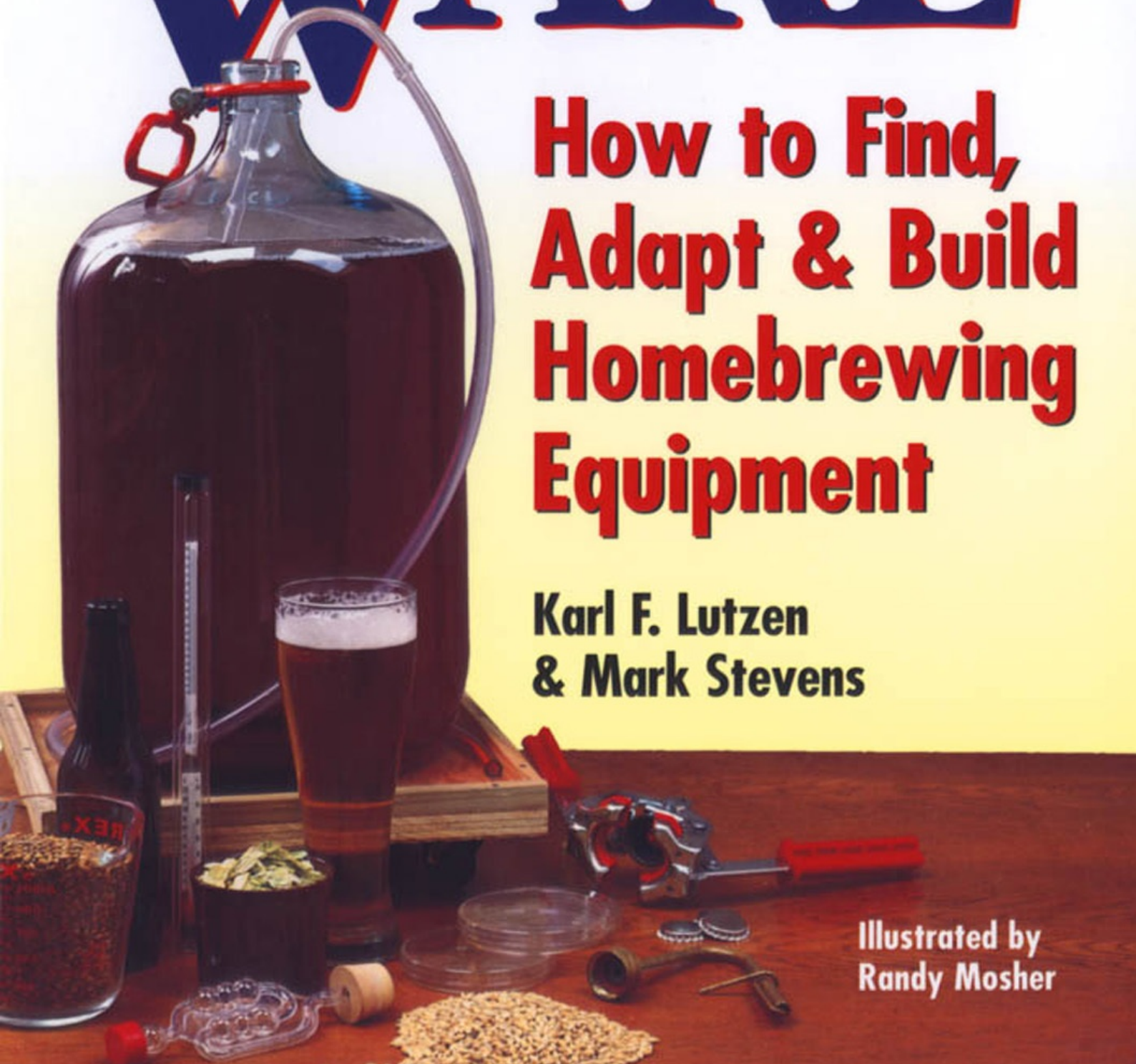
BREW WARE

How to Find, Adapt & Build Homebrewing Equipment

Karl F. Lutzen
& Mark Stevens



Illustrated by
Randy Mosher

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And finally, we would like to thank Marc Tewey, brewmaster of Brimstone Brewing Company, of Baltimore, Maryland, for taking the time to explain commercial brewing equipment operation to us and allowing us to photograph his brewery.

