The Refinery Applications

Sulzer Chemtech
Mass Transfer Technologies: Products

- Conventional
- High performance

Trays
- Bubble Cap
- Sieve
- Valve
- Nutter Shell

Grids
- Mellagrid
- NutterGrid

Random packing
- Nutterring

Structured packing
- Gauze BX, CY
- Mellapak
- MellapakPlus

Column internals
- Vapor distributors
- Liquid distributors
- Collect /Accumulator
- Supports

Static mixing units

Membranes

The full spectrum of Mass transfer Components for the most efficient and economical solution
Sulzer global TRAY portfolio

**Conventional**
- Sieve Trays
- Nutter V Grid
- Floating Valve Trays
- Cage Valve Trays
- Bubble Cap Trays

**High Performance**

**Nutter Technology**
- Mini V-Grid MVG™
- Enhanced Mini V-Grid - MVGE
- Mini V-Grid -Truncated DC - MVGT
- Mini V-Grid -Multiple DC - VGMD™

**Shell Technology**
- HiFi
- Calming Section
- ConSep

**Other**
- Dual Flow Trays
- Disc & Donut Trays
- Cartridge Trays
- Shower Decks / Baffle
V-GRID™ Trays (fixed-valve)

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
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
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
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

**Advantages**
- Simple design

**Disadvantages**
- Limited Capacity
Conventional Tray

How trays work

Correct froth dispersion
Conventional Tray

Vapor Flooding

Entrainment
Conventional Tray

- Downcomer
- Flooding
- High liquid
Conventional Tray

Weaknesses:
- Inactive zone
- Vapor Channeling
- Liquid Gradient
- Weeping
Conventional Tray

Increase tray capacity by:

... type of perforation

Bubble Cap Trays

+ 5 ÷15 %

V-GRID™

+ 5 ÷15 %

BDH™

+ 5 ÷20 %

MV-GRID™
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

Added active area

+ 5 ÷ 10 %
How To Boost Tray Performances Up?

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

- Froth Promoter
- Mini V Grid Openings
- Liquid flow pusher
High Performance VG Plus™ Trays

VG Plus™ 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
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
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
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 splitters
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
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
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

The full spectrum of Mass transfer Components

- **Grids**
  - Mellagrid
  - NutterGrid

- **Structured packing**
  - Gauze BX, CY
  - Mellapak
  - MellapakPlus

- **Random packing**
  - NutterRing
### Grids

#### Grid in Refinery Towers

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<th>Application</th>
<th>Section</th>
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<td>Main Fractionator</td>
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<td>FCC Vacuum Tower</td>
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<td>Coker Fractionator</td>
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<td>Visbreaker Vac. Tower</td>
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<tr>
<td>Water Quench</td>
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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
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™

![Mellapak™ Image](image)

<table>
<thead>
<tr>
<th>Type</th>
<th>NTSM</th>
<th>Limit Capacity F Factor</th>
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<tr>
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<tr>
<td>250.Y</td>
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<tr>
<td>750.Y</td>
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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](http://www.sulzerchemtech.com)
- Everything you already know about Mellapak remains valid for MellapakPlus
- More MellapakPlus types to come
Packings

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 m³/m²h

L < 0.1 m³/m²h

VKG

VKH

VKR

VEP

VKRP
VEP™ Liquid Distributor
The Best Liquid Distributor

• 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