HARD SELTZER FILTRATION AND STABILIZATION BEST PRACTICES

This guide is for small to medium-sized producers of hard seltzer and similar ready-to-drink alcoholic beverages. It offers recommendations for filtration, carbon to remove aroma and flavor, and VELCORIN™ for microbial stability.

BACKGROUND

Hard seltzer and other ready-to-drink blends of carbonated water, alcohol, and flavoring are popular with consumers looking for low calorie, low carbohydrate, gluten-free alcoholic beverages. When adding hard seltzer to your production capabilities, filtration and stabilization options should be considered carefully. The options you choose can have a significant impact on operation efficiency and profitability.

Hard seltzer bases need to be cleaned up after fermentation.

Seltzer bases typically have unwanted color, flavor, and heavy turbidity due to yeast and other solids. Clean-up can be achieved in many ways and will vary depending on the needs of each producer. Clean-up procedures generally achieve the following:

1) **YEAST & SOLIDS REMOVAL** - removes majority of yeast solids, reduces haze and cloudiness, visually improves product, mild sensory improvements.
2) **COLOR & AROMA REMOVAL** - produces a sensory neutral seltzer base.
3) **STABILIZATION:**
   a) **Sterile Filtration:** further reduces microbial load in preparation for final package stability.
   b) **Final Package Stability:** inactivates yeast and other spoilage microorganisms that can cause refermentation and sensory defects.

Order of operations is important. *The sequence in which clean-up steps are performed will affect efficacy and efficiency of operations. The order of operations will vary depending on package type, batch size, and production goals.*

Filtration is commonly used for hard seltzer clean-up.

Filtration is the process of removing solids by passing liquids through some kind of filter media. It is a highly flexible tool that can be used for many steps of seltzer clean up. Filters vary in media type (porosity, composition, etc), how that media comes into contact with the liquid (equipment and housings), and how solids are collected after liquid separation.

Filtration media can generally be categorized into two types: depth media and membrane (surface) media. Depth media has a high dirt or solids holding-capacity and retained solids are trapped in the media itself. Depth media comes in a range of porosities, but the pore size rating is nominal and represents an average pore size. Membrane media has a very low solids holding-capacity, meaning it does not trap solids and is easily fouled by solids and colloidal material. However, its pore size rating is absolute and can be relied upon to exclude any solids larger than its pore size (assuming proper preparation of the media and liquid being filtered). This makes membrane media ideal for removing unwanted microorganisms.

The following are the most common types of filtration for hard seltzer:

SHEET FILTRATION (PLATE & FRAME) – Sheet filter media are preformed depth filters traditionally made from cellulose, diatomaceous earth (DE), and other materials. Depending on the material, sheet filter media can be used to achieve a variety of filtration goals. These sheets are commonly positioned between plates in a frame, with the number, size, and type of sheets configured for the desired throughput and product clarity. Sheet filtration is typically used for yeast and solids removal prior to color and aroma removal and sterile filtration. This type of filtration is highly flexible and is useful for smaller production batch sizes but is labor intensive and has relatively high losses of product and media.

PRESSURE LEAF FILTRATION – Pressure leaf filters are a type of depth filtration wherein DE or other depth media (perlite) cakes are formed on filter leaves. Unfiltered product enters the filter and passes through the cake which retains the solids. While this equipment is common in many breweries, this type of filtration has fallen out of favor in recent years due to environmental issues with spent cake material and the complexity of building the cake. It is also labor intensive and difficult to get consistent outcomes.

LENTICULAR FILTRATION - Lenticular filters are essentially sheet filters (see above) that are pre-configured in a stacked-disc module and housed in a closed system. In comparison to plate and frame filtration, lenticular filtration is user-friendly, re-usable, has lower product loss, has a smaller footprint, can be heat sanitized, and comes in a

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wide range of porosities and materials making the system highly flexible. **Lenticular filtration is our preferred filtration method for yeast and solids removal in hard seltzer.**

CARTRIDGE FILTRATION – Cartridges are tubular, modular filters that are inserted into a housing. Cartridge media comes in a variety of depth and membrane types and porosities. Cartridge membrane filters are commonly used for sterile filtration due to an absolute pore size rating and ability to be integrity tested. This high precision filtration method is a popular choice due to its ease of integration into production lines and ability to withstand higher system pressures making it suitable for in-line packaging operations.

