

# Brew

THE HOW-TO HOMEBREW BEER MAGAZINE

YO

DECEMBER 2009, VOL.15, NO.8

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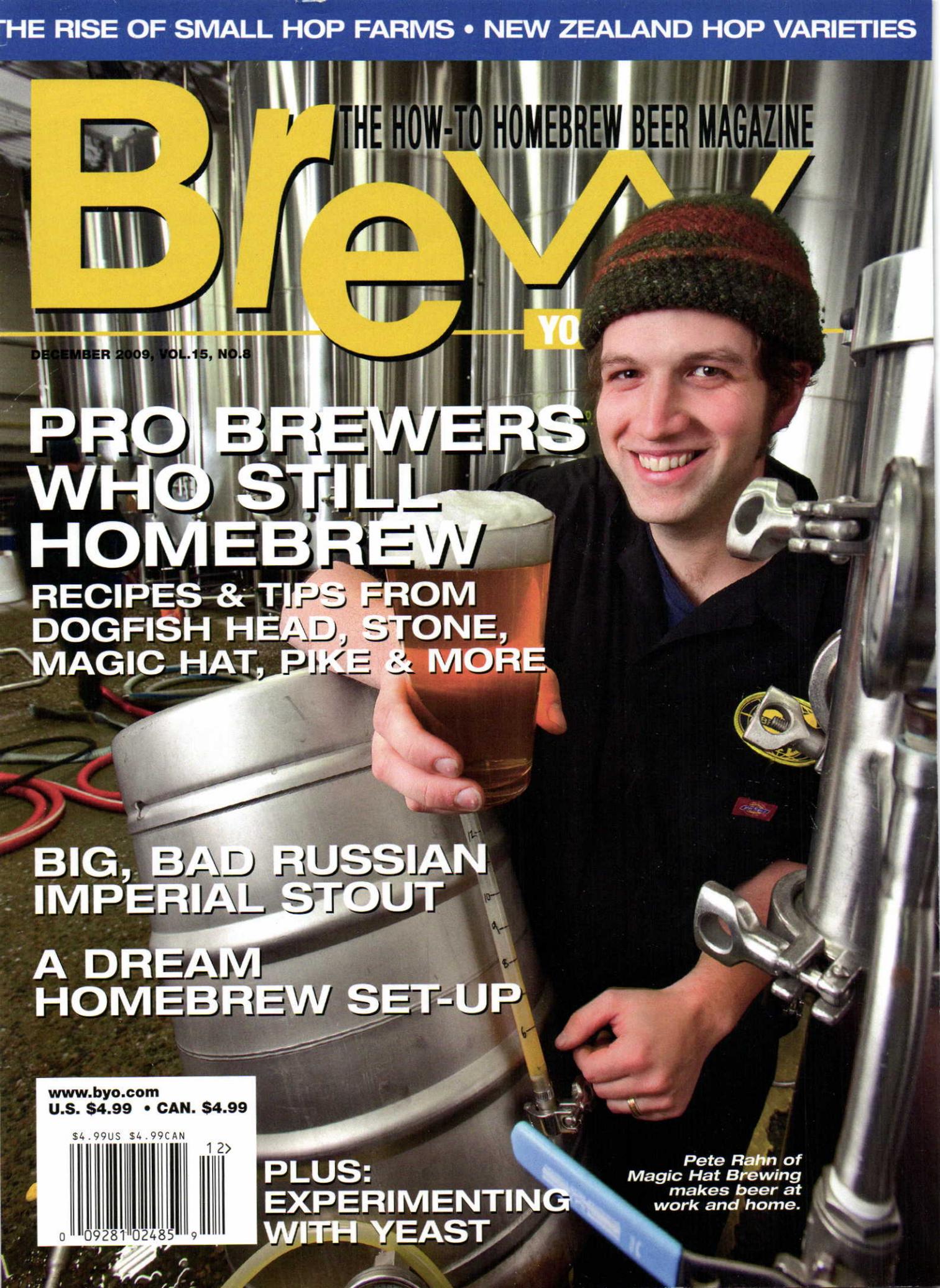
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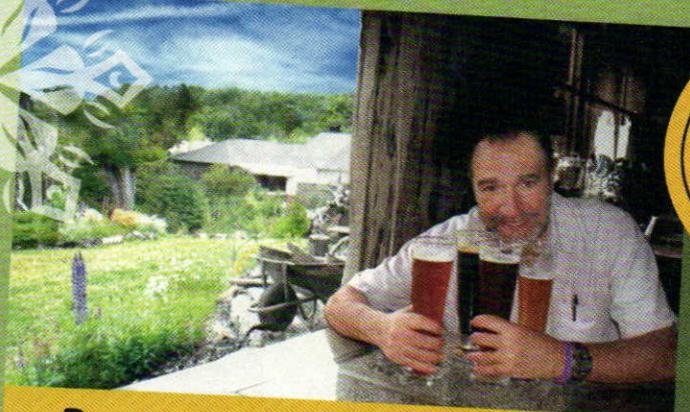
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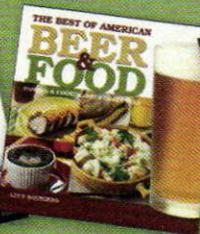
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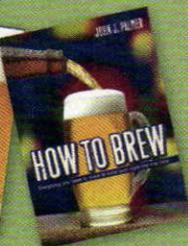
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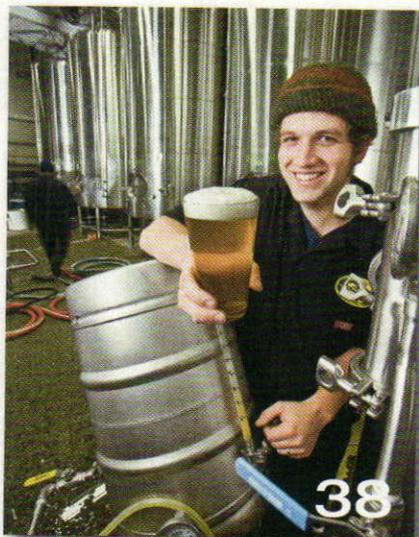
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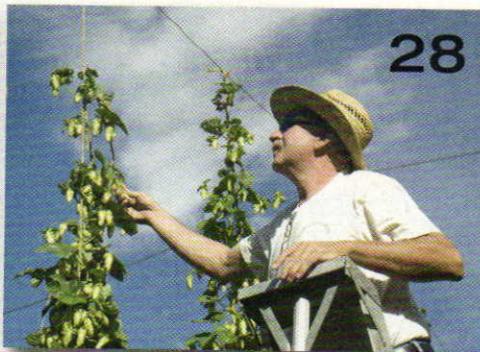
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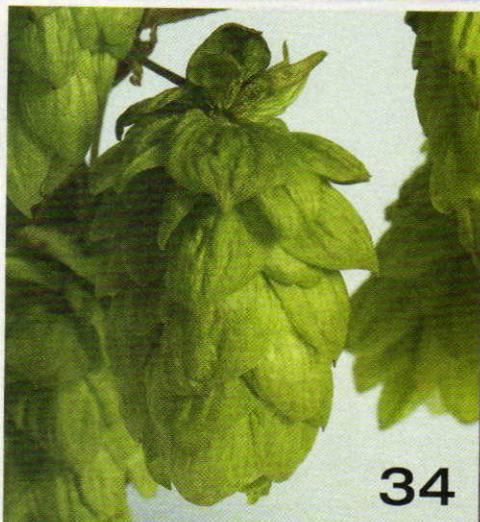
A California homebrewer ups the ante on home brewery automation.



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## BYO RECIPE STANDARDIZATION

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

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

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

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

# Brew

THE HOW-TO HOMEBREW BEER MAGAZINE

YOUR OWN

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Cover Photo: Charles A. Parker

## Hohenzollern Hops

I was just inputting the Hohenzollern Kaiser Pils recipe out of the October 2009 issue into my BeerSmith program. My numbers came in way lower than yours, and so I wanted to double check them. I only got 56 IBUs with the listed hop additions, and the stats at the top of the recipe list 75 IBUs. I use the Rager formula in BeerSmith. Can you please confirm or deny the 75 IBUs for this recipe?

Jeffrey "bo\_gator" Morgan  
via email

Recipes in BYO are standardized so that the IBU calculations are done the same way for every recipe. Other brewing calculators — and different options within brewing software packages that allow you to pick different hop utilization curves (Rager, Garetz, Tinseth, etc.) — will yield different estimates of bitterness (in IBUs) from the same hop schedule. One way of looking at this is that you type your hop schedule into your brewing calculator and it gives you a prediction (or guess) at your resulting bitterness. This "guess" is based on hop amounts, alpha acid ratings and the hop utilization curve. Since the hop utilization curves used by brewing calculators vary, estimates of hop bitterness vary. The actual hop utilization that you obtain depends on your boil vigor, kettle geometry and other factors.

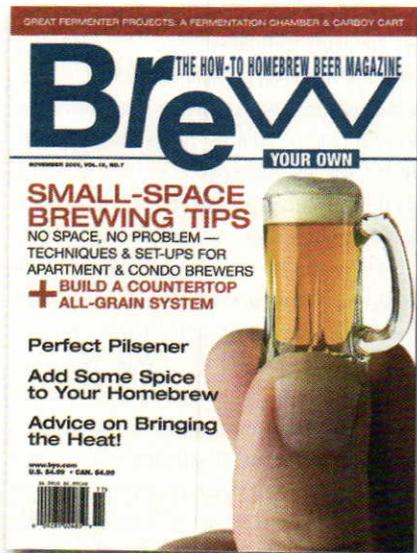
We chose a hop utilization curve that we believe provides a reasonable IBU estimate for most homebrewers, but realize that everyone's system and procedures are different.

If you use the Rager formula consistently and feel this provides a good IBU estimate in your brewery, then you should adjust the amount of bittering hops in the BYO recipe such that the Rager formula yields the IBU rating found in the recipe statistics. In your case, this would mean adding bittering hops.

## Weeping at the Wedding

Thanks for the Replicator article on the Weeping Radish Black Lager (October 2009). It brought back good memories, as I had my wedding reception at the Weeping Radish location in Durham, NC when it was in operation. In addition to no possibility of running out of beverages, I learned two universal truths: I married a good woman and my new father-in-law was truly a wise man.

Daryl Habit  
Cincinnati, Ohio

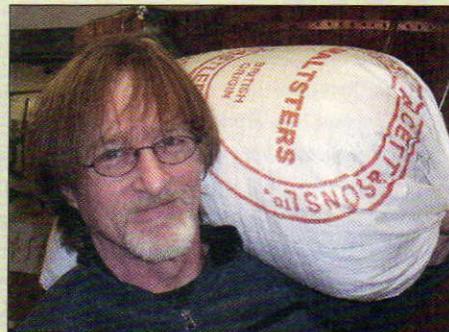


## Experiment Extension

Regarding "Does Delayed Racking Harm Your Beer?" (September 2009), I am an amateur brewer and found the article on delayed racking extremely interesting. I was very impressed with the lack of bias in the experiment and learned a lot from the information given. There is only one thing that is still bothering me about the experiment. I realize that the results showed a split decision on whether delayed racking improves or worsens the beer and that delayed racking, in general, does not harm the beer. However, the experiment had the beer sitting on the yeast for only two additional weeks. What about one month or even two months delayed racking? How would prolonged delayed racking affect the beer, if any, more than what was seen in the results for two additional weeks?

Casey Ferrell  
San Diego, California

*In the first BYO/BBR Collaborative Experiment, we found out that forgetting to rack your beer and letting it sit in primary for two extra weeks had little impact on the finished beer. In order to know what would happen to the beer in one month or two months without racking, we would have had to increase the amount of beer brewed for the recipe, extended the timeline and delayed publication of the results. Although this additional time and analysis could potentially have yielded more interesting information, we feel that it also would likely have caused many of the experimenters to drop out of the experiment. We tried to design an experiment that would provide useful information and be*



**GREG NOONAN** passed away October 11 after battling cancer at the age of 58. He was a pioneer in the craft brewing industry and an inspiration to many homebrewers.

In 1988, Noonan opened the Vermont Pub & Brewery in Burlington, Vermont — the first brewpub in Vermont and only the second on the East Coast. In order to do so, he had to spend three years lobbying the Vermont legislature to legalize brewpubs. The brewery gained renown far beyond Burlington, winning medals at the Great American Beer Festival (GABF), Great International Beer Festival and the World Beer Championships. It was listed as one of the 25 best craft breweries in America in the book "America's Best Brews," by Steve Johnson (1997, Gulf). The pub's smoked porter, made from malt smoked at the brewery, was a favorite of many patrons.

Among homebrewers, he is best known for his book "Brewing Lager Beer" (1986, Brewers Publications). He later updated this book with the release of "New Brewing Lager Beer" (1996, Brewers Publications). Along with the books of George Fix, these works helped guide homebrewers in the 1980s and 1990s looking for a more detailed explanation of the brewing process. Noonan also wrote "Scotch Ale" (1993, Brewers Publication) and co-wrote "The Seven Barrel Brewery's Brewer's Handbook" (1997, G. W. Kent) with Mikel Redman and Scott Russell.

At *Brew Your Own*, we knew Greg as a member of our review board. Recently, he appeared in an installment of "Tips from the Pros" (September 2008), discussing Scottish ales. He also let us put his "Water Witch" spreadsheet on our website ([www.byo.com](http://www.byo.com)) for readers to download.

So please join us in raising a glass to Greg Noonan — there are more and better informed homebrewers in the hobby today because of him.

something that would actually get done in a reasonable time frame.

### Fermenter Safety

In the May-June 2009 issue of Brew Your Own, we published an article showing how to build a large fermenter from a grey Rubbermaid Brute garbage can ("Big on a Budget," by Forrest Whitesides). This product — and also white and yellow Rubbermaid Brute trash cans — have an NSF #2 rating, indicating they are safe for food contact. (They are also USDA Meat and Poultry Equipment Group listed as safe for meat contact.) These vessels are widely used by winemakers and sold in some wine making shops for use as fermenters. Still, we received letters questioning their suitability for this use. Specifically, readers asked if the alcohol in beer would leach anything from the plastic that would cause off flavors or cause health concerns.

At Brew Your Own magazine, we take safety seriously, so we called Rubbermaid Commercial Products (the division that makes Brute trash cans) to confirm what we discovered in our usual review process. A representative from Rubbermaid reiterated the NSF rating, but told us the compa-

ny does not recommend the products for the storage of syrups, wine or apple juice. The reason was that the plastic did not maintain a vapor barrier capable of retaining the volatiles in those liquids during storage. They specifically said there were no safety concerns with the plastic leaching undesirable elements into the wine. As such, we believe that these containers are safe for use as fermenters. (We've brewed in them ourselves, in fact.)

The vapor barrier issue is, however, worth considering. For an average-strength ale, or even a moderately strong one, fermentation should be finished within a week. Considering that some beers are fermented in open fermenters, we doubt that a slight seepage of volatiles from the Brute would cause a problem. If you rack your beer in a reasonably prompt manner, everything should be fine. However, we would not recommend that you store, lager or condition your beers in this vessel.

There are pluses and minuses to any fermenter material. Two materials that are safe and widely used in brewing are stainless steel and glass. Stainless steel is corrosion resistant, not permeable to gases, inert to beer and widely used in commercial brewing. Unfortunately, stainless steel fermenters are relatively expensive. Glass carboys

are another popular choice as fermenters. These are not permeable to gases, inert to beer and inexpensive. They are fragile, however, and can break and cause injury.

Although stainless steel and glass are not permeable to gases, keep in mind that oxygen can enter through the liquid in fermentation locks as well as through rubber bungs or gaskets. Under normal time frames, however, this should not cause you any problems.

Questions, concerns, comments?

Contact us!

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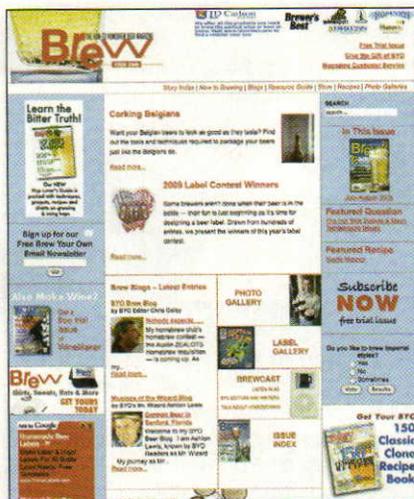
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## reader PROFILE + RECIPE

### Bryan Hampton

Wheeler, Texas



Bryan Hampton named his brewery the Toxic Waste Brewing Company after working as a driver hauling toxic waste.

I got into homebrewing when I was living in Utah in 1988. I was growing unsatisfied with the same old beers I had been drinking when I happened on a little homebrew store. That day I bought

my first brew kit. I started out as an extract brewer, but for the last 18 years I have been brewing all-grain.

Soon after that I moved back to southern California and found a store in Upland. The homebrewing store was planning on starting a homebrew club soon after. After joining I was elected president and served a term of one year.

I worked as a truck driver hauling toxic waste when I started brewing, thus the name of my brewery became the Toxic Waste Brewing Company.

In 1998 I moved to Wheeler, Texas and found out very fast it was a dry county. Oh the horror! That fact made me unpack my brewing equipment really fast. I also quickly learned there was nowhere to buy

supplies and I had to start buying them online. I also started joining the online brewing community forums and developed many friendships online. One of my dearest and closest friends is Aaron Pachthofer of Mad Scientist Brewing Company. My friends can't wait for my next batch to be ready for sampling.

I show dedication in everything I do whether it is in my music, my job as a luthier, woodworking, being a semi-professional musician, or just being a dad. My daughter has helped me brew since she was 2-years-old and she is now a good homebrewer in her own right. In 1990 my son was born. He has Asperger syndrome ADHD and Bi-polar disorder. He is now my little brew buddy.

### Grandpa Otis's Chocolate Oatmeal Cookie Stout

(5.5 gallons/21 L, all-grain)

OG = 1.077 FG = 1.019

IBU = 37 ABV = 7.5 % SRM = 36

#### Ingredients

10 lbs. (4.5 kg) American 2-row malt  
2 lbs. (0.91 kg) Belgian CaraMunich malt  
8 oz. (227 g) American crystal malt 40 °L  
8 oz. (227 g) Canadian honey malt  
4 oz. (113 g) British roasted barley  
4 oz. (113 g) American black patent malt  
4 oz. (113 g) American chocolate malt  
1 lb. (0.45 kg) rolled oats  
(8 ounces/227 g of the oats toasted)  
1 lb. (0.45 kg) molasses (1 jar unsulfured)  
8 oz. (227 g) cocoa powder (last 10 min.)  
3 cinnamon sticks (soaked in Maker's Mark and added in secondary)  
8 oz. (227 g) raisins (soaked in Maker's Mark and added to secondary)  
1 pint of Maker's Mark (to soak the cinnamon

and raisins and add to secondary)

10 AAU Willamette hops (2.5 ounces/71 g at 4% alpha acids) (60 min.)

4 AAU Willamette hops (1 oz./28 g at 4% alpha acids) (30 min.)

Rogue Pacman Ale yeast  
4 oz. (113 g) of Madagascar Bourbon Pure Vanilla (in secondary)

#### Step by step

Step mash all the grains at 121 °F (49 °C) for 30 minutes and then raise the temperature to 130 °F (54 °C) for 20 minutes. Raise the temp to 152 °F (67 °C) for 60 minutes. Add the molasses directly to boil and add the cocoa powder in the last ten minutes of the boil. Add the cinnamon, raisins, Maker's Mark and Madagascar Bourbon Pure Vanilla to secondary and let age for two months. Bottle with a half cup of corn sugar.



# homebrew systems that make you DROOL

**Brian Davis**

Arlington, Washington

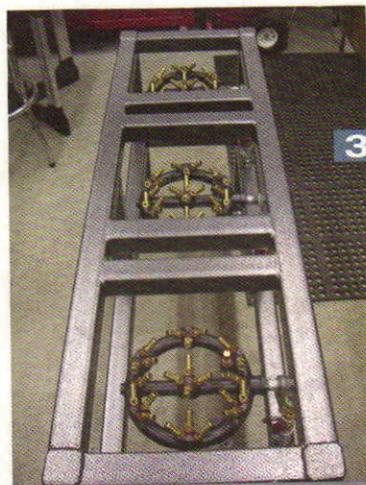
I was first inspired to build a brew system when I saw the BYO article on "Brutus Ten." (Plans are available at [byo.com/store](http://byo.com/store).) Rather than build just one 10-gallon (38-L) all-grain system, a buddy of mine and I decided to each build one at the same time. So the birth of the "Brew Twins" was born.



1

We started fabricating and hand building the entire systems ourselves in my home garage. But shortly after the progress began, my friend had to abort the build due to an illness. So rather than give up, I made the decision to keep and finish both systems myself.

I kept the progress of both systems the same by building both of them at the same time. The build took me almost a year to complete but was a blast to create. The framework is constructed from 2" x 2" steel tubing then finished with high temp powder coating.



3

Heat is supplied by three 150,000 BTU propane fired burners nestled inside the framework.

Pumps, burners, and temperatures are monitored and controlled by a 110v digital-displayed control panel. HLTs, mash tuns, and brew kettles are made from 15.5-gallon stainless kegs and equipped with sight tubes, thermowells, and recirculation systems.

Two brew pumps control the transfer of liquids through stages of sparging, fire-mashed recirculation, and wort chilling. Both systems are on swivel casters so mobility is a breeze. Having two systems can make for some great brew days.

I can create 20 gallons (76 L) of brew in almost the same time most people take to make 5 gallons (19 L). Some brew sessions consist of two different beers being brewed while others utilize both systems to create some unique decoction mash beers that would take forever with only a single system. One thing is for sure, when you brew 20-gallon (76 L) batches, friends are never far away to help consume the creations!



2



4



6



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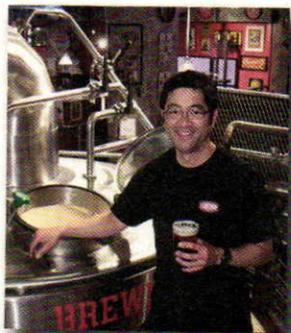
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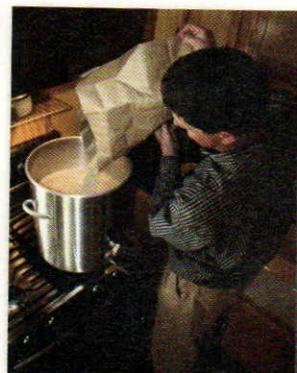
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## replicator

by **Marc Martin**

Dear Replicator,

I have a request for the Great Lakes Brewing Edmund Fitzgerald porter. I have made lots of my own porters and stouts, however, there is just something about their version of porter that is different. If I could get a recipe that was very close I would be thrilled.

*Bill Somrak  
Madison, Ohio*

**W**hile Cleveland, Ohio is famous for the Rock and Roll Hall of Fame and its waterfront, it is also home to several excellent breweries and brewpubs. In 1997 the American Homebrewers Conference was held in Cleveland and one of my fondest memories is of a private tour at Great Lakes Brewing. I still recall thinking that their porter was fantastic and that one day I would attempt to duplicate it. Your request has inspired me to brew it too.

When contacting the brewery for details I was fortunate enough to talk with one of the co-owners, Patrick Conway. In the mid 80s he and his brother, Daniel, often discussed their shared appreciation of the wonderful beers they had enjoyed while studying and traveling in Europe. In 1987, armed with Daniel's business knowledge and Patrick's "can do" attitude, they developed a business plan and made the jump by purchasing a historic downtown Victorian building. Great Lakes Brewing opened in 1988 as the first micro-brewery/brewpub in the state. Part of their original facility had a rich beer history as The Market Tavern, established in 1865. One of its most notorious patrons was Elliot Ness, leader of the famed Chicago's "Untouchables" Prohibition agents. The Taproom houses Cleveland's oldest bar made of Tiger Mahogany complete with bullet holes said to have come from Elliot Ness himself.

