Distillation Plants for Industrial Production

U·I·C
UIC GmbH

Custom Vacuum Distillation Plants

turnkey distillation plants • capacity range: 100 grams to over 10 tons per hour • from UIC: a leading international supplier

Vacuum distillation plants

Vacuum distillation plants are used in R&D labs, in pilot applications, and for full-scale industrial mass production.

Each plant can be configured to run around the clock, at feed rates ranging from ca. 0.1 kg/h to more than 10 t/h. In addition to the main components – the Thin Film Evaporators and the Short Path Distillators – all secondary devices are integrated to guarantee smooth and reliable operation.

Applications

While vacuum distillation plants cover large areas of the process industry, common requirements of all applications are particularly gentle process conditions. The thermal load of heat-sensitive substances is minimized to avoid any deterioration of quality.

An overview of applications:

- Food additives
- Oils and fats
- Flavors and fragrances
- Fine chemicals
- Pharmaceutical products
- Separation of monomers and polymers
- Mineral oil products

Test distillations

The UIC Technology Center carries out test distillations with sample materials from our customers to provide reliable data on separation efficiencies, yields, and capacities – relatively quickly and with a minimum of effort. These parameters form an important part of the customers' investment decision.

UIC: leading international supplier

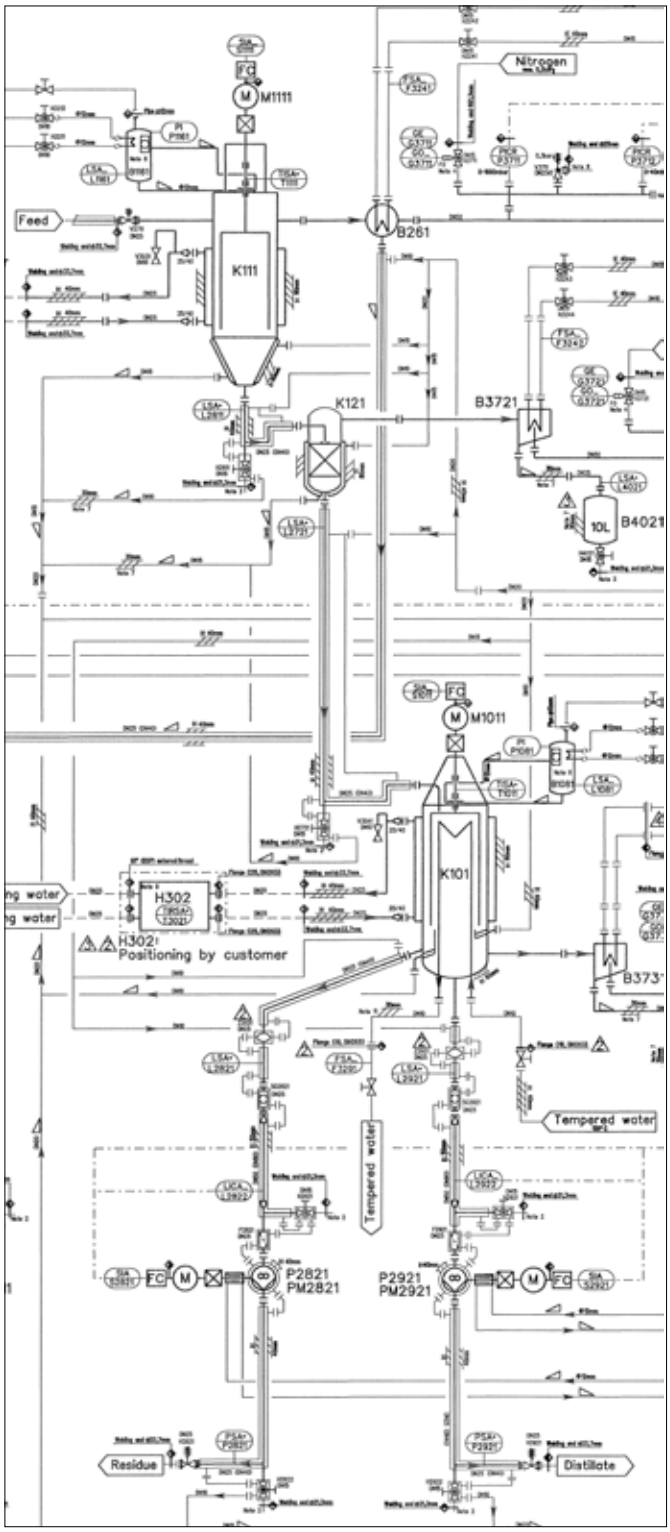
Specialized in the engineering and delivery of turnkey plants, UIC designs each solution to meet specific customer requirements. Today, we are a leading supplier of vacuum distillation plants around the world.

optimized for each distillation task • to meet all requirements

Unlike laboratory and pilot plants, which are composed of standardized components in a modular system, industrial production systems feature individualized designs, including the system layout and all individual devices.

