

Freeze Concentration

Break barriers in liquid processing



GEA Messo PT

GEA Messo PT is well established as globally recognized technology supplier and plant constructor in the field of solution – and melt crystallization and related concentration technologies with focus on business activities to a selected range of industrial applications.

GEA Messo PT has been established as a merge of the German based GEA Messo GmbH and the Netherlands based GEA Niro PT B.V. into one operational entity. The newly formed company combines the two technology centers for solution crystallization (Messo) and melt crystallization/freeze concentration (Niro PT) allowing to use all cross-fertilizing synergies between solution and melt crystallization. At the same time, our customers profit from a better support out of larger and consolidated departments in sales, project management, services and administration. Today, GEA Messo PT is selling Messo technology and Niro PT technology as one company from our two technology centers in Duisburg and 's-Hertogenbosch.

GEA Messo PT forms part of the GEA Process Engineering segment of the GEA Group.



Multistage freeze concentrator

Introducing Freeze Concentration

Many industries need to dewater aqueous solutions. The objectives of the process, though, may vary widely. They range from achieving concentrates (food liquids) to creating ultra-pure substances (pharmaceutical industries) or residues that can be safely disposed or re-used (treatment of hazardous waste water).

Freeze concentration comes into the picture where the water of aqueous solutions can be transformed into spherical, and consequently easily separable ice crystals. The result is unprecedented product quality. This process is generally referred to as freeze concentration when applied to aqueous solutions.

When supreme quality liquid food concentrates are requested freeze concentration is the process of your choice. Niro PT invented, commercialized and further developed this leading edge technology over the last decades. No other concentration processes can obtain the outstanding product qualities which are achievable with the Niro PT technology.

The very gentle concentration at sub-zero temperatures allows product freshness to be maintained and prevents biological degradation to occur. Since no vapour phase is present all volatile aromas will be preserved in the food concentrates. Over 60 freeze concentration plants have been put into operation throughout the world with more than 100 Niro PT Purifiers in commercial service. Various configurations with capacities ranging from 100 to 400,000 tons per year have been installed..

Multistage freeze concentrator



Your business and Freeze Concentration

The freeze concentration process can be used to achieve:

- ♣ premium quality concentrates;
- ♣ development of new products
- ♣ reduction of production cost in combination with freeze drying
- ♣ recyclable waste streams, while reducing the volume of hazardous waste streams for disposal.

Further, the process can be used to change product properties, increase stability and is an interesting alternative for products not-from-concentrate.



Industrial Wash Column Unit



Liquid foods

Concentration has been common procedure among liquid food processors for many years. Rather than moving tons of water around the world, they reduce volume to economize on packaging, storage and transportation. Conventional concentration methods, however, often compromise quality. Here, the Niro PT freeze concentration process makes the difference, as it has proved to be superior in retaining the liquid's original properties.

Pharmaceutical processes

The pharmaceutical industry has discovered that the applied freezing point technology is ideal for treating heat-sensitive substances, which would experience a loss of activity if processed through different methods. As in the chemical industry, the reward of the Niro PT technology consists of the more efficient use of raw materials and compounds, better quality and, in the end, better returns.

Hazardous waste water

A new feature involves the proven suitability of the Niro PT technology for treating hazardous waste water and other effluents. The NIRO system divides the waste stream in two streams: a pure water stream that is either disposed or brought back into the process and a concentrated waste stream for further processing, such as incineration. Handling and incineration costs are significantly reduced.

Process objective	Concentration	Separation	Purification	Improvement	New products
<i>Liquid foods:</i>					
Coffee	•			•	•
Tea	•			•	•
Citrus juices	•			•	•
Fruit juices	•			•	•
Vinegar	•	•			•
Wine	•		•		•
Beer	•			•	•
Dairy				•	•
<i>Pharmaceutical products</i>	•	•	•	•	
<i>Hazardous waste water:</i>	•	•			

Economics

Freeze concentration presumably entails higher initial costs than other concentration systems such as evaporation. On the positive side, freeze concentration yields premium quality products. Additional advantages include low energy costs and a continuous process that enables long operating periods without intermediate cleaning. Overall, total cost is indeed competitive with conventional systems, with unmatched quality as an extra reward. Our specialists will be happy to provide detailed insight about the feasibility of the process for your product.

