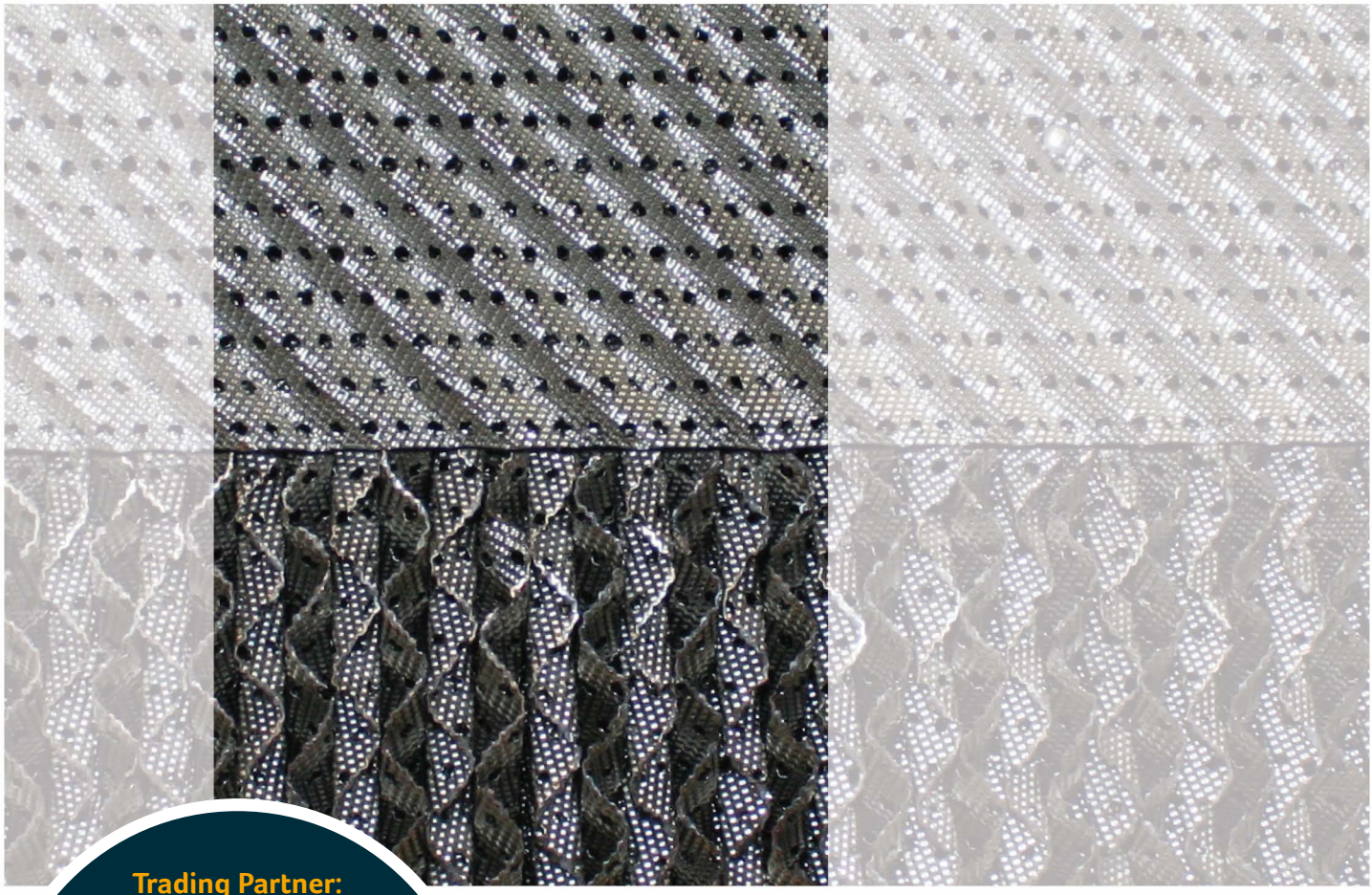
STRUCTURED
Packing



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YOU CAN RELY ON US.

KOCH-GLITSCH®

Structured Packing

For improved performance in new and existing towers.

The uniform arrangement of structured packing provides many advantages compared to random packing or fractionation trays. Using structured packing can provide:

Lower pressure drop through the column

- Lower bottoms temperature for heat sensitive systems
- Higher relative volatility for difficult separations
- Lower energy consumption
- Reduced foaming tendency

Higher efficiency in the same tower height

- Large number of theoretical stages required
- Reduced reflux requirement

Higher capacity

- Reduced vessel diameter
- Increased operating rates

Excellent liquid spreading characteristics

- Improved efficiency
- Offshore applications subject to permanent tilt and motion

Reduced liquid hold-up

- Smaller amounts of polymer inhibitor

Koch-Glitsch Structured Packing

Each type of Koch-Glitsch structured packing has specific performance characteristics. Under certain conditions or in specific applications, each provides a particular benefit that may make one style more desirable than another.

- FLEXIPAC® structured packing has been the industry standard since the 1970s and offers increased capacity compared to trays and conventional random packings.
- The improved FLEXIPAC® HC® high capacity structured packing offers a lower pressure drop when operating near its maximum capacity.
- INTALOX® structured packing provides higher "efficient capacity" than other structured packings.
- Wire gauze structured packings provide very high efficiency combined with low pressure drop.