In the beginning the Conways solicited the expertise of master brewer Thaine Johnson to develop recipes and incorporate brewing techniques like those used by European breweries. The first brew was a Dortmund-style beer called The Heisman, named for the famous football player who lived around the corner from the brewery. That first year only 1,000 barrels were produced but word of their great



beer spread quickly. Heisman was renamed Dortmund Gold and was soon joined by several other popular styles.

Growing demand has necessitated two major expansions since then. One in 1992 and another eight million dollar project in 2000. Three of the buildings that were renovated had originally served as horse stables and kegging facilities for the long defunct Schlather Brewing Company, which was built in 1878. The brewery is now housed in six buildings and has increased from an original seven-barrel system to a 75-barrel brewhouse. The increased capacity now allows distribution in nine surrounding states. An interesting side note is that a monk visiting the neighboring Saint Ignatius High School christened their new kettles.

Patrick reports that even though Dortmund Gold is their flagship beer, the Edmund Fitzgerald Porter makes up fifteen to twenty percent of their sales - and they keep it available year round. He describes it as a robust porter but with a slightly lighter, creamy mouthfeel. Flavor begins with sweet roastiness coupled with bittersweet chocolate and coffee notes dominate the long aftertaste. The color is deep brown with beautiful garnet highlights topped with a tight tan head that follows to the bottom of the glass. This is a beer that is best served in the 50 °F (10 °C) degree range and Patrick says that it makes a perfect complement to many chocolate-based desserts.

Judges obviously agree that this is an excellent example of the style as it has earned ten gold medals since 1991 and The Brew Site ([www.thebrewsite.com](http://www.thebrewsite.com)) rates it as one of the 50 beers you have to drink before you die.

Now Bill, you can satisfy your yearning for this excellent porter because you can "Brew Your Own." For further information about the brewery and their other fine beers visit the Great Lakes Brewing Co. website at [www.greatlakesbrewing.com](http://www.greatlakesbrewing.com) or call them at 216-771-4404.

## Great Lakes Brewing Edmund Fitzgerald Porter

(5 Gallons/19 L, extract with grains)

OG = 1.060 FG = 1.015

IBUs = 37 SRM = 34 ABV = 5.8 %

### Ingredients

6.6 lbs. (3 kg) Coopers light, unhopped malt extract

1.1 lbs. (0.49 kg) light dried malt extract

12 oz. (0.34 kg) crystal malt (60 °L)

8 oz. (0.22 kg) chocolate malt (350 °L)

8 oz. (0.22 kg) roast barley (450 °L)

9 AAU Northern Brewer pellet hops (60 min.) (1 oz./28 g of 9% alpha acid)

2.4 AAU Fuggle pellet hops (30 min.)

(0.5 oz./14 g of 4.75% alpha acid)

2.9 AAU Cascade pellet hops (0 min.)

(0.5 oz./14 g of 5.75% alpha acid)

½ tsp. Yeast nutrient (last 15 minutes of the boil)

White Labs WLP 013 (London Ale) or Wyeast 1028 (London Ale) yeast

0.75 cup (150 g) of corn sugar for priming (if bottling)

### Step by Step

Steep the crushed grain in 1.5 gallons (5.6 L) of water at 155 °F (68 °C) for 30 minutes. Remove grains from the wort and rinse with 2 quarts (1.8 L) of hot water. Add the liquid and dried malt extracts and bring to a boil. While boiling, add the hops, yeast nutrient as per the schedule. Now add the wort to 2 gallons (7.6 L) of cold water in a sanitized fermenter and top off with cold water up to 5 gallons (19 L).

Cool the wort to 75 °F (24 °C). Pitch your yeast and aerate the wort heavily. Allow the beer to cool to 68 °F (20 °C). Hold at that temperature until fermentation is complete. Transfer to a carboy, avoiding any splashing. Condition for one week and then bottle or keg. Allow the beer to carbonate and age for two weeks.

### All-grain option:

This is a single step infusion mash using a total of 11 lbs. (5 kg) 2-row pale malt. Mix the crushed grains with 3.75 gallons (14 L) of 170 °F (77 °C) water to stabilize at 155 °F (68 °C) for 60 minutes. Sparge slowly with 175 °F (79 °C) water. Collect approximately 6 gallons (23 L) of wort runoff to boil for 60 minutes. Reduce the 60-minute hop addition to 0.75 oz. (21.3 g) Northern Brewer pellet hops to allow for the higher utilization factor of a full wort boil. Follow the remainder of the extract with grains recipe.

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## Homebrew CALENDAR

### December 5 Temecula, California TVHA Homebrew Competition

The 2009 TVHA Homebrew Competition will be held at the Black Market Brewery in Temecula, California on December 5. Entries for the competition must be received by November 25. Entry fee is \$5 per entry and registration must be done online. For info, visit <http://competition.temeculahomebrewers.com/>.

### December 5 Dunedin, Florida Walk the Line on Barleywine

Florida's Walk the Line on Barleywine homebrew competition has been expanded this year to include imperial styles. Entry fee is \$6 per entry and deadline for entries is November 28. Visit <http://www.dunedinbrewersguild.com/> for more information.

### December 12 Signal Mountain, Tennessee Fugetaboutit Homebrew Competition

The Barley Mob Brewers of Chattanooga are proudly hosting their first-annual Fugetaboutit Homebrew Competition. This year's event will be held on top of Signal Mountain near Alexian Village. All entries will be judged according to the 2008 BJCP guidelines. More information, rules and deadline can be found at <http://www.barleymob.com> or email Tony Giannasi at [tony@giannasi.com](mailto:tony@giannasi.com).

### December 12 Hampton, Virginia Virginia Beer Blitz

The third annual Virginia Beer Blitz homebrewing competition will be held on Saturday, December 12, at 9 a.m. at the St. George Brewing Company in Hampton, Virginia. The BJCP/AHA sanctioned competition will accept entries in 28 categories including cider and mead. Deadline for online registration is November 30 and all entries must be physically received for judging by December 5. Visit [www.colonialalesmiths.org/beerblitz](http://www.colonialalesmiths.org/beerblitz) for more information.

# BEGINNER'S block Keeping Warm

by Betsy Parks

**C**older months are good opportunities to brew lagers and other cooler fermenting styles, but there are ways to keep your fermentations warm if you're not ready to give up on ales for the season. Even though it is chilly, you can still brew what you like as long as you find a way to maintain the proper temperatures throughout the fermentation.

## Why warm

No matter what style of beer you plan to brew, the yeast you choose will prefer a specific temperature range in order to thrive. For instance, most ale yeasts do their best work in the 68 to 72 °F (20 to 22 °C) range, while lager yeasts like temperatures from 45 to 55 °F (7 to 13 °C). Individual strains come with particular temperature recommendations, but cold temperatures, especially for warm-fermenting ale yeasts, will prevent the yeast from expressing the flavors and aromas that hallmark particular styles, such as in wheat beers and farmhouse ales. More importantly, the colder temperatures will also slow or even stop the fermentation.

## How it's done

One of the easiest ways to keep your beer warm and prevent too much temperature fluctuation is to wrap the outside of the fermenter with a blanket or some kind of barrier to insulate it against the fast-changing air temperatures.

If you are fermenting in a carboy, you can also use a carboy jacket, which are available at many homebrew supply stores. If your fermentation needs an additional heat source, you can use a FermWrap heater, which is like a carboy-sized electric heating pad (about \$40). These types of wraps will raise the temperature of a 5-gallon (19-L) batch by about 10 °F (5 °C). You can also use a FermWrap in conjunction with a temperature control probe and stopper for more control over the heat. Some brewers have used regular electric blankets in the same

way, however, electric blankets can create too much heat, are not as easy to control, and are notoriously unsafe for homebrewing as they can cause serious electrical injury if they come in contact with liquid.

Some brewers keep their fermentations warm with submersible, aquarium heaters. The best way to use these heaters is to submerge your fermenter in a large tub of water and put the aquarium heater in the tub of water. The water temperature you maintain in the tub will dictate the temperature in the fermenter. Keep in mind that you will need a heater that can heat all of the water in the tub as well as the liquid in the fermenter. For example, a 200–300 watt heater will warm 20 gallons (76 L) about 10 °F (5 °C).

If you have access to a temperature-controlled fermentation box, such as an old refrigerator, you can use this to prevent large fluctuations in temperature. Incorporate a 60 to 100-watt light bulb to the box to increase the heat, just be sure the bulb doesn't come in contact with the fermenter or any of the surfaces of the fermentation box to prevent anything melting or causing a fire. Again, always monitor the temperature to make sure you aren't heating the wort too much or letting it get too cold.

## Maintain the temperature

Of course, no matter what style you brew, maintaining constant temperatures is always the most important principle to observe in order for the yeast to thrive as well as perform at its best. A stick-on thermometer is easy, cheap and helpful for keeping an eye on the temperature without opening the fermenter. Avoid keeping your fermenter in a place where the temperature changes more than a few degrees throughout the day or where you know the air dips below fermentation temperatures, such as the garage. Fermenting indoors can also be a problem if the heat in your home spikes and drops, such as a glassed-in porch, or if you turn the heat down at certain times of the day or night. ☺

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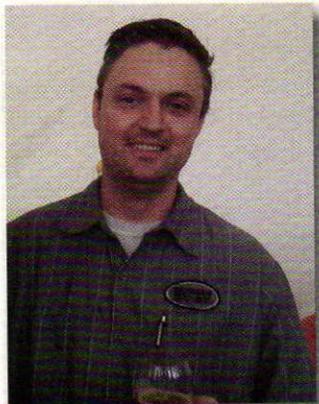
homebrew NATION

# Using Hop Extracts

## Exploring fresh hop alternatives

by Betsy Parks

*Hop extracts and oils aren't what most brewers think of when coming up with a beer recipe, and they aren't used all that often in the craft brewing or homebrewing realms. Extract and oils can, however, be of use in certain types of beers. This issue three hop-loving experts explain when and how to use extracts and oils.*



**VINNIE CILURZO**, Brewer and Owner, Russian River Brewing Company in Santa Rosa, California. Vinnie was hired as the Brewmaster at Russian River when it was founded by Korbelt Champagne in 1997. He and his wife bought the business in 2002. Over the years Vinnie has earned many awards for his brewing, including two bronze medals at the 2009 Great American Beer Festival for Blind Pig IPA in the

American-Style India Pale Ale category and for Supplication in the Belgian-Style Lambic or Sour Ale category.

**W**e use hop extract at Russian River for a few of our beers, but we only use it for bittering. We do not use any hop oils for aroma in the finish

of the boil or for dry hopping.

There are a few reasons we use hop extract, particularly in Pliny the Elder and Pliny the Younger, mainly because it eliminates a lot of the green matter we would have accumulated in the kettle if we were to use pellets (or flowers). So by using the hop extract we eliminate all the vegetal flavor that the mass of hops leaves behind when used in a large quantity. Also, the hop extract really helps with yields as all those hops in the kettle, whether they are pellets or flowers, absorb a lot of wort so by using the extract you really gain a good amount of wort back, particularly in a double IPA.

One of the most important things to keep in mind when using hop extract for bittering, particularly for a homebrewer or anyone brewing small batches is to be very, very careful that the quantity you are adding is correct and well measured out. A little goes a long way and even the smallest amount extra will over bitter your beer. Some brewers are opposed to the use of extract. I think this is more from a traditional standpoint. If brewers can get over the fact that using hop extracts is a non-traditional way of brewing, the technique can really work towards their advantage in certain hoppy beers.



**TOMME ARTHUR**, Director of Brewery Operations for Pizza Port and Port Brewing Company as well as Head Brewer for The Lost Abbey, all based in San Marcos, California. A native San Diegan, Tomme returned to San Diego in 1995 after earning his Bachelor of Arts in English from Northern Arizona University where he cultivated his

passion for brewing. In March of 1996, he began his professional brewing career at the now defunct Cervecerias La Cruda (The Hangover Brewery) in downtown San Diego.

After La Cruda closed its doors in March of 1997, Tomme went to work for White Labs in San Diego. In May of 1997 he was hired by Pizza Port in Solana Beach where he remained the Head Brewer until June of 2005 when he was named the Director of Brewery Operations.

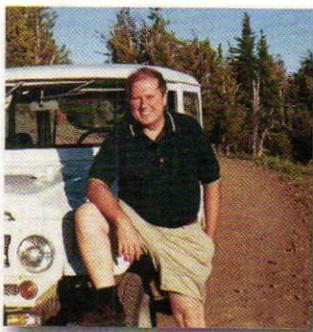
**O**ne example of a benefit to using hop extracts is that when we use CO<sub>2</sub> extract hop oil for bitterness, we reduce the amount of trub in our kettle and increase our yields, which at the commercial scale is a very impor-

tant cost savings function.

The main drawbacks for using oils are the stigmatism associated with them and the fact that not all hop varieties are converted into extract form and therefore extract options can be somewhat limited. Also, not all hop oils are varietal specific, and as such you may not know exactly where the alpha acids came from (although they typically come from high alpha acid variety hops like Warrior, Columbus, etc.)

Hop oils can be used interchangeably with regular hops, but there is always a bit of tinkering that needs to be done. We use them for 90- and 60-minute additions, but prefer to stay away from them as aromatic additions. There are several different ways the oils are packaged. We currently use only non-isomerized oils for our beers. There are Tetra additions, and others (beta oils as well), but all of these varieties and the techniques go way over my head for day-in and day-out use of hop oils. Duvel, for example, uses tetra hop oil for aromatic properties. It also contributes to foam stability and retention.

Using hop oils for small batches is typically not practical. Our cans come measured in 300-gram units. Trying to measure this down into a useable format that could be used in homebrewing scales would be tough. But it may be done if you can purchase small enough amounts to be appropriate for small batches.



**RALPH OLSON**, General Manager and Owner of HopUnion CBS LLC. Ralph is a hop expert who has been buying, selling, handling, storing and processing hops for more than 25 years. In past years he has served as President and on the Board of Governors for the Master Brewers Association of America, chaired the advisory

board for the Brewers Association and was a member of the Board for the Brewers Association transition. In 2003 Ralph attended the International Hop Grower's Congress where he was awarded the international "Order of the Hop."

**h**op extract works like regular hops — you have to boil it. It is only used for bittering. It is generic, meaning that there is no one specific hop in each extract. It is most often used by big brewers to bitter large batches, but some craft brewers use it because they're trying to put so many hops in their kettle, they're trying to cut down on the amount of the vegetative matter. Extracts also have long shelf lives as they are stored in sealed cans and don't have to be kept cold like fresh hops.

I don't think that homebrewers will encounter using extracts

very often (if at all). It's easy to work with in a commercial-sized batch, but it's not like whole hops or hop pellets, although it does nothing different than a high-alpha hop addition. In a big brewery they take the cans and drop the whole thing in the kettle. Most brewers who use extracts often use a combination of extract and fresh hops or pellets.

It is very concentrated, very sticky and it stains. Think of it as like liquid tar, and that's about the way that it would react on the carpet. This is why it is not used much for small batches — it's like trying to take a tiny amount from a can of tar and get it into your brew kettle. I don't know of anyone who packages the extract in a small enough size to be useful to hobbyists.

There are also other hop alternative products like hop oils that you can add to your boil to get the resin out, but these products have to be mixed with a very high proof alcohol (190 proof) to work, and can also be tricky to brew with. Also, like fresh hops, hop oils need to be stored cold.

Probably the most common way you would come across hop extracts in homebrewing is in a kit. Some Australians have been putting hop extract in with the malt extract, and in that case you would not need to measure the extract as the kit manufacturer has already done it for you.

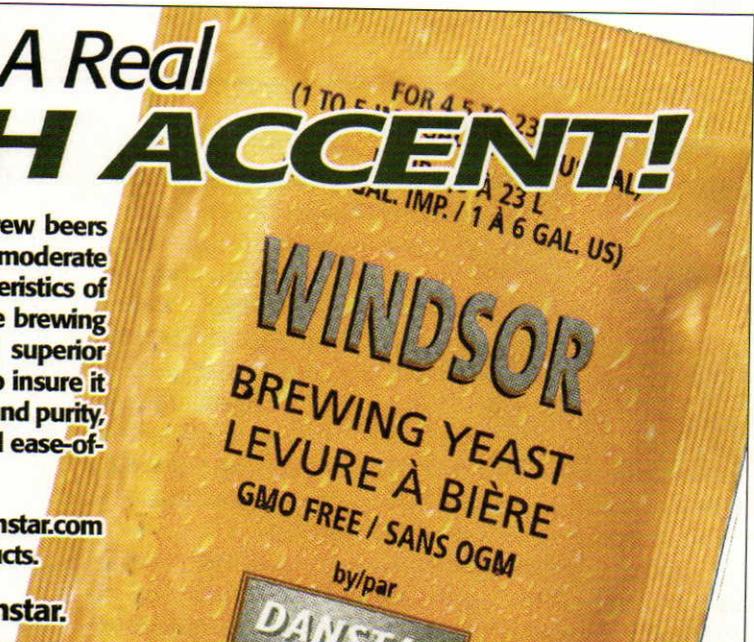
The biggest problem I could see for homebrewers is getting the right amount. As I mentioned, nobody makes extract packaging in that small of a size. Hop extract use even in the craft brewing world is less than one tenth of one percent. ☹

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# Adding Air

## Irish moss, malt flavor, welding woes

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

by Ashton Lewis

### Aeration clarification

I have been a homebrewer for four years and have noticed quite a few articles in *BYO* regarding aerating the wort to promote initial yeast growth. These procedures range from shaking or stirring rapidly to injecting O<sub>2</sub> directly into the wort via an in-line setup. (July-August 2009, Vol. 15, No. 4). Having been deeply immersed in the saltwater aquarium hobby prior to homebrewing (I owned and maintained a 300-gal./1,136-L tank), I read many similar articles in aquarium magazines, which stated that the air stones in aquariums only served to aerate the water by providing movement across the surface of the water. This movement promotes the exchange of oxygen at the surface; breaking the surface tension to allow for aeration. There was no "oxygen injection" directly into the liquid, only at the surface interface. The articles I read in *Brew Your Own* seem to indicate that the air stones, O<sub>2</sub> injectors, etc. actually provide a direct injection of air into the wort - so how is wort any different?

Steven C. Tillman, O.D.  
Denver, Colorado

I am not familiar with the specifics of aquarium aeration, but it seems odd to me that aquarium aeration is mainly considered a method of agitation. Gas diffusion into liquids is a function of gas surface area, concentration gradient between gas in the bubble and gas concentration in the liquid, and contact time. A very common method of increasing the area when dissolving gas into a solution is to make very small bubbles with a sparging stone. In brewing, this method is used to aerate wort and also to carbonate beer. In other fermentation systems, such as those used for the production of pharmaceuticals, similar methods are used to supply oxygen to growing cell cultures.

Prior to the use of closed wort cooling systems and closed fermenters, wort was aerated by exposing a large surface area of wort to the atmosphere. Many breweries used Baudelot chillers to cool wort. These

falling film chillers cooled the wort by allowing wort to cascade over an undulating copper surface, where chilled water passed on the opposite side of the wort. In the process of cooling, the wort was also aerated. Other brewers used large, shallow cool ships to chill and aerate wort. Others used a combination of the two. The

"The reason that Irish moss works as a fining agent is that it has a high density of negative charges on its surface and when added to wort it binds with certain proteins that have positive surface charges."

big downside to these methods was bacterial and wild yeast contamination.

When the plate heat exchanger replaced these cooling methods a different type of aeration was required since the plate heat exchanger chiller is closed to the atmosphere and fermenters, even when open, are usually too deep to provide much interface between the atmosphere and wort. To address the aeration dilemma, wort aeration was performed by injecting air or oxygen directly into the wort stream. Almost all beer that you buy from commercial brewers is made using some sort of wort aeration device. There are several common designs, but they all work by transferring oxygen directly into

the wort stream. The Springfield Brewing Company where I work has a Venturi device that uses sterile-filtered compressed air.

Although I cannot reconcile the differences between aquarium and brewing magazines, I can assure you that wort aeration works by the various methods you list in your question and can also assure you that proper aeration makes a big difference to beer. Properly aerated wort will ferment faster and cleaner than wort that is under-aerated, assuming both are pitched with healthy yeast at the proper concentration. And for that reason I suggest something that is actually designed for aeration, as opposed to shaking or rocking your carboy. Aeration devices are not expensive and they provide a very important function in setting the stage for fermentation.

### Irish moss substitutions?

I have read about using Irish moss in brewing to clarify beer but I have not tried it yet. I am curious, however, as to whether or not I could use other sea vegetables in the same way or as a nutrient boost in my homebrews. Would there be any advantage or disadvantage to adding kelp/kombu or alaria/wakame (or any of the other number of seaweeds) to the wort? Would it matter when I added it?

David Bigelbach  
Shirley, Massachusetts

Irish moss is the general name given to the red algae *Chondrus crispus* that grows in the Atlantic ocean off the shores of Europe and North America. The reason that Irish moss works as a fining agent is that it has a high density of negative charges on its surface and when added to wort it binds with certain proteins that have positive surface charges. Like many things added to beer I often wondered when some brewer decided to add this "seaweed" to the kettle . . . it probably was the same brewer who added fish swim bladders to beer!

The nice thing about Irish moss is that

## "Help Me, Mr. Wizard"

it works and it is pretty cheap. I have never heard of adding kelp or wakame to wort for similar purposes. I suppose they may contain similar charged polysaccharides and may also act as fining agents. The only way to know is to give these other seaweeds a try. But I don't see much advantage since the use of kettle finings is pretty simple and these other seaweeds most likely will perform no better than Irish moss and may not work as well.

### Mashing malt

I think very grainy flavors are really good, especially with those clean German Lagers. I have tried to get this flavor by striking in hotter, step mashing, mashing longer, and mashing longer at below conversion temperatures. Of these different methods, some were successful but there is no consistency when I try it again. My mentor tells me it's the type of grain I use. How do you get those awesome grainy flavors?

*Kevin Adams  
Norcross, Georgia*

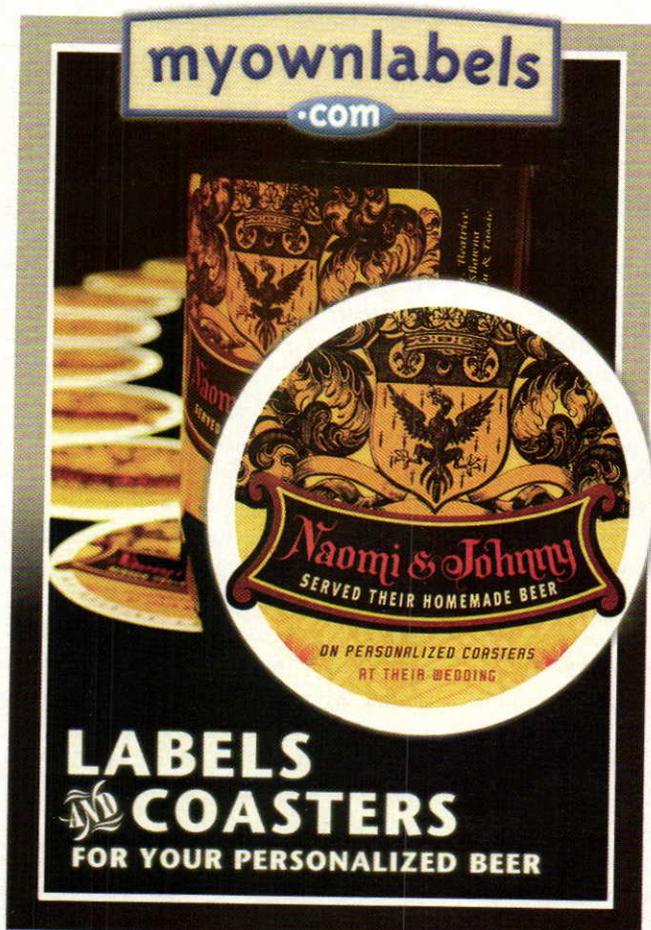
It's nice to hear the term mentor used, as it seems to me that many people today could use a good mentor. Mentors prevent us from constantly reinventing the wheel and a good brewing mentor can teach a lot of the art of brewing that you don't get from reading books and blogs. My mentor was my graduate professor, Dr. Michael J. Lewis, and he continues to influence brewers young and old with his ideas about beer and brewing.

