Separation Technology for the Hydrocarbon Processing Industry
Sulzer Chemtech produces a wide array of tower internals. With this broad spectrum of custom-designed fractionation trays, random and structured packing we can meet any process requirement in any size tower throughout the chemical, refining, petrochemical, and gas processing industries. For over 50 years, Sulzer Chemtech has been serving these industries with our innovations, which set a new standard in many applications.

**Sulzer Chemtech Achievements:**
- 1956  Nutter Float Valve trays in an olefin plant, among others for a 120” i.d. C2 Splitter
- 1964  BX gauze packing for Distillation of heat sensitive fragrances
- 1975  BX plastic gauze packing for HCl Absorption towers
- 1977  Nutter V-Grid trays for C3 Splitters
- 1985  Nutter Ring for Demethanizer
- 1985  Mellapak for Water Quench towers
- 1988  Design of Heat Pump systems
- 1988  Mellapak for Ethylene Oxide towers
- 1995  Mellagrid for Water Quench towers
- 1997  Katapak for Reactive Distillation of Methylal
- 2000  MellapakPlus for various applications

For classical column operations such as distillation, absorption, stripping and extraction, and for alternatives such as crystallization, membrane permeation and reactive distillation, we are continuously developing new product ideas to meet the economical and technical objectives of our customers. For numerous applications Sulzer Chemtech provides superior plant performance, improved product quality, increased capacity, and reduced energy consumption.

Sulzer Chemtech offers the full range of column internals with trays, random and structured packings optimized through column simulation, process design, basic engineering and field services.

Sulzer Chemtech is a worldwide leading supplier for separation technology; thanks to our customers and the confidence they instill into our products and capabilities.

From the very first to the very last of our more than 30,000 columns in operation we have never stopped listening to our customers about their needs. At Sulzer Chemtech, we are eager to develop a successful application for your needs.

**Industrial Applications from A to Z**

<table>
<thead>
<tr>
<th>Application</th>
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<tr>
<td>Ammonia and fertilizer production</td>
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<tr>
<td>DMF / DMAc recovery</td>
<td>13</td>
</tr>
<tr>
<td>Ethylene / Propylene</td>
<td>4/5</td>
</tr>
<tr>
<td>Ethanolamine</td>
<td>6/7</td>
</tr>
<tr>
<td>Ethylene glycol</td>
<td>6/7</td>
</tr>
<tr>
<td>Ethylene oxide</td>
<td>6/7</td>
</tr>
<tr>
<td>Heat pump / heat integration</td>
<td>13</td>
</tr>
<tr>
<td>High pressure gas saturation</td>
<td>8/9</td>
</tr>
<tr>
<td>Methanol</td>
<td>12</td>
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<tr>
<td>Selective H₂S absorption</td>
<td>8-10</td>
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<tr>
<td>Synthesis gas applications</td>
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<td>Tail gas treating</td>
<td>10</td>
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<tr>
<td>Treatment of corrosive products</td>
<td>14</td>
</tr>
</tbody>
</table>

**Color index of the diagrams**
- Structured packing
- Trays
- Random packing
Application Know-How and Service are our Driving Force

Sulzer Chemtech has 50 years of accumulated application know-how and experience in developing, designing, supplying and servicing mass transfer equipment in the Chemical, Petrochemical, Refining, Gas Processing and Speciality industries. Only the very best technical solutions can secure the competitive advantages which our customers need in today’s highly demanding conditions. Leadership in technology and application know-how is fundamental to our success.

