The Monolith: Recreating Belgian Spontaneous Brewing Techniques Using Modern Technology

Introduction

Blind Enthusiasm Brewing Company (BE) is located in Edmonton Alberta, Canada. It operates two brewery locations, one of which is a spontaneous and mixed fermentation facility called The Monolith. This facility has been built for the sole purpose of brewing mixed, natural and spontaneously fermented beers using traditional wort production and barrel fermentation methods, while adding in modern technology and analytical techniques.

Since 1984, Specific Mechanical Systems (SMS) has handcrafted brewing and distilling systems for the craft beer and spirits industries. Started as a two person company, the company has grown to now employee a team of over 85 people. Its mission is to provide the world's finest handcrafted brewing and distilling systems, complimented by the industry's most comprehensive customer success program.

SMS manufactures breweries ranging in sizes from 5 hectolitre to 120 hectolitre. Brewhouses are available operated either manually, semi-automated or fully automated using its in-house developed SpecBrew automation. Distillation system sizes range from 450 litre to 10,000 litre, operated either manually, semi-automated or fully automated using its in-house developed SpecProof automation. Systems are provided with all associated equipment including fermentation tanks, bright beer tanks, collection vessels, hop dosing systems, keg washers and CIP systems. All handcrafted for you.

History of the Process

Lambic Wort Production

Turbid Mash is the historical mashing technique used for Lambic production. It was developed out of a necessity to have small mash tuns, as this was how breweries were taxed at the time. Due to no common method to measure alcohol content of beer, and inconsistent wort density measurements, the government taxed breweries based on volume of grain able to be used within a mash tun. Turbid mash allowed brewers to optimize how much grain went into the mash tun while still being able to perform step infusion mashes. This was achieved through a series of hot water (aka Hot Liquor) infusions to do the temperature steps and liquid decoctions to keep the mash tun from overflowing. The resulting wort just so happened to work perfectly for Lambic production.

The technical name for a turbid mash is "A step infusion mash with a triple liquid decoction". What this means is the different temperature steps are achieved by adding hot liquor to raise the temperature for each rest. Before the hot liquor is added to raise the temperature, the liquid portion of the mash is

decocted and put it into a heated vessel and brought to a light boil. This denatures enzymes, makes soluble proteins available, and gelatinizes starches. This process is done at each temperature rest (totaling three times), then the combined decocted portions are added back to the mash to raise the temperature for the last rest before lautering. The lautering process is similar to the typical brewing process, with the only exception being that it is done with 85-95°C liquor. What is then achieved is the production of a wort that has a complex carbohydrate profile that has a makeup of everything from simple glucose to soluble starches and has a very nutrient rich content. This carbohydrate complexity and nutrient content allows for different microorganisms to be favoured at different times over the long 1 to 4 year fermentation.

Turbid Mash is often discounted as unnecessary in the modern era of brewing and is often done as a novelty by home brewers to try something that is traditional. However, what Turbid Mash offers the brewer, if done correctly and with the right equipment, is control over fermentation conditions and can help favour different organisms to get a certain profile and fermentation time. It also allows for an easy way to use high percentages of un-malted grain which is often desired for reproduction of traditional techniques.

Aged Hops, and the Long Boil

Aging hops is another process unique to Lambic brewing tradition. While aged hops have likely been used since the start of their use in beer – due to lack of refrigeration and other circumstances – the purposeful aging is what is unique to Lambic. The brewers use aged hops because they add a unique tea and oxidative quality to the beer, but also because they have a reduced amount of bitterness while still maintaining their antibacterial properties. It is counter intuitive to think hops are wanted for their antibacterial properties considering it is desired that the beer go through lactic acid bacteria fermentation. However, they are needed to control the lactic acid bacteria, so they don’t go rampant

and quickly produce too much acidity. They are also a deterrent for other bacteria that are not resistant to the antibacterial compounds.

Like any other hop, they are used in the boil. The only difference being the boil is 3-4 hrs long. The hops are put in as first wort addition to maximize utilization due to being whole leaf and are left in for the entirety of the boil. Traditionally, brewhouses did not have a whirlpool function so the hops were extracted after the boil through a hop strainer. This left protein and hot break in the wort, some of which would be present in the koelschip after cooling and even further into the barrels, and act as nutrient while helping to increase texture in the beer.

Much of the reasoning behind the long boil comes as a result of the relatively aggressive treatment of the mash, extraction of the wort and the ingredients used. The use un-malted grains of any kind allows for a high percentage of volatile compounds, which would typically be taken care of in the malting process, to be extracted into the wort. The extraction of those compounds is amplified through the use of extra hot liquor in the lauter, due to increased extraction at higher temperatures. These compounds will also be amplified as a result of the decoction stage which reduces the time the mash would typically have to reduce or break them down. All this adds up to wort that has a lot of volatile compounds that can be reduced through longer aggressive boils. A by-product of the long boil is a nice amount of Maillard Reaction that occurs due to higher protein content in the boil and the extended time at high temperature. This enhances the malt profile adding complexity and body to the beer.

Spontaneous Fermentation and Barrel Fermentation

Spontaneous fermentation is a technique that utilizes a Koelship. This is a wide shallow vessel used to cool wort from boiling temperature down to fermentation temperature. Cold air, vented from the exterior of the building into the koelschip room, cools the wort while also inoculating the wort with dozens of different microorganisms. These microorganisms range from different genus of yeasts to fatty and lactic acid bacteria. The beer is then put into wine barrels where these natural microorganisms slowly ferment the wort over a period of 1 to 4 years. This type of fermentation is the most unique process that separates these beers from ones typically brewed today. The inoculating microorganisms lend to a fermentation profile unachievable any other way, and produces a product truly unique to the region where it is created.