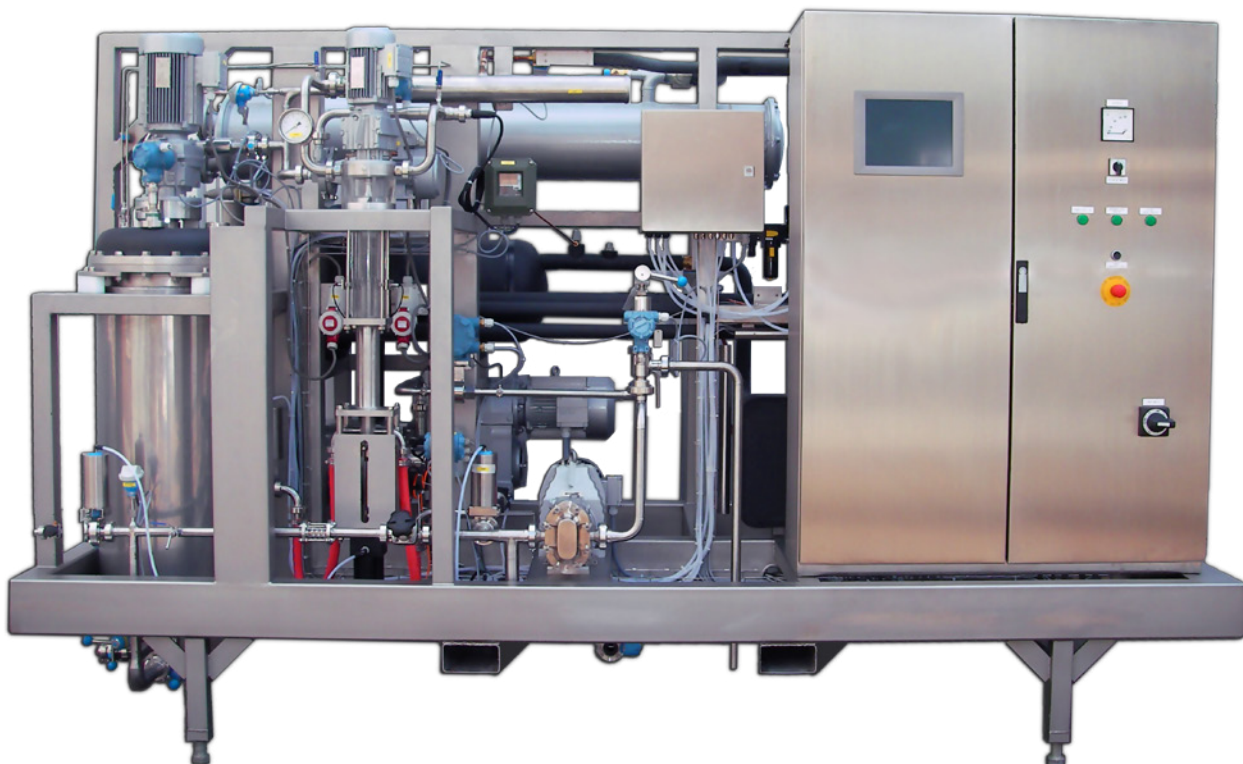
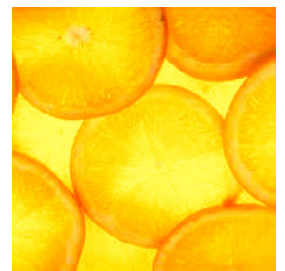
Capacities

The capacity range is very broad. Today, freeze concentration units have water removal capacities ranging from 100 kg per hour to 25,000 kg per hour. Thus, the process is suitable not only for a variety of products, but also for small-volume specialty runs and large-scale operations.

Trial service

Seeing is believing. Where calculations may suffice for proven applications, it is only normal that for new concepts and products the technical feasibility is assessed prior to the investment.

GEA Messo PT rents out pilot plants for in-house trials. The prospective customer could also supply feed for pilot runs on the premises of GEA Messo PT.