Technical and Process Support

- Column simulations and design
- Process simulations and plant optimization
- Feasibility studies for capacity and/or purity improvements
- CFD modelling
- Pilot plant testing

Field Services

- Installation consulting, inspection or supervision
- Full installation services
- Trouble shooting assistance
- Scanning
- Start-up assistance

Replacement Service

Reliable and fast supply through a world-wide manufacturing network of:
- any hardware
- most valves
- most tray decks
- complete trays
Ethylene / Propylene Plants
Whatever your plans are, we have the right solution for every service

Water quench tower with Mellapak/Mellagrid

**Before revamp**
- Random packing
  - Δp = 100 mbar
  - Trays
- 230 t/h
- 99 °C

**After revamp**
- Melapak
- 1230 m³/h
- 57 °C
- 70 °C
- Δp = 10 mbar

**ΔT = 8 °C**

**Hot section**

- Cracker/Furnace
- Oil quench/Primary fractionator
- Water quench
- 3-stage gas compression
- Caustic wash tower
- 4th-stage gas compression
- Olefins
- Aromatics
- Water quench
- 3-stage gas compression
- Caustic wash tower
- 4th-stage gas compression

**Benefits:**
The revamp of the water quench tower trays and random packing to structured packing Mellapak® led to improvements in capacity and in efficiency. In addition, energy costs were reduced considerably due to the following reasons:

- Less cooling energy requirements and no steam consumption for the reboiler of the C3 Splitter, due to better efficiency of structured packing.
- Less energy requirements for the compression stage due to low pressure drop in the packed bed.

**Benefits of structured packing:**
- Smaller column diameter, due to higher capacity
- Reduced packing height, due to higher separation efficiency
- Lower pressure drop
- Reduced foaming tendency, due to less turbulences
- Less entrainment
- Higher fouling resistance
Benefits:
- For higher capacity: Replacement of existing trays enables handling of increased column loads at higher exchanger duties.
- For higher capacity and/or higher efficiency: Replacement of existing trays by a higher number of new high capacity trays enables a reduction in reflux and load requirements, but puts more emphasis on tray capacity and efficiency at low tray spacing.
- For new columns: Technology can be used to minimize dimensions of new columns, such as the diameter and height.

Cold section

De-methanizer

De-ethanizer

C₂ Splitter

De-propanizer

C₃ Splitter

De-butanizer

New C₃ Splitter with conventional trays

Reuse of existing C₃ Splitter with VGPlus trays

High performance VGPlus trays allow the reuse of the existing tower without replacing it by a new one.

The advantages of VGPlus:
- Higher capacity at same efficiency
- Tray spacing can be kept
- No welding to column shell, as existing attachments can be reused
- Minimized plant shut down time
- Lower revamp costs
Ethylene Oxide and Derivates

- Antifreeze agent
- PET production
- Polyester production
- Heat transfer liquid
- Plasticizer / softener
- Solvent
- Textile finishing
- Cosmetics / Soaps
- Detergents
- Gas purification
- Brake fluid
- Solvent for paint
- Detergents
- Gas purification
- Detergents
- Surfactants
- Emulsifiers

Revamp of a CO₂ absorption column from high capacity trays to Mellapak

<table>
<thead>
<tr>
<th></th>
<th>Bevore revamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas quantity (t/h)</td>
<td>110</td>
</tr>
<tr>
<td>CO₂ at entry (vol. %)</td>
<td>4.7</td>
</tr>
<tr>
<td>CO₂ at exit (vol. %)</td>
<td>1.4</td>
</tr>
<tr>
<td>CO₂ absorption (t/h)</td>
<td>7.1</td>
</tr>
</tbody>
</table>

Know-how

- Distillation of Ethylene Oxide (EO)
- Technologies and key components for:
  - Ethylene Glycols
  - Ethanolamines
  - Glycol Ethers
  - Alkylethanolamines
  - 67% Ethylene Glycols
  - 7% Ethanolamines
  - 5% Glycol Ethers
  - 21% other Ethoxylates