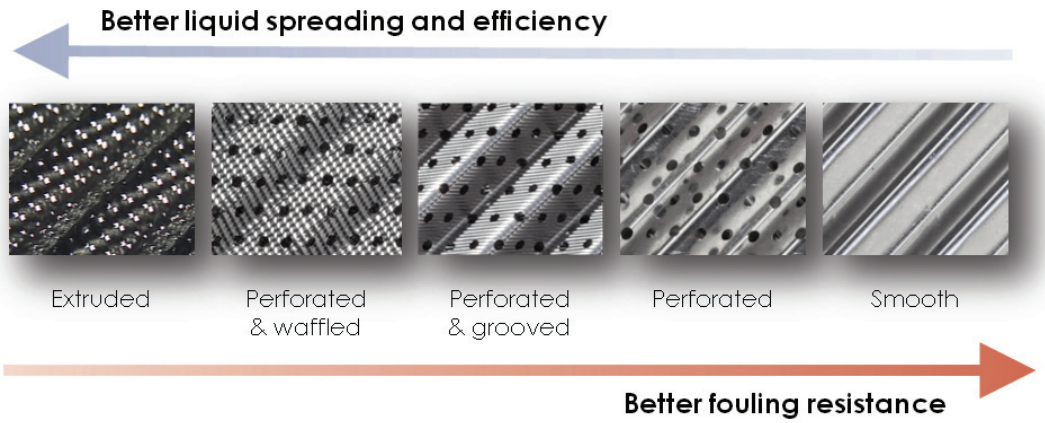
Surface Treatments of Sheet Metal Structured Packing

It is important to achieve good contact between the liquid and vapor phases. A packing that spreads the liquid evenly in a thin film will exhibit better performance. Mixing the film creates turbulence that enhances the mass transfer.

Modifications to the texturing of the packing surface improve the liquid spreading which, in turn, leads to enhanced packing efficiency.

A variety of surface treatments are available to meet any process requirement.

All types of Koch-Glitsch structured packings are available in a variety of corrugation sizes. This provides the versatility needed to optimize a packing configuration to best meet the efficiency, capacity, and pressure drop requirements for a particular application.



FLEXIPAC® Structured Packing

The industry standard used in thousands of columns worldwide.

FLEXIPAC® structured packing provides a lower pressure drop per theoretical stage and increased capacity compared to trays and conventional random packings. Available in multiple materials from traditional stainless steel to high alloys, modern duplex steel and exotic materials such as titanium and zirconium, FLEXIPAC structured packing is applied in a wide variety of applications.

FLEXIPAC® structured packing with a perforated and textured surface.

Columns packed with FLEXIPAC structured packing can improve product yields and purities, reduce reflux ratios, increase throughput, lower pressure drop, reduce liquid holdup and increase heat transfer.

Efficiency FLEXIPAC® Structured Packing	
Size	**HETP***
700Y	6.3 in [160 mm]
500Y	9.1 in [230 mm]
1Y	8.3 in [210 mm]
350Y	8.9 in [225 mm]
1.6Y	10.0 in [255 mm]
250Y	12.4 in [315 mm]
2Y	13.8 in [350 mm]
2.5Y	22.4 in [570 mm]
3Y	31.5 in [800 mm]
3.5Y	43.3 in [1100 mm]
4Y	62.6 in [1590 mm]

Efficiency FLEXIPAC® Structured Packing	
Size	**HETP***
1X	13.4 in [340 mm]
350X	14.2 in [360 mm]
1.6X	16.9 in [430 mm]
250X	20.1 in [510 mm]
2X	22.4 in [570 mm]
2.5X	32.3 in [820 mm]
3X	45.3 in [1150 mm]
3.5X	61.9 in [1570 mm]
4X	89.4 in [2270 mm]

* HETP values are estimates based on atmospheric distillation systems with low relative volatility and good liquid/vapor distribution. Contact Koch-Glitsch for non-ideal systems.

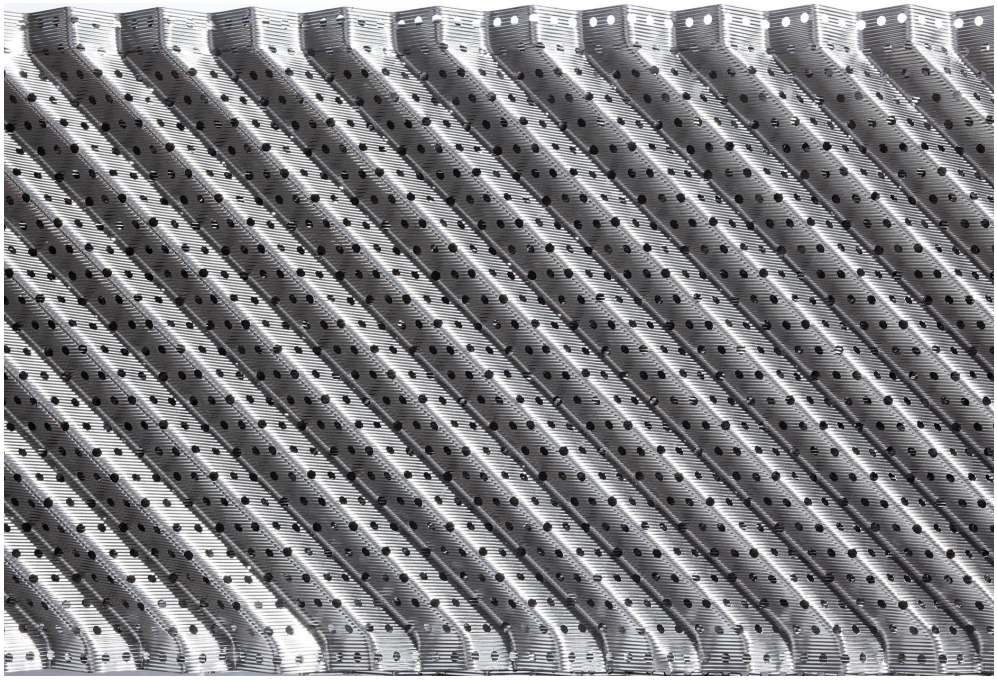
FLEXIPAC structured packing is available in two configurations: Y and X. The "Y" designated packings have a nominal inclination angle of 45º. They are the most widely used in new installations. The "X" packings have a nominal inclination angle of 60° from horizontal and are used where high capacity and low pressure drop are the foremost requirements for a specific application. The "X" packings provide a lower pressure drop per theoretical stage compared to the same size "Y" packing.

FLEXIPAC structured packing is available in a variety of corrugation crimp sizes.

FLEXIPAC® HC® Structured Packing

Increased capacity and reduced pressure drop in new construction and revamps.

Since its introduction in 1997, FLEXIPAC® HC® structured packing has been used in thousands of columns to increase capacity and reduce pressure drop both in new construction and for replacing standard sheet metal structured packings, conventional random packings and trays.



