopping for his equipment, Jim was told that unless he wanted to become a professional brewer, this equipment would probably be a bit excessive. Nielsen was undeterred. "When you want the best, you want the best," he says.



Steel fermenter

This is one of Jim's two stainless-steel conical fermenters. The 12.2-gallon fermenter is controlled by the digital controller in front. Jim can control his fermentation temperature to plus or minus one degree Fahrenheit. The rotating racking arm is at the right height for a Cornelius keg for easy transfers. Once the beer is in the keg, carbonation is easy, since each keg has its own stainless carbonation stone.



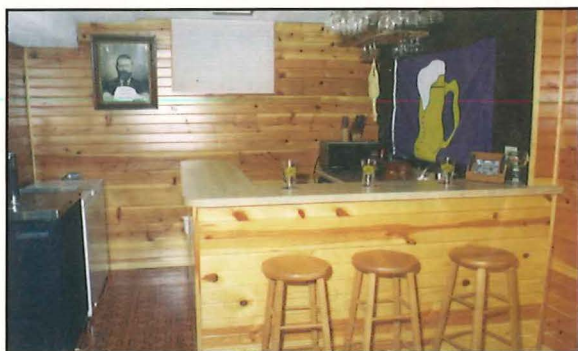
A fine collection of kegs

Here is Jim's fleet of 15 Cornelius kegs. (Cornelius, or "Corny," kegs are the same type of containers that are used to dispense soda.) Each of Jim's kegs has its own dedicated carbonation stone. A temperature-controlled 10-cubic-foot chest freezer can hold six Corny kegs for beer dispense. From here, the beer goes to Jim's very own bar (see final photo below).



Step into my laboratory

Jim's "laboratory," sitting atop a stainless table in his brew room, includes a few balances, plus the usual hydrometers and thermometers. A small fridge underneath this table is used for yeast storage and harvesting. In the background, you can see the pegboard, holding a variety of beer-making necessities. Just visible in the upper right are more shelves.



Jim's tavern and pub club

"This," says Jim, "is my favorite place to be." Lined in knotted pine — what? not stainless? — this room adjoins the brewery and features a fully-stocked bar, a cigar humidor and several beers on tap. The selection includes a keg from a local microbrewery. Great-Great Grandpa Nielsen looks out sternly from a photo on the wall and commands all to finish their beers.



RAYMOND STEINHART

TINLEY PARK, ILLINOIS

Ray's rad RIMS

The acronym "RIMS" stands for *Recirculating Infusion Mash System*. During the mash, wort is drawn off the bottom of the mash vessel, heated and returned to the top of the grain bed. These systems became very popular with homebrewers in the mid to late 1990s. A RIMS system delivers clear wort during the run-off because it has been recirculating during the mash. In addition, because the wort is heated, the temperature of the mash can be tightly controlled and brewers can easily brew step-mashed beers through the use of their heating loop. RIMS enthusiasts also claim higher extraction efficiencies. Raymond's all-electric RIMS lets him do all of this, plus wort boiling, indoors.



PHOTOS BY RAYMOND STEINHART

Raymond Steinhart has been brewing since 1991. "Call me a control freak," he says, "but I felt that the only way to brew a great beer was to have control over as many aspects of the brewing process as possible." As a result of his quest to brew a tasty batch of beer, he built his all-electric RIMS system. He reviewed many of his fellow homebrewers' set-ups and designed a system that would take some of the variability and manual labor out of the process.

By using electric power for the hot

liquor, re-circulating and the boil, he is able to precisely control the temperature of the process. He also can brew indoors without worrying about the hazards of using gas. As an added benefit, his PID digital controllers have built-in timers. Raymond usually brews in the morning and sets the hot liquor tank to start before dawn, so he has boiled water ready by the time he gets out of bed. "Building my own RIMS helped me to better understand the brewing process," Raymond says. "Plus, it was a lot of fun."



PID digital controllers

Ray's electronic control box can take charge of his system, even when he's not there. The built-in timers can start heating the water long before a brewing session. That way, when he arrives, he can begin brewing immediately. The PID controllers, common in heating applications, help prevent temperature overshoots.



The RIMS heater

The heating loop is the heart of any RIMS system. Made entirely of 304 stainless steel, this element heats the wort before it is returned to the top of the grain bed. A sight glass on the side of the mash tun helps Ray judge the flow rate through the heating loop. If too much water is drawn off the bottom of the grain bed, it can compact the grain bed. The level of wort, as viewed through the sight glass, should remain constant throughout recirculation.



Spectacular sparge arm

Made from Loc-Line hose, this sparge arm allows water or heated wort to sprinkle over the top of the grain bed. The plastic used to make the arm is heat-resistant and reasonably inert. The yellow valve in the upper left of the photo directs water to the sparge arm for sparging. Wort from the RIMS heating loop enters from the right.



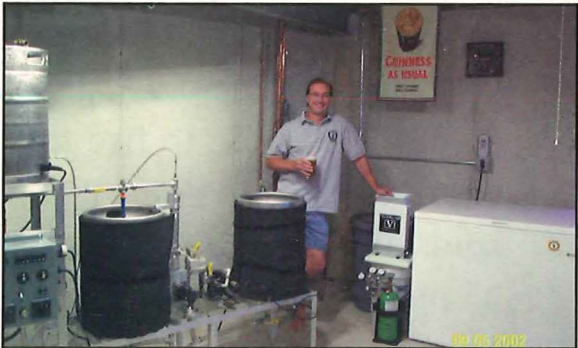
Wort pump and counter-flow wort chiller

A magnetically coupled pump (on the left) recirculates wort through the RIMS loop during mashing. The pump also moves wort from the mash tun to the kettle once mashing is complete. The counter-flow wort chiller (on the right) cools down the wort after the boil. The wort temperature can drop from boiling to 63° F when the flow rate is 1/2 gallon per minute.



All-electric kettle

Raymond's electric kettle has four heating elements that he bought at a surplus gadget store. The elements were originally part of electric tea kettles. About 20 minutes after the end of sparging, the wort is boiling. The heaters easily accomplish a good, rolling boil. In fact, Raymond only runs at about 70% of their possible output to avoid scorching the wort.



The man and his machine

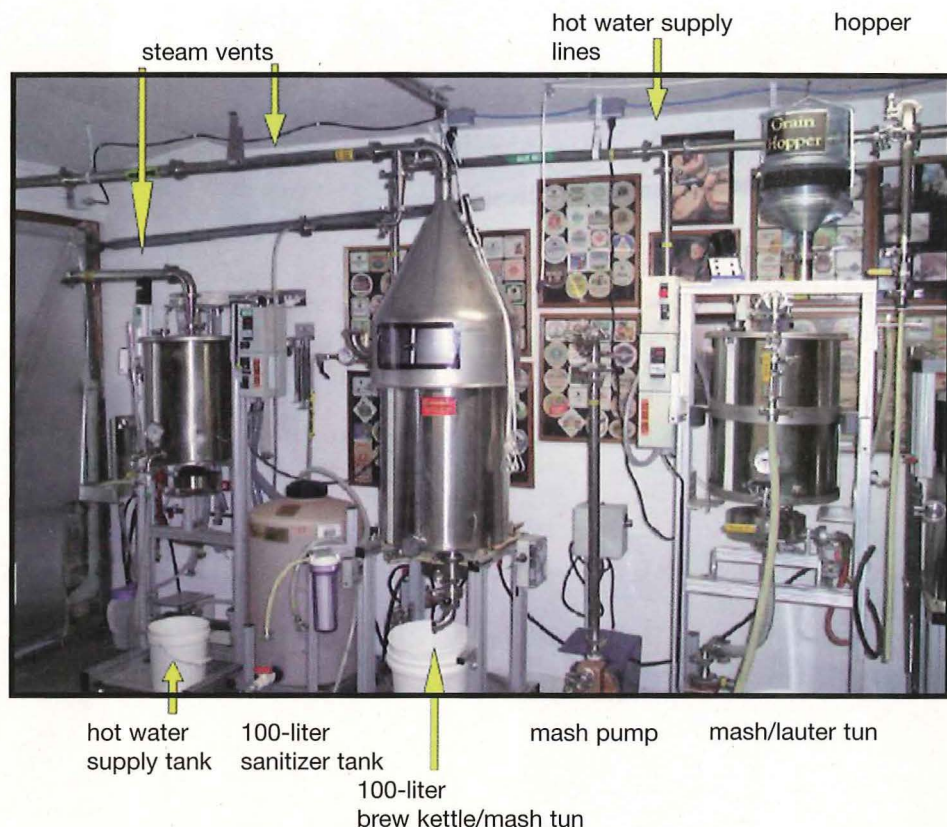
Here's Raymond with his RIMS rig, grain mill and beer cooler. He uses a Valley mill powered by a drill, which "works great." His cooler is temperature-controlled to 38–40° F and can hold six Cornelius kegs. He also stores his yeast in it. Raymond often has a pale ale and wheat beer on tap and continues to search for the secret of a killer dry stout.



THE BUDDE FAMILY EL PASO, TEXAS

The St. Angelo Brewery

If you're a "keep up with the Jones" type of person, you might want to skip ahead a few pages. If not, check out what the Budde family of El Paso, Texas has in their garage. In this shot you can see their hot liquor tank, mash-lauter vessel and 26-gallon (100-liter) kettle. (They call the kettle the Tin Man.) These vessels are all fired by propane and are vented to the outside. Hot water is distributed in the brewery through hot water lines running above the equipment. You can also see their sanitizing solution tank and mash pump. The stainless steel pots and piping were custom-fabricated to their exacting specifications. The rest of the system was built or modified by patriarch Claudius Budde.



PHOTOS COURTESY OF THE BUDDE CLAN

The Budde family started building their homebrewery in 1995, in El Paso, Texas. A dedicated power circuit was installed to protect their equipment. Propane gas is piped from the outside to fire the burners. Grain milling is done with a motorized mill and full kegs are lifted with a motorized winch "to conserve energy for drinking." Claudius Budde gives all the employees at his company one Friday off per month so he can enjoy a full day of brewing his German lagers. This summer, a

family member even flew in from Germany to try his hand at brewing.

