



## **THERMAL SEPARATION**

### by wiped film and short path distillation

- Laboratory and Pilot Plants
- Industrial Plants
- Package Units
- Components
- Engineering and Manufacturing
- Laboratory and Pilot Tests
- Toll Distillation



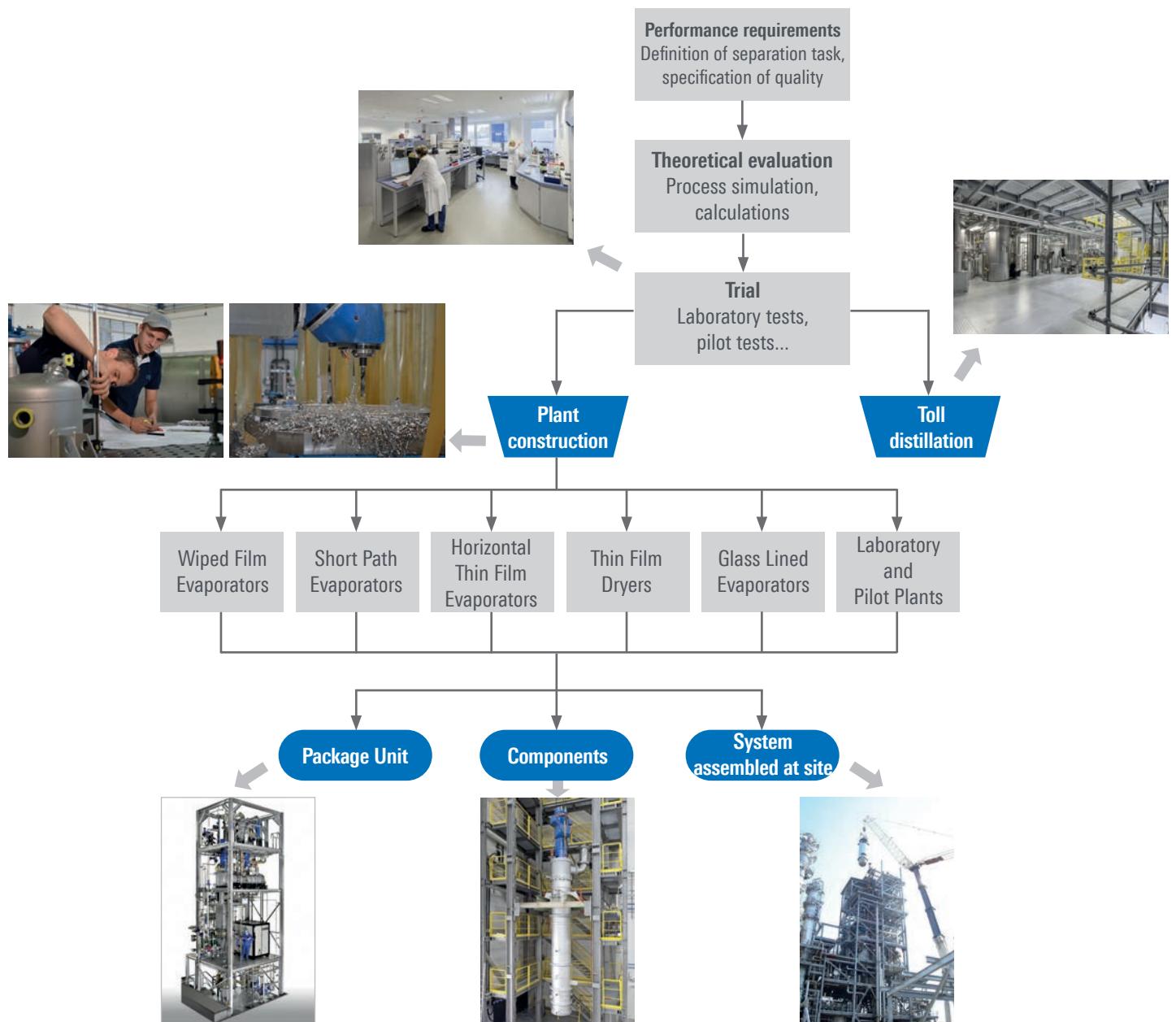
VTA Verfahrenstechnische Anlagen GmbH & Co. KG, based in Niederwinkling, is a wholly-owned subsidiary of MAX STREICHER GmbH & Co. KG aA and specialised in the field of thermal process engineering. The main focus of production is wiped film and short path distillation plants at laboratory, pilot and industrial scale as well as the manufacturing of the related components.