FLEXIPAC® HC® structured packing with textured surface.

Efficiency FLEXIPAC® HC® Structured Packing	
Size	**HETP***
700Y	6.3 in [160 mm]
500Z	7.1 in [180 mm]
1Y	8.3 in [210 mm]
350Y	8.9 in [225 mm]
500Y	9.1 in [230 mm]
1.6Y	10.0 in [255 mm]
250Y	12.4 in [315 mm]
2Y	14.6 in [370 mm]
2.2Y	18.5 in [470 mm]
2.5Y	23.0 in [585 mm]

* HETP values are estimates based on atmospheric distillation systems with low relative volatility and good liquid/vapor distribution. Contact Koch-Glitsch for non-ideal systems.

Combining excellent capacity and efficiency characteristics with a lower pressure drop per theoretical stage, it is the preferred packing for use in vacuum distillation columns.

FLEXIPAC HC packing is similar in construction to standard FLEXIPAC packing, except for a subtle modification in the geometry of the corrugation at the top and bottom of each packing layer. This relatively small change in geometry eliminates the abrupt change in flow direction of the liquid and vapor phases at the packing layer interface.

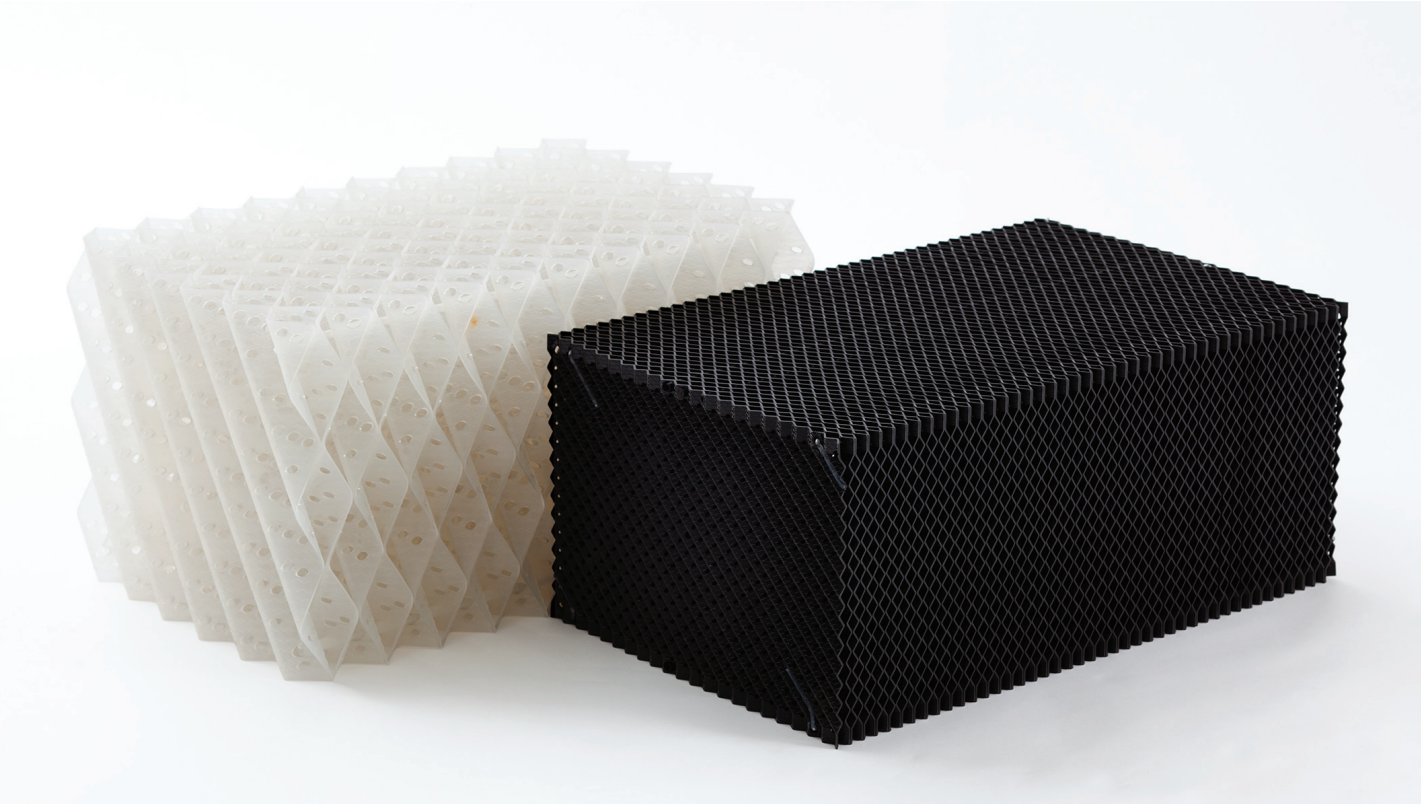
Conventional structured packing capacity is limited by flow interaction at the layer interface where the abrupt directional change limits the amount of counter-flowing liquid and vapor. As the liquid flow becomes restricted by the upward-flowing vapor, the liquid begins to build up at the layer interface which increases the pressure drop and may ultimately lead to flooding.

The geometry of FLEXIPAC HC packing relieves the liquid flow restriction. Because the premature build-up of liquid is eliminated, the low pressure drop characteristics of structured packing are better maintained throughout the efficient operating range of the packing. The benefits of FLEXIPAC HC packing are more significant for smaller corrugation crimp size, higher surface area packings. Depending on application and packing style, up to a 40% increase in capacity has been reported.

Plastic FLEXIPAC® Structured Packing

Excellent performance in chemically corrosive applications.

Plastic FLEXIPAC and FLEXIPAC HC structured packings provide the same combination of high efficiency, high capacity and low pressure drop as their metal counterparts. The variety of plastics available makes this product suitable for some of the most demanding corrosive applications. NOTE: The wetting characteristics of plastic combined with any unique attributes of the specific material of construction may cause the actual HETP to vary significantly.



FLEXIPAC® 2Y structured packing in polypropylene (white) and FLEXIPAC® 500Z HC® structured packing in PFA (black).