"It's amazing the variety of people who have strolled into our garage brewery, curious to see what's going on as they walk or drive by the house," says daughter Xochitl Budde, a teacher. "We've talked to delivery guys, firefighters, teachers and lots of neighbors. The electrical meter reader thought it was some type of medical equipment. Once they enter, they leave with a wealth of knowledge and a new appreciation for German beer."



mash/lauter tun

whirlpool

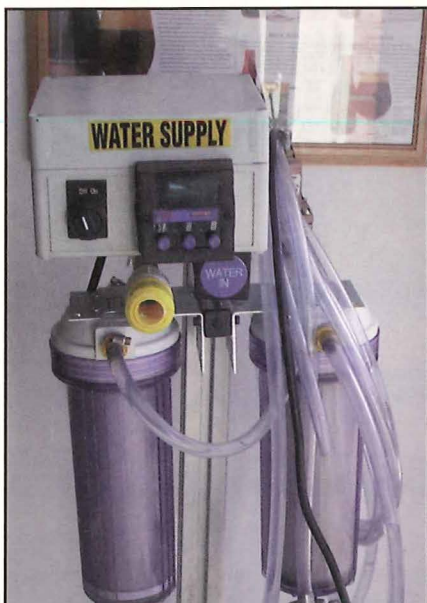


wort chiller

CO₂ & oxygen tanks

Mash tun, whirlpool and wort chiller

This picture shows the mash-lauter tun with grain hopper on top. This tun is used for mashes smaller than 50 liters. The kettle is used for larger mashes. The mash tun is equipped with a thermocouple and a temperature controller. The grain hopper holds 10 kilograms (22 pounds) of grain and has a stainless dump valve.



Water supply

If you're brewing beer, you've gotta have water. This two-stage water filter filters the water leading to the hot water tank. The hot water tank (see picture on previous page) supplies all the water to the garage brewery through the custom-made water distribution system. The tank is equipped with a pump, sight tube, thermocouple (and back-up thermometer) and sample valve. From the hot liquor tank, water is pumped to either of the vessels that are used for mashing.



Sanitizer tank

Without strict sanitation, you can't brew good beer. Everything in a brewery needs to be clean and as free of microbial growth as possible. To this end, the Budde brewery has a dedicated 100-liter tank to hold sanitizer solution (they use iodine). This tank has its own filtration system (seen at right front) and a pump to move the sanitizing solution.



High-tech grain bins

A series of hoppers (and smaller airtight containers) hold the Budde's grain. As brewers of German and Czech lagers, they use plenty of German and Czech malts and hops. Everyone in the family helps out with the brewing. Xochitl is in charge of measuring and milling the grain. Her mother, Martha, is in charge of the water.



Grain mill

A motorized grain mill crushes their malt — would you crush all that malt by hand? Once milled, the rest of the brewing falls to Claudius. He is also responsible for one more thing: the St. Angelo Brewery logo (shown at top left). "The brewery name comes from the middle name of our own mad scientist," says Xochitl. (The mad scientist, of course, is Claudius.)

BUDDE BREWERY (continued)



Hopper and tun

Here's a close-up of the small mash tun and grain hopper. The cone of the hopper is made from aluminum and has a stainless-steel dump valve. The rest of the hopper is constructed from a water bottle. The mash tun has a false bottom so it can also be used for lautering. You can see the temperature controller to the left and the hot-water delivery pipes behind the grain hopper. The mash tun also has a grain dump feature.

Whirlpool

Sitting to the right of the mash tun is the whirlpool vessel. Hot wort is pumped here after the boil. The action of the whirlpool collects the hops and trub in a pile at the bottom of the stainless vessel. The wort can then be pumped off to the chiller box, which contains two counter-flow chillers and an aeration system.



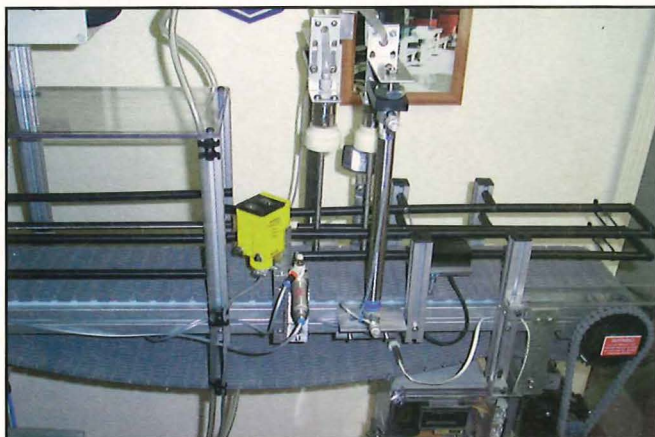
The "Tin Man" brew kettle and mash tun

The 100-liter stainless brew kettle is shown here with the steam vent hood — the Tin Man's hat — removed. This kettle, which doubles as a large mash tun, has a thermocouple (with back-up thermometer) and temperature controller, just like the small mash-lauter tun. Since it is used for mashes over 50 liters, it has a motorized grain mixer.



Wort chiller box

In Texas, tap water is rarely cold, so Texas homebrewers need to go to extra lengths to cool their wort. The Budde's chiller box contains two counter-flow chillers. The box is filled with ice water when in operation to reduce the temperature further. The box also contains an oxygenation system and is connected to a hot-water collection tank.



Bottling line

How many homebrewers have an automated bottling line with a conveyor belt? Well, the Buddes do.



Five-liter keg filler

As if the bottling line were not enough, the Budde family also has a semi-automatic 5-liter keg filler. The keg filler was designed and built by Claudius.



Cold room

In El Paso, you need to control your fermentation temperatures, even if you're brewing ales. And if you brew German lagers, as the Buddes do, you need to get serious about temperature control. The Budde's miniature "cold room" holds two stainless fermenters. You gain entrance to the cold room through access doors on either side. In addition, there is a sliding window on the bottom for taking samples of beer.

Fermenter

This 10-gallon (37-liter) stainless-steel conical fermenter sits in the temperature-controlled cold room. Their other 5-gallon (19-liter) fermenter sits behind it. As with all conical fermenters, yeast and trub can be dumped out the bottom after primary fermentation. In addition, beer can be sampled from valves on the cone. Each fermenter has a thermocouple for monitoring the beer's temperature.



Beers on tap

"The only drawback to our system is the waiting," says Xochitl Budde. "We only brew German beer and use traditional German brewing and aging methods, which don't allow us to taste the fruits of our labor until a few months have passed." The aging process is over for the helles, altbier and Oktoberfest beers on tap here. In the end, it is worth the wait. "As Warsteiner's ads say, 'Life is too short to drink cheap beer,'" says Xochitl.



Beer sampling table

The beer sampling table in the Budde garage brewery is probably the favorite place for non-homebrewers who wouldn't know a mash tun from a hole in the ground. Appropriately, the walls are covered with plenty of "beeraphernalia."



Prost!

Xochitl Budde, Mauricio Dreher (a visitor from Bavaria) and brewmaster Claudius Budde gather at the sampling table to raise a toast to another outstanding batch of homebrewed German beer.

Have you built a divine custom brewery? Does your system make other homebrewers drool? Have you made any unique or interesting equipment? Contact BYO at edit@byo.com and your beer gear may be featured in a future issue of the magazine.



DENNIS COLLINS KNOXVILLE, TENNESSEE

The HERMIT

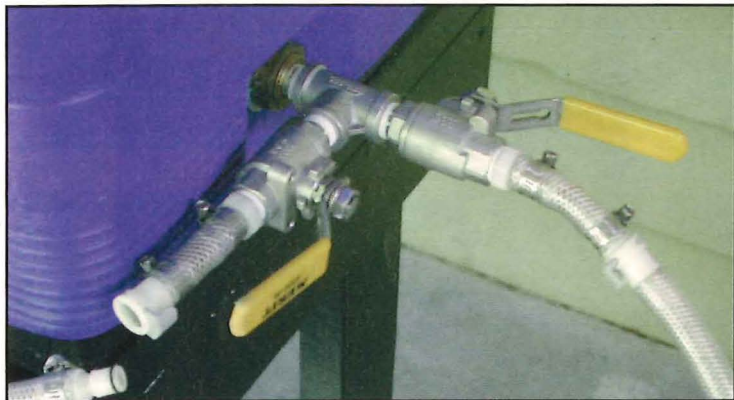
Dennis Collin's HERMIT (*Heat Exchanger Recirculating Mash Infusion Technique*) system consists of three main sections. The modular design allows him to pack up his brewery and take it on the road in his Honda Civic hatchback. It also allows him to start tearing down and cleaning his system during the boil, saving time. On the left is the hot liquor tank, a converted keg that Sabco was selling as a turkey fryer. It has a built-in thermometer and sight glass. The middle section holds the mash tun, heat exchanger and control box (in yellow, underneath the mash tun). On the right is his kettle, another converted keg. You can also see his homemade counter-flow chiller for wort cooling.



PHOTOS BY DENNIS COLLINS

Dennis Collins' homebrewing obsession began in 1992 after he moved from northern California to Mississippi. He started with extracts and brewed as often as he could, but his ever-changing locale made it difficult to brew regularly. Job changes, marriage and a new home in Knoxville, Tennessee caused a five-year hiatus in his lofty homebrewing aspirations. Finally, in 2000, it was time to renew his quest for the perfect beer. "My results were less than spectacular," says

Dennis. "This prompted me to join the local homebrew club, the Tennessee Valley Homebrewers. I hooked up with John Peed, a seasoned all-grain brewer, who let me watch the all-grain process." Soon after, Dennis made the jump to all-grain. After extensive Internet research, he decided to build a completely portable two-tier recirculating system with a stand-alone heat exchanger. The homemade HERMIT (*Heat Exchanger Recirculating Mashing Infusion Technique*) was completed in May 2001.

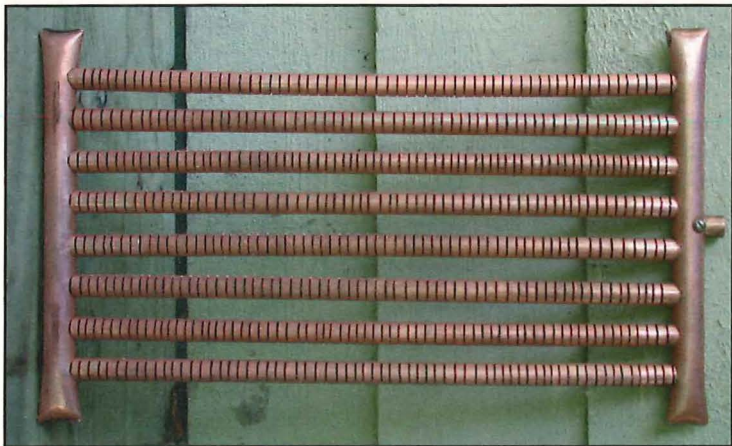


Quick disconnects

This is the outlet of Dennis' mash tun, with valves leading to the recirculation heating loop and the kettle. The hoses are fitted with quick disconnects (QDs). In fact, all of his hoses are fitted with QDs because he *hates* barbed fittings. Much of his Website — at sdcollins.home.mindspring.com — is devoted to this pet peeve.

The pump

Like the pumps most RIMS brewers use, Dennis' pump is magnetically coupled. Magnetically coupled pumps are much easier to sanitize than other pumps. It has two inputs — one from the mash tun and one from the hot liquor tank. The output can be directed back to the mash tun or to the kettle. Magnetically coupled pumps must be primed before use and care must be taken not to have bubbles in the line, as this is hard on the pump.



Copper manifold for mash tun

Dennis' mash tun is a modified picnic cooler (see picture on page 40). This slotted copper manifold sits at the bottom of the mash and allows the wort to drain away from the grain bed. Dennis made it out of 1/2" copper pipe slotted by sawing slots approximately every 1/2 inch. A similar manifold sits atop the mash for wort return.



