Tools & INVENTIONS

BLINDING YOU WITH SCIENCE... AND BEER

Being an actual tool doesn't count.

words: Don Osborn

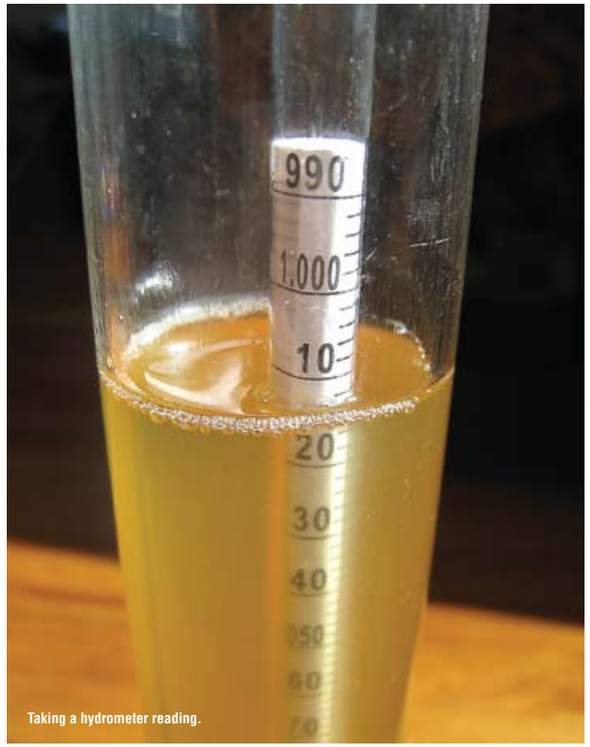
Brewing has changed since the days when wet grain mysteriously fermented. Science has given us a thorough understanding of what happens during all stages of brewing, and we don't need to leave pots of grain out in the rain. Many home and commercial brewers use scientific tools to measure gravities, cool down wort and attain predictable results. On a slightly different note, brewers also like to invent gadgets to produce new flavors and effects. Most use a little bit of both science and artistic invention to make unique beer.

DENSITY DOES MATTER

The amount of sugar extracted from malted barley is of great interest to brewers, especially those brewing in large-scale operations. The more sugar they can coax from the barley, the more efficient their system and the cheaper their grain costs. Homebrewers take gravity readings to determine if their mashing techniques are correct and their fermentations healthy.

A hydrometer measures the specific gravity, or density of liquid, by floating in it. When newly created wort is thick and full of sugar, the hydrometer floats higher. After the fermentation is done, the beer is less dense due to sugars being converted to alcohol and CO_2. Since alcohol is thinner than water, the hydrometer sinks "lower" than it did before fermentation. These readings not only show how much alcohol is in the beer, but also let a brewer know facts about the fermentation.

Refractometers accomplish the same thing, but do so differently. They use the way light reflects through liquid to determine how dense it is. Only a few drops are needed and placed between the measuring prism and cover plate. This works wonderfully for wort, but after it becomes beer and contains alcohol, some conversion work is necessary for the reading to make sense. For this reason some brewers primarily use a refractometer on brew day before alcohol is present. Without tools like the hydrometer and refractometer, there would be more guesswork in the brewing process.



Taking a hydrometer reading.

COOL IT NOW

To understate the situation slightly, boiling wort is hot! As soon as the boil is finished, though, brewers race to cool the wort as quickly as possible to bring it into a temperature range that is safe for yeast.

There are many ways to chill wort, from kitchen-sink ice-water baths for stove-top homebrewers, to complex plate chiller heat exchangers in large commercial brewers.

While the goal of rapidly cooled wort is the same for home and commercial brewers, the methods vary. Homebrewers may create their own gadgets for cooling down wort, and a common one is the immersion chiller made from copper tubing. Immersion chillers are coils of copper tubing with cool water entering one end, removing heat from the wort, and coming out the other end as hot or warm water. As the temperature of the wort drops, the water coming out the other side also becomes cooler. These are fairly cheap to make and will cool 5 to 10 gallons fairly easily.


An immersion wort chiller.

Counter flow chillers are immersion wort chillers taken to the next level. The copper tubing is run inside of a garden hose. Wort runs one direction inside of the copper tubing, while cold water runs the other direction inside the hose. This is more efficient than a simple immersion chiller, but also more complicated to use, and more difficult to clean.

Plate chillers are more advanced, and while they do a faster job of cooling, they require more equipment—such as a pump—to work. The concept is that hot wort passes one way through the device, over many layers of plates, while cool water passes the other way, not contacting the wort but cooling down the plates and removing the heat. Homebrewers sometimes use smaller versions of these plate chillers, such as Blichmann's Therminator. Commercial brewers use much larger plate heat exchangers, and because there is a lot of heat involved, they sometimes recover some of that energy. That is, as wort is cooled, the escaping heat might be captured and used to heat strike water for the next batch.

