

# Evaporation Technology

## Top performance made to measure

The manufacture of sensitive products calls for technologies that operate reliably and treat the product with care. Evaporators with short residence times and high heat transfer rates are indispensable for the production of sugar from beet or cane.

For many years GEA PHE Systems has been specializing in plate evaporators for these demanding applications.

- **EVAPplus Plate Falling Film Evaporators**
- **Concitherm Plate Rising Film Evaporators**



Process Equipment Division  
**GEA PHE Systems**

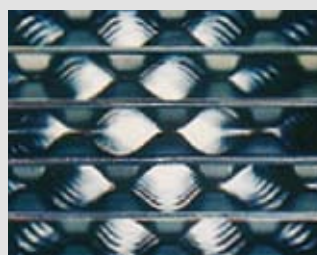
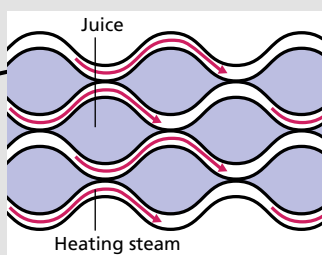
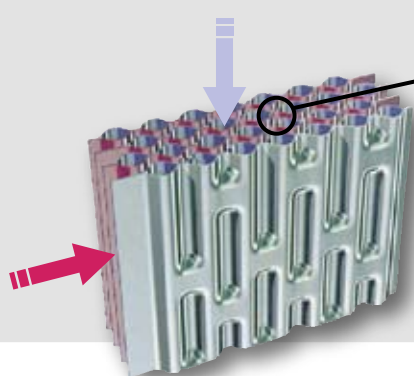
## Plate Falling Film Evaporators

When product-sensitive and energy-saving applications are involved, the EVAPplus plate falling film evaporators are exactly the right choice. State-of-the-art technology ensures high-efficiency concentration of juice from sugar beet and cane.

The special feature of EVAPplus is the combination of tube and plate evaporators. The plates are arranged in such a way that two separate flow channels result: a tubular channel with 6 or 9 mm diameter for the juice and a corrugated channel for the condensing steam or vapour. The plate packs are fully welded without the need for gaskets.

### Convincing functionality

The hot juice is fed into the evaporator at the lower end where it is flashed and pumped from the feed tank into the juice distributor (see Fig. 1) which ensures that a uniform film of liquid is formed on the plates in the tubular channels. The recirculation pump ensures that the heat exchanger surface is adequately covered with juice to prevent any occurrence of dry zones.



View into the tube side flow direction



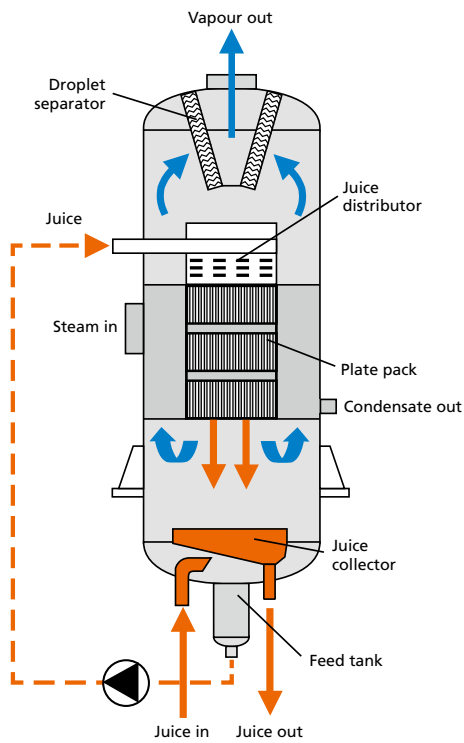


Fig. 1

The concentrated juice and the vapour produced during evaporation leave the plate packs at the bottom. The juice falls into the juice collector and is transferred to the next effect.

The heating steam condenses within the plate packs and the condensate is fed to an external receiver. Non-condensable gases are drawn off at the top and bottom of the steam chamber.

Depending on the design the vapour is either led upwards through internal vapour channels or external vapour ducts to the upper section of the evaporator or directly led off to the side in the lower section. Centrifugal or lamella separators are used for further removal of entrained juice droplets from the vapour.

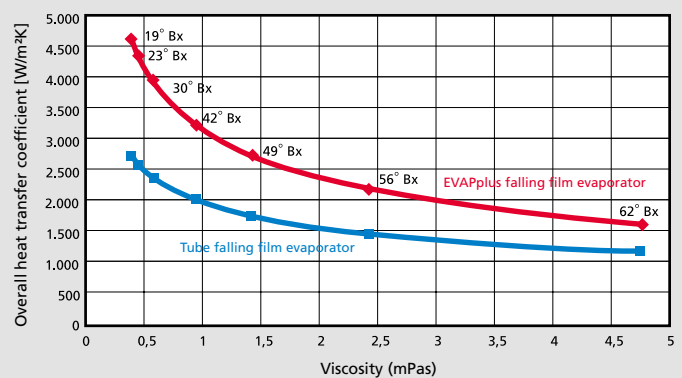


Fig. 2:  
Comparison of heat transfer values of the EVAPplus with tube falling film evaporators

# EVAPplus

## Keeping the juice flowing

The EVAPplus provides trouble-free operation at all times by using a recirculation pump running at a constant speed to ensure that the liquid film flows continuously uniform even with fluctuating operating conditions.

## Retrofitting Robert-type evaporators

The advantages of the EVAPplus can also be used to achieve greater efficiency by retrofitting existing Robert evaporators. In most cases no changes are necessary to buildings, foundations or the static design of the plant. The calandria from the old Robert evaporator is simply removed and replaced with an EVAPplus plate pack and the respective distributor. With minimum expenditure the heating surface area and the system efficiency is considerably increased.

