

THIN FILM APPARATUS

ENGINEERING · TESTS · APPARATUS · COMPLETE PLANTS

THIN FILM EVAPORATOR

rigid blade
wiper blade
radial wiper

THIN FILM DRYER

pendulum blade

THERMAL PROCESS ENGINEERING

FUNDAMENTALS

SYSTEM

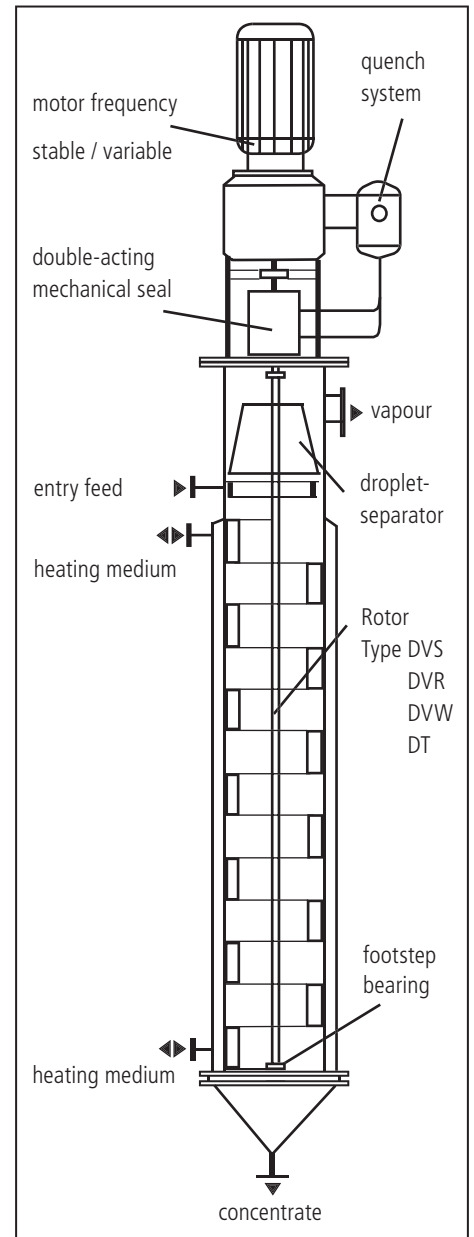
The thin film technology includes all thermal processes in mechanically produced thin films. Depending on the application, different types of thin film evaporator have been developed for specific uses.

The typical thin film evaporator consists of a tubular heat transfer area with an external heating jacket and a fast-revolving, inner rotor with flexible or rigid wiper elements.

The driving speed is adapted to the particular specification and task.

IMPORTANT ADVANTAGES

- Good heat conductivity (k-value), even when working with highly viscous and contaminated products
- Minimal thermal stress, thanks to low operating capacity, therefore a short dwell time (10-20 s mean dwell time)
- No dead zones, herefore overheating prevented and a constantly high product quality guaranteed
- Permanent mechanical cleaning of the heating surface prevents incrustations



Scheme of thin film evaporator

Limitations of use

	Operating Pressure mbar								Product Viscosity mPa s						Evaporation Rate %							
	10 ²	10 ¹	1	10 ⁻¹	10 ⁻²	10 ⁻³	10 ⁻⁴		10	10 ²	10 ³	10 ⁴	10 ⁵	10 ⁶		70	75	80	85	90	95	
Thin film evaporator Type DVS rigid blade	█								█									█				
Thin film evaporator Type DVR wiper blades	█								█									█				
Thin film evaporator Type DVW radial wiper	█								█									█				
Short path evaporator Type DVK				█					█							█						
Thin film dryer Type DT	█								█							█						
Thin film heat exchanger Type DW	█								█							█						