These distillation plants are operated for purification, concentration, removal of low boilers, colour improvement and drying of products in various industries. Highly qualified and responsible professionals ensure the highest quality standards. They are the foundation of the sustainable development of VTA.

VTA is a problem solver! From process development, via trials to the finished plant or the execution of a toll distillation, everything comes from one single source at VTA.

The close coordination of process development, design and manufacturing enables VTA to quickly respond to customer requests even during the manufacturing phase. Thus, the best possible solution even for complex problems is achieved for customers.







### Wiped Film Distillation

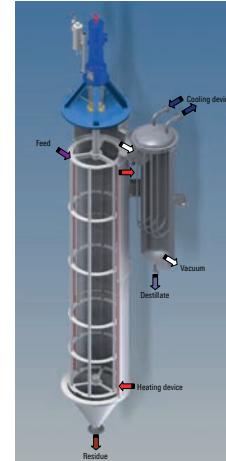
A rotating wiper system distributes the crude product to a film on the inner surface of a heated pipe. The wiping system speeds up the evaporation process by keeping the product film turbulent so that the heat transfer and mass transfer are optimised.

The lower boiling fraction of the raw material evaporates out of the product film within a short time; the residence time of the product at the evaporator wall is very short. The vapours are condensed on an external condenser. The concentrate is continuously discharged out of the bottom part of the evaporator.

The processing of viscous or crystallising substances at pressures down to 1 mbar is possible.

### Advantages Wiped Film Distillation

- Continuous distillation process
- Short residence time
- High evaporation rates
- Low processing temperatures due to low operating pressures
- Processing of high-boiling or high viscosity products is possible
- Combination with a column to increase the number of theoretical plates is possible
- Low fouling on evaporator wall

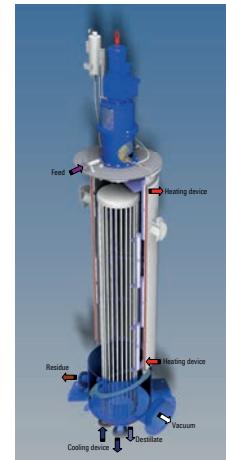


### Short Path Distillation

The short path evaporator combines thin film evaporator and condenser in a single apparatus. The vapours are condensed on the built-in condenser. The product path between the evaporation and condensation is extremely short, therefore, the pressure drop is low.

### Advantages Short Path Distillation

- Continuous distillation process
- Short residence time
- High evaporation rates
- Low processing temperatures (down to 0.001 mbar)
- Low fouling on evaporator wall
- Compact design



### Evaporators – manufactured by VTA

VTA provides evaporators from laboratory to production scale in sizes ranging from 0.01 - to 80 m<sup>2</sup> and for operating temperatures up to 400 °C. Different wiper systems are selected depending on the product properties.

The material for the product wetted evaporator parts will be selected depending on the corrosiveness and the reactivity of the processed products.



## DISTILLATION METHODS

### Horizontal Thin Film Evaporators

In order to increase the residence time of the product in the evaporator, the possible evaporation rate or the percent distillate, it makes sense to use horizontal evaporators, so that gravity has less influence on the product stream.

In this type of evaporator it is possible to vary the required residence time within wide ranges.