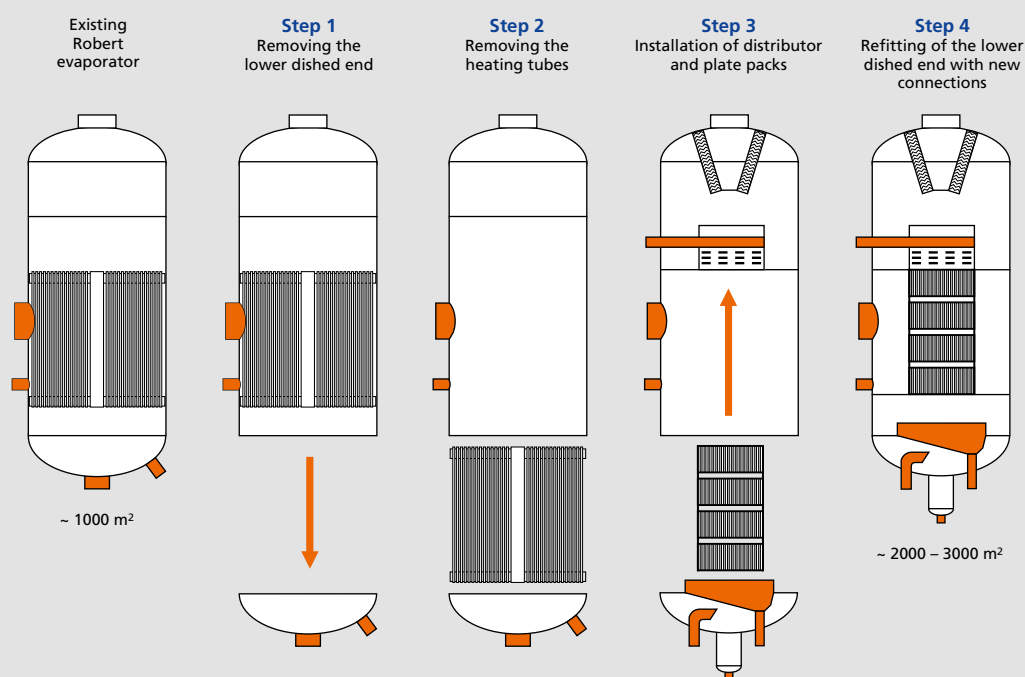


Fig. 3:  
Retrofitting of a Robert evaporator

## Simple to clean

The EVAPplus can be easily and quickly cleaned to maintain its maximum performance. Evaporators used for processing beet sugar juices are cleaned at the end of each campaign. When processing cane sugar juice, a sensible cleaning cycle is every one to two weeks.

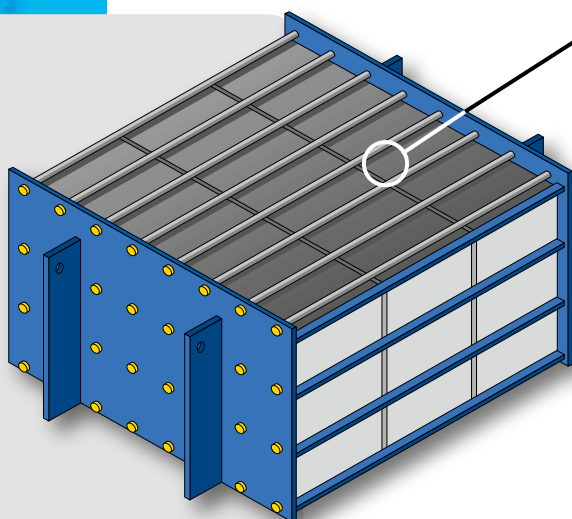
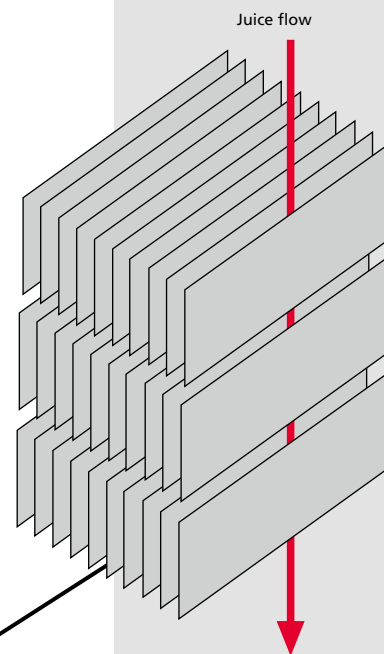