When I was a student eager to learn about brewing, which of course begins with mashing, I was disappointed that Michael's brewing science curriculum began with the agricultural aspects of barley and hop growing. At the time I was certainly interested in these topics, but I was intent on being a brewer and was anxious to get on with the mashing lectures. But that would have to wait because after learning about growing barley we then had to learn about malting. See, Michael worked in a malting facility at a young age and has the big soft spot in his heart for maltsters. Malting seemed really boring at

the time and I was certain that the real action of beer brewing occurs in the brew-house and was again anxious to get on with the mashing lectures.

That was eighteen years ago and these days I am fairly convinced that my mentor was right on target with drilling the importance of barley and malting (and hops) into the brains of his nascent brewers. You don't end up with really nice flavors from malt without beginning with really nice malt. You can attempt to convince yourself that using really intricate mashing methods will lend all sorts of complex grain flavors, but you will probably discover, as I did, that things go much better if you start with great malt.

I take a pretty simple approach to brewing by recognizing some really obvious and important facts. Some of my philosophy of brewing is centered in the importance of the raw materials for brewing. When I formulate a new beer I mentally "go to the grocery store" and select the ingredients of my beer. Today this is pretty easy, but our brewing ancestors often

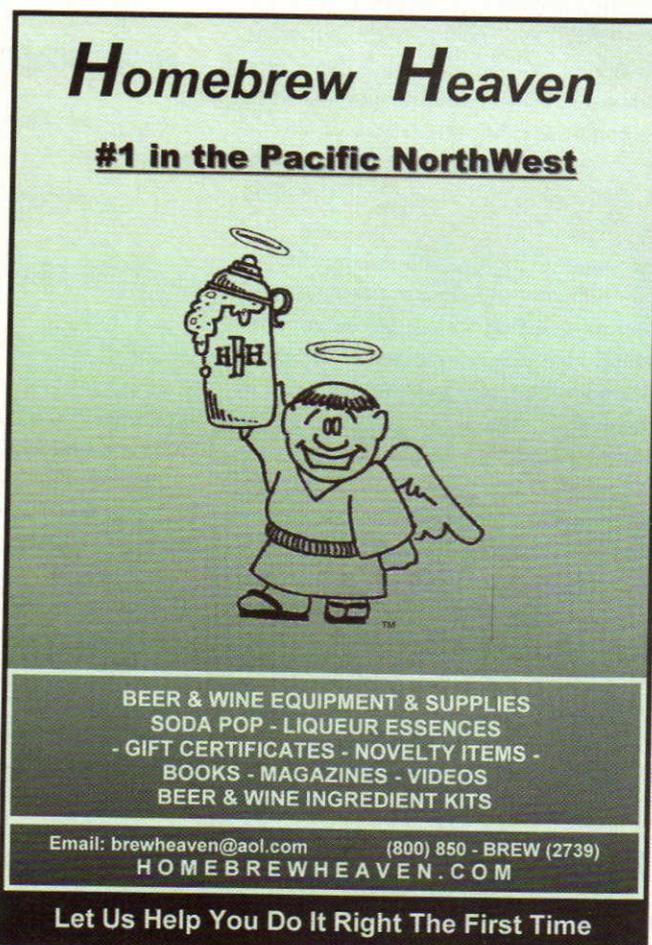


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had to develop their own raw materials; this is why malting and brewing are taught together in formal brewing classes.

When sourcing your ingredients you need to have an idea of the flavors you wish to add to the beer and seek ingredients with these characters. Go to a homebrew store with a good selection of malts and taste the grains. If you chew malt that has a very mild grainy flavor, don't expect your mashing methodology to turn this subtle raw material into a source of rich flavors. I rely pretty heavily on Munich malts for malt complexity in the toasty, nutty realm and not so much malt sweetness. If I want to brew a beer that has this toasty, nutty character and also malt sweetness I use crystal malts to add the caramel, toffee characters. If I want candy-like sweetness I use crystal malts very low in color. As color with crystal malts increases so does the flavor intensity.

Malt flavor comes from malt. The fact is that brewers today have it pretty darn good since there are many exceptional raw material suppliers that sell their products to brewers large and small. I am not downplaying the importance of mashing, but if you had to answer the question, "what is the purpose of mashing in beer brewing?" the answer would not begin with the formation of complex flavors from malt; that primarily happens in the kiln. Listen to your mentor and look for malt flavor from malt.

### Multi-purpose brew room

I am a beginner brewer and have a strong interest in brewing both beers and wines. I also make cheeses and other food items on the side. I am planning a new home construction, which includes a basement and possible sub-basement of my own design. My main question is if I can ferment beers and wines in the same room without the risk of contamination? And with the other foods, I use bacterial cultures as well as several other types of yeast both engineered and wild. I also work with edible mushroom spores to grow my own mushrooms.

Verne Leo  
via email

without a huge risk of contamination. In my mind this is no different than using multiple yeast strains in the same brewery. This practice at one time was very uncommon in commercial breweries, but these days the practice is quite common and commercial brewers are doing this with great success.

So how about the other organisms in the same room? The mushrooms don't worry me much because mushroom

spores don't spoil beer. However, the bugs used to make cheese can and do spoil beer and wine. But again, look at what a large number of US craft brewers are doing to make sour beers. These brewers are intentionally bringing the most obnoxious beer spoilage organisms into their breweries and encouraging them to grow. Most sour beers use a mix of lactic acid bacteria and the ever-funky yeast *Brettanomyces* to develop the flavor com-

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**t**he short answer to this question is that you can certainly ferment beer and wine in the same room

## "Help Me, Mr. Wizard"

plexity in these beers.

The keys to handling multiple organisms in the same general area are: A.) A good understanding of how cross-contamination occurs. B.) Using common tools that can be cleaned and sanitized. C.) Having special tools dedicated to your various special processes (a special tool is something that cannot be safely used for multiple duties, such as an oak barrel inoculated with *Brettanomyces*). D.) Adopt a fanatical approach to cleaning and sanitation. With control over sanitation you will have a fair shot of success.

### Welding concern

I have been brewing for years, and my brewing equipment is constantly being upgraded. I was able to buy some kegs, cut them, drill them, and had 1/2" NPT couplers welded on for ball valves and thermometers. I am concerned about the wire the welding company used for MIG/TIG welding. I know that if they brazed the kegs or used a "generic" wire that the welds may not be foodsafe. How can I

rest assured that beer made in my kettles is safe to drink?

Aaron Baxter  
Blacksburg, Virginia

**W**hen you have things welded to kegs or other legally obtained stainless steel containers it is important to use weld wire that is consistent with the metal alloy of the parts being welded. Without drifting into the nomenclature of stainless steel types, if you know that your local welder used either type 304 or 316 weld wire you will be fine. Most kegs are made using type 304 stainless steel. This alloy is also called "18/8" since it contains about 18% chromium and 8% nickel in the alloy.

The primary difference between types 304 and 316 is that 316 contains about 2% molybdenum; this element adds some resistance to pitting caused by chlorides. Types 304 and 316 stainless steel are the most common alloys used to produce food processing equipment, including tanks, piping, pumps and valves. And

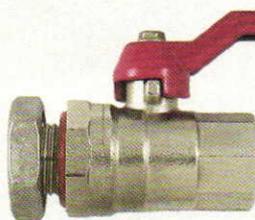
since both alloys are fairly similar you can always use the "higher alloy" 316 to weld 304 to 304 or 304 to 316. The difference in cost between the alloys is not insignificant because molybdenum is expensive, but the difference is pretty trivial when you are buying weld wire. In other words, ask your welder to use type 316 weld wire and you will be fine. ☺



*Brew Your Own* Technical Editor Ashton Lewis has been answering homebrew questions as his alter ego Mr. Wizard since 1995. A selection of his Wizard columns have been collected in "The Homebrewer's Answer Book," available online at [brewyourownstore.com](http://brewyourownstore.com).

Do you have a homebrewing question for Ashton? Send inquiries to *Brew Your Own*, 5515 Main Street, Manchester Center, VT 05255 or send your e-mail to [wiz@byo.com](mailto:wiz@byo.com). If you submit your question by e-mail, please include your full name and hometown. In every issue, the Wizard will select a few questions for publication. Unfortunately, he can't respond personally. Sorry!

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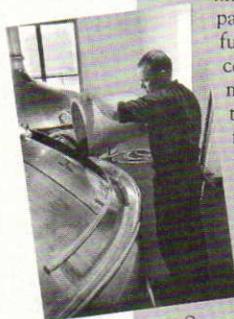
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— Mike Mizioro  
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# Big and Bold

## Russian imperial stout

by Jamil Zainasheff

**R**ussian imperial stout was one of the first beer styles that caught my interest. I remember tasting North Coast Old Rasputin as I read and reread the BJCP style guidelines for the style. I also liked the idea that this was, according to the Courage Brewery, the beer of "Catherine II, Empress of all the Russias" as far back as the late 18th century. How cool is that? I would be happy brewing beer for my local city councilperson. Two hundred years ago, brewers were exporting this beer from England to the Russian Imperial Court and around the Baltic states. It is wonderful to see that this beer has survived so many changes of fortune over the past 200 years.

There are two variants of the style, English and American. As you might expect, the American versions are bolder, cleaner and often feature American hops. The English versions are more complex and feature more fermentation character. No matter what the variant, Russian imperial stout is as big, rich, and intensely flavored as a stout can be. It seems that in this style there are no upper limits, only

minimums. At a minimum, a good version of this beer needs to have a big roasted malt character that is reminiscent of coffee, dark chocolate and even tar-like notes. There should also be dark fruits, hops, and warming alcohol, although the alcohol should never be hot or harsh.

Russian imperial stout ranges from dark reddish-brown to jet black. The overall balance is often bittersweet, though some examples might be more bitter and others might be more sweet. Regardless, there is always some sweetness to help balance the substantial bitterness of the roasted grains and hops. The finish ranges from sweet to dry, though the best examples finish closer to balanced. While this is a full-bodied, creamy beer, it should not be syrupy-thick or cloying. Fruity esters range from low to medium-high. It can be a variety of esters, but the ones that really seem to fit well with the style are dark, dried fruit flavors such as raisin, prune and fig.

Late hop character in this style varies from substantial hop character to relatively little. Of course, the amount of hop character present depends on aging. Young samples tend to be hoppy, while aged beers have progressively less hop character over time.

While this style has a substantial amount of alcohol, it should never be hot or solventy. This is one of the most common mistakes brewers make when brewing a big beer. Paint thinner is never an acceptable flavor or aroma.

You have some flexibility in choosing base malt for Russian imperial stout. Using domestic two-row gives the beer a clean, subtle, background-malt character common to many American craft beers. Using domestic pale ale malt adds a slightly richer background malt character, somewhat of a light bread note. Again, this is

Continued on page 21



### RUSSIAN IMPERIAL STOUT by the numbers

OG: . . . . .1.075–1.115 (18.2–26.9 °P)	IBU: . . . . .50–90
FG: . . . . .1.018–1.030 (4.6–7.6 °P)	ABV: . . . . .8.0–12.0%
SRM: . . . . .50–90	

StyL<sup>e</sup> profile

## RECIPE

### Russian Imperial Stout The Czar's Revenge (5 gallons/19 L, extract with grains)

OG = 1.098 (23.4 °P)  
FG = 1.030 (7.5 °P)  
IBU = 77 SRM = 61 ABV = 9.2%

#### Ingredients

11.4 lb. (5.17 kg) Edme Maris,  
Muntons or similar pale English  
liquid malt extract  
22 oz. (624 g) Great Western roasted  
barley 500 °L  
14 oz. (397 g) Dingemans Special B  
120 °L  
8 oz. (227 g) Briess caramel Munich  
60 °L  
7 oz. (198 g) Briess chocolate malt  
350 °L  
7 oz. (198 g) Crisp pale chocolate  
malt 200 °L  
15.99 AAU Horizon hops  
(1.23 oz./35 g at 13% alpha acids)  
(60 min.)  
8.3 AAU Kent Goldings hops  
(1.66 oz./47 g at 5% alpha acids)  
(10 min.)  
8.3 AAU Kent Goldings  
(1.66 oz./47 g at 5% alpha acids)  
(1 min.)  
White Labs WLP001 (California Ale),  
Wyeast 1056 (American Ale) or  
Fermentis Safale US-05 yeast

#### Step by Step

Mill or coarsely crack the specialty malt and place loosely in a grain bag. Avoid packing the grains too tightly in the bag, using more bags if needed. Steep the bag in about 1.5 gallon (~6 liters) of water at roughly 170 °F (77 °C) for about 30 minutes. Lift the grain bag out of the steeping liquid and rinse with warm water. Allow the bags to drip into the kettle for a few minutes while you add the malt extract. Do not squeeze the bags. Add enough water to the steeping liquor and malt extract to make a pre-boil volume of 5.9 gallons (22.3 L) and a gravity of 1.084 (20.2 °P). Stir thoroughly to help dissolve the extract and bring to a boil.

The total wort boil time is 60 minutes. Add the bittering hops as soon as the wort begins to boil. Add Irish moss or other kettle finings with 15 minutes left in the boil. Add the remaining hop additions at 10 min-

# RECIPE (continued)

utes and 1 minute. Chill the wort to 67 °F (19 °C) and aerate thoroughly. The proper pitch rate is 16 grams of properly rehydrated dry yeast, three packages of liquid yeast or one package of liquid yeast in a 6-liter starter.

Ferment at 67 °F (19 °C) until the yeast drops clear. Allow the lees to settle and the brew to mature without pressure for another two days after fermentation appears finished. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar and bottle. Target a carbonation level of 2 to 2.5 volumes. Store the beer in a cool, dark place and allow to age. The beer will improve over time and should mature six or more months before drinking.

## The Czar's Revenge

(5 gallons/19 L, all-grain)

OG = 1.098 (23.4 °P)

FG = 1.030 (7.5 °P)

IBU = 77 SRM = 61 ABV = 9.2%

### Ingredients

- 17 lb. (7.71kg) Crisp British pale ale malt or similar 3 °L
- 22 oz. (624 g) Great Western roasted barley 500 °L
- 14 oz. (397 g) Dingemans Special B 120 °L
- 8 oz. (227 g) Briess caramel Munich 60 °L
- 7 oz. (198 g) Briess chocolate malt 350 °L
- 7 oz. (198 g) Crisp pale chocolate malt 200 °L
- 15.99 AAU Horizon hops (1.23 oz./35 g at 13% alpha acids) (60 min.)
- 8.3 AAU Kent Goldings hops (1.66 oz./47 g at 5% alpha acids) (10 min.)
- 8.3 AAU Kent Goldings (1.66 oz./47 g at 5% alpha acids) (1 min.)
- White Labs WLP001 California Ale, Wyeast 1056 American Ale or Fermentis Safale US-05

### Step by Step

Mill the grains and dough-in targeting a mash thickness that will enable your system to achieve the necessary pre-boil volume and gravity. Hold the mash at 154 °F (68 °C) until enzymatic conversion is complete. Infuse the mash with near boiling water while stirring or with a recirculating mash system raise the temperature to mash out at 168 °F (76 °C). Sparge slowly with 170 °F (77 °C) water, collecting wort until the pre-boil kettle volume is around

6.5 gallons (25 L) and the gravity is 1.076 (18.4 °P). If your system loses efficiency on big beers, start with an additional 4 to 5 lbs. (2 kg) of base malt or make sure you have a couple of pounds (1 kg) or more of malt extract on hand to make up any deficiency in efficiency.

The total wort boil time is 90 minutes. Add the bittering hops with 60 minutes remaining in the boil. Add Irish moss or other kettle finings with 15 minutes left in the boil. Add the remaining hop additions at 10 minutes and 1 minute. Chill the wort to 67 °F (19 °C) and aerate thoroughly. The proper pitch rate is 16 grams of properly rehydrated dry yeast, three packages of liquid yeast or one package of liquid yeast in a 6-liter starter. Follow the remainder of the extract with grains recipe.

## Mike Riddle's Tricentennial Stout

(5 gallons/19 L, extract with grains)

OG = 1.100 (23.8 °P)

FG = 1.037 (9.2 °P)

IBU = 100 SRM = 100 ABV = 8.5%

*Many consider Mike Riddle one of the best brewers of this style. He has won many best of show awards with this recipe.*

### Ingredients

- 8 lb. (3.63 kg) Edme Maris, Muntons or similar pale English liquid malt extract
- 2.6 lb. (1.18 kg) Wheat liquid malt extract 2 °L
- 2.25 lb. (1 kg) Great Western chocolate malt 475 °L or similar
- 2.25 lb. (1 kg) Great Western roasted barley 575 °L or similar
- 0.75 lb. (340 g) Great Western crystal malt 120 °L or similar
- 13.97 AAU Northern Brewer hops (2.15 oz./61 g at 6.5% alpha acids) (60 min.)
- 10.73 AAU Northern Brewer hops (1.65 oz./47 g at 6.5% alpha acids) (30 min.)
- 5.46 AAU Northern Brewer hops (0.84 oz./24 g at 6.5% alpha acids) (15 min.)
- 8.25 AAU Kent Goldings hops (1.65 oz./47 g at 5% alpha acids) (15 min.)
- 12.5 AAU Kent Goldings hops (2.5 oz./71 g at 5% alpha acids) (3 min.)
- 8.25 AAU Kent Goldings hops (1.65 oz./47 g at 5% alpha acids) (dry hop)

White Labs WLP004 (Irish Ale) or Wyeast 1084 (Irish Ale) yeast

### Step by Step

Mill or coarsely crack the specialty malt and place loosely in a grain bag. Avoid packing the grains too tightly in the bag, using more bags if needed. Steep the bag in about 1.5 gallons (~6 liters) of water at roughly 170 °F (77 °C) for about 30 minutes. Lift the grain bag out of the steeping liquid and rinse with warm water. Allow the bags to drip into the kettle for a few minutes while you add the malt extract. Do not squeeze the bags. Add enough water to the steeping liquor and malt extract to make a pre-boil volume of 5.9 gallons (22.3 liters) and a gravity of 1.085 (20.5 °P). Stir thoroughly to help dissolve the extract and bring to a boil.

The total wort boil time is 60 minutes. Add the bittering hops as soon as the wort begins to boil. Add Irish moss or other kettle finings with 15 minutes left in the boil and the remaining hop additions according to the hops schedule. Chill the wort to 70 °F (21 °C) and aerate thoroughly. The proper pitch rate is 17 grams of properly rehydrated dry yeast, about 4 packages of liquid yeast, or 1 package of liquid yeast in a 6.3-liter starter.

Ferment at 70 °F (21 °C) until the yeast drops clear. Allow the lees to settle and the brew to mature without pressure for another two days after fermentation appears finished. Transfer to secondary and add dry hops. Allow it to finish fermenting until completely settled, about seven additional days. Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. Target a carbonation level of 2 to 2.5 volumes. Once carbonated, store the beer in a cool, dark place and allow to age. The beer will improve over time and should mature one to three years before drinking.

## Mike Riddle's Tricentennial Stout

(5 gallons/19 L, all grain)

OG = 1.100 (23.8 °P)

FG = 1.037 (9.2 °P)

IBU = 100 SRM = 100 ABV = 8.5%

### Ingredients

- 14 lb. (6.35 kg) Crisp British pale ale malt 3 °L or similar
- 2.25 lb. (1 kg) Great Western chocolate malt 475 °L or similar
- 2.25 lb. (1 kg) Great Western roasted barley 575 °L or similar

1.88 lb (850 g) Great Western wheat malt 2 °L or similar  
 0.75 lb. (340 g) Great Western crystal malt 120 °L or similar  
 13.97 AAU Northern Brewer hops (2.15 oz./61 g at 6.5% alpha acids) (60 min.)  
 10.73 AAU Northern Brewer hops (1.65 oz./47 g at 6.5% alpha acids) (30 min.)  
 5.46 AAU Northern Brewer hops (0.84 oz./24 g at 6.5% alpha acids) (15 min.)  
 8.25 AAU Kent Goldings hops (1.65 oz./47 g at 5% alpha acids) (15 min.)  
 12.5 AAU Kent Goldings hops (2.5 oz./71 g at 5% alpha acids) (3 min.)  
 8.25 AAU Kent Goldings hops (1.65 oz./47 g at 5% alpha acids) (dry hop)  
 White Labs WLP004 (Irish Ale) or Wyeast 1084 (Irish Ale) yeast

#### Step by Step

Mill the grains and dough-in targeting a mash thickness that will enable your system to achieve the necessary pre-boil volume and gravity. Hold the mash at 149 °F (65 °C) until enzymatic conversion is complete. Infuse the mash with near boiling water while stirring or with a recirculating mash system raise the temperature to mash out at 168 °F (76 °C). Sparge slowly with 170 °F (77 °C) water, collecting wort until the pre-boil kettle volume is around 6.5 gallons (25 L) and the gravity is 1.078 (18.8 °P). If your system loses efficiency on big beers, start with an additional 4 to 5 lbs. (2 kg) of base malt or make sure you have a couple of pounds (1 kg) or more of malt extract on hand to make up any deficiency in efficiency.

The total wort boil time is 90 minutes. Add the bittering hops with 60 minutes remaining in the boil. Add the other hop additions according to the schedule. Add Irish moss or other kettle finings with 15 minutes left in the boil. Chill the wort to 70 °F (21 °C) and aerate thoroughly. The proper pitch rate is 17 grams of properly rehydrated dry yeast, about 4 packages of liquid yeast, or 1 package of liquid yeast in a 6.3-liter starter.

Follow the remainder of the extract with grains recipe.

also likely to include some mid-color crystal (40–60 °L), which adds some caramel flavors and some residual sweetness to help balance the bitterness of the roast grains and hops. Even though you have a lot of leeway, you do not want to add a lot of low color crystal malt (< 30 °L), as it adds sweetness without much caramel character. Also, watch the total amount of crystal malt in your recipe. If the total amount exceeds 10% of the grist, it can

result in an overly sweet and heavy beer.

