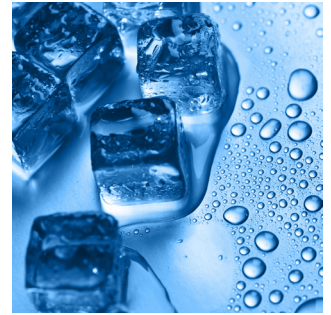
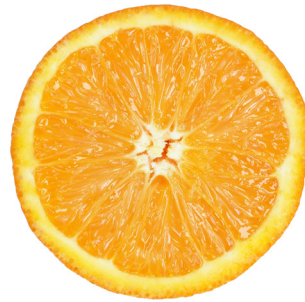




Freeze Concentration of Citrus and other Fruit Juices



Application

The beverage industry's demand for high quality products at acceptable prices generally drives the development of new process technologies. Maintaining the natural look and fresh taste creates a conflict with factors like shelf life, transportation and storage cost.

Water is the focus of this problem. A variety of concentration techniques have been developed for the efficient removal of this single component. The aim of concentration is to add value to the product.

Factors that affect the added value are:

- Concentration factor
- Microbiological and chemical factors that affect the product stability and reduce shelf-life
- Bulk handling
- Water removal costs, which are influenced by capital, operational, equipment cleaning and maintenance costs, product losses and even charges for disposing the water you just removed.

The GEA Messo PT Freeze Concentration technology provides the highest quality retention with a relatively high concentration factor against reasonable cost.

GEA Messo PT freeze concentration is commercially applied in the citrus industry for concentrating orange-, grapefruit- and mandarin- juices and other fruit juices like strawberry juice, grape juice, lemon juice, black/red current juice, raspberry juice, blue/black berry juice, grape juice, peach juice, banana juice, cranberry juice, and others. The maximum achievable concentration is in the range of 35 to 50°Brix.

Features:

High product quality as a result of:

- **Low processing temperature** - the concentration takes place at the freezing point of the product (e.g. -8°C). All microbiological, bio-chemical and chemical reactions have virtually stopped. There is no thermal damage to the product.
- **Efficient separation of the water** - the separated ice crystals are 100% pure ice without any inclusions. The separation of ice crystals in the unique wash column separator is 100% efficient so that all the original components remain in the concentrated product.
- **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.
- **No need for intermediate cleaning** - the process operates 24 hours per day and can go for weeks without intermediate cleaning. Throughput is flexible between 0 and 100% of design capacity.



The wash column (ice separator) of a commercial Freeze Concentration plant for orange juice illustrating the sharp separation between washed ice (top) and ice with concentrate (bottom).

Continuous operation

Thanks to the continuous operation, there is no need for intermediate cleaning. The process operates 24 hours per day for weeks without intermediate cleaning. Throughput is flexible between 0 and 100% of design capacity.

Fresh from Concentrate

- Alternative to not-from-concentrate.
- Single strength juices have gained market share due to its quality and image. Cost levels are limiting this growth. Freeze concentration can produce reconstituted juices at the same quality and at lower cost and thus can contribute to expansion of top quality juices in the market.

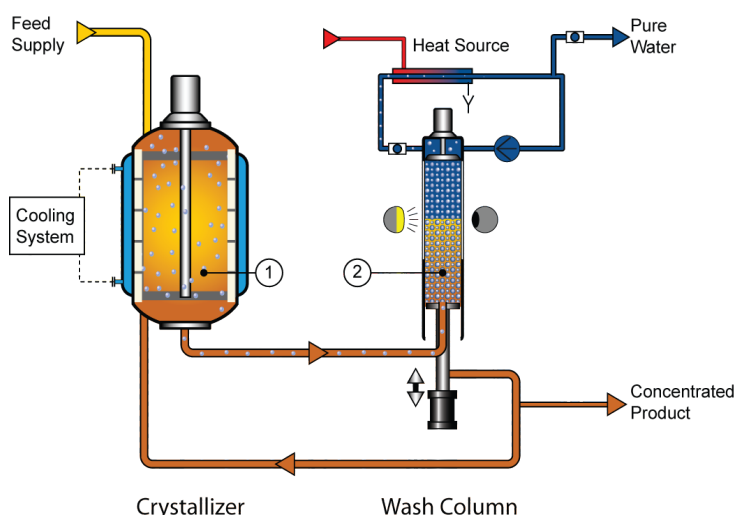
Freeze Concentration answers the demand for:

- High quality, healthier chilled juices.
- Enhanced market position in increasingly competitive markets.
- New product development.

Process Description

Water removal is the key to concentration of all liquid food products. Various methods are available to remove this water. They can be divided into three main categories:

1. Evaporation 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 is the most common and the most applied technique for concentration. 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.

Freeze Concentration as a Crystallization Process

Crystallization of water from liquid products has commonly been referred to as Freeze Concentration. The process has been applied for centuries. In its earliest form it was as simple as leaving a barrel filled with product outside in the winter and draining the remaining liquid as concentrated product. The ice is formed as pure water crystals and everything else remains in the liquid. GEA Messo PT has enhanced the freeze concentration process with its unique solid-liquid separation into a more sophisticated process that fits quite well into the modern food processing plant.

Commercial systems are designed from standard component sizes depending on your throughput requirements. Multistage systems are developed along with larger components to allow for any capacity up to > 30,000 kg/h.

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 (1) and one wash column (2). The crystallizer is a vessel with a cooling jacket. The inner wall of the vessel is scraped. The outer wall is cooled by a circulating refrigerant. 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.

Next Steps

On-site demonstration of this technology is possible in various configurations using GEA Messo PT's pilot plants. For more information regarding this technology and your specific configuration requirements please contact us at: info.niropt.nl@gea.com or phone +31 73 6390 390.

GEA Messo PT

De Beverspijken 7b, 5221 EE 's-Hertogenbosch, The Netherlands

Tel +31 73 6390 390, Fax +31 73 6312 349

info.niropt.nl@gea.com, www.gea-messo-pt.com

TSF02.042013-H