ASPECTS REGARDING MICROBIOLOGICAL STABILIZATION OF BEER BY FILTRATION

C. MIEILĂ, prep.ing. “Politehnica” University of Bucharest, Romania
Gh. VOICU, conf. dr. ing., “Politehnica” University of Bucharest, Romania
D. ȚUȚUIANU, prep.ing., “Politehnica” University of Bucharest, Romania

ABSTRACT: Pentru stabilizarea microbiologică a berei se utilizează ca alternativă la pasteurizare filtrarea în profunzime, care elimină contaminanții fară a afecta caracteristicile naturale ale produsului, datorită faptului că procesul de filtrare se efectuează la temperatura mediului ambient. În lucrare se prezintă schema alternativă de filtrare a bereii folosind cartușe filtrante de tip membrană pentru îndepartarea contaminanților în locul filtrelor clasice, și o descriere a procesului de filtrare în profunzime utilizând medii filtrante specifice scopului.

KEY WORDS: microorganisms, filter media, microbiological stabilization, filter cartridge, removal rating.

1. INTRODUCTION

Filtration, through mechanism of removing microbial contaminants from selected beverage fluids, is one method which can be used to achieve microbial stable products.

The term "sterile filtration" refers to the reduction of yeast and bacteria to levels that do not result in spoilage of the beer over its planned shelf life. Viruses do not survive the brewing process. Sterile filtration has been used as an alternative to pasteurization for many years. It has the advantage over pasteurization in that the risk of flavor damage by heat is eliminated.

The brewer should set a specification for the maximum allowable concentration of yeast and bacteria in sterile-filtered beer since not all microorganisms are removed by sterile filtration. Opinions differ about what is the critical level for contaminants, and for beer it has been set at between 4 and 10 yeast cells per 0.35 liter bottle. In the case of lactobacilli, it has been reported that between 1 and 3 organisms per 0.35 liter bottle is acceptable. In other words, there is no universally agreed-upon minimum safety level for Lactobacillus sp., and use of the term "sterile filtration" can be misleading.

Filtration provides following benefits:

- extends product shelf life by removing spoilage microorganisms and particulate contaminants from beverage fluids;
- reduced requirements for preservative and other additives used to inhibit microbial growth;
- natural flavors of beverage products are not altered; thereby improving product quality;
- economic advantages over thermal processing.

Today, with few exceptions, all packaged beer is stabilized biologically before it leaves the brewery. The shelf life of such beers needs to be measured in months rather than weeks and the degree of stabilization required may be achieved by using either heat treatment (pasteurization) or filtration.

Absolute filtration removes all spoilage organisms and suspended particles larger than absolute rating to provide a biologically stable and bright product. This is achieved without affecting flavor, color, and alcohol content or foam stabilization.

Whilst the removal of spoilage organisms without affecting the beer's natural characteristics is the major benefit of absolute filtration, there are additional benefits too:

- Energy costs are low;
- Filter assemblies are compact and easy to operate;
- Modular system, which is easily upgraded;
- No requirement for buffer tanks or re-circulation systems.

Absolute filters are used to remove kieselguhr / PVPP fines, collapsed foam particles and for the biological stabilization of both top and bottom – fermented beers. They are being used successfully for the stabilization of keg and bottled beer over a wide range of flow rates in the Germany, UK and USA.

2. THE FILTRATION PROCESS

The filtration process typically comprises three stages:
1. A particle trap filter is positioned downstream of the kieselguhr (or PVPP) filter to remove powder bleed through and other gross material. The fixed and stable pore structure of the media used for this applications means that powder fines can be continually removed and the trap filter removal efficiency will not vary throughout its on stream life, to blockage.
2. A high efficiency prefilter situated upstream of the final filter which removes fine particles and the bulk of the microbiological contamination.
A final filter located next to the packaging equipment, which provides complete assurance of spoilage organism removal. The purpose of this filter is microbial stabilization.

The filter medium of trap filter (1) can be pleated polypropylene or multilayer polypropylene.