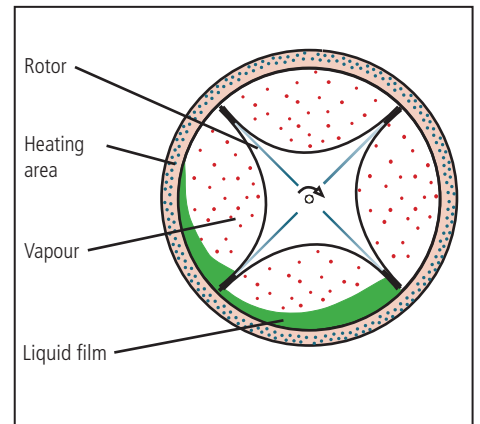
IMPLEMENTATION ▪ RANGE OF APPLICATION

Thin film apparatus are mainly used for the solution of difficult vaporization and heat-exchange processes. Particularly when dealing with highly viscous products, conventional plants can no longer meet user demands because heat transfer is insufficient. Due to the liquid film mechanically generated on the heating surfaces, thin film apparatus achieve much better heat transfer rates - even with highly viscous products, containing solids.

Typical uses for thin film apparatus include

- Concentration of highly viscous products, polluted liquids, salt solutions, oils, resins etc.
- Use as sump evaporator for vacuum rectification columns (minimum pressure drop).
- Sludge drainage
- Continuous drying of powdery residues
- Pure distillation (short path distillation) of high-boiling substances under high vacuum
- Degasing, removal of volatile components (monomers) from highly viscous products, melts and pastes
- Heating or cooling of viscous media

Depending on the process and the product involved, different types of rotor are used.