Efficiency Plastic Structured Packing	
Size	**HETP***
500Z HC	9.8 in [250 mm]
1Y	11.4 in [290 mm]
2Y	19.2 in [485 mm]
2Y HC	19.2 in [485 mm]
3Y	43.3 in [1100 mm]
3X	76.8 in [1950 mm]

* HETP values are estimates and are for reference only. Contact Koch-Glitsch for additional information.

Materials of Construction

- Polypropylene
- Glass filled polypropylene
- CPVC
- PVDF
- ECTFE
- Glass-filled ECTFE
- PFA
- Glass-filled PFA

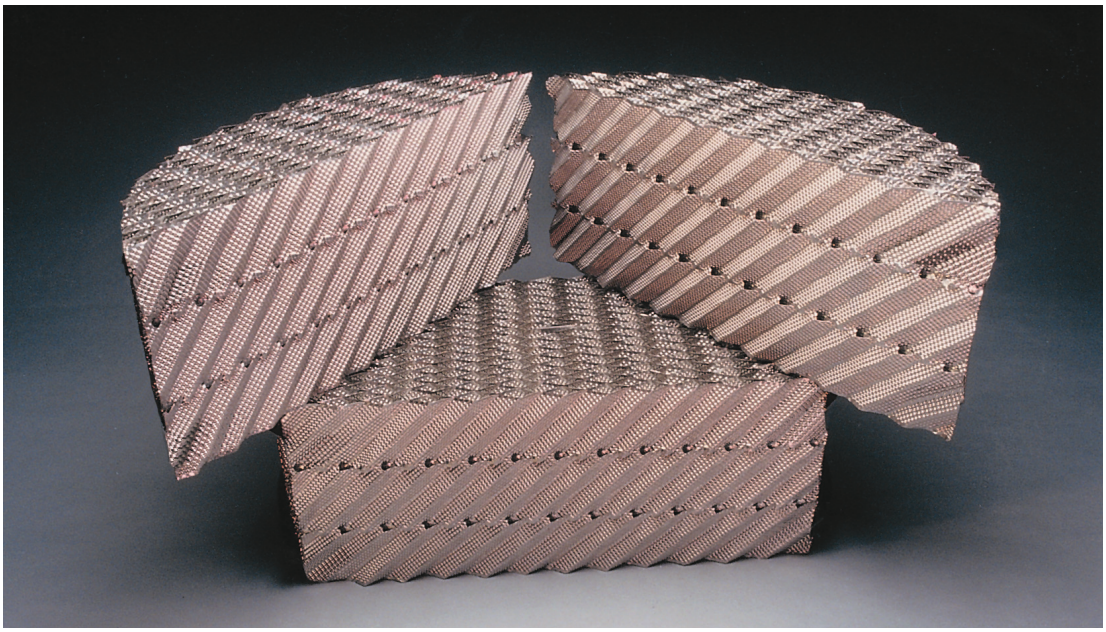
Applications

- Air separation plant direct contact cooler
- Flue gas cooler
- Seawater scrubber
- HCl absorber
- SO_2 absorber
- Cl_2/ClO_2 scrubber
- HNO_3
- Deaerators

INTALOX® High Capacity Structured Packing

Greater "efficient capacity" than other structured packings.

The unique geometry of INTALOX® structured packing has allowed it to be successfully applied in a variety of high-liquid-rate, high-pressure applications. It is also used in vacuum and atmospheric pressures. The aggressive surface texture of INTALOX structured packing provides excellent surface wetting, making this the preferred packing in aqueous distillation applications.



INTALOX® structured packing with textured surface.

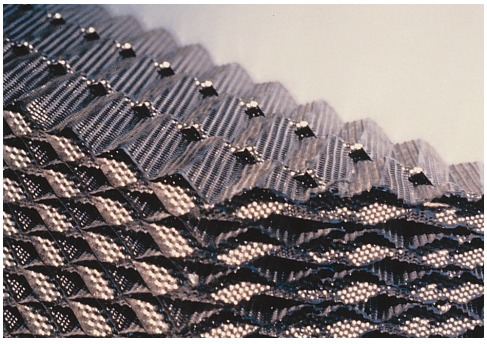
The benefits of INTALOX structured packing are particularly noticeable in the large corrugation crimp sizes. The unique physical attributes of INTALOX packing provide superior efficiency compared to other structured packings of similar surface area while maintaining excellent capacity and pressure drop characteristics.

Efficiency INTALOX® Structured Packing	
Size	**HETP***
1T	11.0 in [280 mm]
1.5T	14.0 in [355 mm]
2T	15.0 in [380 mm]
3T	18.0 in [457 mm]
4T	24.0 in [610 mm]
5T	30.0 in [760 mm]
5TX	36.6 in [930 mm]

* HETP values are estimates based on atmospheric distillation systems with low relative volatility and good liquid/vapor distribution. Contact Koch-Glitsch for non-ideal systems.

INTALOX structured packing obtains its higher capacity from:

- An aggressively textured surface
- Corrugation reversals in each packing layer
- Proprietary geometric features

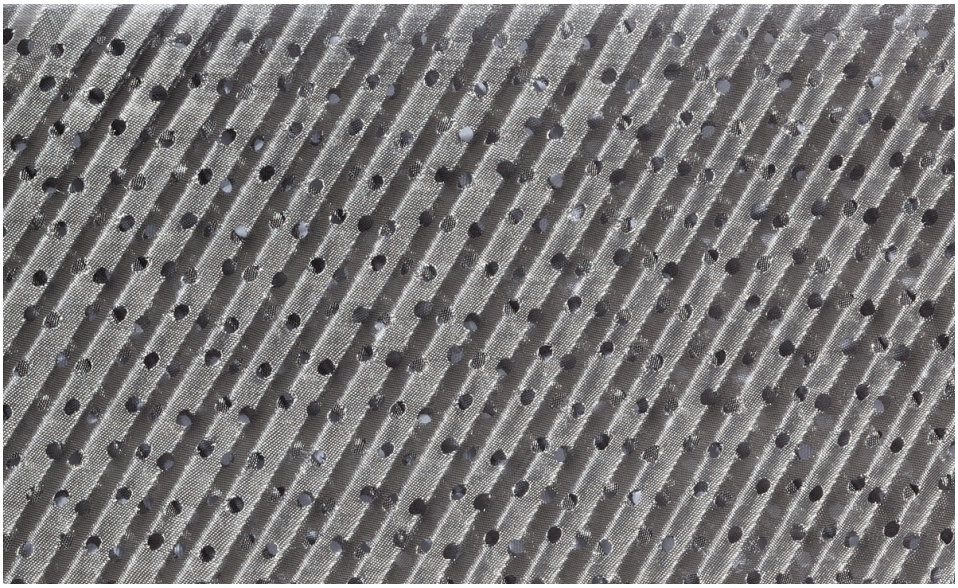


INTALOX® structured packing - corrugation reversals and surface texture.

