



CENTRITHERM

A thin film, spinning cone evaporator that reduces the product contact time to a single second.



ft industrial

The FT Industrial Centritherm is a thin-film, spinning cone evaporator. The Centritherm, with its unique design, develops the thinnest liquid film possible in any evaporator system. The liquid takes barely a second to pass over the rotating contact surface yet in this brief time receives all the heat it needs to evaporate the product to its final concentration.

The Centritherm is a compact unit particularly suited for the concentration of heat-sensitive, valuable and viscous products. It offers an exceptionally short residence time, less thermal impact and much greater processing flexibility than traditional rising or falling film evaporators.

More than 1,000 Centritherm units have been delivered worldwide for a wide variety of applications in industries such as the pharmaceutical, fruit and vegetable, coffee, tea, nutraceutical (e.g. herbal extracts), chemical and biochemical industries.

HISTORY

The Centritherm is based on a revolutionary design that had its beginnings in the Swedish company Alfa Laval in the early 1960s. During the following three decades the Centritherm established itself as the standard for thin film evaporation, particularly for heat sensitive products.

In September 2001 FT Industrial purchased the Centritherm technology from Tetra Pak AB in Sweden and immediately commenced an extensive review of engineering standards, manufacturing procedures and product specifications.

Within twelve months a purpose-built 1500 square metre manufacturing facility was completed, two new models were added to the range, new design and manufacturing procedures implemented and an ongoing R&D programme established to take the technology to new levels.

Using historical customer records, drawings and specifications, FT Industrial has established the manufacture and stocking of an extensive range of spare parts needed to service the large number of Centritherms delivered since 1960, many of which are still in operation. A special program has also been



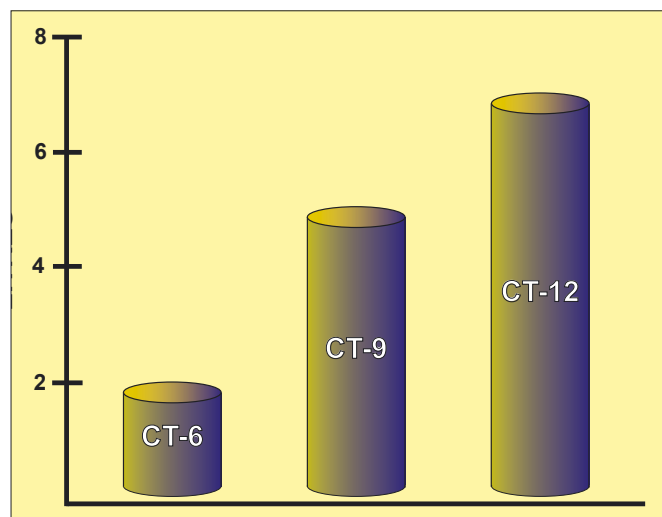
Centritherm assembly line in the new manufacturing facilities.

established to provide a cost-effective refurbishment and upgrade service for these older units.

THE COMPANY

FT Industrial is a privately owned Australian company that together with Flavourtech and Flavourtech Research form a group that is a world leader in the development, design and manufacture of thin film evaporation and distillation systems based on spinning cone technology.

The group products include the Centritherm, the SCC (a spinning cone column distillation technology) and the IES (an integrated extraction system).



The volume of liquid in the Centritherm evaporator unit is only a few litres (total volume will depend on pipework layout, etc.).



High speed photo of the liquid film on the heat transfer surface of the Centritherm. The film is only 0.1 mm thick and crosses the surface in about 1 second resulting in a well defined residence time. The photo also shows substantial agitation in the liquid film, one of the factors that contribute to the Centritherm's high efficiency.