If you are looking for more complexity or increased head retention it is possible to add other malts as well. Wheat malt, Victory, Munich and more are common additions in many recipes. Just use restraint so the beer does not become saturated with unfermentable dextrins or cloying flavors. Keep in mind that with such a big beer there tends to be plenty of body and head-building compounds in

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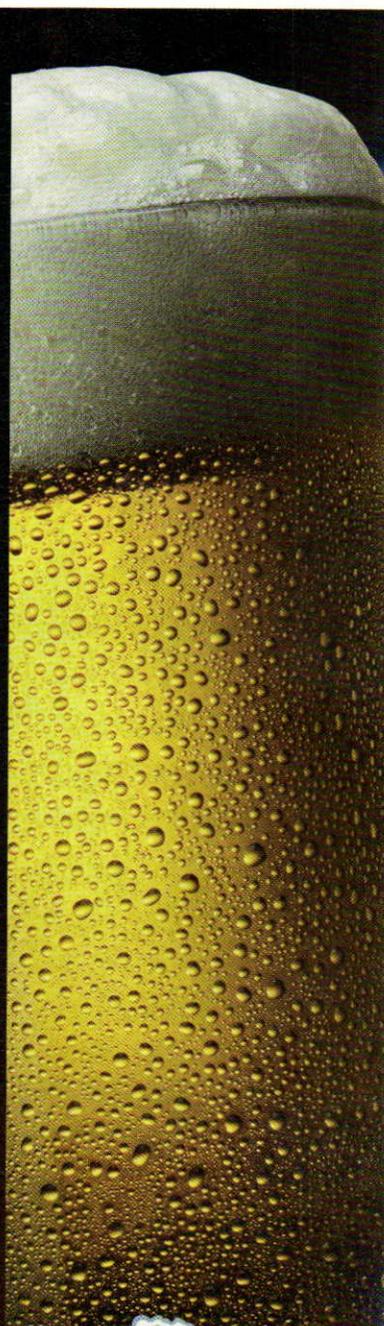
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the large quantity of base malt, so it isn't really necessary to try and boost those aspects of the beer. Target between 0 and 5% for these additional specialty grains.

Traditional British commercial examples most likely include some simple sugar, which boosts the alcohol without increasing the body or malt character. Sugar isn't really a requirement, although it can be a useful tool if you're having trouble reaching a proper level of attenuation.

In which case, replacing a small portion of the base malt with sugar can help the beer finish a bit drier.

Hop flavor and aroma also varies from minimal to bold. In any interpretation, late hop additions are acceptable, but you need to have some idea of when you will be drinking the beer. The longer the period before drinking, the more the late hops will fade. If you want late hop character a couple years down the road, you will need

big late hop additions. Typical hop additions for this style are British or American varieties. You do have plenty of leeway when making your hop choices, including hops from the southern hemisphere. Almost anything is fair game as long as you do not try to build a big German noble hop character or something along those lines. When targeting more of an American interpretation, I like using citrusy or piney American variety hops such as Cascade, Centennial, Columbus and Amarillo for flavor and aroma. For more of a traditional interpretation, any British hop is fine as long as you feel it has a pleasant character. It is the overall impression that matters. You can bitter with almost any hop as well, but clean, neutral hops are most common. The big picture is that you want to have some hop character and a firm bitterness, but both should complement your malt and yeast choices.

In order to cut back on the amount of hop material at the end of the boil and subsequent wort loss, I prefer to use high alpha hops. Even so, with the large hop additions of many recipes, you might want to increase your batch size to account for increased loss at the end of the boil. While all Russian imperial stouts should have a medium to aggressively high bitterness, the balance of bittering versus malt sweetness can range from sweet to boldly bitter. The bitterness to starting gravity ratio (IBU divided by OG) can range anywhere from 0.5 to 1.0 or more, but I like to target in the range of 0.6 to 0.8. Keep in mind that beers designed for long-term aging should target the higher end of the scale, as a good amount of the bitterness can drop out of the beer over time.

Even though this was at one time a British beer for a Russian court, the resurrection of its popularity in the United States means that a brewer has a number of fermentation choices. The only real must do is avoiding hot, fusel alcohols and an overly sweet finish. If you prefer a cleaner, less fruity, more American ale version, ferment with White Labs WLP001 California Ale or Wyeast 1056 American Ale. You will not have to worry too much about leaving an overly sweet beer with these yeasts either, as they tend to attenuate well even in big beers and at a range of temperatures. If you want a more complex beer, you should consider yeasts that

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produce more characterful esters and alcohols such as British ale yeasts. Try to stick with the British strains that still attenuate well, such as White Labs WLP007 Dry English Ale Yeast, Wyeast 1028 London Ale, or Danstar Nottingham if you use dry yeast. If you decide to use a strain that does not attenuate as well, you will need to account for lower attenuation in your recipe. You do not want the beer to be overly sweet, cloying, or worty tasting. My friend Mike Riddle, well known for his award-winning Russian imperial stout, does use a lower attenuating Irish ale strain. He counters this with very high levels of roast malt and hops to try to balance out the residual sweetness. He also keeps the amount of crystal malts to one modest addition of dark crystal. Even so, he advises waiting years for the drinkability to improve. Unless you are going that route, either use a more attenuative yeast strain or back down on the starting gravity and substitute a portion of simple sugar.

In any case, this is a big beer so make certain you oxygenate the wort and pitch

an appropriate amount of clean, healthy yeast. Most of the fermentations should be around the 65 to 70 °F (18 to 21 °C) depending on the yeast strain and recipe. Try to pick a temperature and stick with it, holding the temperature steady throughout fermentation. Holding the temperature steady is important to getting a proper level of attenuation and avoiding off-flavors, especially if you are making a bigger beer. Letting the beer go through large temperature swings can result in the yeast flocculating early or producing solventy and/or overly estery beers. If you wish, you can raise the temperature a few degrees near the end of fermentation to help the yeast clean up some of the intermediate compounds produced during fermentation, but with an appropriate pitch and proper temperature control, it should not be necessary.

I have been told that classic examples of the style, such as North Coast Old Rasputin Imperial Stout are brewed, fermented, packaged and on the store shelves in as little as two weeks. While

there is no denying that Old Rasputin is a great beer fresh out of the brewery, it certainly does mellow and develop a bit of complexity over time. For this style, I believe it is better to go for a big beer and anticipate aging it for a minimum of six months if not more. Time affects the balance and intensity of flavors, mellowing some of the harsher aspects and exposing some of the more delicate aromas and flavors. With time, it is also possible to develop vinous or Port-like qualities, which just add to the complexity. No matter what recipe you start with, always try to stash at least a few bottles for at least a year or two. With a really big beer, a decade wouldn't be too much. ☺

*Jamil Zainasheff is host of Can You Brew It, a show about cloning commercial beers and Brew Strong, a show that answers technical questions about brewing. Both can be found on the Brewing Network ([www.thebrewingnetwork.com](http://www.thebrewingnetwork.com)). He is the co-author of Brewing Classic Styles (Brewer's Publications, 2008) and writes the "Style Profile" column in every issue of Brew Your Own.*



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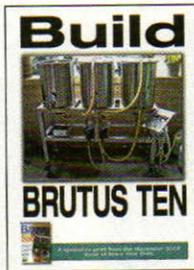
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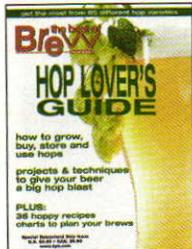
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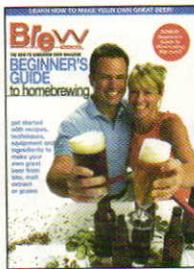
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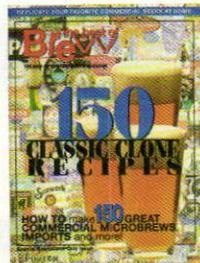
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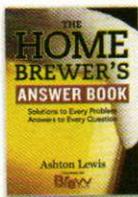
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Photos Courtesy of Glen Fuller



# HAIL TO THE SMALL-SCALE **HOP FARMS**

**LET'S FACE IT:** a hoppy beer is a happy beer. Homebrewers and commercial brewers alike know the range of nuances using "just the right hop" can add, whether bold or subtle, or in aroma or flavor. That's why the recent world-wide hop shortage sent shock waves through the beer industry as a whole. From brewers, to sellers, to drinkers, nearly everyone felt the impact of a more meager variety selection and higher costs.

However, the sudden shortage also served as an opportunity for one industrious segment of the population: small-scale farmers. This group quickly stepped up to the plate, intent on filling the void of the coveted *Humulus lupulus* from larger-scale farming operations. "A few years ago, I started thinking of things to do with my farmland because my regular income began to dry up," explains Glen Fuller of Colorado Organic Hops in Paonia,



Colorado. "I did a lot of research into what would be a good cash crop. This was right at the beginning of the hop shortage, and it just kept coming up, so that's how hops came into the picture. Everything pointed to hops."

## WHY HOPS?

While the ability to produce a crop garnering above-average prices certainly captured the interest of small-scale farmers, money was not the only factor that came into play for many of them, including James Altwies, Director/Horticulturist of Gorst Valley Hops in Mazomanie, Wisconsin. "Most folks think that it was simply the price of hops that attracted us to start producing and processing in Wisconsin, but that is not entirely true. Granted, the price spike and shortage of hops did get our attention but not for the potential revenue — rather because the current production and distribution systems were not benefiting our local brewers. In the Upper Midwest, especially Wisconsin, brewing is a major revenue generator and livelihood of hundreds of people, both of which were upset during the recent shortage," Altwies explains. His dedication to helping the local economy has proven successful. "In general we're adding approximately 15 acres per year in conjunction with independent farmers through our Charter Grower Program. The farmer receives all the technical service he or she wants or needs in areas like plantation design and operations and management practices, as well as state-of-the-art processing/analysis at our facility. Once the hops are sold to the brewer both the grower and Gorst Valley Hops gets paid, with the vast majority of the gross profits returning to the farmer. The grower is happy, the brewer is happy and I'm happy."

Yet other growers were drawn to hops through their rich and colorful history. "Our hop growing experience began with an interest in local history," recounts Larry Fisher, owner of Foothill Hops in Munnsville, New York along with Kate Fisher. "In the 1880s, the central New York area including Madison County where we live, produced 21 million pounds of hops — 80% of the nation's hop supply at that time. Our landscape is still dotted with the remnants of 19th century hop houses

where the hops were dried and prepared for shipment via rail and barge. In the year 2000, we went to the Madison County Hop Fest to learn more about our area's hop heritage and we were hooked!"

"As we talked with others at the Hop Fest, the question arose, why don't they grow hops in New York now?" The Fishers found that hops found their demise in New York because of cheaper production in the Northwest, a major mold epidemic and Prohibition. "After the repeal of Prohibition in 1933, hop prices soared, but efforts to revive the industry in New York state failed." That is, until now. "More than 50 years later, a small group of hop enthusiasts at the 2000 Madison County Hop Fest joined to form the Northeast Hop Alliance (NeHA) to research the feasibility of reintroducing hops in New York and to preserve and promote the hop growing heritage of the region through architectural preservation and agri-tourism. We were part of that group."

## JUST FOR HOMEBREWERS

Different small-scale farms fill different niches, such as growing organic hops or supplying commercial craft breweries with a locally-grown product, but one couple began growing hops just for homebrewers. Matt and Anne Whyte, owners of Vermont Homebrew Supply, planted a ½-acre hop yard to supply their shop with whole hops.

"We grow about a dozen varieties," says Matt Whyte. These include English varieties, such as Goldings and Fuggles, and German varieties, such as Tettang and Hallertau, in addition to the American varieties including Cascade and Chinook. This year they produced about 35 lbs. (16 kg) of organic hops (dry weight) from a mixture of 1-year-old and 2-year-old vines. Given the small overall yield, the hops were not sent out for alpha acid analysis; homebrewers had to use the typical alpha acid range for each variety when formulating their recipes. To dry the hops, Matt built his own oast. This hop oven is basically a box that holds several window screens, on which the hop cones are spread. Hot air from a 1,500-W space heater flows up through screens and dries the hops.

## OTHER BENEFITS

The surge in small-scale hop farms has

afforded the average homebrewer access to an assortment of services and products not typically offered by larger-scale operations. Fuller offers a Brew Class and Hop School at his farm where students have hands-on learning experiences amidst the towering rows of hop bines. Better yet, because of the personalized nature of these farms, students can take advantage of added benefits — ideas hatched during class can actually come to fruition. "Eight or ten of the students who took the brew school are coming up to help harvest. After all the work's done we'll probably have a sip or two of beer and that's that," Fuller explains. "It ought to be pretty fun, kind of like the old hop-picking camps they had back in the 1800s."

And for the homebrewer who loves to experiment with hops, but could use a little assistance in variety selection or brewing technique, help is just a phone call or email away. Places like Gorst Valley Hops offer inexpensive consulting services to homebrewers and other farmers. Foothill Hops maintains a blog all about hops. Additionally, most allow people to visit and tour the hop farms, learning all-things-hops along the way. "We have a constant stream of visitors and future growers. It's part of the dynamics of having a small farm," Fuller says. The homebrewer can gain a wealth of knowledge about hops through these types of resources.

Brewers can also find fresh hops in places once reserved primarily for the average tomato or pepper. Matt Hendry at Anjali Farms in Vermont sold 20 potted Willamette hop rhizomes for \$15 each last year at a local farmer's market. In addition, many small hop farms offer fresh hops and rhizomes online, including Gorst Valley Hops in Mazomanie, Wisconsin and Foothill Hops in Munnsville, New York among many others.

## FARMERS BREW, TOO

If a brewer's fantasy involves plucking a hop cone from a thick row of lush, perfectly developed bines, then these small-scale farmers are "living the dream." What they have learned can benefit even the most novice of homebrewers.

"Hop varieties add distinct attributes to beer: bitterness, flavor, aroma, head retention, storage life. We have our hops tested by a brewing and vinification labo-

# TIPS FOR HOME GROWERS

If you're a homebrewer with some land at your disposal, and would like to plant more than the typical few vines alongside the house, here are some tips for small-scale hop farming. For general equipment suited for small-scale farming — ATVs, sprayers, etc. — look to publications that cater to “hobby” farmers.

## Plan the Hop Yard

Plant your rhizomes 4–5 feet (1–1.5 m) apart and separate your rows by at least 7–8 feet (2–2.5 m). Airflow between plants will greatly reduce problems with fungus. Likewise, if your hop yard is big enough, you'll want enough room to drive an ATV through the rows.

## Sturdy Trellis

Hops can grow in excess of 30 feet (9 m) tall. You'll need your trellis to be able to hold the weight of all the plants plus withstand the force applied when the wind blows. Your trellis should be installed before you plant your fields. For a small-sale “hobby” farmer, this will be your largest start-up cost.

## Irrigation

If you live in a region where rainfall alone is likely to be

insufficient to grow your hops, you will need to plan for irrigation. A drip irrigation system, installed at the same time you put up your trellises, is probably your best bet.

## Weeds, Insects and Fungi

Manually pulling weeds becomes a less viable option as the size of your hop yard increases. Mulch with straw or wood chips once the hop shoots have emerged. For insects and fungi, know what pesticides and fungicides are legal in your area and how long before harvest you need to stop spraying.

## Time Commitment

Managing a small “hobby” hop yard will make some demands of your time. Early in the season, hops need to be strung to their guides. Likewise, at harvest, you'll need a crew to help pick hops. Throughout the growing season, you'll need to spend some time monitoring your hopyard, assessing your irrigation needs and looking for potential problems with insects or fungus. Different hop varieties mature at different times, and differently maturing strains are available within hop varieties. If your hop yard is big enough, plant so that your whole crop does not need to be harvested at once.

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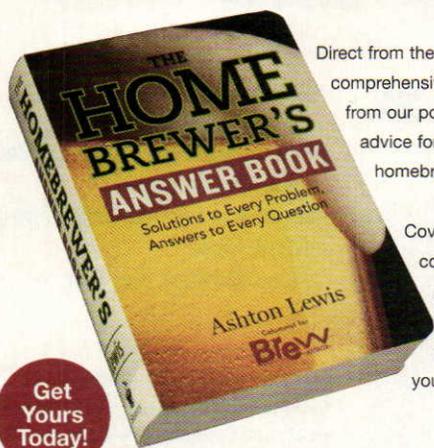
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### The Homebrewer's Answer Book



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Covering nearly every situation a homebrewer could encounter, this 432-page guide is the perfect reference for any amateur brewer.

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ratory to determine the alpha and beta acid content and use that information to select the variety, amount, and schedule for adding hops to our brew kettle to achieve the desired bitterness and aroma profile," Fisher says. "Start with a proven recipe and then experiment. Take notes! Producing great beer is both a science and an art. Ultimately, it is the many distinct qualities of hops, grains, sugar, yeast, and even water, that come together to produce a specific beer style and taste."

Fuller enjoys checking out the aromas of his fresh hops. "You open the Cascades up and they smell citrusy, vanilla-y, and maybe a little nutty. The Chinooks smell kind of grapefruity, the Magnums smell really strong, maybe with even a touch of sulphur and a touch of vanilla. They've all got a unique odor to them, and all the cones on the different varieties have a different shape. I pick them just to open them up, smell them, and see how they are coming along."

Those who work with Fuller like his habit of testing out the aromas as well. "They say hops have great calming properties. Since I started sniffing cones, I stopped yelling at my employees when they goofed up. Last year when it happened they all thought something was wrong with me!" he jokes.

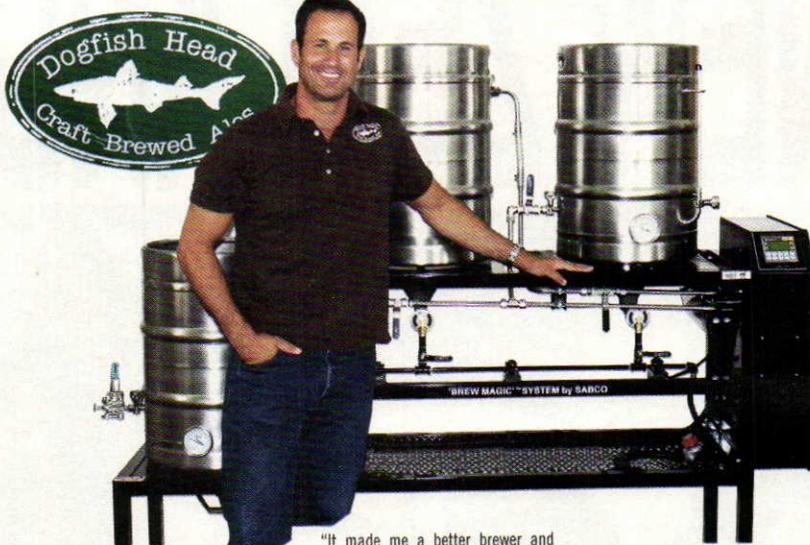
Experimenting can enable brewers to craft beers with just the right aroma or flavor, but achieving the perfect balance always requires the use of just the right ingredients. "When selecting hops — online, at homebrew shops, wherever — always try to select the freshest hops available," advises Altwies. "Hops will retain more of the aroma and essential oils if they have not been repackaged and have been stored in the proper environmentally controlled conditions. Hops spoil easily and proper handling and storage is very important."

Using the freshest hops can add layers of complexity to a brew. "The biggest contribution that locally grown ultra high quality (UHQ) hops can impart to beer is the aroma," Altwies explains. "The trend in large scale production is toward very high alpha varieties for big bitterness and extraction. However many of the craft and artisan brewers are looking for more from their hops than just bittering. Low temperature processing preserves these volatile

compounds. The oil components play a huge part in the beer drinking experience and are under-appreciated in my opinion. Some hops, like Sterling and Saaz, have very unique earthy and spicy oil profiles that can be lost when overpowered by the citrus/grassy nose of big bittering hops."

The fact that some of these farmers also brew their own beer has resulted in a few perks for other homebrewers as well. "We began homebrewing about 12 years ago, before we started our hops enterprise. As other local homebrewers started to buy our hops, they began asking if we had malt, yeast and that type of thing. To serve their needs, we opened a small homebrewing shop in 2007. That business is growing steadily and we are brewing more as a result of having all the necessary supplies at our fingertips. There is nothing like the satisfaction of using your own leaf hops in a brew kettle. We also like to use our hops in cooking and have created mustards, lemonade, salad dressings and herb mixes utilizing our hops," said Larry Fisher of Foothill Hops.

## IT ALL BEGAN ON A **BREW-MAGIC™ SYSTEM** *by Sabco*



**S**am Calagione, avid home-brewer, opened Dogfish Head Craft Brewery in 1995, brewing three times a day on his original Brew-Magic System.

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{ SAM IS PICTURED HERE WITH HIS NEW  
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### BOOMING INDUSTRY

The small farmers who opted to grow hops have generally seen their businesses expand. "The demand for organic hops is definitely increasing," Fisher says.

Fuller's hop production is also increasing. "I'll probably produce somewhere around 7,000 lbs. (3,200 kg) of fresh hops this year, and 20,000 lbs. (9,100 kg) next year." He notes that start-up costs are significant. "It costs between \$10,000 and \$12,000 per acre depending on what you're putting in. It takes a lot of money to get started, and realistically you won't see any return on your investment until the second year. The capital investment is enormous."

He attributes his expected increase in output to the fact he's been able to perfect his process. "This year, in growing I didn't make the same mistakes as last year regarding nutrients and nitrogen levels. There's a learning curve," he says.

Fortunately for brewers and other beneficiaries of fine hops, people like Fuller readily make the commitment of both money and time to keep the hop harvests coming. 🍷

Kristin Grant is a frequent contributor to Brew You Own magazine.



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# NEW ZEALAND HOPS

Hops are grown worldwide, mostly in two "belts" from 30° to 50° in latitude in both hemispheres. The islands of New Zealand nearly span these latitudes and, in the valleys of the Nelson region, at 41° south latitude, sit most of New Zealand's hop farms.

According to Ralph Olson, owner of Hop Union, which imports and distributes hops from around the world, New Zealand currently cultivates approximately 1,000 acres of hops — less than half the acreage farmed in England. Olson added that the amount of New Zealand hops entering the United States is less than one percent of the total hops imported into this country.

Yet, being in the Southern Hemisphere does have its advantages, especially for Northern Hemisphere brewers since this means fresh hops are available approximately six months after the Northern Hemisphere's harvest. Sierra Nevada Brewery takes advantage of this with their Southern Hemisphere Ale, which is made with 100 percent fresh, wet hops jetted up from New Zealand and put into immediate production. The result is a lively brew with plenty of fresh hop aroma and subtle citrusy to grassy notes that linger throughout the consumption.

New Zealand hops also benefit from being grown in an area devoid of the pests that infest hopyards in the Northern Hemisphere. As such, there is no need to spray pesticides and thus a substantial portion of the world's organic hops come from New Zealand.

Many New Zealand varieties can work as substitutes for other domestic or European hops, such as the Pacifica, which is very much like a European Hallertau, the NZ Cascade, which is produced to emulate the classic US Cascade hop, or the Nelson Sauvin, which works well in IPAs and other brews that want a heavy nose upfront.

On the other hand, New Zealand's hops have unique characteristics that should inspire imaginative homebrewers on the quest for different hop profiles in their beers.

Here we present profiles of eleven hop varieties grown in New Zealand.



**"New Zealand hops have unique characteristics that should inspire imaginative homebrewers on the quest for different hop profiles in their beers."**

## KIWI HOPS HAVE PLENTY TO OFFER

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## AROMA HOPS

### Motueka

This hop, available in both conventional and organic options, was bred by crossing a Saazer variety with a New Zealand breed. It is frequently used in Belgium and is ideal for Belgian style ales, but also traditional European lagers and Pilsners. According to New Zealand Hops Limited (quoted throughout these descriptions), the "first impressions are very lively and lifted lemon and lime followed by a background of tropical fruit. [. . .] It imparts a balanced bitterness as well as a desirable new world 'noble' type aroma."