The "pancake screen"

Probably the most unique part of Dennis' system is his pancake screen. This screen sits at the bottom of his brew kettle and filters out hops and trub when he runs the wort off to the chiller and fermenter. His Website contains the construction plans for this piece of equipment.



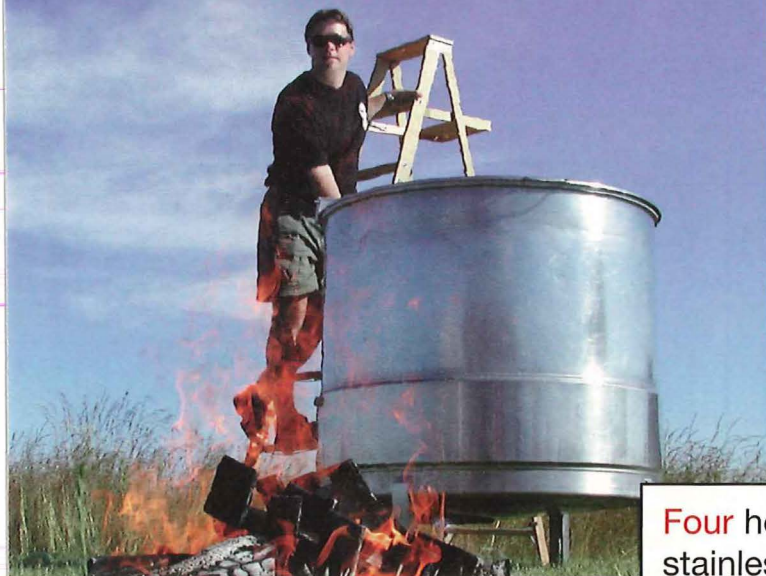
Liquid-liquid heat exchanger

Dennis' heat exchanger consists of copper tubing submerged in a small water bath. The water is heated with a heating element and the wort, running through the copper tubing, is heated by the water. This method, in which "heating elements of unknown composition never touch the wort," makes scorching of the wort impossible.



The HERMIT and his companion

Here's Dennis relaxing with his HERMIT and a beer. (He's smiling because there are no barbed fittings in sight.) If you're interested in building a rig, his Website describes his system in detail, plus offers a lot of insight into the logic behind designing home breweries in general.



fire brew!

BY THOM CANNELL

AT 10:45 AM, THE FIRST FIVE OF 235

gallons splashed into our enormous stainless brew kettle. Arranged in a confusion only a chaos theorist could appreciate were 22 homebrewers and their brew systems, plus wives, kids and dogs. What were four mid-Michigan homebrew clubs doing on a sunny Saturday in the summer of 2001? Fire Brew! An ambitious event months in the planning.

Maybe it was because Sean Royston, president of the Red Ledges Homebrewers, has a large brewhouse and lots of room. Maybe it was the 250-gallon, stainless-steel vessel that Karl Glarner rescued from a commercial bakery eight years ago. Maybe it was growing up 100 miles from Stroh's Brewery and hearing thousands of "The King of Fire-Brewed Beer" commercials during adolescence. Or maybe it was just having four homebrew groups in one county. Whatever the confluence of factors, there was only one answer: Fire Brew.

For almost a decade, Karl Glarner, owner of the Red Salamander homebrew shop in Grand Ledge, Michigan, has carried a massive stainless-steel tank as he moved from residence to residence. "It's so large we were thinking of using it for a hot tub," he says. The temptation to brew a commercial-sized batch of beer, 250 gallons or eight barrels, proved stronger than sybaritic comfort. But how could we bring eight barrels of sweet wort to a full rolling boil? Fire! Leaping flames and red-hot coals was the answer.

Sean and his brother Todd offered the shovels, digging a fire pit in Sean's backyard and lining it with fire brick. Next was lining up at least twenty all-grain homebrewers to haul in their own equipment. Their job was to heat 320 gallons of water and lauter 490 pounds of grain.

You do the math: Most homebrewers brew five-gallon batches and lauter ten to fourteen pounds of grain. A few brew ten gallons with twenty to thirty pounds of grain and fewer still have equipment for fifteen-gallon batches. Fortunately, the Red Ledges Homebrewers, Lansing Brew Crew, Mid Michigan Maltmeisters and Firkin Home Rackers of Williamston have several brewers capable of lautering 30 to 50 pounds. Even with everyone in place, we figured the lautering would take half a day.

Four homebrew clubs, 22 brewers, one 250-gallon stainless-steel kettle, 320 gallons of water and 490 pounds of grain. Add it all up, and you've got one huge batch and the first annual **FIRE BREW BASH**.

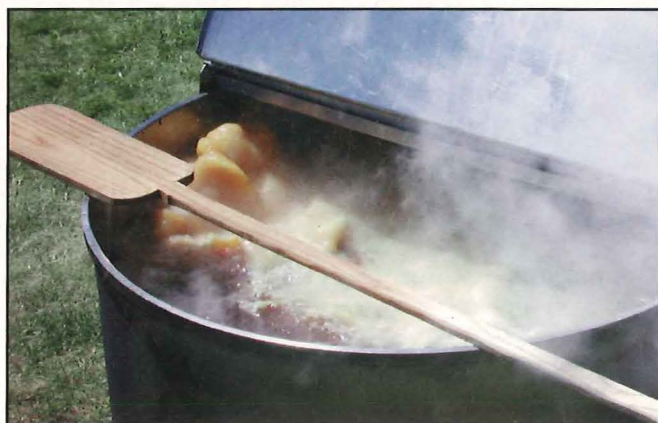
A date was set, committed brewers signed a pledge to attend, and the game was afoot. Or rather, aboil. *Brew Your Own* aided this massive effort, arranging for Chris White of White Labs to contribute some free yeast. We selected WLP820 (Oktoberfest Lager), plus WLP001 (California Ale) and WLP029 (German Ale/Kölsch) for those without lagering facilities. Briess provided the entire grain bill.

Notes from a red-hot brew day

There is a great saying, "Murphy was an optimist." Maybe true, maybe not. But to gather so many homebrewers with their individual burners and kettles, hot liquor tanks, mash paddles, sparge arms, lauter tuns and general paraphernalia would seem to issue Murphy a personal invitation.

He never appeared. However, such a huge undertaking did help each of us understand some of the difficulties of large-scale brewing — like not requesting crushed grain when talking to Briess. Fortunately, Gruber thought of that little detail. And at noon, three hours after the first mash tun was filled, we were still doling out grains. "If Mary Anne hadn't been smarter than us and sent precrushed grain, we'd still be crushing," Glarner said.

Our recipe was the carefully-formulated winner of last year's Lansing Brew Crew Oktoberfest (see recipe at right.)



But how the heck could we mix 490 pounds of grain? So instead of a uniformly mixed, even proportion of base and specialty grains, some brewers got mostly Briess Bonlander with some Dextrine and Vienna, while others mashed Ashburne and Victory. Every batch of sweet wort was different, not only because of technique, but due to the variable grist.

Notes from a massive mash

According to the database I used to reformulate the recipe from 10 to 200 gallons, mashing-in would require 153 gallons of 161° F water. Mash-out needed 170 gallons of boiling water. So mash-out and sparge water proved to be the largest problem; brewers were fighting for hot water all day.

At noon we had 110 gallons in the kettle with lots of hot break churning in the wort. (Of course, some of us were having a big argument about whether it was hot break or sloppy sparging and chunks of grain. I think hot break won our nickel bet.) Sprinkled around the grounds were kettles, burners and stands, mash tuns, chairs, kids running through sprinklers, coolers, Frisbees and busy brewers. At 1 PM we calculated we'd hit 194.5 gallons of wort, with a mere 25.5 to go.

Someone wondered aloud what the current gravity was. Nobody actually knew (or really cared), but curiosity has a way of winning when homebrewers gather. Interestingly, the recipe software I use said 240 gallons at 80% efficiency would result in a gravity of 1.054. We actually sparged about 235 gallons, had some boilover (very minimal considering the vigor of the boil) and OG was 1.054 at 72° F. We all agreed that the crush of the grains was a huge contributor to the absolutely amazing utilization we got.

First hops, almost two pounds of Tettnanger — all donated by the Red Salamander — went in for 90 minutes. The kettle had been boiling since 190 gallons. Thirty minutes later, at 2:30 PM, a second addition of Tettnanger whole hops was added. Saaz at 15 minutes and zero would finish the hop additions. The fire was extinguished — with lots of sparks and steam — at 3.

We failed to place a stainless-steel scrubber into the discharge channel,

which meant we could have a significant amount of trub in our runoff. That's where the ten-foot paddle that Tolin Annis made came in; a good whirlpool would lessen the trub discharge, as would the use of bagged hops. Our extremely vigorous boil would surely utilize most of the hops.

Tolin built a PhilChill-based counterflow chiller, I built another, and I also brought the original 10-foot *BYO* all-copper chiller plus another 20-foot copper model. We also decided to use a large immersion chiller set in a 40-gallon ice bath as a prechiller for the cooling water. By running water through the copper tubing immersed in ice water, we could prechill the water entering the counterflow chiller. After all, with 200 gallons to cool and two chillers, that still meant at least 100 minutes (one gallon per minute, 212° to 80°) of run-off.

At 3:15, a line of carboys that reached from the kettle to the Royston brothers' brew house awaited filling. As the kettle drained and the hop bags became exposed, some threatened to jump into the kettle and foot-squeeze the plump bags like oversized grapes. Luckily, nobody acted on this dangerous idea. Instead, we squeezed the hop bags between two mash paddles. We estimate that the seven pounds of hops sponged up ten gallons of liquid, more than most folks brew!

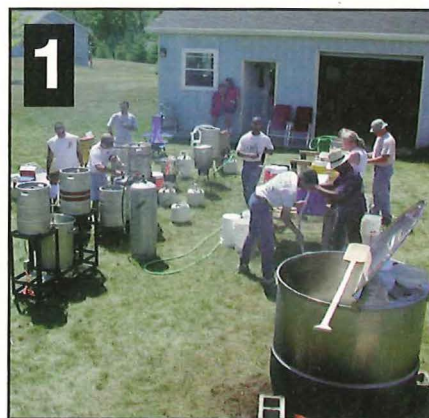
Any good thing has to end, and the first Fire Brew shut down at 6 PM. Everyone was satisfied, but completely whipped. The work and fierce sun had done its work. All that remained was to wait impatiently for a chance to gather and sample our fire-brewed beer ...

...and start making plans for Fire Brew II! (For details, turn the page.)