Pilot plant unit

Proven Applications

Liquid Foods

Soluble coffee

Key aspects

- ◆ quality concentration
- ◆ aroma retention
- ◆ new varieties
- ◆ quality boost of freeze or spray drying
- ◆ cost reduction

Citrus juices

Key aspects

- ◆ natural freshness
- ◆ quality concentration
- ◆ premium pricing
- ◆ cost reduction

Other fruit juices

Key aspects

- ◆ product development
- ◆ high quality ingredients
- ◆ in many cases the only viable concentration technique
- ◆ cost reduction

Beer

Key aspects

- ◆ only proven concentration technique
- ◆ economic storage and distribution
- ◆ peak shaving
- ◆ reducing aging time
- ◆ new products,
 - ◇ low or non-alcohol
 - ◇ ice beer
- ◆ stability

Vinegar

Key aspects

- ◆ ingredient of high concentration
- ◆ cost reduction

Wine

Key aspects

- ◆ control of alcohol level
- ◆ cost reduction
- ◆ high quality intermediate

Other

Dairy products (improved final products, better semi-finished products for processors), tea, vegetable juices and other plant extracts.

Pharmaceutical Industry

Key aspects

- ◆ mild process conditions
- ◆ heat sensitivity
- ◆ aseptic operation
- ◆ no thermal damage to active components

Hazardous Waste Water

Key aspects

- ◆ less impact on environment
- ◆ high purity water for re-use
- ◆ reduced incineration load
- ◆ reduced energy consumption and CO₂ emission

Inherent Advantages of the Niro Process

- ♣ The Niro PT process can remove pure water from most multi component aqueous solutions without any loss of volatile compounds or soluble solids;
- ♣ Operating at freezing point temperature, the process prevents quality degradation, because of the low microbiological, chemical and biochemical activity;
- ♣ The use of wash columns for separating the ice crystals eliminates soluble losses in or around the crystals;
- ♣ As the system is pressurized, ambient air cannot enter, which prevents oxidation;
- ♣ Continuous operation: the hygienic design, in combination with low temperature, eliminates the need for intermediate cleaning;
- ♣ The totally closed system prevents losses of volatile aromas and other valuable components;
- ♣ Stable operation, simple control, insensitive to variations in feed composition.

Our SNG Freeze Concentration Technology

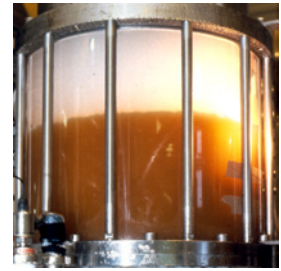
Most (food) liquids consist of water and dissolved solids. In most cases the water content is 90% or more. Part of this water can be removed at low temperature by the freeze concentration system, which consists of a crystallization section and a separation section. In the crystallization section part of the water present in the product is converted into pure spherical ice crystals. In the separation section these ice crystals are separated from the concentrated liquid by means of a wash column.

Our traditional Niro Freeze Concentration technology (NFC) is based on SEPARATE NUCLEATION and GROWTH (SNG). The ice crystal production is separate from the ice crystal growth area.

How the process works

In its simplest form, the process works as follows: the unconcentrated liquid is pumped from the feed tank into a scraped surface heat exchanger (1), where small ice crystals (2) are formed instantly. These very small crystals are then pumped to a separate recrystallizer (3). Here the small crystals, which have been formed in the heat exchanger, are mixed with the larger crystals. Smaller crystals have a slightly lower equilibrium temperature than larger ones. When large and small crystals are mixed, the smaller crystals will melt and recrystallize on the surface of the larger crystals, which will grow. The product is recycled over the scraped heat exchanger via a filter (4).

