Application Summary

Protecting the Quality of Wine – Filters that Remove Spoilage Organisms

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Winemakers are practical microbiologists. They use the alcohol levels, oxygen content, and pH in wine to promote the growth of bacteria and yeast that create a great wine – and inhibit the growth of organisms that can ruin the wine. This delicate balancing act takes place from the grape harvest through the fermentation and aging of the wine. When the aging process is complete, and the bacteria and yeast have done their work, it is time to remove them and stabilize the wine. The stabilization process is critical to the shelf life and long term quality of the wine.

The winemaker uses some lactic acid bacteria (LAB), especially Oenococcus oeni, to provide desirable flavor and aroma characteristics to the wine during fermentation and aging. But other LAB like Lactobacillus, Leuconostoc and Pediococcus can produce undesirable aroma and flavor compounds. Acetic acid bacteria (AAB) such as Acetobacter and Gluconobactercan can also cause spoilage issues.

Wine may also be spoiled by yeasts. The most common spoilage yeasts are Saccharomyces cerevisiae and Candida species, though other yeasts such as Debaryomyces or Kloeckera or Zygosaccharomyces can also find their way into the wine and act as spoilage organisms.

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

The housings marked 1 and 2 in the figure are the clarifying filters. As described in a separate Application Summary, "Choosing the Right Filters for Wine Clarification", the filters chosen may be used as initial stabilization filters. The choice is based on the type and number of microorganisms present in the wine at this stage.

The final microbial stabilization is accomplished by passing the wine through the bioburden reduction filter (housing 4) and then the sterilizing filter (housing 5). Similar filters are also used for water to wash and rinse containers (housings 6 and 7), thus preventing the introduction of organisms from the wash water.

Process gas (most often nitrogen, CO_2 or a combination) is used to limit the oxygen in contact with the wine at various stages of the process. It is filtered (housings marked 3) to prevent particles and organisms from entering the process by being carried in the gas.

Some of the factors to consider when choosing final stabilization filters used for wine, gas and wash water functions are reviewed briefly below.

Choosing the Right Filter

The most critical filter in Figure 1 is the final stabilization filter (housing 5) - the one that removes the microorganisms discussed above. The most commonly used filter is membrane based with either 0.65 or 0.45 micron pore size rating. These will remove both bacteria and yeasts. Winemakers may choose the smaller pore size to assure capture of all bacteria, including the vegetative forms of some species that may survive in wine, but there is a risk that some flavor or color elements will also be captured by membranes with 0.45 micron pores. For that reason, 0.65 micron membranes may be used for red wines.

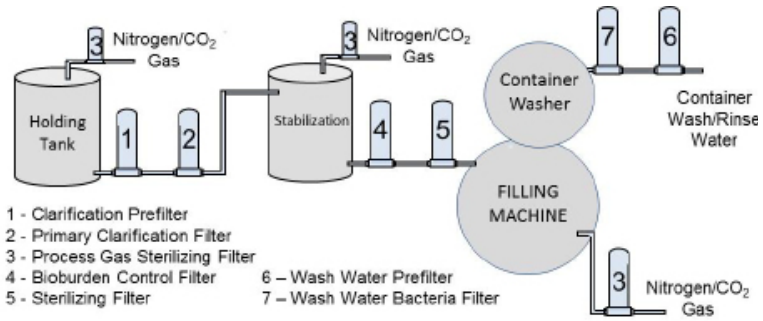

Figure 1: Wine Clarification & Stabilization Filters

The winemaker should test filters before choosing a micron rating or material to be sure that the filters will remove the target organisms and also preserve wine flavor and color.

Protecting Sterilization Filters

The system shown in Figure 1 has a single filter before the final stabilization filter (housing 4). This filter is called a bioburden reduction filter. It is used to control the level of organisms that need to be captured by the final filter. As mentioned above, the clarification filters can also be a part of the stabilization process and remove some microorganisms. However, the bioburden reduction filter is specifically in place to extend the life of the final sterilizing filter. Winemakers and plant operators evaluate the size and number of particles and organisms in the wine, then choose the filter that will remove particles and larger organisms that might prematurely clog that final filter.

The bioburden reduction filter is usually a membrane based filter with a pore size rating of anywhere from 0.65 microns to 1.2 microns. The filter chosen is 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 and bioburden reduction 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 “3” in Figure 1) are also critical to the quality of the packaged wine. 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. Almost all process gas filters have 0.22 micron pore size ratings, and most are highly hydrophobic PTFE membrane based.

Safeguarding Filling Operations

The filter housings marked 6 and 7 on the right side of Figure 1 are not used to filter wine but to filter container wash and rinse water. Process water systems may contain bacteria, so these filters are used to make sure that water borne organisms cannot be accidentally introduced during the final packaging of the beer. The final filter for water is usually a 0.22 micron rated filter with the prefilter usually a 0.45 micron or 0.65 micron rated filter with the same membrane material that will protect the bacteria filter from premature fouling.

Filter Options

The filters chosen must be designed to function after whatever disinfection or sterilization process will be used. The organisms targeted for removal also need to be considered.

Critical Process Filtration has several filter options, as shown in the table below. These filters are available as cartridge filters and disposable capsule filters as well is in flat disc form for laboratory scale testing.

Process Area	Filter Application	Filtration Function	Media **
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

CWPS = High Capacity PES Membrane PS = Polyethersulfone Membrane PVWB = High Capacity Hydrophobic PVDF Membrane
PVWL = High Capacity Hydrophilic PVDF Membrane TM = PTFE Membrane

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