Fire Brew Oktoberfest

(approximately 200 gallons, all-grain)

200 lbs. Briess Bonlander (Munich)
150 lbs. Briess Ashburne (mild ale)
90 lbs. Briess Vienna
25 lbs. Briess Dextrine
25 lbs. Briess Victory
28 oz. Tettnanger (90 minutes)
23 oz. Tettnanger (30 minutes)
21 oz. Saaz (15 minutes)
21 oz. Saaz (0 minutes)
White Labs WLP820 (Oktoberfest) ■



1: The grain was divided between 22 brewers and their mash tuns. 2: Spent grain gets hauled away. 3: Sean Royston (also at upper left) stirs the sweet wort in the 250-gallon kettle. 4: Empty grain bags, full kettle.



huge mash!

BY THOM CANNELL

HOW AMBITIOUS IS YOUR CLUB?

The group brew sessions organized by the Red Ledges Homebrewers, a club in Grand Ledge, Michigan, give new meaning to the words “big beer.” Last year, they gathered two dozen brewers and their equipment to make a communal Oktoberfest using multiple mash tuns and one 250-gallon kettle (*see page 42*).

This year, ambition struck again. We wanted to brew 150 gallons of Imperial stout with a gravity of 1.110 OG, using one gigantic mash tun with capacity for 660 pounds of grain. Guess who got to build it? Fortunately, I had help.

Any mash tun has one duty, to hold the grains and hot water while enzymes convert the starch to fermentable sugars. If the tun can keep the mash temperature constant, so much the better. After all, did ancient Sumerians have steam-jacketed stone vessels? A lauter tun has a different duty, to separate sweet wort from spent grain. Combining the two functions is a typical homebrewers’ solution, and that is how we chose to design and build our big mash tun.

Designing the mash tun required calculations. I asked Mary Anne Gruber, the “semi-retired” technical director at Briess, how big a mash tun would need to be to hold 660 pounds of grain. “It depends on the malts and the milling equipment,” she answered, “but the average weight of brewers’ grist is 28 pounds per bushel.” Hhhmmm ... 660 pounds means 23.57 bushel baskets of grain! And 1.25 cubic foot per bushel equals 29.46 cubic feet — or one heck of a big mash tun. Our tun is larger than a kiddie pool, but smaller than an old VW Campmobile. As mash tuns go, it’s big . . . really big.

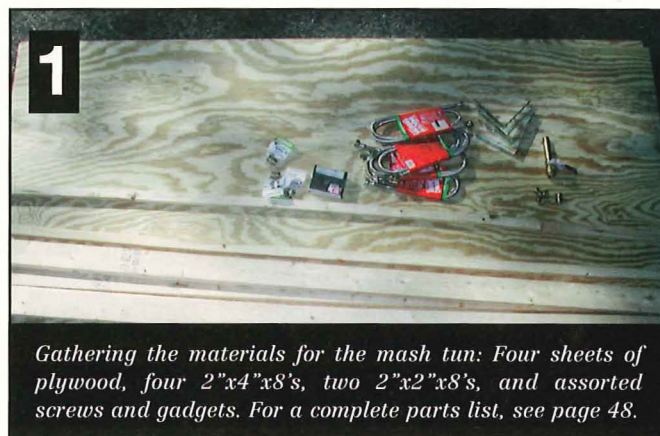
Then there’s the issue of mash water and sparge water. At a 2:1 ratio of water to grain (by weight), we’ve got 1,320 pounds of water to add to the grain and a total weight of 1,980 pounds. Material strength is now a significant issue.

If your club is interested in building a monster mash tun — and hell, why wouldn’t you be? — here’s how we did it. (In case you’re wondering: Yep, it worked.)

Building our big fat mash tun

Plywood, the handyman’s friend, comes in 4’x8’ sheets. A plywood box 4’x8’x4’ tall has a capacity of 128 cubic feet.

Inspired by the smashing success of their first 200-gallon batch, the Red Ledges homebrew club put their heads (and hammers) together to build a monster mash tun that holds 660 pounds of grain.



1
Gathering the materials for the mash tun: Four sheets of plywood, four 2"x4"x8's, two 2"x2"x8's, and assorted screws and gadgets. For a complete parts list, see page 48.



2
Brooks drives the deck screws slightly below the wood's surface to prevent cutting the liner. Before laying the liner, cover each screw head with duct tape or silicone sealant.

That's plenty of room for our mash volume, but it's a bit too hard to reach over. Cutting the sides down to 3' yields a volume of 96 cubic feet, which should be sufficient to contain the mash at a reasonable mash thickness.

Begin construction with good quality $\frac{3}{4}$ " plywood and the straightest, most knot-free 2"x4" boards you can find. Pay extra; construction-grade isn't good enough. But don't buy cabinet-making grade, either. Good quality plywood is under \$20 per sheet and quality 2"x4"s are about \$3. You'll need four sheets of plywood, plus four 2"x4"x8's and two 2"x2"x8's.

We began with a frame that elevates the tun bottom and stiffens it to prevent it from bowing down or outwards under the weight of the grain. This will also allow gravity to prime your pump and speed your runoff. The weight on the bottom of the mash tun is considerable; 230 gallons of water at 60° F weighs a cool 1,915 pounds. Sounds like a lot of weight — but it only adds up to 0.415 pounds per square inch, less than 7 ounces. Where we really need strength and support is at the corners. That's where we have pressure pushing both down and out. So a majority of our fasteners are concentrated on keeping the sides attached to the bottom. (If your carpentry skills are nonexistent or your nuts and bolts are a bit wonky, you could spill the goods. Be careful!)

Our frame is simple and very rigid, a rectangle of 2"x4"s laid tall with two cross-braces. The framework is joined together with 3" spiral nails (Ardox) and the plywood bottom is fastened to the rectangle with 1- $\frac{5}{8}$ " galvanized deck screws. All deck screws are driven slightly below the wood's surface to prevent cutting the plastic liner, which we will add later. Before laying the plastic liner, we will cover each screw head with two layers of duct tape (if you're a fanatic you could coat them with silicone sealant, it's soft.)

With the frame and bottom complete, Red Ledge member and engineer Bejeir Brooks and I drilled holes through one side rail and one side. We began by clamping a 4'x8' sheet of plywood to the 2"x4" base with the best side of the plywood facing into the tun, starting at one corner. Because almost

every 2"x4" is slightly warped, we worked our way down its 8' length, drilling $\frac{5}{16}$ " holes and attaching a bolt with washer and nut on the exterior. This allowed us to push and pull the frame into alignment with the true edge on the plywood. We spaced our bolts 2" from each end or brace, plus a centered bolt. That's 9 bolts per side.

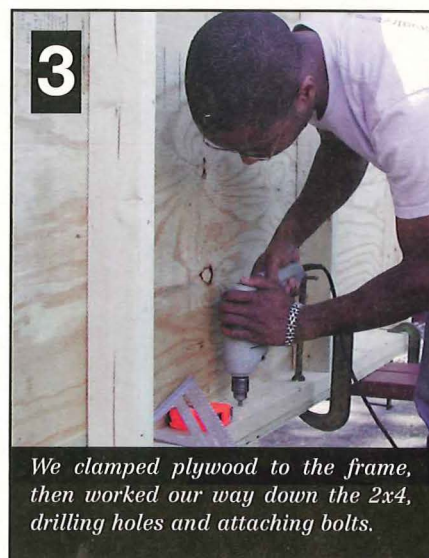
Next, we set one end loosely into the corner between side and bottom and added a vertical 2" x 2" batten. This is our "corner" for bolting side to end. Bolts are inserted on the sides, 2" from top and bottom and centered. End-securing bolts are inserted from inside to outside, 3" from the top and bottom and centered, making sure no bolt is closer than 1" to another. Be sure any bolt head is on the inside of the mash tun, not the bolt and nut.

At the base of each side piece, we attached a brace made of leftover 2"x2". It's attached with four 3" deck screws. This is the piece that prevents the ends from bowing and blowing out.

Bejeir and I attached the other end, then rotated the structure and attached the remaining side. Cutting the pieces to size, nailing up the frame, drilling holes and fitting required about 14 labor hours.

The next requirement, according to engineer Brooks, was to add a cross brace at the top to prevent the top from bowing out. By cutting this brace slightly ($\frac{1}{16}$ - $\frac{1}{8}$ ") undersized, the sides are placed in tension. This adds to overall stiffness. The brace is just a piece of 2"x2" that measured 47- $\frac{7}{8}$ " long. We attached a large angle bracket at each end. The brace also helps us lay a sheet of plastic atop the mash tun while in use to keep heat in.

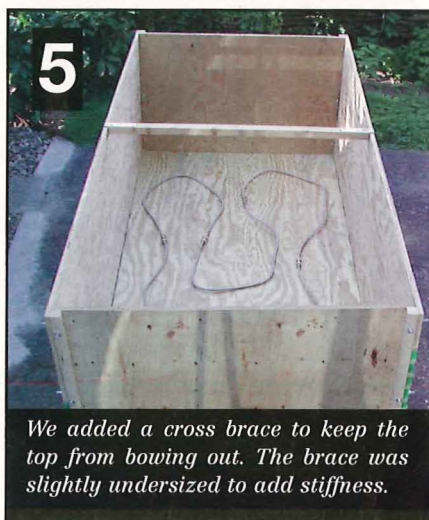
Last we created a portal for a bulkhead fitting. We attached a 6" piece of leftover 2"x4" centered atop one end brace. It's screwed in from the inside with countersunk 1- $\frac{5}{8}$ " galvanized deck screws. Then we drilled a 1" hole, sized to fit our $\frac{3}{4}$ " full port valve. Inside the mash tun, attached to the valve and 3" close nipple, will be a brass "Y" fitting. Threads will be sealed with Teflon tape and leaks will be prevented with a rubber "O" ring, one inside, one outside. The thickness of the wood will prevent any wobble in the valve or pipe.



We clamped plywood to the frame, then worked our way down the 2x4, drilling holes and attaching bolts.



We spaced our bolts 2 inches from each end or cross brace, plus a centered bolt. That's nine bolts per side.



We added a cross brace to keep the top from bowing out. The brace was slightly undersized to add stiffness.



Last we created a hole for a bulkhead fitting to drain the sweet wort. It's sized to fit our $\frac{3}{4}$ -inch valve.

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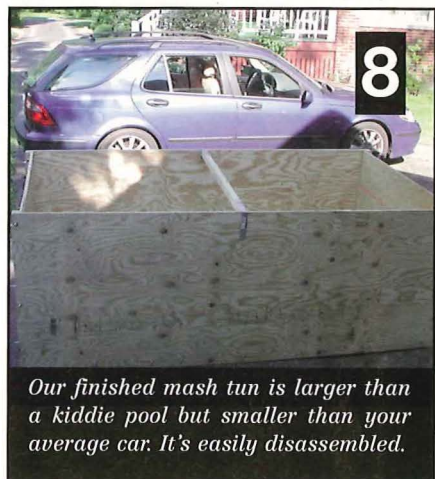
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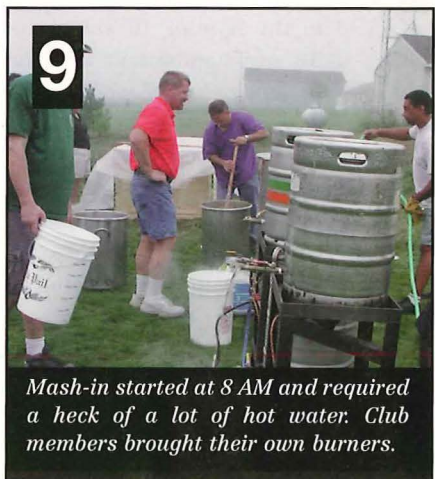
Inside, a brass "Y" fitting attaches to the stainless lauter sheath. O-rings and Teflon tape will prevent leaks.

