

Delayed coking Seminar

SULZER

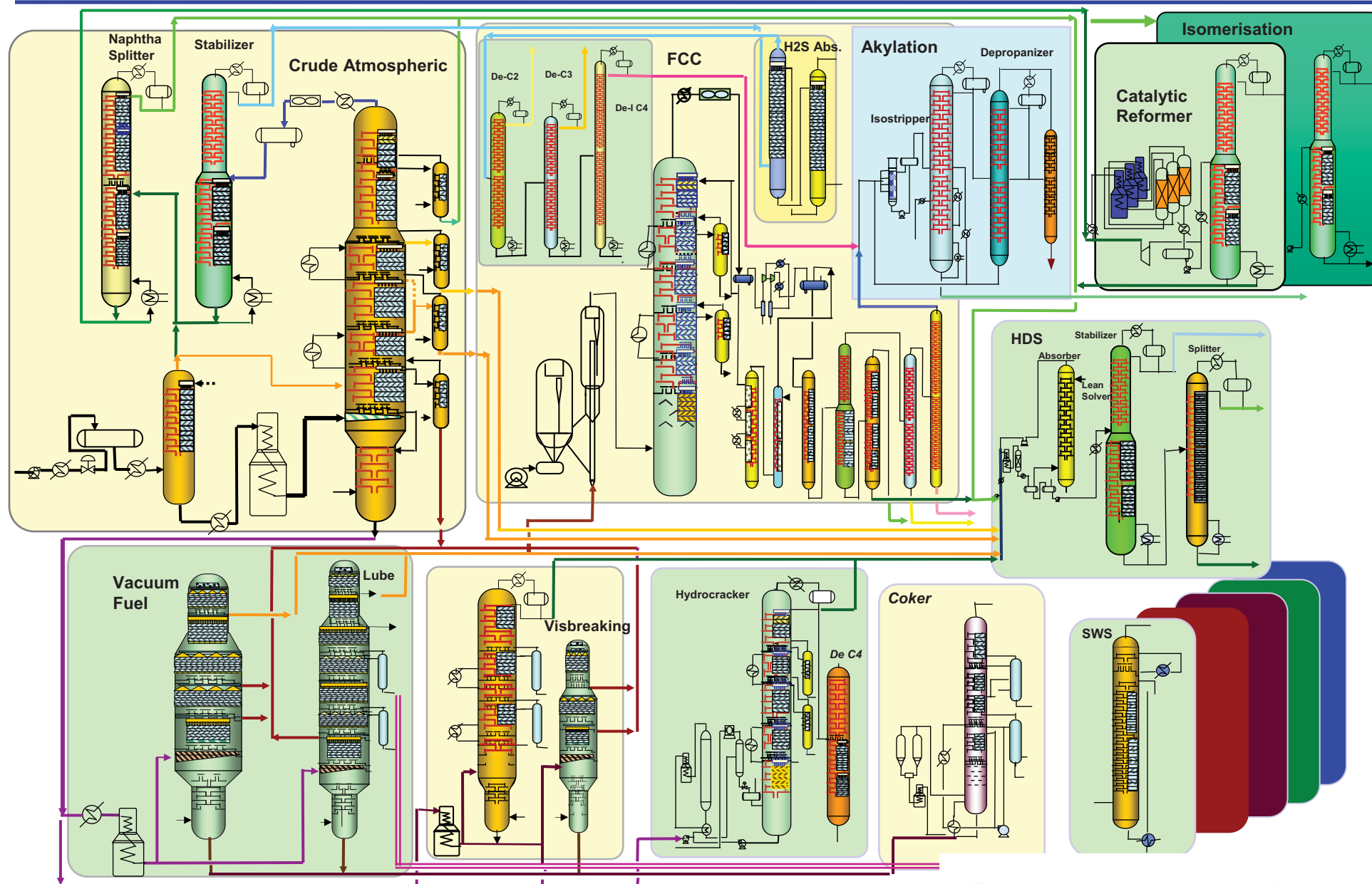
The First Name in Mass Transfer
The Only Name in Service

Presented by
Vilas Lonakadi

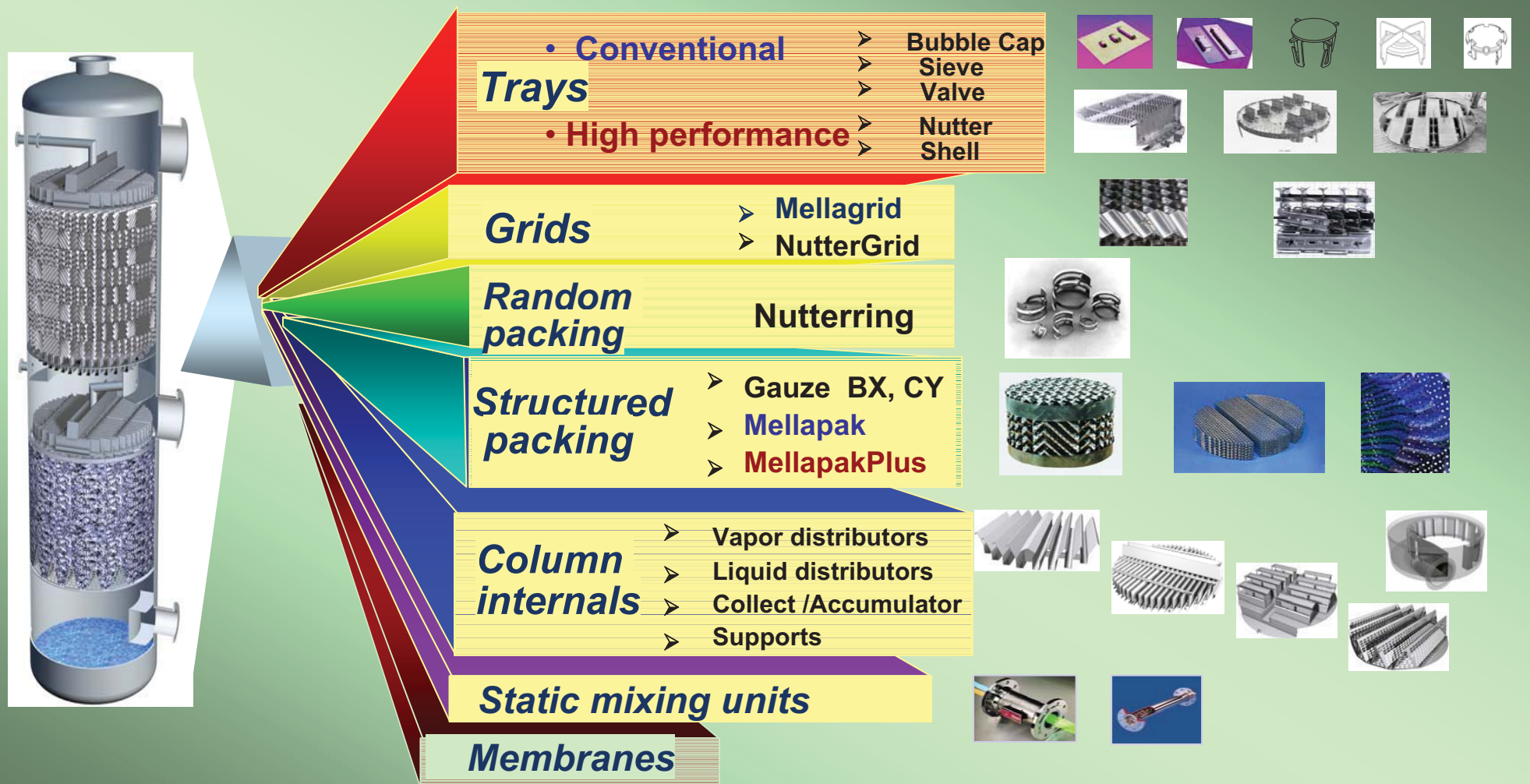
19th April, 2005 Houston, Texas



The Refinery Applications

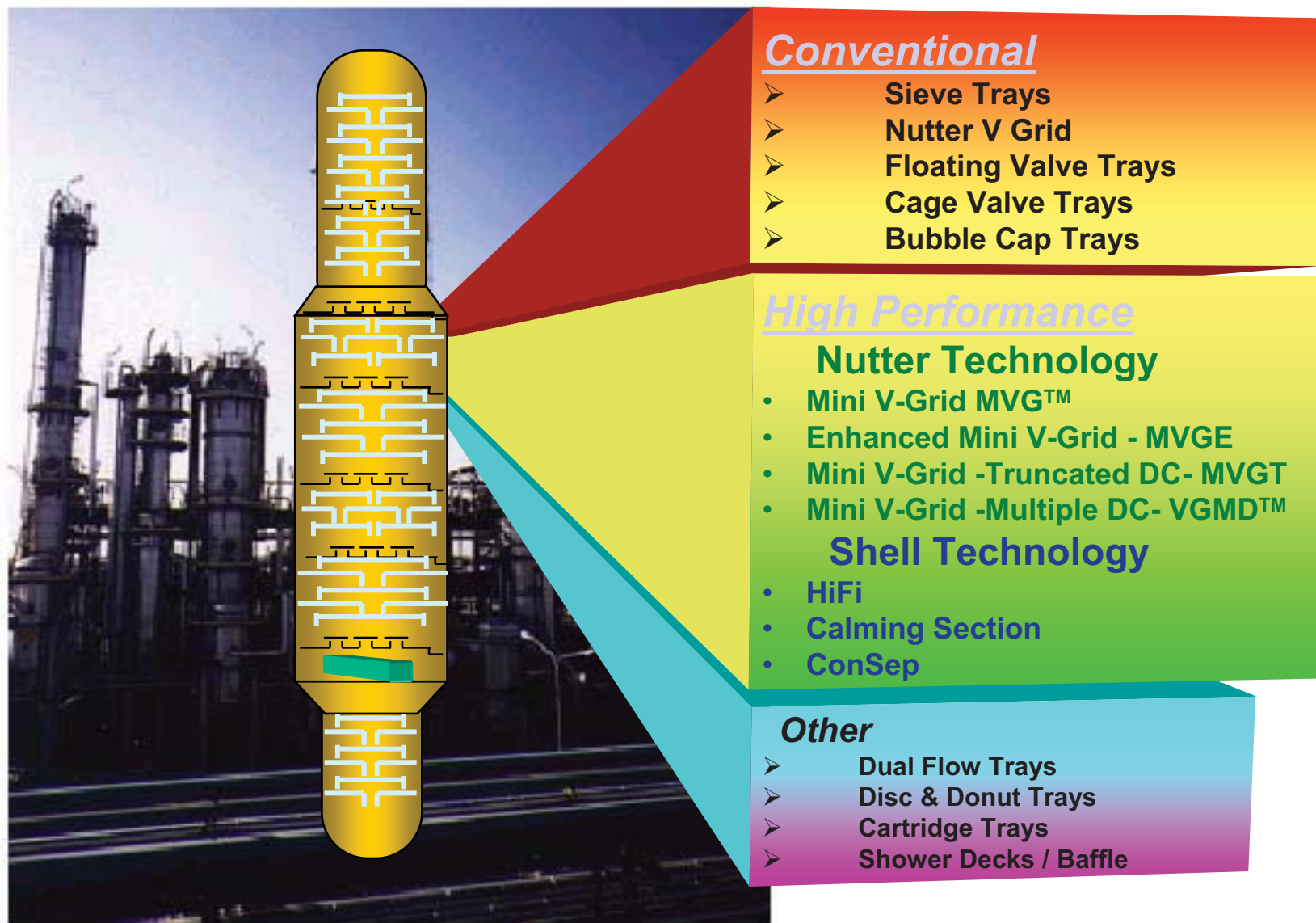


Mass Transfer Technologies: Products



The full spectrum of Mass transfer Components for the most efficient and economical solution

Sulzer global TRAY portfolio



V-GRID™ Trays (fixed-valve)

SULZER

Sulzer Chemtech

LVG Trays



SVG Trays



MVG Trays



Advantages

- Simple Design
- High Capacity* at Low Cost
- Fouling resistant
- Short Installation Time
- Smaller Grassroots Towers*
- High Turndown*
- **MVG** - Highest capacity-efficiency

* Compared with Sieve trays

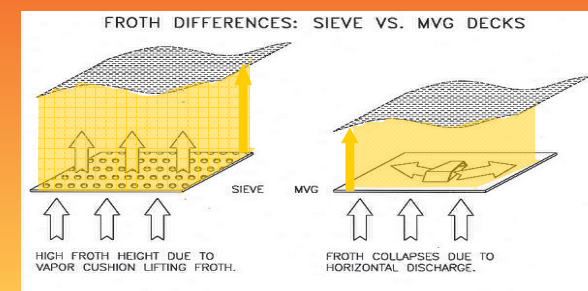
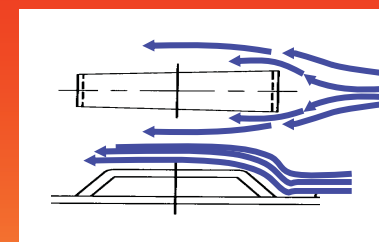
هر آنچه یک مهندس شیمی نیاز دارد

t.me/Chem_Eng_World

Valve trays (fixed-valve)