Wire Gauze Structured Packing

Unsurpassed high efficiency and low pressure drop characteristics.

Koch-Glitsch wire gauze packing is the preferred packing in distillation service for deep vacuum and low liquid rate applications. The characteristic of lowest pressure drop per theoretical stage makes wire gauze packing the preferred device for processing specialty chemicals, pharmaceuticals and temperature-sensitive materials.

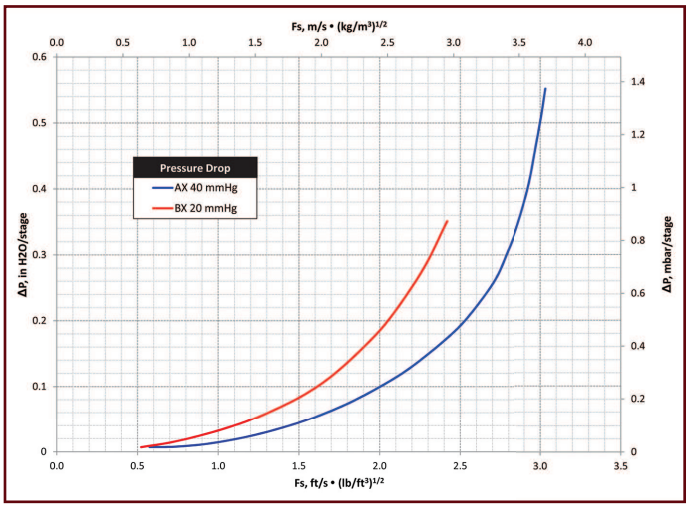


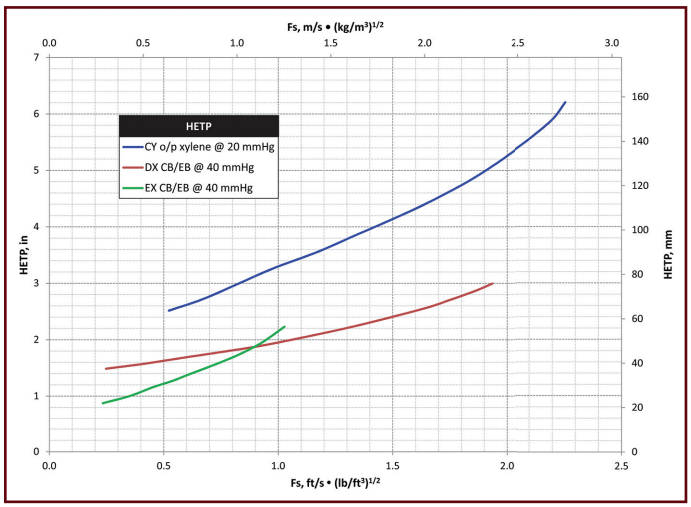
AX wire gauze packing.

Wire gauze packing is generally used in small to medium diameter columns to achieve the maximum number of theoretical stages in the minimum column height. Because of the capillary effect, the wire gauze material provides an extremely wettable surface resulting in excellent mass transfer efficiency particularly at very low liquid rates.

The new high-performance AX wire gauze structured packing provides improved performance over the original BX wire gauze packing. With lower pressure drop and similar efficiency, AX wire gauze packing minimizes pressure drop per theoretical stage. This is especially important where a large number of theoretical stages are required in deep vacuum service.

Wire gauze packing is also available in BX, CY, DX and EX sizes.