8

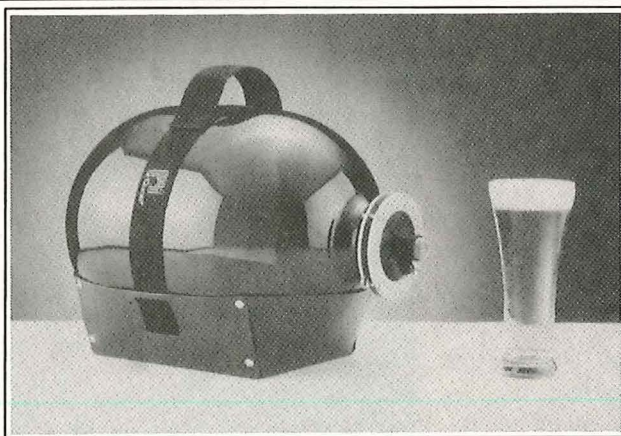


Our finished mash tun is larger than a kiddie pool but smaller than your average car. It's easily disassembled.

9



Mash-in started at 8 AM and required a heck of a lot of hot water. Club members brought their own burners.



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Making a filter for lautering

So how will we lauter and manage the runoff? What kind of a manifold will we create? Stainless-steel braided hose. Yes, we thought of making a copper or CPVC manifold, but no one would volunteer to cut two kerfs per inch in four 8' pipes. That's 256 cuts.

Stainless-steel sheathed hoses have interior hoses; the sheathing is

designed to protect the interior hose from bursting. To use the stainless sheath as a lautering device, first you have to remove the interior hose, which means cutting each hose into three sections: two ends and a middle.

Cut the tubing with a high-speed cutoff tool about 3" from each end and remove the tube from the middle. Then slip a stainless-steel Oetiker clamp over each short end, expand the mesh of the middle enough to push 1/2" to 3/4" of mesh over the short end, and clamp. Now you have 52" of highly effective stainless filter. With five hoses we have almost 60' of manifold.

Join the hoses with male adapters for a garden hose, and lay them out in your mash tun. Done. But we'd suggest that all metal parts get a thorough washing in PBW prior to use, plus a rinse in Star San.

One of the design parameters was the ability to disassemble the mash tun, unless you've got some toddlers who need an above-ground pool. It took Bejeir and I under fifteen minutes to completely disassemble the tun and store it in a spare garage stall.

Prior to use, cover every screw with a piece of duct tape, line the container with 6-millimeter plastic sheet (one or two layers) and carefully cut the hole for your bulkhead fitting. Then add the stainless-steel manifold, grist and water, and send us a couple of bottles of your club's big brew.

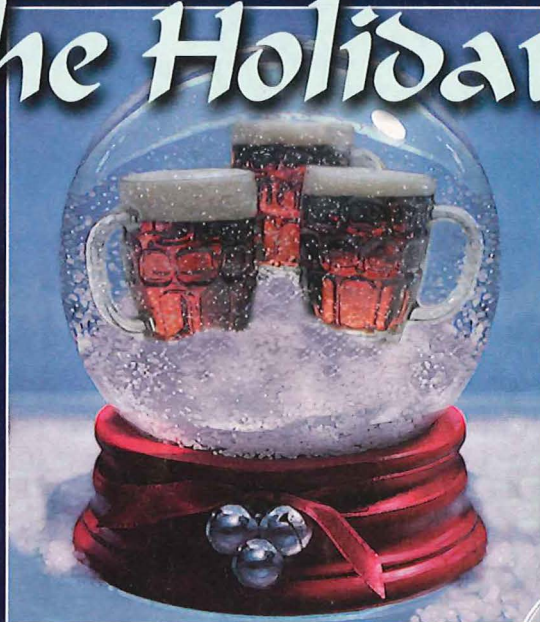
Doing the monster mash

Mash-in started at 8 AM and required the might of every three-burner system and every single kettle we could muster; heating 200 gallons of water is an effort.

Doubters? There were some in the Red Ledges group who said it couldn't be done, that the rectangular mash tun would bulge, fold, fail catastrophically.

Ha! Phooey! Pffffffppp! We knocked out 190 gallons of 1.088 OG stout an hour after mash-in was complete and the temperature drop was only about 1° F over that time. Then we pulled another 80 gallons of second runnings at 1.047 OG. The mash tun ran at nearly full pump volume and the wort was clear with absolutely zero particulates. The projects crew was triumphant!

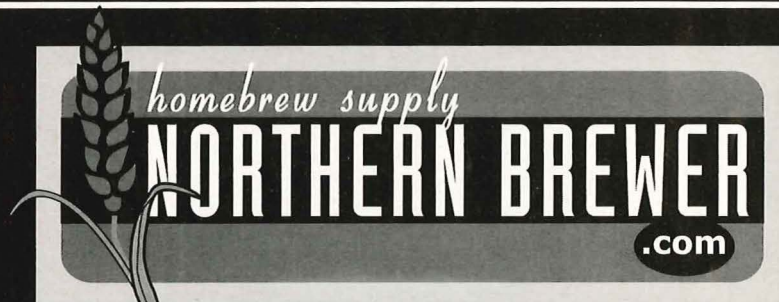
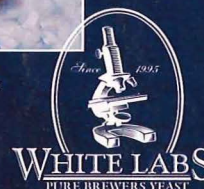
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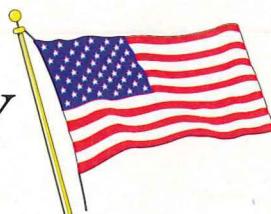


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Jack Adkins' Bourbon Imperial Stout

(approximately 150 gallons, all-grain)
OG: 1.056 FG: 1.110 IBU: 24

450 lbs. Maris Otter two-row malt
60 lbs. aromatic malt
45 lbs. Belgian chocolate malt
30 lbs. Briess roasted malt
30 lbs. Beeston brown malt
45 lbs. flaked barley
240 oz. East Kent Goldings hops
(5.5% alpha acids)
90 oz. East Kent Goldings hops
(6.6% alpha acid)

Mash at 150° F for 60 minutes. Boil 90 minutes with 240 ounces EKG hops (5.5% alpha acid), 20 minutes with 90 ounces EKG (6.6% alpha acid). Ferment as desired with your favorite strain. ■

PARTS LIST

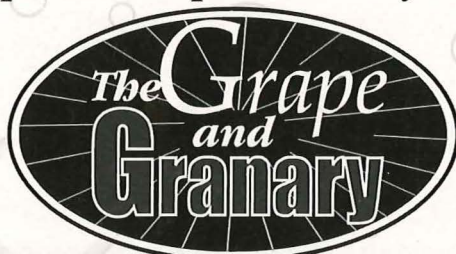
Cutting sizes (approximate)

Bottom (uncut): 4'x8'
Sides: 36" x 8'
Ends: 31-5/8" x 4' (inset)
Frame (2x4) sides (uncut): 4' x 8'
Frame interior (2x4): 45"
Stiffeners/battens (2x2): 31-5/8" (four)
End braces: 32-3/4" (remainder of 2x2)

Shopping list

Four sheets of 3/4" x 4' x 8'
interior-grade plywood \$18.00
Four 2"x4"x8' \$3.75
Four 2"x2"x8' each \$2.10
50 #6 x 1-5/8" galvanized
deck screws \$4.00
24 #6 x 3" galvanized
deck screws \$4.00
50 3" x 5/16" carriage bolts,
nuts and washers \$10.00
6-mil plastic sheeting \$11.00
5 60" stainless-steel sheathed
utility hoses (female-female)
each \$11.00
4 or more male-male brass adapters
each \$2.00
1 3/4" full port valve \$9.00
1 3/4" x 3-3/4" brass pipe nipple
(bulkhead) \$4.50
1 3/4" x 3-3/4" brass pipe nipple
(valve extension) \$4.50
1 3/4" x "x" pump inlet
hose-size adapter (if required)
1 3/4" garden hose Y (two male
out, female input) adapter \$5.30
Teflon tape or pipe dope

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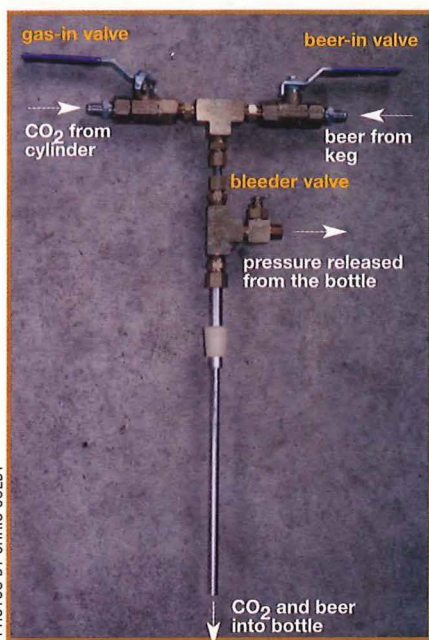
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Under Pressure

Sediment-free beer with counter-pressure bottling

Techniques

by Chris Colby



PHOTOS BY CHRIS COLBY

This counter-pressure filler has three valves — a beer-in valve, a gas-in valve and a bleeder valve.

Back when I was a graduate student in Boston, I threw a lot of homebrew parties at my apartment on Commonwealth Avenue. I remember explaining over and over to my party guests that they had to pour the beer into a glass because of the sediment in the bottles. I must have given that speech 50 times every party night. If only so I could have relaxed and enjoyed my parties, I wish I could have served my homebrew from sediment-free bottles back then.

Later on, I got a keggling system that allowed me to serve sediment-free homebrew, but my bottled beer still had the yeast sediment from bottle conditioning. Finally, I learned of a procedure that allows homebrewers to produce sediment-free bottles — counter-pressure bottling.

In counter-pressure bottling, finished beer is moved from a keg to a bottle. No sugar is added at bottling and the beer doesn't need to bottle-condition to carbonate. If the kegged

beer is sufficiently conditioned, you will have clear, carbonated beer in the bottle . . . and no yeast sediment.

The main challenges of counter-pressure bottling are to retain the beer's carbonation and minimize its exposure to oxygen during the transfer. When performed correctly, almost all of a beer's carbonation is retained when it is counter-pressure bottled. Likewise, with a little practice, the beer can be transferred with minimal exposure to oxygen. Oxygen speeds staling reactions in beer. So, the less oxygen your beer encounters, the longer it will taste fresh.