V-GRID™ Trays - ADVANTAGES

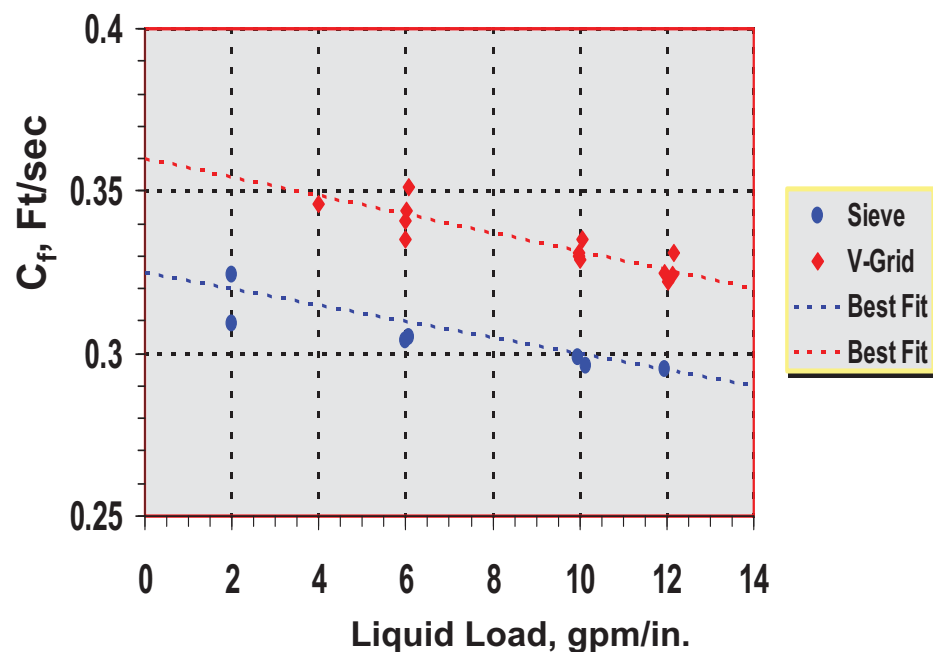
- Tapered slot of V-Grid reduces **Weeping**
- Lateral release of vapor decrease **Entrainment**
- Lateral release of vapor at tray deck
Reduce Fouling by effectively wiping deck clear.
- **Superior strength**
Forming of V-grid from tray deck; cross sectional 3 times stronger than sieve tray



V-GRID™ Trays (fixed-valve)

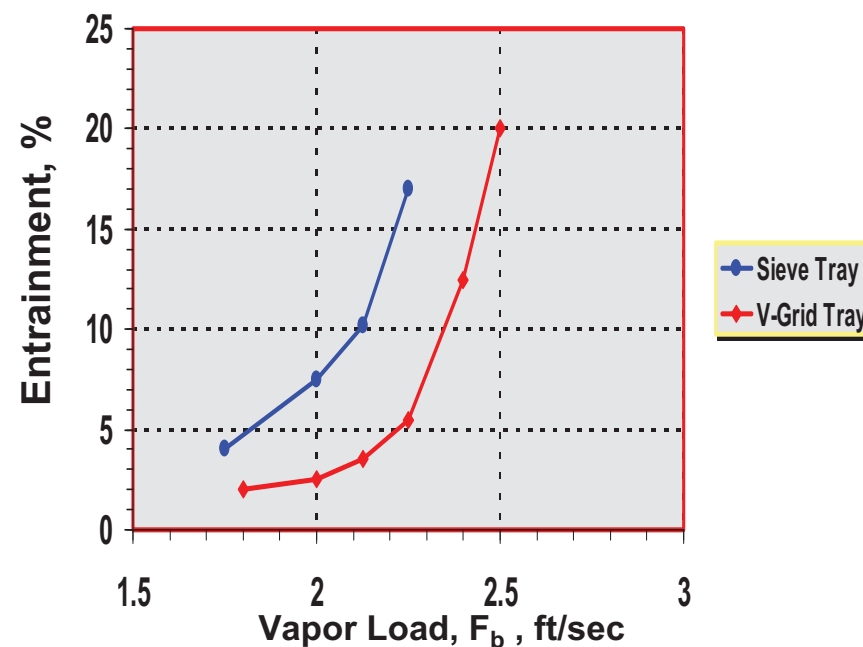
Sieve Tray & V-Grid Capacity

10% Observed Entrainment
4' Test Column, 24" Tray
Spacing - Air/Isopar M



Sieve Tray & V-Grid Capacity

2 GPM/in. Weir Loading
4' Test Column, 18" Tray
Spacing - Air/Isopar M



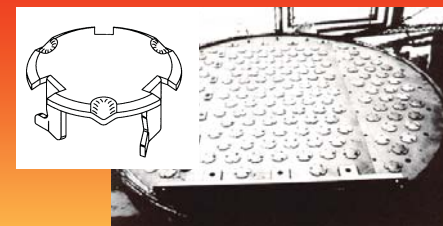
Float Valve Trays

Conventional Trays

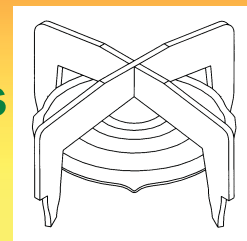
➤ Floating Valve Trays

V type

Metawa Snap in

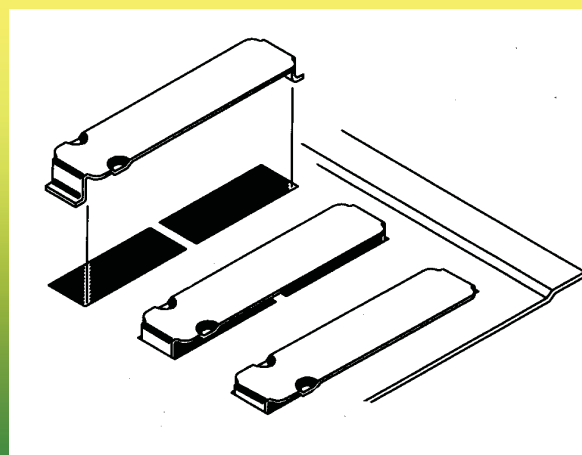


Cage Valve Trays



Sulzer

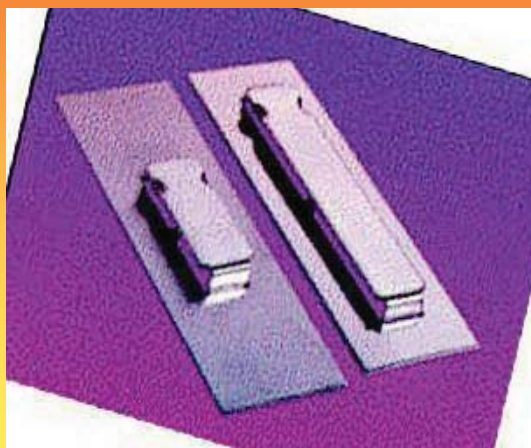
BDH and **BDP**
Float Valve Trays



BDH / BDP Float Valve Trays

Conventional

BDH and BDP Float Valve Trays



Lateral (axial) Vapor Release

- Assures Uniform contacting in ALL Active Area
- Turndown: 3 to 7 : 1
- Capacity high to very high.
- High efficiency .
- Pressure Drop moderate.

Wide Valve legs

- Prevents Weeping
- Reduces chances of damage during installation
- Easily crimped shut for reduced vapor flow

Longer Life:

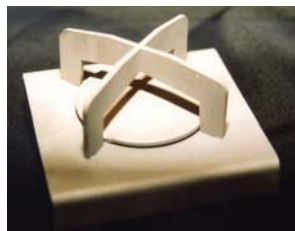
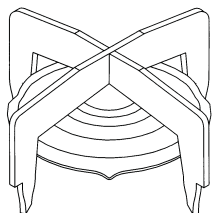
- NO wear due to valve spinning
- Top side replacement

FRI tested

Sulzer Global Tray Portfolio

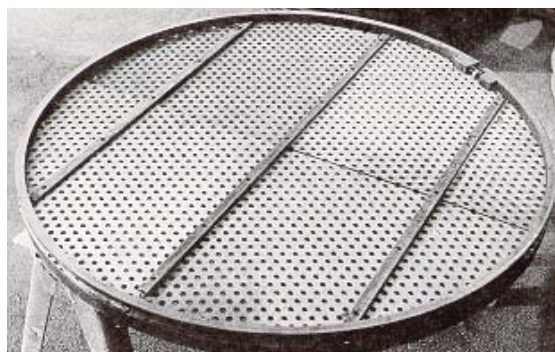
Cage valve tray

- Capacity relatively high.
- Efficiency lower than other tray types.
- Pressure Drop low to moderate.
- Narrow optimum performance range
- Suitable for high fouling services.



Dualflow Tray

- Perforated deck with no downcomers.
- Tray action is simultaneous eruption & drainage of liquid when vapor forced clusters of holes.
- Capacity relatively high.
- Efficiency lower than other tray types.
- Pressure Drop low to moderate.
- Narrow optimum performance range
- Suitable for high fouling services.

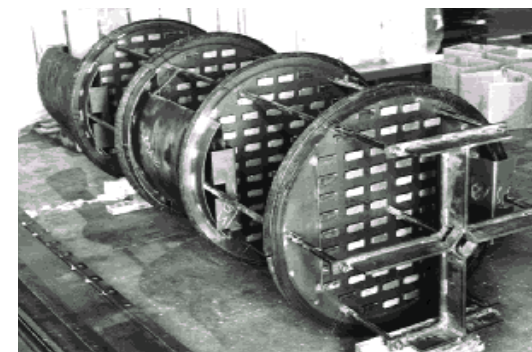


Cartridge Trays

- For small column diameter (< 800mm)
- equipped with Valve, V-Grid, Sieve, Bubble cap

and

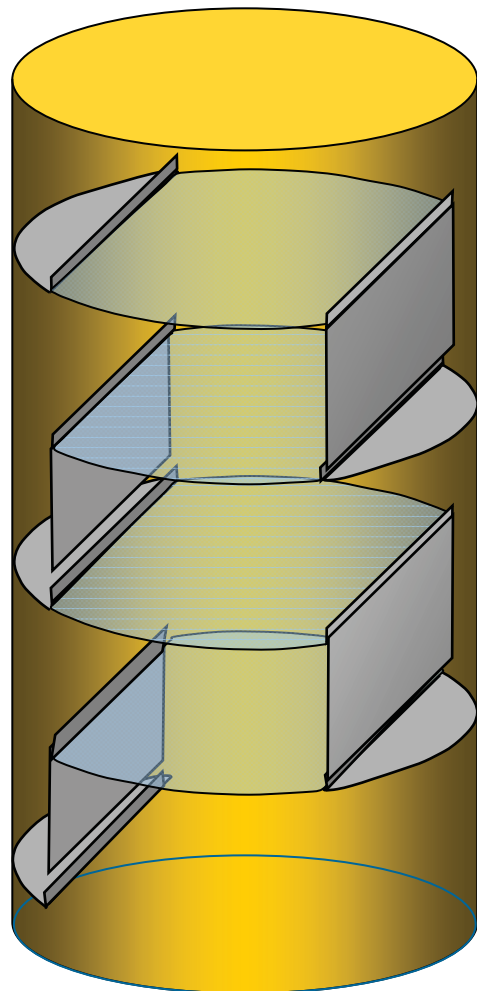
- EXXON Jet - Tab Trays
- Transition & Chimney Trays