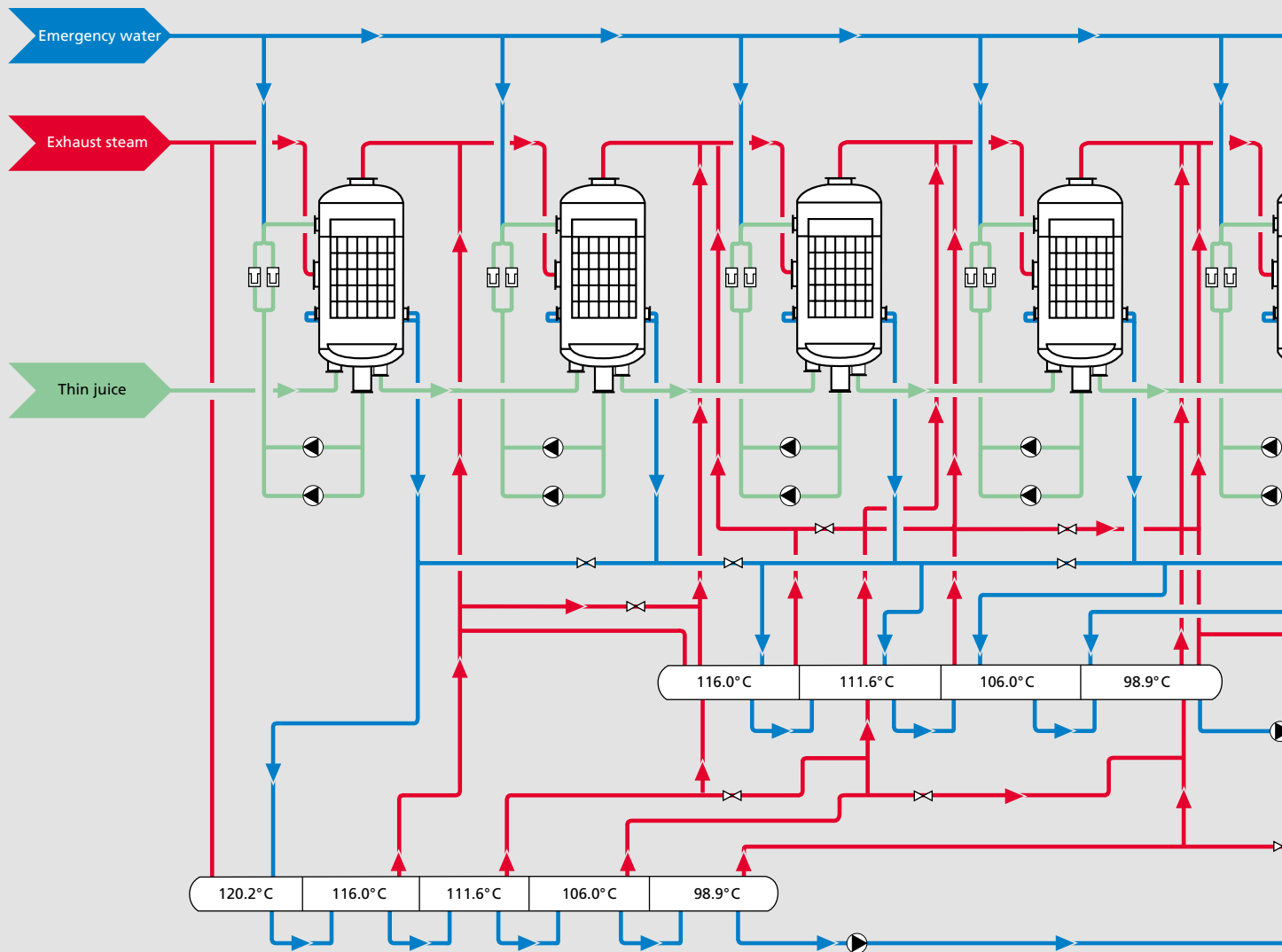
Fig. 4  
Plate pack arrangement

GEA PHE Systems generally recommends the following three-step cleaning procedure:

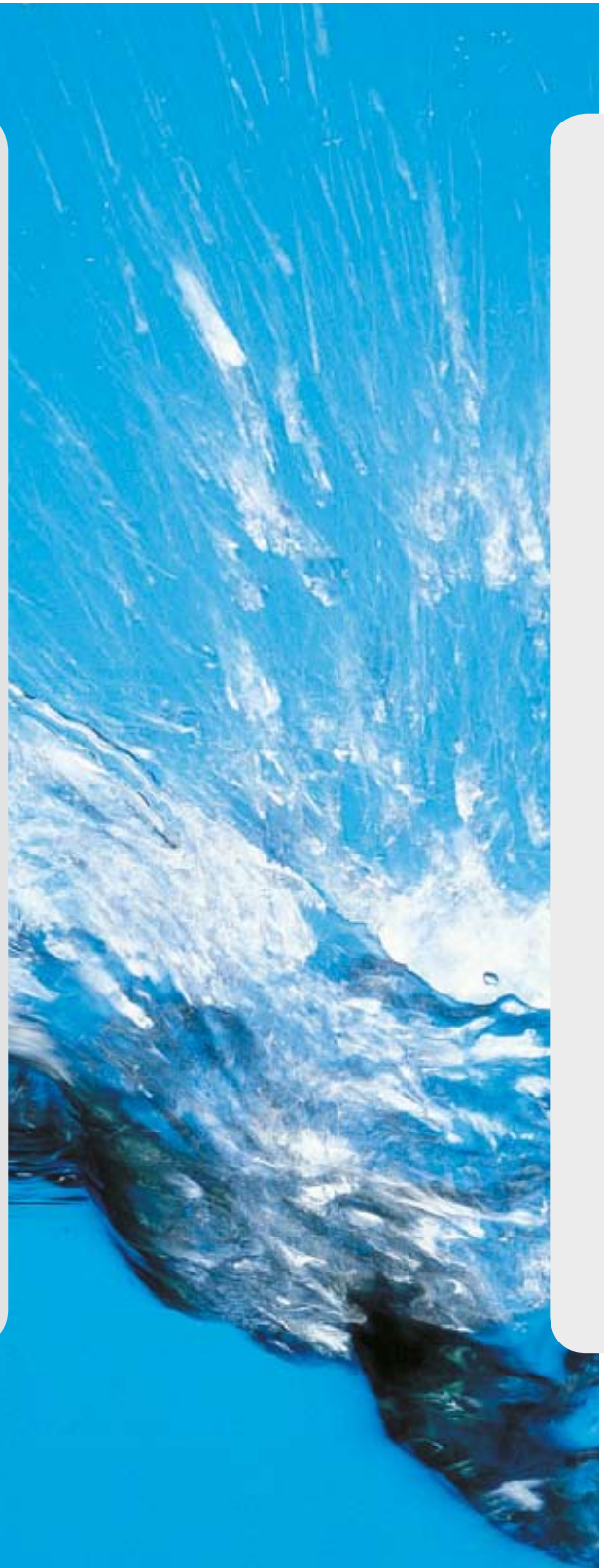
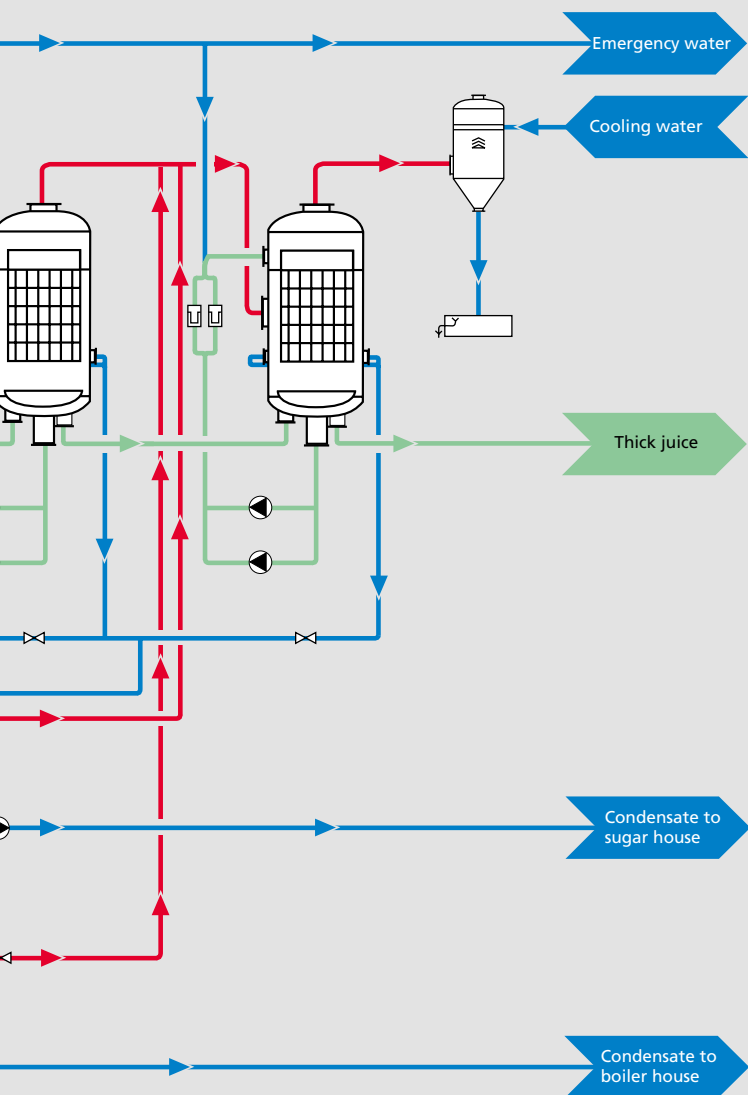
1. Caustic soda ( $\text{NaOH}$ ) and sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) – also to convert sulfates and oxalates into acid-soluble carbonates.
2. Acid cleaning using formic acid ( $\text{HCOOH}$ ) at  $100^\circ\text{C}$  or sulfamic acid ( $(\text{NH}_2)\text{HSO}_3$ ) at  $70^\circ\text{C}$  to dissolve phosphates and carbonates.
3. Alkaline washing to neutralize the remaining acid in the vessel.