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FOREWORD

GETTING INTO THE SPIRIT OF HOMEBREWING

The last decade has seen immense growth in the ranks of homebrewers, just as it has seen immense growth in the number of brewpubs and microbreweries — what has come to be known as the craft brewing industry. In many ways the two feed on each other: The growth of small breweries inspires hobbyists to brew ever-better beer, and the hobby itself serves as a training ground and experimental laboratory for the craft brewing industry. More than a few brewpubs and microbreweries were started by or are staffed by former homebrewers who had the desire and dedication to learn about and brew great beers.

Indeed, much of the spirit of homebrewing is an experimental one. It's the attitude of tinkerers who are unsatisfied with simply brewing good, clean beers. That very attitude leads brewers to experiment with unusual ingredients or unconventional ways of approaching the brewing process. There are some great brewing ideas out there — many of which we undoubtedly have yet to hear about or see in action. The same is true for brewing hardware. In this book, we have tried to give a reasonably comprehensive view of equipment and gadgets used in homebrewing today; however, new gadgets unquestionably will come to market between the time we researched and wrote this book and the time it reaches your bookshelf. And because homebrewers are experimenters and tinkerers, the process will continue. The coming years should see even more great ideas for new equipment and for solving problems as homebrewing continues to grow.

Homebrew supply shops are a vital part of the homebrewing community, providing not only a ready source of ingredients and equipment, but also a ready source of information, tips, and troubleshooting help. The supply shop often serves as a focus point for homebrewers in a local area — a place where homebrewers can meet, form clubs, and find out about homebrewing events, such as competitions or beer festivals. A good, knowledgeable, well-stocked local supplier is a valuable resource.

Our intention in writing *Brew Ware* is to serve the homebrewer and especially the tinkerer — those brewers who are not content with the cheapest or easiest route but who seek out alternatives and ever-better gadgets in their quest for great beer.

So if in *Brew Ware* we show you how to drill a hole in a rubber stopper, it is not because that will be the best approach for everyone, but because that approach best meets the needs of some brewers sometimes. In fact, better solutions (such as the carboy cap) are often available at your local homebrew supply shop, and often at lower cost. Homebrew supply shops can often order the gadgets we describe here, and often at lower cost than you could get by calling the manufacturer directly. But, as we said, our goal in writing this book is to serve the homebrewer, and so we include

contact information of the manufacturers so that if you are unable to find a local supplier who carries or is willing to order a gadget that best meets your needs, you can contact the manufacturer to find a supplier who does carry it.

INTRODUCTION

AN OVERVIEW OF BREWING

THE FIVE BASIC STEPS OF BREWING BEER are wort production, boiling, cooling, fermenting, and packaging. Wort production is the creation of a solution of water and the sugars needed for fermentation. For most beginning homebrewers, wort production is simply the blending in a pot of malt extracts and water. For an advanced all-grain brewer, it involves mashing the grains by soaking them in water at an appropriate temperature for an appropriate length of time and then rinsing the grains with water to fully extract the sugars. In the boil, hops are added to the wort and the wort is boiled for at least an hour. The wort is then cooled to a temperature adequate for yeast growth (usually below 80°F). To start fermentation, the mixture is shaken vigorously to aerate it, yeast is added, and the beer is allowed to ferment for several days or weeks. During the fermentation period it may be transferred (or "racked") to another vessel one or more times in an effort to reduce the amount of sediment and improve the beer's clarity. The finished beer is then usually packaged in either bottles or kegs. It's then time for the most important step of all — drinking the finished beer!