Advantages

There are several benefits to counter-pressure bottling beyond saving explanation time at parties. The yeast in homebrew bottles is a minor inconvenience for homebrew served at home, but it can become a major problem when you try to transport or ship homebrew. Yeast gets disturbed and it takes time, sometimes a couple of days, to settle back down. And even then, the beer may take on some off-flavors from the roused yeast. Many homebrewers buy a counter-pressure filler just for shipping beer to contests. With counter-pressure bottling, you can also bottle the last few beers from a keg (the "keg dregs") to make room in the fridge for fresh kegs.

Disadvantages

One drawback to counter-pressure bottling is the initial cost. Counter-pressure fillers cost around fifty dollars, and you need to have a keggling system. In addition, counter-pressure fillers have interior spaces that can't be seen by the homebrewer. Unless you clean the filler thoroughly after each use, deposits can build up inside the unit. Like the crud that forms in tap lines, you don't want this stuff touching your beer. Soaking the filler in TSP or PBW immediately after use, then rins-

ing thoroughly with hot water, should keep everything clean.

Bottling beer with a counter-pressure filler takes a little more effort, especially with regard to set-up, than standard homebrew bottling. However, few homebrewers with counter-pressure fillers bottle the entire keg, as this would be time-consuming. Instead, only a few bottles — usually for bringing to a party or shipping to a contest — are filled. The rest of the beer is dispensed from the keg.

Connecting the system

To set up your counter-pressure system, you'll need your counter-pressure filler, a keg of beer, a CO₂ tank and the required connecting tubing. (Your filler should have all the necessary tubing supplied when you buy it.) To begin set-up, take the filler and close all the valves. Likewise, turn the gas off on your CO₂ tank. Unless you like the sight of beer spraying or the sound of CO₂ hissing, don't connect the filler to anything until you're sure all the valves are closed. Connect the CO₂ tank to both the keg and the filler. This is usually done by splitting the gas-out line with a "T" connector. One line goes from the CO₂ tank to the "in" connector on your keg (as usual); the other connects to the filler. Finally, connect the beer-out line from the keg to the filler. (Some counter-pressure fillers require the beer to flow downhill into the bottles. If this is the case with your filler, elevate the keg above your bottling station.)

The keg of beer should be cold, carbonated and conditioned. The colder the beer is, the better. Carbon dioxide (CO₂) dissolves more readily in cold beer, so you will have fewer problems with foaming (from CO₂ breakout) in cold beer. Ideally, your keg should be around 32° F (0° C). (The freezing point of normal-strength beers is slightly lower than this. Stronger and sweeter beers have a freezing point

significantly below this.) Since some carbonation is inevitably lost during the process, your beer should be fully carbonated. You may, in fact, want to slightly overcarbonate your beer prior to counter-pressure bottling to compensate for this loss. To do this, simply increase the CO₂ pressure by two to three psi overnight. Don't go nuts with the carbonation, however, unless wrestling with wildly foaming beer bottles is your idea of a good time.

It's always good to have a couple hand towels or a roll of paper towels on hand, as it's relatively easy to spill a little beer while counter-pressure bottling. You'll also need your bottle capper, caps and — of course — clean and sanitized bottles.

Bottling the beer

Once the filler is connected, check again that all the filler valves are off and open the valve on the gas cylinder. Opinions differ on how much pressure should be applied for counter-pressure

bottling. I've seen pressures from 3–15 psi recommended. Lower pressures allow you to fill the bottles slowly, but CO₂ can break out of solution fairly easily when beer enters the bottle and is exposed to a lower pressure than the level at which it had been conditioned. Higher pressures move the beer faster, but the filler is more likely to pop off the bottle while filling. And the beer can suddenly start foaming when the filler is pulled off and the beer experiences a large pressure drop. I usually just leave the pressure at the level at which the keg was conditioned, usually somewhere between 8–12 psi, depending on the beer style.

Purging the bottle

The first step in counter-pressure bottling is to fill the bottle with CO₂, displacing the air that was formerly there. Filling the bottle with CO₂ first will minimize the amount of oxygen the beer encounters during the transfer.

To fill the bottle with CO₂, place the

filler on the bottle and make sure the stopper is securely positioned in the opening of the bottle. Next, open the gas-in valve and then crack open the "bleeder" valve. Once the bleeder valve is open, you'll hear the gas hissing and the bottle will begin filling with CO₂. Gas from the cylinder is flowing through the filler tube to the bottom of the bottle. Since CO₂ is heavier than air, it will form a "blanket" on the bottom of the bottle. As this "blanket" rises, it displaces the bottle's existing air (approximately 20 percent of which is oxygen) and forces it out of the bleeder valve.

After 10 or 12 seconds, the bottle should be full (depending on how far open you cracked the bleeder valve). You can't see CO₂, so you'll just have to estimate how much CO₂ is enough. I try to think of how much gas escaping the bleeder valve it would take to fill a balloon the size of the bottle I'm filling. Once the bottle is "gassed," close the bleeder valve first, then close the gas



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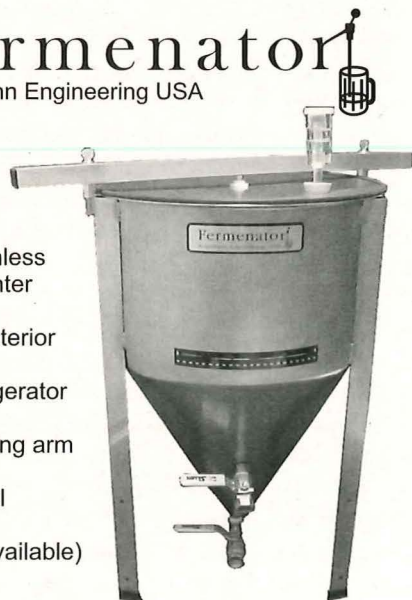
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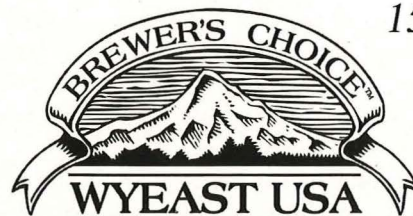
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valve on the filler. (The valve on the gas cylinder remains on throughout filling.)

Transferring the beer

The second step in counter-pressure bottling is to fill the bottle with beer. The filler's tube extends almost to the bottom of the bottle. So during the transfer, the bottle is filled from the bottom, under a blanket of CO₂. This minimizes foaming and aeration, because there's always bound to be some stray oxygen in the bottle, even after it's purged with CO₂.

To fill the bottle, open the beer-in valve. Beer will not start flowing yet because the pressure in the bottle is equal to the pressure pushing the beer. Counter-pressure bottling is named for the opposing pressures at this stage. To get the beer to flow, crack the bleeder valve. Once the bleeder valve is opened, the pressure in the bottle will decrease and the beer will start to flow. The farther you open the bleeder valve, the faster the beer will flow. You

should aim to fill the bottle slowly enough that foaming is controlled. A little foam on top of the beer is OK, good even, but the bottle shouldn't quickly fill with foam. Once the bottle is filled, close the bleeder valve first, then close the beer valve on the filler.

If you are using a gravity-flow counter-pressure system, the beer will start flowing (downhill) immediately after opening the beer-in valve.

The pressure difference between the keg and the counter-pressure relief valve should ideally be about 3 psi. With this pressure differential, you can fill a bottle in 5–10 seconds. Of course, in the absence of modifying your bottler with a gauge, you'll just have to estimate this differential from your fill rate. Try opening the beer-in valve until the beer just foams, then close the valve a bit and aim to fill the bottle within 5–10 seconds. You can fill the bottles to the level of commercial beers, or you can go a little higher. Either way gives good results.



You'll need a keg and a carbon-dioxide cylinder to connect to your counter-pressure bottler.

Capping

The final step in counter-pressure bottling is capping. Capping should be done as quickly as is feasible. Cap each bottle right after filling it rather than filling several bottles, then capping them all. While the bottle is uncapped, carbonation is being lost and the beer is being exposed to oxygen. The loss of carbonation is relatively slow, of course. Think about opening a bottle of



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beer. The carbonation dissipates over time, but your beer doesn't instantly go flat. So move quickly during this step, but don't worry overly much about it.

To begin capping, check that all the valves on the filler are closed. If any of the valves are opened, you will lose beer or CO₂ when you take the filler off the bottle. I also take the time at this point to ensure that I have a bottle cap and my capper ready. Remove the filler from the bottle and it set aside. Now quickly place a cap on the bottle and crimp it closed with your capper.

Ideally, you should try to cap over foam. When foam rises in the bottle, it displaces the gas above it. In doing so it displaces any oxygen in that gas. While filling, adjust the flow rate so a bit of foam forms on top of the beer. Once you remove the filler, the beer will likely start foaming some more. Place the cap on top of the bottle and wait for the foam to rise to the top, then cap. You may need to lightly hold the cap on with your finger to stop it

from being knocked off while the foam is rising.

If the beer is not foaming, you can either just cap the beer or try to induce foaming. To induce foaming, take another beer bottle and lightly tap the top of the just-filled bottle. Be careful, though — if you hit the bottle too hard it will foam uncontrollably. (If you're like me, you've probably seen this performed as a prank, turning the victim's beer into a geyser.) This takes a bit of practice. Don't try it unless you are willing to risk losing some beer and having a mess to clean up.

Conditioning

Counter-pressure bottled beer can be served immediately. You will notice, however, that newly-bottled beers won't make the "phsst" sound of escaping gas when opened. Initially, the gas pressure in the bottle's headspace is equal to the atmospheric pressure at the time the beer was bottled. Over time, CO₂ from the beer will diffuse out

of solution and pressurize the headspace. This is why some homebrewers feel that it is best to minimize the amount of headspace in the bottles. The smaller the headspace, the less carbonation is lost from the beer to pressurize the headspace.

At first, counter-pressure bottling can seem complicated. There's tubing running all over the place and four valves (counting the main valve on the CO₂ tank) to keep track of while filling. Just keep in mind that, any time you're unsure of how to proceed, you can turn all the valves off and figure it out or look it up. Also keep in mind that all the valves should be closed whenever you hook up the system and whenever you take the filler off a bottle. Although counter-pressure bottling initially seems complicated, it will seem like second nature once you've done it a couple times. ■

Like the bottles described here, Chris Colby is frequently full of beer and gas.