For various reaction technologies cooperating with experienced partners

Upgrade with Mellapak and MellapakPlus

<table>
<thead>
<tr>
<th></th>
<th>100 %</th>
<th>100 %</th>
<th>137 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasload</td>
<td>100</td>
<td>100</td>
<td>137</td>
</tr>
<tr>
<td>EO production</td>
<td>100</td>
<td>100</td>
<td>185</td>
</tr>
<tr>
<td>EO in outlet gas</td>
<td>250 ppm</td>
<td>22 ppm</td>
<td>100 ppm</td>
</tr>
<tr>
<td>Pressure drop</td>
<td>170 mbar</td>
<td>52 mbar</td>
<td>73 mbar</td>
</tr>
</tbody>
</table>

EO production
<table>
<thead>
<tr>
<th>Process Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Continuous process</td>
</tr>
<tr>
<td>• Low by-product formation</td>
</tr>
<tr>
<td>• Flexible product ratio</td>
</tr>
<tr>
<td>• High yields on raw materials</td>
</tr>
<tr>
<td>• High recovery rates</td>
</tr>
<tr>
<td>• Low energy consumption</td>
</tr>
<tr>
<td>• Extremely low pressure drops in the distillation section</td>
</tr>
<tr>
<td>• High product purity</td>
</tr>
<tr>
<td>• Joint developments</td>
</tr>
</tbody>
</table>

**Table:**

<table>
<thead>
<tr>
<th>After revamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>168</td>
</tr>
<tr>
<td>5.1</td>
</tr>
<tr>
<td>0.3</td>
</tr>
<tr>
<td>14.0</td>
</tr>
</tbody>
</table>
Synthesis Gas Application

Compact Column Size
Sulzer packings permit high gas and liquid throughputs resulting in small column diameters (important factor for pressurized columns or when upgrading existing columns). High separation efficiency also allows the use of short-height columns. New columns incorporating these features result in large savings, both in weight, volume and in investment costs.

The increased selectivity leads to a higher CO\(_2\) slippage in the treated gas and to a lower CO\(_2\) content in the acid gas which leads to a higher capacity of the existing Claus plant or to lower CAPEX in case of a new plant.

Selective absorption of H\(_2\)S with MDEA

- **Mellapak**
  - 90% CO\(_2\) slippage
  - 2 Vol ppm H\(_2\)S
- **Lean MDEA**
  - Diameter 700 mm
  - Height ca 11 m
  - L/G ca 0.15
  - Natural gas with H\(_2\)S + CO\(_2\)
    - ca 1 Vol %
- **Rich MDEA**
  - Pressure: 56 bar
  - Gas temperature: 30-35 °C
  - Natural gas with H\(_2\)S + CO\(_2\)
    - ca 1 Vol %
  - Diameter 1100 mm
  - Height ca 15 m
  - L/G ca 0.15

Tray column
- 60% CO\(_2\) slippage
- 2 Vol ppm H\(_2\)S
**Benefits for Conversion Units**

- Reduced steam requirements, less energy consumption
- Lower OPEX
- Pay back time approx. 1 year
- Less fouling problems

**CO - Conversion unit**

- Steam
- \( \text{CO} + \text{H}_2\text{O} \rightarrow \text{CO}_2 + \text{H}_2 \)

**Saturator No. 2 Diameter: 2.94 m**

- \(181^\circ\text{C} \geq 22^\circ\text{C}\)
- \(188^\circ\text{C} \leq 12^\circ\text{C}\)
- \(203^\circ\text{C} \rightarrow 200^\circ\text{C}\)
- \(203^\circ\text{C} \rightarrow 200^\circ\text{C}\)
- \(140^\circ\text{C} \leq 10\text{ mbar}\)
- \(134^\circ\text{C} \leq 10\text{ mbar}\)
- \(152^\circ\text{C} \rightarrow 146^\circ\text{C}\)