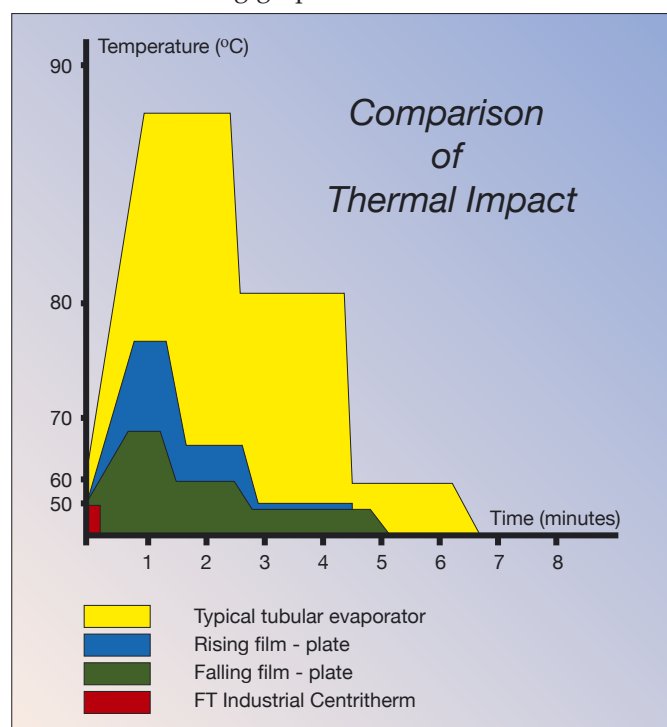
THE BENEFITS OF THIN FILM CENTRIFUGAL EVAPORATION

Low Thermal Impact:

Prolonged heating of many products results in a degradation of quality, including such things as, decomposition, deterioration of colour, caramelisation of naturally-occurring sugars, coagulation of proteins, polymerisation and loss or damage of distinctive flavour notes.

Thermal impact is defined as the time that heat sensitive products are exposed to high temperatures during processing. The renowned Swedish Chemist Arrhenius (1859-1927) discovered "that every time the operating temperature of a product increased by 10 °C the thermal impact doubles".

Compared to other evaporators the Centritherm imparts minimal thermal impact on the product due to its short residence time and low operating temperatures. The following graph illustrates this difference



in thermal impact, based on the Arrhenius model, between the Centritherm and traditional evaporators, where the area under the graph is a measure of the thermal impact.

Processing Flexibility:

The nature of the Centritherm process, in particular the low hold up volume and high heat transfer rate, make the unit particularly suitable for –

- **Multiple products:** Rapid turnaround to change from one product to another.
- **Small batches:** Easy to process a series of small batches of product.
- **High value products:** Can process valuable product with minimal loss during the shut down and cleaning or if the operation is interrupted.

- **Wide range of operating parameters.** The Centritherm uses centrifugal force to distribute the liquid evenly over the heat transfer surface whereas conventional tubular or plate units use either gravity (falling film), or vapour velocity (rising film). This fundamental difference means the Centritherm is capable of a wide range of operating conditions compared to tubular or plate units that have limited flexibility and need to operate very close to their design parameters. This is a distinct advantage if, for example, the solids concentration in either the feed or the final concentrate needs to vary between batches.

Compact Installation:

Compared to several other types of evaporators the Centritherm can evaporate more water (solvent) per unit area and is therefore very compact for a given operating capacity.

High Concentrations:

A Centritherm can achieve high concentrations, usually in a single pass operation. Generally, concentration ratios of 10:1 are achievable while in some instances it is possible to exceed 20:1. Concentrations in excess 85% dry solids have been achieved and generally the Centritherm is capable of producing substantially higher concentrations than traditional plate or tubular evaporators.

Viscous products:

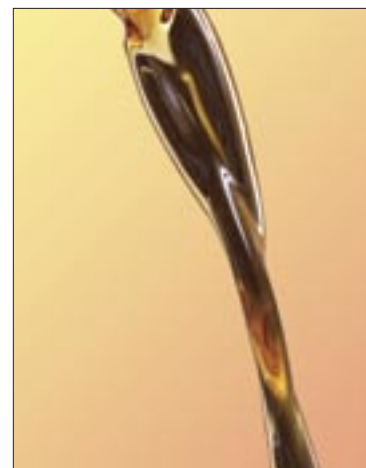
In the Centritherm the application of centrifugal force helps to counteract the effects of high viscosity. Because different products can vary in how they behave, an upper limit of 20,000 cP is usually quoted for spinning cone evaporators. The Centritherm has, in fact, achieved good results on some products where the final concentrate has a viscosity well in excess of this figure.

Solvents:

The Centritherm is ideal for evaporating organic solvents. The design of the unit makes it particularly suitable for processing flammable and toxic materials.