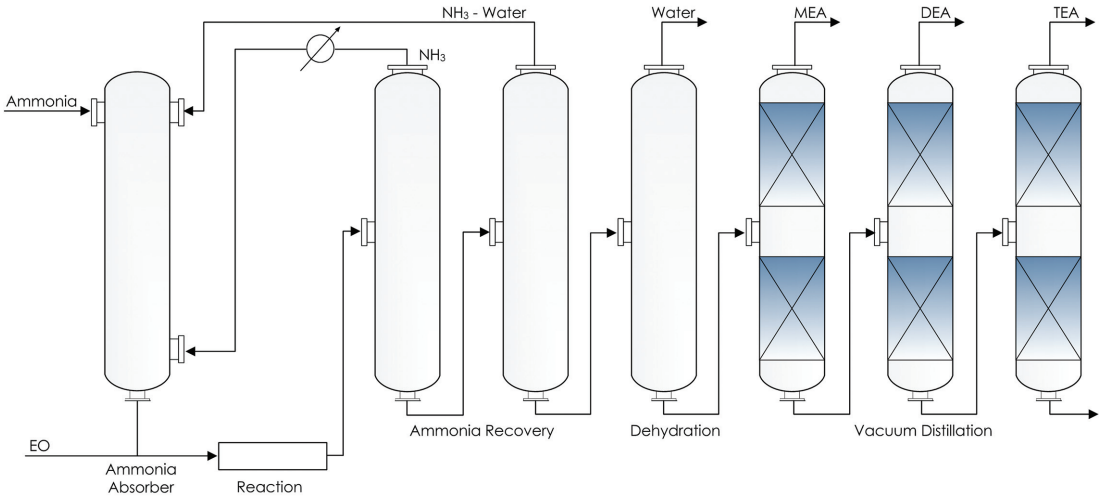




Applications

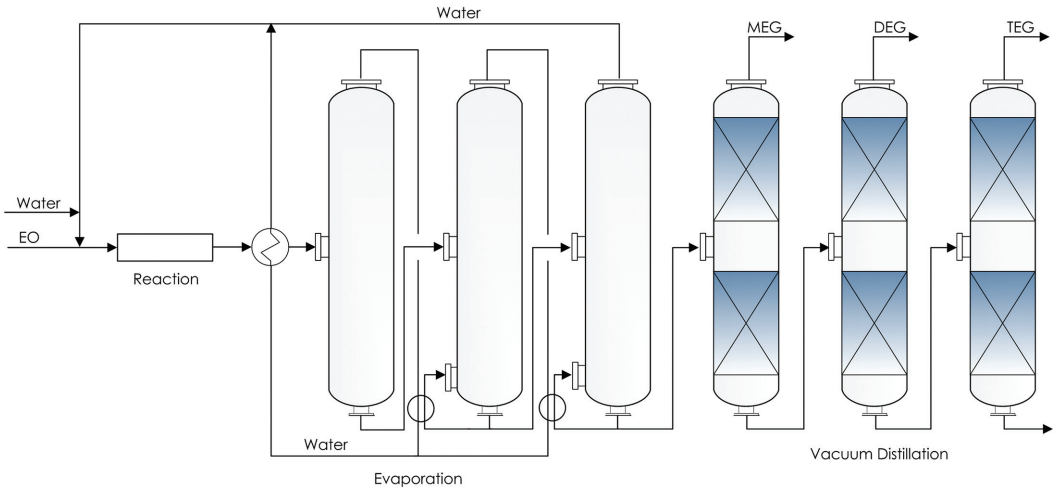
Ethanolamine Production

Monoethanolamine (MEA) is produced by reacting ethylene oxide with aqueous ammonia. The reaction also creates diethanolamine (DEA) and triethanolamine (TEA). MEA is used in aqueous solutions for scrubbing certain acidic gases. It is also used as feedstock in the production of detergents, emulsifiers, polishes, pharmaceuticals, corrosion inhibitors and chemical intermediates. MEA, DEA and TEA are separated in a distillation train operating under vacuum. This allows the distillation to proceed at lower temperatures, which reduces product degradation and poor color quality. FLEXIPAC HC structured packing provides the very low pressure drop and high efficiency required for this application. AX and BX wire gauze packing can be used to achieve even lower pressure drop and higher efficiency when liquid rates are low enough to take advantage of the capillary effect to wet the packing. The high separation efficiency of AX and BX wire gauze packing results in low energy consumption through reduced reflux rates and higher purity products at shorter column heights.



Glycol Separation Train

A three-column distillation train separates the glycols, namely MEG, DEG and TEG. For improved separation and to run at low temperatures, the columns are operated under vacuum. FLEXIPAC and FLEXIPAC HC structured packing as well as AX and BX wire gauze structured packing offer very high efficiency combined with low pressure drop. The benefits are lower bottoms temperature, less product loss due to degradation, increased capacity and lower energy consumption.