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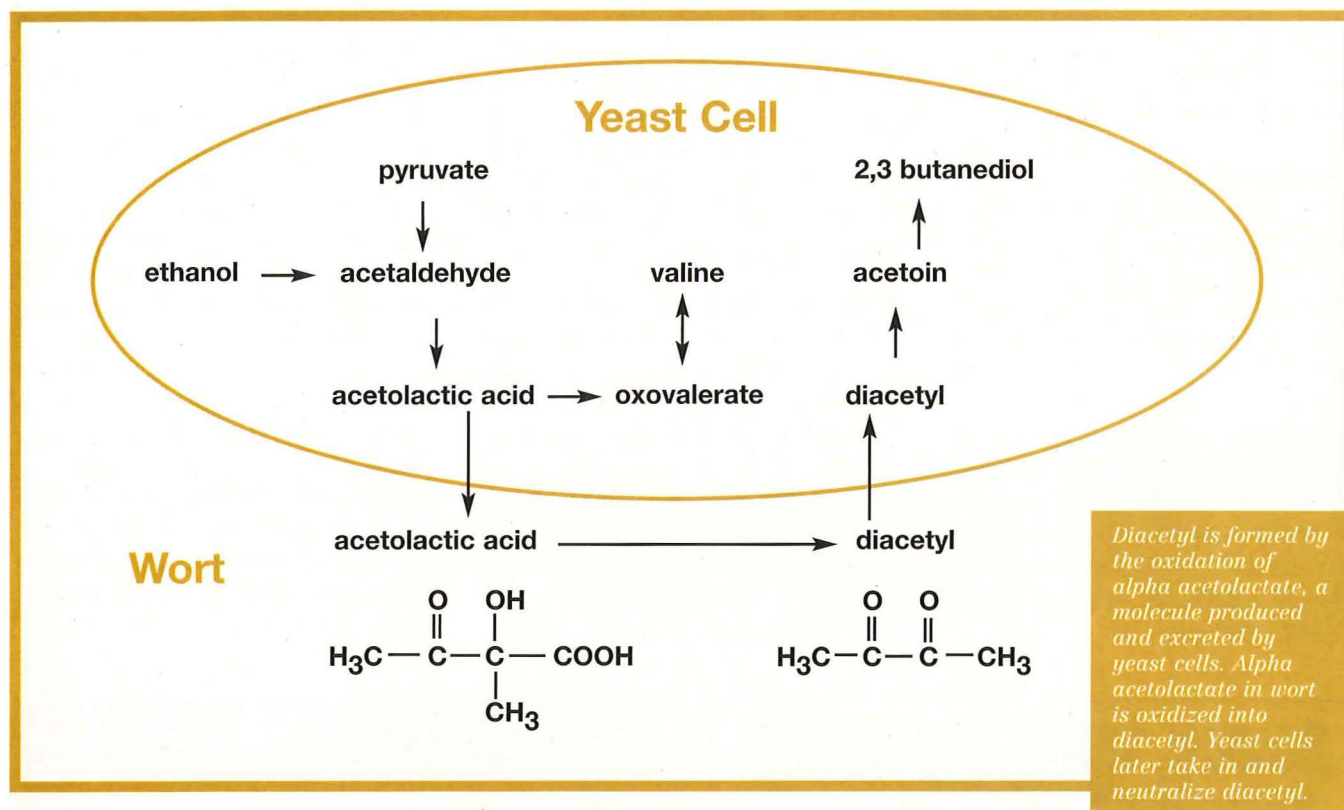
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Dreaded Diacetyl

Taming unwanted butterscotch flavors and aromas

Homebrew
science

by Steve Parkes



Beer is an alcoholic beverage, a fact we appreciate every time we taste a non-alcoholic beer. The alcohol in beer is produced during fermentation. Fermentation also produces a small amount of highly volatile compounds that are largely responsible for beer flavor. Some are of great importance and contribute directly to beer flavor, while others form part of the vast number of compounds responsible for beer's background flavor.

Diacetyl: butter in your beer

Few flavor compounds evoke such strong feelings among brewers as diacetyl. Opinions of diacetyl range in intensity from ambivalence to utter hatred. At low levels, diacetyl is characterized by a sweet, butterscotch aroma and flavor. As diacetyl levels rise, so does the intensity of the butter character. Eventually the beer will smell like the foyer of a movie theater,

as the character resembles rancid butter. Diacetyl can also give beer a mouth-coating characteristic that will make it difficult to drink.

What is it?

Diacetyl is one of a small class of compounds known as vicinal diketones (VDKs). ("Vicinal" means adjacent, "di" means two and a ketone is an organic compound with a double-bonded oxygen somewhere inside the molecule.) Diacetyl is the common name for 2,3 butanedione. The other common VDK in beer is 2,3 pentanedione. The flavor threshold of 2,3 pentanedione is 10 times that of diacetyl, meaning that there needs to be 10 times more 2,3 pentanedione present for the taster to detect it. This means that 2,3 pentanedione is rarely considered alone as a beer flavor problem. The flavor threshold of diacetyl is 0.04 ppm in U.S. lagers, 0.08 ppm in lighter ales, and 0.1 ppm in stronger beers.

Levels of diacetyl rise during early fermentation, then fall as the beer matures. Understanding the control of diacetyl character in beer is easier if the brewer has an understanding of the biochemical mechanisms by which it is first created, then removed.

Formation

While yeast cells synthesize certain key amino acids — such as valine, leucine and isoleucine — various intermediates are created in excess. In the case of diacetyl, the precursor is alpha acetolactate, which is excreted from the cell as the requirement for valine and leucine diminishes. Once outside the cell, alpha acetolactate can be oxidized to diacetyl. There are many oxidizing agents in wort that can do this, and this is a spontaneous (not enzyme-catalyzed) reaction. Alpha acetolactate is flavorless and aromaless, but diacetyl is strongly flavored and has a low flavor threshold. That's the bad

news. The good news is that healthy, happy yeast will later be able to reabsorb diacetyl. The yeast will then reduce it, first to acetoin, then to 2,3 butanediol. Acetoin has a musty flavor and 2,3 butanediol has a high flavor threshold. So, diacetyl flavor will appear in your beer during fermentation, and then your yeast will remove it for you during conditioning.

Diacetyl formation

Many factors lead to an increase in diacetyl production.

Yeast strain. Different yeast strains differ in their ability to produce (and remove) diacetyl.

Rate of fermentation. A fast, healthy fermentation reduces the release of alpha acetolactate into the wort. Ideally, wort gravity should drop to its terminal level in three to five days for ales. In lagers, five to seven days is usually required.

Temperature. Higher temperatures lead to more diacetyl formation. For example, a lager beer that is fermented at 57° F can produce up to three times as much diacetyl as a similar beer fermented at 40° F.

Yeast growth. Factors that inhibit yeast growth also result in the release of the alpha acetolactate into the wort. These factors include yeast nutrient deficiencies, a too-low temperature for fermentation, lack of wort aeration or low yeast vitality.

Pitch rate. A higher pitching rate will lead to an increase in the formation of alpha acetolactate. However, pitching a sufficient amount of yeast is necessary for a healthy fermentation.

Wort quality. The wort must contain sufficient amino acids or the yeast will need to manufacture them. Amino acid production will result in more formation of alpha acetolactate.

Diacetyl removal

The presence of sufficient healthy yeast during aging increases diacetyl removal. Yeast remove diacetyl much faster than they produce it. Sending the beer into secondary fermentation or maturation with some yeast still in suspension should be sufficient to reduce the diacetyl in a timely manner. The majority of the yeast will sediment. The yeast that remains in solution will hopefully be sufficient for maturation.

Diacetyl removal is accelerated at higher temperatures. Some lager brewers raise the temperature of the beer to around 57–61° F for a day or so after primary fermentation and prior to cold conditioning. This is called a diacetyl rest. Ale brewers can also perform a diacetyl rest by waiting for a couple of days after primary fermentation is over before chilling the beer.

At pH levels between 4.2 and 4.4, the conversion of alpha acetolactate to diacetyl is rapid. This rate decreases as the pH rises.

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The addition of actively growing yeast along with the fresh wort encourages a rapid removal of diacetyl in the finished beer.

Increasing the surface area for yeast sedimentation also speeds diacetyl removal. This will allow the use of a flocculant strain and still shorten the maturation time. It can be achieved by using beechwood chips or horizontal maturation tanks. Laying your Cornelius tank on its side helps.

Residual diacetyl

The amount of diacetyl left in finished beer is a result of the interaction between the mechanisms of diacetyl formation and diacetyl removal. The timing of some events, such as beer transfers, can also be important.

Poor wort aeration leads to diacetyl. Yeast use oxygen absorbed at the start of fermentation to desaturate fatty acids which, in turn, increases the fluidity of membranes produced in subsequent generations. Cells with less

fluid (or rigid) membranes late in the fermentation, or in maturation, are less able to reabsorb diacetyl.

Diacetyl levels may be too high if the beer experienced too short of a

**Diacetyl flavor will
appear in your beer
during fermentation,
then your yeast will
remove it for you
during conditioning.**

maturation period. It takes time for yeast to remove diacetyl. The large lager brewers of the world use the final disappearance of diacetyl below its flavor threshold as their criteria for

determining how long the maturation period should last, usually three to four weeks. Care must be taken to ensure a complete conversion of the precursor to diacetyl, since alpha acetolactate can oxidize to diacetyl at any time. If this reaction happens after the yeast has been removed, there is no other mechanism available by which diacetyl can be removed.

If your yeast is very flocculant, then it may drop out of the beer before it has the chance to reabsorb the diacetyl. Some English, Canadian and U.S. ale brewers use flocculant yeast strains that require a recirculation pump to keep them in contact with the wort until diacetyl can be absorbed. A system that also allows oxygen contact, or even just an open fermenter, can cause an increase in diacetyl in beer. A Yorkshire square fermenter is a two-chambered vessel designed for use with a non-flocculant yeast. Wort is collected into the larger, lower chamber and the yeast rises through a man-

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hole into the upper chamber. A pump continually recirculates the wort from the bottom chamber and sprays it over the yeast in the top chamber, re-suspending it and allowing it to mix back in with the bulk of the wort. This results in a lot of wort aeration, yeast growth and hence diacetyl production. The fact that the yeast is very flocculant means that it doesn't reduce diacetyl once it's formed in the beer.

Mutated yeast can also lead to diacetyl in your finished beer. One of the most common yeast mutations is one that causes the yeast to lose the ability to reduce diacetyl. On an agar plate, these cells produce small colonies, which explains why they are called "petite mutants."

Crash-chilling too early will leave diacetyl in beer. Some brewers ferment in the primary fermenter until the terminal gravity is reached, and then crash-chill the fermenter to around freezing point to "drop out" the yeast. Unfortunately, if the yeast is dormant

and stuck on the bottom of the fermenter, it isn't up in the beer where it can be removing the diacetyl.

Uptake of oxygen late in fermentation leads to excessive diacetyl production. Yeast will begin releasing more alpha acetolactate if oxygen is introduced late in the fermentation. This eventually leads to an increase in diacetyl, so care must be taken to avoid oxygen pickup during beer transfers.

Diacetyl can come from bacterial contamination. Lactic acid bacteria are capable of producing diacetyl by a similar pathway to that used by yeast. However, they are unable to reduce it again. This was once known as "sarcina sickness" after the original name for Gram-positive brewery bacteria.

Clean brewing equipment and a yeast carrying a low contamination load will ensure that bacterial sources of diacetyl will be minimal. If your procedures are geared toward minimizing diacetyl and it suddenly shows up, this is the first place to look.

