Schmidt

AN API HEAT TRANSFER COMPANY

SCHMIDT®
EVAPORATORS

Technology

Schmidt® technology is know-how.

Know-how for the design of evaporation plants. It is distinguished by high quality results from the competence and creativity of our engineers. With over one hundred forty years of experience as manufacturers of heat exchangers and plants for thermal processing, we have had a major influence on evaporation technology. In processing liquids with suspended solids, Schmidt® has made major contributions to the state of the art.

We have been designing plants with plate evaporators for more than 40 years, and have been guided by the following objectives:

- To design plants that deliver the best possible product quality
- To provide economical systems with low operating costs

Schmidt® designs, manufactures and installs complete turnkey plants for many different feed streams, taking into account their inherent product characteristics.

In close cooperation with our customers, we develop the most appropriate process for the product to be treated. When required, we also act as an engineering partner and manage the overall technical design of the plant.

Schmidt® technology is the culmination of our extensive research and development. In the early 80s, motivated by a growing need for better, more flexible evaporation systems, we developed the SIGMA**STAR**® evaporator.

Since its design is fundamentally new, the SIGMA**STAR**® has been awarded patents in many countries. The unique characteristics of SIGMA**STAR**® evaporation plants allow Schmidt® to supply equipment to many different and diverse industries. The performance of the SIGMA**STAR**®, on widely different products, far surpassed the most optimistic projections.

Areas of Expertise

Schmidt® concentration plants are used in the food, chemical, fermentation and pharmaceutical industries. They are also used for waste treatment. We manufacture plate & frame designs, with energy saving options such as mechanical vapor recompression (MVR) and thermal vapor recompression (TVR).

Foods and Beverages

We have designed and delivered systems for fruit juices, fruit purees, pulp concentrates, vegetable juices and purees, tomato juice, vegetable extracts, pectin, edible gelatines, malt extracts, sorghum extract, beer wort, cane and beet sugar, liquid sugar, dealcoholized wine and beer and aroma recovery for many different kinds of products.

Chemicals and Pharmaceuticals

We have provided systems for acids (citric acid, etc.), bases (sodium hydroxide, etc.), salt solutions (ammonium nitrate, ammonium sulphate, aluminium sulphate, magnesium chloride), amine solutions (urea, etc.), alcohols (glycol, methanol, glycerine, etc.), aromatic compounds (toluol, xylene, etc.), raw and intermediate products for synthetic materials and fibres (caprolactam water), synthetic glue, pharmaceutical products (sorbitol, sorbose, enzyme solutions, antibiotics, monosodium glutamate), as well as many types of waste water.

Organic Natural Products

We have built plants for processing stick water, hide and bone glue, protein hydrolysates, technical and photographic gelatines, oils, molasses, slops, yeasts, yeast extracts, wort, drug extracts, hops extracts, plant extracts, tanning extracts, corn steep water, glucose, dextrose, fructose, and waste waters from potato and wheat starches.

Effluent Treatment

Applicable to many types of effluent from all branches of industry.

Industries Served:

- Beverage
- Chemicals
- Dairy
- Food
- Nutraceuticals
- Pharmaceuticals
- Waste Water

SIGMA**STAR**® Pilot Plant

Installed Evaporation Plan

The SIGMASTAR® Evaporator Plate

Due to their special construction, SIGMA**STAR**® evaporators can be used for nearly all evaporation processes. Especially for problem products (e.g. viscous streams, slurries, and liquids with fouling tendencies) which cannot be processed with falling-film evaporators, the SIGMA**STAR**® evaporator performs smoothly and successfully.

The heart of the SIGMA**STAR**® evaporator is the SIGMA**STAR**® rising-film plate (Fig. 1 & Fig. 1.2). SIGMA**STAR**® plates have a heat transfer surface of up to 1.5m2. Only two plate types are needed, a “steam” plate and a “product” plate. The SIGMA**STAR**® plate has longitudinal corrugations that are sinusoidal and extend over the full width of the plant. Looking at two plates, aligned in such a way that the projecting points touch, vertical channels are formed which are almost circular and can be considered as single tubes.