A complete examination of all these steps would take a book to explain. Fortunately, that book has already been written. Most basic equipment kits sold at homebrew supply stores today will include a basic introduction to brewing. These instructions will explain, in simple terms, what you need to do to brew better beers, have more control over the finished product, and develop a more complete understanding of brewing ingredients, styles, and processes. If you want a book that fully examines the brewing process in a straightforward, technically sound manner, we recommend *Dave Miller's Homebrewing Guide*.

PREPARING TO BREW

Before you get started, you need to have a recipe in mind (or an ingredient kit with the proper ingredients assembled) and your equipment and work area ready and sanitized. Some brewers like to pre-boil their brewing water or let it sit overnight to drive off the chlorine usually present in municipal water. Pre-warming malt syrups will also help them pour better.

WORT PRODUCTION

For most beginning homebrewers, wort production is easy. You simply pour the malt syrup or powder into a pot of water and stir. For the all-grain brewer, it's an involved

process that begins by crushing grain and then adding hot water to reach an appropriate temperature. The target temperature will depend on which type of mashing schedule the brewer is using. The simplest of the mashing schedules is what's known as a single-step infusion mash. For this type of mash, water is added until a temperature in the range of about 148° to about 158°F is reached. This could be preceded by other, lower temperature steps, such as what is called an "acid rest," or perhaps a "protein rest," or both. Each of the different types of steps promote the activity of a different type of enzyme reaction in the grains. After the grains are mashed (i.e., all the starches are converted to sugars), the mash is sparged with water, which is the rinsing of the grains to fully extract the sweet liquid from the grain.

BOILING THE WORT

The boil is important for several reasons. It's during the boil that hops are added and their bitterness extracted in a process known as "isomerization." There are also a number of kettle reactions that change the character of the beer, drive off unwanted flavors from the grain, and contribute to the color of the beer. For all-grain brewers, the boil reduces the volume of the wort, concentrating the sugars. A rolling boil is best, and the brew kettle should not be covered or else those unwanted substances that would normally be driven off will be unable to escape from the pot.

Hops are often added in stages during the boil. When the boil first begins, add the hops that will provide bitterness. These should boil for at least one hour. Often brewers will add more hops about 30 to 40 minutes into the boil to provide flavor and again at the very end of the boil to provide aroma.

COOLING THE WORT

After the boil is finished, you need to cool the wort before you can add yeast. One way that extract brewers often cool their wort is to begin the brewing by only boiling 6 quarts of water, boiling with the extract and syrup, and then at the end of the boil mixing the hot wort in the fermenter with about 3½ gallons of cold water. This works fairly well except during the summer months when the water is too warm. All-grain brewers will always have at least 5 gallons that need to be chilled, and many extract brewers find that boiling with a full 5-gallon volume can help improve their beers. If you need to cool a large amount of beer, a wort chiller is invaluable.

FERMENTATION

After the wort is cool enough to pitch yeast (usually somewhere in the 60° to 68°F range for ales, but always below 80°), you will want to aerate the wort. One way to do this is to simply shake the fermenter as vigorously as possible, or to splash the wort as you siphon it into the fermenter. Aeration is important because oxygen will help promote vigorous yeast growth.

You then add the yeast, shaking the fermenter or stirring the mixture. Many

homebrewers prefer to grow large starters before adding the yeast. It's important to realize that low yeast pitching levels are one of the biggest problems homebrewers face. Using starters can solve that problem. If you're not comfortable with yeast starters and are using only dry yeast, adding 3 or 4 packets of yeast instead of the 1 or 2 that some recipes suggest can also give your yeast a leg up on their growth cycle.

After the yeast is added, seal the fermenter (put the lid on if you have a bucket, or use a cap if you have a carboy), put an airlock in place, and leave the beer alone for several (usually 3 to 5) days. Sometimes, after the initially high level of yeast activity settles down, homebrewers will transfer the beer to a second fermenter so that they can remove the clean beer from sediment and, hopefully, end up with a cleaner-tasting and clearer beer. This process of transferring beer from one fermenter to another is called "racking." After racking, the beer is allowed to continue fermenting. This second stage is referred to by brewers as "secondary fermentation."