Plant design parameters:

- The composition of the product to be distilled
- Possible variations of the composition
- The maximum plant capacity and turn-down-ratio
- Physical data of the feed flow (e. g. temperature, pressure, temperature of solidification, viscosity)
- Material restrictions (e. g. regarding corrosiveness or FDA-requirements)
- Installation dimensions (e. g. regarding available floor area, maximum height, weather conditions, danger of earthquakes, explosion protection requirements)
- Available utilities (e. g. electricity, heat carrier media, steam, cooling water, cooling agents, compressed air, instrument air)
- Planned mode of operation (e. g. day shift, multi-shift operation, continuous operation)
- Frequency of feed material change (single purpose or multi purpose plant)
- Applicable GMP or hygiene regulations
- Degree of automation
- Connection to DCS system
- Operating pressures of the individual distillation stages and the required suction volumes
- Required distillation results (e. g. composition of distillate and residue, yields)
- Physical data of the discharged product flows (e. g. temperatures, pressures)



Piping and instrumentation diagram (P&ID)

Our Know-How

50 years of experience in plant engineering and delivery • know-how gained from over 4,000 trial distillations

We first began supplying Short Path Distillation plants in the 1950s (under the Leybold brand) that were used for the concentration of emulsifiers (monoglycerides).

Leybold – a pioneer in vacuum technology – designed robust and reliable vacuum pumps and pump systems that met the requirements of Short Path Distillation technology – enabling Short Path Distillation in industrial production.

This Short Path Distillation technology and know-how was seamlessly transferred to UIC. Our engineers are leading specialists in vacuum technology, engineering optimal vacuum systems for every distillation task.

A comprehensive understanding of the distillation task is a prerequisite for the engineering of a distillation plant. Our chemical engineers have years of experience in the design, delivery and commissioning of hundreds of distillation plants. Furthermore we can draw from the results of 4,000 test distillation series performed on laboratory and pilot plants with a great variety of test materials at our Technology Center.

Our order processing engineers carry out the design and engineering of the apparatuses and secondary plant components, the piping and installation planning, instrumentation, plant control, etc.

The project management process at UIC – from the consulting stage to the hand-off of a functional system – is guided by a rigorous quality management system.

Concentration of pharmaceutical intermediate products	
Degasser	1st stage: RF 50 (Thin Film Evaporator, 0.5 m²) with vacuum rectification column 2nd stage: KD 30 (Short Path Distillator, 0.30 m²)
Vacuum system	Feed and discharge
Place of installation	Europe

Main Components of our Distillation Plants

evaporation surface areas: 0.1 – 50 m² • distillation capacities: 10 kg/h – 10 t/h

KD 1200

Main components: Thin Film Evaporator and Short Path Distillator

The principle of operation of a Thin Film Evaporator and a Short Path Distillator is described in detail in a separate brochure, including the roller wiper system that is usually installed in our products.

With an evaporator surface area between 0.1 and 50 m², our Thin Film Evaporators and Short Path Distillators cover the capacity range between approximately 10 kg/h and 10 t/h (max. feed rate). The standard sizes are listed in the adjoining table. Intermediate sizes are possible upon request.

Evaporation surface area (m²)	Series of Thin Film Evaporator	Series of Short Path Distillator
0.1	RF 10	KD 10
0.3	RF 30	KD 30
0.5	RF 50	KD 50
0.75	RF 75	KD 75
1.0	RF 100	KD 100
1.5	RF 150	KD 150
2.0	RF 200	KD 200
3.0	RF 300	KD 300
4.0	RF 400	KD 400
6.0	RF 600	KD 600
9.0	RF 900	KD 900
12.0	RF 1200	KD 1200
15.0	RF 1500	KD 1500
18.0	RF 1800	KD 1800
24.0	RF 2400	KD 2400
30.0	RF 3000	KD 3000
36.0	RF 3600	KD 3600
40.0	RF 4000	KD 4000
50.0	RF 5000	KD 5000

Purification of bio-diesel made of animal waste	
Degasser	KD 900 (Short Path Distillator, 9 m²)
Vacuum system	Feed and discharge
Place of installation	Europe