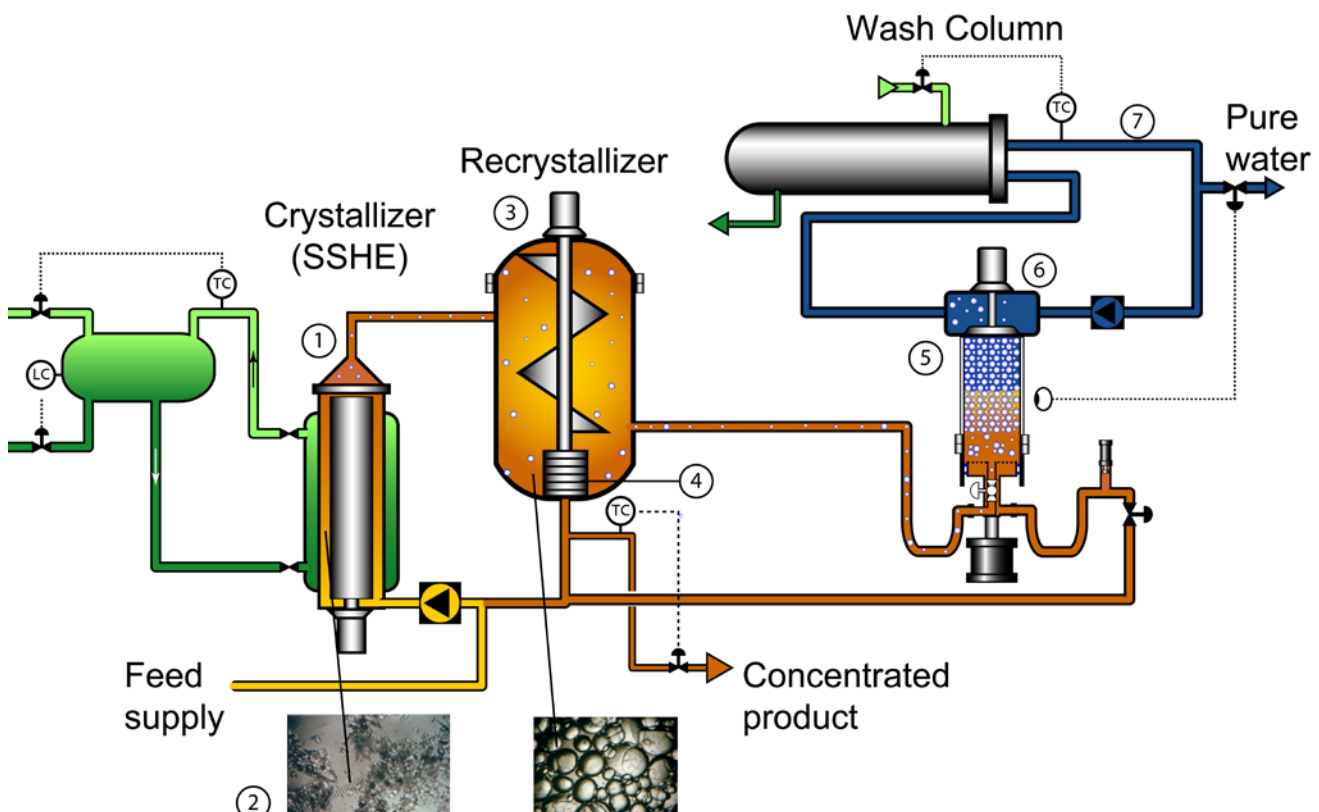
The slurry (concentrate and crystals) is transported from the



Wash Column with washfront

recrystallizer to the wash column (5). In the wash column, the concentrate is "squeezed" through a filter at the bottom. In this way a packed bed of ice crystals is formed. The packed bed is "pushed" upwards. At the top of the wash column the ice is scraped off (6) and melted (7). Part of the melted ice is used to "wash" the packed bed. The concentrate, which is still present in between the ice crystals, will be displaced by water.

A sharp separation will be formed between the washed part of the bed (crystals and water) and the not-washed part of the bed (crystals and concentrate). This is called the wash front. The water is removed at the top of the wash column. In this separation process, the loss of soluble solids in the removed water is generally in the ppm or even ppb range. The final concentrate will be pumped to the storage vessel or to the next stage in the production process. The diagram shows the complete process in its simplest form (single stage). Multi-stage operation can bring about a significant reduction in production costs.



IceCon Freeze Concentration



Industrial Multistage Plant

Our latest development in our freeze concentration process is based on SLURRY CRYSTALLIZATION.

In this technology the nucleation (ice production) and growth are done in one area. The ice production is done with either an external or internal scraped heat exchanger.

This design results in less pressure vessels and consequently lower equipment cost.

