

ALCOHOLIC PRODUCTS

Freeze Concentration of
Fermented Alcoholic Products



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Application

In the alcoholic beverage industry, the variety of beverages is enormous. It is increasingly more difficult to expand in this competitive market. There is a drive to examine new technologies for the development of new products and/or reduce the present production costs. In fermented beverage processes water is often the focus of this problem. Higher alcohol concentrations are not possible due the mortality of the enzymes used in alcohol production. For this reason, a variety of water removal techniques have been developed. The most used concentration techniques can be divided into three main categories:

1. Evaporation/distillation - converts water (and other components) into a vapour.
2. Membrane technology - provides a barrier that allows water (and all smaller molecules) to pass.
3. Crystallization - converts the water into solid ice crystals. Solid-liquid separators are required to remove the ice.

Evaporation/distillation is the most common and the most applied technique for concentration. The volatility of alcohol, the limited selectivity and high temperatures generally result in relatively poor retention of the original product quality. Membranes can provide low operational costs but provide a relatively poor concentration factor and limited selectivity. Crystallization provides the highest selectivity toward water removal and due to the low operating temperatures the activity of sensitive nutritional and flavour components is maintained.

The main criteria in the evaluation of a new process are product quality and cost.

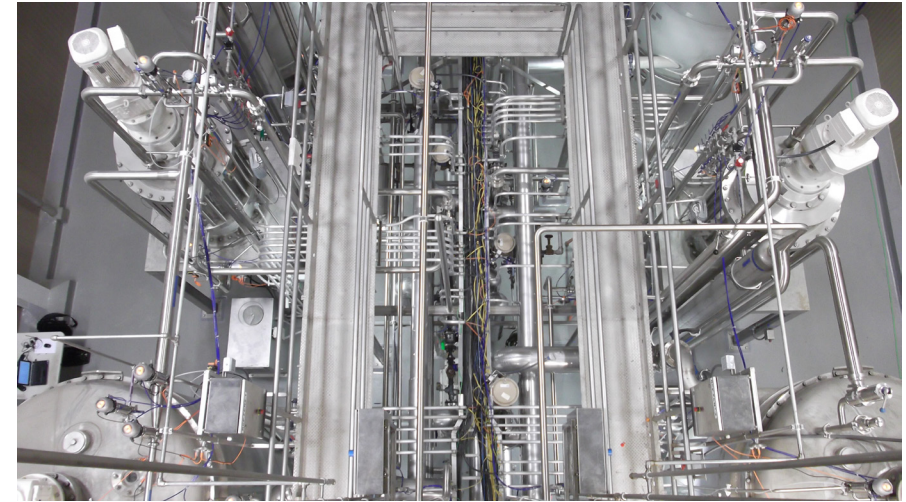
Factors that have a positive affect on the gross added value are:

- Concentration factor
- Microbiological and chemical stability
- Organoleptic properties, taste, smell, etc.

The main factors influencing the economics of a concentration process are capital cost, operational cost, maintenance cost, product losses and possible charges for disposed water.

Freeze Concentration

Crystallization of water from liquid products has commonly been referred to as Freeze Concentration. GEA enhanced this process with its unique solid-liquid separation into a sophisticated process that fits well into the modern food



processing plant. Commercial systems (called: IceCon®) are designed from standard component sizes depending on your throughput requirements.

The technology provides the highest quality retention with a relatively high concentration factor against reasonable cost. By applying Freeze Concentration an alcoholic beverage can be concentrated in one single step.

Due to the closed system design and low operating temperatures, there is no need for intermediate cleaning. This saves valuable production time, cleaning agents and effluent disposal.

GEA Freeze Concentration is commercially applied in a wide range of industries, and a proven technology for the production of red/white wine-, cider- and beer-concentrates. Alcoholic beverages are typically concentrated up to an alcohol percentage of 20 to 27 %ABV.

Advantages of IceCon® technology

The IceCon® Freeze Concentration technology can be used for the production of alcoholic beverages. The reconstituted concentrate made by Freeze Concentration is identical to the starting material and can therefore compete with fresh products not made from concentrate. Freeze Concentration has following advantages;

- Avoids thermal degradation
- Pure water discharge
- Preserves volatiles
- Prevents oxidation
- Inhibits bacterial growth
- Natural freshness, functionality, and nutritional value of the original product is secured.

Process features

The production of high quality concentrates is a result of:

- *Low processing temperature*
The concentration takes place at the freezing point of the product (e.g. -8°C). All microbiological and chemical reactions have virtually stopped. There is no thermal damage to sensitive flavour components and the product.
- *Efficient water separation*
The separated ice crystals are 100% pure water without any included product. The separation of ice crystals in the unique wash column separator is near perfect, meaning that all flavour components remain in the liquid concentrate. Typically only small traces of product (ppb/ppm level) can be detected in the discharged water. The discharged water can therefore be (re)-used in any up/down-processes or sent straight to the drain.
- *No contact with air*
The process operates as a pressurized liquid filled system. Consequently, all contact with air/oxygen is eliminated and the potential for oxidation is minimized.

Applications

Concentration is done for all kind of reasons, below an overview of some typical applications.

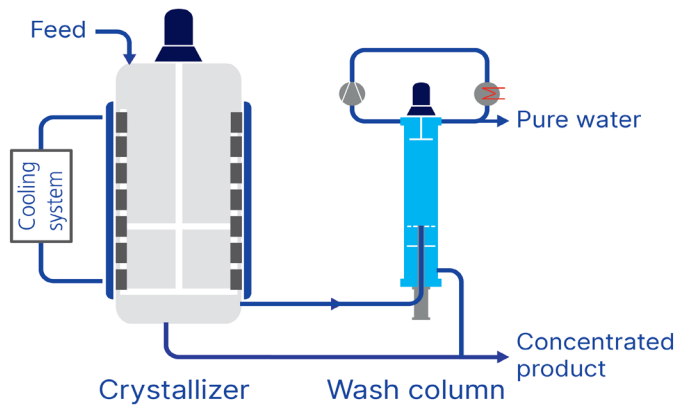
- Volume reduction, cost savings
- Product development (increased alc.%)
- Intermediate base product for production of aperitifs
- Standardization of alc. % (because of seasonal variations)
- Higher product stability
- New distribution concept (post mix)
- Increase concentration of raw material (grape juice), before fermentation.

Product	Maximum concentration*
Beer	25 %ABV
Alcohol free beer	45 %RE
Wine	27 %ABV
Cider	28 %ABV

* Product properties like viscosity behavior and freezing point depression, both relevant parameters for freeze concentration process, differ per product. The presented values are realistic maximum numbers but need to be confirmed by pilot plant testing.

Table 1: List of products and concentrations

Figure 1: Process flowsheet



How the process works

Freeze concentration is the removal of pure water in the form of ice crystals at sub-zero temperatures. IceCon® is the latest innovation of freeze concentration design. The diagram shows the complete process in its simplest form. This single stage process consists of one crystallizer and one wash column. The crystallizer is a vessel with a cooling jacket. The inner wall of the vessel is scraped. Ice production and crystal growth take place inside the crystallizer. By creating residence time ice crystals grow, creating an optimal crystal size distribution for efficient separation. In the wash column, the concentrated liquid is separated efficiently from the ice crystals. A compressed ice crystal bed is washed with melted ice to remove all traces of concentrated liquid. Freeze concentration ensures that all original product characteristics remain in the concentrate.

On-site demonstration of this technology is possible in various configurations using GEA pilot plants. For more information regarding this technology and your specific configuration requirements, please contact us or get in touch with your local GEA contact on gea.com.

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