## Flow Sheet

5-effect plate falling film evaporator plant for cane sugar juice with one stand-by unit







## Outstanding features

- High density of heating surface ( $170 \text{ m}^2/\text{m}^3$  or  $240 \text{ m}^2/\text{m}^3$ )
- Outstanding overall heat transfer values
- Low temperature differences
- Short residence time of the juice in each effect
- Low juice colour formation

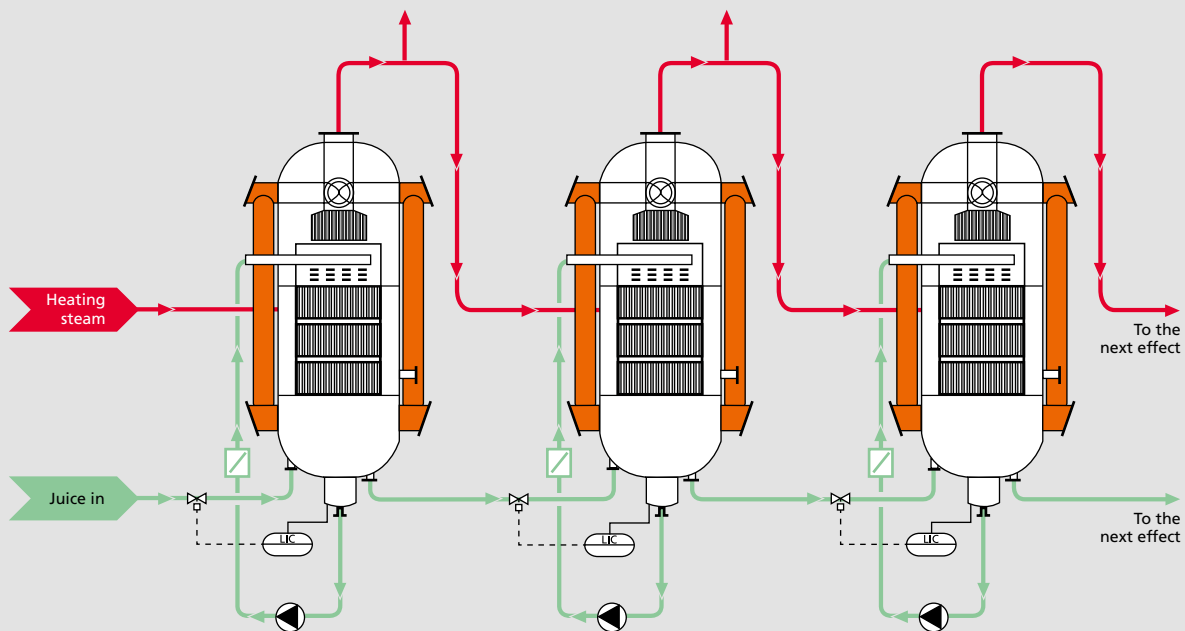


Fig. 5:  
Three effects as plate falling film evaporator with 6,000 sqm  
heating surface each



## Plate rising film evaporator

### Compact form, top performance

The Concitherm CT 193 is the ideal evaporator system for liquid media containing particles. Compared with traditional tube evaporators the Concitherm offers high heat transfer values and an extremely short residence time of the media which has a particularly beneficial effect on the quality of sensitive products.