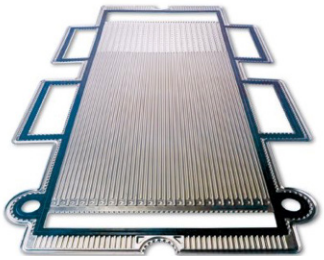


Fig. 1 : SIGMA**STAR**®-90 Evaporator Plate

Product enters the lower part of the evaporator plate and floods the tubes. In this manner, every tube has equal access to the product feed. Steam condenses on one side of the plate, product boils on the other. The vapors generated in the tube channels create a thin, high-velocity film which rises to the top of the plate.

Since Service steam cannot cross corrugation peaks in the transverse direction, we employ a distribution area in the upper part of the plate. Here the corrugation is arranged to permit vapor to flow in the transverse direction, and to the channels. The cross-sectional flow area is the same on both sides of the plate.

SIGMA**STAR**® evaporator plates can be combined in many different ways to increase the flexibility of our plants, from small to very large duties.

Figure 2 shows a variation of the SIGMA**STAR**®-90 plate; the partitioned SIGMA**STAR**®-45 plate. This plate allows two products to be processed simultaneously. On the right is the correspondingly partitioned steam plate. Steam can enter either the left, the right or both sides of the plate, the condensates exit from the bottom of the corresponding side(s) of the plate.

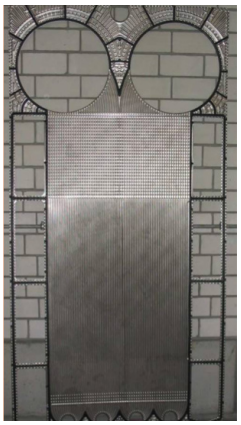


Fig. 1.2 : SIGMA**STAR**®-150 Evaporator Plate

As the dimensions of both plates are identical, the same frame supports can be used. Expansions and modifications involving both plate types are possible at any time.

Some advantages of the rising-film SIGMA**STAR**® - 45, SIGMA**STAR**® - 90 and SIGMA**STAR**® - 150 are:

- Superior product distribution due to the thermo-siphon principle. As product boils and rises in the tube, fresh product automatically rises to refill the tube. This distribution technique operates independently of the feed rate, and allows a high degree of flexibility and the possibility of partial-load processes
- Very short residence time; product is in the SIGMA**STAR**® plate for less than a second. This is due to the short flow distance and the high product film velocity. This feature guarantees the gentle treatment of the product
- Low pressure losses across the tubes, a benefit of the short tube length
- High vapor velocity in the rising film, which allows the processor to achieve high concentrations and viscosities
- Clearly defined product-flow path. There is no chance of local over-concentration
- High heat transfer coefficients are obtained even when the feed temperature is lower than the boiling temperature
- Compared to other evaporator systems less expensive for high grade materials

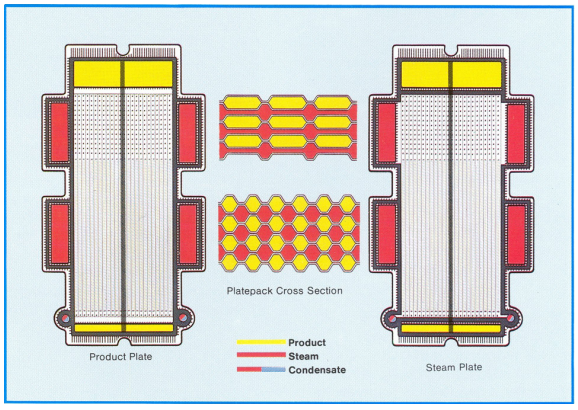


Fig. 2: SIGMA**STAR**®-45 Evaporator Plates

The SIGMASTAR® Evaporator

- Figure 3 shows an assembled SIGMA**STAR**®-90 evaporator. The evaporator plates are fitted in a frame. Perimeter bolts clamp the fixed and movable covers together. This compresses the gasket seal at the edges of the plate. The function of the flooded lower product chamber is to distribute the product evenly to the tubes.