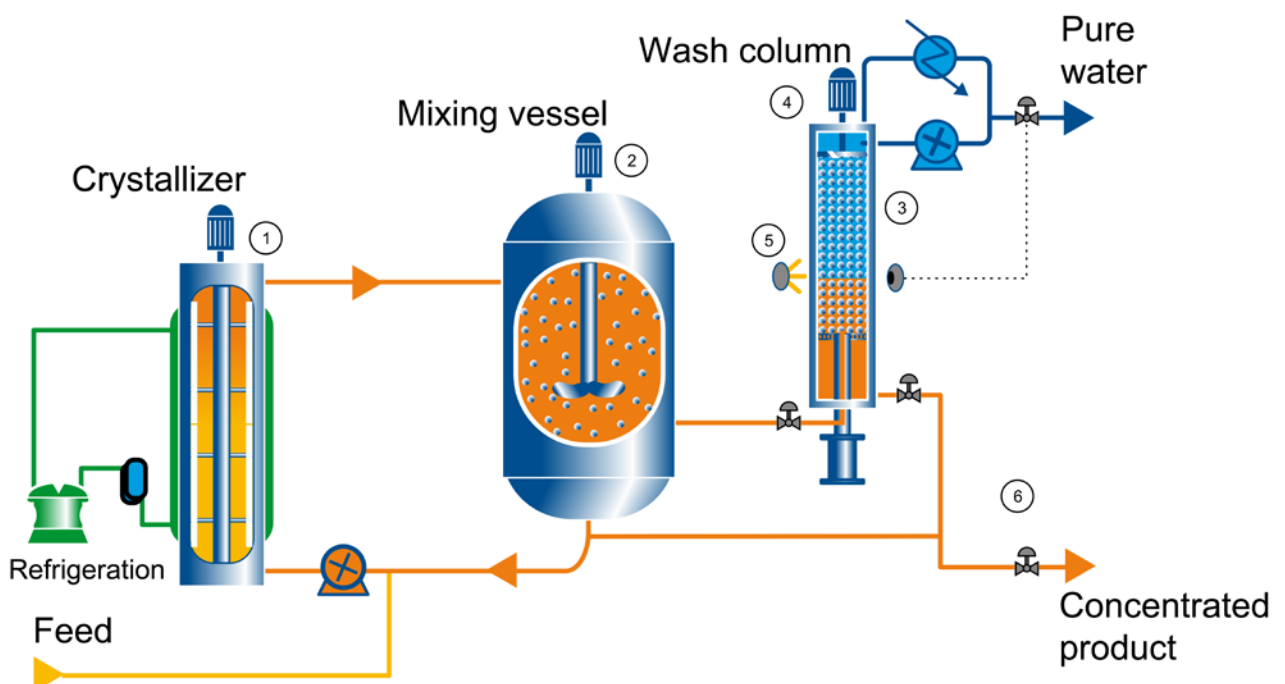
How the process works

In its simplest form, the process works as follows: the unconcentrated liquid is pumped from a feed tank into a scraped wall heat exchanger (1), where small ice crystals are formed instantly. These very small crystals get directly in contact with larger crystals in a mixed tank (2). When large and small crystals are mixed, the smaller crystals will melt and recrystallize on the surface of the larger crystals, which will grow.

Like with the traditional technology the slurry (concentrate and crystals) is transported from the recrystallizer to the wash column (3). In the wash column, the concentrate is “squeezed” through a filter at the bottom. In this way a packed bed of ice crystals is formed. The packed bed is “pushed” upwards. At the top of the wash column the ice is scraped off (4) and melted. Part of the melted ice is used to “wash” the packed bed. The concentrate, which is still present in between the ice crystals, will be displaced by water.

A sharp separation will be formed between the washed part of the bed (crystals and water) and the not-washed part of the bed (crystals and concentrate). This is called the wash front (5). The water is removed at the top of the wash column. In this separation process, the loss of soluble solids in the removed water is generally in the ppm or even ppb range. The final concentrate (6) will be pumped to the storage vessel or to the next stage in the production process. The diagram shows the complete process in its simplest form (single stage).

The positive effect of slurry crystallization in the design of the equipment is that the manufacturing cost can be considerably lower. Especially the design of the scraped heat exchanger surface and mixing vessel can be simplified. In combination with modifications in the ice separator cost compared with the traditional design are significantly lower. Additionally the specific energy consumption is also less which results in much lower overall production cost for the final user. The choice which freeze concentration technology is most optimal depends on parameters like capacity, product and concentration level.





Contact us at:

www.gea-messo-pt.com



Process Engineering

GEA Messo PT

The Netherlands:

De Beverspijken 7b
5221 EE 's-Hertogenbosch
Tel. +31 73 6390 390, Fax +31 73 6312 349
sales.niropt.nl@geagroup.com

Germany:

Friedrich-Ebert-Strasse 134
47229 Duisburg
Tel. +49 2065-903 0, Fax +49 2065-903 199
info.geamesso.de@geagroup.com