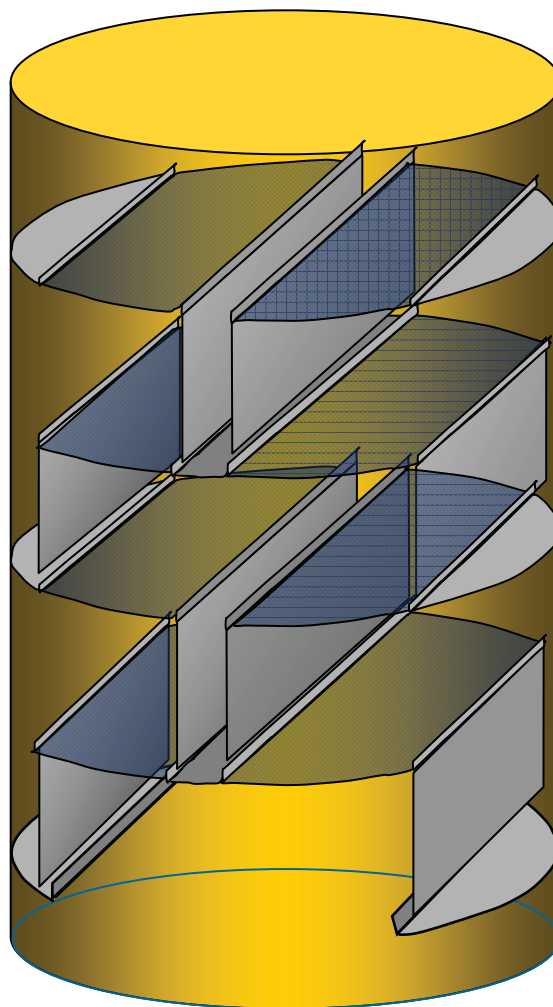
Sieve Tray, Round valve tray and bubble cap trays also available

Conventional Tray

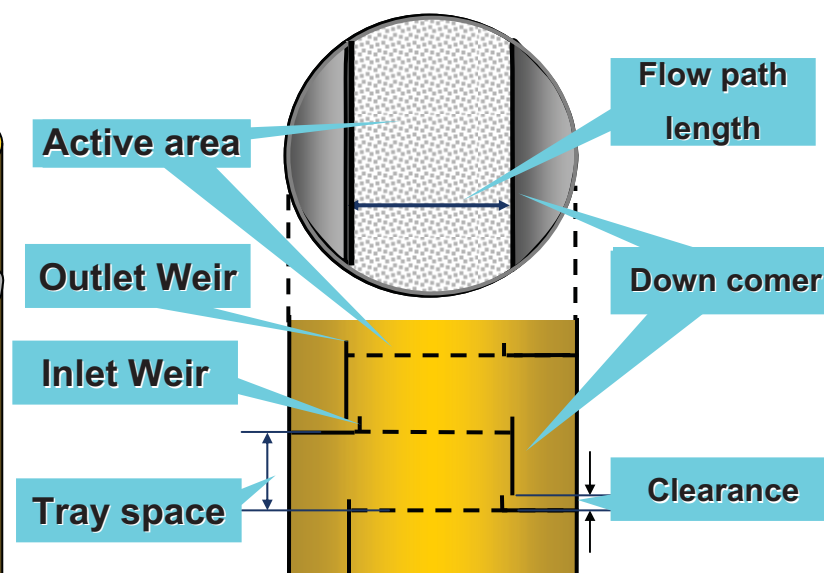
One Pass Tray
Straight Down comer



Two Pass Tray
Straight Down comer



Tray features



Advantages

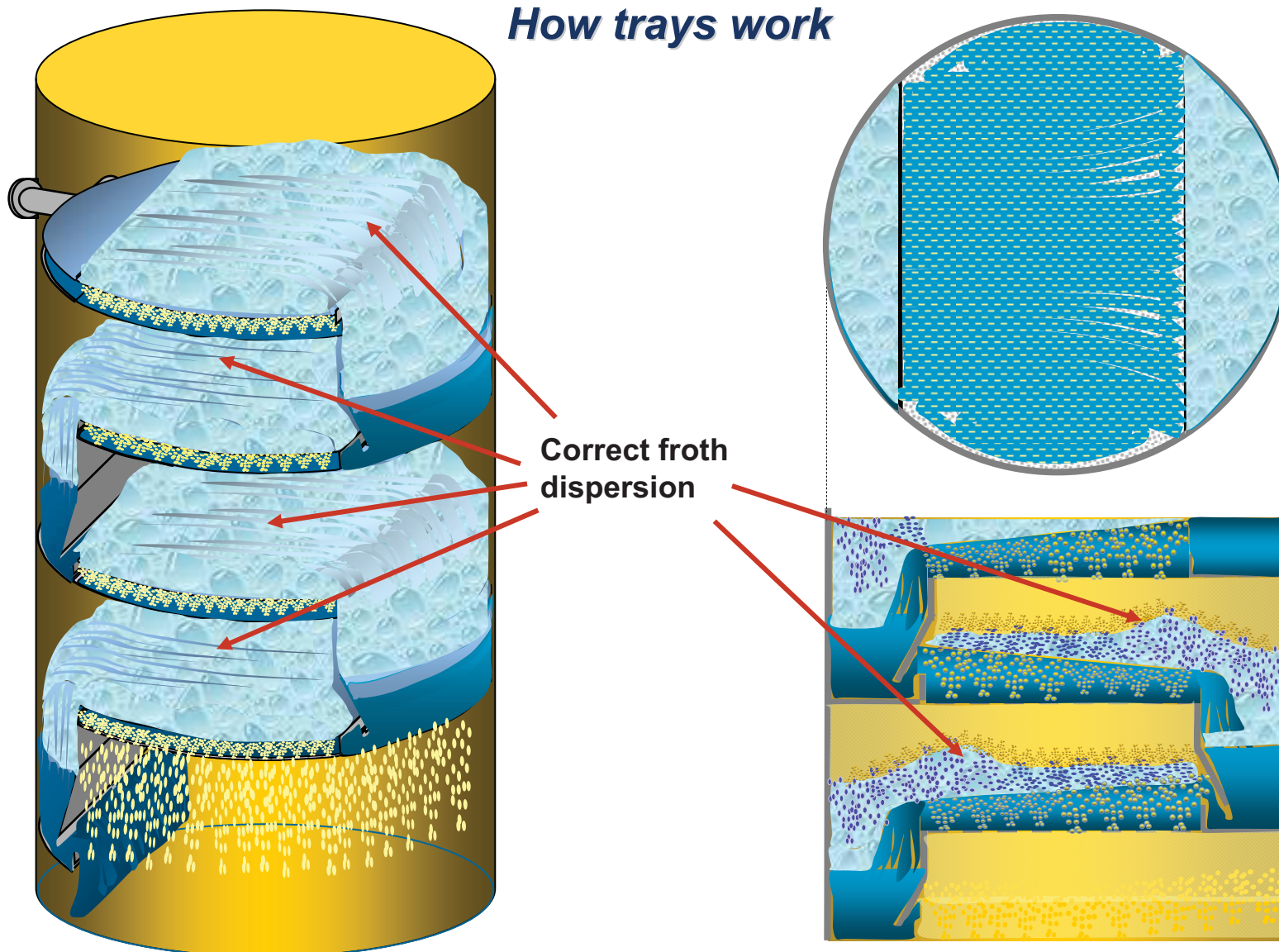
- Simple design

Disadvantages

- Limited Capacity

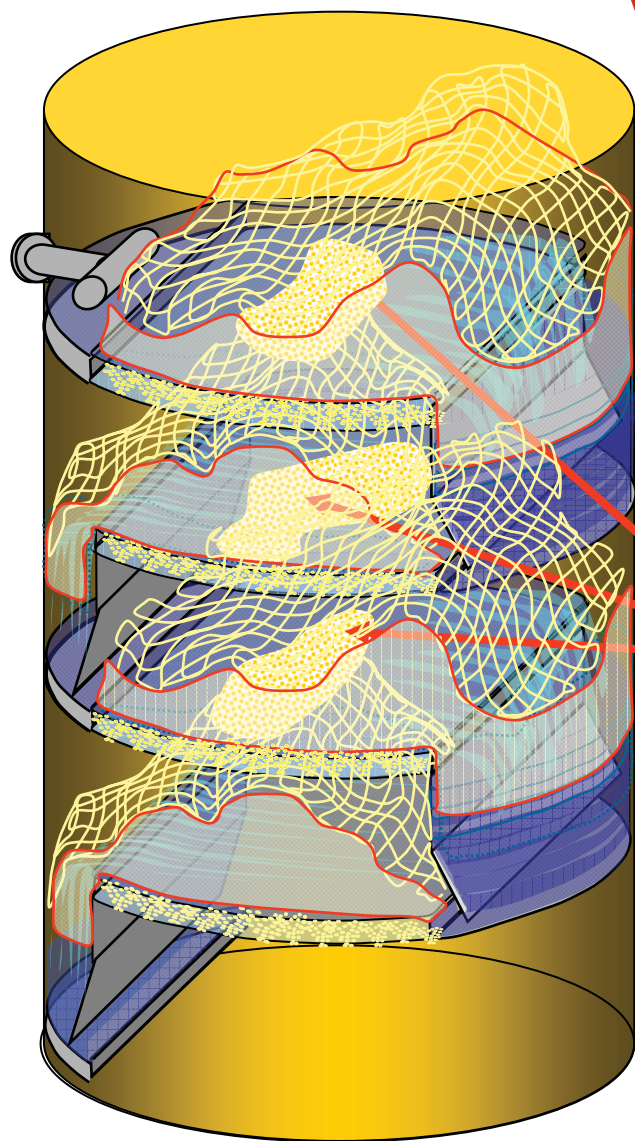
Conventional Tray

How trays work

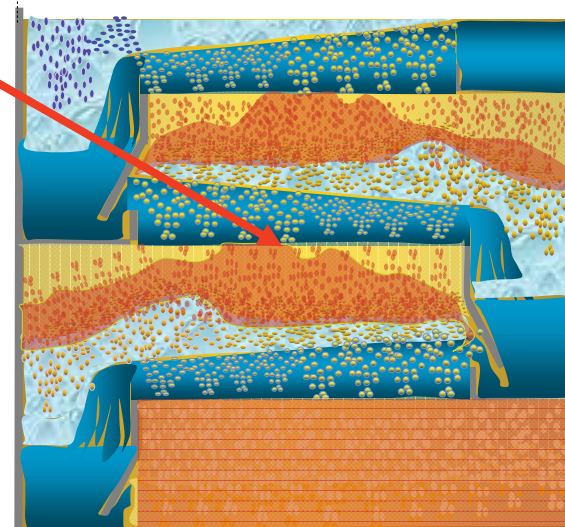
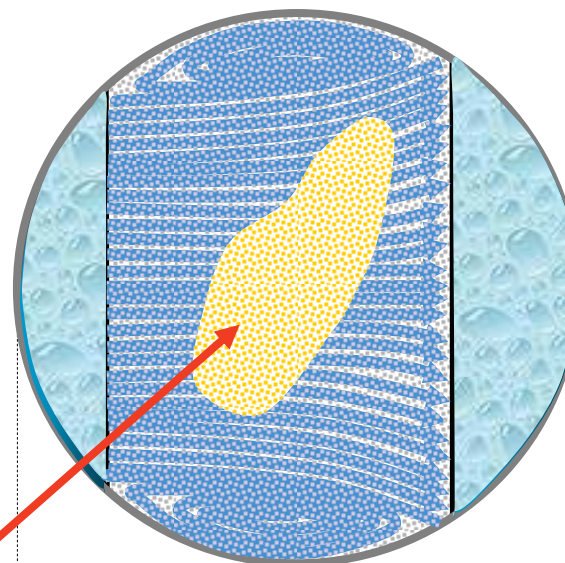