PACKAGING

After the beer is finished fermenting, you're ready to put it in bottles or a keg. Most homebrewers start out using bottles because of their low cost and ready availability, but a keg is easier to clean and requires a lot less time to deal with.

If you bottle, you'll need at least 2 cases of bottles (that's 48 bottles) to handle a 5-gallon batch. You'll need to clean and sanitize the bottles and then prime your beer to provide carbonation. Priming is the addition of a small amount of sugar to induce a small second fermentation that produces carbon dioxide. Usually ¾ cup of corn sugar is used. Some homebrewers have added priming sugar by the teaspoon to each bottle, but that's more work than is necessary and produces inconsistent results. It's easier to add the corn sugar to the entire volume of beer, mix it in, and then siphon the beer into the bottles.

Then it is time to cap the bottles, wait about 2 weeks, and enjoy a cool, refreshing homemade beer!

Terms used throughout the text may be unfamiliar to novice homebrewers; therefore a glossary has been added at the end of the book. Suppliers named in the text can be found at the end of the book in the Sources section. The Supplier list is by no means exhaustive, and many of the gadgets described here may be available at lower cost directly from your local homebrew supply shop.

1

THE HOME BREWERY

EVERY HOMEBREWER HAS DIFFERENT PRIORITIES, constraints, and philosophies. These differences are reflected in the wide range of approaches used in selecting and making homebrewing equipment. Some brewers feel that cost is no object if performance can be boosted even slightly, no matter that the improvement may exist only in the brewer's mind. Others get pleasure in finding ways to do things themselves even if it takes hours or days of effort to save a few dollars. Different folks have different priorities, but in the end all brewers have the same number one priority — making great beer.

Brewing equipment, therefore, has just one purpose: to do its job well, with the goal of producing great beer. For example, mash tuns hold the mash at constant temperatures for prescribed periods of time; filters remove particles of a certain size; and so on. There are often many ways to accomplish any given step, and the way one brewer does something may not be the way another does it. Even experienced brewers disagree about the "best" way to brew. Getting hung up on minor points wastes time and money that could be better spent brewing and drinking, but discussing preferred brewing techniques is fun and a great excuse to get together to drink beer.

In this chapter we introduce a few basic ideas about brewing equipment: what kinds of equipment you need to equip a home brewery, what kinds of equipment are generally used in a small commercial brewery, and how to keep your brewing equipment clean and in good condition.

EQUIPMENT FOR THE HOME BREWERY

The equipment needed to start brewing at home is fairly minimal. You probably already have a large stock pot and a mixing spoon — that takes care of your brew kettle. You'll also need a fermenter, some tubing to move the beer from one place to another, and a way to package the beer, which usually means getting a bottle capper. The investment in equipment is small. Many homebrew supply shops sell basic equipment sets for less than $50. That's what it costs to play the game.

A homebrewing set usually includes:

- ✔ One 6½ gallon plastic bucket with lid drilled and fitted with a grommet or stopper for an airlock
- ✔ Plastic airlock

✔ Hydrometer
✔ Bottle brush
✔ Siphon tube
✔ Racking cane
✔ Sanitizer
✔ Introductory book
✔ Bottle capper

Equipment sets do vary. Some may also include a bottle filler, a tube clamp, bottle caps, or upgrades to certain basic equipment. If the set doesn't include a thermometer, you may want to buy one. You *won't* find a kettle, spoon, or bottles in these basic equipment sets, but other than that, they'll have the items you need to brew your first batch.

Basic homebrew equipment should include: a plastic bucket and lid, a hydrometer, a

bottle brush, a siphon tube, a racking cane, sanitizer, a bottle capper, a plastic airlock, and an introductory book.