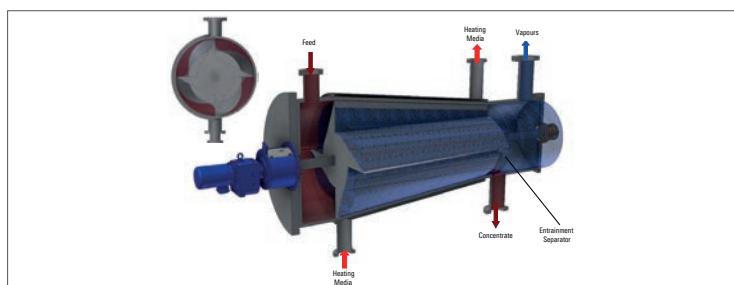
By increasing the product residence time, horizontal evaporators can also be used to carry out continuous reactions and reactive distillation in the thin and turbulent film at vacuum conditions.

### Thin Film Dryers

Thin film dryers are suitable for drying dissolved or slurried crystallising or amorphous products to a pourable powder.

### Advantages Horizontal Thin Film Evaporators

- Continuous distillation process
- Very high evaporation rates and high distillate splits possible
- Suitable for reactive distillation



### Advantages Thin Film Dryers

- Continuous process
- Low evaporation temperatures within the product film
- Short residence time
- High evaporation rates
- Combination with a column to increase the number of stages possible



### Glass lined Wiped Film and Short Path Evaporators

For the distillation of highly corrosive products or metal active substances, VTA is offering glass lined wiped film and short path evaporators. Glass lined evaporators are also used for applications where sterility is important or where contact with metals would cause catalytic decomposition or other chemical reactions.

Internals of the evaporator are made of enamel and other corrosion resistant non-metallic materials.





### Standard sizes of VTA Wiped Film Evaporators (vertical design)

Type	Surface [m <sup>2</sup> ]	Height [mm]	Inner Diameter [mm]
VDL 70-4 *	0.04		70
VDL 70-7 *	0.07		70
VDL 125-15 *	0.15		125
VDL 200-30 *	0.30		200
VD 83-6 **	0.06	1,000	83
VD 100-10 **	0.10	1,150	100
VD 125-20 **	0.20	1,700	125
VD 200-50 **	0.50	2,300	200
VD 260-100 **	1.00	2,900	260
VD 350-200 **	2.00	4,200	350
VD 500-400 **	4.00	5,600	500
VD 630-650 **	6.50	6,800	630
VD 800-1000 **	10.00	7,500	800
VD 1000-1500 **	15.00	9,000	1,000
VD 1250-2000 **	20.00	9,300	1,250
VD 1250-2500 **	25.00	10,500	1,250
VD 1400-3000 **	30.00	12,000	1,400
VD 1600-3500 **	35.00	13,000	1,600
VD 1600-4000 **	40.00	14,000	1,600
VD 1800-5000 **	50.00	14,500	1,800
VD 2000-6000	60.00	16,000	2,000
VD 2600-8000	80.00	16,500	2,600

\* The Wiped Film Evaporators (series VDL) are manufactured in borosilicate glass.

\*\* These sizes are also available as Thin Film Dryers.



### Standard sizes of VTA Thin Film Evaporators (horizontal design)

Type	Surface [m <sup>2</sup> ]	Length [mm]	Inner Diameter [mm]
VDLH 70-4 *	0.04		70
VDH 83-6	0.06	1,200	83
VDH 125-12	0.12	1,700	125
VDH 250-40	0.40	2,200	250
VDH 370-100	1.00	3,400	370
VDH 630-250	2.50	4,200	630
VDH 800-450	4.50	4,500	800
VDH 1000-650	6.50	6,500	1,000
VDH 1250-1000	10.00	7,000	1,250
VDH 1500-1500	15.00	7,500	1,500
VDH 1800-2000	20.00	8,500	1,800

\* The Wiped Film Evaporators (series VDL) are manufactured in borosilicate glass.

If required, the evaporator sizes can be customised based on special requirement.