Applications

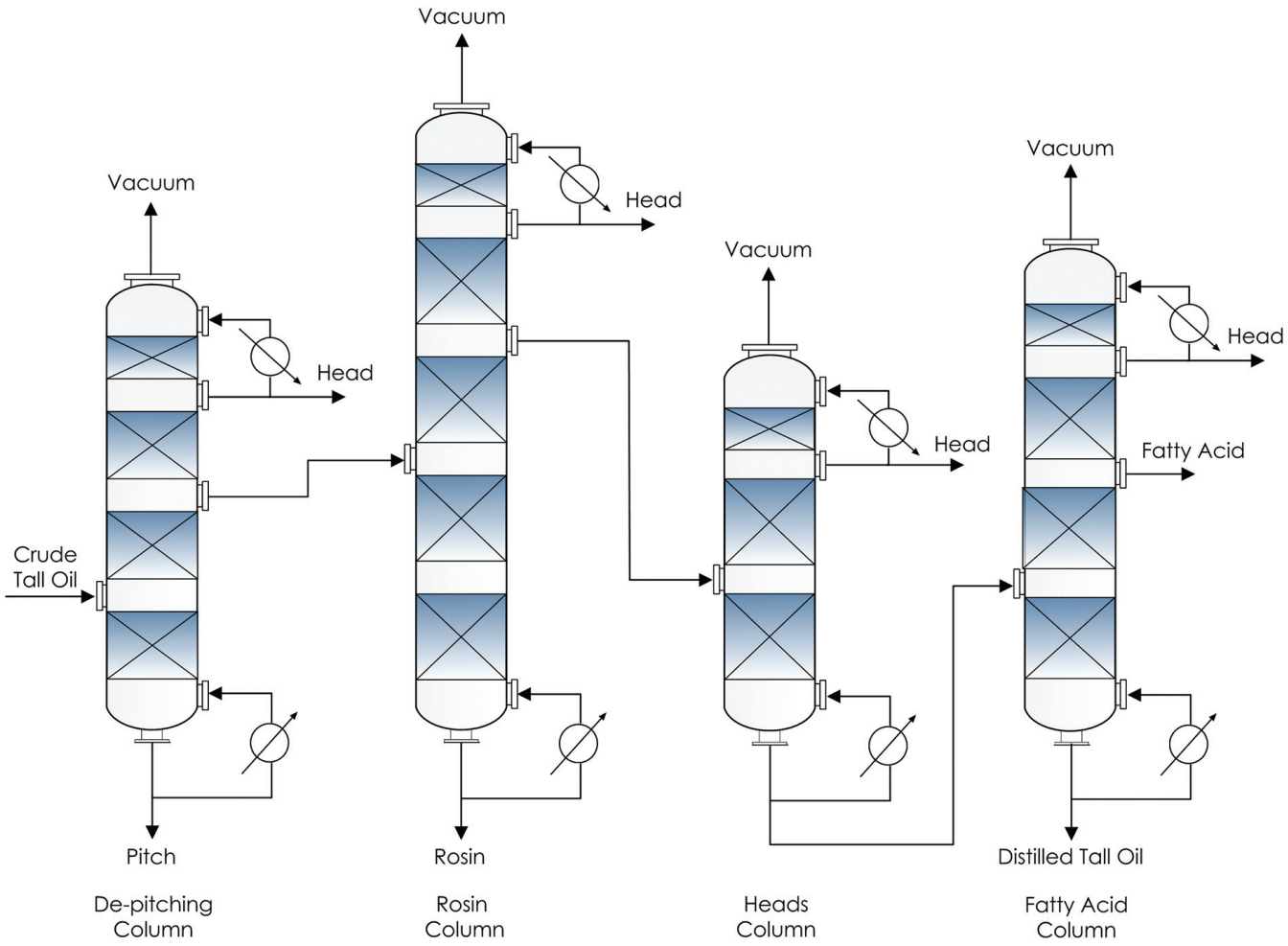
Tall Oil Fractionation

Tall oil is a name frequently used for the fatty acids obtained as a by-product of the Kraft process of wood pulp manufacture. The compounds of principal interest in crude tall oil are fatty acids and rosin acids. The tall oil rosin finds use as a component of adhesives, rubbers and inks and as an emulsifier. The pitch is used as a binder in cement, an adhesive and an emulsifier for asphalt. Tall oil fatty acid is a low-cost alternative to tallow fatty acids for production of soaps and lubricants. When esterified with pentaerythritol, it is used as a compound of adhesives and oil-based varnishes.

Vacuum distillation is used to minimize the exposure to elevated temperatures of the crude feed components, many of which are heat sensitive. The oil is distilled into five components with different boiling points: heads (which boils first), then fatty acids, distilled tall oil (a mixture of fatty and resin acids), resin acids (collectively known as rosin) and pitch (the residue). All of these can be used in various industries as is, but some of the rosin is also further processed on site.

Originally this separation was made using steam distillation; however, the very low vapor pressure of these fatty acids required a large amount of steam. Modern tall oil plants use a dry distillation system operated at very low top column pressures. Tall oil fractionators were among the first vacuum distillation operations to take advantage of the low pressure drop characteristics of FLEXIPAC structured packing. Additional benefits include higher efficiency and lower bottom column temperature, which increases the relative volatility between the fatty acids and the rosin acids and enhances their separation.

The diagram below shows a possible tall oil fractionation configuration; many variations exist.



Applications

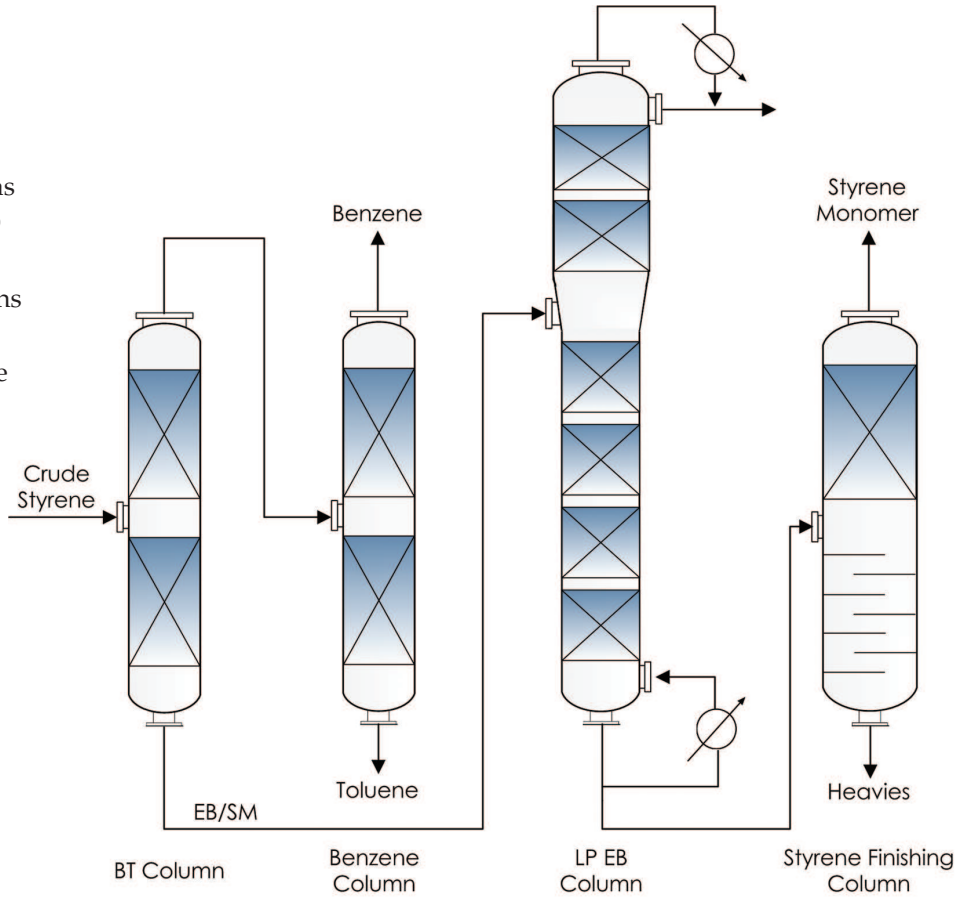
Styrene Monomer

In the styrene monomer (SM) unit, the reversible, endothermic dehydrogenation reaction is carried out over an iron oxide based catalyst. Steam is the diluent and heat carrier used in commercial reactors. The reactors typically operate under vacuum conditions as diluent steam reduces the partial pressure of the reactants. The steam also acts as a catalyst decoker via water-gas-shift reactions. A very small amount of ethylbenzene (EB) is thermally converted, with most thermal reactions resulting in by-products, such as benzene and toluene. Other by-products include C9s, such as alpha-methylstyrene and cumene.