**Acid gas**
- to Claus plant
- (see also tail gas treating on next page)

**Lean amine**
- S - R removal unit

**Converted gas**
- to \(\text{CO}_2\) amine unit:
  - \(\leq 6\%\text{wt CO}\)
  - \(\geq 82\%\text{wt CO}_2\)

**Reactor CO converter**
- \(\approx 390^\circ\text{C}\)

**Reboiler**
- \(\geq 188^\circ\text{C}\)

**Regenerator**
- \(203^\circ\text{C}\)

**Saturator No. 1**

**Saturator No. 2**

**Cooler**
- \(110^\circ\text{C}\)
- \(65^\circ\text{C}\)
- \(212^\circ\text{C}\)

**Solvent heat exchanger**

**from H\(_2\)S removal**
- \(p = 29.3\text{ bar}\)
- \(82\%\text{wt CO}\)

**Pall ring 3”**
- \(\Delta T \geq 40\text{ mbar}\)
- \(140^\circ\text{C} \rightarrow 152^\circ\text{C}\)

**Mellapak**
- \(\Delta T \leq 10\text{ mbar}\)
- \(134^\circ\text{C} \rightarrow 146^\circ\text{C}\)
Tail Gas Treating

High Selectivity

The higher selectivity of structured packing over other components results in the following advantages:

- Reduction of CO₂ concentration in acid gas which leads to
- Reduction of pressure drop of the Claus plant which leads to
- Increase of capacity of the Claus plant

Low Pressure drop with Mellapak

Means smaller blowers or compressors power compared with trays and random packing, as well as advantages for the upstream Claus process stages.

Quench for tail gas treating unit

<table>
<thead>
<tr>
<th></th>
<th>Trays</th>
<th>Random packing</th>
<th>Mellapak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column diameter</td>
<td>6.1 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure</td>
<td>Atmospheric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas flow rate</td>
<td>260,000 kg/h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure drop (mbar)</td>
<td>70</td>
<td>25</td>
<td>9</td>
</tr>
<tr>
<td>Energy savings (millions kWh/year)</td>
<td>-</td>
<td>2.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Cost reduction (US$/year)</td>
<td>-</td>
<td>180,000</td>
<td>260,000</td>
</tr>
</tbody>
</table>
Applications in Ammonia and Fertilizer Production

**Condensate stripper**

- Revamping of process condensate strippers (improving efficiency)
- High pressure ammonia absorbers
- Waste water strippers
- Ammonia strippers in ammonium nitrate production

<table>
<thead>
<tr>
<th>Type of packing</th>
<th>Original column</th>
<th>Revamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow (t/h)</td>
<td>65 - 75</td>
<td>65 - 75</td>
</tr>
<tr>
<td>NH₃ outlet (ppm)</td>
<td>10 - 30</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Methanol outlet (ppm)</td>
<td>50 - 100</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Reuse of condensate</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

**Formaldehyde Production**

- Mellapak in the pump-around sections for the removal of the considerable amount of absorption heat
- Trays or plastic gauze packing for top part (final absorption with low water flow)

Further Process Technologies:
Katapak for Methanol separation from bottom formaldehyde product
Katapak for production of acetics

**Formaldehyde absorber**

- Gas from reactor HCHO ~ 7%
- HCHO 37-55%

Katapak-SP® structured packing containing catalyst
Methanol

Applications
- Methanol splitters with fixed valve trays
- Methanol absorption columns with structured packing
- Gas saturators with random or structured packing

Methanol distillation unit

![Diagram of methanol distillation unit]

<table>
<thead>
<tr>
<th>Design</th>
<th>Conventional tray</th>
<th>High performance tray</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column diameter</td>
<td>8’300 mm</td>
<td>7’300 mm</td>
</tr>
<tr>
<td>Number of trays</td>
<td>85</td>
<td>85</td>
</tr>
<tr>
<td>Tray spacing</td>
<td>650/700 mm</td>
<td>600/650 mm</td>
</tr>
<tr>
<td>Pressure drop</td>
<td>760 mbar</td>
<td>565 mbar</td>
</tr>
<tr>
<td>Valves</td>
<td>movable</td>
<td>MVG</td>
</tr>
<tr>
<td>Downcomer</td>
<td>standard</td>
<td>ModArc</td>
</tr>
<tr>
<td>Redirecting devices</td>
<td>–</td>
<td>Push valves</td>
</tr>
</tbody>
</table>