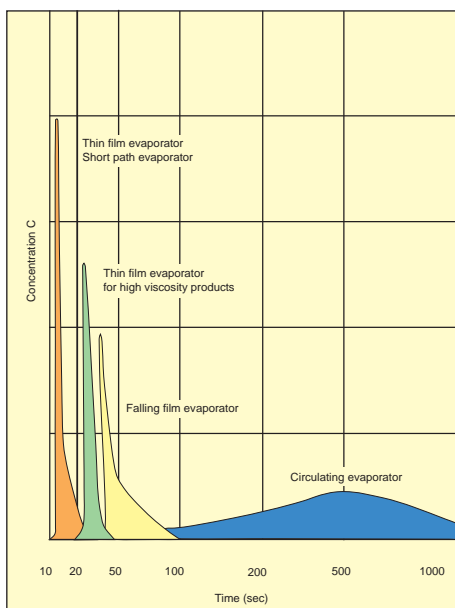


Thin film principle

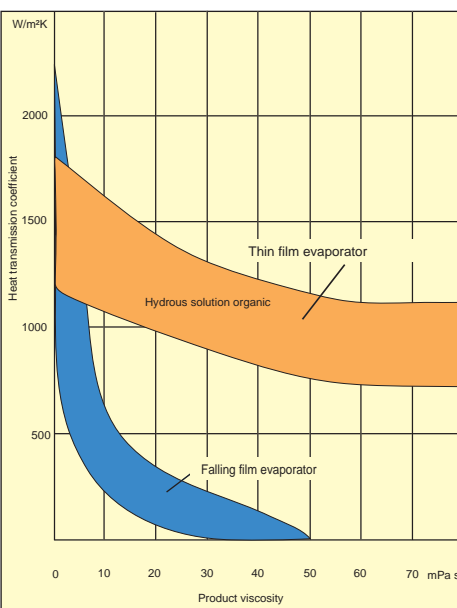


Thin film evaporator, type DVW 6.3

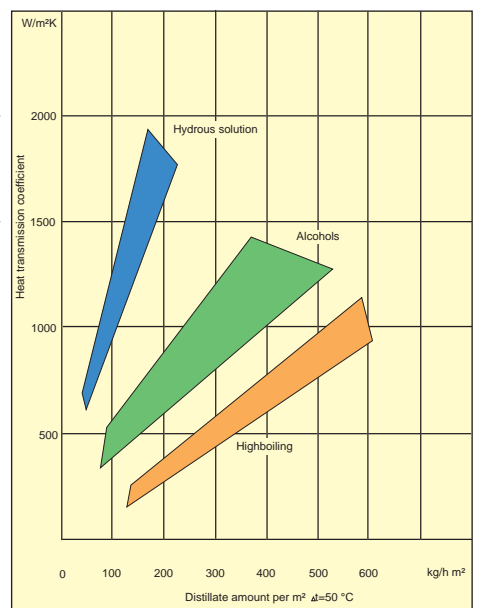
Comparison: dwell time of diverse apparatus



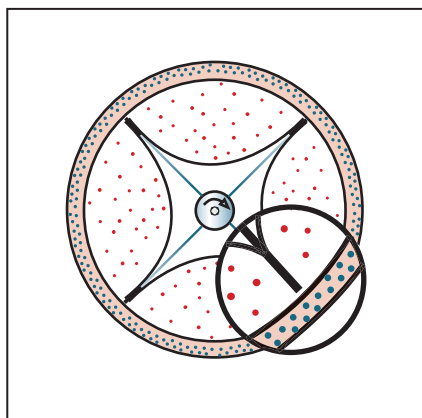
Comparison: thin film-/falling film evaporator



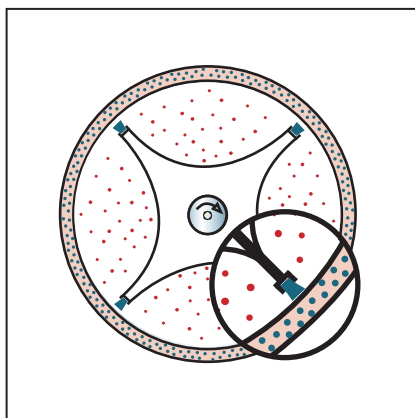
Comparison: distillate capacities



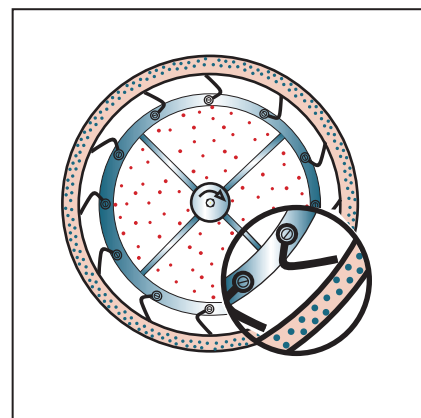
ROTOR CONSTRUCTION



RIGID BLADE
TYPE DVS



RADIAL WIPER
TYPE DVR



WIPER BLADES
TYPE DVW

DVS
high
no
yes
max. 300°C
>100 kPa
max. 40'000 mPa s
max. 80 Vol. %
no
no

DVR
low
yes
no
max. 250°C
>100 kPa
max. 20'000 mPa s
max. 98 Vol. %
low
no

DVW
low
yes
no
max. 400°C
>100 kPa
max. 20'000 mPa s
max. 95 Vol. %
low
low

Rigid blade rotor type DVS

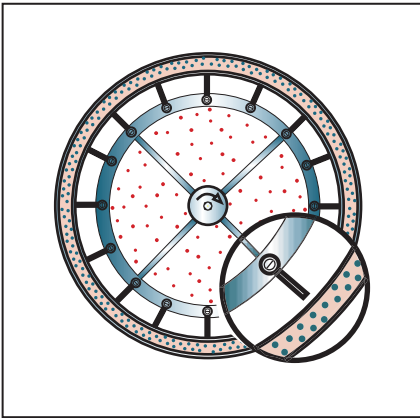


Radial wiper rotor type DVR



Wiper blades type DVW





PENDULUM BLADES
TYPE DT

DT
high
no
no
max. 400°C
>1000 kPa
max. 15'000 mPa s
max. 95 Vol. %
high
high

THIN FILM DRYER

Continuous drying in a thin film dryer usually delivers a powdery product which seems to be absolutely dry, but actually still contains residual moisture in the range of a few percent. Transporting such residual moisture from the inside of the powder particles to their surfaces involves very slow diffusion processes. For physical reasons this requires comparatively long dwell times that cannot be reached in a thin film dryer.