Conventional Tray

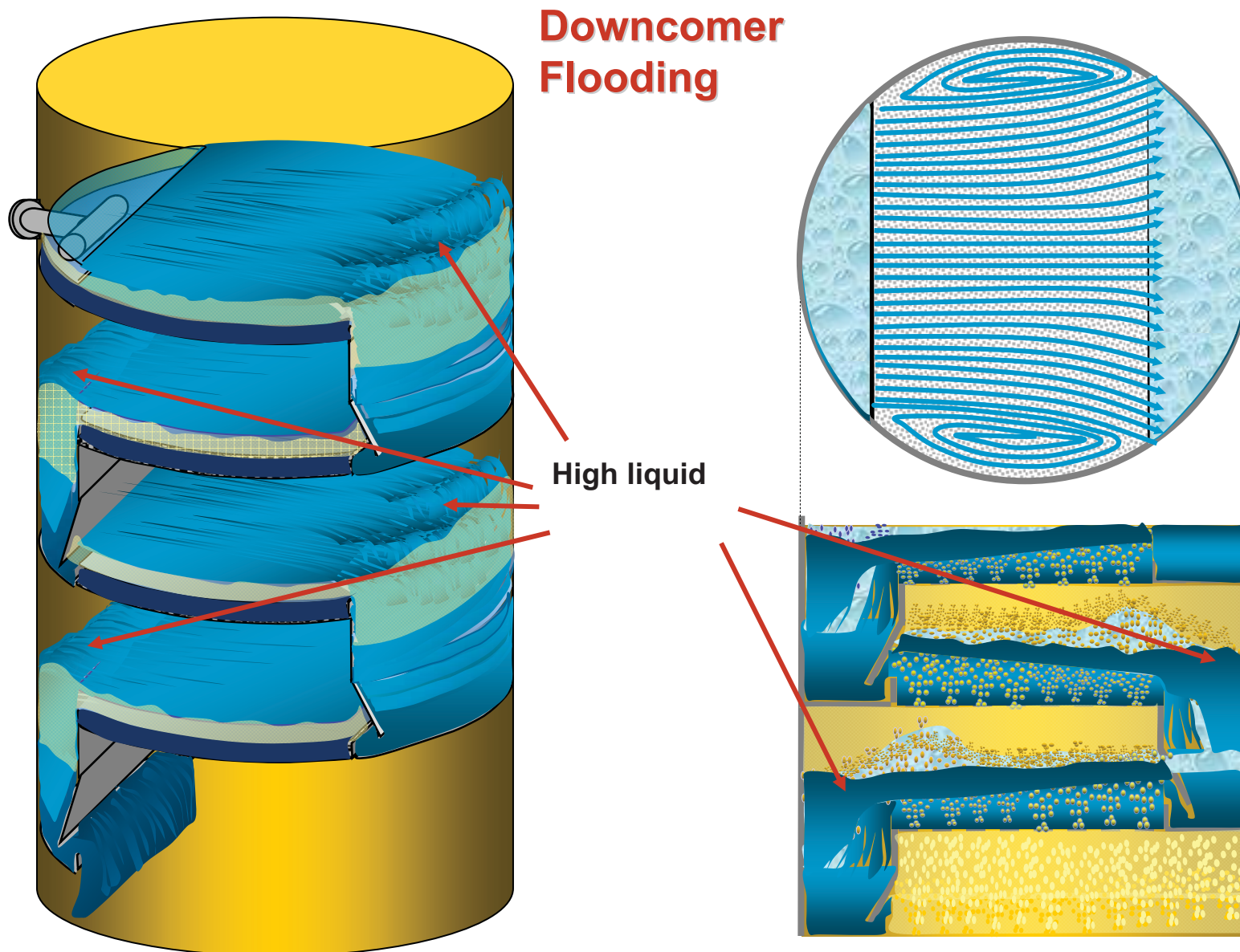
Vapor Flooding



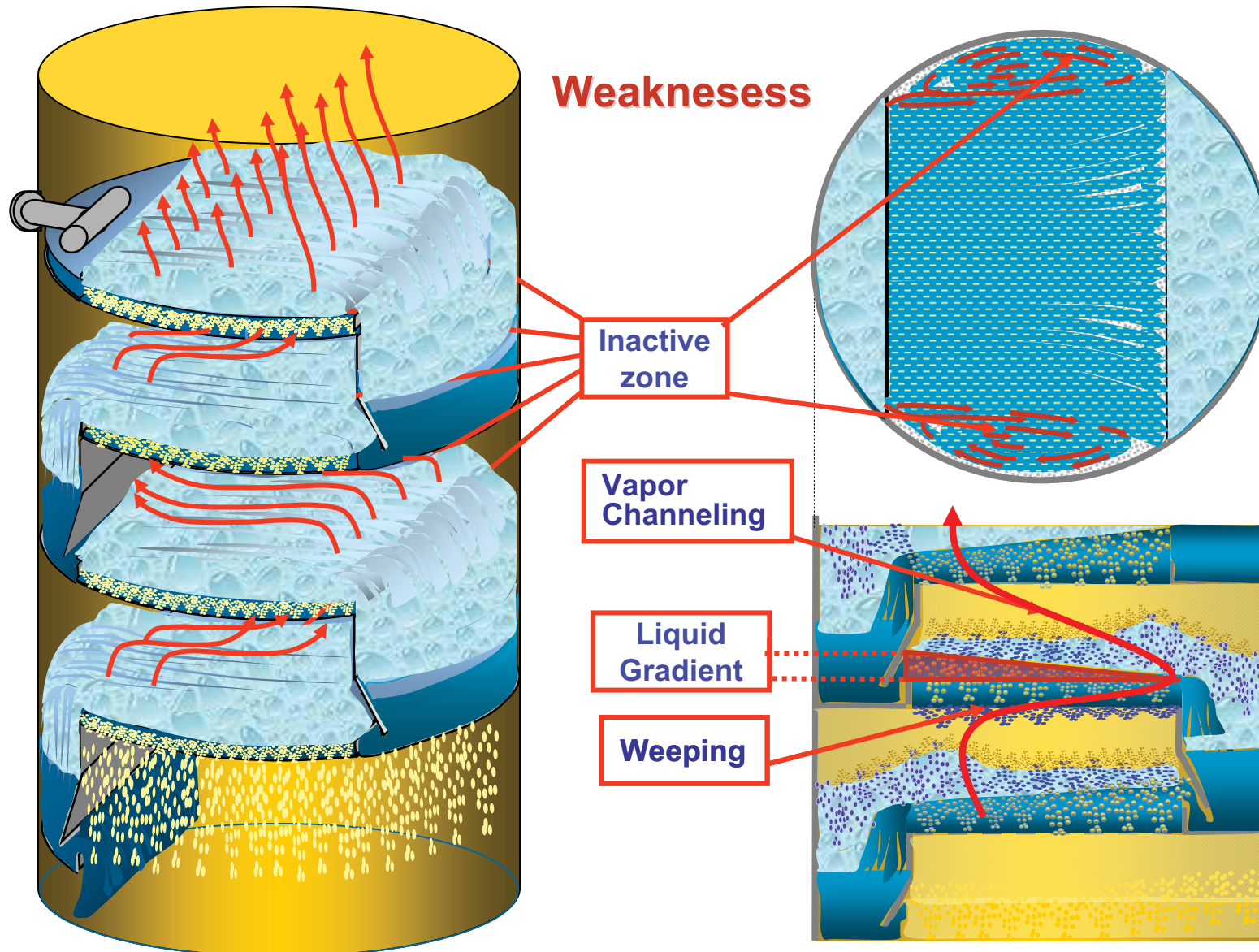
Entrainment



Conventional Tray



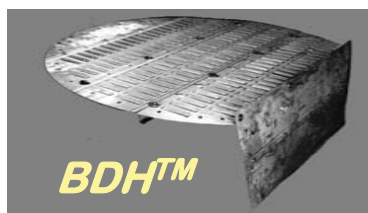
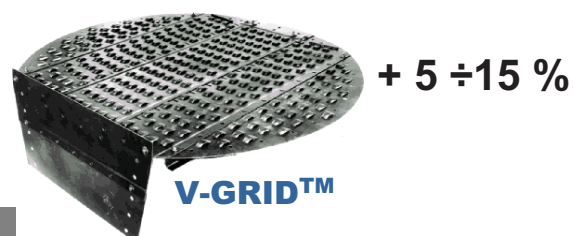
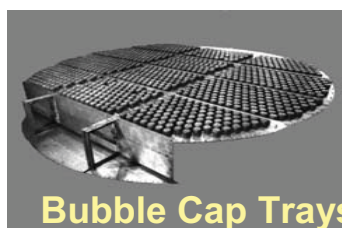
Conventional Tray



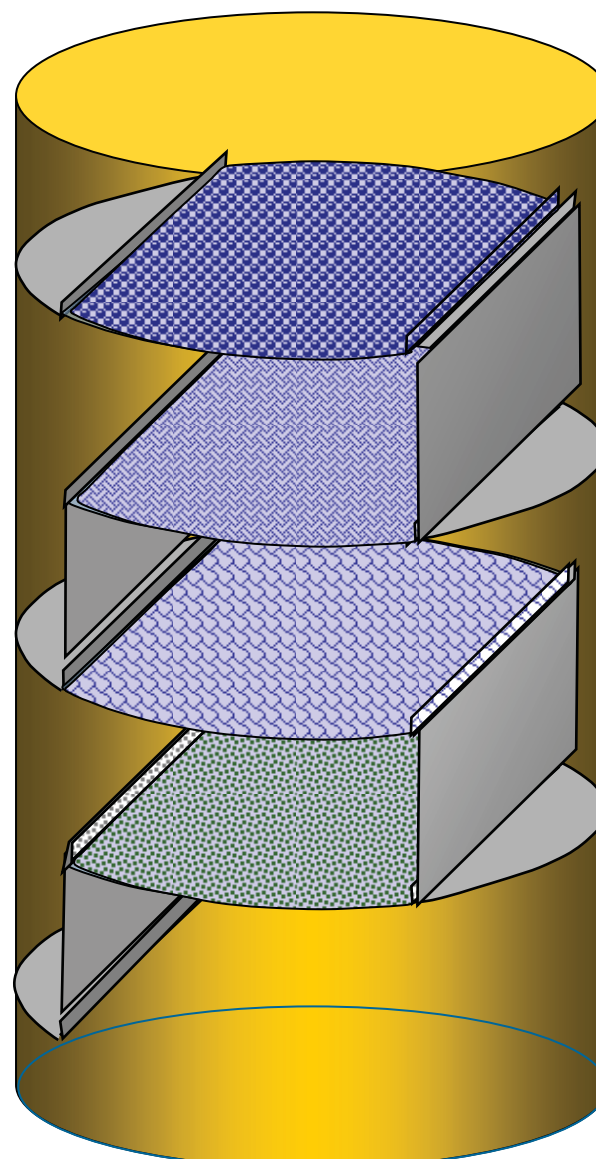
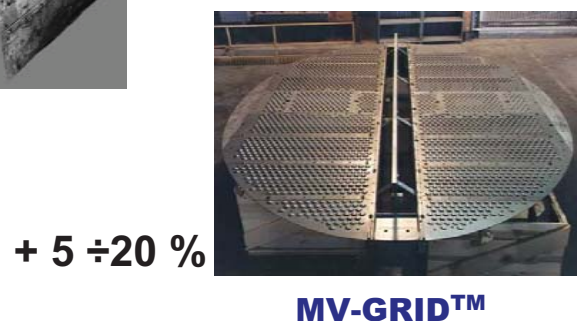
Conventional Tray

Increase tray capacity by:

... type of perforation



+ 5 ÷ 15 %

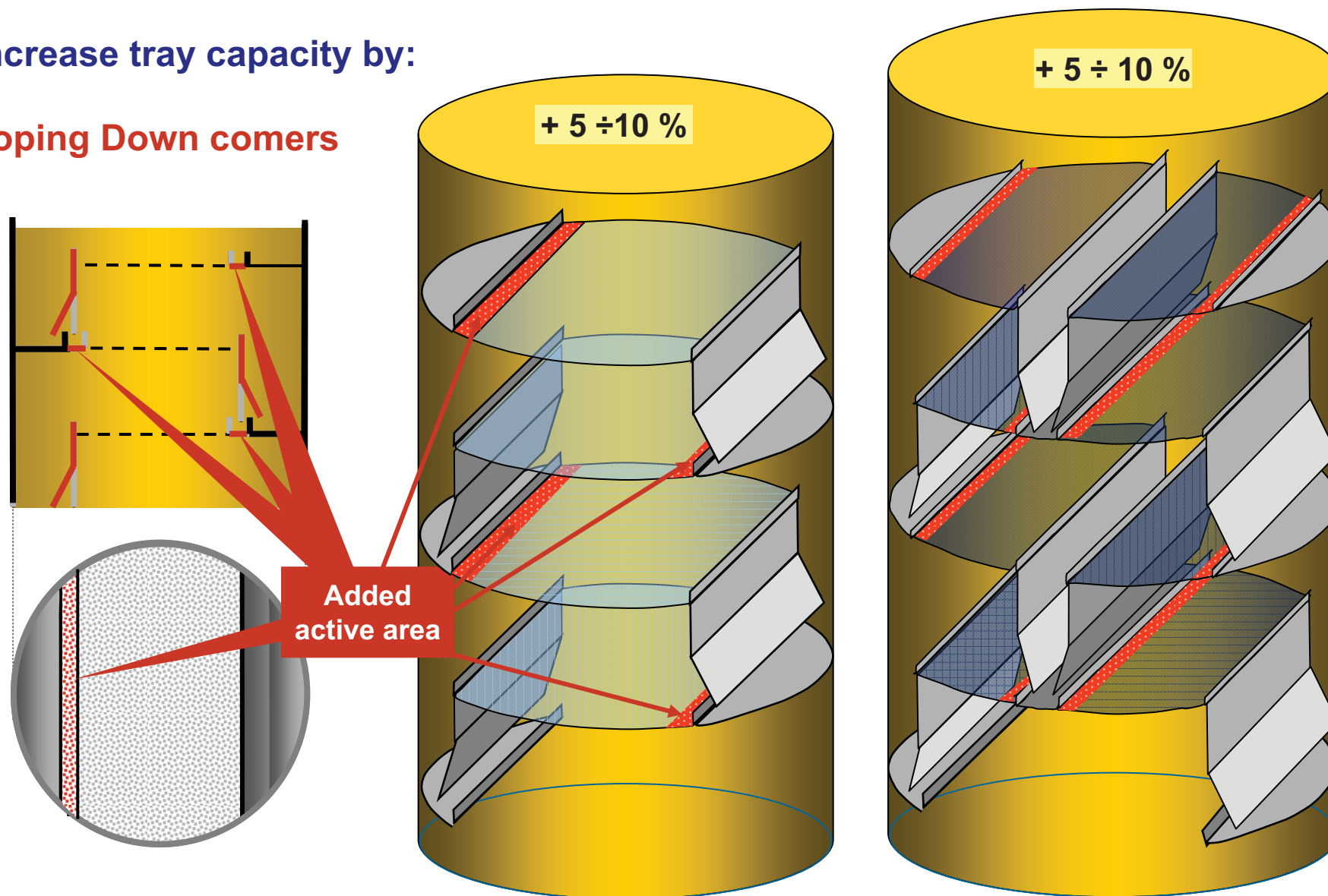


How To Boost Tray Performances Up ?