## SIZES OF VTA EVAPORATORS

### Standard sizes of VTA Short Path Evaporators

Type	Surface [m <sup>2</sup> ]	Height [mm]	Inner Diameter [mm]
VKL 38-1 *	0.01		38
VKL 70-4 *	0.04		70
VKL 70-5 *	0.05		70
VKL 125-10 *	0.10		125
VKL 125-15 *	0.15		125
VKL 200-30 *	0.30		200
VK 83-6	0.06	1,100	83
VK 100-10	0.10	1,250	100
VK 125-15	0.15	1,600	125
VK 200-40	0.40	2,000	200
VK 260-80	0.80	2,200	260
VK 350-150	1.50	3,600	350
VK 500-240	2.40	3,800	500
VK 630-450	4.50	4,000	630
VK 800-600	6.00	5,500	800
VK 800-800	8.00	6,400	800
VK 1000-1000	10.00	6,600	1,000
VK 1250-1500	15.00	8,000	1,250
VK 1250-2000	20.00	9,200	1,250
VK 1400-2500	25.00	10,100	1,400
VK 1600-3000	30.00	12,000	1,600
VK 1800-3500	35.00	13,200	1,800
VK 2000-5000	50.00	13,700	2,000
VK 2600-8000	80.00	15,500	2,600

\* The Short Path Evaporators (series VKL) are manufactured in borosilicate glass.

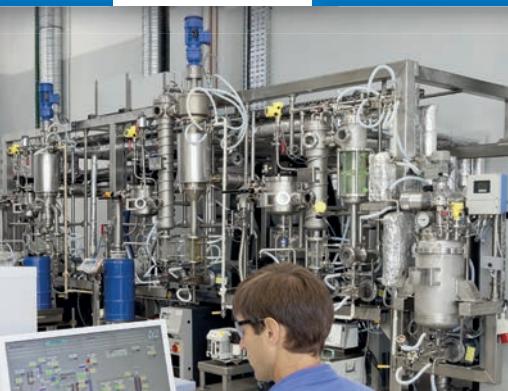


### Standard sizes of glass lined VTA Wiped Film and Short Path Evaporators

Type	Surface [m <sup>2</sup> ]	Height [mm]	Inner Diameter [mm]
Wiped Film Evaporators - glass lined			
VDE 125-15	0.15	1,700	125
VDE 200-40	0.40	2,000	200
VDE 350-100	1.00	2,400	350
VDE 500-200	2.00	4,000	500
VDE 800-500	5.00	6,100	800
VDE 1000-800	8.00	6,900	1,000
VDE 1250-1500	15.00	8,500	1,250
Short Path Evaporators - glass lined			
VKE 200-40	0.40	2,000	200
VKE 350-100	1.00	2,400	350
VKE 500-200	2.00	4,000	500



If required, the evaporator sizes can be customised based on special requirement.



## LABORATORY AND PILOT TESTS AT VTA

### Laboratory and pilot tests

For complex mixtures, theoretical calculations are often not sufficient to design an industrial plant or to determine the optimum process conditions for a distillation. In the VTA test centre, tests for every offered technology can be performed.

Laboratory tests	Pilot tests
· Determination of the general feasibility	· Dimensioning of process equipment and aggregates of the industrial plant
· Determination of process parameters	· Selection of the optimum wiper system
· Determination of achievable product quality and yields	
· Production of sample volumes up to several kilograms	· Final determination of process parameters
	· Identifying and confirming the achievable product quality and yields
· Production of sample volumes up to several tons	
· Determination of process parameters required for toll distillation	
· Required raw material quantities about 1 - 3 kg	· Production of sample volumes up to several tons
· Monitoring of product properties during distillation (foaming, fouling etc.)	· Determination of design parameters for the planned distillation system
	· Verification of the results of the laboratory tests under real process
	· Monitoring of the product properties during distillation (foaming, fouling etc.)

### Analytics

A central analytical department is assigned to the VTA test centre and tolling facilities.

Retained samples of all raw materials and purified products are kept for at least three years. In this way VTA obtains a completely documented data base for the evaluation of products and processes.