- The rising-film evaporation creates a two-phase flow: The generated vapors induce a product film on the tubes. The resulting mixture of liquid and vapors flows to the channel at the top of the plate. From there it flows forward to the fixed cover of the frame and into a downstream vapor/liquid separator.

- The steam enters through two channels at the top of each side of the plate. Heating steam is distributed across and along the plate, condensate is discharged at each side of the bottom.

- Since all connections and steam inlets are on the fixed frame, it is no problem to open the unit or to rearrange the evaporation surface.

- Furthermore, it is possible to direct steam to all four steam inlet areas. When all four steam inlets are used, a portion of the steam passes to the rear of the plate pack allowing the SIGMA**STAR**® to be used for larger evaporation capacities and at higher vacuum.

- Besides the possibility of a large number of operating variations, the SIGMA**STAR**®-45 plate offers the advantage of incorporating different effects or stages into a single frame. An extremely compact system can be built for a reasonable cost.

- Figure 4 shows a 2-stage unit with a downstream condenser as an example. In the first evaporation stage, the raw product is pre-concentrated by means of a mixture of vapors and motive steam. In the second stage, concentration is continued by means of vapors coming from the first stage. The vapors boiled off of the product in the second stage are condensed by means of cooling water in the condenser.

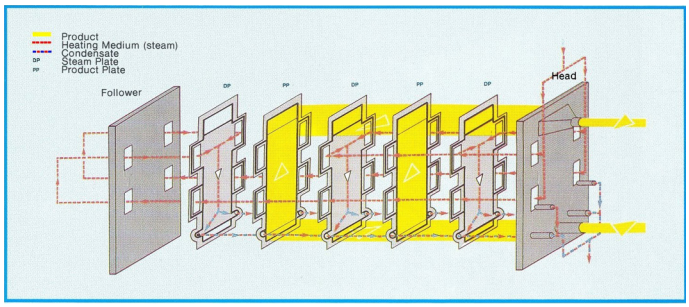
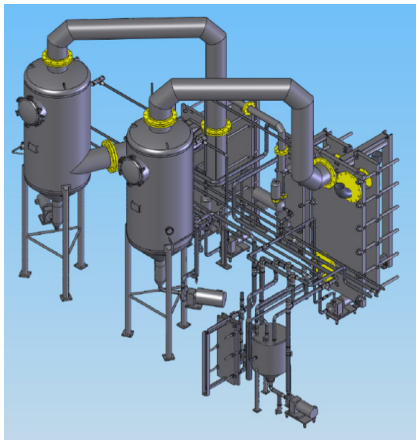


Fig. 3: SIGMA**STAR**®-45 Evaporator



SIGMA**STAR**®-45 Evaporator Plant

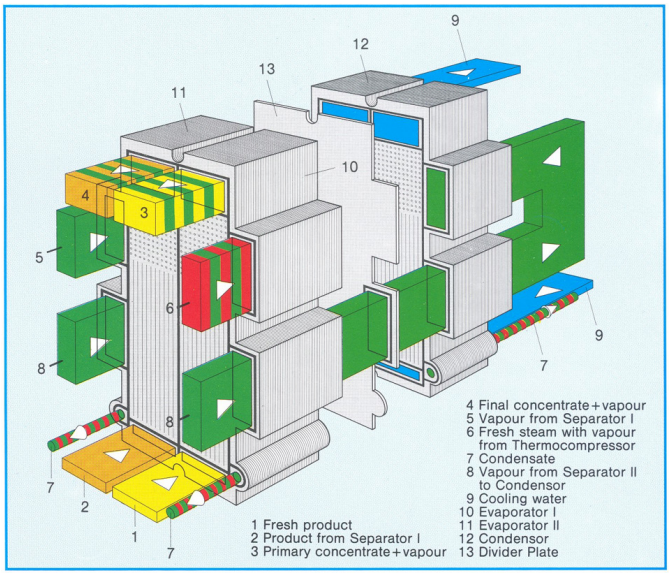


Fig. 4: SIGMA**STAR**®-45 Multisection Evaporator

Single and Multiple-Effect Evaporation

The evaporation of liquids is, independent of evaporator type, always associated with high energy costs. Thus the energy cost is the major in the overall operating cost.