- ➔ ***Maximize Bubbling Area***
 - ✱ ***Reduce Jet Flooding***
 - ✱ ***Reduce Entrainment***
- ➔ ***Optimize Down Comer Design***
 - ✱ ***Reduce Choke Flooding***
 - ✱ ***Reduce Liquid Back up***
 - ✱ ***Reduce DC Aerated Flooding***
- ➔ ***Maximize Outlet Weir Length***
 - ✱ ***Reduce Crest height***
- ➔ ***Optimize Down Comer Inlet Area***
 - ✱ ***Reduce Hydraulic liquid Gradient***
 - ✱ ***Eliminate Inactive Zones***

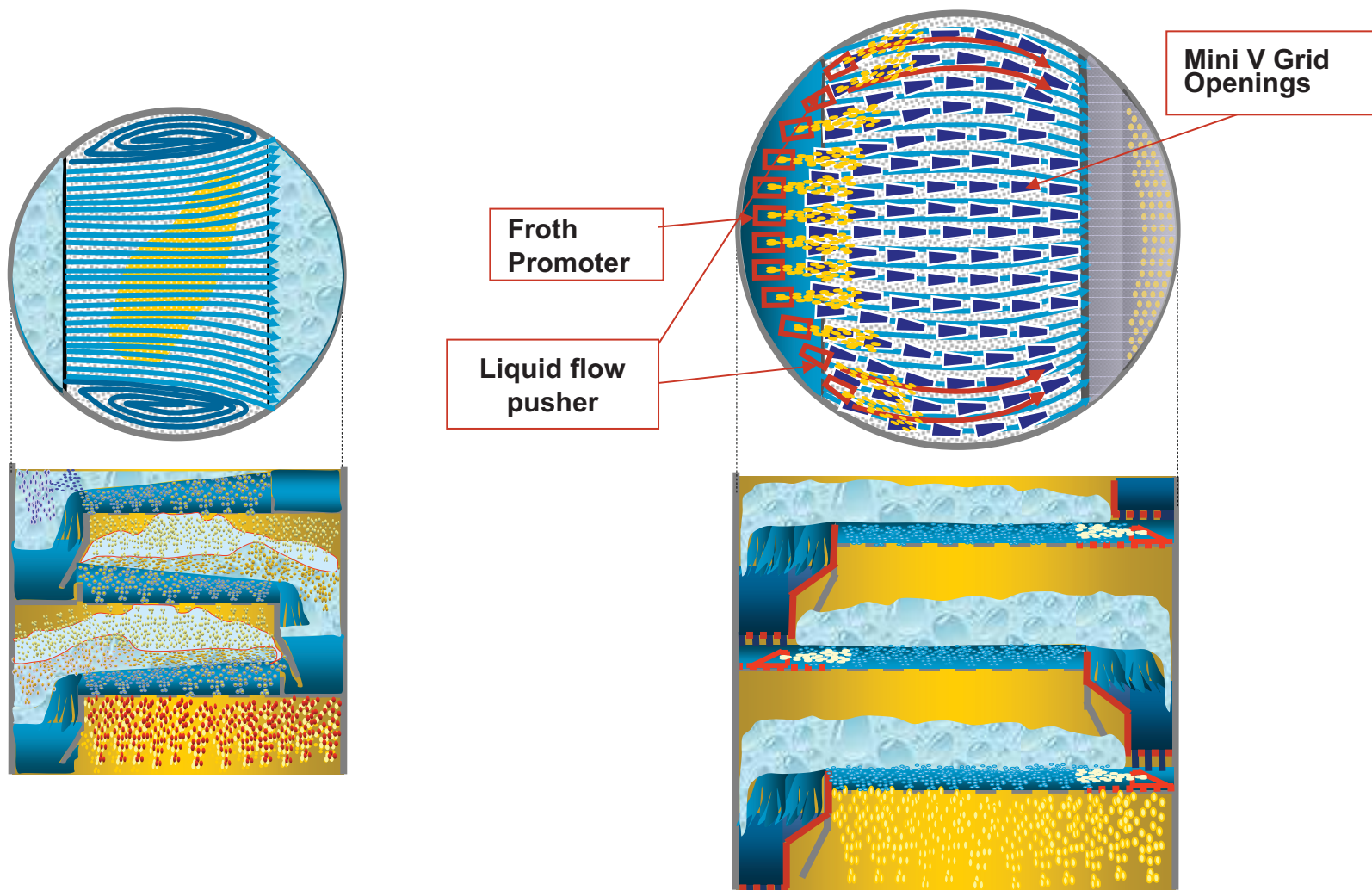
Conventional Tray

Increase tray capacity by:
sloping Down comers



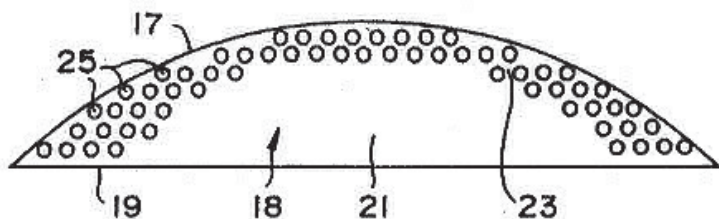
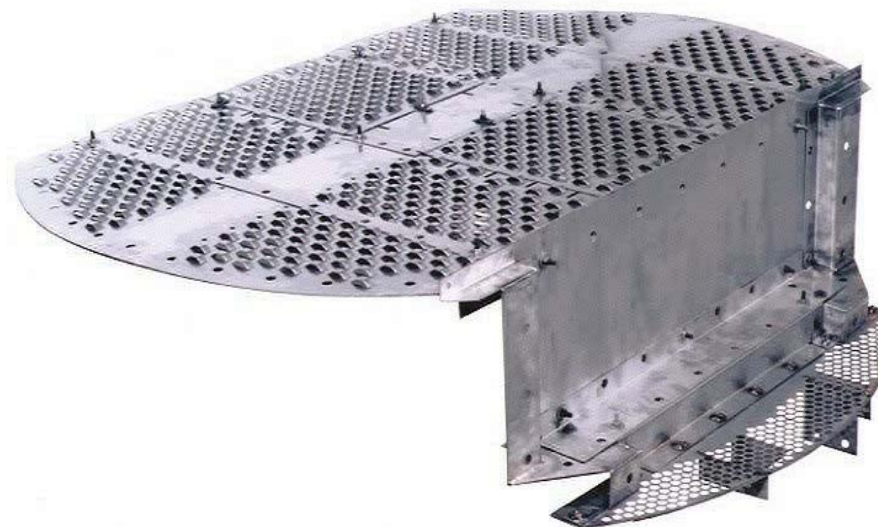
How To Boost Tray Performances Up ?

Increase tray capacity by: **Truncated downcomer and liquid distribution**



High Performance VG Plus™ Trays

VG Plus™ Trays



High Performance Trays

MVG tray deck advantage over Conventional Trays

- ⇒ **15% to 40% Greater capacity;**
- ⇒ **Uniform Liquid flow;**
- ⇒ **Minimum Hydraulic gradient;**
- ⇒ **Uniform Vapor Distribution;**
- ⇒ **Uniform L/V on the Tray Deck;**
- ⇒ **Equal or Greater efficiency.**
- ⇒ **Lower Pressure Drop;**
- ⇒ **Lower & Equalized Froth Height;**
- ⇒ **Lower Foaming Tendency;**
- ⇒ **Lower Entrainment;**
- ⇒ **Fouling Resistance**
- ⇒ **High turn down**
- ⇒ **Mechanical strength**

High Performance Trays

The Functional Features of Mini V-Grid Trays (VG Plus Trays)

- ⇒ *Enhanced tray deck design:* *Shape & Size of the openings (MVG)*
- ⇒ *Enhanced Down Comer design:* *Multi-Chordal, Truncated, Radius Tip*
- ⇒ *Enhanced Inlet Area design:* *Froth Promoter, Liquid Flow Pusher, Jet Tab;*
- ⇒ *Enhanced Outlet Weir design:* *Swept back, Stepped*

The Shell and Sulzer Alliance

Brand Names

Licensed Products

Shell Calming Section™ tray
Shell HiFi™ tray
Shell Schoepentoeter™ inlet device
Shell Calming Section Grid™ trays
Shell SMS™ separators

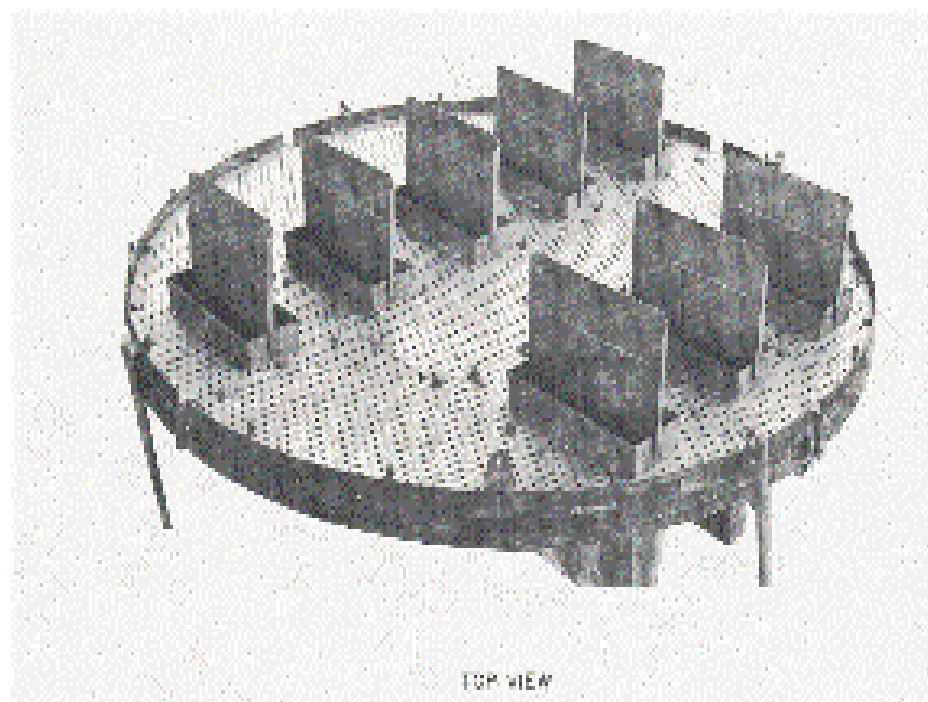
SSP Equipment

Shell Calming Section Plus™ tray
Shell HiFi Plus™ tray
Shell ConSep™ tray
Shell Swirl Tube™ tray
Shell SMSM separator
Shell Extraction HiFi™ tray

The Shell and Sulzer Alliance

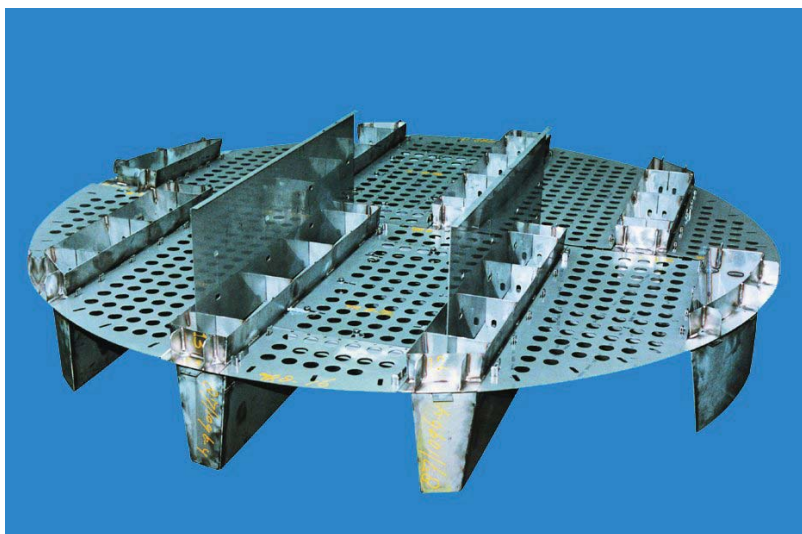
Shell Calming Section™ Trays

- Maximizes bubbling area
- Highest jet flood and vapor handling capacity
- Long flow path length. High efficiency
- Available in boltless construction. Minimum installation time
- Can use many types of bubblers (sieves, valves, fixed valves, etc.)
- Small tray spacing to provide maximum stages
- Several hundred columns in operation
- Typical applications
 - Main Fractionators
 - Deisobutanizers, C6/C7/C8 fractionations
 - Atmospheric and mild vacuum chemical columns
 - Any place where entrainment is a concern



