CRITICAL PROCESS FILTRATION, INC.

Protecting the Quality of Beer – Filters That Remove Spoilage Organisms

The alcohol, low oxygen content, relatively low pH, hops extracts (alpha-acids) and dissolved carbon dioxide in beer inhibit the growth of pathogenic bacteria. That is why beer has been a safe drinking alternative for so many centuries. However, there are microorganisms that can survive and even thrive in beer and spoil the flavor and aroma of any good brew.

Beer can be spoiled by bacteria or wild yeasts. The most mentioned spoilage bacteria in beer are *Lactobacilli* and *Pediococci*. Other possible spoilage bacteria are *Pectinatus* and *Megasphaera* species.[1] If wild yeasts such as *Saccharomyces cerevisiae* or *Candida pelliculosa* find their way into the brewing process they can cause off flavors and higher attenuation.[2] Lactic acid bacteria (LAB) can provide some benefits to the brewer. They can create desirable compounds and even inhibit the growth of molds during the brewing process.[3]

There are many other microorganisms ranging from bacteria and yeasts to molds and spore formers that can also contaminate a brewing process and cause quality issues. Some of these bacteria may be beneficial during the process, but they can cause spoilage issues if they remain in the beer after packaging.

The brewmaster and plant operators work diligently to prevent most undesirable organisms from entering the brewing process, yet they find ways to enter through equipment, ingredients or the environment. This summary focuses on using filtration to remove these organisms during production, protect beer shelf life and assure quality after packaging.

Figure 1 shows a simplified beer clarification, stabilization and packaging process. The fermentation and aging processes are complete in this example, and the beer has been bulk filtered and stored in a bright beer tank.

The housing marked 3 in the figure is a clarifying filter. As described in a separate Application Summary "Beer Trap and Clarifying Filters Safeguard Beer Quality", the clarifying filter chosen may be used as an initial stabilization filter. The choice is based on the type and number of microorganisms present in the beer at this stage.

The final stabilization filter (housing 4) is used for both the beer and for water that is used to wash and rinse containers, thus preventing the introduction of organisms from the water system.

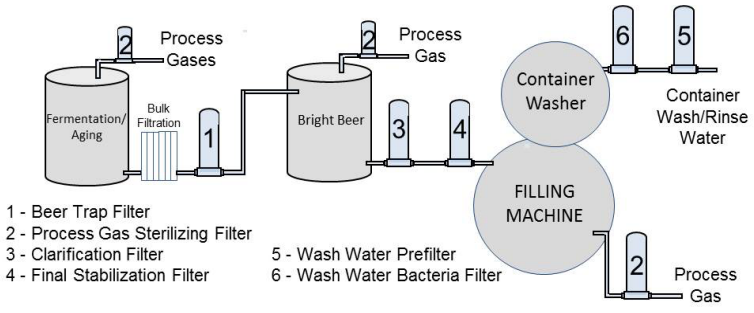
Process gas (most often CO_2) is filtered to prevent particles and organisms from entering the process by being carried in the gas.

Some of the factors to consider when choosing filters to perform the final stabilization function are reviewed briefly below.

Choosing the Stabilization Filter

The most critical filter in Figure 1 is the Final Stabilization Filter (housing 4) – the one that removes the microorganisms discussed above. The most commonly used filter is membrane based with either a 0.65 or 0.45 micron pore size. These will remove both bacteria and yeasts[2]. Brewers may choose the smaller pore size to assure capture of all bacteria, including the vegetative forms of some species that may survive in the beer, but there is a risk that some flavor or color elements of the brew will also be captured by membranes with 0.45 micron pores. For that reason, 0.65 micron membranes may be used for darker or heavier beers. The brewer should test filters in their beer before choosing a micron rating or material to be sure that the filters will remove the target organisms and also preserve beer flavor and color.

Figure 1 - Beer Clarification & Stabilization Filters



Application Summary

Protecting Stabilization Filters

The system shown in Figure 1 has a single filter before the final stabilization filter. This filter is called a clarification filter, but it can also be used to control the level of organisms that need to be captured by the final filter. The clarification filter should be chosen with the aim of extending the life of the final filter. Brewmasters and plant operators evaluate the size and number of particles and organisms in the bright beer, then choose the filter that will remove particles and larger organisms that might prematurely clog that final filter.

The filter housing marked 3 in Figure 1 holds this clarification filter. The filter is often a depth media based filter to remove sediment and visible particles. However, depending on the particle and organic load, the filter chosen may be a "bioburden reduction" membrane filter designed to capture most, but not all spoilage organisms and reduce the bacterial load that must be removed by the final filter.

Some operators may choose to add a filtration step here, especially if the particle load is high. If a 2-stage clarification process is installed, it is usually a depth media filter for particle reduction followed by a membrane filter to reduce the bacteria load.

Preventing Contamination of Stored Product

Process gas filters (housings marked 2 in Figure 1) are also critical to the quality of the packaged beer. These hydrophobic membrane filters keep particles and bacteria that may be carried by process gas from entering tanks as they are emptied or from being deposited in bottles as they are filled.

Figure 2 – Critical Process Filtration's pleated filters with multiple membrane options are used for spoilage organism removal.

Safeguarding Filling Operations

The filter housings marked 5 and 6 on the right side of Figure 1 are not used to filter beer but to filter container wash and rinse water. Process water systems may contain bacteria, so these filters are used to make sure that waterborne organisms cannot be accidentally introduced during the final packaging of the beer.

Filter Options

All of the filters chosen need to tolerate any heat sterilization or sanitization processes used (hot water or steam).

The table below shows the filter media options from Critical Process Filtration. All are available in cartridges and also in capsules for research systems or laboratory applications.

Contact Critical Process Filtration for help determining the best filter options for you.

Filter Options for Beer Stabilization and Process Gas Filtration

Process Area	Filter Application	Filtration Function	Critical Process Media*
Clarification	Remove Turbidity/Haze	Remove particles and large microorganisms	MB, NS, PD, GD
Bioburden Control and Sterilizing	Bioburden Reduction	Remove most bacteria and yeasts	CWPS, PS, PVWL
	Bacteria Removal (Sterilizing)	Remove all bacteria and yeasts	PS
	Process Gas Filtration	Prevent bacteria from entering tanks when liquid is drawn from them and from entering bottles during filling	PVWB, TM

*Media Codes

MB = Melt-Blown Polypropylene Depth Media
PD = Pleated Polypropylene Depth Media
PVWB = High Capacity Hydrophobic PVDF Membrane
NS = Nano-Spun Polypropylene Depth Media
CWPS = High Capacity PES Membrane
PVWL = High Capacity Hydrophilic PVDF Membrane
GD = Pleated Fiberglass Depth Media
PS = Polyethersulfone Membrane
TM = PTFE Membrane

References

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2. Hammond, J., Brennan, M. and Price, A. (1999), The Control of Microbial Spoilage of Beer. Jnl Institute Brewing, 105: 113–120. doi: 10.1002/j.2050-0416.1999.tb00014.x
3. Lowe, D. P. and Arendt, E. K. (2004), The Use and Effects of Lactic Acid Bacteria in Malting and Brewing with Their Relationships to Antifungal Activity, Mycotoxins and Gushing: A Review. Jnl Institute Brewing, 110: 163–180. doi: 10.1002/j.2050-0416.2004.tb00199.x

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