With multiple-effect plants and the judicious use of thermal and mechanical recompression, energy consumption can be reduced. (Specific steam consumption under 3%).

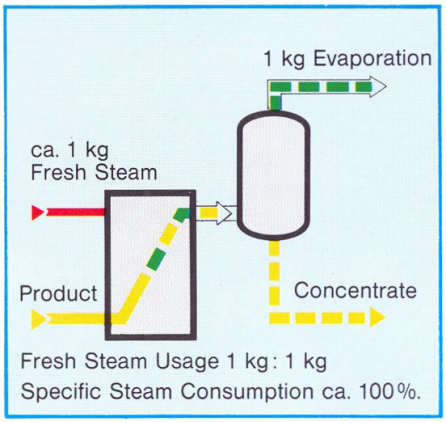


Fig. 7 : 1-Effect Plant Evaporator

Single-Effect Evaporation

The steam requirements for single-effect evaporation are approximately the same as the water removed, i.e. the heat contents of the vapor leaving the plant is roughly the same as that in the heating steam. The resistance to heat transfer occurring on the heat transfer surface requires a driving force indicated by a temperature difference; thus the vapor temperature is always less than the steam temperature.

Multiple-Effect Evaporation

In multiple-effect evaporators the same heat energy is used several times. This is effected by progressively lowering the temperature from stage to stage. Fresh steam is used to heat the first effect. The vapor product, at a lower temperature, is used as a heating medium for the second effect which operates at an even lower temperature.

In a similar way this vapor can be used to heat a further effect; thus two, three or multiple effect evaporators can be constructed.

With such evaporators the water evaporated per unit mass of steam approaches the theoretical optimum of 2:1 with double-effect plants, 3:1 with triple-effect plants and so on. Thus with an increasing number of effects the specific steam consumption decreases. The necessary temperature difference per effect is achieved by progressively lowering the operating pressure (i.e. increasing vacuum).

- However, lower operating costs entail a higher initial investment. The most profitable balance depends on the individual application criteria (concentration, performance, annual production times, length of production, product data, cost and availability of energy, etc.).

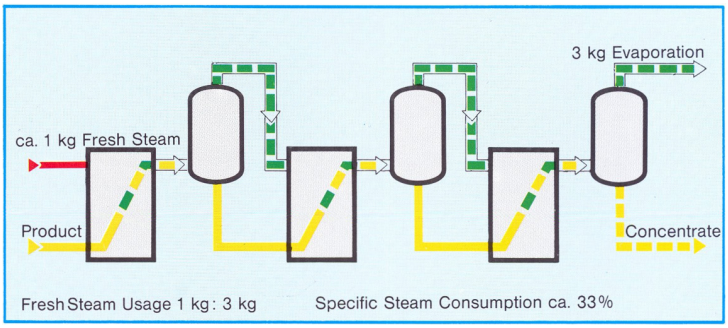


Fig. 8a : 3-Effect Plant

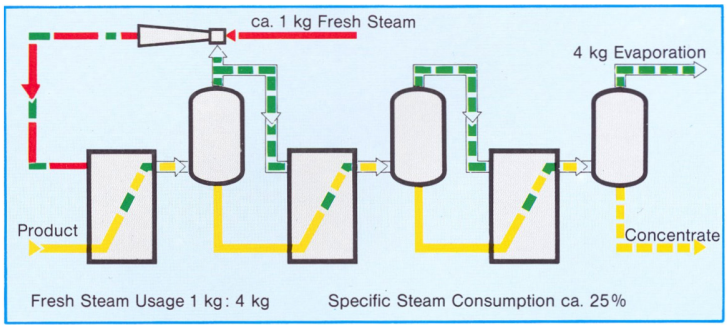


Fig. 8b : 3-Effect Plant with Thermocompression

Evaporation with Vapor Recompression

The reuse of heat in the multiple-effect evaporator can also be achieved by means of thermal or mechanical recompression.

