PILOT PLANTS TESTING

Freeze Concentration Application Development

GEA Engineering for a better world.

GEA.com

GEA Pilot Plants
Test Unit

Introduction

GEA has various freeze concentration pilot plants available for application development or sample production.
The picture on the right side shows our mobile skid-mounted highly automated IceCon® Compact 6 pilot plant.
The design is based on “plug and play”, meaning that after connecting feed supply line, product discharge line and the required utilities the unit is ready to run.
Table 1 illustrates the wide variety of products that can be concentrated by using Freeze Concentration.

Our pilot plants are designed using the same principles as our commercial units and provide reliable operational data.
The test results provide all the information necessary for scale-up and design of a commercial installation. The produced high quality concentrate can for example be used for lab flavour analysis or even small market studies.
Tests are typically executed at our test facility in ‘s-Hertogenbosch in the Netherlands, where our skilled personnel will generate a suitable test plan and execute the pilot tests to meet client’s requirements. In special cases, the pilot plant can be shipped to the production site ensuring optimum product handling for the freshest possible concentrate production. Our skilled supervisors can assist during the trial after a first training period.

Apple juice	Meat, fish & vegetable extracts
Aroma and flavour solutions	Pineapple juice
Beer and wort	Many other juices
Citrus juice	Strawberry, grape juice
Coffee extract	Tea extract
Dairy products	Tomato juice
Enzyme solutions	Wine and sake
Herb extracts	

Table 1: Extract of successfully tested products

Test execution

Most tests require a significant concentration time before reaching target/maximum concentration. A test is typically executed based on continuous operation. In order to generate valuable product information and gain maximum knowledge of the product tested GEA engineers will be present on site during the whole test. On the next page you will find some typical test durations for concentration of various products;

Product		Citrus juice	Beer	Milk	Coffee
Feed concentration	wt%	8	5*	8	7
Final product concentration	wt%	45	22*	34	36
Concentration fold	-	5.6	4.4	4.3	5.1
Feed requirements	kg	320	250	230	280
Test duration	hours	29	20	20	25
Amount of concentrate available at end of test	kg	20-25	20-25	20-25	20-25

* in %ABV

Table 2: Product requirements for typical operation

The mentioned test duration includes time for filling, start-up, actual concentration and product recovery at end of test. Excluded are preparation time and cleaning.
The test duration is related to the dewatering capacity of the plant which is depending on the physical properties of the product to be processed.
The main factors are:

- Viscosity of the final product at final product concentration and at freezing point.
- The freezing point of the final product at final product concentration.
- The amount of suspended solids.
- The ice crystal growth velocity.

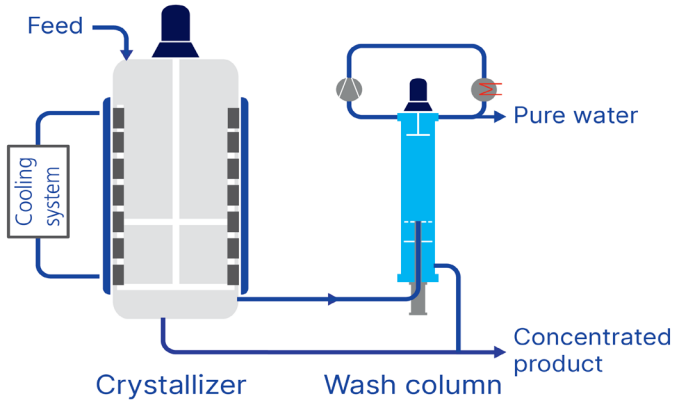
A typical test includes following test goals:

- Demonstrate the freeze concentration process on product.
- Demonstrate pure water discharge and produce samples to determine product quality.
- Determine maximum concentration factor of the product.
- Determine design parameters for commercial system.

Design

The plant is designed for generic liquid food application. Depending on your needs the unit will be completely dismantled and cleaned prior to testing, making it possible to use the samples for human consumption, as well as exhaustive analytical testing and product deployment.
For optimal working it is assumed that that there will be no precipitation of components during the concentration process and that the formed ice crystals will be free from inclusions of impurities.
The product to be processed shall only contain a limited amount of suspended solids. For most carbonated drinks it is important that the product is (partly) degassed prior to concentration. Please contact our specialist for product-specific requirements.

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 processs 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. 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.

Pilot plant data (indoor testing)

Dimensions (l x w x h)	m	2.6 × 1.4 × 2.6
Footprint (l x w x h), incl. maintenance area	m	4 × 3 × 5
Estimated operational weight	kg	1,500
Filling volume	liters	60
Dewatering range (low - high viscosity)	kg/h	6-12
Installed power	kW	12.7
Electrical consumption	kWh	5
Cooling water consumption @20 °C	m^3/h	0.3
Instrument air (min. 6 barG)	Nm^3/h	2
Refrigerant	-	R-449

Table 3: pilot plant data

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 .

GEA Niro PT B.V. Sneeuwhaas 21, 5236 NX ‘s-Hertogenbosch The Netherlands Phone +31 73 6390 390 info.niropt.nl@gea.com

TSF05-102024