Easy to Clean:

The Centritherm is a hygienic system, with all parts in contact with the product manufactured from high grade stainless steel. An effective CIP function is an integral part of the Centritherm design.



The Centritherm can produce concentrates with high soluble solids levels and a high viscosity.

THE OPERATING PRINCIPLE OF T

OPERATING PRINCIPLE - THE EVAPORATOR

The Centritherm is a single effect, thin film spinning cone evaporator that operates under vacuum and uses steam as heating medium. The unit consists of a nested stack of hollow conical discs rotating on a common spindle and contained within stainless steel covers. The spindle is supported in a stainless steel bearing housing

The liquid to be concentrated enters the evaporator through a common feed tube at the top of the machine, and injection nozzles distribute the liquid onto the underside of each rotating cone.

Centrifugal force spreads the liquid out over the entire heating surface in a thin (approximately 0.1 mm) liquid layer, passing across the heating surface in less than a second. The liquid is immediately heated to the boiling temperature which is governed by the pressure (vacuum) in the system.

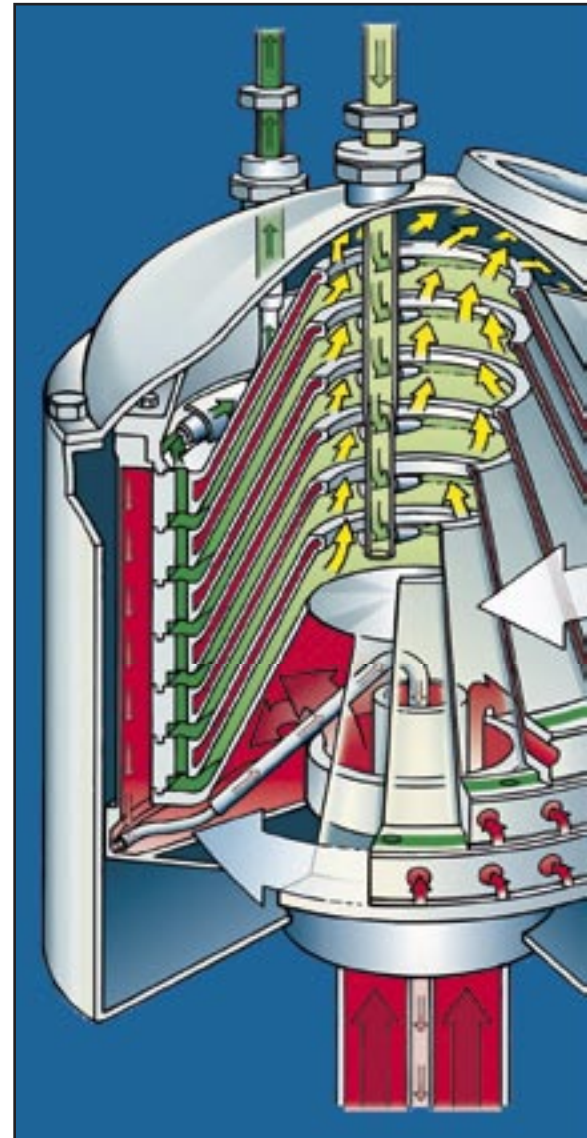
As the liquid film is so thin, the vapour produced is easily released and rises through the centre of each cone, then through the vapour outlet port to an external indirect condenser.

The product concentrate col-

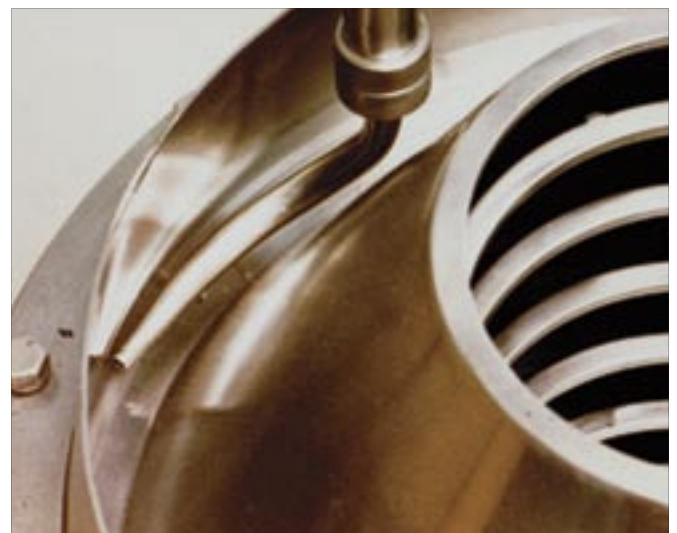
lects at the bottom of each cone from where it is transported by centrifugal force, through vertical holes to a paring channel at the top of the cone stack. A stationary paring tube picks up the concentrate and conveys it out of the evaporator.