### Concitherm CT 193

The Concitherm CT 193 is a semi-welded plate rising film evaporator with embossed special steel plates and a carbon steel frame. Two pressed plates are welded at the edges to form a gastight cassette. This creates welded plate gaps for the heating steam and gasketed gaps for the product to be evaporated.

The free flow of the medium is ensured by a 7.5 mm plate gap. The plate structure is specially designed for evaporation applications. The system's performance can be adapted or changed at any time simply by increasing or decreasing the number of cassettes. And the Concitherm CT 193 is extremely lightweight, easy to install and compact to save space within the evaporator plant.

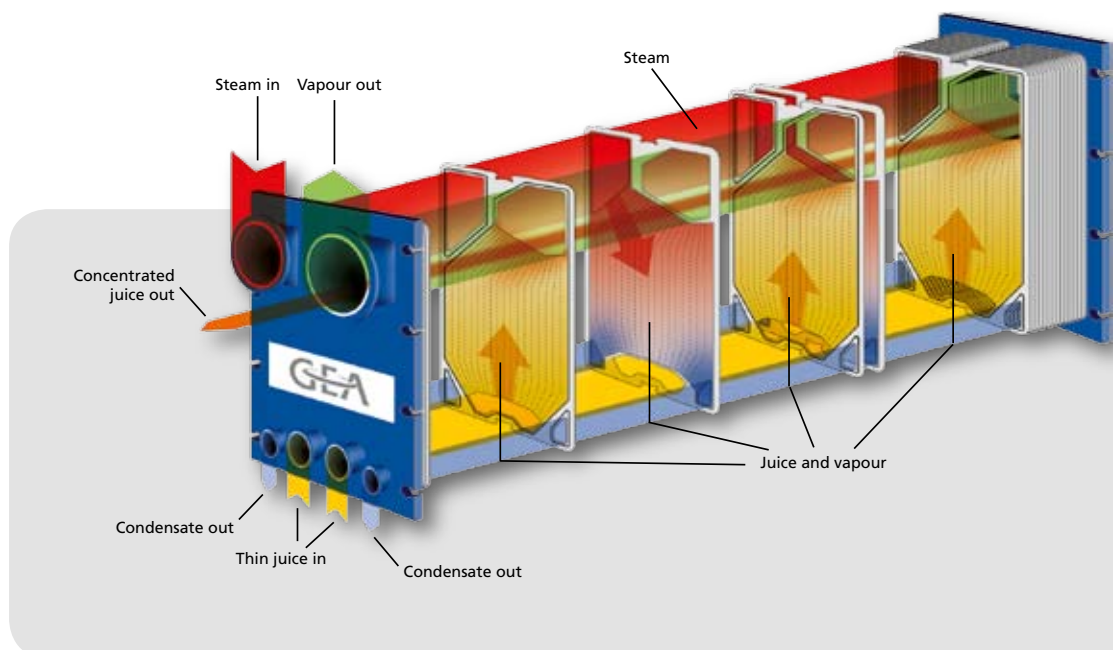


Fig. 6:  
Concitherm CT 193 plate rising film evaporator

## Efficient function

The Concitherm CT 193 works according to the rising film principle, i.e. the product is introduced into the plate pack at the bottom and heated. The formation of steam bubbles causes a mixture of vapours and juice to rise in a countercurrent to the heating steam. The heating steam (or vapour) condenses in the welded cassettes of the plate pack and the condensate exits at the bottom.

### Maintenance made easy

The special design of the Concitherm plate evaporator gives easy access to the plates, e.g. for inspection. The small product volume requires only small quantities of cleaning fluid during cleaning (CIP). The special embossed structure of the plates also helps the cleaning effect.