And in conclusion...

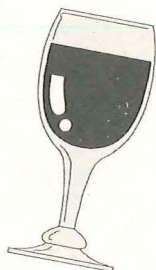
So what can homebrewers do to control the level of diacetyl in their beer? First, conditions need to be appropriate to minimize the release of the alpha acetolactate into the wort. There must then be a rapid conversion of this precursor to diacetyl. This should be followed by effective removal of any diacetyl that is formed.

Diacetyl removal is helped by a strong, rapid fermentation performed by well-aerated, correctly pitched yeast. A large, early reduction in wort pH, and the prevention of further oxygen uptake later in the fermentation will also help. A short period of warm conditioning will help to convert all of the precursor still in the wort into diacetyl. Then it is essential that enough live, active yeast are present during maturation to remove the remaining diacetyl. ■

Steve Parkes' next article will cover other flavor-active molecules.

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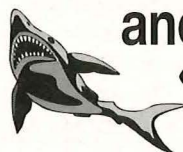


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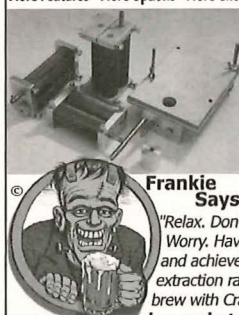
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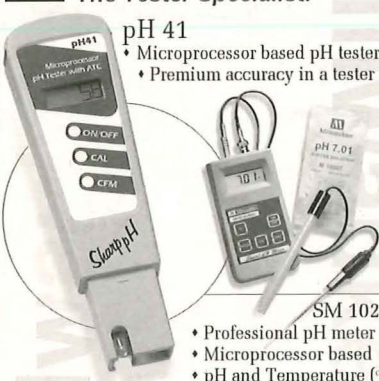
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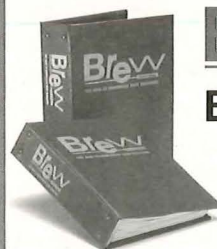
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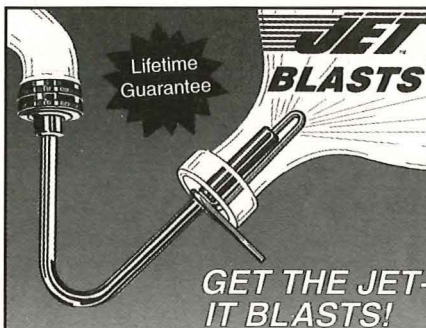
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The Art of Wort

Be a warrior. Win the homebrew game.

by Chris Colby

More than 25 centuries ago, the Chinese military strategist Sun Tzu wrote "The Art of War." Although ancient, his insights can help anyone in any competitive endeavor they undertake, including the homebrewing game. (No, not homebrewing contests. I'm talking about the homebrewing game.) In this article, I will show you how a true homebrew warrior gains supremacy over his fellow homebrewers by employing the teachings of Sun Tzu.

Every beer has its faults . . . even if only the homebrew warrior can taste them. Let's say you're sampling a perfectly brewed helles. The discussion goes around the table, everyone loves it and now it's your turn to comment. What do you do? Praise a fellow homebrewer for a job well done? A true homebrew warrior might do the following: Take a sip, turn to whoever at the table has the best palate and thoughtfully ask, "Is that trans-2-nonenal I taste?"

"Wait a second," you might say, "How can he get away with tasting beer faults that aren't there?" Two things will allow him to taste things that are not there. First, he will always claim that the flavor was right around (or below!) threshold value. If anyone questions him, he'll simply claim that he's particularly sensitive to trans-2-nonenal. Second, he'll often receive backup from an expert — the guy at the table with the best palate. "But won't he challenge the warrior's impression?," you might ask. No. In fact, Palate Boy is most likely to say, "Now that you mention it, I am catching a bit of trans-2 in there." Palate Boy doesn't want to be upstaged by the warrior, so he'll suddenly start tasting whatever the warrior claims to taste.

It's not contaminated — it's Belgian! At some point, the shoe will be on the other foot and other brewers will be

evaluating the warrior's beer. When this happens, the warrior knows that beers are not judged against any objective standard. Instead, they are judged according to what they are supposed to be. Accordingly, a true homebrew warrior always strives to convince others that his beers taste exactly as he wanted them to taste. For example, if his stout doesn't have enough roasted grain flavor, he'll tell everyone it's a

"Neutralizing an adversary's forces without battle is absolute perfection," says SunTzu. For that reason, a true homebrew warrior never enters homebrew contests.

porter. Even a beer with obvious faults can be excused using this method. Some selected commercial beers have (intentional) beer faults. A homebrew warrior gets to know these beers. If he brews a pale ale that ends up with some diacetyl showing through, he will surely tell you that Red Hook ESB has a noticeable amount of diacetyl in it. He will also know that, until recently in brewing history, most beers probably soured over time. His brown ale may turn as sour as Janet Reno in a Florida voting booth, but it won't be a failed batch — it'll be an historic recreation. And finally, if his batch is horribly contaminated, he'll tell you it's an obscure Belgian style that is supposed to taste that way.

Keep your own score: As homebrewers, our beer is not the only thing that gets judged. Our brewing skills are frequently judged as well. One aspect all-grain brewers love to compare is their extract efficiencies — how much sugar they extract from their grains. To cal-

culate efficiency, a brewer needs a calibrated hydrometer and a calibrated carboy. A true homebrew warrior, however, realizes that he's the guy in charge of calibrating them. Almost all homebrew hydrometers are wildly inaccurate. Roughly half of all hydrometers read high, the other half read low. A warrior always has a hydrometer that reads high. He may have kept buying hydrometers until he got one that told him what he wants to hear or he may never have calibrated his hydrometer, assuming that of course his efficiency would be better than everyone else's. Secondly, a true homebrew warrior always assumes that any volume of beer in a mostly-full five-gallon carboy must be five gallons. Ignoring any deficiencies in batch volume always helps in the efficiency calculations. So, the next time you hear a brewer claim he brewed ten gallons of CAP from two pounds of barley and a single flake of maize, look at him with admiration. He is a true warrior.

Avoid contests: In the "Art of War," Sun Tzu says, "Neutralizing an adversary's forces without battle is absolute perfection." For that reason, a true homebrew warrior never enters homebrew contests. He realizes that there are three levels of homebrewers: those who do poorly at contests, those who do well and — finally — those who deem themselves too exalted to enter. When the topic of homebrew contests arises, the homebrew warrior will explain that he used to score quite well at contests, but doesn't bother anymore. For good measure, he may add, "In the meantime, I've been improving so much that it really wouldn't be fair to other brewers for me to enter contests anymore. Oh, and try my latest beer — it's Belgian! I brewed 15 gallons of it from 14 grains of pale malt and 32 molecules of sugar." When he does, just reply, "Mmm, it's good . . . but is that trans-2-nonenal I taste?" ■

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Fermentap

\$22.50



Carboy Handles

5,6 gal \$4.50 • 6.5 gal \$5.50



Carboy Hoods

5,6 gal \$2.50 • 6.5 gal 2.75



V-Vessel

5.5 gallon plastic conical
Thick plastic makes this ideal
for ales and wine kits.

~~\$175.00~~

Sale! \$139.00



Bottle Tree

80 Seat \$22.00
Iodophor injector \$14.95



Bench Cappers

\$22.00 – \$34.95



Brew Kettles

9 gal \$120.00
14 gal \$145.00
28 gal \$205.00



Wort Chillers

3/8" Immersion \$34.90
1/2" Immersion \$59.00
Counterflow \$109.00



Mash Paddles

26" Maple Paddle \$34.95
36" Maple Paddle \$43.95



New

Kegging Setup

\$180.00



Kegs

Refurbished 5 gal \$34.95
New 5 gal \$89.00
New 2.5 gal \$74.95



New Grain Mills

2" Non-Adjustable \$99.00
2" Adjustable \$119.00
4" Adjustable \$139.00



Insulated Bag

\$34.95



Digital Scales

6lb Stainless Scale \$68.00
13lbs Stainless Scale \$92.00



Handheld pH Meters

pH + \$44.00
pH 3 \$64.00
pH 5 \$76.00



New

Bench Top pH Meters

\$109.00



Refractometer

\$99.95



Stainless Steel Conical Fermenters

7, 12, and 24 gallon
sizes, cooling options
available.

Starting at \$400.00



Coffee Roasting Starter Kits

Roast your own fresh coffee at home. Starter Kits
ranging from \$99.99 to \$399.99 (shown). Green
beans as low as \$3.85/lb. Makes a great gift.



Tap-A-Draft Starter Kit

\$59.95

All-Grain Brew Stands

Stands for creating all-grain systems.
Comes with three, high-output burners
running off one regulator.



New

5 gallon \$565.00
10 gallon \$595.00



Filtering Kits

Regular \$39.00
Stainless Deluxe \$65.00
Extra Filters \$3.95



Stainless Drip Trays

6" wide \$29.50
13" wide \$49.00
13" w/backsplash \$69.00
(pictured)

Customizable Brew Sculptures

5, 10, and 20 gallon
sizes with tons of
options available.

Starting at \$895.00



Hats and T-Shirts

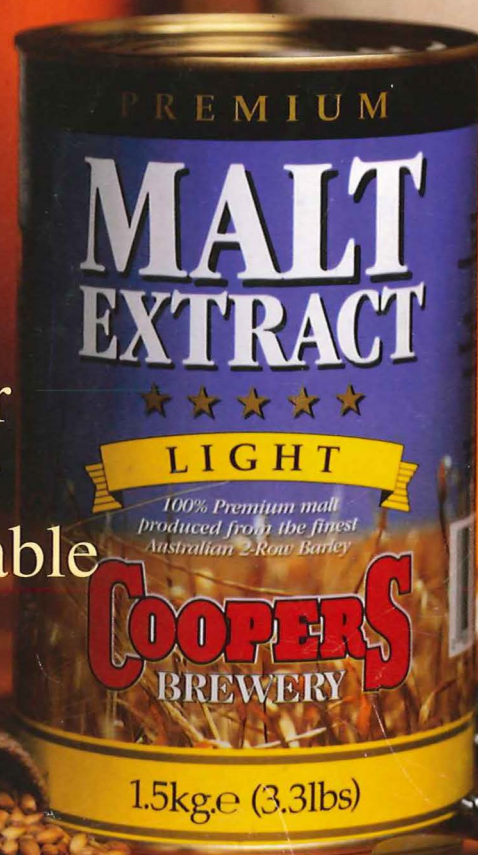
Many styles of hats and
T's are available online at
www.morebeer.com.

Hats \$12 and up
T-Shirts \$9 and up



From Our Brewery To Yours

Wheat
Dark or
Amber
also available



CASCADIA IMPORTERS

For the retailer nearest you, award-winning
recipes, & more, visit our web site
at www.cascadiabrew.com