The heating medium, steam, is supplied to the evaporator through the hollow spindle to the steam chamber surrounding the cone stack. It enters the steam channels inside each cone and condenses on the lower surface transferring its energy (latent heat) through the cone wall to the product.

Immediately the steam condenses, centrifugal force throws the condensate away from this surface (dropwise condensation) to the upper wall of the channel in each cone. The condensate flows down these walls to the outer edge where it exits via the same holes through which the steam entered. The steam condensate then runs down to a condensate paring channel at the bottom of the rotating steam chamber where it is picked up by a stationary condensate paring tube and forced away through the hollow spindle.

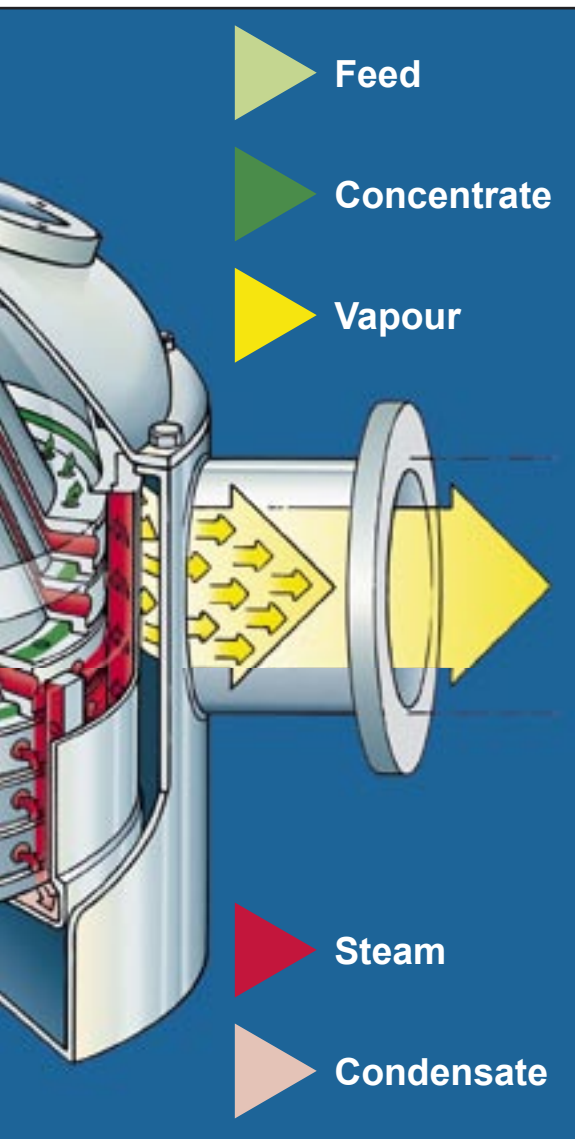


Feed tube and injection nozzles



Product paring tube

THE CENTRITHERM EVAPORATOR



OPERATING PRINCIPLE - THE SYSTEM

The complete evaporation system consists of the Centritherm evaporator unit installed on a base frame and integrated with a support system that includes feed, condensing, discharge and vacuum sections.

The final system design depends on the product to be processed, along with other factors such as the degree of evaporation, level of automation and any special electrical requirements. The following describes the operation of a typical plant (refer diagram below).

Product is fed to a balance tank, (1). This tank contains two level regulators. The first maintains a high liquid level to ensure a constant feed to the Centritherm. The second regulator detects a low liquid level and introduces water to prevent possible fouling of the evaporator heating surface.

From the balance tank the product is pumped by a product feed pump (2) through a control valve (3) that regulates the flow to the Centritherm (4).