### Available analytical methods, among others:

- Capillary gas chromatography with autosampler (GC)
- Overhead capillary gas chromatography
- High pressure liquid chromatography (HPLC) with autosampler
- Gel permeation chromatography (GPC) with autosampler
- Capillary and rotational viscometers
- Determination of colour index by means of colorimeters
- Aqueous and non-aqueous titrations with automatic titration systems
- Water determination according to Karl Fischer (coulometric method)
- Determination of ash content





## VTA – EVERYTHING FROM ONE SOURCE

### Concept studies

- Preliminary plant layout
- Economic feasibility

### Process studies and product development

- Process simulation
- Lab and pilot tests in the inhouse test centre

### Basic engineering

- Preparation of process relevant documents (e.g. PID, PFD)
- Sizing of evaporators, heat exchangers, vessels and components
- Arrangement drawing

### Detail engineering

- Mechanical design of evaporators, heat exchangers, vessels and components
- General arrangement
- Skid and piping design
- Selection of valves and instruments
- Design of switch cabinet
- Programming of PLC and visualisation

### Manufacturing of components

- Production planning
- Manufacturing of apparatuses
- Purchasing
- Quality assurance, approval with necessary certificates and inspections (FAT)

### Assembly: Industrial Plants / Package Units

Packing and shipping (industrial plants)

Assembly of the plant

- Assembly of skid
- Installation of main components
- Installation of piping, valves and instruments
- Electrical installation (switch cabinet, cabling, control system and visualisation)
- Insulation
- Factory Acceptance Test (FAT) (industrial plants) ⇒ vacuum, pressure, electrical, control system

Disassembly, packing and shipping (Package Units)

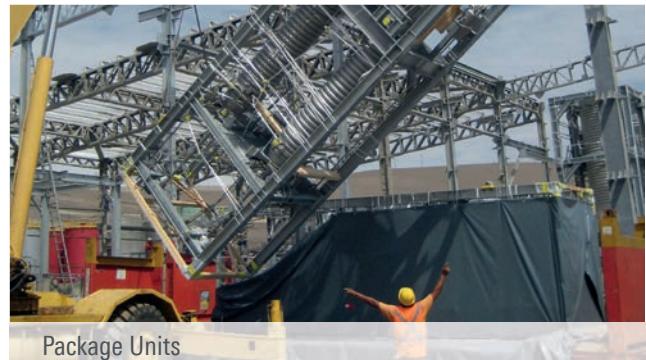
### SAT and commissioning

### After sales service

- Maintenance
- Spare parts
- Training
- Toll distillation



Industrial Plants



Package Units



## PACKAGE UNITS

Package Units are skid mounted, pre-assembled systems for wiped film and short path distillation, rectification and thin film drying. Assembly of the plant directly at VTA's site.

### Package Units ensure the customer

- Minimised design effort
- Smooth project execution
- Minimised amount of interfaces
- On schedule completion
- Minimised development effort
- Fast and smooth implementation in existing production facilities

Ready assembled units are not only interesting for new installations, but also in the expansion of existing production facilities e.g. to increase capacity or to improve existing processes. Implementation of the package units into existing operating production facilities is done with only a short interruption in production. Even moving of a package unit to a new location is possible within short time and with little effort.



Package Unit (before delivery)

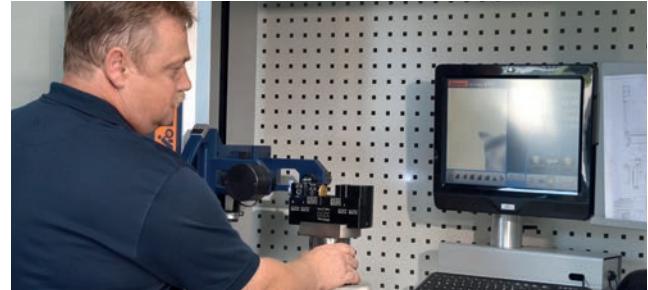


## MANUFACTURING AT VTA

All core components are manufactured in modern manufacturing facilities by highly qualified workers either of VTA or of the STREICHER company group, especially of STREICHER Maschinenbau GmbH & Co. KG. In modern production halls welding structures up to 100 tons piece weight are manufactured and machined. All common and prescribed surface treatments can be performed.