- The use of thermal vapor recompression (thermocompression) can, for example, be used to give a triple-effect evaporator the same energy economy as a quadruple-effect plant with a corresponding reduction in investment.

- The use of mechanical vapor recompression allows almost complete energy recovery and a theoretical zero steam consumption. The operating costs are low but the technically complex plant is expensive.

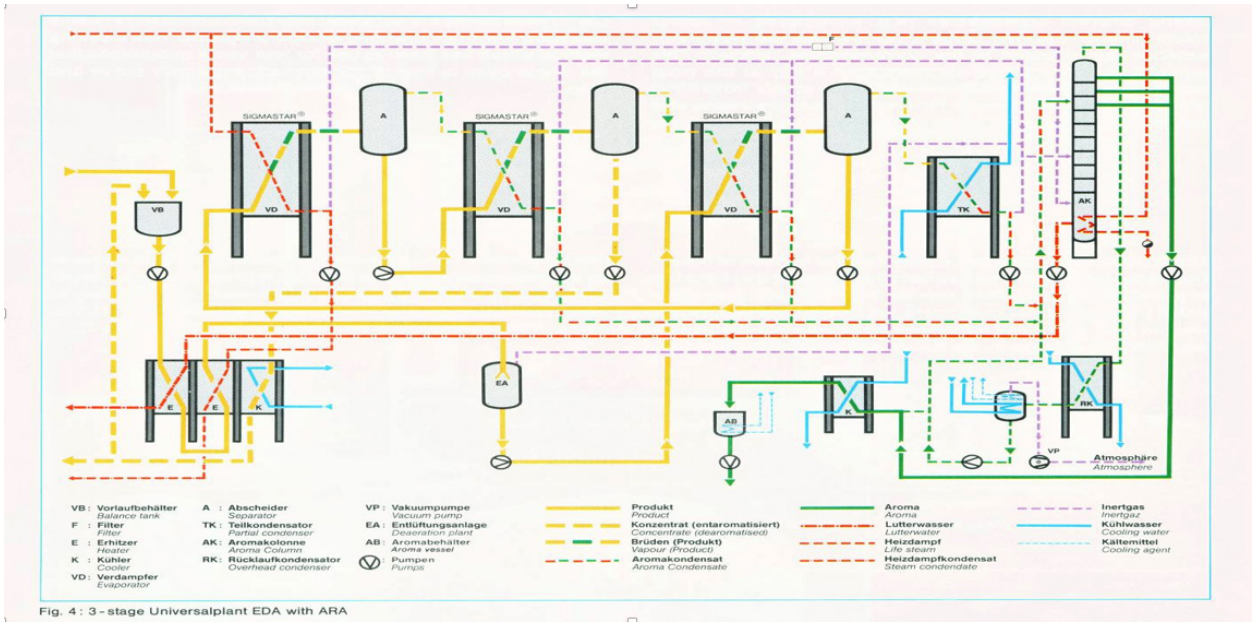
Juice Concentration with Aroma Recovery

One of our most common applications is a concentration plant with SIGMA**STAR**® evaporators for fruit juice with aroma recovery.

Evaporation capacity: 44,000 kg/h
Concentration: from 12 to 72 % t. s.
Steam Economy: approx. 25 %

- For this product, preservation of original flavor and color was of utmost importance. Continuous operation coupled with extremely short residence times maintain the highest product quality.
- This plant has an additional feature that makes Schmidt® world-renowned. Our aroma plants produce the highest quality juices on the market. We have installed our aroma recovery systems on existing competitor's equipment to help with juice flavor.