Alpha Acids: 6.5–7.5%

Beta Acids: 5–5.5%

Cohumulone: 29% of alpha acids

Total Oil: 0.8 mL oil per 100 grams

### Riwaka

This hop was first released in 1997, a second variety from the breeding program that produced Motueka. Also from Saazer parentage, "If you want to say 'hops' in your beer then this variety says it all. [. . .] Its powerful grapefruit 'citrus' characters are literally breathtaking." This hop is a great late kettle addition that's perfect for American style pale ales and Pilsners. Locally, it is a "cult hero that is established in the New Zealand craft beer culture."

Alpha Acids: 4.5–6.5%

Beta Acids: 4–5%

Cohumulone: 36% of alpha acids

Total Oil: 0.8 mL oil per 100 grams

### Pacifica

Bred from the Hallertauer Mittelfrüh variety, this hop was released to market in 1994, originally as Pacific Hallertauer. This hop offers up traditional citrus notes and bright floral qualities, and works well in both early and late kettle additions. When employed as a late hop, the citrus aroma takes on an orange-marmalade-like character.

Alpha Acids: 5–6%

Beta Acids: 6%

Cohumulone: 25% of alpha acids

Total Oil: 1.0 mL oil per 100 grams

### NZ Cascade

The name pretty much says it all with this hop, which works exceptionally well with American-style pale ales, summer beers and lighter ales. Origins hail from 1950s U.S. breeding programs and the original Cascade, which in New Zealand was crossbred with English Fuggle. Similar in many aspects to US domestic Cascade hops, this variety has the distinguishing qualities of *terrior*, or that special difference associated with distinct soil types. This hop "displays quite exceptional levels of citrus moving more toward grapefruit characteristics," and performs well in both early and late kettle additions.

Alpha Acids: 6–8%

Beta Acids: 5–5.5%

Cohumulone: 37% of alpha acids

Total Oil: 1.1 mL oil per 100 grams

### NZ Cascade



## BITTERING HOPS

### Green Bullet

A high alpha hop that has exceptional bittering qualities, this hop also has "aromatic qualities not usually associated with alpha varieties." Typically employed in bitters, lagers and dry Irish stouts. Green Bullet also works well with finishing hops such as Willamette and Fuggle.

Alpha Acids: 11–14%

Beta Acids: 6.5–7%

Cohumulone: 41–43% of alpha acids

Total Oil: 1.1 mL oil per 100 grams

### Pacific Gem

This variety developed from a cross between the New Zealand "Smoothcone" and California Late Cluster x Fuggle. This hop has been "described as producing oaken flavors with a distinct blackberry aroma." Pacific Gem has an even bitterness and flavor that works with most beer styles, and particularly with European lagers.

"Sought internationally for its ability to

deliver consistent alpha, much of the crop is transformed by supercritical CO<sub>2</sub> to resin. This creates a reliable off-season source of kettle extract for the northern hemisphere brewer."

Alpha Acids: 13–15%

Beta Acids: 7–9%

Cohumulone: 37–40% of alpha acids

Total Oil: 1.2 mL oil per 100 grams

### Pacific Jade

A newcomer, this hop debuted in 2004. "The aroma of this hop is described as 'bold' as it delivers a herbal infusion of fresh citrus and crushed black pepper. Brewing trials have illustrated Pacific Jade as an excellent hop that delivers a pleasing soft bitterness matched to desirable aroma characteristics." An excellent choice in dry lagers and full-bodied ales that require more malt-to-hop balance.

Alpha Acids: 12–14%

Beta Acids: 7–8%

Cohumulone: 24% of alpha acids

Total Oil: 0.8 mL oil per 100 grams

### Southern Cross

This cross between a "Cali" hop and English Fuggle has resulted in a bold character and aroma of "lemon peel and pine needles layered beneath a clean spiciness. [...] A kettle variety of the highest order, Southern Cross imparts a soft bitterness with a subtle resinous quality. The essential oil component is such that it can deliver a delicate balance of citrus and spice when added toward the end of boil." This hop is a solid choice for lagers, milds and ales.

Alpha Acids: 11–14%

Beta Acids: 5–6%

Cohumulone: 25–28% of alpha acids

Total Oil: 1.2 mL oil per 100 grams

### Super Alpha

Super Alpha mixes grassy notes with "aromas such as pine needles and lemon-grass," which stand out when used in late-additions. This hop is popular with Asian breweries as it can "deliver a very crisp bitter edge on the back palate as well as excellent aroma qualities."



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### Pacific Gem

Alpha Acids: 10–12%  
Beta Acids: 7–8.5%  
Cohumulone: 36–39% of alpha acids  
Total Oil: 1.3 mL oil per 100 grams

### DUAL PURPOSE HOPS

#### Hallertau Aroma

Used primarily in lagers, this hop scores well for both flavor and aroma offering hints of “freshly-zested lime” over a “restrained floral character” that holds up throughout the brew process. “New Zealand Hallertau measures up on flavor scores as well as flavor stability trials. Its rounded flavor, moderate cohumulone and outstanding oil profile create a truly rewarding finish.”

Alpha Acids: 6.5–8.5%  
Beta Acids: 8.5%  
Cohumulone: 28–30% of alpha acids  
Total Oil: 1.0 mL oil per 100 grams

#### Nelson Sauvin

Named after the Sauvignon Blanc variety of grape because the oils show “fresh crushed gooseberries” notes. “The fruitiness may be a little overpowering for the un-initiated, however those with a penchant for bold hop character will find several applications for [this hop].”

Alpha Acids: 12–13%  
Beta Acids: 6–8%  
Cohumulone: 24% of alpha acids  
Total Oil: 1.1 mL oil per 100 grams

Glenn BurnSilver is a frequent contributor to Brew Your Own.



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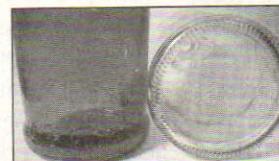
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As a former sous chef, I remember many questions and comments about cooking at home for friends and family. Many people assumed that a chef in the family meant the kitchen would always smell of baking bread, roasting meat, onions and garlic... In my world, however, a full-time work schedule of fifty hours or more in the restaurant translated into a fridge boasting only the random bottle of ketchup or six-pack of beer.

**“Some brewers still brew small as a matter of course. It just feels right.”**

Just like restaurant kitchens, commercial breweries are filled with brewers who work odd hours and long shifts. So when the brewing day is done, do they put aside their rubber boots and call it a day, or do they go home and mash in on a batch of homebrew? While some of their colleagues might think it madness, many pro brewers actively brew their own beer outside of work. Meet some of the pro brewers behind some well-known craft brews who keep their homebrew kettles boiling.

# EAT.SLEEP.BREW

## Pro Brewers Who Homebrew

**W**hat makes a professional brewer want to brew on his or her own time? It goes without saying that most brewers get into the industry for a love of making great beer. But that doesn't necessarily mean they want to take their work home with them. In this age of craft brewing popularity, professional brewers are just as likely to learn the science and process of brewing in a classroom then move directly to working at a commercial-scale brewery than to have started out as a homebrewer. And even those who started out as homebrewers can eventually tire of messing around with carboys and immersion chillers when they have been working with brewing systems that make hundreds of barrels a day, day in and day out. For homebrewing pros, however, making beer never gets old.

### From Hobby to Pro: HOW THEY STARTED

Lots of professional brewers started out as homebrewers, and many of them agree that a passion for brewing is one of the most important qualities any brewer with an interest in going pro should have.

**SAM CALAGIONE**, Owner and Founder of Dogfish Head Craft Brewery, started homebrewing in 1993 when he worked at a bar in New York City that featured craft brews. After his first brew, a cherry pale ale, he mapped out his future as a brewer.

“My next two batches sucked but by then I already told all my friends I wanted to be a pro brewer and I didn't want to chicken out,” said Calagione.

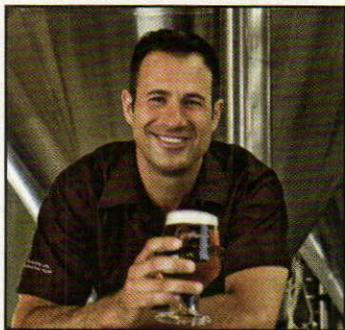
Since then Calagione has overseen the growth of the brewery



*Pete Rahn of  
Magic Hat Brewing  
makes beer at  
work and home.*

Photo by Charles A. Parker/Images Plus

**SAM CALAGIONE**



**MITCH STEELE**



**DEAN MOCHIZUKI**



**KYLE LARSON**



**PETE RAHN**



from a brewpub with a Sabco system that he, "rode hard and put away wet almost every day the first year we were open," to a 100-person company with a restaurant, brewery and distillery at the original site in Rehoboth and a 240,000-barrel capacity regional brewery in Milton, Delaware.

**MITCH STEELE**, Head Brewer and Production Manager at Stone Brewing Company, started homebrewing twenty-five years ago when he went to college for a degree in fermentation science.

"I had just taken a brewing science class from Dr. Michael Lewis at UC-Davis and I wanted to give homebrewing a try," Steele said of his first attempt at homebrewing and his excitement about making beer. "A friend of mine had a homebrew kit, so we went for it. I remember the beer was really bitter, completely unbalanced with hop character. But we really enjoyed the process and loved the result — I was hooked."

Since then Steele has carried his homebrewing roots through an enviable brewing career from San Andreas Brewing in Hollister, California, to many years as a Brewmaster in the New Products division with Anheuser-Busch, as well as an Assistant Brewer at their St. Louis and Merrimack, New Hampshire locations, and now, of course at Stone, where he frequently brews on their 20-gallon (76-L) MoreBeer! pilot system.

Many other pro homebrewers have also parlayed their hobby into a regular gig in professional brewing.

**DEAN MOCHIZUKI**, Assistant Head Brewer at Pike Brewing Company in Seattle, has homebrewed for eighteen years. His first homebrew came from a homebrewing kit his wife gave as a Christmas gift. By his sixth batch he was brewing all-grain. He eventually started regularly visiting the brewery to exchange yeast for homebrew, which resulted in a job offer.

"The decision was not too hard," Mochizuki said.

**KYLE LARSON**, Brewer at Double Mountain Brewery in Hood River, Oregon, also started out as a homebrewer, and found the hobby to be a helpful way to clear his head.

"I was at a difficult time in my life and homebrewing provided a much needed outlet," said Larson. "I was able to immerse myself in the process, focus my energy and efforts on an interesting hobby, submerge myself in books and, of course, enjoy the fruits of my labor."

About five years ago it dawned on Larson that he could parlay his homebrewing hobby into a professional career. He completed the prerequisites to attend the Master Brewers Program at UC-Davis, but was placed on the acceptance waiting list, which pushed him to pursue a brewing job. After blanketing 150 breweries with his resume, he accepted an offer to work at Full Sail Brewing Company in Hood River, Oregon.

**PETE RAHN** has homebrewed for about eight years, during which time he got his foot in the door at Magic Hat.

"I always enjoyed homebrewing, but didn't know how to do it professionally," said Rahn, who graduated from the American Brewer's Guild in Middlebury, Vermont. While attending the ABG's distance learning program, he found a job as a keg racker at Magic Hat, which he describes as, "very glamorous." Once he finished his coursework at the ABG, he moved into cellar positions at the brewery, later moving up to Quality Control Supervisor at the Vermont brewery.

## Why Hold On To Homebrewing?

Even though homebrewing can be the way in to a pro brewing career, the hours are long, the work can be tough and it's not unlikely for a brewer to let their small systems gather dust at home in order to keep their work at the brewery. So what keeps these brewers interested? For some, homebrewing not only keeps them fresh and creative, it is also a way to try out new ingredients or techniques.

"The primary reason why I brew small batches is to get a feel for ingredients and beer styles that I may not have a good comfort level, such as new hop varieties, different specialty malts and yeast strains." Steele explained. "It's great to be able to explore these ingredients in a smaller system to be sure the recipes and usage rates are dialed in before we scale up to a big brew."

"Now that I'm a professional brewer my home brewery doubles as a personal pilot brewery," said Larson. "Every batch I make, I make because I think it will taste great, but every batch is also a potential candidate for a commercial recipe."

Homebrewing is also a way for pro brewers to brew what they like, whereas commercial brewing often means making the same beers over and over or styles they may not prefer themselves.

"It keeps me fresh and enthusiastic about brewing," said Rahn. "I am lucky to work where we have a rotation of seasonal beers, as is the case with most professional breweries, you end up making the same beer a lot. I like to make new beers and get creative with the craft."

Brewing small batches at home is also still a fun hobby for these brewers as it was when they started out.

"I always get the question, 'Why?'" said Dean Mochizuki of his pro brewing peers. "I still homebrew because I get to relax, not worry and be creative. I view it as a way to have fun and enjoy what I do on a totally different level. I think that brewing professionally actually influences the way that I approach homebrewing in that I think about processes and ingredients more to get to the end result."

"I still homebrew because I enjoy the process, from recipe creation to cleaning my kettle," said Larson.

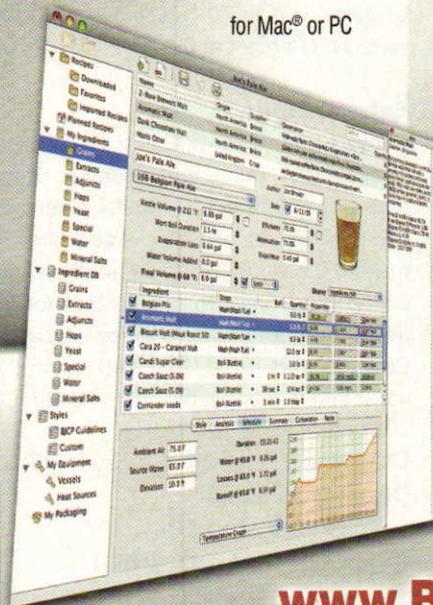
"Sometimes it is hard to spend an evening or a day off brewing when I spend forty-plus hours a week in the brewery, but I still love to homebrew so it is really rewarding when I find the time," said Rahn. "It's still fun!"

And some brewers still brew small as a matter of course. It just feels right.

"I just homebrewed a 10-gallon (38-L) batch with Paul from Blind Bat on a Sabco in Brooklyn," said Calagione. I wish I did it more. Brewdays are still my favorite workdays. I mostly brew on the 5-barrel system at our pub with Bryan Selders, our lead brewer. I never brew on the 100-barrel brewhouse at our production facility — we have awesome staff brewers here who are way better at that complicated giant stuff than I am."

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A collection of favorite homebrew recipes from these professional brewers starts on the next page.

## The Driveway Barley Wine

Mitch Steele, Stone Brewing Co.

(5 gallons/19 L, all-grain)

OG = 1.096 (24 °P) FG = 1.020 (5 °P)

IBU = 85 SRM = 18 ABV = 10%

*I brewed this beer with the Manchester Area Society of Homebrewers (MASH) homebrew club at my home in Bedford, New Hampshire when I was an Assistant Brewer at Anheuser-Busch in Merrimack, New Hampshire.*

### Ingredients

18 lbs. (8.2 kg) Maris Otter pale malt

1.0 lb. (0.45 kg) crystal malt (60 °L)

1.0 lb. (0.45 kg) light Munich malt

13.5 AAU Columbus hops (60 mins)

(1.0 oz./28 g at 13.5% alpha acids)

9.75 AAU Centennial hops (60 mins)

(1.0 oz./28 g at 9.75% alpha acids)

9.75 AAU Centennial hops (15 mins)

(1 oz./28 g at 9.75% alpha acids)

1.5 oz. (43 g) Cascade whole hops

(5 mins)

Wyeast 1056 (American Ale) or White

Labs WLP001 (California Ale) yeast

(4 qt./4 L yeast starter, OG 1.030)

### Step by Step

Mash ale grains in with hard water (target 300–400 ppm hardness) at 150 °F (66 °C) and hold for 60 minutes before lautering. Chill the wort to 70 °F (21 °C), pitch the yeast and ferment at 62–72 °F (16–22 °C).

### Extract Option:

Replace pale malt with 8.75 lbs. (4.0 kg) Briess Light dried malt extract. Steep grains at 150 °F (66 °C) for 45 minutes in 5.5 qts. (5.2 L) of water. Add water to make 6.0 gallons (23 L), stir in dried malt extract and bring to a boil. Boil for 60 minutes, adding hops at times indicated. Chill the wort to 70 °F (21 °C), pitch the yeast and ferment at 62–72 °F (16–22 °C).

## Double Trouble-Double IPA

Dean Mochizuki,

Pike Brewing Co.

(5 gallons/19 L, all-grain)

OG = 1.077 FG = 1.017

IBU = 80+ SRM = 8 ABV = 8.2%

### Ingredients

12.5 lbs. (5.7 kg) British pale malt (Maris Otter)

8.0 oz. (227 g) Munich malt

4.0 oz. (113 g) British crystal malt (70–80 °L)

1.25 lb. (0.57 kg) cane sugar (20 mins)

21 AAU Chinook pellet hops (75 mins) (1.75 oz./50 g at 12% alpha acids)

21 AAU Columbus pellet hops (75 mins) (1.75 oz./50 g at 12% alpha acids)

9.5 AAU Centennial pellet hops (10 mins) (1.0 oz./28 g at 9.5% alpha acids)

12 AAU Chinook pellet hops (10 mins) (1.0 oz./28 g at 12% alpha acids)

2.5 oz. (71 g) Amarillo whole hops (end of boil, steep 10 mins)

1.0 oz. (28 g) Columbus hops (dry hops)

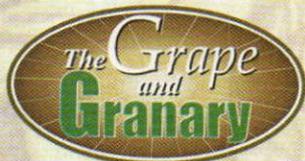
1.0 oz. (28 g) Amarillo hops (dry hops)

White Labs WLP013 (London Ale) or

Wyeast 1028 (London Ale) yeast

### Step by Step

Mash in grains with 160 °F (71 °C) water with a 1.25 quarts of water to 1 lb. grain ratio with 2 tablespoons of gypsum. Rest



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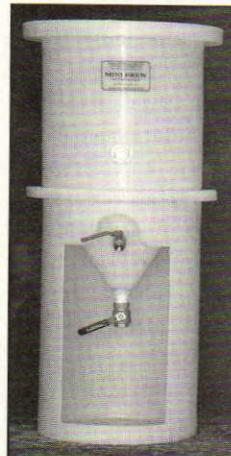
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at 150 °F (66 °C) for 30 minutes. Recirculate the mash until clear. Start runoff then sparge with 168 °F (76 °C) water. Collect 6.5 gallons (25 L), boil to 5.25 gallon (20 L) final volume. Bring to boil — total boil time 75 minutes. Add the hops per the ingredients list. Add the cane sugar with 20 minutes left in the boil. Chill the wort to 70 °F (21 °C) and pitch the yeast. Ferment at 70 °F (21 °C) until primary fermentation is complete. Rack to secondary fermenter and dry hop for one week with 1 oz. (28 g) Columbus pellet hops and 1 oz. (28 g) Amarillo pellet hops. If bottling, prime with ¾ cup corn sugar. If kegging, add 1.0 oz. (28 g) Columbus whole hops and 1.0 oz. (28 g) Amarillo whole hops to the hop sack, chill and force carbonate.

#### Extract option:

Reduce pale malt to 1.25 lb. (0.57 kg). Steep grains at 150 °F (66 °C) in 2.75 qts. (2.6 L) of water for 30 minutes. Add water to make 6.5 gallons (25 L), stir in 6.25 lbs. (2.8 kg) Muntons Light dried malt extract and boil to 5.25-gallon (20-L) final volume (about 75 minutes). Add the hops per the ingredients list. Add the cane sugar with 20 minutes left in the boil. Chill the wort to 70 °F (21 °C) and pitch the yeast. Ferment at 70 °F (21 °C). Dry hop in secondary for one week.

#### The BISness

##### Belgian Imperial Stout

Kyle Larson, Double Mountain Brewery and Taproom

(5 gallons/19 L, all-grain)

OG = 1.085 before sugar additions

(1.100 after sugar additions)

FG = 1.016 IBU = 90

SRM = ~60 ABV = 12%

#### Ingredients

15.5 lbs. (7.0 kg) organic 2-row malt

1.75 lbs. (0.80 kg) roasted barley

1.0 lb. (0.45 kg) flaked barley

1.0 lb. (0.45 kg) Special B malt

2.0 lbs. (0.91 kg) cane sugar  
(added during fermentation)

1.0 lb. (0.45 kg) treacle

(black strap molasses will also work)

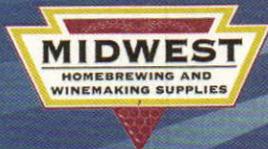
26 AAU Magnum hops (60 mins) 80 IBU's  
(1.6 oz./45 g of 16% alpha acids)

2.0 oz. (57 g) E.K. Goldings hops  
(5 mins)

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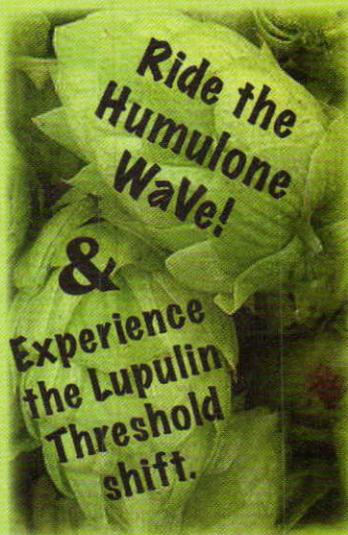
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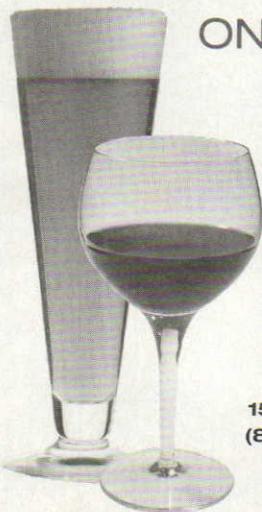
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1 tsp. Whirlfloc (10 min.)  
2 tsp. Wyeast yeast nutrient (10 min.)  
Wyeast 1214 (Abbey Ale) or  
White Labs WLP500 (Trappist Ale) yeast

### Step by Step

Mash in at 149–150 °F (65–66 °C) at a mash thickness around 1.20 qts. of water for one pound of grain. Let the mash rest for 60 minutes. Do not perform a mash out. Run off to the kettle, sparging with 172 °F (78 °C) water. Boil the wort for 90 minutes. At 60 minutes until the end of the boil add your bittering hops. At ten minutes until the end of the boil add whirlfloc, yeast nutrient and treacle. At five minutes until the end of the boil add your flavor and aroma hops. At the end of the boil, whirlpool or let the wort stand for ten minutes to extract a bit more flavor from the late addition hops. Cool the wort to 70 °F (21 °C). Run cooled wort into a clean carboy that has a yeast cake from a previous brew. Oxygenate the wort for three minutes with pure oxygen through a diffusion stone. Keep the fermentation temperature between 75 and 80 °F (24 and 27 °C) for the entire fermentation. Once fermentation is approaching high kräusen, add one pound of hydrated cane sugar directly to the carboy. (On the brew day boil 2 qts./2 L of water for a few minutes and then dissolve the two pounds of sugar in it. Split the mixture into two sanitized mason jars and store in the fridge until needed.) Twenty-four hours later add 1 pound of hydrated cane sugar to the carboy. Let the beer sit in the primary fermenter for three weeks. After the three weeks rack to a secondary 5.0-gallon (19-L) carboy and cold condition cold for two months. Bottle condition to around 2.60 volumes of CO<sub>2</sub>. I use the kräusen method outlined by George and Laurie Fix on page 69 of the "Märzen, Oktoberfest, Vienna" Classic Beer Style Series books.

