



# THIN FILM APPARATUS

ENGINEERING · TESTS · APPARATUS · COMPLETE PLANTS

## THIN FILM EVAPORATOR

rigid blade  
wiper blade  
radial wiper

## SHORT PATH EVAPORATOR

## THIN FILM DRYER

pendulum blade

## THERMAL PROCESS ENGINEERING

# FUNDAMENTALS

## SYSTEM

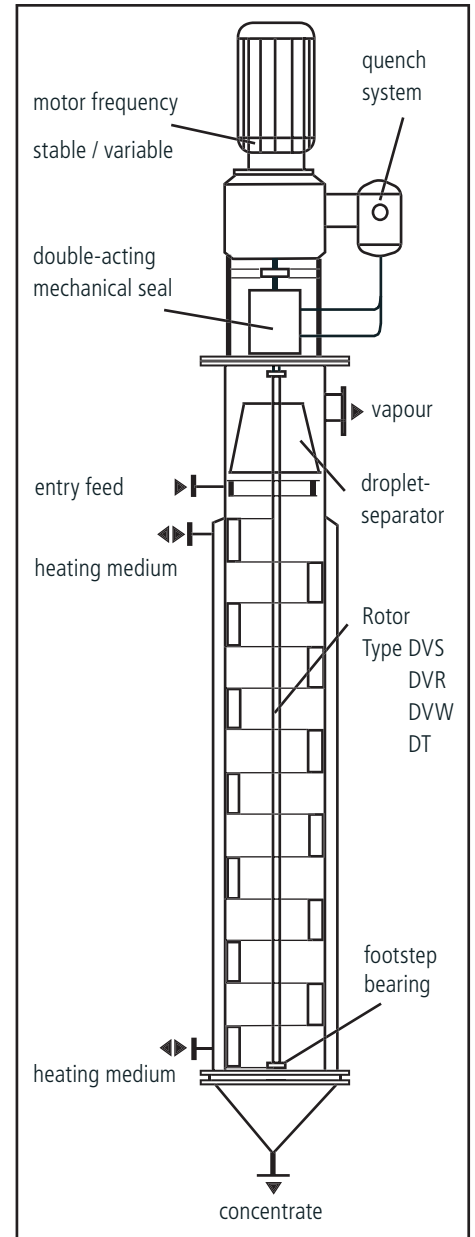
The thin film technology includes all thermal processes in mechanically produced thin films. Depending on the application, different types of thin film evaporator have been developed for specific uses.

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 kPa								Product Viscosity mPa s						Evaporation Rate %							
	10 <sup>2</sup>	10 <sup>1</sup>	1	10 <sup>-1</sup>	10 <sup>-2</sup>	10 <sup>-3</sup>	10 <sup>-4</sup>		10	10 <sup>2</sup>	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>6</sup>		70	75	80	85	90	95	
<b>Thin film evaporator</b> Type DVS rigid blade	█								█									█				
<b>Thin film evaporator</b> Type DVR wiper blades	█								█									█				
<b>Thin film evaporator</b> Type DVW radial wiper	█								█									█				
<b>Short path evaporator</b> Type DVK				█					█									█				
<b>Thin film dryer</b> Type DT	█								█									█				
<b>Thin film heat exchanger</b> Type DW	█								█									█				

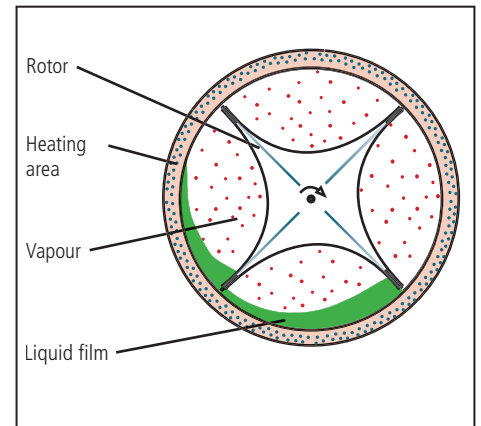
## ■ IMPLEMENTATION ▪ RANGE OF APPLICATION

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.

