Nitrogen Generator for Craft Beer Breweries

Market Application Publication

As a result of the craft beer movement, Americans are enjoying more beer than ever before. Although it may seem easy enough to go to your local beer market to pick up a six-pack, the process for brewing, bottling and taking that beer to market is quite extensive.

Brewing is normally broken down into four stages-malting, mashing, boiling and fermenting. The complex chemical processes begin with a few simple ingredients - hops, grain, yeast and water. Recently there have been technological advancements to safeguard that these steps are attained accurately, efficiently and with cost-savings. One particular improvement is the use of nitrogen during the brewing process. The addition of an onsite nitrogen generator allows brewers to reduce their nitrogen costs, eliminate downtime, and reduce safety risks related to bulk gas cylinder delivery and changeouts.

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Features & Benefits

- Reduce costs
- Eliminate downtime
- Reduce safety risks related to bulk gas cylinder delivery and changeouts
- Compact - save valuable floor space
- Easy to install and operate
- Simple annual maintenance
- Increase profitability
- Eliminate dependency on gas suppliers
- Reduced gas waste

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Reducing Brewing Costs With Onsite Nitrogen Generation

The Brewing Process

Let's examine the four stages of brewing: malting, mashing, boiling and fermenting. The first of the process is malting, which is broken down into multiple stages itself, but essentially this is where the ingredients of starch, enzymes, protein, vitamins, and minerals are combined to create the main raw material for the batch. Mashing then takes the created malt and mixes it with heated water, where the natural enzymes of the malt breakdown the starch into sugars. These sugars are then separated from the main mixture to create wort, which is then boiled to a controlled temperature to allow for a brewer to add additional ingredients specific to the type of beer being produced. After this step is finished, the mixture is cooled and separated. Once divided, the brewer adds in the yeast that is essential for the fermentation to begin. When the fermentation is finished, the beer is fully matured to deliver the taste intended.

Nitrogen in the Brewery Process

Nitrogen is commonly used throughout the brewing process because of its inert characteristics. Once a completed batch of beer is removed from the large tanks that are used throughout the process, nitrogen is used to purge the tanks of any leftover residual from the wort, beer and mash. The act of purging a tank with nitrogen eliminates the chances for the residual ingredients to oxidize in the tanks, creating sour flavors in subsequent batches.

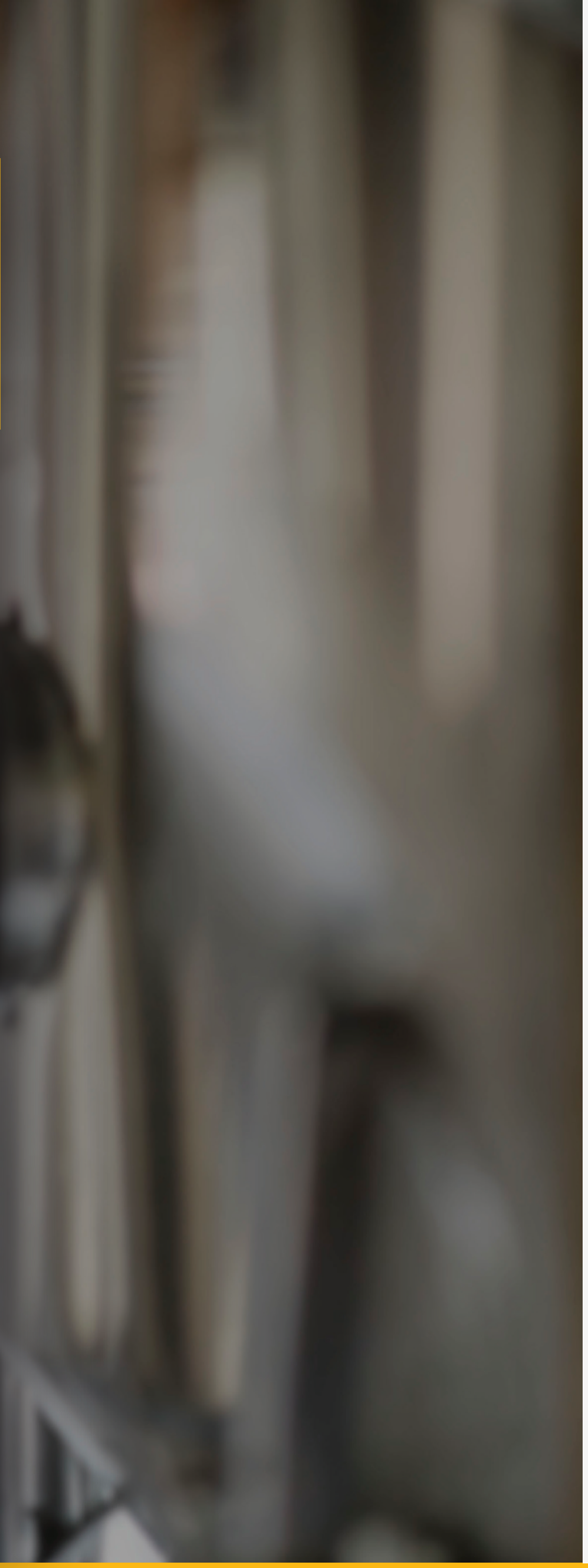
Because nitrogen is capable of displacing oxygen and carbon dioxide in the air, brewers use nitrogen to help transfer the beer through different tanks during the process. Once all stages of brewing are complete, nitrogen is used to pressurize kegs and bottles to help maintain the freshness of the beer. This preserves the finished product from spoiling quickly by reducing the oxygen content that is in the final product.