Pleated polypropylene medium combines a constant pore size downstream section for absolute rated filtration and a continuously graded upstream section. As result of this construction, this type of filter hold more contaminants and provide for long on-stream service life – up to four times greater than conventional pleated polypropylene filters. Multilayer polypropylene medium contains effective pore sizes varying over a range as much as 40 to 1, a ratio many times higher than is achievable by simply varying the density.

Pore size variation within the multilayer polypropylene medium is achieved by varying the fiber diameter, while maintaining uniform density – and hence, uniform compressibility.

Because uniform density and compressibility are maintained, multilayer polypropylene elements can be made at lower density, and for this reason, have higher void volume – which means more pores and longer service life.

Removal rating of trap filter (1) is 5 to 10 micrometers. The trap filter (1) is used for diatomaceous earth fines removal.

The filter medium of prefilter (2) is multilayer polypropylene. Removal rating of prefilter (2) is 0.3 to 1 micrometers, because the purpose of prefilter is to protect downstream final filter. The depth filters constantly remove diatomaceous earth prior to final filtration or pasteurization.

The filter medium of final filter (3) is hydrophilic polyvinylidene fluoride. This filter is constructed of a double layer, hydrophilic polyvinylidene fluoride membrane supported between two layers of polypropylene. The final filter elements can be repeatedly hot water sanitized, autoclaved or steam sterilized.

Removal rating of final filter (2) is 0.65 micrometers. Hydrophilic polyvinylidene fluoride filter medium are suitable for the microbial stabilization of beer in the production of “draft beer”. Applied as a final filter prior to bottling, hydrophilic polyvinylidene fluoride filter medium retain beer spoilage organisms such as yeast, Pediococcus and Lactobacillus.

As an alternative to pasteurization, cold stabilization of beer by filtration with hydrophilic polyvinylidene fluoride membrane filters retains the natural flavor of beer.

Although cartridge filters are not used for rough or polish applications they are suitable for sterile filtration. It is common to have these filters downstream as a final step after using powder filters and sheet filters. Typically, cartridge filters (fig.2) are constructed for depth filtration. Cartridge filters must be stacked or manifolded, usually in a single housing, in order to handle a meaningful flow. Depth filters are made from a great variety of materials, including melt-blown polypropylene, and polyester.

Filter cartridges can be sterilized or sanitized in-situ using steam, hot water or compatible chemicals. The upstream processing must to provide a beer with high filterability.

Regular cleaning of tanks, pipes and hoses and effective sterilization of the primary filters will assist in the delivery of beer in the right condition to the filters.

The filtration cost is determinate by the effective conditioning of the beer before it is passed to the filters for microbiological stabilization. Filter cartridges can be cleaned in-situ to provide a long service life.

Filter cartridges are designed to provide secure sealing and rapid cartridge replacement.
The filters consist of one or two layers of one of several type of membrane, pleated between either polyester or polypropylene support and drainage material. This rugged pleated filter medium pack is then formed into a cylinder and side-sealed by melting the two opposing pack edges together. It is then assembled about a polypropylene internal support core and enclosed by a sturdy outer polypropylene protective cage.

Polyester and polypropylene end caps are attached by melt. The material of end caps is melted and used to make homogeneous connections.

Multi-length elements are assembled by melt welding the cartridge end to end. The final step is the attachment of end closures and O-ring adapters to the ends using the same melt welding process.

3. CONCLUSIONS

Extended lagering periods and the addition of flocculation aids both greatly reduce yeast and haze loading. Centrifuges are mainly used in the preliminary reduction of suspended particles, primarily in yeast before sending to the conditioning tanks. Although these methods are very effective in prefiltering the beer, a final filtration is needed to remove residual yeast, other turbidity-causing materials, and microorganisms in order to achieve colloidal and microbiological stability.

If there is a significant quantity of suspended material to be removed, powder filters using diatomaceous earth or perlite must be employed. Although powder filters can produce beer of acceptable brilliance after a single filtration, a two-stage filtration process is needed for a final polish. Polish filtration may employ a sheet filter, used as an intermediate step in handling heavier loads but also can involve a cartridge filter with high removal rating, followed by a cartridge filter as a final filter.

4. REFERENCES

[5] * * * - Pall Filtration Products for the Food and Beverage Industry, Pall Ultrafine Filtration Company brochures.