For a brewer using recipes based on malt extract, the basic homebrewing set will work fine for quite a while. Eventually you may want to upgrade some of these items, as through your own experience and contact with other homebrewers you become aware of other brewing techniques. Some typical upgrades may include:

- ✔ Replacing the plastic buckets with a glass carboy, or even a stainless-steel vessel
- ✔ Replacing the bottle capper with a bench capper
- ✔ Obtaining funnels and strainers
- ✔ Replacing the airlock with other models
- ✔ Upgrading the bottle filler
- ✔ Buying more books
- ✔ Using larger bottles, or maybe even investing in kegging equipment

Eventually, you may decide that all-grain recipes aren't too hard (they really aren't), and then you'll need a few more gadgets:

- ✔ Some sort of mashing and sparging setup (can be built for as little as $15)
- ✔ A larger pot (unless you've already got one that can boil at least 7 gallons)
- ✔ A wort chiller (can be built for about $20)

That's really all you need to start mashing — although most homebrewers find that better equipment is easier to use, easier to keep clean, or produces better beer. Once you've really got the homebrew bug, you'll probably want some other equipment. Some items that really can make a difference in the pleasure you get from the hobby include:

- ✔ Roller malt mill
- ✔ Kegging equipment
- ✔ Refrigerator for fermenting and storing beer

Buying homebrewing equipment is a lot like buying cars. The ultimate goal might be to get you from your home to your office. Both a $1,000 clunker and a $250,000 Lamborghini will accomplish that — the choice is yours. It's the same thing. with homebrewing equipment. Although you can enter the all-grain brewing game for as little as $50 over your initial equipment investment, there are also some very well built, well designed stainless-steel systems that can easily run you $5,000. And just like the car market, there are products everywhere in between the two extremes. Each does things in different ways, each has its merits and drawbacks, and each has a price tag (either in terms of money or your time). We'll try to guide you around the showrooms, and we'll try to let you know when you can get a better deal elsewhere. Ultimately it's your choice, your money, and your brewery, so weigh the benefits and

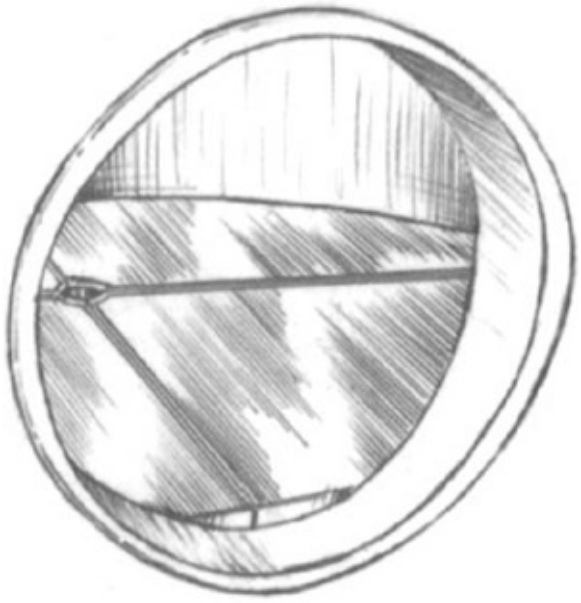
drawbacks carefully, and use the setup that best suits your needs and your brewing style.

LESSONS FROM THE PROS: EQUIPMENT IN A SMALL COMMERCIAL BREWERY

The processes used in a commercial brewery are similar to those that homebrewers follow. The difference is in scale: Whereas a pot on a stove works fine for a homebrewer, a commercial brewer may have a 900 gallon brew kettle with a gas-fired burner. Let's take a moment to tour a small microbrewery—Brimstone Brewing of Baltimore, Maryland—and look at some of the equipment used there.

The brewing process begins with the malt mill. Brimstone's two-roller mill, typical to those found in many small craft breweries, is similar to the roller mills used by homebrewers except that the hopper is bigger, the rollers are bigger, and there's a chute to carry the milled grain from the mill to the mash tun.