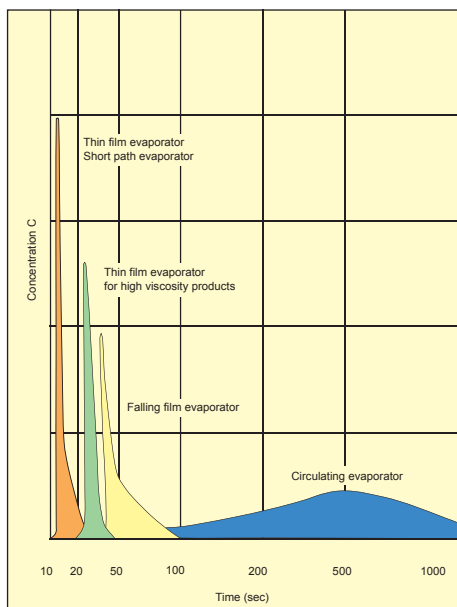


Thin film principle

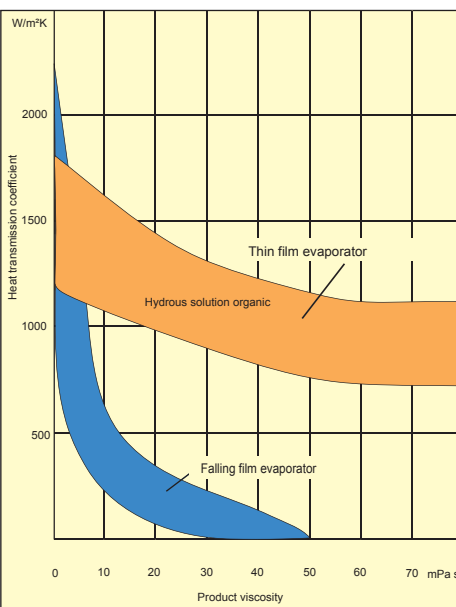


Thin film evaporator, type DVW 6.3

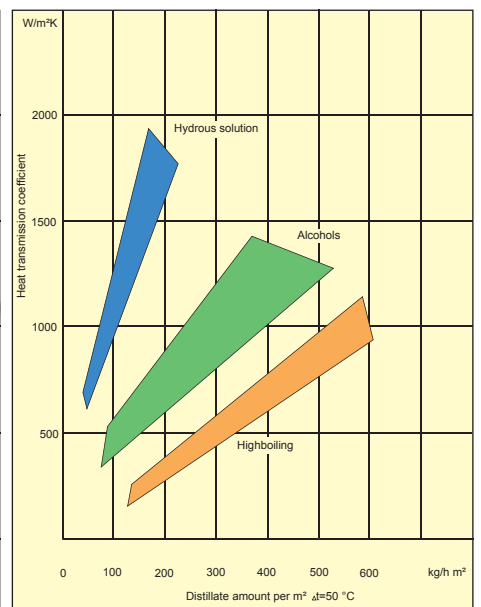
Comparison: dwell time of diverse apparatus



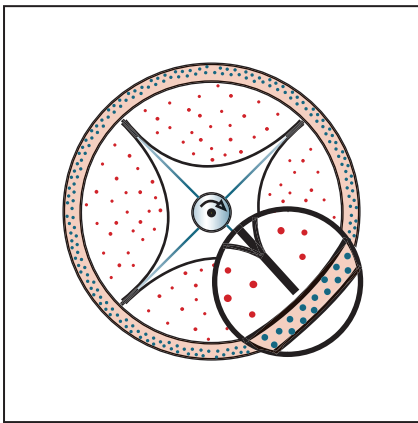
Comparison: thin film-/falling film evaporator