The Shell and Sulzer Alliance

Shell HiFi™ Tray



- Best in high liquid load services. Longest weir length with longest flow path. Minimum dead zones
- Highest liquid handling capacity
- Best tray efficiency at large liquid loads
- No requirement for trusses.
- Available in boltless construction. Minimum installation time
- Can use many types of bubblers (sieves, valves, fixed valves, etc.)
- Tray spacing as low as 300 mm are achievable
- Several hundred columns in operation

Typical applications

Pump-around sections in fractionators
Any place where liquid capacity is a concern
High pressure absorbers and scrubbers

The Shell and Sulzer Alliance

Shell Calming Section™ Grid Trays

- Shell CS Grid trays offer the best efficiency of any grid tray or packing with equivalent capacity
- The tray is a dual flow tray with calming baffles to enhance distribution and prevent sloshing
- Grid trays are generally more resistant to fouling in services where chemical instability can cause coking
 - Round bar Grid Trays offer the most fouling resistance
 - Slotted Grid Trays offer the least
- **Typical Applications**
 - For FCCU Main fractionator slurry sections
 - Bottom section of Crude distillers
 - Bottom section of Pygas fractionators
 - Sour water and Waste water strippers

Shell Calming Section™ Plus and HiFi™ Plus Trays

- Newer versions of the previous CS and HiFi trays
- Incorporate more efficient downcomer designs to increase liquid handling capacity by 10-20% over normal CS and HiFi trays
- Incorporate low entrainment bubblers (MVG fixed valves)
- Improved liquid distribution features that give higher efficiency at higher flow parameters
- Developing experience data base
- **Typical applications**
 - Superfractionators (C2 and C3 splitters)
 - Gas plants (De-C2, De-C3, De-C4, DIB)
 - Workup sections of Catcrackers and Hydrocrackers

The Shell and Sulzer Alliance

ConSep™ Tray Background

Factors limiting tray capacity

Jet flood “ Excessive vapour flow causing liquid to be entrained in the vapour up to tray above and backing up the liquid in the downcomers”.

DC flood “ High liquid traffic requires larger DC volume and longer weir length.

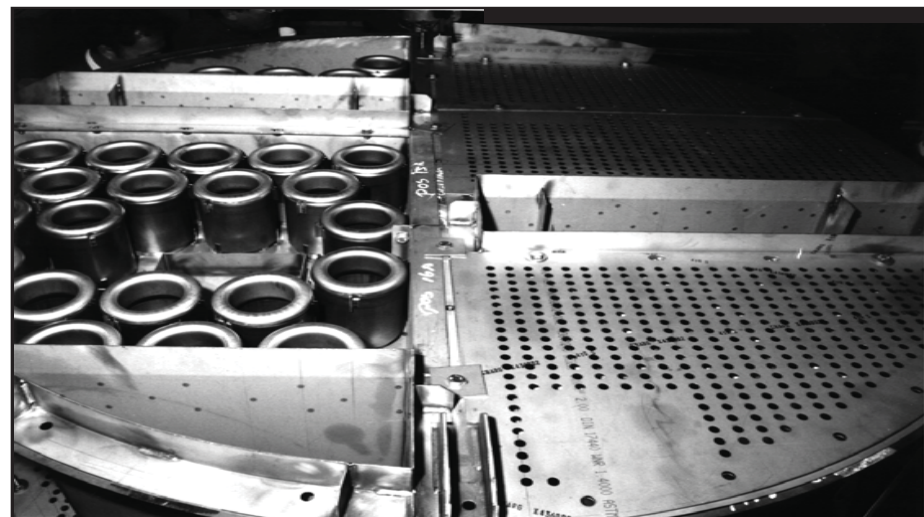
Option to overcome the limit

Conventional high capacity trays shift the jet flood limit maximizing the bubbling area; this limits the DC capacity therefore ultimate capacity achievable

The Shell and Sulzer Alliance

Shell ConSep™ Tray

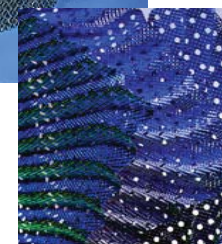
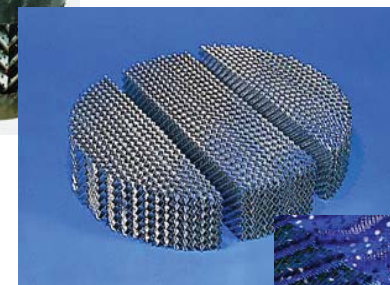
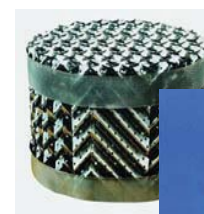
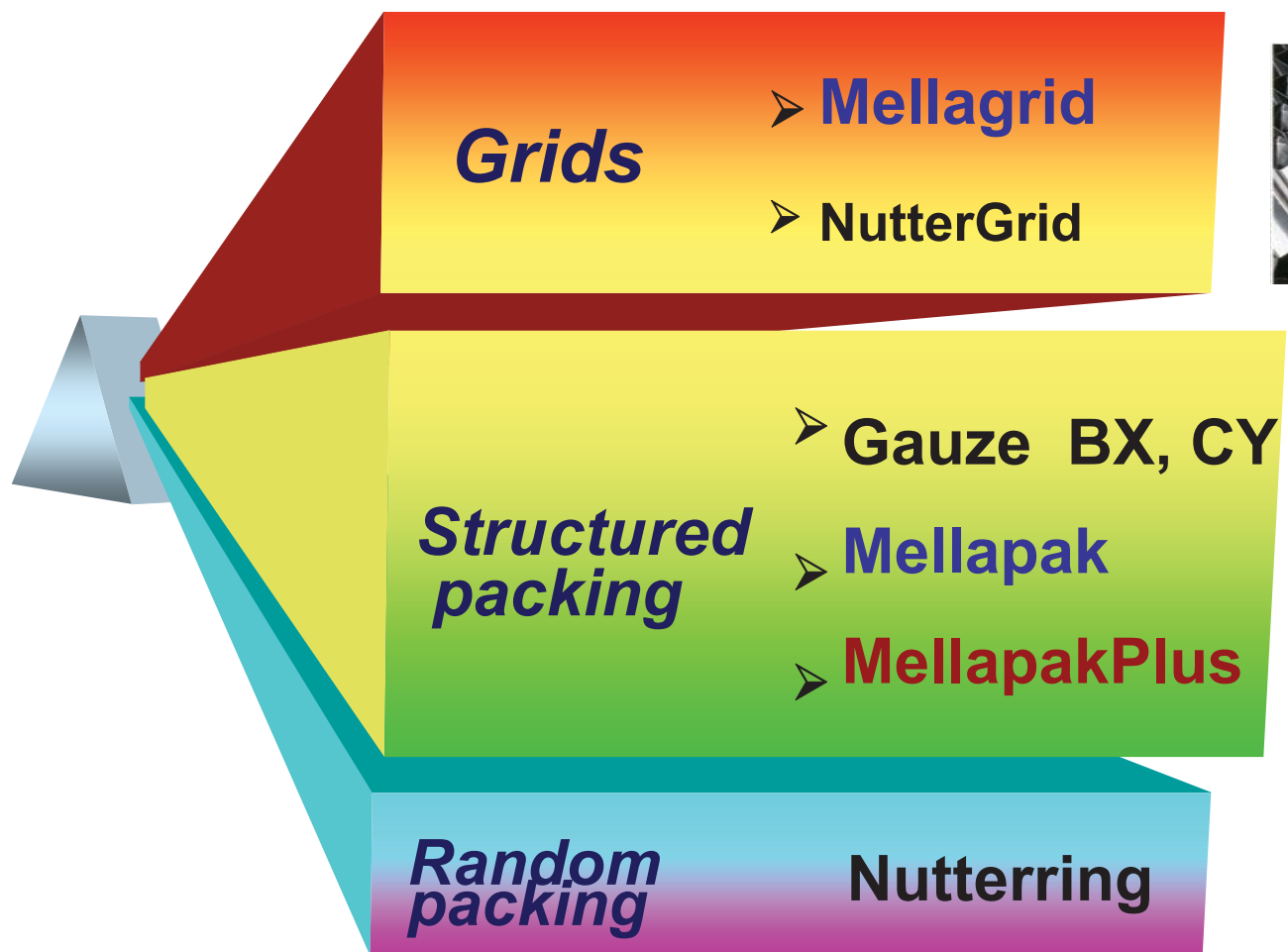
- Highest capacity device in the family and in the market
- Can increase capacity of conventional trays by 50-80% and 30-50% over CS or HiFi trays
- Maximizes jet flood capacity
- Maximizes liquid handling capability
- Can be retrofitted to existing towers
- Provides equivalent efficiency to other trays
- Requires some additional pressure drop



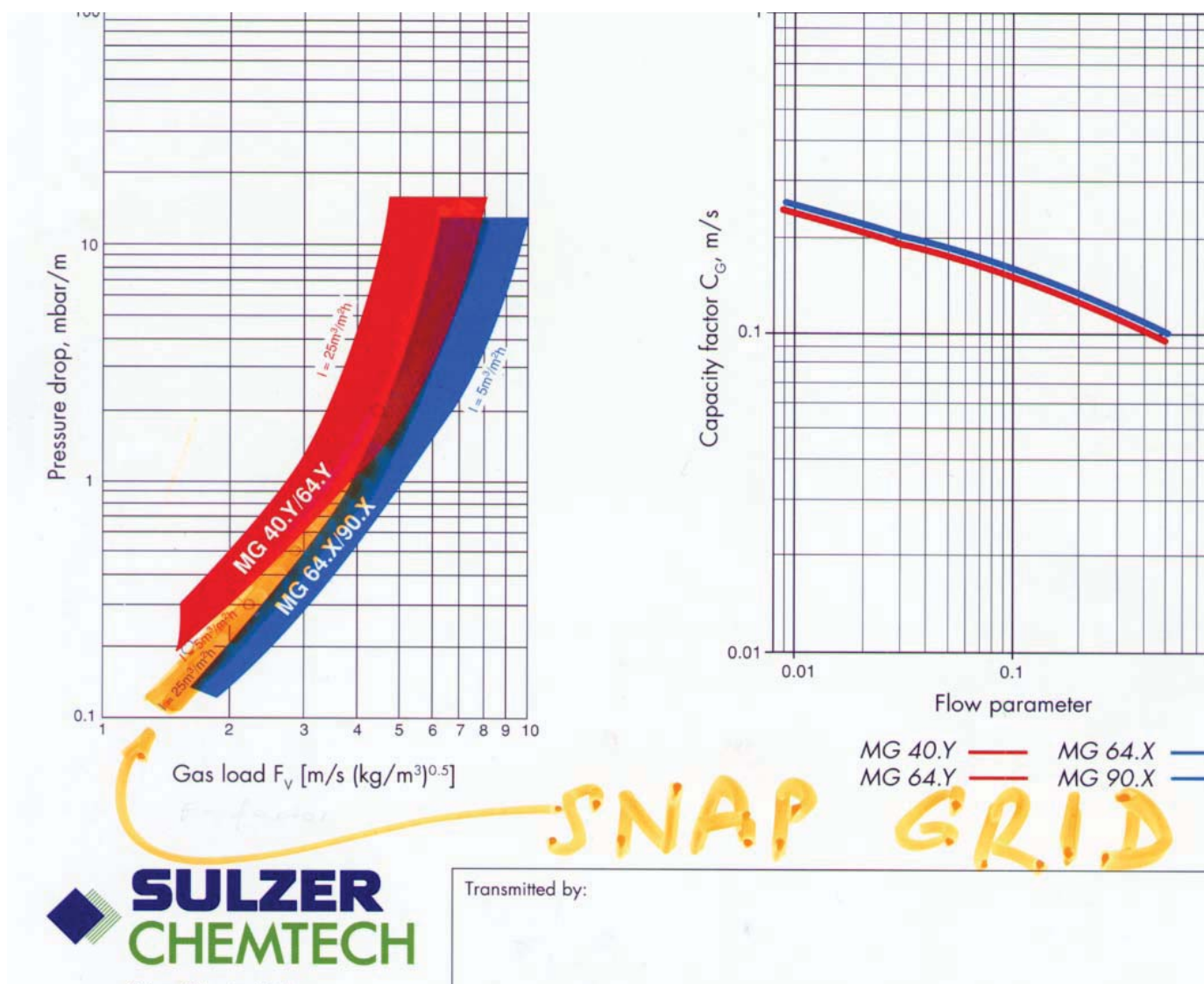
Packing

SULZER

Sulzer Chemtech



The full spectrum of Mass transfer Components



Grid in Refinery Towers

Application	Section	No.
Atm. Crude Tower	TPA	1
Main Fractionator	Slurry PA	6
FCC Vacuum Tower	Wash	11
Lube Vacuum Tower	Wash	1
Coker Fractionator	Wash	1
Visbreaker Vac. Tower	Wash	4
Water Quench		1