As brewers are continuing to enhance the taste and flavors of beer for consumers, they have also started experimenting by adding nitrogen into the beer itself during the process to create carbonation. Typically, carbon dioxide is used to carbonate beer but by adding a larger percentage of nitrogen into the mix, the nitrogen creates a better taste and a smoother finish.

Return on Investment

When deciding to change over from delivered gas to onsite nitrogen generation, there are upfront costs that usually deter a brewer from making the switch. Once it is understood that the investment will save the brewery money in the long run, it's a much easier decision to make. Most can expect to see a return on their investment between 18 to 24 months after startup, depending on the amount of nitrogen consumed and the cost paid for the generator.

Not every brewer pays the same amount of money for nitrogen, as many gas suppliers charge based off the type of nitrogen required, the distance away from the generation site and whether the nitrogen is delivered in cylinders, mini tanks, or as bulk storage. Costs usually include a standard rental fee for the storage medium, as well as delivery of the nitrogen. Once the brewery gets past the initial costs of procuring a nitrogen generator, the brewer will quickly start saving money because it is significantly less expensive to produce nitrogen onsite.



Eliminate Dependency

With gas delivery the brewer will only use about 90% of the nitrogen that is in the tank since about 10% of the gas is returned unused. Gas is also lost when the cylinders or tanks become hot. The pressure within the tank begins to rise, requiring "boil-off" of the gas. Boil-off is when the tank needs to be opened and gas is released into the atmosphere to reduce the pressure of the tank. With the installation of an onsite nitrogen generator, 100% of the gas that is produced can be used for brewing.

When dependent on cylinder or tank delivery, breweries may run into unplanned downtime. It can be quite difficult to estimate how much nitrogen is needed for production. If this is not estimated correctly, production can come to a standstill until the next shipment arrives. Gas suppliers may not always deliver nitrogen in a timely matter to meet the needs of the brewery, and they can be left without a nitrogen supply, which ultimately results in lost revenue. With an onsite nitrogen generator the brewer can maximize uptime and eliminate the dependency on a gas supply company.

Increased Available Footprint

Depending on the type of storage medium used for the nitrogen, the brewer will need to clear space for cylinders, mini tanks, or even bulk gas. If multiple cylinders and tanks are required, it can reduce the amount of free space in the facility remarkably. If bulk gas is used, the brewery will be required to create the necessary foundations outside the facility to hold the weight of the heavy tanker. Onsite nitrogen generators are compact and have the capability to bank together to save storage space in the facility, and do not have any foundation specifications to support them properly.

Two Type of Nitrogen Generators

There are two main types of nitrogen generators, Pressure Swing Adsorption and Hollow Fiber Membrane. Hollow Fiber Membrane nitrogen generators operate by selectively allowing nitrogen gas to flow through the fibers of the membrane. Oxygen and other contaminants are then released back into the atmosphere through a port in the generator. The fibers of the membrane are sometimes made from Polyphenylene Oxide, which allow for permeability and robustness to the membrane fibers. The permeability of the fiber pulls the oxygen and other contaminants out of the compressed air, leaving only nitrogen to pass through.