The styrene distillation section typically consists of a 3- or 4-column configuration, including a superfractionator for the EB/SM split. The superfractionator is commonly called the EB Recycle column or EB/SM splitter. With commercial designs of 100+ theoretical stages in 6 to 7 packed beds and tower diameters of up to 39 ft [12 m], the splitter is one of the largest commercial applications of distillation and performs a critical separation. Structured packing is ideally suited for styrene columns and was first used in the 1980s. Because styrene is a reactive monomer, a low bottom temperature, achieved through a low column pressure drop and low liquid residence times, is desirable. Many plants have conventional FLEXIPAC structured packing installed. For revamps and also new plant construction, FLEXIPAC HC structured packing and high performance tower internals are preferred.

The last section of the distillation train is styrene recovery from residue. Because of fouling potential, structured packing typically is not used in this step. For improved fouling resistance and to handle concentrated heavies and polymers, sieve trays and dual flow trays are most often used in the stripping section. As an alternate unit operation, flash drums and wiped film evaporators are also used.

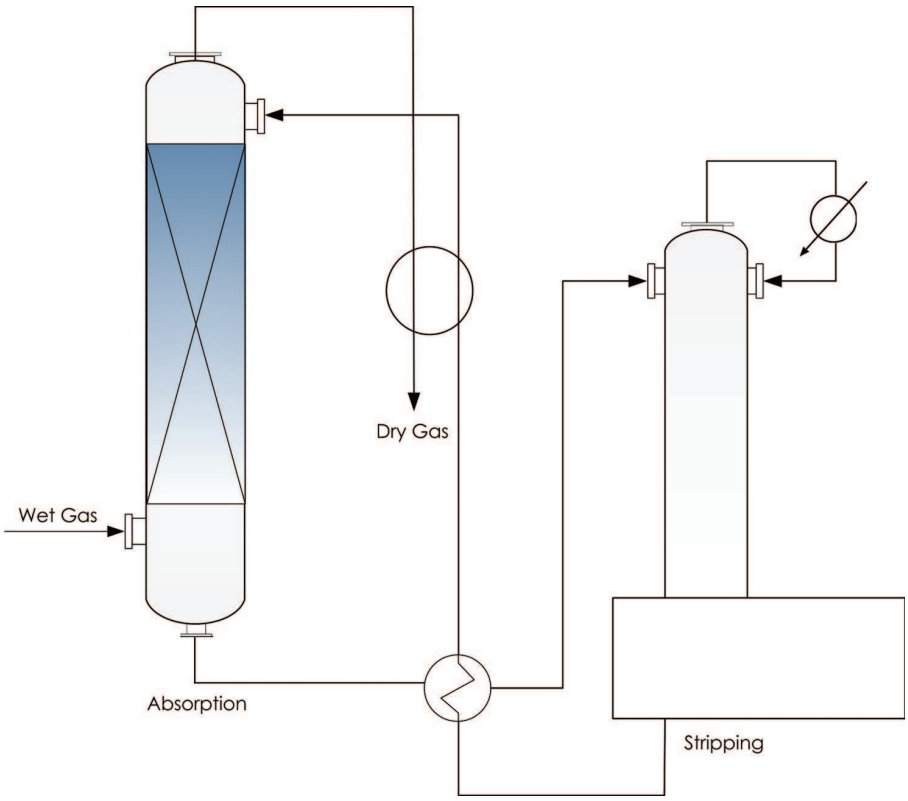
A second commercial route for styrene production is propylene oxide/styrene monomer (PO/SM), but it accounts for a much smaller share of global styrene production. This process also uses EB as the intermediate and produces both PO and SM as co-products. Although the distillation configuration and separations are significantly different, the mass transfer products used are the same due to similar design considerations.



Applications

Glycol Dehydration

Removing water vapor from natural gas prior to transporting in pipelines or processing in liquid removal plants prevents ice formation that could damage processing equipment. An absorption tower using a highly concentrated glycol solution, such as triethylene glycol (TEG), is the usual choice for water removal. Historically these towers were fitted with bubble cap trays because the absorber is operated with very low glycol circulation rates. More recently FLEXIPAC HC structured packing has been used to either increase the capacity of existing trayed towers or to reduce the diameter of new towers. In a revamp of an absorber from trays to structured packing, the gas handling capacity can improve from 50-100% depending on the size and configuration of the tower.



To reduce investment costs, decreasing the tower diameter and shell thickness is important. At high operating pressures, the shell thickness of the tower decreases significantly with diameter decrease. A column designed with structured packing can be shorter and, therefore, considerably lighter. This is useful in offshore applications where the performance of structured packing is less affected by motion and static tilt.

Excessive overhead glycol losses are typically associated with trayed contactors. The use of structured packing reduces the entrainment of glycol by minimizing localized high gas velocities. In addition, the use of an INTALOX high performance enhanced baffle distributor minimizes liquid entrainment while providing superior liquid distribution quality.

Emergency Delivery

Emergencies happen . . .

Koch-Glitsch has a wide variety of products to provide optimum performance whatever the application. Many common materials are in stock, and equipment can be quickly manufactured to meet your requirements regardless of original equipment manufacturer.

With manufacturing facilities and warehouses strategically located worldwide, Koch-Glitsch leads the industry with its on-time performance for delivery of emergency trays and hardware, packing and internals, and mist elimination equipment.

For emergencies, call the Hotline of your nearest Koch-Glitsch office:

- In the USA and Latin America, call 1-888-KOCH-911 (mass transfer), 1-316-207-7935 (mist elimination), or your local Koch-Glitsch office.
- In Canada, call 1-905-852-3381 (Uxbridge, Ontario)
- In Europe, call +39-06-928-911 (Italy), +44-1782-744561 (UK), or your local Koch-Glitsch office.
- In Asia, call +65-6831-6500 (Singapore) or your local Koch-Glitsch office.

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Patents

The following technologies are protected by one or more patents in the USA; other foreign patents may be relevant: FLEXIPAC® HC® structured packing (US5632934, US6478290).

Available exclusively from Koch-Glitsch, FLEXIPAC® HC® structured packing is protected by US Patent 5,632,934 and other patents worldwide assigned to Praxair Technology, Inc. Koch-Glitsch, LP is the exclusive worldwide licensee of Praxair Technology, Inc. for the manufacture and sale of this packing in all markets except for industrial gas separation.

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