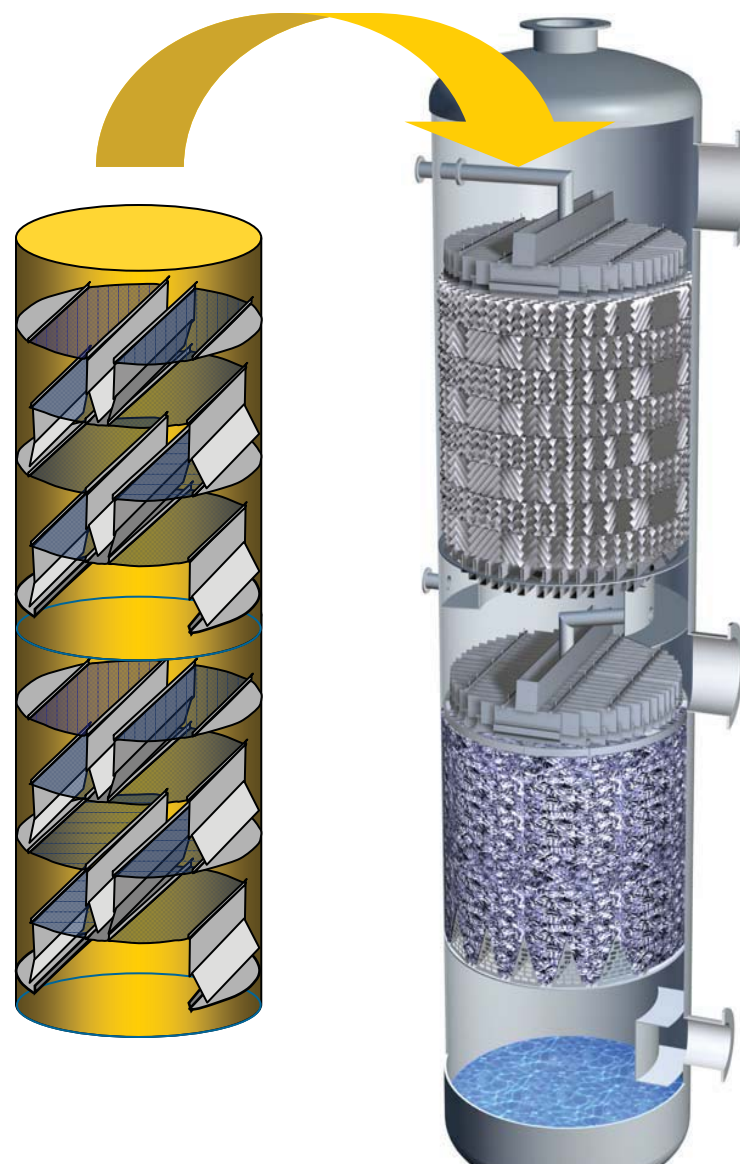
Packing

Alternatively to Trays, **Packing** may allow advantages related to:

- High Hydraulic Capacity
- High Mass Transfer Efficiency
- High Heat Transfer Capability
- Low Pressure drop

Benefits are:

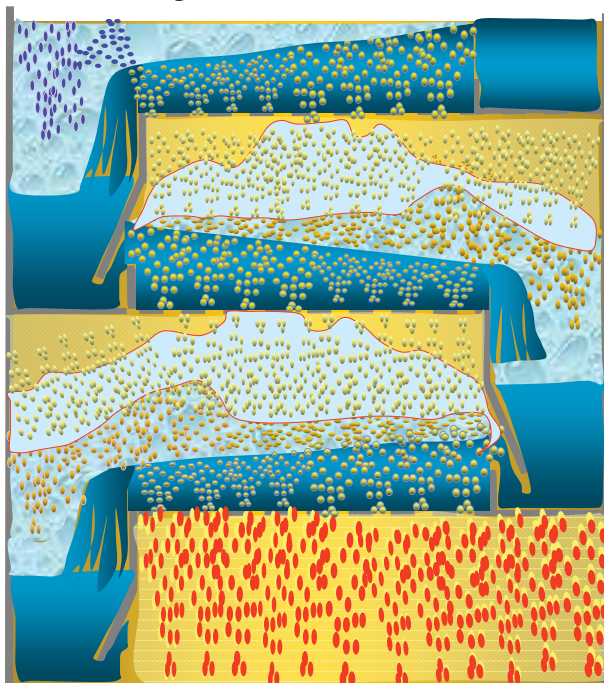
- Increased Vap/Liq internal loads for:
 - higher Feed rate (capacity)
 - higher Reflux (efficiency)
- Increase Number of separation stages per meter of column (NTSM) for:
 - higher efficiency



Packing

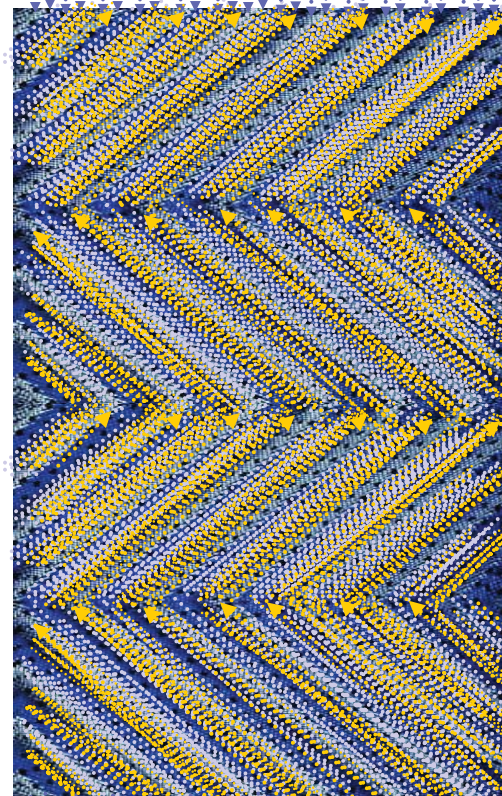
the mass transfer mechanism

in trays



- Vapor is dispersed in liquid
- Vapor to move through 8-15 % open sectional area

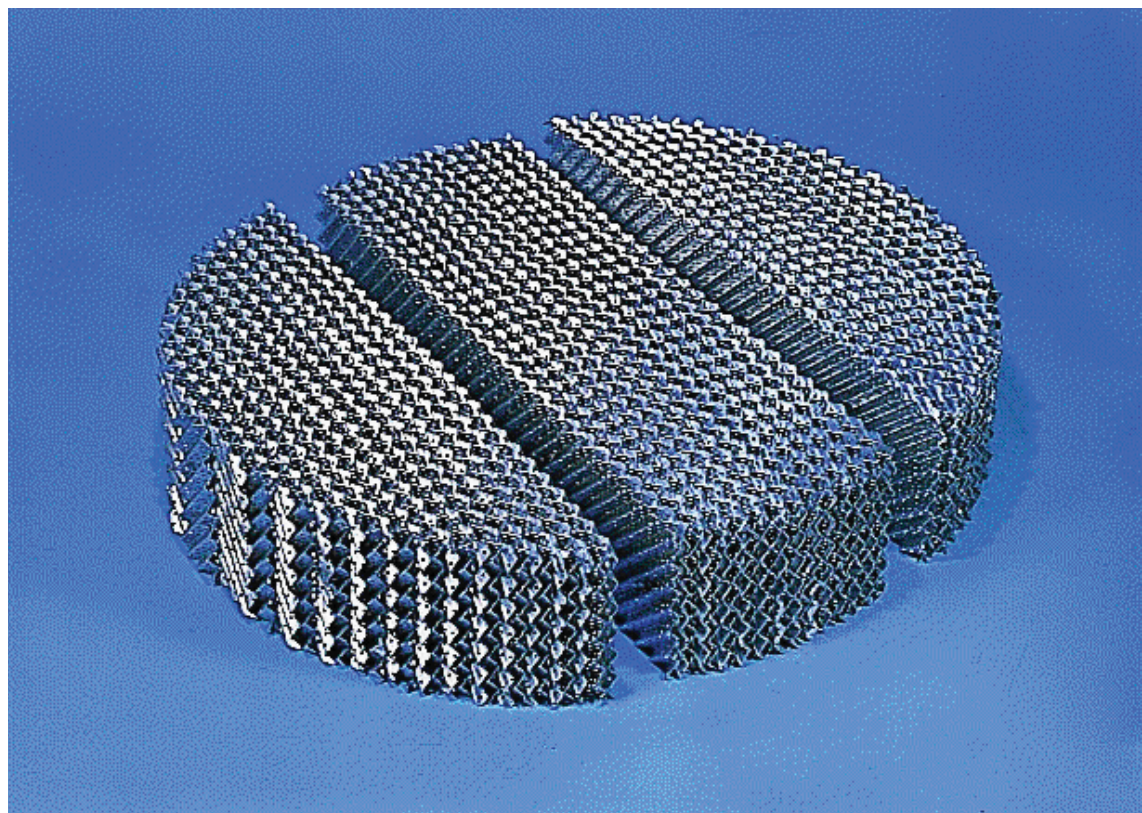
In structured packing



- Liquid is dispersed in vapor
- Vapor moves through 92 -95 % open sectional area

Structured Packing

*Mellapak*TM

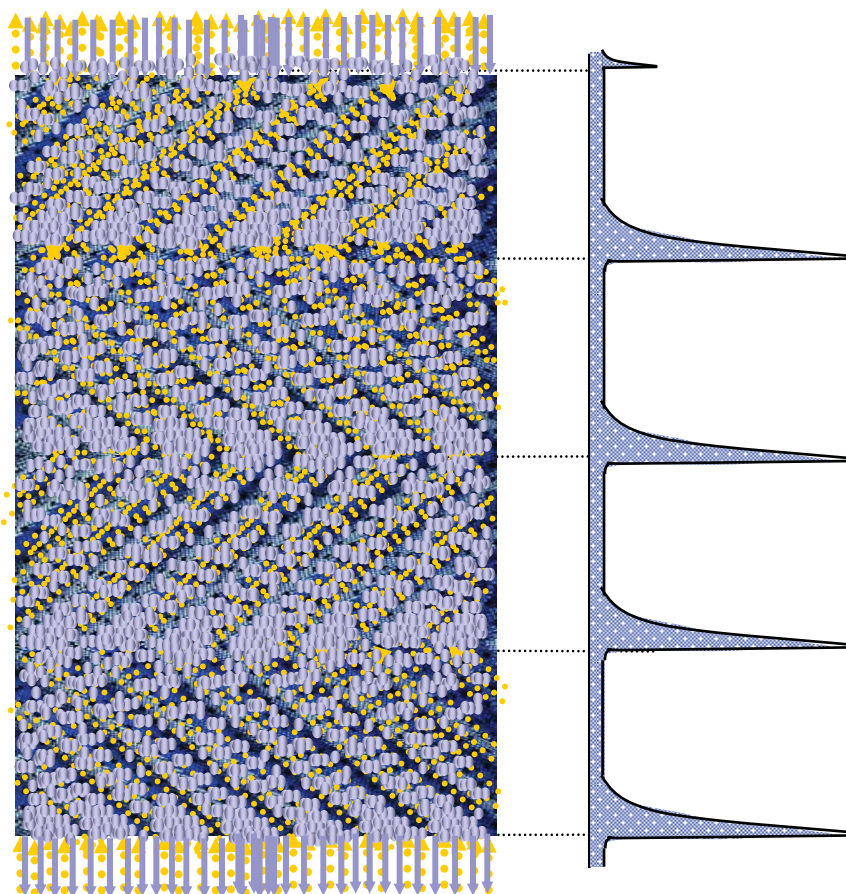


Type	NTSM	Limit Capacity F Factor
2.Y	2.0	3.5
250.Y	2.5	2.6
350.Y	3.5	2.2
500.Y	4.0	1.6
750.Y	5.9	1.5