### The following equipment is available in the manufacturing halls:

- Plasma and gas cutting machine
- TIG , MIG, orbital and MAG welding equipment
- Bending rollers and sheet metal benders
- Boring machines and turning machines
- Sand blasting, passivation and painting systems
- Non-destructive testing equipment



The design of the systems and components will be planned depending on the location and type of installation in accordance with the relevant regulations and documents such as:

- Machinery Directive 2006/42/EC
- PED (AD 2000), ASME, SQL, DIN EN 13445, DIN EN 1090
- ATEX Directive 94/9 EG (ATEX) or NEC „National Electrical Code“
- cGMP
- GAMP5 and CFR 21 Part 11



### Wiped Film and Short Path Distillation Units for laboratory use

With laboratory units, reliable conclusions about the feasibility of a separation process can be made by only using small product amounts.

#### Lab units are used for

- Verifying the feasibility of a separation task
- Performing first process development steps
- Producing small sample amounts of final products
- Optimising existing processes

#### Features of laboratory units

Feedrate	20 g/h up to 6 kg/h
Product wetted material	Borosilicate glass, stainless steel or other special materials
Max. heating temperature	350 °C
Evaporator size	0.01 up to 0.30 m <sup>2</sup>
Achievable pressure in wiped film evaporator	<0.1 mbar
Achievable pressure in short path evaporator	<0.001 mbar

#### Set-ups and options:

- Short path distillation systems VKL in different sizes
- Wiped film distillation systems VDL in different sizes
- Wiped film distillation systems with rectification column
- Horizontal wiped film evaporator VDLH
- Multi-stage lab units
- Completely jacketed (trace-heated) systems
- Continuous feeding and discharge options (pumps)
- PLC and visualisation
- Different wiping systems





## LABORATORY AND PILOT PLANTS

### Pilot plants for Wiped Film and Short Path Distillation

Main target is to generate scalable data and results during the pilot tests (with small sample quantities) to enable a later scale up to industrial systems. Furthermore these pilot systems can be used for distillation or drying of small product quantities.

#### Pilot plants are used for

- Generating the scalable data for industrial systems
- Producing certain sample quantities
- Optimisation of existing processes

#### Features of pilot units

Feedrate	5 kg/h up to 50 kg/h
Product wetted material	Stainless steel or other special materials
Max. heating temperature	350 °C (hot oil) For temperatures > 350 °C inductive heating possible
Evaporator size	0.06 up to 0.5 m <sup>2</sup>
Achievable pressure in wiped film evaporator	<0.1 mbar
Achievable pressure in short path evaporator	<0.001 mbar

#### Set-ups and options:

- Short path distillation systems VK in different sizes
- Wiped film distillation systems VD in different sizes
- Wiped film distillation systems with rectification column
- Multi-stage pilot units
- Different wiping systems
- Completely jacketed (trace-heated) systems
- Continuous feeding and discharge options (pumps)
- PLC and visualisation
- GMP and ex-proof design (if requested)





## TOLL DISTILLATION – EFFICIENT OUTSOURCING WITH VTA

VTA operates various wiped film and short path distillation plants for toll distillation of different products.

### Reasons for toll distillation:

- Capacity constraints
- Securing a second production site
- Market launch of new products
- Hold back investment for own distillation facility
- Collection of production know-how for new products
- Improving the quality of market introduced products
- Continuation of the production of expiring products while new products are produced on the customer's own plants
- Ensuring the cost base in the production of new products
- No setting up of own production facilities

### General features of the toll distillation plants

Toll distillations are performed on multi purpose plants. Variable connection of wiped film evaporators, short path evaporators and equipment for rectification.