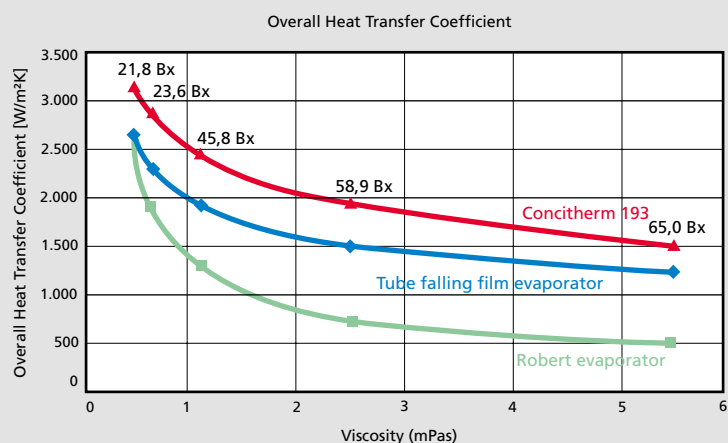
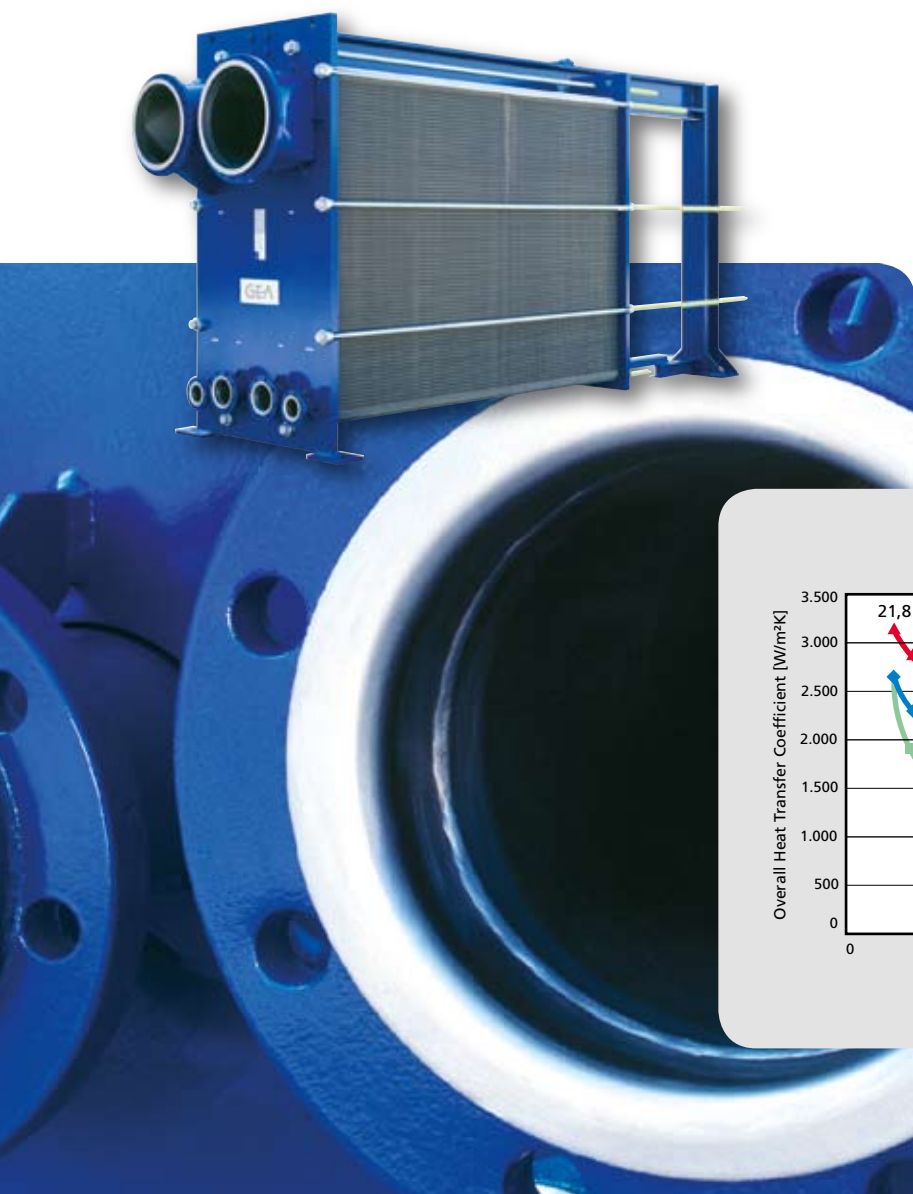


Fig. 7:  
Comparison of the heat transfer coefficients  
of selected evaporator types

## Modular expansion

The modular design is a particular advantage in the Concitherm CT 193, allowing the capacity to be adapted at any time to meet changing requirements by increasing or reducing the number of plates.

### Also a top-class solo performer

The Concitherm CT 193 can also be used with a separate cyclone as an independent evaporation stage.

### Booster solution – Optimisation of Robert-type evaporators

The Concitherm CT 193 is also highly suited to upgrade Robert evaporators. Here the Concitherm is connected in parallel on the vapour side to the

Robert evaporator, and connected in series on the product side. This external booster solution increases the heating surface in existing tube evaporators. The Concitherm's higher heat transfer rates can decisively improve the overall performance of an existing evaporator station. The Concitherm CT 193 can also be used as pre-evaporator or as an additional final stage or for the concentration of liquids.