Type
Rotor speed
Wall contact
Necessity of bearing lubrication
Temperature range
Pressure - Vacuum
Viscosity
Evaporation grade
Solids content (suspension)
Crystallisation

Therefore, a combination dryer is used. In this solution, a horizontal contact dryer that also operates continuously, is connected to the outlet side of a normal thin film dryer. The additional dwell time in this horizontal dryer (typically 30 min) ensures that the end product is as dry as possible.

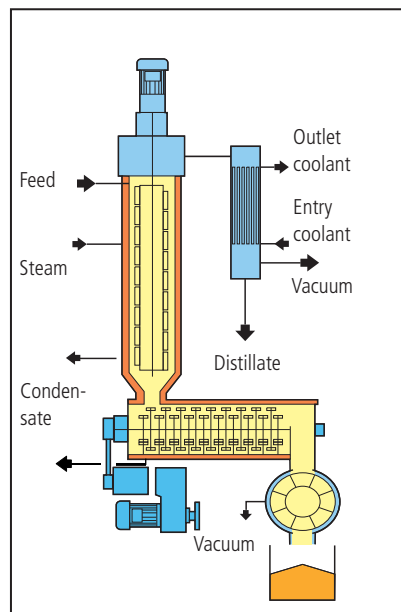
CAD-model type DVW



Thin film dryer (rotor with pendulum)



Thin film combination dryer



TYPES

OPTIONS

- Drive unit:
Constant speed / frequency controlled
Explosion-protected design (according to ATEX, FM or NEPSI)
- Shaft sealing:
Double-acting mechanical seal (standard) with a quench unit or rotary shaft seal
- Footstep bearing:
Sliding bearing made of hard metal or hard carbon, with or without external lubrication
Needle bearing in case with double-acting mechanical seal/quench unit with circulating pump
- Droplet separator, various implementations
- GMP-/ FDA-conform

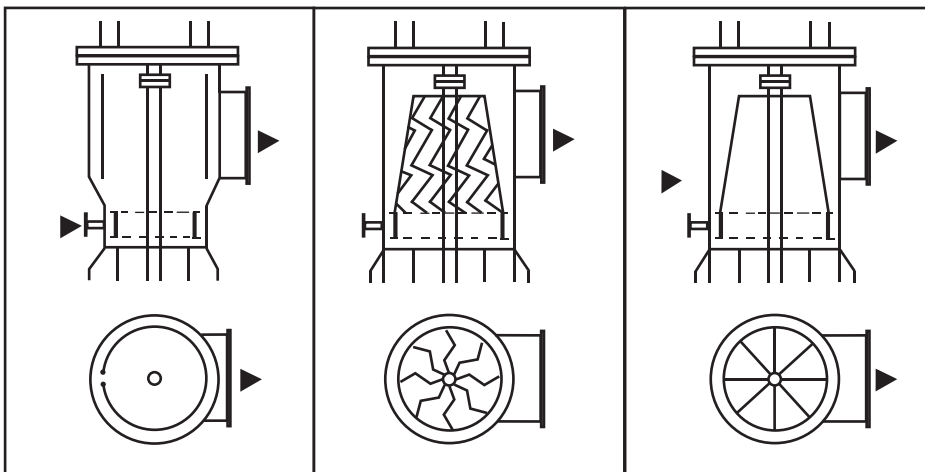


Drive unit on top of an evaporator

STATIC
ROTATION SEPARATOR

DYNAMIC
CENTRIFUGAL SEPARATOR

DYNAMIC
IMPACT SEPARATOR



Centrifugal separator

Installation sizes type DVS / DVR / DVW

Heating-surface m ²	Dimensions		
	ØD ₁ - mm	H - mm	L - mm
0,16	100	600	1800
0,4	150	900	2300
1,0	250	1300	3400
1,6	300	1800	4100
2,5	350	2400	4900
4,0	420	3000	5800
6,3	500	4000	7200
10	700	4600	7900
16	1000	5000	8700
25	1400	5800	9900
40	1700	8100	12800