### Extract Option:

Reduce pale malt to 2.25 lbs. (1.0 kg). Steep grains at 149–150 °F (65–66 °C) in 2.0 gallons (7.6 L) for 45 minutes. Add water to make 6.5 gallons, stir in 5.5 lbs. (2.5 kg) Cooper's Light dried malt extract and boil the wort for 90 minutes, adding hops at times indicated. Add treacle with 10 minutes left in boil. Ferment between 75 and 80 °F (24 and 27 °C). See all-grain

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recipe for conditioning instructions.

### Sir Walter Scotch Ale

Pete Rahn, Magic Hat Brewing Co.

(5 gallons/19-L, all-grain)

OG = 1.100 FG = 1.015

IBU = 10 SRM = 28-30 ABV = 11-12%

*My brother went to Scotland for a year. I brewed this Scotch ale the day he left and conditioned it for the year he was gone.*

#### Ingredients

18 lbs. (8.2 kg) Crisp pale malt

2.5 lbs. (1.1 kg) crystal malt

0.5 lb. (0.23 kg) chocolate malt

0.5 lb. (0.23 kg) biscuit malt

0.5 lb. (0.23 kg) caramel malt

8.5 AAU Brewers Gold hops (60 mins)

(0.5 oz./14 g at 8.5% alpha acids)

Heather, juniper or elderberry (10 min.)

White Labs WLP028 (Edinburgh Ale) or

Wyeast 1728 (Scottish Ale) yeast

#### Step by Step

Mash at 153 °F (67 °C) for 60 minutes.

Total boil time is 90 minutes. Add the hops at 60 minutes. Add heather, juniper, or elderberry in the last 10 minutes. I often add various aromatic herbs or hops at the "whirl" or chilling point (either/or with the herbs in the last 10 minutes of the boil) and let them steep as the wort cools down and the trub settles out. Chill to 70 °F (21 °C), pitch the yeast and ferment at 55-75 °F (13-24 °C). After primary fermentation is complete, rack to conditioning vessel. Leave in a cool dark place for as long as you can stand it. Bottle/carbonate and enjoy with friends.

#### Extract option:

Omit pale malt. Steep grains in 5.5 qts. (5.2 L) of water at 153 °F (67 °C) for 45 minutes. Add water to make 3 gallons (11 L). Stir in 4.25 lbs. (1.9 kg) light dried malt extract and bring to a boil. Boil 60 minutes, adding hops and spices at times indicated. Stir in 6.6 lbs (3.0 kg) Muntons Light liquid malt extract for the final 15 minutes. Ferment at 55-75 °F (13-24 °C).

### Raisin D'etre

Sam Calagione, Dogfish Head (5 gallons/19 L, all-grain)

OG = 1.084 FG = 1.018

IBU = 26 SRM = 24 ABV = 8.4%

#### Ingredients

15.5 lbs. (7.0 kg) pale malt

0.25 lbs. (0.11 kg) crystal malt (60 °L)

0.50 lbs. (0.23 kg) chocolate malt

0.38 lbs. (0.17 kg) raisins

0.50 lbs. (0.23 kg) candi sugar

4 AAU Warrior hops (60 mins)

(0.25 oz./7.1 g of 16 % alpha acids)

2 AAU Vanguard hops (60 mins)

(0.50 oz./14 g of 4% alpha acids)

English ale yeast (your choice)

#### Step by Step

Mash at 150 °F (66 °C). Boil for 60 minutes. Add honey and raisins with 15 minutes left in boil. Ferment at 70 °F (21 °C). ☺

Betsy Parks is Associate Editor at Brew Your Own magazine.

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# EXIT UP

## EXPERIMENT WITH MIXED YEAST STRAINS

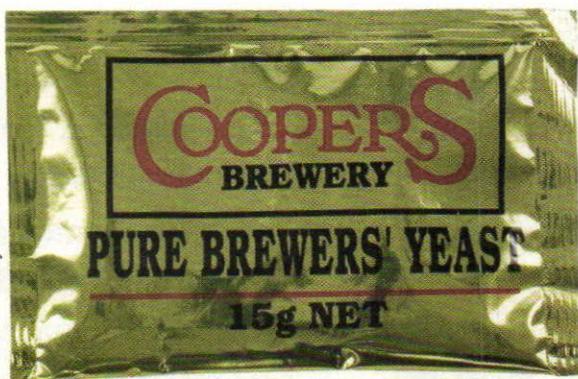
**I** have used various sources of yeast for my brewing over the years, from yeast harvested from bottle-conditioned beers, liquid yeast strains from Wyeast and White Labs and various dried yeasts, usually with good results. Dried yeast has the advantage of convenience and Fermentis Safale S-04 has become a favorite of mine. It ferments very well indeed (usually everything is over in 3 days or less), it is extremely flocculant (so I don't need to bother with finings) and it produces beer that tastes pretty good.

However, in my opinion, S-04 has one small problem in that it produces beer having a distinctive "bready" nose. This character is not unpleasant and fades after about a month, but can dominate a young beer. I think that this is a shame because some early fresh hop aromas can be masked by this feature. I wondered if there was a way of getting around this problem without losing any of the benefits of S-04. It is known that some commercial breweries use mixed yeast strains in order to achieve desirable characteristics from two or more different yeast strains. Also, it is often suggested that, when using dried yeast, two sachets should be used for a 5-gallon (19-L) brew length rather than just one. This got me thinking. Would it be possible to use two different sachets of yeast in a brew and obtain beneficial aspects from each strain? In particular, could I use a sachet of S-04 and a sachet of a different yeast and obtain the strong fermentation and high flocculation of S-04, but without its breadiness and maybe additional desirable characteristics? It should be easy enough to try, but which combination is best?

So, for the last few years, I have been trying this on some of my brews and a summary of the results so far are given in the table below. I keep reasonably good records of the brewing process, but when it comes to tasting the product, I am not good at recording my thoughts. So, I have scored "S-04 nose as either "Yes" (as strong as using S-04 alone), "Some" (detectable but weaker than S-04 alone) or "No" (no obvious breadiness noted). I have scored the clarity on a scale of 1 to 4 where 4 denotes very good clarity and 1 is definitely cloudy. "Score" is also a scale of 1 to 4 and is a crude indication of how good I thought the beer was with 4 being excellent through to 1 being fair. Fortunately, none of the beers were bad, in my estimation. "Yeast" is the second yeast added along with the S-04.

Yeast	S-04 nose?	Clarity	Score
Danstar Windsor	No	1	-
Danstar Nottingham	Some	4	4
Muntons Gold	No?	3	1
Safale US-56/US-05	No	3	1
Safbrew T-58	No	1.5	2
Danstar Windsor	Some	2	4
Coopers	No	4	3

One variable worth bearing in mind is yeast rehydration. I always rehydrate my dried yeast in warm, boiled water rather than simply sprinkling it on the surface of the wort. I have belatedly realised that this might be an issue when rehydrating mixed yeasts. The usual advice is to add the yeast to the warm water and leave without stirring for ten minutes before stirring



and pitching. When you add two sachets of yeast, the yeast from the second sachet will tend to sit on top of the yeast from the first sachet as it slowly hydrates and falls into the water. This could mean that the yeast from the second sachet will not be as hydrated as that from the first. If so, the yeast from the first sachet may get a head start over that from the second sachet. Because of this, for more recent brews I have started taking some care to add the yeast from each sachet to the water together. Rehydrating the strains separately would also be an option.

There are many ways a mixed yeast trial could turn out. It is possible that one yeast will grow faster than the other and come to dominate the fermentation, the result being that the beer tastes very similar to a beer fermented with only the dominant strain. On the other hand, if both strains grew and fermented at roughly the same rate, the cofermented beer could taste like a blend of two beers, each brewed with the one of the two yeast strains. More interestingly, a character of one of the yeast strains might be altered or eliminated. For example, let's say you cofermented an ale with two yeast strains. The first strain was a weak diacetyl reducer and usually left a butterscotch character in the finished beer. In contrast, the second yeast strain was a strong diacetyl reducer. It's possible that the cofermented beer would show many of the fermentation characteristics of the first strain, minus the diacetyl. It's further possible that individual characters produced by either yeast strain are weakened in any cofermentation, simply due to dilution.

In my trials, two of seven cofermentations (29%) showed a reduction in the bready character. In the remaining five (71%), the character was eliminated. My guess is that the second yeast is metabolizing the "bready" component from the S-04. It is also possible that each of the cofermenting strains simply grew faster than the S-04 and crowded it out of the fermentation. Given that S-04 is a strong fermenter by itself, I consider this somewhat unlikely. Also, some of the mixtures have produced good clarity in the beer, which again indicates that mixtures do not necessarily have adverse effects on the flocculation of S-04. Finally, there are some good beers there! But can I

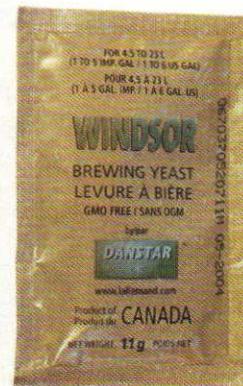
get everything I want from a mixture? Nottingham was looking promising but it now looks like Coopers Ale yeast is a front runner.

The trials so far show that the use of mixed dried yeast sachets can indeed achieve some benefits from each strain, but often in an unpredictable way. For example, I love the flavor of Windsor yeast and, when mixed with S-04, some of this comes through and at least some of the S-04 breadiness is lost, but it loses the flocculant advantages of the S-04. In these cases, I might as well have used Windsor yeast alone. There are many other dried yeasts out there (and more keep coming on to the market), so this experiment is far from complete — these are just preliminary findings. A quick look at the web site of a well-known US homebrew store indicates that they currently supply 14 varieties of dried yeast, which I reckon allows for 91 two-strain combinations! Also, there are many other variables involved such as temperature, recipe and the brewing process, so I intend to continue with my experiment and try further yeast combinations as well as repeating some I've already tried.

If you find a combination of yeast strains — let's call them A and B — that you like, an additional experiment would be worth trying. Make a batch of wort and split it into three equal volumes, Pitch the first with one unit of yeast A, the second with one unit of yeast B and the third with a half unit of each of the two yeasts. This would yield three equal volumes of wort pitched at the same rate. The three beers could be compared to see if the cofermented beer showed characters from each of the two component strains and, of course, if using two strains provided any benefit in terms of overall beer quality.

I'm very happy with the results of my experiment so far, and I believe that the use of mixed yeast strains gives me another variable to adjust in my ongoing search for better beers. 🍷

Les Howarth is author of The Home Brewer's Recipe Database.

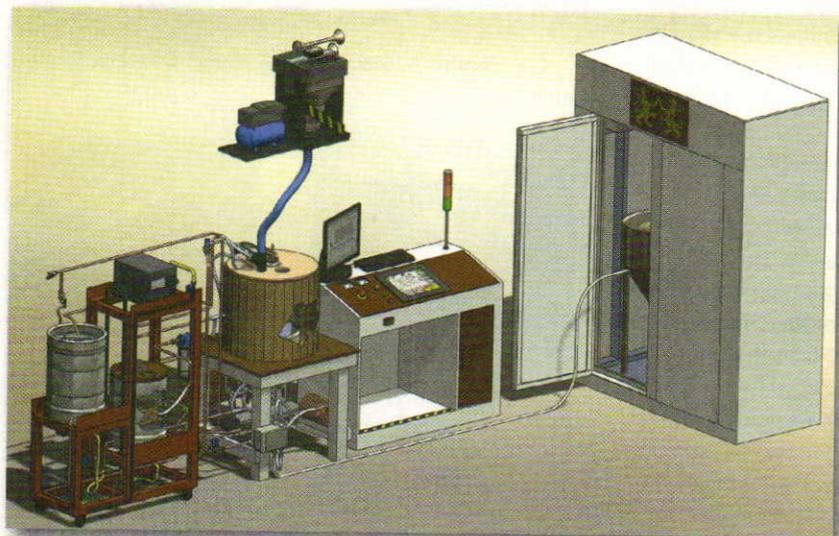




# HOME AUTOMATED BREWERY



Would you like to control your brewery at the touch of a button? Would you like brewday data gathered, displayed and recorded automatically for you? Would you like your brewery to remind you when it's time to add the hops? Chris Enegren, along with his friend Joe Nascenzi and brother Matt Enegren have built, and are continually revising, an automated 10-gallon (38-L) home brewery in his California garage. Although the brewery does require human supervision, many of its functions are automated or can be activated from a touch screen control panel. Check out Enegren's system for ideas on what elements of homebreweries can be automated.



**Top:** From left to right, Chris Enegren, Duke, Joe Nascenzi and Matt Enegren show off their brewery uniforms in front of their automated garage brewery. They have been continually modifying the brewery for years.

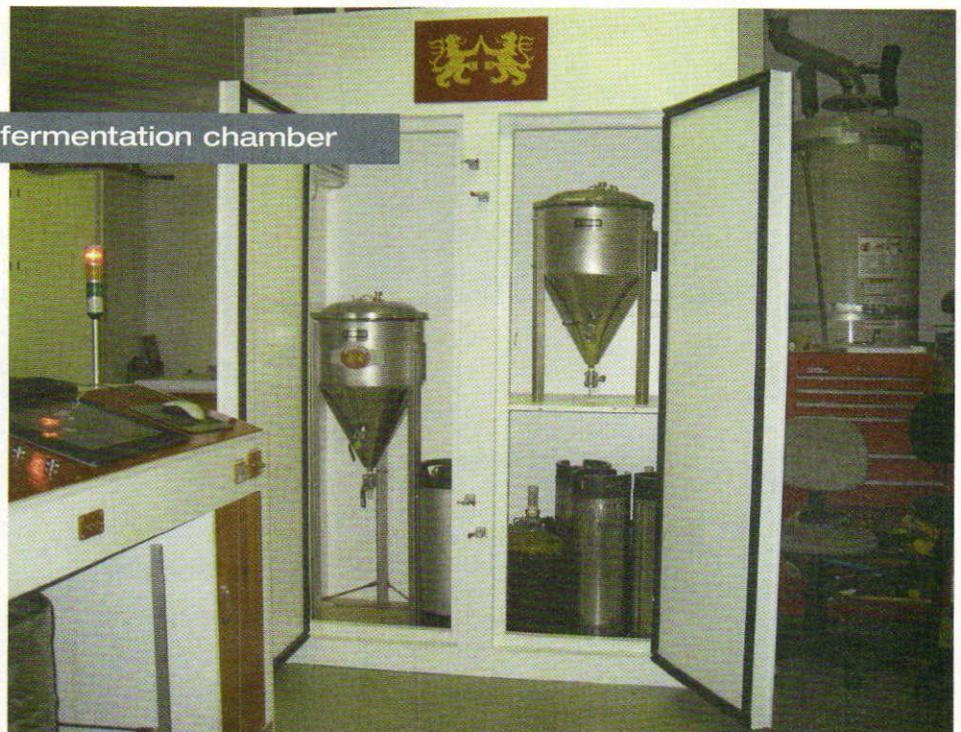
**Bottom:** A 3-D model of the brewery.



brewing line

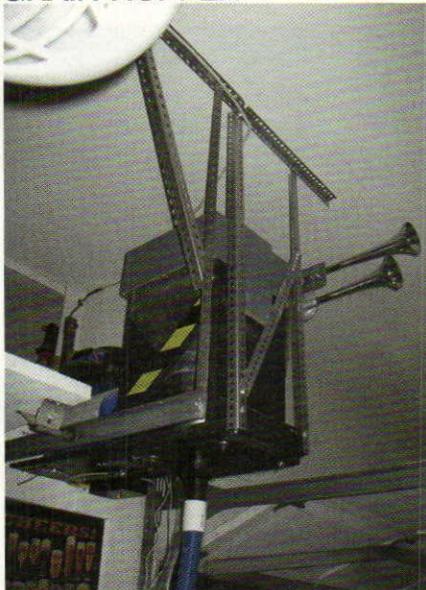
**Top:** Three 15.5-gallon (59-L) kegs were modified to make the hot liquor tank (HLT), kettle and mash tun. The mash tun is surrounded by a 24" (61 cm) wooden barrel, with insulation filling the gap. Thermocouples and flow meters measure key variables in the brewing process. A programmable logic controller (PLC) turns pumps and burners on at the appropriate times. There's even a computerized female voice to give the brewers warnings such as, "caution, mash mixer activating."

**Bottom:** Primary fermentation is conducted in two 14.5-gallon (55-L) conical fermenters. They sit in a scratch-built, air-conditioned chamber, capable of maintaining 45 °F (7.2 °C).



fermentation chamber

## GRAIN HOPPER



The hopper above the mash tun holds the crushed grains. Enegren mills his grains on his friend Meleq Kacani's mill. A pneumatic cylinder, powered by an air compressor, opens and closes a door beneath the hopper. The compressor also powers the air horns, which alert brewers when they are needed in the brewery.

## GRAIN DROP

An auger near the bottom of the hopper keeps the grain flowing when the hopper door is open. As the grain falls down the black tube, strike water is pumped from the hot liquor tank (HLT). The hopper door is opened and closed and the mash is stirred, as needed, until the grains are mashed in.

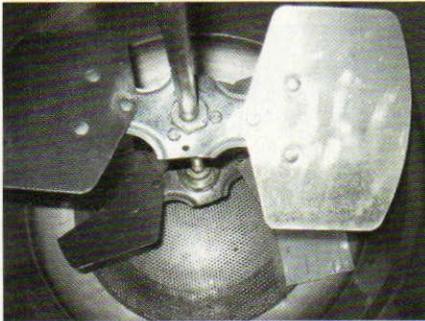


## MASH TUN



Strike water from the HLT mixes with crushed grain before dropping into the mash tun. A motor powers the belt-driven mash mixer and copper tubing for sparging and a recirculation loop are built into the vessel.

## MASH MIXER

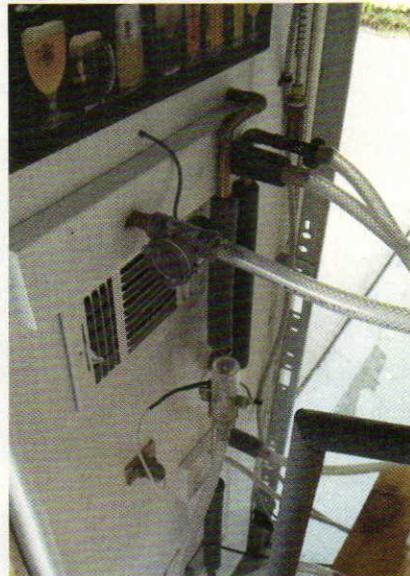


These blades spin at 30 rpm and stir the grains when mashing in. Plastic rakes attached to the lower blades brush against the false bottom and keep it from getting clogged.

## AUTO SPARGE SENSORS

When the mash tun is being filled, water from the HLT passes through a flow meter, allowing the brewers to know how much water is in the mash tun.

During sparging, optical level sensors (low and high) send information to the programmable logic controller (PLC, see next page for description), which opens and closes valves leading from the HLT, turning the sparge water on and off.



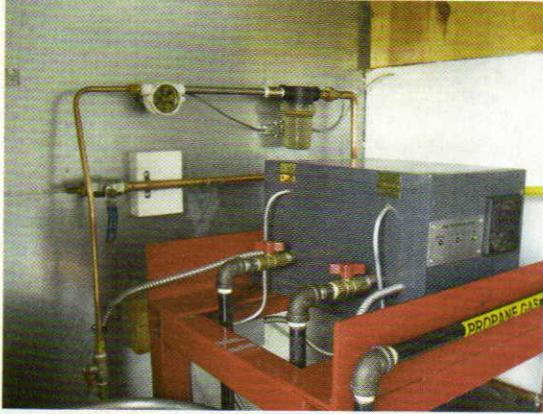
## KETTLE AND HLT



The 15.5-gallon (59-L) kettle and hot liquor tank sit on a metal cart. The gas ignition module (see next page) sits on the top shelf. All the gas and water lines are fixed so they don't need to be set up on brew day. Thermocouples in the vessels relay the temperatures to the control panel. A mixer stirs the HLT when water is being heated.

Hops are added manually in the boil, but Enegren has tinkered with an automatic hopper for this.

## PROPANE IGNITION



The gas ignition module lights the burners under the kettle and HLT, when instructed to by the control desk. Initially, the module turns on a pilot line, that supplies a small amount of gas to the burner. When a sensor indicates a flame is present, the main gas line is opened.

## PUMPS



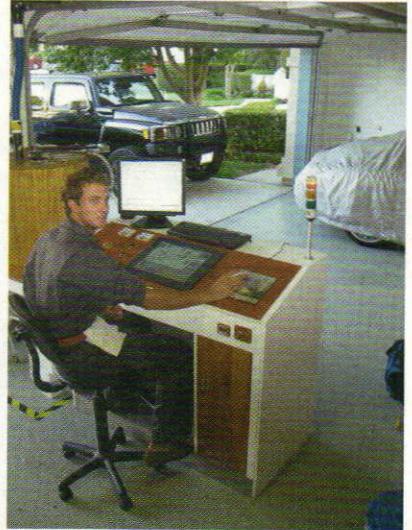
Three magnetically-coupled centrifugal pumps sit under the mash tun and move liquids from this vessel. One pump recirculates the wort for clarification, another pumps wort through a heat exchanger in the HLT during step mashing and the third pump moves wort from the mash tun to the kettle.

## WORT CHILLERS



A plate chiller, connected to tap water with a garden hose, chills the wort down to 70–80 °F (21–27 °C). If further cooling is required — for example, when brewing lagers — an ice-cold bath water in the mash tun is pumped through the counterflow chiller and this second chiller completes the process.

## CONTROL DESK

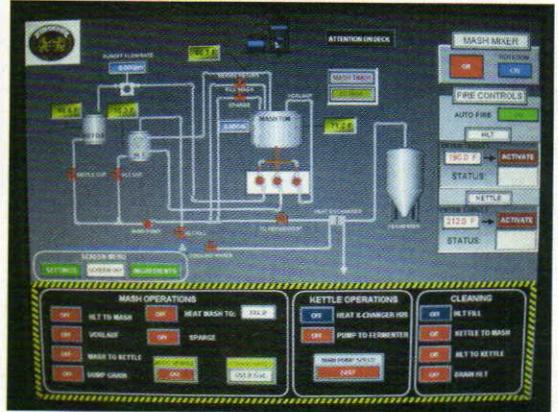


Many key aspects of a brewing session can be monitored or controlled through the control panel. A kill switch on the control panel shuts everything down in case of an emergency.

“Our record is four hits in one brewday,” says Enegren.

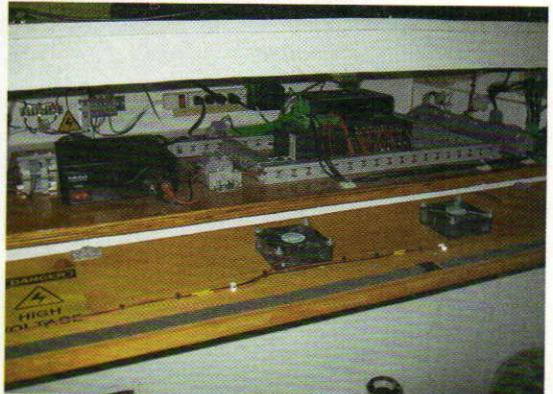
An indicator light tower — with green, red and yellow lights — gives the status of operations on brew day.

## CONTROL SCREEN



Temperatures and flow rates at various points are displayed on the touch-sensitive screen. Burners and pumps can be activated through the programmable logic controller (PLC), the heart of the system. The control panel also turns on the yellow indicator light, when a brewer action (such as adding hops) is required.