Thin Film Evaporator and Short Path Distillator Specifications

flexibility for each application • operational pressures starting at 0.001 mbar

Typical capacities (relating to the evaporator surface area): - Thin Film Evaporators - Short Path Distillators	 100 – 300 kg / m² h * 25 – 200 kg / m² h *
Operating pressure: - Thin Film Evaporators - Short Path Distillators	 As of 1 mbar * As of 0.001 mbar *
Operating temperature	Up to 350°C (upon request: up to 400°C)
Heating media	Steam, thermal oil, hot water
Design standard	AD data sheet (DIN) (ASME, JIS and other standards upon request)
Leakage rate	< 0,001 mbar • l / sec
Construction materials	Stainless steel (1.4571), other alloys and materials upon request
Elastic sealing materials	E. g. FKM (Viton®), PTFE, EPDM, FFKM
Wiper elements	Rollers, PTFE glass fiber reinforced, other wiper elements upon request
Shaft sealing	Simple acting mechanical sealing (double acting mechanical sealing: upon request)
Wiper system drive	Electrical motor, designed for local electricity systems, upon request with frequency converter to regulate RPM
Condensers - Thin Film Evaporator - Short Path Distillator	 Externally, execution depending on application Located in the center of the distillator

* depending on the operating conditions

Concentration of valuable products from edible oils		
Degasser	1st stage: KD 150	(Short Path Distillator, 1.5 m²)
	2nd stage: KD 15	(Short Path Distillator, 0.15 m²)
	3rd stage: KD 15	(Short Path Distillator, 0.15 m²)
	4th stage: KD 6	(Short Path Distillator, 0.06 m²)
Vacuum system	Feed and discharge	
Place of installation	Asia	

Vacuum Systems

individual pump set designs • combinations of different vacuum pump types

The vacuum systems of Thin Film and Short Path Distillation plants must be carefully selected for each individual distillation task. Any shortcomings in the engineering of the vacuum systems usually result in extensive maintenance and repair costs.

The first layout criteria are operation pressures in the individual stages and the required suction speeds. However, the compatibility of the selected vacuum pumps with the expected entrainment of vapors from evaporators and distillators into the vacuum system is an aspect for reliable and continuous operation. This entrainment cannot be completely avoided, even with highly effective cold traps installed between distillators and vacuum systems.

Our engineers select from a large range of vacuum pumps to find those with performance that is best suited for each individual distillation task. The number of vacuum pumps for a distillation plant ranges from 2 to 10 pumps.

Some of the vacuum pump types used include:

- Liquid ring pumps
- Steam ejectors
- Roots blowers
- Oil booster

The adjustment of the suction speed to fluctuating distillation tasks is done by regulating the RPMs of a roots blower through a frequency transformer.

Vacuum pump sets at final inspection

Separation of isocyanates from polyurethane pre-polymers	
Degasser	1st stage: RF 2200 (Thin Film Evaporator, 22 m²) 2nd stage: KD 1500 (Short Path Distillator, 15 m²)
Vacuum system	Feed and discharge
Place of installation	Asia

Distillation Processes

exact adjustment of the individual components • reliable computer-controlled process management

Heating / Cooling

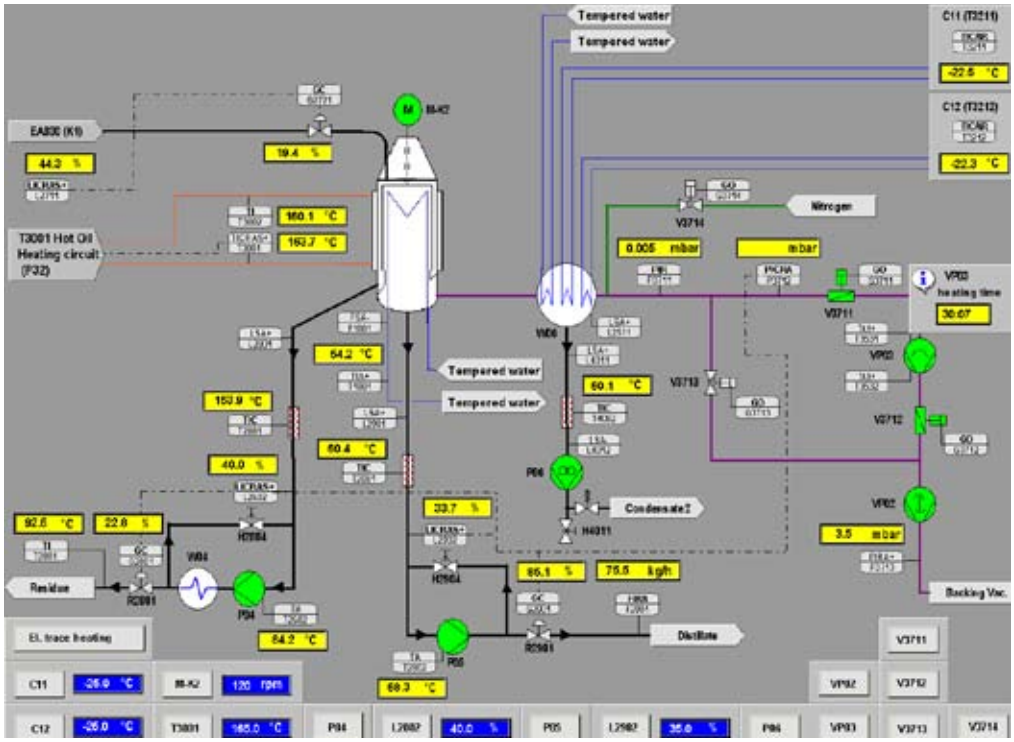
In addition to evaporators and distillators, often other product-wetted components – including the pipes – have to be heated to avoid problems caused by highly viscous or even solidified materials. On the other hand, the heat loads transferred to the condensers by the vapors need to be discharged. The cold traps also require cooling. For these reasons, we design a comprehensive heating / cooling system, which may also include a heat recovering.