Thin film dryer 10 m² for
leachate



PILOT TESTING

Thin film evaporators and dryers are often difficult to dimension because the behavior of the product is not completely predictable (depending on specific composition or content of solids). By carrying out tests in our pilot plants, the specific chemical properties of the product can be determined and the design of the apparatus optimized. This reliably prevents over-dimensioning of the plant.

Available thin film evaporators at S+P pilot plant stations

- 1 DVS 0,25 m² Rigid blade rotor
- 1 DVR 0,25 m² Radial wiper rotor, PTFE-/ GRP-inserts
- 1 DVW 0,25 m² Wiper blade rotor
- 1 DVT 0,25 m² Pendulum blade rotor

ENGINEERING

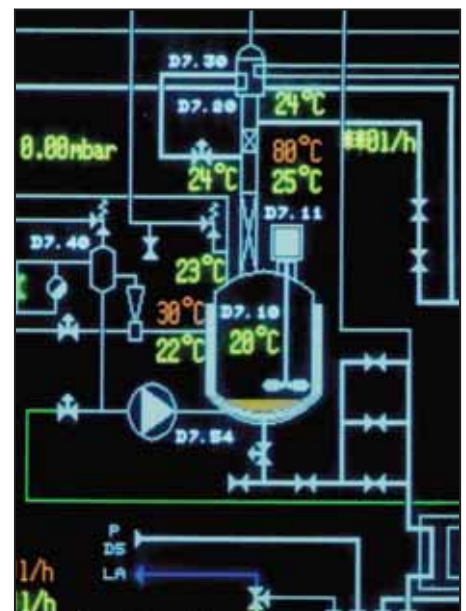
Schulz+Partner provides all the planning and processing input required for the construction of chemical and industrial plants.

- Technical pre-projects, process solutions & consulting
- Process simulation and lab-/pilot-plant testing
- Basic & detail engineering
- Automation, measuring & control engineering
- Installation & project management
- Commissioning, personnel training
- After-sales service, operator instructions

PLANTS

Schulz+Partner delivers installations out of the field of thermal process engineering

- Turn-key installations and processing units with process guarantee
- Preassembled and transportable skid-units
- Installation servicing & After sales service



FIELDS OF ACTIVITY

ENGINEERING

- Consulting
- Laboratory/pilot testing
- Process development
- Process simulation
- Project evaluation
- Basic- and detail engineering
- Installation planning 3D
- Measuring and control engineering
- Automation, Procurement of materials
- Assembling and supervision, startup
- Operators instruction

PLANT CONSTRUCTION

- Turn key plants
- Complete process units
- Premounted skid-units
- Plant equipments

MAINTENANCE

- Service contracts for all delivered plants and external plants, especially for heat pump units

EVAPORATION

- Heat pump evaporators
- Natural/forced circulation evaporators
- Falling film evaporators
- Evaporators with vapour compression
- Thin film evaporators
- Short path evaporators

CRYSTALLISATION

- Evaporation crystallisers
- Cooling crystallisers

DRYING

- Thin film dryers, 'Combi'dryers
- Heat pump dryers (batch mode)

RECTIFICATION - ABSORPTION

- Rectification columns
- Trays and structured packings
- Absorption columns

LIQUID-LIQUID-EXTRACTION

- Extraction columns, agitated and pulsed
- Mixer-Settlers
- Multistage reaction columns

- CONCENTRATED ON SOLUTIONS -

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