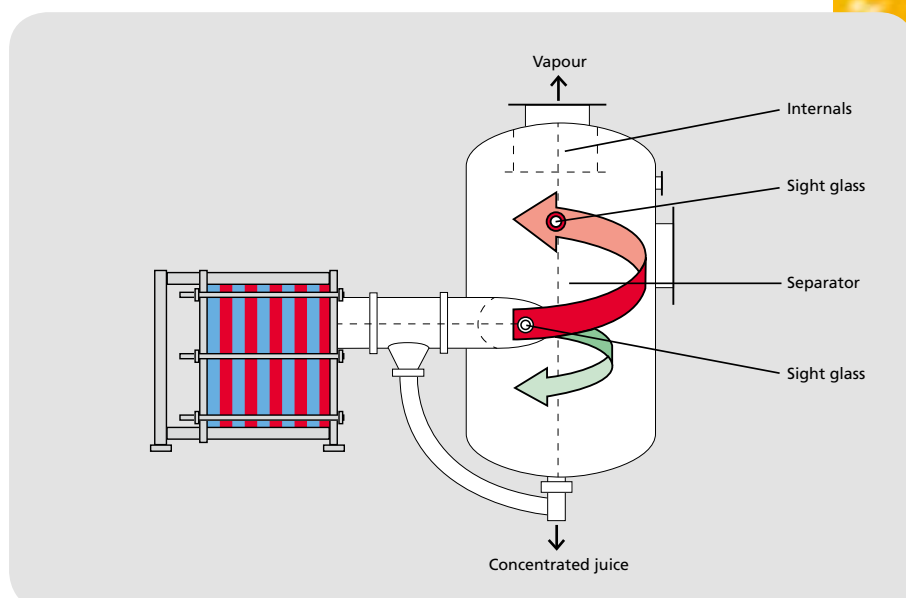
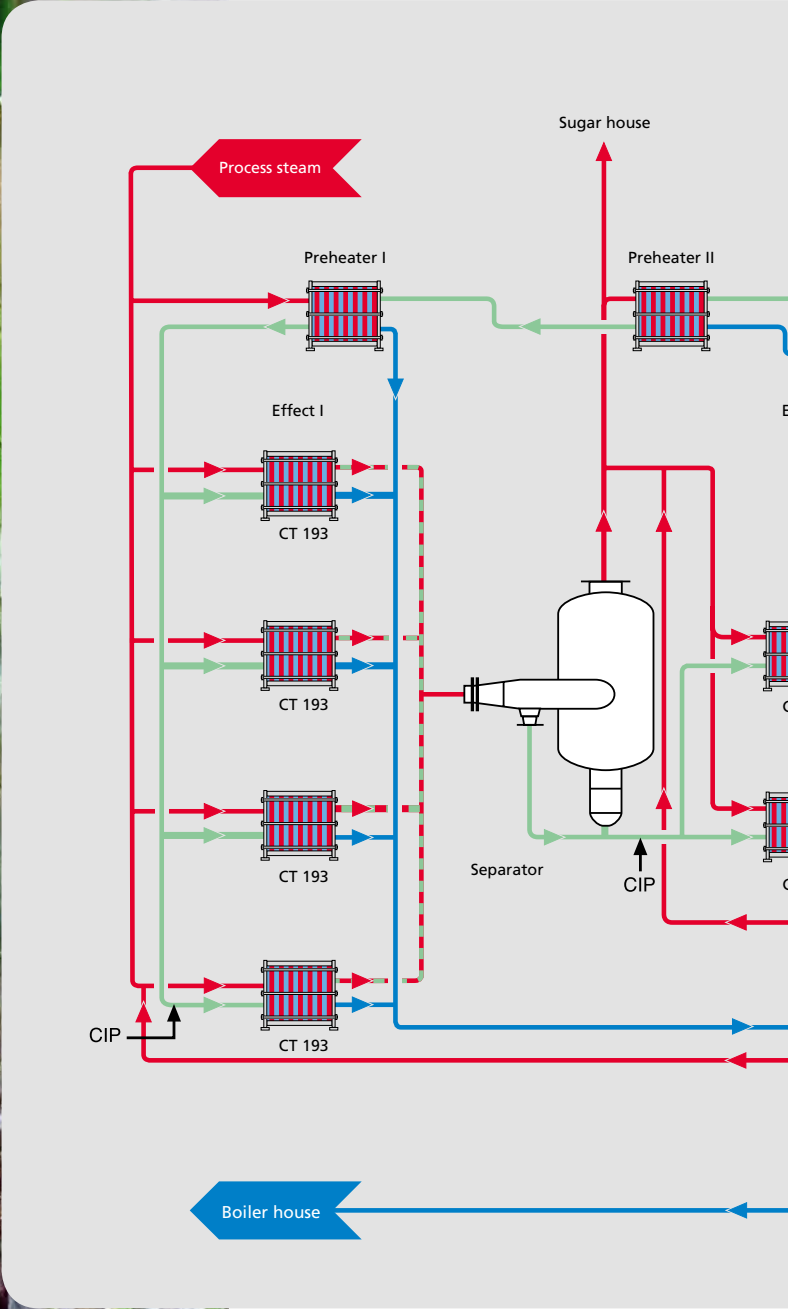


Fig. 8:  
Concitherm with cyclon (droplet separator)



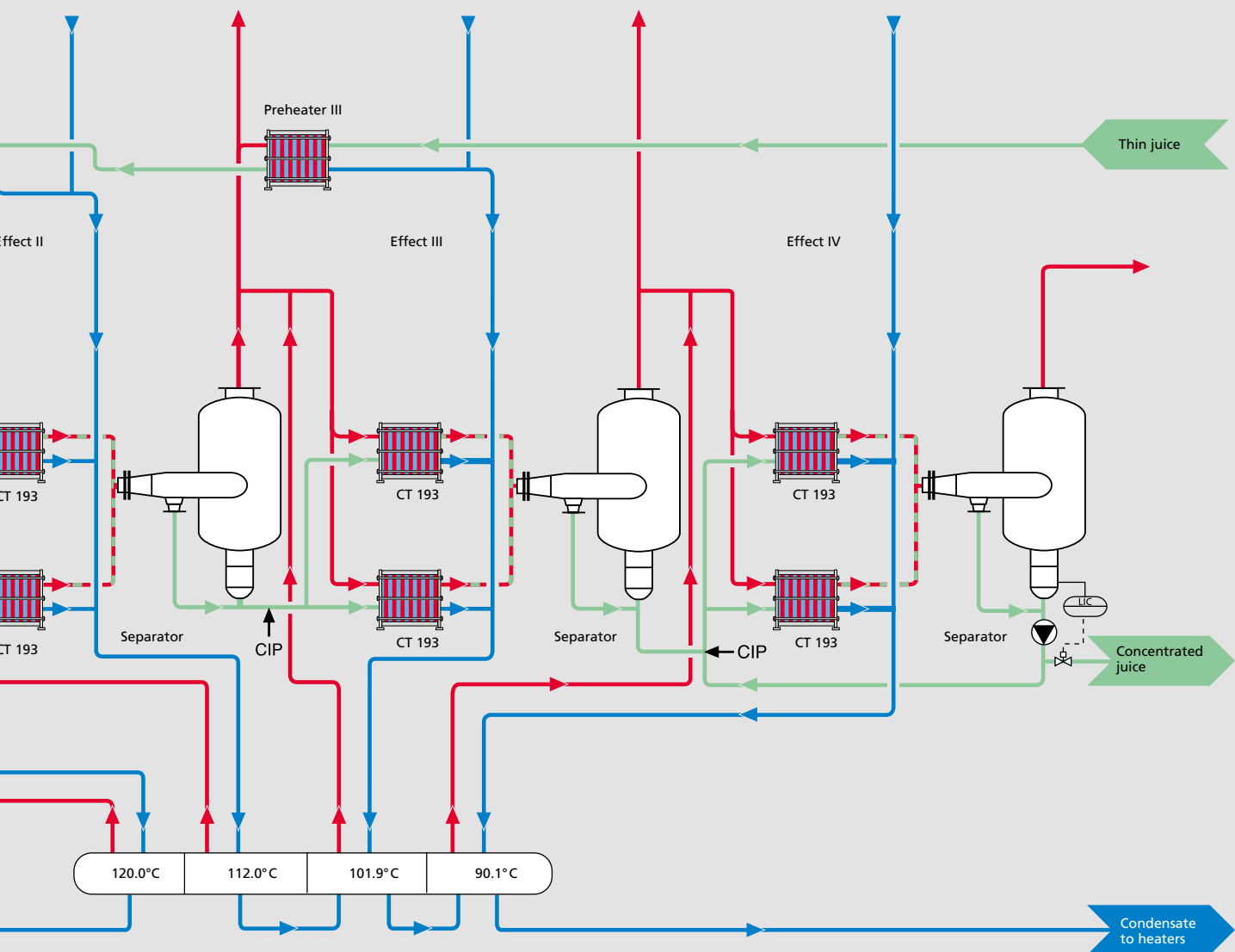


# Concitherm



# Flow sheet

4-effect rising film evaporator plant for a cane sugar mill





## Outstanding features

3 m<sup>2</sup> of heating surface per cassette ensure:

- Compact design, simple operation
- Short residence time of the product in the unit
- Flexible performance adaptation capability  
by varying the number of cassettes
- Booster solution does not require a separate trap

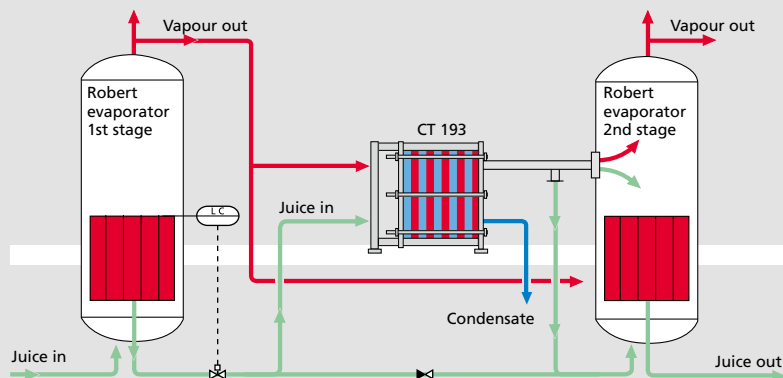


Fig. 9:  
Concitherm CT 193 as evaporating station booster



# EVAPplus Plate Falling Film Evaporators

The EVAPplus system represents the best developed evaporator technology for sensitive products and energy-saving applications. Conventional Robert-type evaporators can also be retrofitted with this system, enabling cost-conscious optimisation of existing systems.

- Heating surfaces from 1,000 to 10,000 m<sup>2</sup> per unit
- Asymmetrical plate design allowing two-phase flow resulting in high-efficiency heat exchange
- Pressure-resistant housings can withstand pressures of up to 60 bars
- Temperatures between -200°C and +900°C

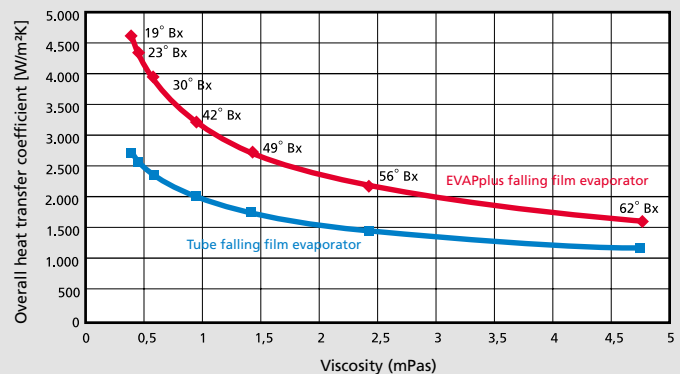


Fig. 10:  
Comparison of the heat transfer coefficients of the EVAPplus with tube falling film evaporators

# Concitherm CT 193 plate rising film evaporators

Concitherm plate rising film evaporators can be used to expand conventional plants or as separate evaporating units in the sugar-processing, foodstuffs and chemical industries. The Concitherm CT 193 is also perfectly suited for use in waste water treatment.

- Heating surface of up to 1,200 m<sup>2</sup> per unit, 3m<sup>2</sup> per cassette
- High evaporation rate, low investment costs and low colour formation
- Free-flow gap on the juice side
- No clogging, easy cleaning, low pressure drop, high overall heat transfer coefficients (k-value)

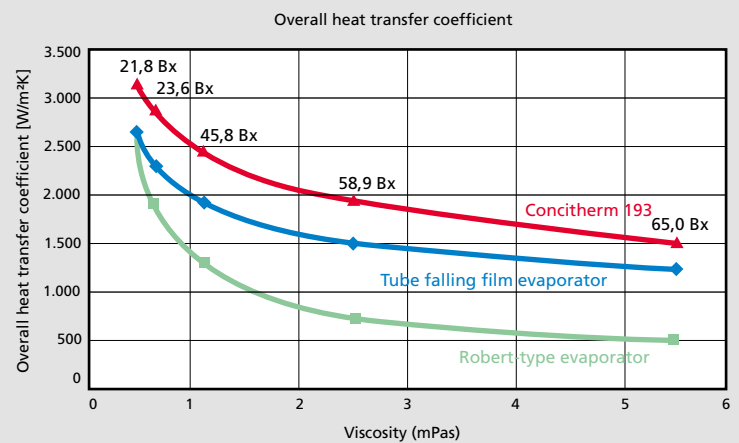


Fig. 11:  
Comparison of the heat transfer coefficients of selected evaporator types

## GEA PHE Systems Competence in Heat Transfer

With emphasis on the highest quality standards and constant innovations, GEA PHE Systems continues to expand its market position: Within the GEA Process Equipment Division, GEA Ecoflex together with GEA ViEX, GEA WTT, GEA Ecobraze, GEA PHE Systems NA and GEA EcoServe forms GEA PHE Systems, the Center of Competence and Service Center for gasketed, fully welded and brazed plate heat exchangers of GEA Group:

- HVAC
- refrigeration
- sugar
- chemical
- paper
- food
- general industry
- marine
- power
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