The mash tun, a stainless-steel vessel with a perforated stainless-steel false bottom, is used to mix the grist with hot water and allow the malt enzymes to convert the grain starch to sugar. Some mash tuns have steam-fired heating systems that enable brewers to adjust mash temperatures. The single-step infusion mashing system used in the Brimstone brewery, however, relies on hot water infused from a hot liquor tank to achieve the proper mash temperature (temperatures are shown on a digital control panel). Even though this mash tun is heavily insulated, the sheer mass of the mash likely would retain heat long enough to achieve saccharification (the conversion of starches to sugars) even if there were no insulation.



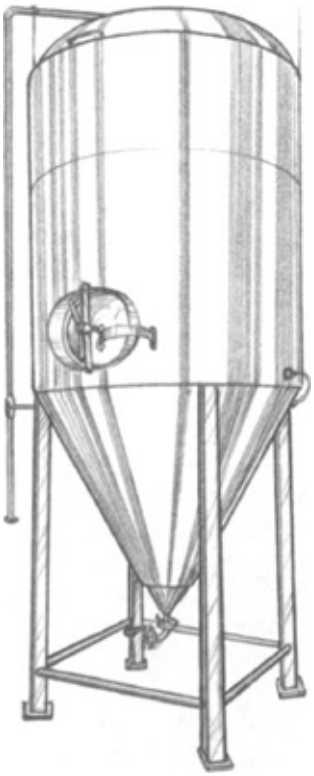
False bottoms are common in commercial small breweries. The slotted false bottom allows sweet liquid to drain across the entire area of the bottom of the grain bed.

At the end of the saccharification period, the mash is sparged with hot water and the sweet liquid is pumped to the brew kettle, which is a 15-barrel stainless-steel vessel with a gas-fired burner. This is similar to setting a modified keg on a propane cooker, but it's more than 30 times larger in scale. (In the brew kettle, the sweet liquid extracted from the grains is boiled and hops are added. At this point we start calling the liquid "wort.")

At the end of the boil, the wort is chilled using a heat exchanger. Homebrewers can accomplish this (achieving a quick drop of temperature in a flow of hot wort) with a counterflow chiller. The heat exchanger used at Brimstone relies on cool water as the heat-absorbing medium and has a fitting for an air stone that allows fresh oxygen to be pumped into the wort as it passes through the heat exchanger. After the wort leaves the exchanger, it is pumped into one of several 30-barrel stainless-steel fermenters.

Depending on the type of beer being produced, the people at Brimstone either use a high-gravity brewing method (in which beer is first brewed to a high gravity and then diluted to a normal gravity to fill the fermenter) or brew twice to fill one fermenter. The fermenters have jackets through which refrigerated glycol (an antifreeze and coolant) is pumped to keep the fermenter cool.

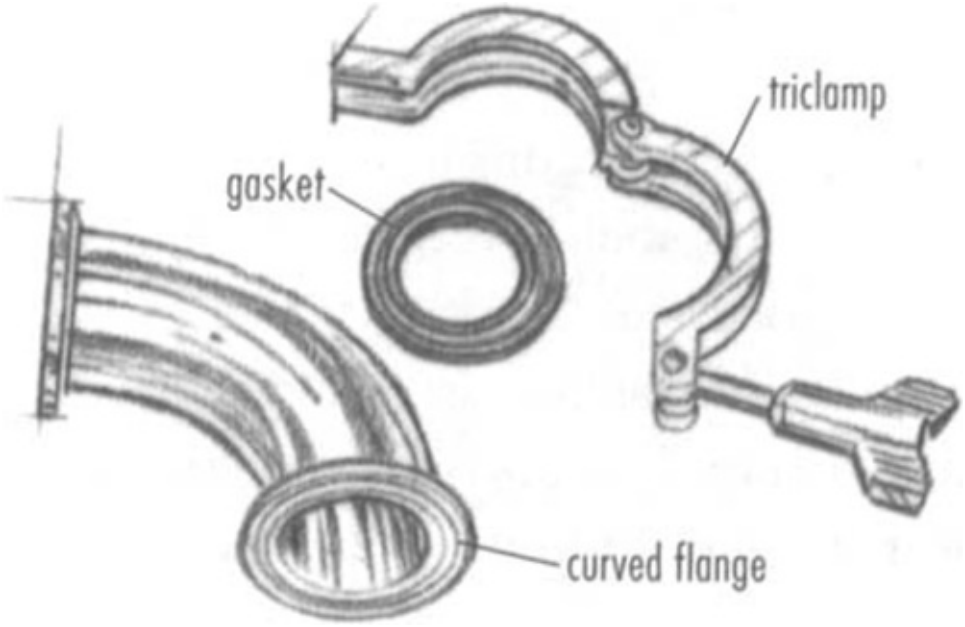
With the Brimstone fermenter setup, the yeast settles to the bottom of the vessel and can be removed from the fermenting beer. This is the idea behind brewing equipment such as the Brewcap inverted carboy fermenter available from BrewCo. It is important to note that the glycol jacket makes it possible to maintain consistent temperature for the fermenting beer. This is critical to achieving consistent product quality. It also illustrates the importance of controlling the temperature range of a fermenting beer — possibly by using a device such as the FermTemp controller from Brewers Resource, which controls not only the lower range of the temperature but the upper range as well.