CROSSFLOW FILTRATION – Crossflow filters separate yeast and solids by passing a liquid tangentially across a membrane surface, rather than into the membrane. Retained solids are removed by tangential motion which prevents fouling of the membrane and increases throughput. Crossflow filtration is an excellent choice for continuous filtration of large volumes of liquids containing relatively high solids content. It is most suitable for large operations desiring automation and the ability to filter product in one pass, producing a brightly polished product this is ready for final stabilization at packaging.

Activated carbon can be used to remove flavors, aromas, and color.

Activated carbon is an adsorptive agent that binds with weakly polar molecules, particularly smaller phenolic compounds, including those responsible for color and flavor. A variety of food grade carbon-embedded filtration media are available in sheet, lenticular, and cartridge formats. Loose (bulk) carbon is also used but can be messy and requires additional depth filter steps to remove.

Microbial stabilization is necessary to prevent refermentation and spoilage in package.

Seltzers are at risk of microbial growth in package if not properly stabilized. Hard seltzers containing added or residual fermentable sugar are particularly at risk of refermentation resulting in over-carbonation, gushing, and in extreme cases, exploding bottles and cans. Several options are available to produce shelf-stable seltzer:

STERILE FILTRATION – Sterile filtration is the process of passing liquid through filter media to remove microorganisms. Filter porosities of <0.8 µm are generally used to remove yeast and porosities of <0.45 µm can remove bacteria. Sterile filtered product is susceptible to recontamination and filtration alone may not be sufficient to provide package stability, especially in the case of product that contains sugar. Therefore, sterile filtration is most used in conjunction with other stability methods.

PRESERVATIVES – Persistent preservatives such as sorbates and benzoates can be used to inhibit some yeast and bacteria. However, these preservatives can impart undesirable flavors, may have labelling requirements, and have specific requirements to be effective (pH, temperature, etc.).

PASTEURIZATION (HEAT TREATMENT) – Pasteurization is the process of applying heat (>140°F) for a prescribed time in order to inactivate yeast and other spoilage microorganisms. The time and temperature required to achieve pasteurization is based on microbial type and load as well as properties of the hard seltzer (pH, carbonation, alcohol, etc.). Hard seltzer can be pasteurized either before or after packaging but always after filtration. Pasteurization can be applied to the un-packaged product (flash pasteurization) and/or the packaged product (tunnel or bath pasteurization). Properly applied pasteurization is highly effective at microbial stabilization, and in the case of in-package pasteurization, can inactivate contaminants associated with filling operations and packaging material. However, pasteurization can have negative flavor impacts and is costly in terms of equipment capital, utilities, and footprint.

VELCORIN™ (DIMETHYLDICARBONATE) – VELCORIN is a cold sterilization agent applied in-line immediately before filling as part of filling and packaging operations. It is highly effective at inactivating yeast and some bacteria and has no impact on product flavor and aroma. After dosing, VELCORIN remains active for a period of time in which it can inactivate microbial contaminants associated with filling equipment and packaging materials. It then breaks down into negligible amounts of methanol and CO_2, compounds normally found in fermented beverages. VELCORIN must be applied with specific equipment, however, this equipment is usually smaller and more cost effective than in-package (tunnel) pasteurizers, making it an attractive alternative to heat stabilization methods.

See next page for complete seltzer filtration best practices.

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BEST PRACTICES FOR FILTRATION AND STABILIZATION

The following table outlines Scott Labs' best recommendations for hard seltzer filtration and stabilization including:

- Order of operations
- Explanations of each step
- Recommended filters and media

These best practices and recommendations are based on Scott Labs' long history of filtration and stabilization solutions and are meant to address the most common questions and situations for small to medium-sized hard seltzer producers. This guide is not meant to provide a comprehensive solution for all situations. Scott Labs' experts can provide support to tailor a filtration and stabilization system that will work for your process, throughput requirements, and current processing equipment.

