THE POWER OF MICROFILTRATION

Contaminants in food production are many and varied. ***David Keay,*** *Director, PoreFilterUK, explains the role microfilters play as the final insurance of quality*

The food and beverage industry faces a range of challenges to prevent contamination of liquid products. These challenges include the need to ensure the quality of incoming ingredients, maintain contamination-free utility gases and liquids coming in to direct contact with products, and make sure the packaging process delivers a consistently high quality product, with the necessary shelf life.

Sources of contaminants are many and varied. The smallest sized particle the human eye can see is 40 μm, therefore many contaminants are not evident when visually inspected.

Spoilage organisms, such as yeast or bacteria that can cause the food or beverage products to deteriorate, impact quality and limit shelf life. These spoilage organisms can come from either liquid or gas sources.

Bleed through of filter aids used in the packaging process, such as PVPP (short for polyvinylpolypyrrolidone; a synthetic polymer used as a fining to extract impurities) and CMC (short for carboxyl methyl cellulose; a thickener, binder and stabiliser used in a variety of foods) can lead to contamination. Corrosion or by-products created when using water in the manufacturing process, such as calcium scale, ferric oxides and organic colloidal material, may also contaminate the final product. All of these products tend not to be visible upon visual inspection.

Filtration is a well-documented technique for their removal, however, this article will focus on the role microfiltration cartridge filters play as the final insurance of quality.

Microfilters have become the tool of choice for removal of contaminants, because they have proven effective in removing particles and microorganisms of 10 μm down to 0.1 μm. Their popularity can also be attributed to a wide range of microfiltration cartridges available in the marketplace. Due to this variety, the optimum choice is dependent on the application. Microfilters act as the guarantee of quality and this is borne by the application name typically found: final, guard, trap or sterile. Furthermore, the loadings that microfilters are expected to handle are very low, typically lower than 1 mg/litre.

Multiple choice

There are a number of different types of microfiltration cartridges:

- Membrane microfiltration cartridges are used for the removal of microbiological contamination (bacteria, yeast). Their structure and operating principals ensure that no microbiological or particulate contamination can pass through. The result is a microbial-free sterile liquid.
- Depth cartridge filters are used for the removal of particulates, hazes and gels, but also as prefiltration to membrane filters. Due to their structure, no particulate passage occurs, but microorganisms will be able to pass through them over time.

Depth filters have far higher dirt holding capacities compared to membrane filters and therefore have a longer operational life by comparison. To extend the life of a membrane filter, depth filters are typically used as a prefilter to reduce the contamination going across the membrane and therefore substantially extend their service life.

Depth filters can be melt-blown or pleated. Melt-blown filters are chosen where there is a wide spread in the size of contamination. However, where the spread in size of contamination is narrow pleated depth filters should be used. When it comes to the process, if the application needs to ensure the clarity and brightness of the product, or provide prefiltration for other microfiltration cartridge filters, then depth filters are the correct choice. If the application is concerned with stabilisation or

sterilisation of the product, then membrane filters are a better option.

Filtration for liquid products

Due to the initial ingredient condition, ingredient packaging, or manufacturing process, there are relatively high levels of particulate contamination in liquid products. To remove this particulate contamination, it is common practice to use filtration technologies, which have high capacity but lack an absolute removal rating.

Removal techniques employ plates or candle filters using sand, powders or earths to form porous cakes around a screen, enabling filtration of the gross particulates to take place.

These types of filter do, however, suffer from the possibility of break through or bleeding of the powder forming the cake, as operating conditions fluctuate. This causes recontamination of the filtered product. Although recontamination is at far lower levels, this will potentially cause the product to look cloudy and certainly stop it from looking bright and sparkling, which is the aim of most beverage manufacturers. To solve this problem, a microfiltration cartridge filter using a polypropylene media is deployed. The microfilter is typically 5 μm or 10 μm allowing it to act as a guard or trap filter to guarantee the clarity of the product.

The water challenge

The use of water in food and beverage products is widespread and a common potential source of contamination. Water can be the main ingredient or can be used for cleaning products or processes. Wherever water is used in the production process, it is imperative potential contaminants are removed.

Water comes from many differing sources, ranging from natural springs through to mains supply, thus the challenge to ensure water is contaminant-free is varied. Spring water is normally very pure but it needs to be free from microorganisms, which could impact shelf life. To achieve this, depth pleated prefilters and final membrane cartridge filters are used.