Benefits with Sulzer high performance VGPlus trays in methanol splitters:
- Reduced column diameter due to greater capacity, compared to sieve or valve tray
- Great fouling resistance
- Minimize vapor cross-flow channeling by improved liquid flow and vapor/liquid contacting through lateral vapor release
Multi-effect distillation systems:
- Reduced energy consumption due to high efficiency structured packings
- Increase of capacity with MellapakPlus
- Low consumption of cooling water

Heat pump technology allows:
- 90% energy saving
- No steam consumption
- Higher cooling water temperature

We deliver:
- Key-components such as column internals, compressors and heat exchangers
- Studies and basic engineering for revamping existing units
- Basic engineering for new units
- Commissioning and start-up services
Treatment of Corrosive Products e.g. Cl₂ and HCl

Features of Corrosion Resistant Packings

- High efficiency even at low liquid loads
- High capacity
- Over 200 columns in operation

Use of Packing and Internals in a highly corrosive milieu, e.g. in chlorine and HCl-columns.

Sulzer Packings and Internals are available in the following corrosion resistant materials:

- Plastics: PP, PVDF, PVC-C, PFA, Halar, PEEK
- Mellacarbon: Graphite
- Mellapak: High-alloy steels, Hastelloy, Nickel, Tantal, Zirconium, Titanium etc.

The pressure swing distillation system for hydrochloric acid produces pure HCl gas without any contamination through by-products.

The Mellacarbon® packing is a key component in the HCl distillation column.
Sulzer Chemtech is your ideal partner for the design of your separation columns. We are able to assist you in the calculation of a new column, or determine potential advantages of a revamp for higher capacity, higher purity or new process conditions. The study is carried out with modern simulation tools based on data from our laboratory, literature, databank and field data.

The calculated number of theoretical stages will then be converted into a packing height or number of trays. In addition to Sulzer’s high capacity trays, further capacity is achievable through our alliance with Shell Global Solutions. The result of a study is of course not only the number of trays but also a design of column internals or special recommendations for the running of the plant.

Our main applications for which we offer our advantages of a theoretical study, based on special knowledge from field experiences and pilot tests, are as follows:

- Columns for Olefin Plants
- Recovery of Ethylene Oxide
- Columns for Ethylene Glycols, Ethanolamines and Glycolethers
- Direct Heat Exchange
- Columns for DMF and DMAc Recovery
- Waste Water Treatment
- Absorption of Formaldehyde
- Formaldehyde, Methanol, Methylal Purification
- Recovery of HCl
- Removal of CO₂ and H₂S

Do not hesitate to ask for design possibilities or for our Engineering Services brochure. If there are no data available for the design of the column, we are also able to offer experimental tests in our laboratory or in cooperation with external consultants and universities.
The activity program comprises:

- Process components such as fractionation trays, structured and random packings, liquid and gas distributors, gas-liquid separators, and internals for separation columns
- Engineering services for separation and reaction technology such as conceptual process design, feasibilities studies, plant optimizations including process validation in the test center
- Recovery of virtually any solvents used by the pharmaceutical and chemical industry, or difficult separations requiring the combination of special technologies, such as thin film/short-path evaporation, distillation under high vacuum, liquid-liquid extraction, membrane technology or crystallization.
- Complete separation process plants, in particular modular plants (skids)
- Advanced polymerization technology for the production of PLA and EPS
- Tower field services performing tray and packing installation, tower maintenance, welding, and plant turnaround projects
- Mixing and reaction technology with static mixers
- Cartridge-based metering, mixing and dispensing systems, and disposable mixers for reactive multi-component material