## INSIDE CONTROL DESK

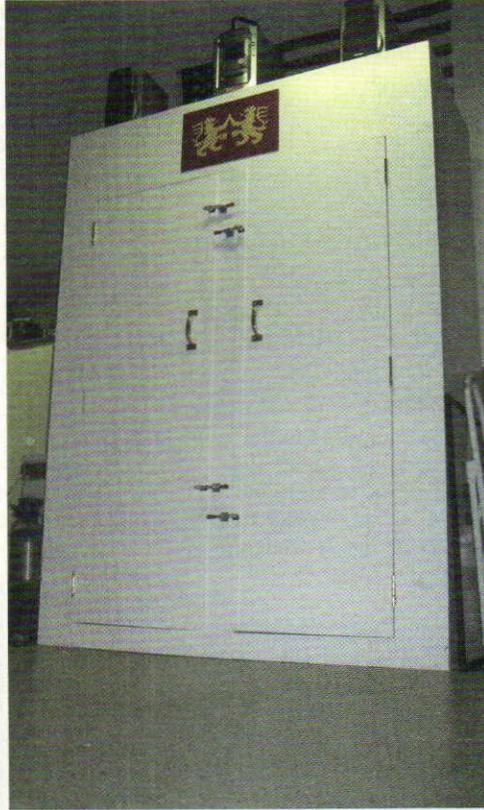


The PLC, pump control unit and power source. The PLC takes input signals from switches and sensors activating the appropriate devices (pumps, mixers, etc.). It also converts analog signals from the thermocouple into temperatures displayed on the control screen. A Microsoft Excel macro records all brewday data.

**FERMENTER**



**FERMENTATION CHAMBER**



The scratch-built fermentation chamber is lined with 3" insulation and painted with anti-bacterial paint. A window air conditioning unit is capable of cooling the interior to 45 °F (7.2 °C). A thermostat outside the chamber displays the inside temperature and allows the set point to be changed. Two 14.5-gallon (55-L) stainless steel conical fermenters are used for primary fermentations. Secondary fermentations are carried out in glass carboys.

All the work Enegren and his team have put into designing, building and reworking this brewery allows them more time to focus on the most important aspect of homebrewing — the beer drinking.

*Chris Enegren holds a degree in mechanical engineering from Loyola Marymount University.*

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# Master Measuring

## Calibrating brewing equipment

Techniques

Story by Jon Stika

**t**here are several points in the brewing process where it becomes necessary to take measurements to either verify that all is well, or know that an adjustment needs to be made to assure success for a batch of beer. There are any number of instruments brewers use to make these assessments. In this article we'll take a look at how to calibrate some of the basic instruments used by nearly every homebrewer: thermometers, hydrometers, scales, brew kettles and fermenters.

### Thermometers

There are many times in the brewing process when I reach for my thermometer, such as; checking the temperature of my strike water, mash, sparge water, wort in the hydrometer test jar and wort in the fermenter prior to pitching yeast. Each of these measurements is critical for proper wort production and yeast performance.

Calibrating a thermometer requires an easily reproducible standard temperature environment for the thermometer to measure. Such an environment is simply a glass of distilled liquid water with a lot of distilled solid water (ice). The point where solid and liquid distilled water are at equilibrium is the standard temperature environment where we can be assured that the water will be exactly 32 °F (0 °C). To do this, simply freeze about a half-cup of distilled water until it is solid. Then place this ice (crushed) into about a cup of cold liquid distilled water and let it sit for at least ten minutes to equilibrate. Next, place the stem of a dial thermometer or the bulb-end of a glass and spirit (alcohol-dyed red) thermometer into the ice water and slowly stir for a minute or two until the thermometer reading no longer moves. If the thermometer reads precisely 32 °F (0 °C) then you are good to go. If a dial thermometer is off from 32 °F (0 °C), then fit a wrench or pliers to the adjustment nut under the dial and carefully turn the stem until the dial reads correctly. For a glass

and spirit thermometer, record the temperature and note how much above or below 32 °F (0 °C) the reading is. If the reading is above 32 °F (0 °C), then you will need to subtract the difference from future measurements or, if the reading is below 32 °F (0 °C), then you will need to add the difference to future measurements with that thermometer.

"If your hydrometer reads precisely 1.000, you have an instrument that is spot-on and requires no adjustment factor."

### Hydrometers

While you have a calibrated thermometer and some distilled water handy, you can also check the accuracy of your hydrometer. The reproducible standard for specific gravity (weight per unit volume) is distilled water at 4 °C (39.2 °F), which has a specific gravity of 1.000 grams per cubic centimeter. Even though distilled water at 4 °C is the scientifically recognized standard, hydrometers are instead standardized to either 60 °F (15.6 °C) or 68 °F (20 °C). My hydrometer is standardized to 60 °F. I know this because the little paper scale inside the glass stem of the hydrometer reads; "SP. GR T: 60 °F". You will have to look at your own hydrometer to determine the standardized temperature for which it is designed to operate.

Knowing the temperature standard

for your hydrometer, place enough distilled water in your hydrometer test jar to float the hydrometer, and with your calibrated thermometer check to be sure the water is at the desired temperature (either 60 °F or 68 °F) for your hydrometer. Carefully warm the test jar and contents by running hot tap water along the outside of the test jar, or cool it by placing it in the refrigerator until the proper temperature is achieved. Once you have the distilled water in the test jar to the correct temperature for your hydrometer, carefully float the hydrometer in the water and give it a gentle twist or two with your fingers to dislodge any bubbles that might be clinging to the glass. Then get your eye at the same level as the surface of the water in the test jar and observe the reading at the point where the scale is visible just under the surface of the water. Do not read where the air meets the water surface, nor where the water rides up the sides of the glass stem of the hydrometer or test jar.

If your hydrometer reads precisely 1.000, you have an instrument that is spot-on and requires no adjustment factor. If your hydrometer reads above or below the 1.000 mark, take note of that number and subtract it from 1.000. For example, if your hydrometer reads .998; subtract that from 1.000 to get +.002 ( $1.000 - .998 = .002$ ). This is your adjustment factor to use with any future readings with that hydrometer at the standardized temperature. Therefore, if you took a reading of 1.044 on a sample of wort you would actually have wort that was 1.046 ( $1.044 + .002 = 1.046$ ). Because it is not always expedient to adjust the temperature of a sample of wort to exactly the standardized temperature for a given hydrometer, all hydrometers have accompanying documentation that shows how to adjust specific gravity readings that are taken at temperatures other than the standard temperature. Such a table provides correction factors that will need to be added to your reading if it was taken above the standard temperature or

## Techniques

subtracted from your reading if the sample is below the standard temperature. That is why it is important to measure the temperature of your sample when it is tested for specific gravity and include the temperature adjustment factor in addition to any calibration adjustment factor you derived by performing the calibration exercise just described.

## Scales

Throughout the brewing process there is a need to weigh malt, hops and other brewing ingredients accurately. Some ingredients, such as malt, are weighed by the pound (or kilogram) to the nearest ounce (or gram), while others, such as hops or spices may be weighed to a fraction of an ounce (or gram). It is difficult (and often expensive) to find a scale that will weigh things accurately across the whole range from several pounds (or kilograms) to fractions of an ounce (or gram). Therefore, most homebrewers have two separate scales; one for big weighing jobs and another for small ones. A kitchen scale

that can weigh up to 10 pounds (or 4 to 5 kilograms) usually works well for weighing malt, malt extract, specialty grains, honey and other mash adjuncts. A postage scale that weighs up to a pound (about half a kilogram), but can discern fractions of an ounce (or gram), is essential for weighing out hops, spices and other adjuncts that are used in relatively small quantities. Depending on the scale, different strategies can be used. For example, a clean US penny (1983 and beyond) weighs 2.5 grams, which is an easy way of checking hop and chemical scales.

To calibrate scales, we again turn to distilled water as our standard. However, water is only an accurate standard of weight if we can accurately measure its volume. If you recall from our discussion of hydrometers and specific gravity, a milliliter of water at 4 °C weighs one gram. Correspondingly, one liter (one thousand milliliters) of distilled water at 4 °C weighs one kilogram (one thousand grams). Since a kilogram weighs 2.2046 pounds, 453.6 milliliters of water would weigh one pound

and 28.4 milliliters would weigh one ounce. Therefore, if we can accurately measure a volume of water to the nearest milliliter, we will have an accurate standard of weight to calibrate a scale.

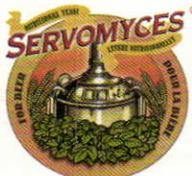
Most kitchen measuring cups are not particularly precise. Accurately measuring the volume of water necessary for accurate scale calibration requires a more exacting volumetric measure such as a graduated cylinder. A graduated cylinder is a cylindrical vessel very similar in size and shape to a hydrometer test jar except a graduated cylinder is "graduated" or marked to show incremental units of volume in milliliters. A graduated cylinder that is a good compromise between size, accuracy and price is one with a capacity of 250 milliliters. Such an instrument can be purchased for around \$10 from laboratory suppliers such as American Science and Surplus ([www.sciplus.com](http://www.sciplus.com)) or ProLab Scientific ([www.prolabscientific.com](http://www.prolabscientific.com)) and at many homebrew or winemaking shops.

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liters of water as your standard for an ounce of weight, or 454 milliliters as your standard for a pound. Note that most graduated cylinders are standardized to measure the volume of water at a temperature of 20 °C (68 °F) instead of 0 °C (32 °F), so for best results check the temperature of the distilled water you are using to get it to the standard temperature stamped on the graduated cylinder. An eyedropper is a handy tool to add water, a drop at a time, to get to the final volume.

Once you have the volume of water measured for your standard weight, adjust the scale to read zero and place a container with the measured water on the scale and note the weight as accurately as possible. Then empty the water from the container and place the empty container back on the scale and record the weight again. The difference between the two measurements should be exactly the chosen weight you are calibrating for (i.e. one pound using 454 milliliters of water). As in the hydrometer discussion, subtract the resulting difference from one to produce a

correction factor. For example, a graduated cylinder with 28.4 milliliters of water in it weighed 2.7 ounces and the empty graduated cylinder weighed 1.5 ounces, which means the scale showed a result of 1.2 ounces for the weight of the water when it actually weighed an ounce. Subtracting 1.2 from 1 yields a correction factor of -.2 ounce for that particular scale (1 - 1.2 = -.2). The correction factor (if any) would have to be included in readings from that scale for any measurements made with it in the future.

### Volumes in vessels

The 250-mL graduated cylinder can also serve as an instrument for calibrating larger vessels such as brewpots or fermenters. Using an intermediate sized container, such as a 1 or 2-L soft drink bottle, one can carefully measure 250-mL of water at a time with the graduated cylinder (at the standard temperature) and transfer the water into a soft drink bottle to achieve a precise measure of one or two liters. A measure of 946 milliliters can be con-

tained in a one liter bottle to represent a quart and 1,892 milliliters can be held in a two liter bottle as a measure of a half gallon. The bottles can then be marked with a permanent marker at the water line while the bottle is resting on a level surface. The bottles can then serve as larger volumetric measures to calibrate brewpots and fermenters to gallons or liters.

Use tape to mark volume increments on brewpots and fermenters. After the containers are heated and/or washed, replace the tape. Use permanent markers to mark the outside surface of plastic fermenters. Use glass etching paste to permanently etch gallon marks on the outside of glass carboys. Glass etching paste can be found at craft stores or from [www.etch-world.com](http://www.etch-world.com). For stainless steel pots, mark a plastic spoon or racking cane with a permanent marker and use it as a "dipstick" in a particular pot to gauge the volume of the liquid in the pot by its depth. ☺

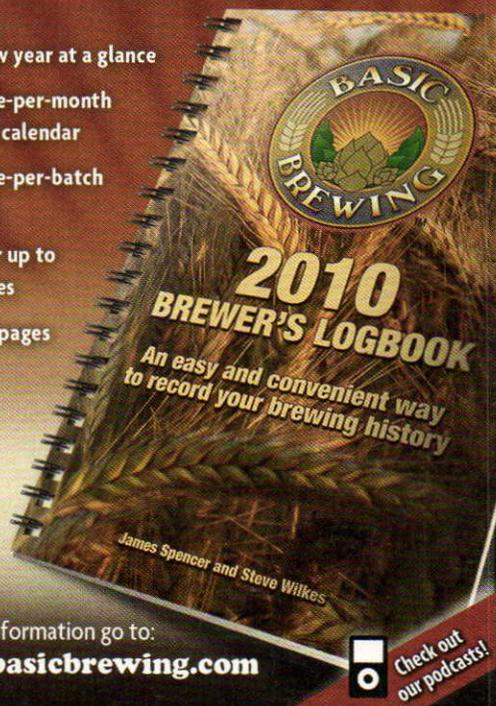
*Jon Stika writes "Techniques" for every issue of Brew Your Own.*

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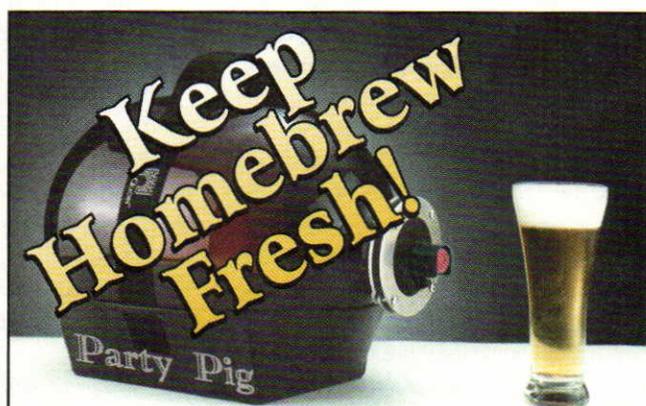
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# Hop Extracts

## The many paths to beer bitterness

by Chris Bible

**t**he compounds associated with hop-derived bitterness within beer are the  $\alpha$ -acids (alpha acids). These  $\alpha$ -acids develop in the lupulin glands in the cones of female hop plants.  $\alpha$ -acids exhibit very poor solubility in water and have almost no bitter taste. When heat energy is applied to these molecules during the boil, the atoms within the  $\alpha$ -acid molecules rearrange themselves (isomerize) by opening up and forming the cis- and trans-isomers that are known as iso- $\alpha$ -acids.

In organic chemistry, "cis-" and "trans-" mean "on the same side" and "on the opposite side," respectively. In iso- $\alpha$ -acids, this refers to the -OH group on the fourth carbon of the ring (counting the carbon atom double bonded to oxygen as carbon number one and numbering clockwise) in relation to the -C<sub>5</sub>H<sub>9</sub> sidechain. The isomerization reaction of  $\alpha$ -acids to iso- $\alpha$ -acids is shown in Figure 1.

In a three-dimensional model, the -OH group on carbon 4 in the trans form would be pointing "up," off of the page and towards the reader, assuming the 5-carbon ring were in the plane of the page. In the cis form, the -OH group would be pointing back, behind the plane of the ring. In both molecules, the bond from carbon 5 to the -C<sub>5</sub>H<sub>9</sub> sidechain (shown in the upper left of the molecules) would be pointing back.

There are three primary  $\alpha$ -acids in hops — humulone, cohumulone and adhumulone. These  $\alpha$ -acids are molecularly similar, but have different side-chain structures chains (the "-R" groups shown in Figure 1). Each of the three iso- $\alpha$ -acids also exists in two different configurations (cis- and trans-). These six iso- $\alpha$ -acids are responsible for hop-derived bitterness, and they each differ in the quality and intensity of their bitterness. Beer bitterness from hops is due to the presence of iso- $\alpha$ -acids in concentrations that are typically between 15 and 100 ppm within the beer.

### How hops affect beer

The compounds derived from hops contribute greatly to the overall quality of beer. The compounds derived from hops are responsible for:

- Providing bitterness in beer
- Providing aroma to beer
- Modifying yeast performance during fermentation
- Contributing to beer mouthfeel
- Protecting beer from some biological spoilage organisms
- Contributing to protein coagulation during the boil
- Improving head retention and foam cling
- Contributing tannins that may improve resistance to oxidation

Homebrewers typically use hops that are either in the form of whole hops (cone or plug) or pelletized hops.

Whole hops tend to have a shorter shelf life than pelletized hops, especially when stored under less-than-ideal conditions, and they also tend to have a lower  $\alpha$ -acid utilization (typically 25–30%) during the boil. This is because the  $\alpha$ -acid is more strongly bound up in the vegetable matter of the hop and therefore less readily available.

Pelletized hops are made by milling whole hops and then compressing the hops into pellets. Milling makes the  $\alpha$ -acid more readily accessible, so pelletized hops tend to have a higher utilization (typically 27–32%) than whole hops. The pellets may be packaged under vacuum or in nitrogen in order to reduce the rate of oxidation and deterioration of the hop oils.

Pelletized hops are available as "regular" pelletized hops (T-90 type), and also as enriched pellets (T-45 type) where some of the hop vegetable material is removed. By removing non- $\alpha$ -acid material, the amount of  $\alpha$ -acid for a given amount of hops is increased. The pelletized hops normally found in homebrew

stores are of the T-90 type, unless otherwise specified.

Other forms of hops or hop-derived compounds are also commercially available. These other forms include isomerized hop pellets, hop extracts, isomerized hop extracts, reduced hop extracts (tetra-hops) and hop essence. These hop products are not widely-used among homebrewers, but are starting to become available from some homebrew shops.

### Isomerized hop pellets

Isomerized hop pellets are milled in a way similar to standard pellets, but have magnesium oxide added as a stabilizer during the pelletizing process. The stabilized pellets are then packed in an inert atmosphere and are heated to a temperature of about 50 °C (122 °F) for approximately 14 days. At the end of the 14 day heating period, up to 99% of the  $\alpha$ -acids are isomerized within the hop. This allows wort utilization rates of 80–90%, and overall  $\alpha$ -acids utilization rates of up to 70%.

### Hop extracts

A concentrated solution of alpha and beta acids, hop oils, and hop resins can be extracted from hops using solvents. Organic solvents used in the extraction process include ethanol and hexane. Supercritical carbon dioxide may also be used as an extraction solvent. (Supercritical fluids are substances that show the properties of a liquid and a gas. Carbon dioxide becomes supercritical when it is above its critical temperature, 88 °F (31 °C) and pressure, 73 atm.) After extraction, the solvents are boiled off and the concentrated hop oils and resins containing  $\alpha$ -acids are left behind.

The immediate availability of the  $\alpha$ -acids in the extracts results in increased overall utilization (typically 35–45%).

### Isomerised hop extracts

It is possible to improve utilization by pre-isomerizing the  $\alpha$ -acid prior to boiling

in the wort.  $\alpha$ -acid can be isomerized by heating in the presence of potassium or magnesium carbonate to produce a substance called pre-isomerized kettle extract. If the pre-isomerized kettle hop extract is added to the boiling kettle, overall utilization of approximately 70% is typical.

Pre-isomerized hop extract that is added to the boiling kettle will incur overall utilization losses due to absorption of the iso- $\alpha$ -acid by trub and yeast. It is also possible to add pre-isomerized hop extract to a beer after fermentation is complete. The isomerized extract that is intended for post-fermentation addition is typically a standard solution of 20% or 30% by weight iso- $\alpha$ -acid from which an overall utilization of 70–95% or greater can be expected. In commercial brewing operations, post-fermentation addition of pre-isomerized hop extracts may be used to adjust the final bitterness level of a beer, or to increase the bitterness level in a high-gravity beer by compensating for poor utilization due to high gravity.

Post-fermentation isomerized extracts contain only iso- $\alpha$ -acids and contribute no hop flavor or aroma character to the beer. They contribute only bitterness. When post-fermentation addition of pre-isomerized hop extract is used as the only source of beer bitterness, base extract or boiled hops should also be used in order to provide the other organoleptic qualities associated with hops.

### Reduced hop extract (dihydro-, tetrahydro- and hexahydro-isohumulones)

When light, especially ultraviolet light, hits beer, it provides the energy necessary to drive a chemical reaction that transforms the hop-derived iso- $\alpha$ -acids into 3-methylbut-2-ene-1-thiol (see Figure 2).

The “thiol” part of the name indicates that there is sulfur present. Sulfur compounds often have strong, offensive aromas. The flavor threshold of 3-methylbut-2-ene-1-thiol is so low that the presence of only a few parts-per-billion is enough to irreversibly spoil the beer and impart characteristic “skunky” or “lightstruck” flavors and odors.

Beer can be entirely protected from the effects of light by storing it in opaque containers such as cans or kegs. Beer that is packaged and stored in bottles, however, is susceptible to developing skunky off flavors and aromas.

There is another way to protect beer from the effects of light. The

Table 1: Comparison of Bittering Properties

Compounds	Relative Bitterness
Isohumulones	1.0
Dihydro-isohumulones	0.6-0.7
Tetrahydro-isohumulones	1.5-1.9
Hexahydro-isohumulones	1.0-1.2

photosensitivity of beer can be reduced by chemically altering the iso- $\alpha$ -acids so that the chemical precursor to the photochemical reaction responsible for producing the “skunky” flavor is not present within the beer.

Iso- $\alpha$ -acids can be converted to reduced iso- $\alpha$ -acids by hydrogenation and/or by reaction with sodium borohydride. Three major types of reduced iso- $\alpha$ -acids can be produced: dihydro, tetrahydro, and hexahydro. Figure 3 shows the reactions.

Figure 1

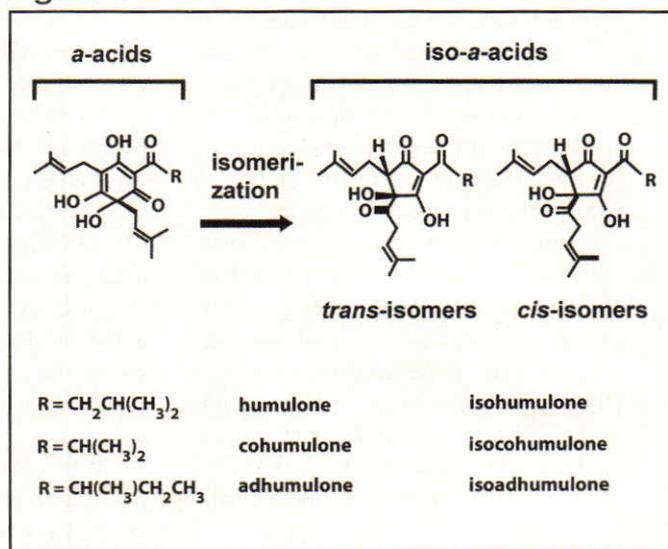


Figure 2

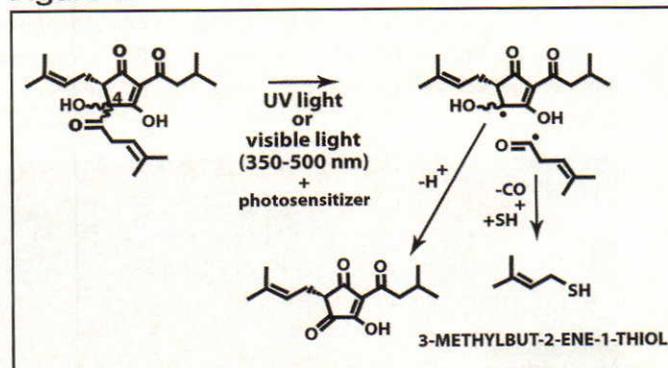
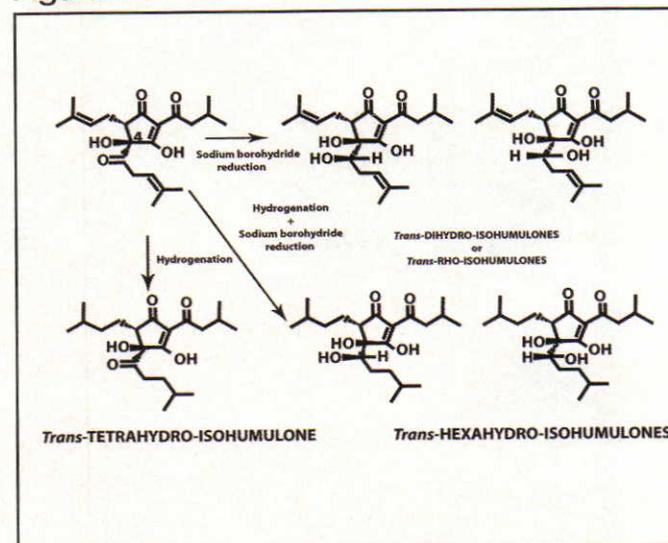


Figure 3



## Advanced Brewing

Although the chemically reduced iso- $\alpha$ -acids are as photoreactive as the ordinary iso- $\alpha$ -acids, 3-methylbut-2-ene-1-thiol cannot be formed from these compounds subsequent to photocleavage. As a result, the lightstruck flavor developed from reduced iso- $\alpha$ -acids has a much less obnoxious taste and aroma than the lightstruck flavor resulting from photocleavage of the ordinary iso- $\alpha$ -acids. Substitution of iso- $\alpha$ -acids by dihydro-, tetrahydro- and hexahydro-iso- $\alpha$ -acids allows brewing of light-stable beers, which can be bottled in clear or green glass. Additionally, the bittering properties of dihydro-, tetrahydro- and hexahydro-iso- $\alpha$ -acids are comparable to that of ordinary iso- $\alpha$ -acids as shown in Table 1.