Pressure Swing Adsorption (PSA) nitrogen generators function by utilizing the technology of carbon molecular sieve. The carbon molecular sieve adsorbs the oxygen and other contaminants from the compressed air under pressure, ensuring that only nitrogen is delivered to the required application. Once the carbon molecular sieve is fully adsorbed with oxygen and other contaminants, the generator will go through a regeneration process to expel the contaminants into the atmosphere. The term Pressure Swing Adsorption comes from the generator's continuous operating pressures between 0 to 100 psi. Once the generator reaches 100 psi it begins the regeneration process. Although there are two main types of nitrogen generators, the primary generator that is used in brewing applications is the PSA generator. The purity of the nitrogen gas is very important since it is being used in a food-based application. PSA nitrogen generators can achieve 99.5% and higher purity at the outlet, which is a great benefit to the user since FDA regulations for food applications require that the outlet gas is of high purity.

Most food and beverage application require nitrogen purities between 99-99.9%. Whether they use nitrogen gas to clean or blanketing tanks, inject it into kegs headed to storage, or infuse it into the beer itself, brewers typically use purities between 99.5%-99.9%. The exact purity used is up to the brewery.

The Most Economical Source of Nitrogen

With traditional methods of gas supply, users are liable for 'hidden extra costs' such as cylinder rental, delivery and administration charges on top of the headline gas price. In addition, liquid 'boil-off' vents expensive gas into the atmosphere, and approximately 10% of the gas in every cylinder is typically returned to the supplier unused.

So when the true costs are accounted for, gas generation with Parker Balston DB Series is the most economical source of nitrogen – making a positive contribution to the bottom line.

How Nitrogen Generators Function

Nitrogen generators operate on compressed air by reducing the percentage of oxygen in the air to solely deliver nitrogen to the required application.

Nitrogen generators use compressed air that is "sieved" so that oxygen and other trace gases are removed, while nitrogen is allowed to pass through to the application. The compressed air supply could be from spare capacity from a central factory air compressor, or from an air compressor dedicate solely to the nitrogen generation system. The compressed air quality used for nitrogen generation is important to maintain the purity and efficiency of the nitrogen generator. Compressed air contaminants, such as oil, particulate and water, must be removed from the compressed air supply prior to entering the inlet of the nitrogen generator.

The typical compressed air system consists of a compressor, air receiver tank and compressed air treatment package. A compressed air treatment package consists of varying levels of pre-filtration, a compressed air dryer and a post-filter. A typical pre-filtration package consists of a water separator for bulk liquid removal, a general purpose coalescing pre-filter and a high efficiency coalescing pre-filter.

Combined, this pre-filtration removes particulate, including water and oil aerosols, down to 0.01 micron and oil down to 0.01 mg/m3. Downstream of the pre-filtration is a compressed air dryer, which removes water vapor from the compressed air. For PSA nitrogen generators, a desiccant dryer is most often required in order to provide pressure dewpoints of -40 °F or lower. Lastly, a general-purpose dust filter is installed downstream of the desiccant dryer to remove any dusting that may result from desiccant degradation.

Onsite Nitrogen Generation Maintenance

Maintenance for nitrogen generators is simple. The most important piece to keeping your nitrogen generator running at peak performance is maintaining the compressed air treatment package upstream.

Regular maintenance of the filter elements, pre-filtration drains and dryer valves ensure proper function of the dryer resulting in continuous clean, dry air to the nitrogen generator. As for the PSA nitrogen generator, annual maintenance requires any filter elements and exhaust silences are changed annually. If equipped with an oxygen analyzer, the analyzer cell requires replacement every two to five years, depending on the manufacturer. Outside of this basic preventive maintenance, most manufacturers recommend servicing of the valves and cylinders every three to five years. Even if operating properly, proactive maintenance prevents from future failures and costly downtime.

In Summary

When it comes to nitrogen use in brewing applications, there are multiple benefits that onsite nitrogen generators can bring to the table. With the simple installation of a nitrogen generator the brewer can take full control of the process and reduce costs of operation for many years to come. Ultimately brewers will see their bottom line grow due to the savings from nitrogen generation and in turn achieve a higher profitability.

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