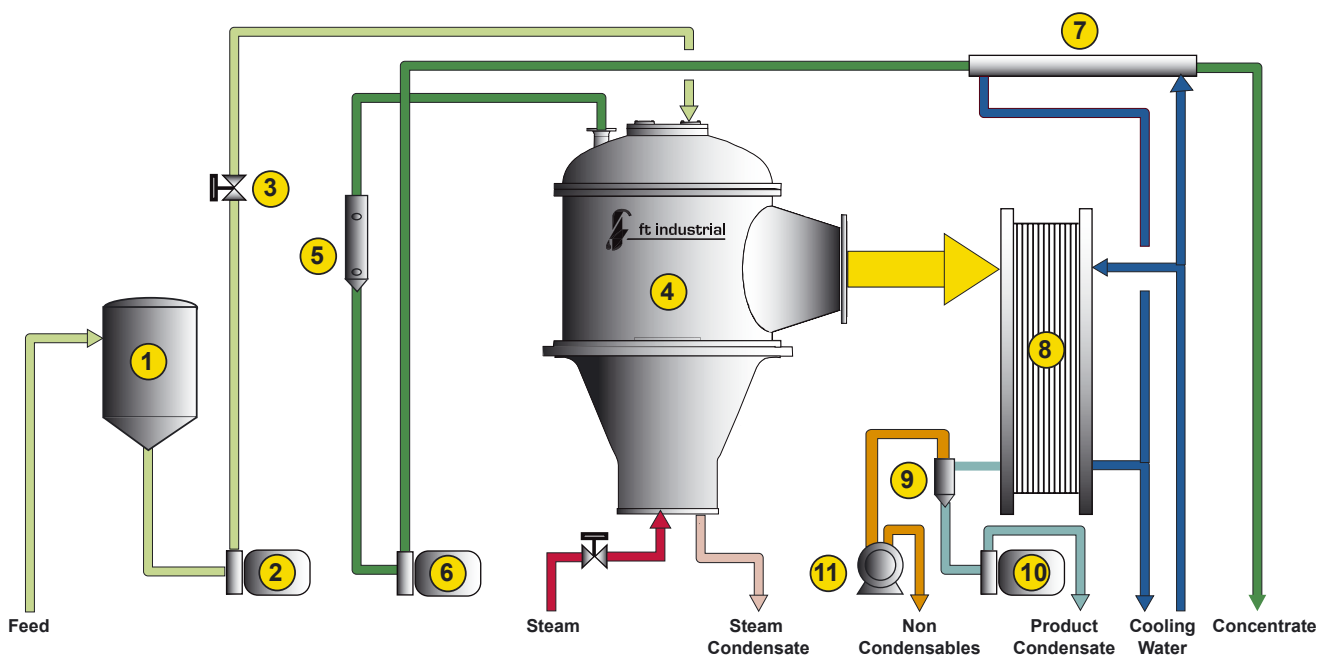
The concentrate is removed from the Centritherm by a stationary paring tube via a level tube (5) that provides a visual indication of the concentrate level prior to the discharge pump (6).

The concentrate is pumped through a tubular heat exchanger (7) designed to cool the product using cooling water.

The product vapour from the evaporator flows to the plate condenser (8) where it is condensed using cooling water. A separation cyclone (9) separates any non-condensable gases before the product condensate is removed by a condensate pump (10).

A vacuum pump (11) is used to remove the non-condensable gases in order to maintain a vacuum in the system

The system is operated from a control panel located on the base frame. This panel includes all necessary motor contactors and in the case of the semi-automatic and automatic plants includes a PLC controller.



CENTRITHERM MODELS AND SPECIFICATIONS

The Centriterm is currently manufactured in six sizes delivering capacities from 25 litres per hour up to 10,000 litres per hour

It is delivered as a pre-assembled, factory tested, system with all the components located on a stainless steel base frame. All electrical wiring, product and services piping is completed in the factory. Only product and service connections need to be completed on site, reducing installation time and cost.

MANUFACTURING STANDARDS.

The Centriterm Evaporator is designed and built to the highest engineering standards using such codes as SEP (Safe Engineering Practice) and GMP (Good Manufacturing Practice).