High-melting or higher viscosity products can be distilled easily. The system is designed according to the European explosion protection directive. For the distillation of food, pharmaceutical and cosmetic products, the specific distillation system is validated separately.

### Analysis and quality assurance

In our analytical department, the quality demands of our customers are monitored by means of wet chemical and instrumental analytical methods. All incoming and outgoing products are analysed. The product quality is documented by certificates of analysis. Product samples will be provided to the customer.

#### Technical data of the toll distillation plants

Campaign sizes	1 kg up to 1,000 t – larger campaigns on request
Melting points	max. 190 °C
Boiling points	above 500 °C at atmospheric pressure
Operating temperatures	max. 350 °C
Operating pressures	down to 0.001 mbar
Viscosities	max. 150,000 mPas at operating temperature
Rectification	approx. 10 theoretical plates
Granulation	by means of flaking roll or cooling belt
Container size	max. ISO tank containers and tank wagons
Storage capacities	depending on substance class and type of containers, acc. to WHG
Operating mode	continuously, shift operation
Explosion protection	acc. to ATEX 94/9/EG
Execution of the equipment	acc. to BlmSchG





## APPLICATIONS

### Oils, fats and food

- Separation of free fatty acids from edible oils and fish oils
- Pesticide removal from edible oils and fish oils
- Fractionation of tall oil
- Concentration of monoglyceride
- Concentration of EPA and DHA in fish oil esters
- Concentration of tocopherols
- Concentration of carotene
- Drying of lecithin
- Pesticide removal from lanolin
- Colour improvement of lanolin
- Concentration of sorbitol

### Chemical, agro chemical and pharmaceutical products

- Concentration of polyphenyl compounds
- Separation of aromatic amines from secondary components
- Purification of amines
- Concentration and colour improvement of amino alcohols
- Separation of long-chain acid chlorides from high boiling impurities
- Distillation of fatty acid amide
- Concentration and purification of dimeric fatty acids
- Removal of volatile components from silicones and silicone resins
- Concentration and purification of esters
- Concentration of insecticides, fungicides and herbicides
- Concentration and purification of glycerol
- Fractionation and removal of low boiling components from natural waxes
- Colour improvement of waxes
- Deodorisation, removal of pesticides
- Concentration and purification of lactic acid
- Colour improvement of lanolin
- Distillation of acrylic acid and acrylic ester
- Distillation of pharmaceutical intermediates
- Distillation of pharmaceutically active substances

### Petrochemical products

- Separation of microcrystalline wax from vacuum residues of crude oil
- Fractionation of synthetic and petrochemical waxes

### Polymers

- Purification and concentration of monomers
- Purification and concentration of polymers
- Purification of plasticisers
- Minimisation of solvents and monomers in polymers

### Fragrances and flavors

- Elimination of terpenes and concentration of essential oils
- Separation of solvents of odorous substances
- Concentration of lemon flavors
- Concentration of pepper and chilli extracts

### Recycled materials

- Refining of used oils
- Purification of used lubricants, brake fluids, glycerol and transformer oils
- Recycling of dimethyl sulfoxide (DMSO) mother liquors
- Recycling of sulfolane
- Recycling and reprocessing of mother liquors of pharmaceutical processes
- Recycling of organic intermediates
- Recycling of mono-chlorinated acids from mother liquors



#### VTA Verfahrenstechnische Anlagen GmbH & Co. KG

Establishment	1994
Number of employees	140
Locations	Headquarters: Niederwinkling/Germany Subsidiaries: Beijing/China: VTA PROCESS EQUIPMENT BEIJING CO., LTD Alzenau/Germany: UIC GmbH Branches: Rock Hill/US
	Visit us online: <a href="http://www.vta-process.de">www.vta-process.de</a>

#### STREICHER Group

Establishment	1909 (MAX STREICHER GmbH & Co. KG aA)
Number of employees	approx. 4,000
Locations	Headquarters: Deggendorf/Germany more than 30 locations worldwide