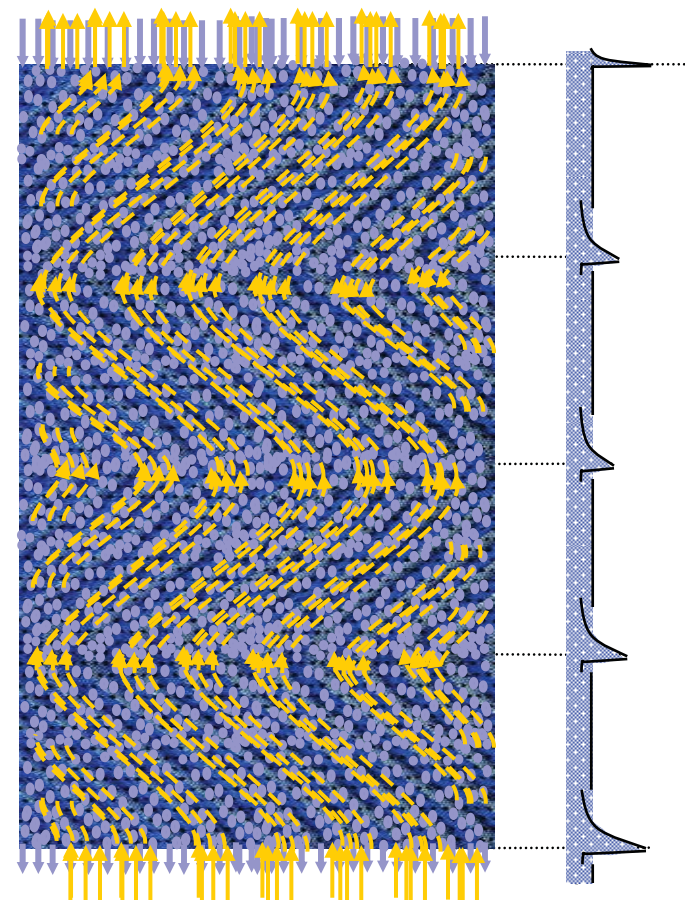
MellapakPlus®:

Gamma ray scanning at operating condition

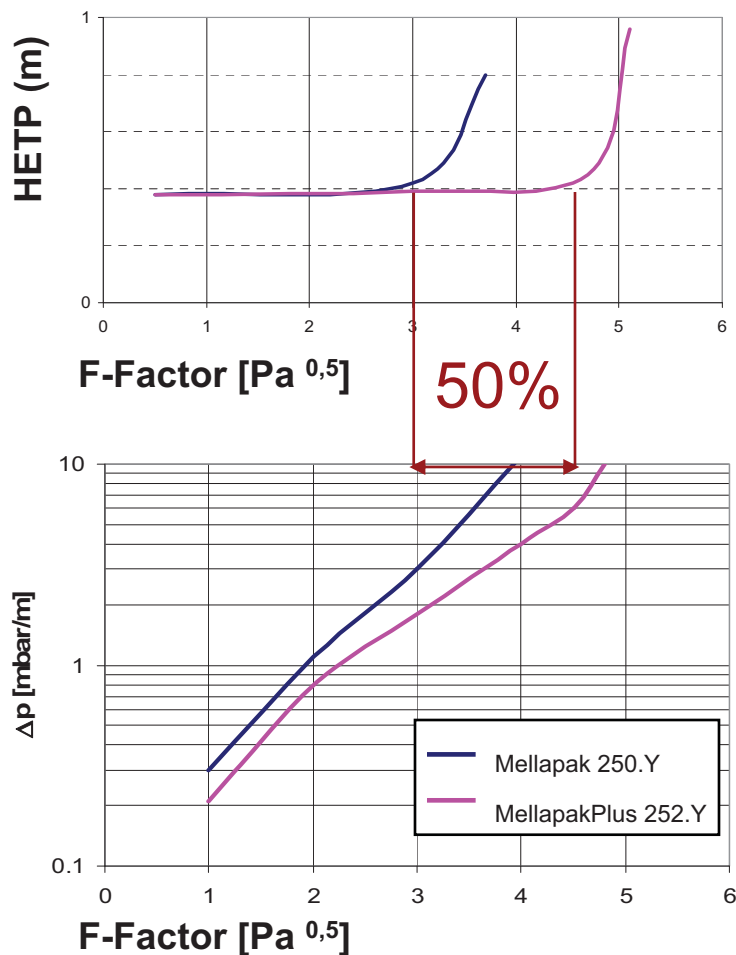
Mellapak



MellapakPlus



MellapakPlus



Main features:

- Up to 50 % more capacity at same efficiency with the new packing generation
 - smaller columns for new plants
 - use existing vessels for plant upgrades
- Stable efficiency up to 5mbar/m pressure drop
- Calculation tool SULPAK available at www.sulzerchemtech.com
- Everything you already know about Mellapak remains valid for MellapakPlus
- More MellapakPlus types to come

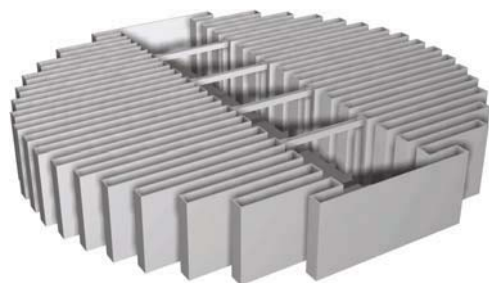
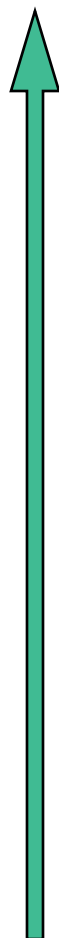
Nutter Ring™

- FRI and other commercial test data proves stated performance
- Pressure drop per theoretical stage is 40% to 55% lower than comparable size pall rings.
- Useable capacity is 13 to 23% greater than comparable Pall ring.
- Cost per theoretical stage is 12 to 55% less than other metal packings.
- Unique shape enhancing lateral liquid film renewal.
- Strength-to-weight ration sufficient to 15m. bed height.

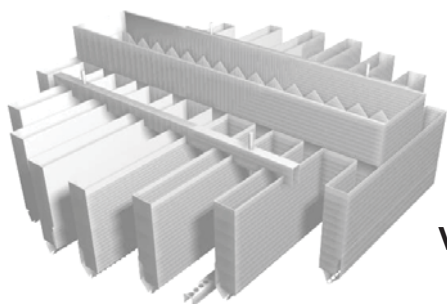


Distributor Systems

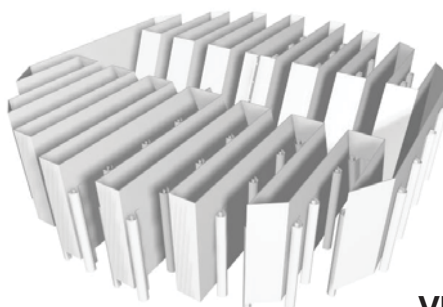
$L > 100 \text{ m}^3/\text{m}^2\text{h}$



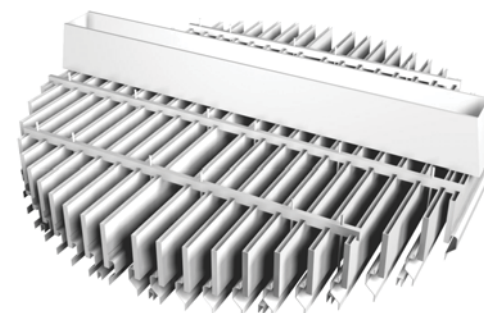
VKG



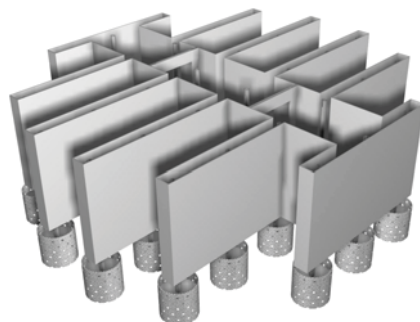
VKH



VKR



VEP



VKRP

$L < 0.1 \text{ m}^3/\text{m}^2\text{h}$

VEP™ Liquid Distributor

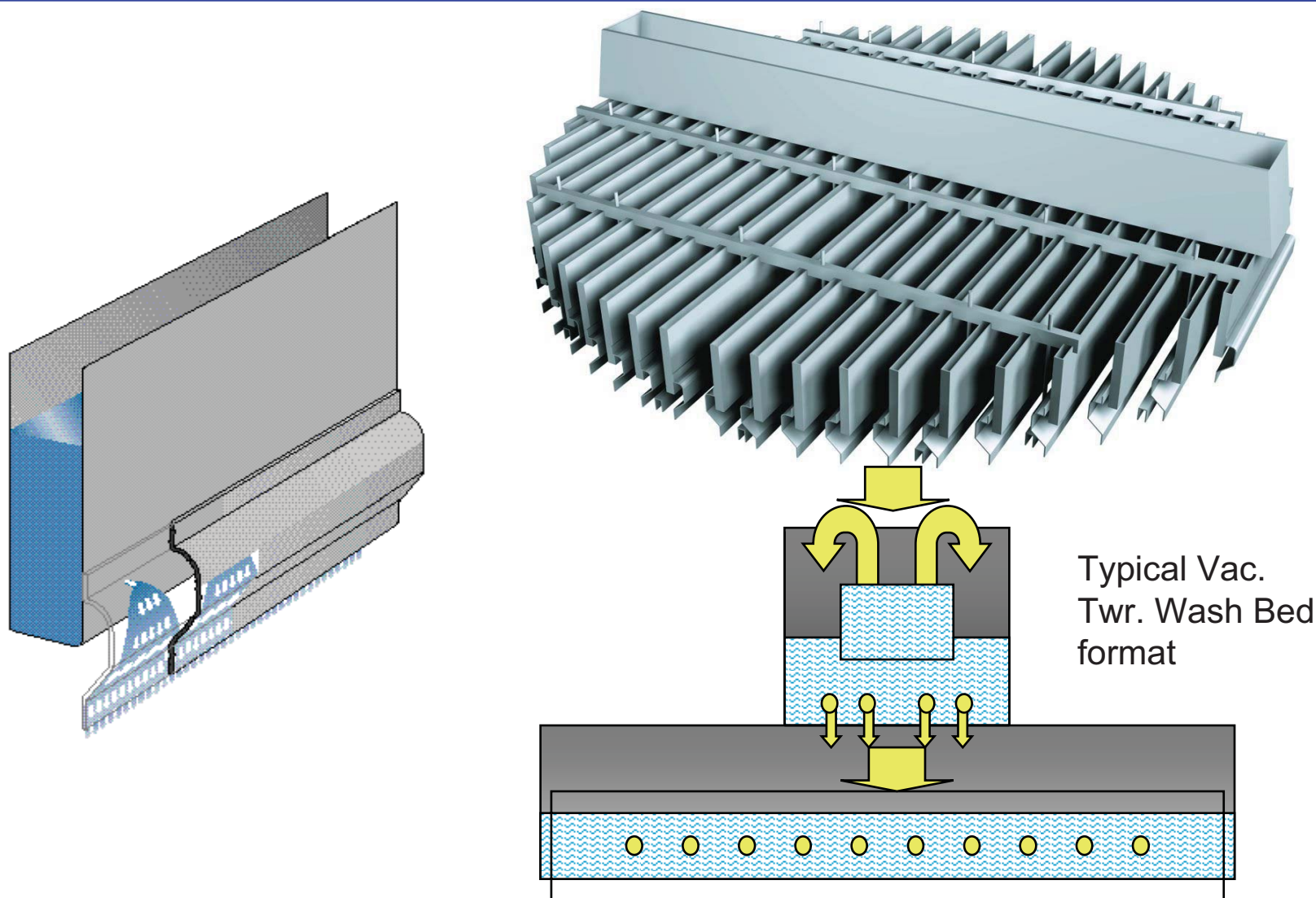
The Best Liquid Distributor

SULZER

Sulzer Chemtech

- Sulzer's VEP™ Liquid Distributor
- High efficiency (low Cv, typically less than 5%)
- Highest Capacity (low pressure drop and minimized entrainment developed for MellapakPlus)
- Excellent Anti-Fouling design (5 points for wash beds)
- Cost is comparable to regular distributors and spray headers
- Good liquid distribution implemented in structured packing in one layer less than drip-tube distributors

VEP™ Liquid Distributor



Typical Vac.
Twr. Wash Bed
format