The Beer is fermented in barrels for a few different reasons. The first being the ability for barrels to develop microflora within them over time. This helps develop a house fermentation profile and consistency. The second reason is to allow for slow oxygen ingress over time to help keep microorganisms active for the long fermentations. This ingress can be changed depending on the size of the barrel, how thick the wood is, and if one tops up the barrels. Lastly the barrel imparts a differing amount of character over time depending on how it's used, how many times the barrel is filled, and type of barrel used. Barrels offer many different techniques for use, the most common being a single vessel leaving the beer on the sediment and lees for the whole fermentation. The different techniques can change the fermentation profile and character of the beer.

Blending

Blending is relatively self-explanatory. It is the mixing of different barrels to create a finished product that is then bottled. It is a necessity to achieve consistency year to year as the different barrels and vintages will all have different profiles. It also spawned the creation of unique types of Lambic that are based on blending different barrels that have had beer in them for different time periods. In modern breweries, we blend for the same reasons as well as to get different effects and profiles than what was possible historically. Blending was historically done only by taste by the Head Brewer or Head Blender. We are now able to measure many different aspects of the beer and pair these analytics with sensory evaluation to better understand what we are trying to accomplish with a given blend.

Designing "The Monolith"

Many differences in techniques and desired results exist between traditional beer production and traditionally produced spontaneous sour beers. As a result, significant changes are required in the equipment and overall design to produce these style of beers. Below is a brief overview of the design of the Monolith brewhouse, its process flow, the koelschip, the maceration tank and the inoculation tank.

Brewhouse

The brewhouse consists of 3 primary vessels, namely the mash/lauter tun, wort decoction vessel and the boil kettle. While these vessels can often be found in more traditional brewhouse arrangements, the design and function differs when designed for dedicated sour production.

Lauter Tun

The lauter tun for example needs to be sized and designed to accommodate a wide range of water to grist ratios that are required throughout the sour brewing process. This results in a lauter tun that has a much larger capacity than equivalent lauter tuns for standard beers. The rake system also differs in that it serves as both a mash mixer and a cutting system for the grain bed. Given the initial low water to grist ratios, the mixing blades and rake tines are much smaller and compact than equivalent systems. The mixing blades are also designed to function both in a forward and reverse direction to allow grain to travel towards the bottom of the vessel or to the top of the vessels depending on the desired mixing characteristics required.

Decoction Vessel

The decoction vessel is required to facilitate temperature steps and dilute the mash in the lauter tun. Unlike traditional decoction vessels, only wort (not mash) is added to the vessel. To promote homogenous mixing, wort consistency and uniform temperature, a dedicated low shear mash agitation blade is included within the vessel. Multiple steam jackets, one low on the shell and one on the bottom cone, are used to facilitate heat transfer to the wort during the heating process. Once heated to the appropriate temperature the wort is transferred back to the lauter tun for the overall temperature step.

Boil Kettle

The kettle operates in a similar capacity to standard systems, although final runoff volumes are higher than what is typical in a standard brewing process. As such, longer boil times are needed to produce the boil off volumes required to achieve the desired final wort gravity. The steam jacket coverage thus needs to be increased and the boiler sized accordingly when considering kettle performance for sour style beers.

Process Piping

One of the major design changes between typical brewhouses and The Monolith is the process flow. This has a major impact on process plumbing arrangement, pump selection, sizing and overall brewhouse layout. For example, since initial runoffs can be quite thick, they are prone to clogging. As a result, each draw off line (4 in total) can be individually controlled using a micro adjustable valve, or proportioning valve, to fine tune flow. Each line also has a sight glass to assess the wort quality and whether a blockage has occurred. In addition, each draw off line also includes provisions to backflush using temperature adjustable process water. Pump selection also needs to be designed appropriately to accommodate higher viscosity wort profiles and required transfer rates. Special consideration was also needed in selecting the kettle pump for knockout transfer due to the elevated positioning of the koelschip within the building.

Koelschip

A modern koelschip was also manufactured. This vessel is circular in shape and constructed fully from 304 stainless steel. It operates in a similar capacity to older traditional vessels. Hot wort is pumped from the kettle approximately 50 ft. vertically into the koelschip. Thermal and fluid dynamic factors were crucial in determining the required surface area and depth to allow reasonable cooling times. Spontaneous inoculation from forced air fans bringing in external air were installed to help promote inoculation of the cooling wort.

Maceration and Inoculation Tanks

Custom designed maceration tanks were also produced for fruit-based beers. The design of these vessels is a cross between a lauter tun and a bright tank. V-wire screens and a discharge manway were included to capture fruit materials and to act as a filter for collection of final product.

An innoculation vessel was also designed for when brewing spontaneous beers is not possible. The vessel was designed with flanged and dished bottom and top heads and includes both heating and cooling jackets. A dedicated temperature controller was provided so that the temperature of the vessel could be maintained above and below mean ambient temperature. Process plumbing and a pump were furnished to allow continuous recirculation to maintain a homogeneous mixture and reduce the possibility of temperature gradients within the fluid.