Material transport

The trouble-free, continuous feed of material from the atmospheric pressure range into the components of a distillation system under vacuum, and the subsequent discharge of distillates and residues from the vacuum chamber to the atmospheric pressure range requires substantial knowledge of the mode of operation and functioning of feed pumps. Our specialists usually apply gear pumps and centrifugal pumps.

Instrumentation, Automation

All important operation parameters, such as flow rates, temperatures, pressures and fluid levels, are constantly monitored. The choice of instrumentation depends on the desired degree of automation. The majority of all plants used in industrial vacuum distillation are equipped with computer control systems (PLC), enabling the operator to supervise all important operation parameters on a monitor; any process adjustments can be carried out immediately by a simple mouse-click. Automatic control devices maintain operation parameters within given tolerances to ensure a consistently high product quality. If any serious deviations from the pre-set process parameters occur, the distillation plant is switched automatically to “safety mode” to guarantee operator safety and product quality.



Visualization of process parameters on a PC monitor

Installation

When installing the individual components of the distillation system, the following criteria need to be considered:

- Available floor space and heights at site
- Existing plant levels at site and frames to be built
- Accessibility of the place of installation for large systems
- Declining pipes for potential vapor condensation
- Required heights in case of barometric discharge
- Explosion protection classifications within the area of installation
- Weather conditions

For smaller plants, racks are often made of steel tubes, and for larger plants of steel beams.

Completely assembled skid-mounted plants including all piping and electrical wiring can be delivered if such large cargo can be transported to the installation site. This reduces assembly on site to connecting the plant to the external utilities, and the product feed and discharge pipes.

With large systems, or difficult access to the place of installation, partly assembled components are delivered.

Our experienced engineers are at the customer's disposal during assembly, start-up, process optimization, and to train customer staff, until the system has passed the final acceptance test.

Distilation plant for omega-3 fatty acid ethyl esters

Loading of a skid-mounted plant with 2 Short Path Distillators (4 m² evaporation surface area each)

Guidelines

pressure equipment directive • explosion protection (ATEX) • machinery safety directive

All relevant directives and guidelines are integrated into the engineering and manufacturing of distillation plants, including:

Pressurized components

Often the heating jackets – in some operating conditions also the inner chambers – of evaporators / distillators and other plant components operate under pressure. The design of the pressurized components incorporates the regional regulations, e. g. European pressure equipment directive (9/23/EG), the U.S. ASME regulations, the Japanese JIS regulations, etc.


TÜV Technische Überwachung Hessen GmbH

ZERTIFIKAT

CERTIFICATE OF CONFORMITY

Interne Fertigungskontrolle mit Überwachung der Abnahme (Modul A1) nach Richtlinie 97/23/EG

Zertifikat – Nr.: ATD-22-02-245

CE 0091

Explosion protection

In order to avoid ignition of explosive gas or vapor mixtures, our distillation plants are designed in accordance with customer's explosion-proof classification to ensure explosion protection.

Combustible mixtures may occur both outside and inside the distillation plant. The "external explosion protection" avoids ignition of explosive mixtures in the vicinity of the plant; the "internal explosion protection" avoids ignitions inside the system or its components.