SIGMA**STAR**® 150 Juice Evaporation Plant



3-Effect Evaporator Flow Diagram with Aroma Recovery

Fine Chemicals and Pharmaceuticals

Fields of application

We have provided systems for acids (citric acid, etc.), bases (sodium hydroxide, etc.), salt solutions (ammonium nitrate and ammonium sulphate), aluminum sulphate, magnesium chloride, amine solutions (urea, etc.), alcohols (glycol, methanol, glycerine, etc.), aromatic compounds (toluol, xylene, etc.), raw and intermediate products for synthetic materials and fibres (caprolactam water), synthetic glue, pharmaceutical products (sorbitol, sorbose, enzyme solutions, antibiotics, monosodium glutamate), as well as many types of waste water.

Vegetable Oil Concentrator

An example of a typical installation

Concentration plant with SIGMA**STAR**® evaporators for the concentration of vegetable oil with the simultaneous recovery of extraction solvent.

Evaporator capacity: 1,500 kg/h of solvent
Final product: solvent-free vegetable oil

- For this particular concentration plant, we designed custom solutions to address the typical problems that occur during the extraction phase.
- Due to the azeotropic nature of the mixture, concentration must be performed in two effects at different process pressures in order to achieve a complete separation.
- A comprehensive cooling and condensation system guarantees minimum solvent concentrations in the exhaust gases. The special construction of the gaskets ensures a maximum service life.

Organic Natural Products

Fields of application

Schmidt® evaporators are used for processing stick water, hide and bone glues, hydrolyzed proteins, technical and photographic grade gelatins, oils, molasses, slops, yeasts, yeast extracts, wort, drug extracts, hops extracts, plant extracts, tanning extracts, corn steep water, glucose, dextrose, fructose and potato waste water.

Installed Evaporation Plant

A typical installation

Concentration plant with SIGMA**STAR**® evaporators for glucose.

Evaporation capacity: 10,000 kg/h
Concentration: 33 to 85 % total solids
Specific steam economy: approx. 27 %

- For this product, the extremely high viscosity required a special plant arrangement. The product flows through the effects in the sequence 4-3-2-1 counter current to the heating steam. Low evaporation temperatures and a final flash cooler prevented thermal damage to the product. Condensate streams from the various effects are used for inter-effect heating thereby reducing steam consumption.

Hydrolyzed Proteins

Another typical installation

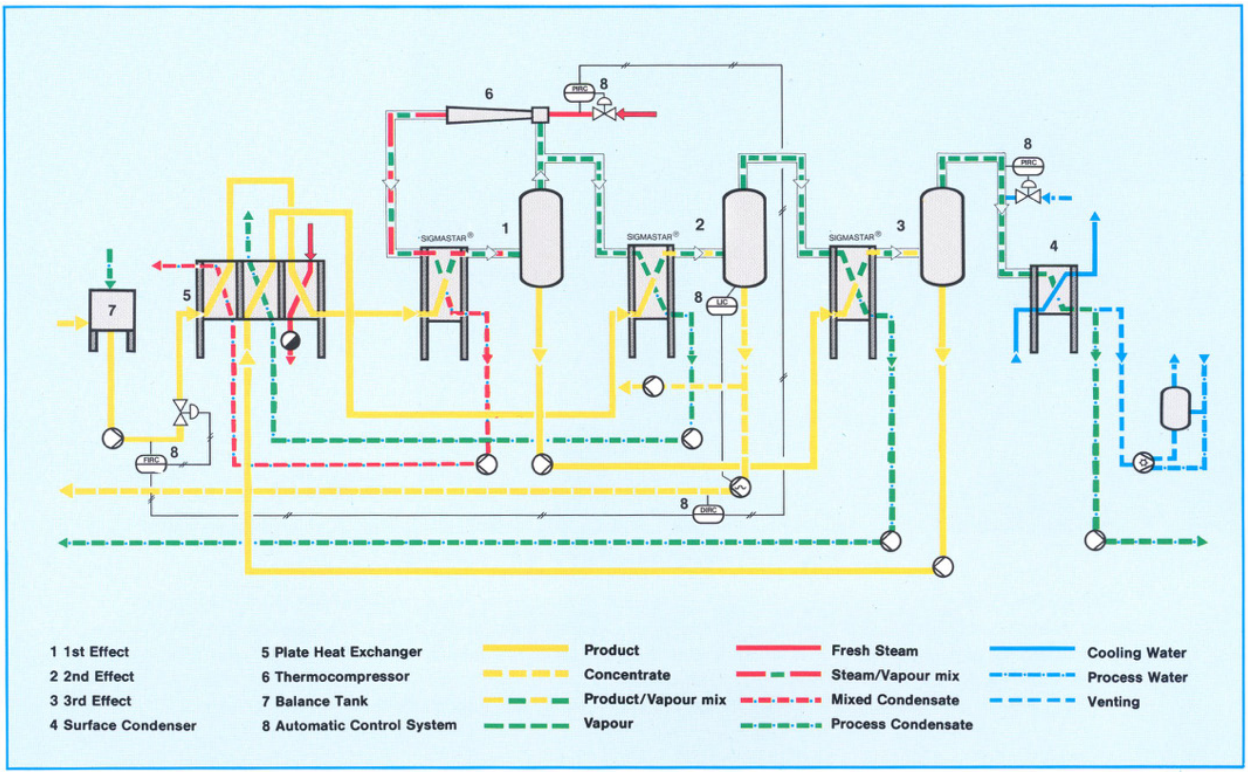
Concentration plant with SIGMA**STAR**® evaporators for hydrolyzed proteins