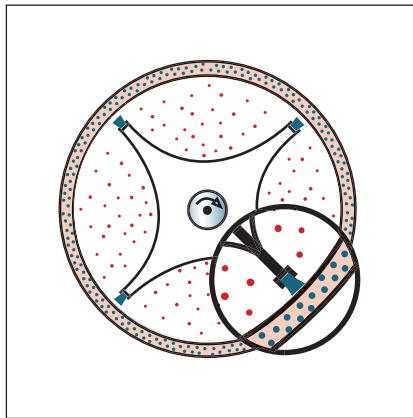
Comparison: distillate capacities



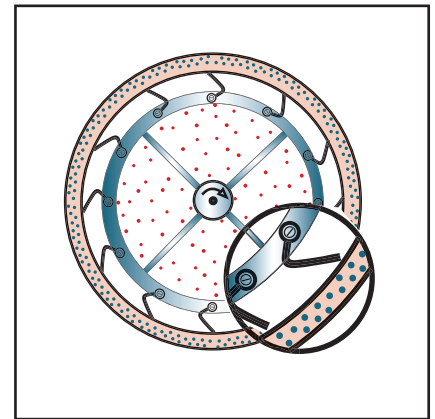
# ROTOR CONSTRUCTION



RIGID BLADE  
TYPE DVS



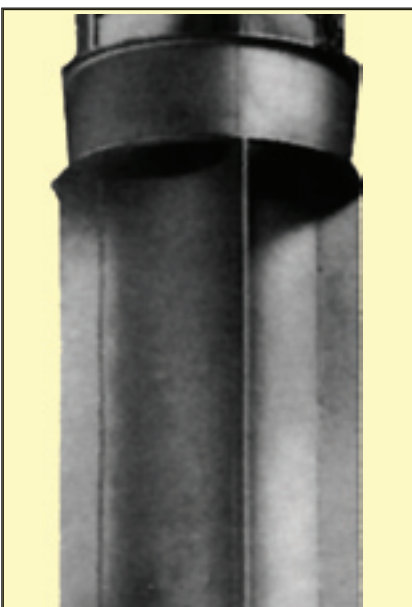
RADIAL WIPER  
TYPE DVR



WIPER BLADES  
TYPE DVW

DVS	DVR	DVW	Type
high (up to 8 m/s)	low (up to 3 m/s)	low (up to 3 m/s)	Rotor speed
no	yes	yes	Wall contact
yes	no	no	Necessity of bearing lubrication
max. 300°C	max. 250°C	max. 400°C	Temperature range
>10 <sup>-1</sup> kPa	>10 <sup>-1</sup> kPa	>10 <sup>-1</sup> kPa	Pressure - Vacuum
max. 40'000 mPa s	max. 20'000 mPa s	max. 20'000 mPa s	Viscosity
max. 80 Vol. %	max. 98 Vol. %	max. 95 Vol. %	Evaporation grade
no	yes	yes	Solids content (Suspension)
no	no	yes	Crystallisation

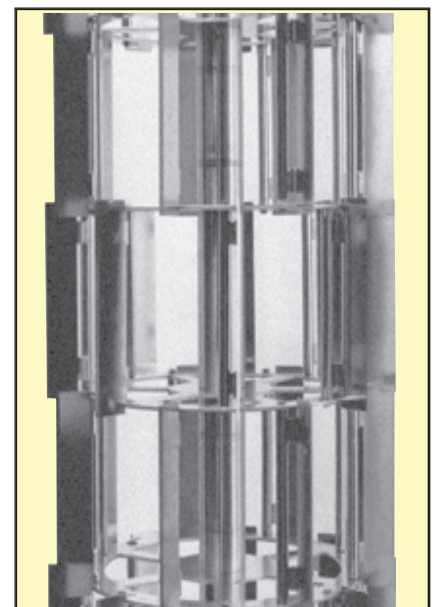
Rigid blade rotor type DVS

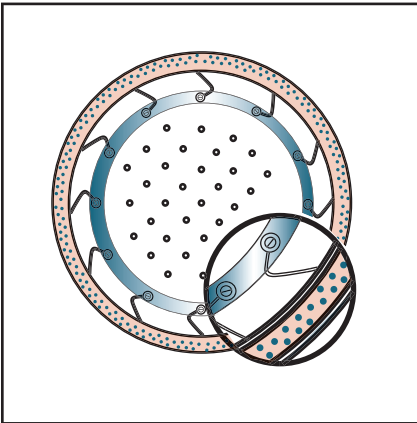


Radial wiper rotor type DVR

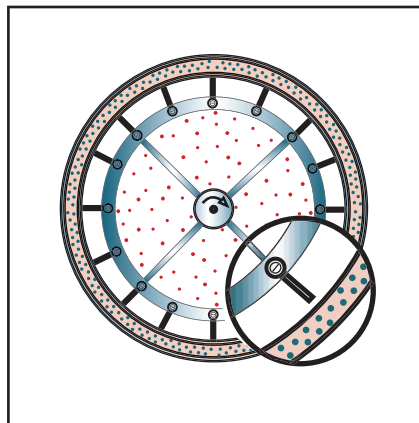


Wiper blades type DVW





**WIPER BLADES**  
TYPE DVK



**PENDULUM BLADES**  
TYPE DT

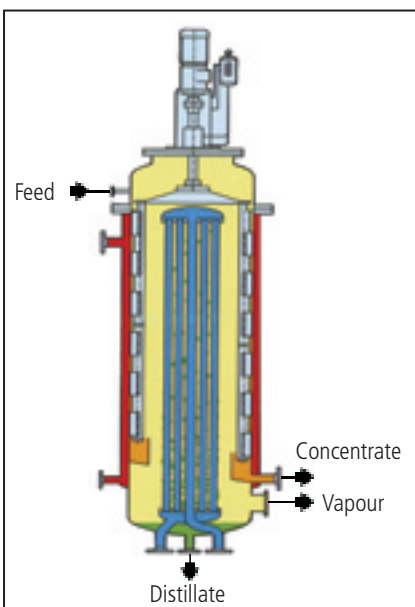
## THIN FILM DRYER

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.