Processing Step	Best Practice	Why?	Recommendation and Notes
Pre-Clarification	Undertake pre-clarification if needed. Many options exist (racking, centrifugation, etc.)	Ensures that solids don't overwhelm or complicate subsequent steps.	Pre-clarification procedures do not produce a consistent bright polish and a subsequent depth filtration step to remove colloidal compounds may be necessary.
Yeast & Solids Removal	Filter to a bright polish *(Click here for advice on filter media grade selection)*	• Removes majority of yeast solids • Reduces haze and cloudiness • Visually improves product • Mild sensory improvements • Helps prevents fouling of carbon-embedded media in downstream steps	Conduct a filtration with 2.5 µm depth media (K250 SUPRAdisc II). • Coarser filtration (>2.5 µm) may not achieve consistent brightness. • Starting with a tighter filtration (<2.5 µm) is acceptable but could result in premature fouling of the filter depending on the turbidity of your seltzer base. For most facilities, lenticular filter setups will be the best choice, as they are re-usable and handle varying batch sizes with ease.
Color & Aroma Removal	Filter through reusable carbon embedded media (lenticular or cartridge).	Carbon removes color and aroma compounds to produce a sensory neutral seltzer base. Carbon-embedded media is less messy and more efficient than loose carbon.	Conduct a filtration with carbon-embedded media: • **Lenticular Filtration**: Use carbon-embedded lenticular modules (SUPRAdisc I AKS4). • **Cartridge Filtration**: Use carbon-embedded cartridges (ScottCart Carbon).

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Processing Step	Best Practice	Why?	Recommendation and Notes
Final blending of flavorings and sweeteners with seltzer base	After blending, allow enough time for ingredients to solubilize and incorporate into base.	Some flavors and sweeteners can inadvertently be removed by subsequent filtration if not given enough time to incorporate into the main blend.	Note: depending on blend ingredients, flavorings, set-up and equipment, some facilities will blend after filtration steps and directly before filling and package stabilization.
Preparation for Sterile Filtration	Filter final blend through a relatively tight filter <24 hours in advance of sterile filtration.	Sterile filtration is more efficient when most particles have been removed. Filtration through a relatively tight filter removes most particles and can break up colloids that might foul a sterile filter. Colloids can reform after 24 hours and sterile filtration should occur before colloids reform.	Filter through 0.5 µm or 0.45 µm depth media (KS50 or EK grade media)
Sterile Filtration	Perform a two-stage sterile filtration using a pre-membrane cartridge and a sterile filter cartridge.	Sterile filtration removes microbes that can cause microbial spoilage and refermentation in seltzer. A two-stage filtration using a pre-membrane cartridge protects the final filter leading to higher throughput and lower risk of final filter cartridge fouling. Without sterile filtration, downstream stabilization steps may not be effective.	• **Use a 0.5-0.8 µm pre-membrane in front of the sterile filter** (ScottCart Pre-membrane PP, GF, or dual layer CA) • **Use a 0.45 µm sterile filter cartridge** (ScottCart Membrane PES) **NOTE:** Mobile canning may not allow in-line sterile filtration. In this case we recommend sterile filtering into a brite tank. **NOTE:** Sterile filtration does not guarantee package stability. It significantly reduces the existing microbial population but doesn't prevent subsequent microbial blooms due to poor equipment and packaging hygiene.
Carbonation	Use pressure-rated (liquid and gas rated) filtration equipment if filtering a carbonated product.	Pressure-rated equipment is necessary for safety when filtering carbonated product.	Some producers choose to carbonate in-line; However, this setup is less common and requires specialized equipment. Order of steps may differ depending on facility needs/set-up

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Processing Step	Best Practice	Why?	Recommendation and Notes
Final Package Stabilization	Use VELCORIN™ for in-package microbial control to ensure a shelf stable product.	• Inactivates spoilage microorganisms that can cause refermentation and unacceptable sensory attributes. • Provides cold sterilization that does not affect taste, color, or aroma • Dosing product in-line to filler provides antimicrobial effectiveness against contaminants from equipment, piping, filler, and packaging.	Dose product in-line with VELCORIN at point of packaging (directly before filler) *Note: VELCORIN is not approved for use in certified organic product

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