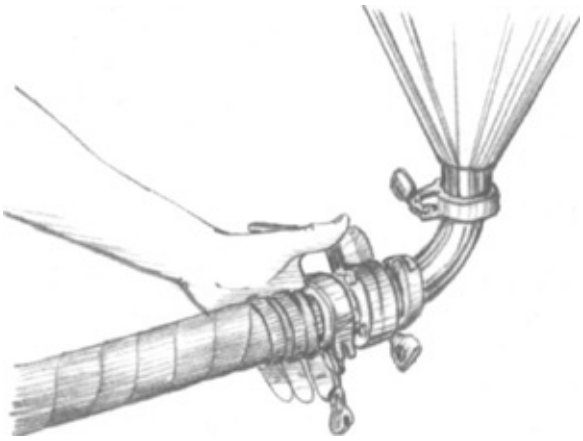
Cylindroconical fermenters, *such as this one at Brimstone, circulate refrigerated glycol to reduce the heat and maintain the proper temperature.*

After fermentation and before going to the keg, the beer runs through a diatomaceous earth (DE) filter for clarity and is pumped to a bright beer tank for conditioning. The bright beer tank holds finished beer that's ready to be carbonated and packaged. As a homebrewer, you can achieve similar clarity and stability with a cartridge or plate-type filter.

One of the things that we can learn from Brimstone Brewing is the importance of moving beer from one vessel to another. The illustration on page 13 shows the connections used in professional brewing equipment. The equipment is fitted with triclamp flanges, and the hoses are connected using triclamp connectors and gaskets. This makes it possible to connect any piece of equipment to a hose and move beer easily from vessel to vessel. Other equipment has quick-disconnect fittings to enable hoses or other equipment to be easily attached, making the brewing process flexible and ultimately easier. The lesson here for homebrewers is to consider the flow of material throughout the brewing process and to try to use standard-size fittings for vessel outlets and standard-size hoses throughout your brewery. Doing so will make your equipment easier to use. Consistent use of simple-to-use connections is a good example of how planning ahead can pay benefits in the long run.



Professional brewers use quick-disconnect fittings such as this triclamp, pictured here with a gasket and flange, to keep the process flexible.



Connecting a hose to a flange with a triclamp is a simple procedure — much easier than traditional plumbing connections.

Tewey also suggests that homebrewers think about doing a little plumbing. For example, an extra faucet at the right height or point in the brewing process is not beyond the skills of many homebrewers, and it can make brewing considerably easier.

Sanitation is stressed in every homebrewing textbook, and a visit to Brimstone further emphasizes its importance. Hoses and equipment are stored full of iodophor, a sanitizing agent. A large bucket of iodophor solution is available for small parts and fittings; after use, the parts are returned to the sanitizing bucket.