The units feature an all stainless steel construction, including the cast bearing housing on the larger units. A high standard of surface finish and an effective CIP system make the unit ideal for hygienic applications.

OPTIONS

Different materials and surface finishes are available to satisfy the requirements of applications from aggressive chemicals to pharmaceuticals and food products.

The units can be built to various electrical specifications, including those suitable for hazardous area operation. Different levels of control are offered - manual, semi-automatic and automatic.

For some applications the system can include an integrated, plate type, evaporation unit that functions as a pre-evaporation stage before the Centriterm. This is an option for situations where a low thermal impact and operational flexibility are not as important as high final product concentration and high viscosity, or lower steam consumption.

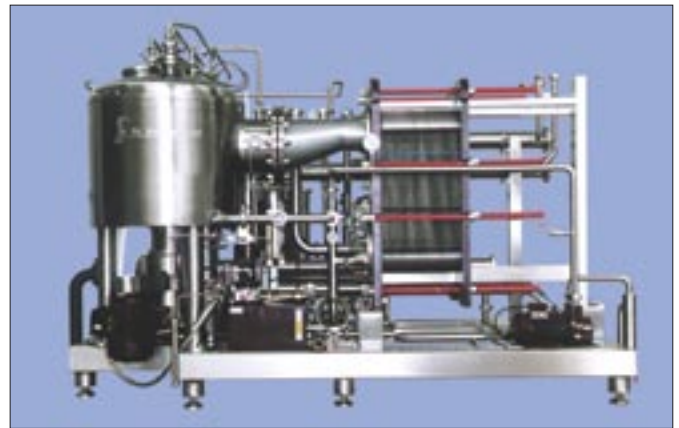
CAPACITY

The actual capacity of any evaporator system depends on a number of variables. The Centriterm is designed to deliver maximum evaporation capacity when the product evaporation temperature is 50 °C (122 °F) and the steam temperature is 120 °C (248 °F).

If an organic solvent rather than water is being evaporated, the maximum evaporation capacity is normally higher when operating at the same temperatures.



Centriterm CT-2.



Centriterm CT-6



Centriterm CT-9



Centriterm CT-12

| MODEL | EVAPORATION CAPACITY KG/HR* | | |
|-------|-----------------------------|-------------|---------------|
| | Water | 50% Ethanol | Butyl Acetate |
| CT-1 | 50 | 70 | 150 |
| CT-2 | 260 | 360 | 800 |
| CT-3 | 400 | 560 | 1200 |
| CT-6 | 800 | 1100 | 2400 |
| CT-9 | 2400 | 3300 | 7200 |
| CT-12 | 4800 | 6700 | 14000 |

* Capacity based on an evaporation temperature of 50 °C, a steam temperature of 120 °C and the concentrate viscosity < 50 cP. at 50 °C

CENTRITHERM APPLICATIONS

Over 1,000 Centritherms have been delivered since production began in the early 1960s. The specific products that have been processed successfully are simply too numerous to mention here; some examples are:

- **Pharmaceuticals:** such as antibiotics, ephedrine, dextran, insulin, penicillin, streptomycin etc.
- **Biochemicals and Fine Chemicals:** such as bacteriological amylase, ascorbic acid, enzymes, etc.
- **Chemicals:** such as dye stuff, cellulose acetate, nitric acid, molybdenum disulphide suspension, polyvinyl chloride, urea formaldehyde etc.
- **Nutraceuticals and Functional Foods:** numerous herb and plant extracts such as green tea, ginseng, aloe vera, echinacea, etc.
- **Flavour and Colour Compounds:** for food and beverage applications such as anthocyanins, carotene, etc.
- **Solvents:** general stripping of various organic and inorganic solvents. Typical examples are acetone, butyl acetate, ethanol, ethyl acetate, hexane, methanol etc.
- **Fruit Juices:** including high quality tropical, berry and other exotic varieties such as passionfruit, mango, melon, black currant, cranberry, etc.
- **Vegetable Juices,** such as carrot, onion, etc. particularly where it is important to minimise the loss of heat sensitive, functional ingredients.
- **Coffee and Tea Extracts:** for the production of high quality liquid concentrates used in "ready to drink" beverages or for producing soluble dry powder (using spray- and/or freeze drying).
- **Proteins:** concentration of extracts from malt, yeast, animal products, fish products, soy and other protein rich products.
- **Alcoholic Products:** de-alcoholisation of alcoholic products such as beer and wine to produce low or non-alcoholic products or to standardise the alcohol content.
- **Dairy Products:** such as whole milk, whey, milk protein, colostrum, etc.