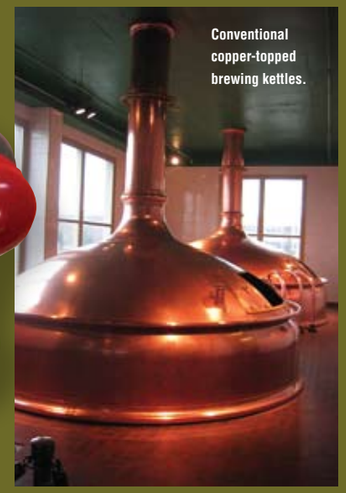
A home-sized version of a plate chiller. Wort goes in one side and comes out the other. There is a separate channel for cool water to flow the opposite direction. The water and wort do not mix.

BOIL BABY BOIL

The copper-topped brewing kettles are icons of the industry. But there is a new way to boil beer that does not require a large volume of wort to be boiled at once. Meet the Merlin system, which, as far as I know, is around 10 years old. Merlin is an appropriate name, since the way it uses less energy and loses less wort to evaporation is a little like magic.

Instead of boiling multiple barrels of wort, the Merlin system uses a heated cone over which a thin layer of wort is pumped. Hops are still a part of this "boil." Undesirable aroma compounds are driven off as the wort is recirculated 5 to 6 times. The amount of energy needed to accomplish the goals of sterilizing the wort and extracting hop bitterness is 65-75 percent less than conventional boiling methods.

One noted green brewery using a Merlin system is New Belgium Brewing. They explain how a ¼-inch layer of wort is "flash boiled." This instant-boil takes minutes as compared to hours. They go a step further by using a copper coil that condenses the escaping steam into hot water, which is later used to clean the tanks. The result of beer made with a Merlin system is said to be equal to beer boiled conventional ways, but I have also heard varying opinions saying it might taste a bit worse.


Conventional copper-topped brewing kettles.

A radiator is an invention?

SIERRA NEVADA • Doing it Their Way

There are traditional scientific tools and methods that brewers use, but there are also brewers who like to create something new. Sierra Nevada Brewing is a brewery that likes to do things its own way. Be it the annual hop attack that is Celebration Ale, or the bitter Bigfoot Barleywine, the brewing crew is no stranger to distinct-tasting beers. Recently they have created yet another new technique for applying hops to beer that has already fermented—The Torpedo.

The brewers here use whole-flower hops whenever possible, as opposed to the pelletized hops popular with most breweries. Whole-flower hops are more hassle to deal with, but some believe they contribute a better hop character. Sierra Nevada wanted to figure out a way to add whole flower hops post-fermentation without the use of hop bags, and they wanted to circulate the beer through a large bed of hops. Eventually they created the Torpedo.

The Torpedo is a 150-gallon vessel loaded with up to 80 lbs. of hops (that's a lot!). Beer is pushed slowly through the Torpedo and back to its original tank. The beer might pass through two Torpedoes before returning to its original tank. The beer might also make more trips through the Torpedo before it is eventually packaged. This technique is different than a hop back, which is a container that is used to contact hot wort with more hops before it is fermented.

The Torpedo's effect is a potent hop aroma and a taste that is a unique fresh hop experience without being overly bitter. You smell piney citrus hops in the beer, they burst brightly in your mouth, and the bitterness covers your tongue, all the while remaining firmly balanced. Extra IPA indeed.

We'll continue with more geeky beer tools soon.