In a small brewery, yeast is reused several times and yeast cultures are maintained and grown as needed. Tewey stresses that maintaining yeasts and growing cultures is easy, ensures proper pitching rates, and is less expensive in the long run than constantly buying yeasts for each batch. In Chapter 12 we discuss the equipment and

processes used for cultivating yeast.

SANITATION

Keeping equipment clean and in good repair is an essential part of homebrewing. In fact, most brewers (both professional and amateur) probably spend more time cleaning than brewing. Sanitation is the single most important factor in determining whether your beer turns out great or is completely undrinkable.

You may hear brewers say they are going to “sterilize” their equipment. They’re really not sterilizing, which means killing absolutely every microorganism. Actually they’re “sanitizing” their equipment, which means that they’re sharply reducing the possibility of microorganisms existing on the surfaces of their brewing equipment.

Sanitation is most often accomplished by using solutions of various chemical sanitizing agents. The agents most commonly used by homebrewers include: chlorine bleach, oxidizers (e.g., B-Brite), iodophor, and trisodium phosphate (TSP). Equipment can also be sanitized by using heat: either by boiling in water or by baking in an oven, which is essentially what an autoclave does. Of course you need to be aware of the temperature range that your equipment can withstand.

Do not mix any sanitizers with other household cleaners; some mixtures, such as ammonia and chlorine, can create dangerous gases.

Homebrewers often use chlorine as a sanitizer, but it is very corrosive to metals and should never be left in contact with stainless-steel equipment for any period of time. If your stainless-steel equipment does come in contact with chlorine, rinse it well with clean water immediately.

One of the best sanitizers available to homebrewers who use stainless-steel equipment is iodophor, a solution of 1.75 percent iodine and 18.75 percent phosphoric acid. Iodophor does not corrode stainless-steel equipment and is often left in unused equipment to keep it sanitary. Further, iodophor does not require extensive rinsing. After soaking equipment in an iodophor solution, simply air dry the equipment and it is ready for use — although rinsing is still often done to avoid possible off flavors.

Some homebrewers are concerned about introducing water-borne bacteria to sanitized equipment by rinsing with water, so they air dry after soaking in iodophor. Our view is that air drying alone means that the equipment is sitting out for long periods of time and runs a small risk of airborne contaminants adhering to it. So either way, some risk is involved; but it’s minimal and not worth the worry. Iodophor is available in small bottles from homebrew supply shops for a couple of dollars. It is sometimes available in 1-gallon jugs from restaurant supply businesses. It is also available in rural areas at feed stores, where it is sold as “Tank Cleaner” in 1-gallon jugs at prices that are not much more than homebrewers pay for a few ounces. Avoid the types sold as “udder wash” or “teet clean,” as they often contain lanolin.

Trisodium phosphate (TSP) is an industrial cleaner that is sometimes available

from paint suppliers, but your local hardware store is likely to have it as well. Painters use TSP to remove wallpaper and clean equipment. If you use TSP as a sanitizer, be sure to rinse the equipment with clean water after contact with the TSP solution.

Alcohol can also be used to sanitize equipment. Some brewers keep a small sprayer of a diluted alcohol solution handy to spray down small areas. Brewers who culture yeast often use alcohol or heat to sterilize equipment and surfaces. Use ethanol, either vodka or grain alcohol. For culturing equipment, we use full strength grain alcohol. For general sanitation we use 20 percent alcohol, which is vodka diluted with water in a 1:1 ratio, or grain alcohol in water at a 1:5 ratio.

Vinegar is acetic acid; using white vinegar right out of the bottle will effectively clean copper utensils such as chilling coils. Phosphoric acid can also be used. This is often available from farm supply stores as dairy acid rinse.

Remember: Sanitize your equipment well before use, and again before storing it.

Although all your equipment should be clean, it is vitally important that you sanitize well those items that are used after the boil. Mashing vessels, boiling vessels, spoons, paddles, and similar items should be clean, but meticulous sanitation of these items is significantly less critical than sanitation of fermenters, chillers, airlocks, hydrometers, or anything that touches chilled wort.