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.

DVK	DT
low (up to 2 m/s)	high (up to 9 m/s)
yes	no
no	no
max. 300°C	max. 400°C
$>10^{-3}$ kPa	1 kPa
max. 15'000 mPa s	max. 15'000 mPa s
max. 95 Vol. %	max. (93-100) Vol. %
no	yes
no	yes

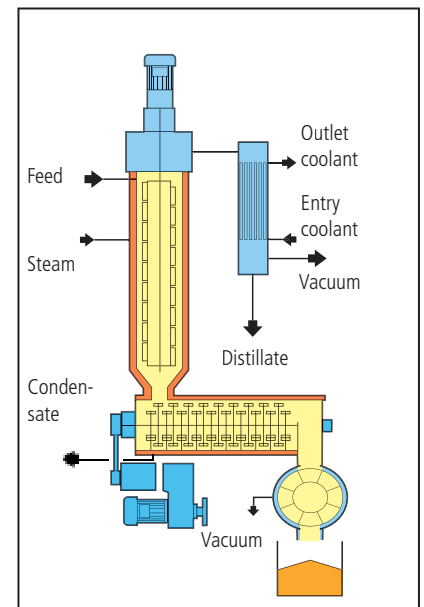
Short path evaporator



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

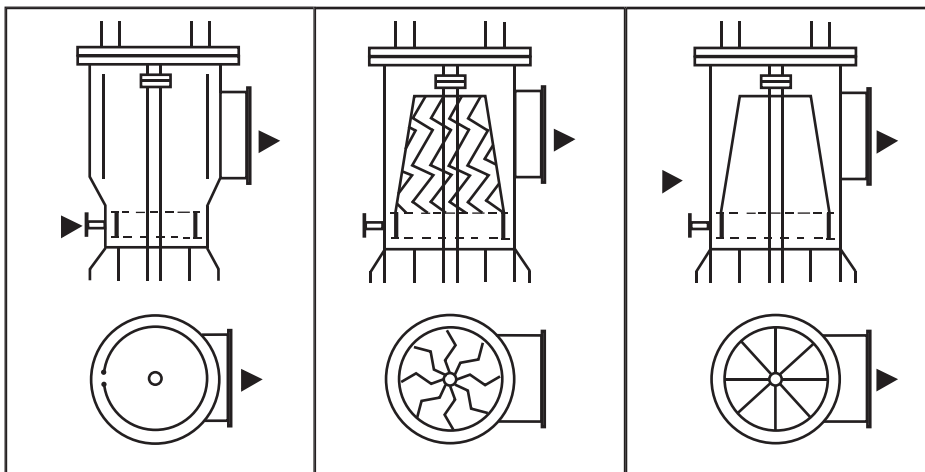


Drive unit on top of an evaporator

STATIC  
ROTATION SEPARATOR

DYNAMIC  
CENTRIFUGAL SEPARATOR

DYNAMIC  
IMPACT SEPARATOR



Centrifugal separator

Installation sizes

	Heating-surface m <sup>2</sup>	Dimensions		
		ØD <sub>1</sub> - 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 m<sup>2</sup> 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 m<sup>2</sup> Rigid blade rotor
- 1 DVR 0,25 m<sup>2</sup> Radial wiper rotor, PTFE-/ GRP-inserts
- 1 DVW 0,25 m<sup>2</sup> Wiper blade rotor
- 1 DVT 0,25 m<sup>2</sup> Pendulum blade rotor

## ENGINEERING

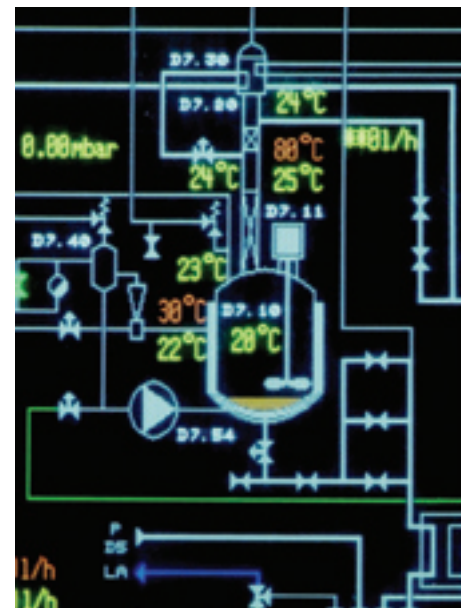
Schulz+Partner provides all the planning and processing input required for the construction of chemical and industrial plants.

- 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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