The corresponding explosion protection regulations vary from country to country. Within the European Community, for example, the ATEX regulation (94/9/EG) applies, which includes both potential electrical and mechanical sources of ignition.

Accident prevention

The machinery safety directive (98/37/EG) comprises the European accident prevention regulations that include: risk evaluations, safety and health requirements, conformity evaluations, documentation and CE identification.

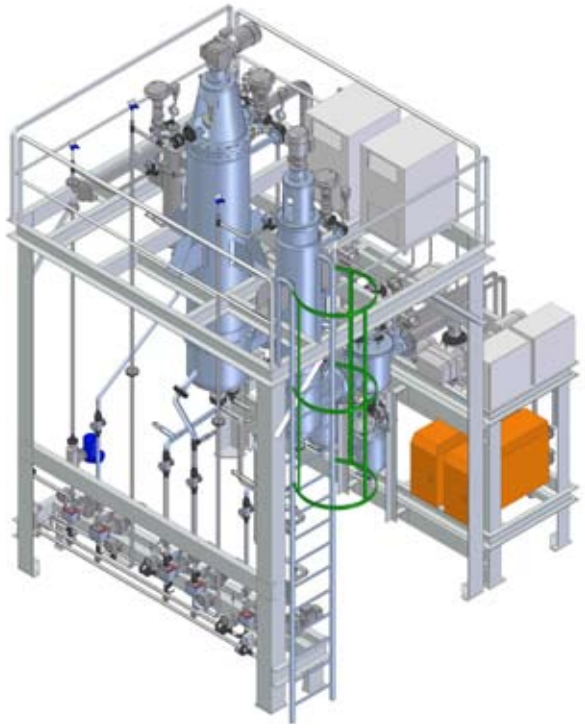
Concentration of valuable products from edible oils	
Degasser	1st stage: Thin Film Evaporator Subsequent stages: several Short Path Distillators
Vacuum system	PLC control with PC visualisation
Place of installation	Asia

Quality Management

As a global market leader for Thin Film and Short Path Distillation systems, UIC is committed to maintaining consistently high product quality standards and integrating the latest technology.

Our quality certification (DIN EN ISO 9001:2000) underlines our commitment across all departments within UIC – sales, engineering, commissioning, documentation, an maintenance.

All our processes are described in our Quality Management Manual and illustrated with flow diagrams. All sequences are understandable and traceable for all UIC employees. This improves teamwork without compromising flexibility.



3-D system design

Our Quality Management Program also includes all our approved suppliers, which are carefully selected and supervised during the manufacturing process – for both quality and on-time delivery.

Project Sequence

In many cases, the chemical composition of the feed material and key physical parameters of individual ingredients are not completely known. To get sufficient data to design and engineer the components of a vacuum distillation system, we offer trial distillation runs on laboratory and pilot plants in our Technology Center. Please ask for our brochure on this subject.

During the basic engineering phase, our engineers first work out a Process Flow Diagram (PFD) in close cooperation with our customers' specialists, which is also the basis to for a Piping and Instrumentation Diagram (P&ID).

Based on these documents, detailed engineering of the individual components is carried out. Our engineers design the parts to be manufactured at an approved supplier (the majority are long-term partners). Purchased parts are carefully selected and inspected.

Depending on the dimensions of the plant, either a complete unit or groups of components are assembled before shipment. Systematic quality control – including leak tests of all vacuum devices – guarantee that only inspected components arrive at the site. Our engineers can supervise the assembly, start-up, and training of customer personnel in preparation for the final acceptance tests.

A project engineer supervises and coordinates the project – from the initial customer order to the final acceptance test.

A comprehensive set of documentation is delivered with the system, with all documents required for the operation, maintenance and repair of the distillation system.

UIC GmbH
Products & Services

As a technology partner, we supply distillation solutions to our customers for the thermal separation of heat sensitive substances. UIC Thin Film and Short Path Distillation solutions operate under vacuum at pressures down to 0.001 mbar.

We offer
Feasibility studies
Distillation trials for laboratory and pilot plants performed at the UIC Technology Center
Basic and detailed engineering
Delivery of turnkey plants for R&D, pilot, and industrial applications
Plant start-up, commissioning, and process optimization
Leak detection, maintenance, and repair
Spare parts service
Consulting and support through our worldwide network

Ask for our other brochures
UIC GmbH – The Specialist in Vacuum Distillation Plants
Function of Thin Film Evaporators and Short Path Distillators
Applications for Thin Film and Short Path Distillation Plants
Client Distillation Trials at the UIC Technology Center
Laboratory and Pilot Plants

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