VISCOUS PRODUCTS
MULTIPLE PRODUCTS
HIGH VALUE PRODUCTS
SOLVENT BASED PRODUCTS
HEAT SENSITIVE PRODUCTS
HIGHLY CONCENTRATED PRODUCTS



CT-9 in a Pharmaceutical plant installed 1970



Three CT-6 plants for the recovery of solvent installed 1974.



Dual CT-6 units for producing no alcohol beer installed 1984



CT-9 for tea and coffee extract installed 2003

PRODUCT TESTING - R&D FACILITIES

The Centritherm is based on a revolutionary design that had its beginnings in the Swedish company Alfa Laval in the early 1960s. Since FT Industrial acquired the technology in 2001, it has embarked on an extensive R&D and engineering design programme that has taken this unique technology to new levels.

LABORATORY AND PILOT PLANT MODELS

The smallest unit in the Centritherm product range is the single cone CT-1. This unit is capable of evaporating 50 kg/hr of water and is ideal for laboratory testing of product and small scale product development work.

One important result of the R&D program has been the introduction of two new models, the CT-2 and the CT-3. Since its introduction the CT-2, with an evaporation capacity of 260 kg/hr of water, has proven a popular unit for larger pilot plant and small scale production work.

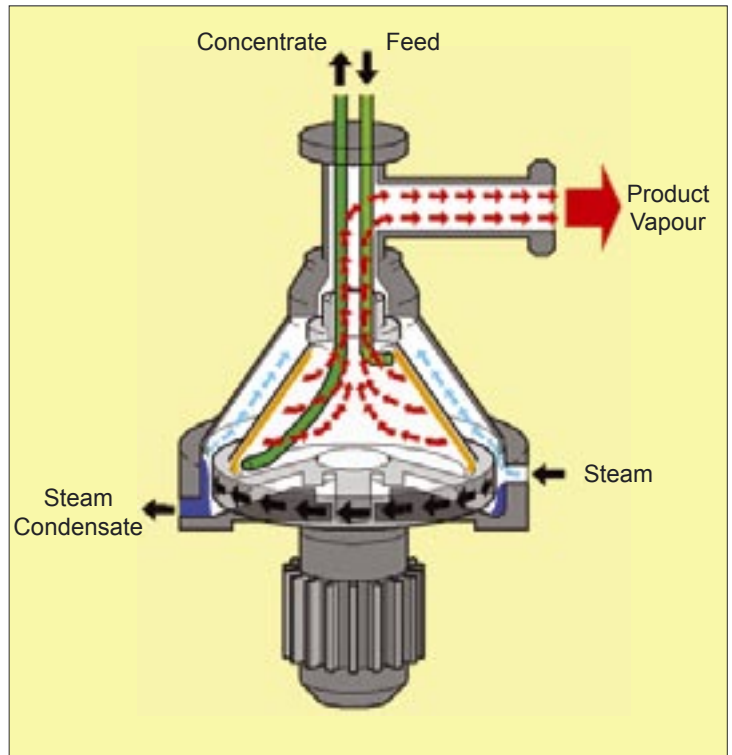
Both the CT-1 and the CT-2 operate on the same principle as the larger Centritherm units meaning the results achieved in the laboratory or the pilot plant can be reproduced on the larger units.

TESTING FACILITIES.

FT Industrial and Flavourtech operate two major pilot plants. The first is located in Australia in the city of Griffith, NSW and the second at Reading in the UK.

These pilot plants contain a range of processing equipment, including Centritherms, and the unique Spinning Cone Column (SCC) distillation / essence recovery system. These plants are used extensively for the group's own basic research and process development.

A full service is also provided to customers for product testing on the Centritherm. This can be either at the group's pilot plant facilities or, if required, on the customers own premises. Pilot scale Centritherm units are available, together with our experienced R&D staff, for trial work virtually anywhere in the world.



Flow principle of the CT-1



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