Evaporation capacity: 4,000 kg/h
Concentration: from 8-12 to 50-58 % t. s.
Steam Economy: approx. 22 %

- For this product, consideration of many product specific characteristics led us to choose a 3-1-2 arrangement. Discharging the product at the slightly higher temperature of the second effect enabled a a trouble-free solution for the final concentration. A thermo-compressor ensured optimum economy. Continuous operation coupled with extremely short residence times maintain the highest product quality.

  This plant has as an additional feature full automatic control for start-up, operation, shut-down and cleaning-in-place.

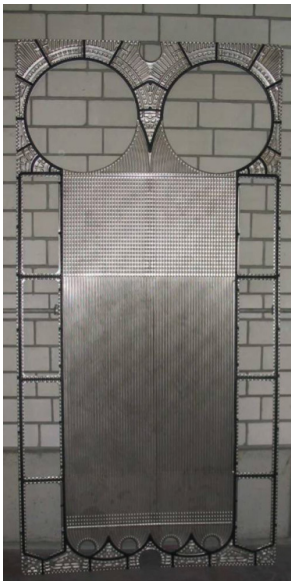
Hydrolyzed Protein Evaporator



New Super Evaporator: SIGMASTAR® 150

- Newly developed SIGMA**STAR**® rising film plate evaporator.
- Heat-exchange surface up to 600 m2 in one unit.
- For particle sizes up to 3 mm and viscosities up to 2,000 cP.
- Suitable in all industrial sectors.
- Available in all current plate and gasket materials.
- Equipped with SIGMAFIX gasketing system.
- The adhesive free economical gasket fixing system guarantees a high operational reliability.
- Gaskets changes are not simple and quick.
- Surface area / plate 1.50 m2.
- Turning plate (product and heating media is one plate).
- Two gaskets (1 product, 1 steam).

SIGMA**STAR**® Display Unit



SIGMA**STAR**® 150 Plate

SIGM**STAR**® 150 Juice Evaporation Plant

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API Heat Transfer, a family of high-performance brands

High-performance heat transfer.

It's who we are and what we do. It's part of our 140-year heritage designing and delivering world-class heat transfer products for nearly every industry. It's bolstered by our worldwide network of manufacturing facilities that provide sales, service, and support. And it's ingrained in a process that has helped customers around the world for nearly a century and a half.

When you work with us, you'll find the performance of our technologies sets the bar for heat transfer products, and our relentless drive to find and create custom heat transfer solutions to meet any industry challenge sets us apart.

See how our performance can improve yours.

Contact your API Heat Transfer sales rep or visit apiheattransfer.com today.

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