In comparison, mains water will already have been treated for municipal use and therefore may need treatment to remove chlorine or colour. For these applications carbon filters and pleated prefilters can be used.

Often the microfilter used is specific to a production location, as water quality can vary greatly between locations. Microfiltration is a flexible tool able to cope with this variation and at the same time offer standard solutions to minimise operating costs.

Ingredients such as liquid sugars have very different challenges as they are typically highly viscous; the rate of filtration has to be lower, because contaminants are more difficult to remove and have greater retention in the liquid, due to its viscous nature. As a consequence filtration systems have to be designed specifically to match these conditions and similar flow-rates are normally larger. For these applications, melt blown depth filters are particularly useful because of the extended path of filtration they offer.

Gases perform a number of functions when used in food and beverage manufacture. Gases are commonly used to move liquid products and ensure that processing lines are completely empty. Carbon dioxide, for example, is universally used in the carbonation of soft drinks.

The use of nitrogen to provide an inert atmosphere during a packaging process is commonly employed to enhance product life. In all instances, these utility gases need to be free of potential contaminants.

There are two choices of microfilter for this application:

- A membrane filter made from pleated PTFE, or polytetrafluoroethylene
- A depth media type made from borosilicate microfibre

The latter is typically used within the food and beverage industry because of the superior gas flow performance that leads to both lower initial capital costs of purchase and lower operating costs in service.

Steam filters

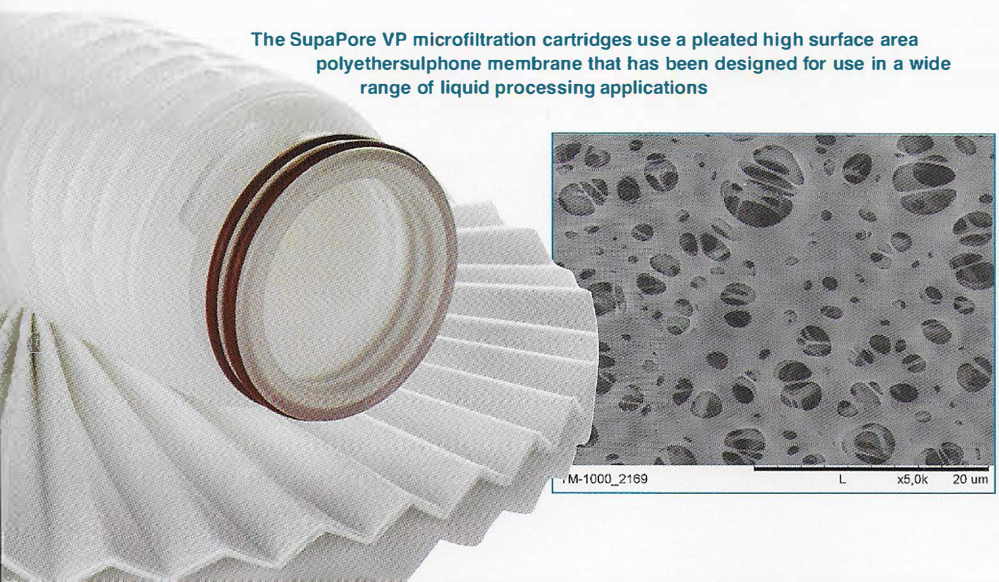
When producing steam that will come into contact with food products either directly or indirectly in the food and beverage industry, it must be of culinary grade (3A-609-03). This means the boiler should only use FDA-approved corrosion inhibitors and it should be filtered as close to the point of use as possible, with a filter that provides 95% retention of 2 μm particles. The steam filter provides three main functions dependent on the application:

- Removal of debris that can affect the efficiency of heat exchangers
- Removal of particulate generated from the boiler and pipework to protect the sterilising gas filter
- Removal of particulate to allow steam to come into contact with the final product

Filtration systems used for these applications may be steam sterilised in-situ and the steam used to do it should be filtered to prevent any blockage of, or damage to, the microfilters. Amazon SupaMesh products have been developed for such applications.

The challenge of keeping contaminants at bay is huge; they come from a wide range of sources throughout the food and beverage manufacturing process, but microfiltration cartridge products are capable of solving problems for most, if not all, liquids and gases.

The end user should remember that filtration is still as much an art as a science, because individual applications are dependent on local conditions. Therefore, the selection of a supplier with experience and knowledge is key in ensuring contamination control success.



The SupaPore VP microfiltration cartridges use a pleated high surface area polyethersulphone membrane that has been designed for use in a wide range of liquid processing applications

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