### Hop essence

Most of the hop products considered so far have been used to enhance the bitterness of beer through contribution of iso- $\alpha$ -acid. Hops are also a source of hop oil aroma. The compounds associated with hop aroma can be separated by steam

distillation or by supercritical CO<sub>2</sub> extraction and captured to produce "hop essence" oils.

These hop oils are ideal for post fermentation addition where they provide a dry-hopped aroma to beer, and provide much of the aroma character associated with the original hop variety. Commercial breweries usually add the hop-essence oils in the form of an emulsion (with a food grade emulsifier). The hop-essence oils are usually marketed in concentrations between 1,000 and 10,000 ppm (0.1–1% by weight) of pure oil.

With column chromatography it is possible to fractionate the whole hop oil into late hop essence, which may be further divided into spicy and floral fractions. Spicy late-hop-essence oils contain terpene and sesquiterpene oxides. These compounds produce a spicy flavor in beer, improve mouthfeel and enhance perceived bitterness. Floral late-hop-essence oils contain ketones. Ketones impart light floral notes and improve the fragrance of the beer.

## Conclusions

There are many commercially available alternatives to the whole hops or pelletized hops that are commonly used by homebrewers. Although there are many different ways to achieve a desired bitterness level and hop flavor/aroma character within a beer, each alternative has pros and cons. To many homebrewers, hops extracts may be seen as "unnatural" and not desirable. And, the economic incentives to use these products aren't strong at our scale. However, as they become increasingly available to homebrewers, some may find use for them in adjusting bitterness post-fermentation, decreasing the amount of plant material in very hoppy worts or adding bitterness to high-gravity worts. As a brewer, it pays to make yourself aware of all of the options that are available to you. By selecting the option that works best in your individual situation, you can brew better beer. ☺

Chris Bible is Brew Your Own's "Advanced Brewing" columnist.

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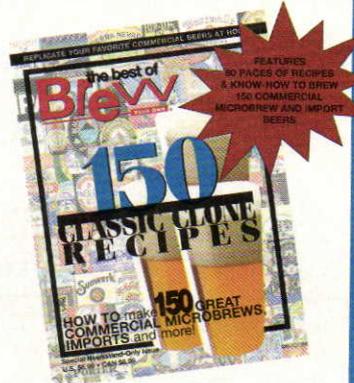


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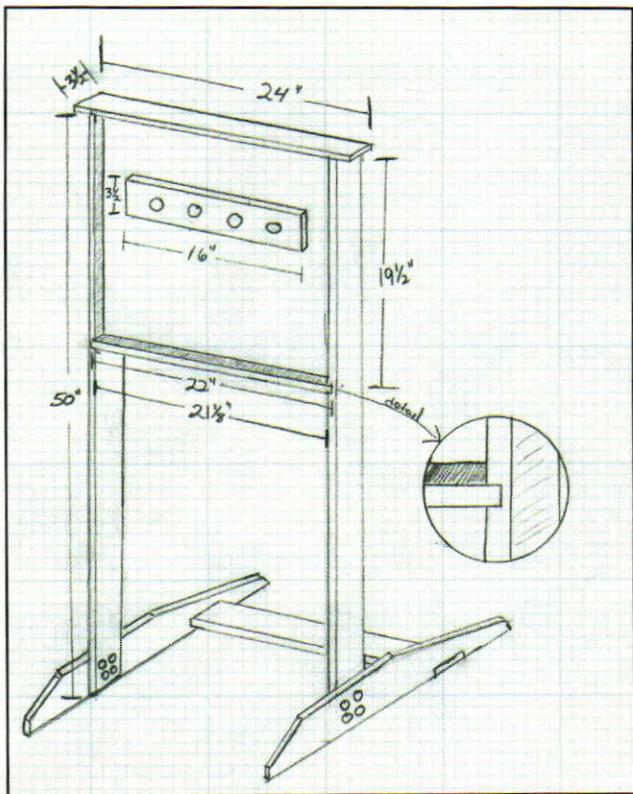
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# Kegs on the Move

Projects

Build a portable brew stand

Story and photos by Matt Wilson



Every year I participate in a large party celebrating the end of the summer and a great scuba diving season. The festivities include bonfires, oysters, conch fritters — and of course beer. I decided that my contribution would be some of my homebrew, but I wanted the presentation to be indicative of the time I invested into making the beer. The presentation needed to showcase the libations more than just a standard “picnic” faucet. After much thought I had a moment of clarity: the skies parted and the lights from the beer gods shown down upon me — I would build a portable brew stand.

I knew I wanted to create something that looked nice, was easy to set up (and tear down) and allowed me to market a few different brews on draft. I decided that using a piece of whiteboard would do the trick. I designed the stand based on a large Rubbermaid tote to fit between the vertical stiles, which are the vertical pieces of the stand’s frame.

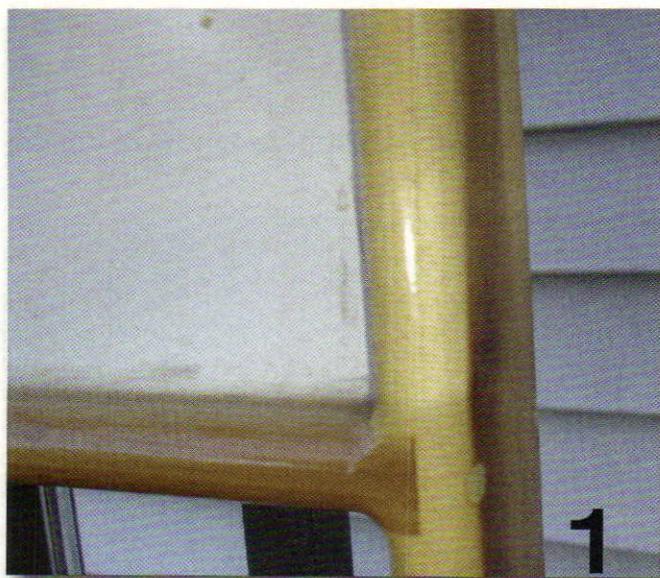
## PARTS LIST

### Materials

- 1x4 Poplar wood (you will need about 19 ft./6 m total)
- 2'x2'x1/2" plywood
- Dry erase board - a sheet big enough to cut into two pieces, each 22"x20" (56x51 cm)
- Four 2" (5.08 cm) shanks
- Four faucets/taps
- Four tap handles (or screwdrivers. See step 6)
- Gas and liquid tubing and disconnects for four lines
- Gas manifold for four lines
- Eight 2" bolts with nuts and lock washers
- A tube of clear silicone caulk
- Pipe insulating foam tubes (to insulate the beer lines)
- Dry erase markers

### Tools

- Router • Hand drill • Table saw
- Hole saw • Wrench or socket set

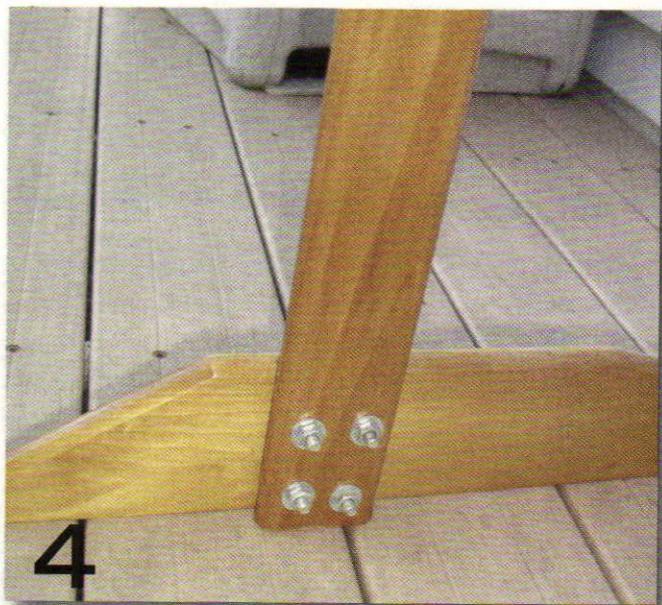


**Step one:** Start by cutting the wood stiles and rails to length. I would recommend cutting the middle rail piece first (22 in./56 cm, end to end). From there, cut the dado (rectangular channeled) grooves into the vertical stiles to accept the middle 22" (56 cm) rail you just cut (photo 1). You will now need to determine the total thickness of your 1/2" plywood and two sheets of white board. Set up your table saw or router to cut a dado into the middle rail end to end, and also the vertical stiles starting at the top and stopping where the middle rail dado was cut. This will give you a groove that the plywood and dry-erase boards will slide into.



**Step two:** Cut your top piece. With a router add an ogee edge, which is just a decorative molding cut with an s-shape, to the top on all four sides for aesthetics (photo 2). Cut a dado into the bottom side of the top piece to accept the plywood and dry-erase board sandwich.

**Step three:** Dry fit the pieces together so you can get a measurement for your plywood and dry-erase board panels. Cut your plywood, and test fit. If your measurements fit, cut the dry-erase boards and slide all three pieces down between the vertical stiles and into the middle rail, and the top should sit right on top. Pre-drill and counter sink the holes, then screw the top portion together. (Photo 3)



**Step four:** The bottom support is pretty free-form (photo 4). Add some angles to the feet (or not) and notch the back so you can put in a cross piece along the back, which will prevent the stand from tipping over because the Rubbermaid tote or ice container you use will sit on top. Drill holes for four bolts on each side. This will make it easy to take the stand apart for storage and transport. Before you stain or apply finish, use your router on the edges to round everything over. I went with no stain and high-gloss polyurethane. I applied a bead of clear caulk to the front side between the frame and dry-erase board, to keep moisture (aka: "beer") out.



**Step five:** For the faucets, determine the location you want the faucets to be on the white board and pre-drill with a small drill bit all the way through. Next, use a hole saw and drill from both sides to prevent damaging the dry-erase boards. Install the beer shanks and faucets. (Photo 5)

**Step seven:** For the gas system, I used a simple gas manifold with shut-offs for each keg (Photo 7). Add some pipe insulating foam tubes on the beer lines to keep them cool.



**Step six:** I made my tap handles from Craftsman screwdrivers, but you can use whatever handles you choose. To make the screwdriver handles, I heated up the metal shaft of the screwdriver with a torch then pulled it out with vice grips. Drill out the handle and install a threaded insert. (photo 6).



**Step eight:** Head to your local office-supply store and buy a pack of colored dry-erase markers for your artwork. Label your beers accordingly and you are ready to serve! The design is up to your creativity and artistic talent (can't help you on that one) (photo 8).

*Matt Wilson is a homebrewer and woodworking enthusiast from Bloomington, Illinois. This is his first article for Brew Your Own.*

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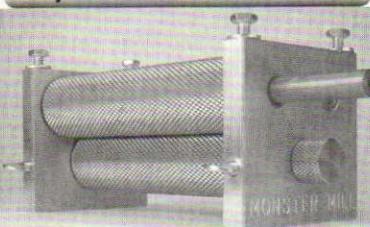
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# Rock and Brew

## Four homebrewers who like it loud

W.B. Moore • Los Angeles, California

**F**inal Gravity isn't a phrase just for beer geeks any more. It is also the name of a band (of beer geeks) and the title of their debut CD release. Featuring four homebrewers, Los Angeles rockers Final Gravity takes the marriage of rock and beer to new heights.

ed in a 5-gallon (19-L) bucket and hand bottled in several dozen of Bill and John's impressive beer bottle collection (more than 700 different bottles when it finally went to the recycler). Pleased with the results, they began to explore their own recipes, the first of which was a California

same time the other band members discovered brewing. Recently divorced, he moved into an apartment across the street from a BJs Restaurant and Brewhouse in the San Fernando Valley. Although he thought he hated beer at the time, he loved pizza, and the combination soon won him over. He quickly discovered that he preferred beer he couldn't see through, and began exploring the darkest regions of the brewmaster's art, becoming a regular at the local BevMo and accompanying Mike to beer festivals.

Through Strand Brewers, Mike became an expert in the science as well as the art of brewing. The brew club offered BJCP training to become a certified beer judge. Learn more about beer? Free beer? Classes at Naja's Place (with over 70 taps)? Mike almost sprained his wrist signing up so fast! After taking the classes, Mike was awarded certified status with the BJCP and is now judging competitions toward gaining his national rating.

While the brewhouse was operating at Mike's, the band got together for the first time in years over an all-grain double IPA. Although it would be a few months more, this meeting planted the seed that led to the reunion of Final Gravity, this time with more intoxicating results.

Looking for a new band name, they settled on Amendment 21 (the anniversary of the repeal of prohibition is also Bill's birthday), only to find another L.A.-area band with that name. Casting around for alternatives, they settled on Final Gravity as indicative of their love for beer and brewing and also representing the craftsmanship they apply to making their music. Nearly two years of work and dozens of recording sessions (accompanied by their favorite beverage, naturally) culminated in their first album, released November 17th. The album is self-titled, but the cover includes four tunes representing the fundamental ingredients of beer: water, hops, yeast, and barley.

Keep up with the band's musical and brewing adventures and appearances on the Web at [finalgravityband.com](http://finalgravityband.com).



The four members of the band Final Gravity are also homebrewers, which makes getting together to practice a good opportunity to make and drink some tasty homebrews.

Final Gravity's beginning as rockers was humble, but steeped in tradition. Drummer John Chominsky and vocalist Bill Moore met when Bill auditioned to sing for John's cover band, Elixir. On the second try he was brought on board and the group played together for two-and-a-half years at venues around Penn State University. Upon moving to Los Angeles, Bill and later John joined guitarist Mike Clark as roommates and eventually became bandmates in another cover project called DeJa Vu. Mike brought his friend Charles Mumford into the mix on bass, and the ingredients of Final Gravity were in place. But something wasn't quite right about that initial brew, and the band fell flat after only a couple shows, drifting their own ways for several years.

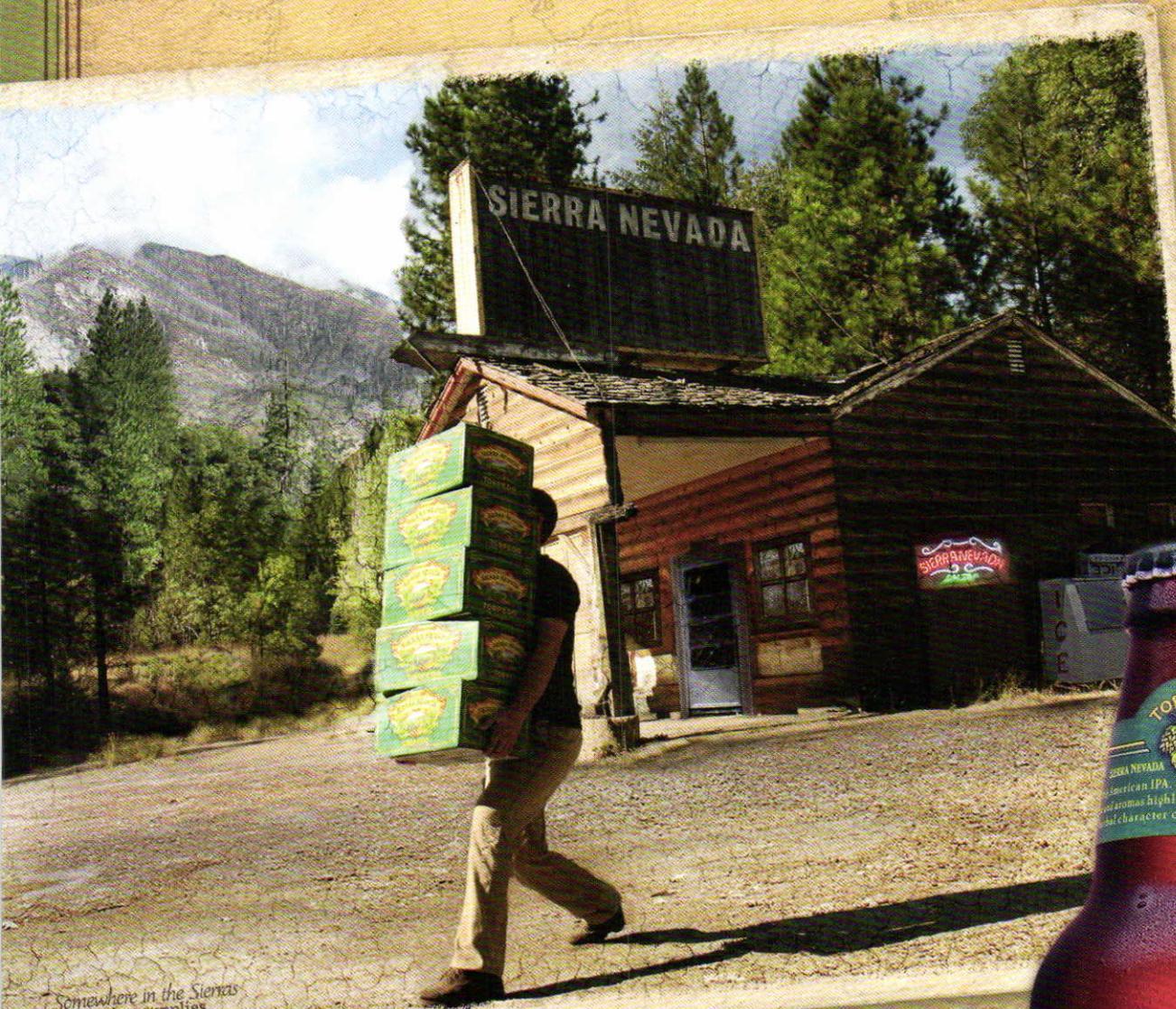
It was during this time that Bill and John began their first brew, which was an extract-based American pale ale ferment-

common they called "667 — One Step Wicked Ale."

This was an exciting time for micro-brewing in Southern California and across the country and Mike started attending beer festivals in the region, beginning with the L.A. Beer Odyssey in 2001. He traveled south to attend some of the early Pizza Port and Stone festivals which have since become regular events for the whole band. But Mike doesn't do things halfway, and besides drinking beer, he also got involved in brewing, joining Strand Brewers in Redondo Beach. He quickly assembled the equipment for all-grain mashes and quite soon (to the chagrin of his wife, Christina) had turned his kitchen into a small-scale brewery.

Though the route Charles took to become a beer aficionado was long and circuitous, he arrived at an appreciation for the heavier side of life at about the

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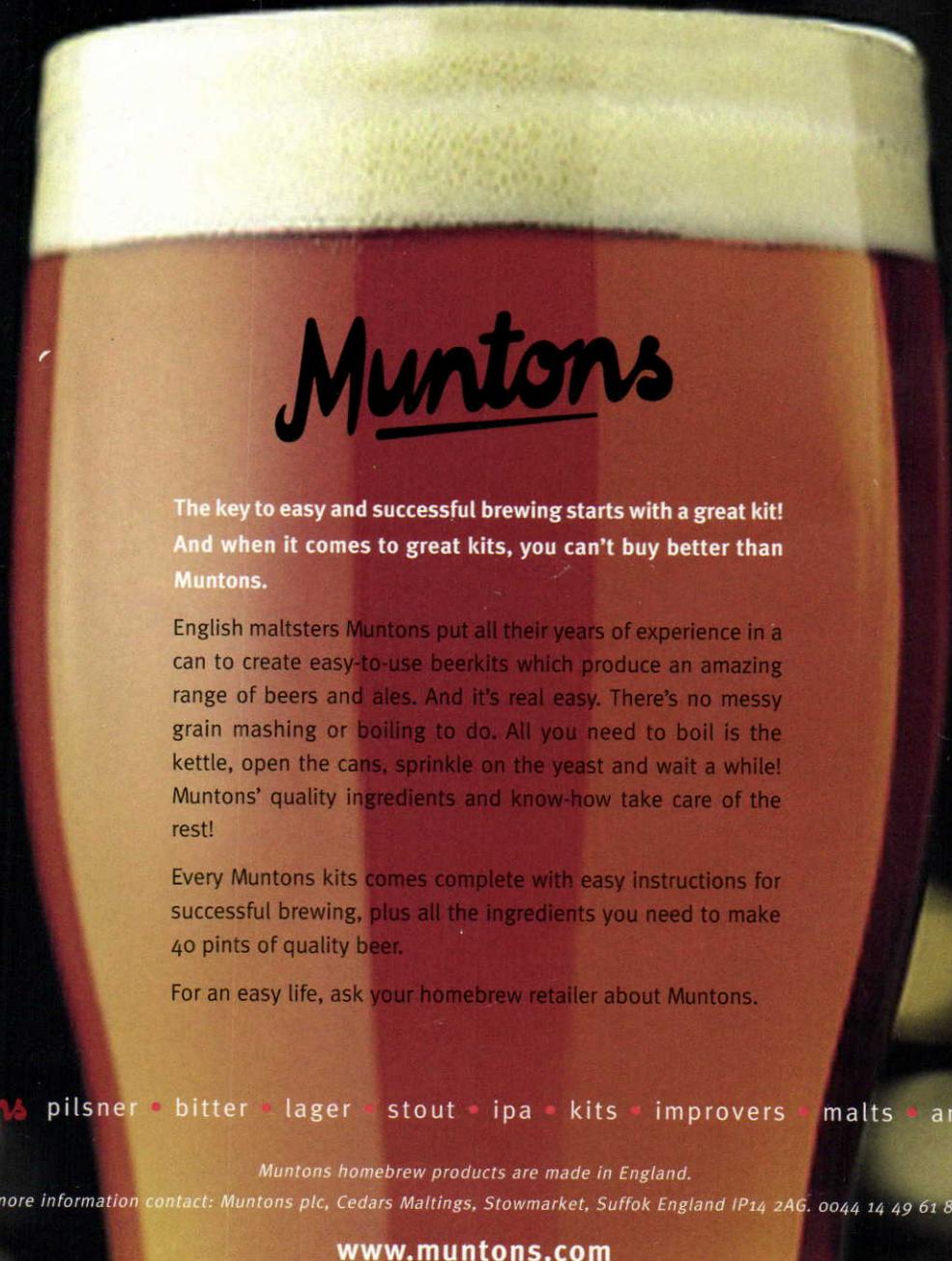


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