DOGFISH HEAD • Beer Inventors

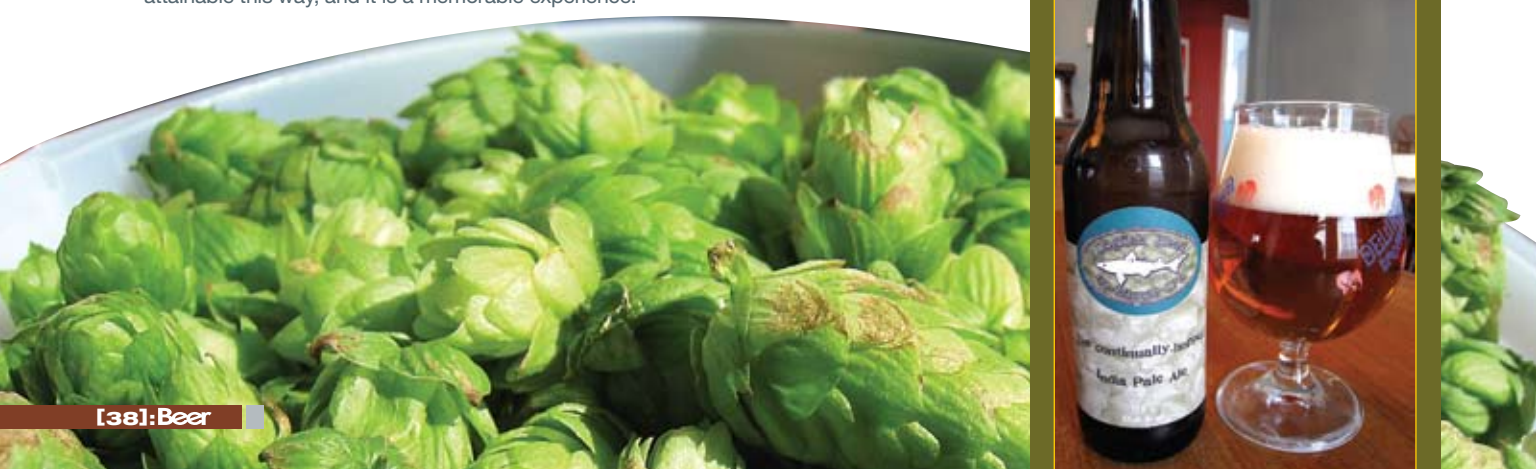
Sam Calagione and co-brewers never hesitate to experiment. Some experiments have resulted in wonderful brewing creations: The brewery is known for unique historical beers like Midas Touch, Chateau Jiahu, and Theobroma. But they are also creative with techniques used to make and serve more ordinary beer.

The celebrated 60, 90 and 120 Minute beers are made by a unique and patented continual-hopping method. Sam Calagione explains he got the idea while watching a cooking show, where the chef claimed it was a better way to add spices, rather than all at once. Calagione's first device was an old vibrating hockey game board. When tilted, hops would trickle into the kettle slowly and continuously. Now they have upgraded to their original "Sir Hops a Lot" machine, which does the same thing as the hockey game, only on a grander scale.

The other interesting creation has to do with the serving, not brewing, of the beer and it is called Randal the Enamel Animal. The name refers to the enamel that the gritty, hop-laden beer will scrape off your teeth. This was Sam's idea to give the served beer a just-added extra burst of hop aroma and flavor. A water cleaning unit is packed with fresh whole flower hops, and carbonated beer is slowly pushed through it on the way to a pitcher. The beer comes out extra foamy and has to be allowed to settle. But the hop aroma and taste are something only attainable this way, and it is a memorable experience.

Dogfish Head 60 Minute IPA

The beer pours a clear orange color with a sticky head. Aroma is of earthy hops. The taste is full of both hop bitterness and hop flavor. The bitterness comes from adding hops earlier in the boil, and flavor from later hop additions. It's sort of a medium-level intensity hop experience with a solid malt backbone. There is a lingering bitterness, which encourages the next taste.



STIR IT UP, LITTLE DARLING

A cool gadget that homebrewers use for yeast starters is straight out of science lab. Stir plates work by attaching a magnet to a spinning device, like an old computer fan, and mounting that inside a box. A stir bar is placed in the bottom of the glass flask that sits on top of the stir plate box. When the motor is spinning, so is the stir bar. This will keep any liquid in the vessel continually spinning.

Why does this work for yeast starters? Yeast needs oxygen to multiply and grow. A normal yeast starter is given oxygen when it is first made, but then sealed tight and no more oxygen is available. A yeast starter on a stir plate gets continuous oxygen so the yeast get as much as they need to reach their full growth potential. A loose foil cover is placed over the top, and the motion of the liquid draws oxygen in. Also the constant stirring keeps the yeast in contact with the sugar longer (they don't settle to the bottom) and allows them to grow as much as possible.

Stir plate yeast starters produce much more yeast than a conventional starter with no more work on the homebrewer's part, other than buying or fabricating a stir plate. They are easy and fun to make, and brewers thrive on such gadgets.

Part science. Part magic!

BARRELS NEVER GO OUT OF STYLE

Beer and barrels have always gone together. The oldest modern brewing vessels were wooden barrels. Each brewery made and maintained their barrels. As stainless steel kegs and larger modern brewing tanks came into fashion, barrels were used less.

Some breweries, like lambic brewers in Belgium, require wood for their end result. But most brewers using barrels are doing it more occasionally or even experimentally. They tend mostly to age strong beers in barrels that will benefit from the flavors of vanilla, port, spices, oak, or others depending on the types of barrels used. Barleywines, imperial stouts, and other strong ales are often barrel aged. The types of barrels used can vary from French to American oak, wine to whiskey, and number of other varieties.

All of these gadgets and inventions are only a sample of the tools breweries use or create. Sometimes out of necessity, and sometimes out of experimentation, brewers have always been creators on many levels. Such inventive brewers will undoubtedly continue to create new tools, tricks and more efficient ways to brew. Most importantly, though, will be the new and exciting beers that are offered for our enjoyment.