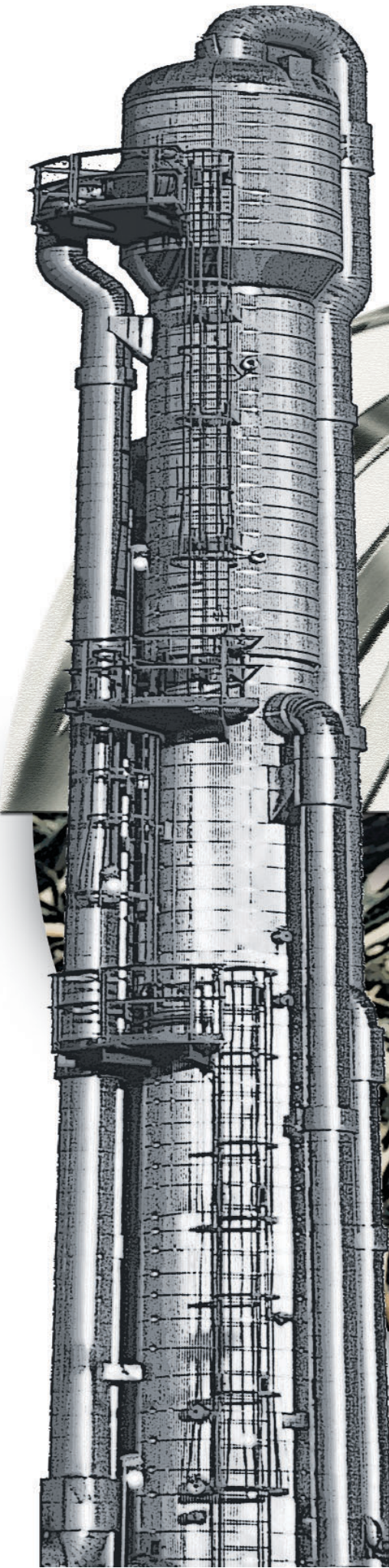


# Intalox<sup>TM</sup>

PACKED TOWER SYSTEMS

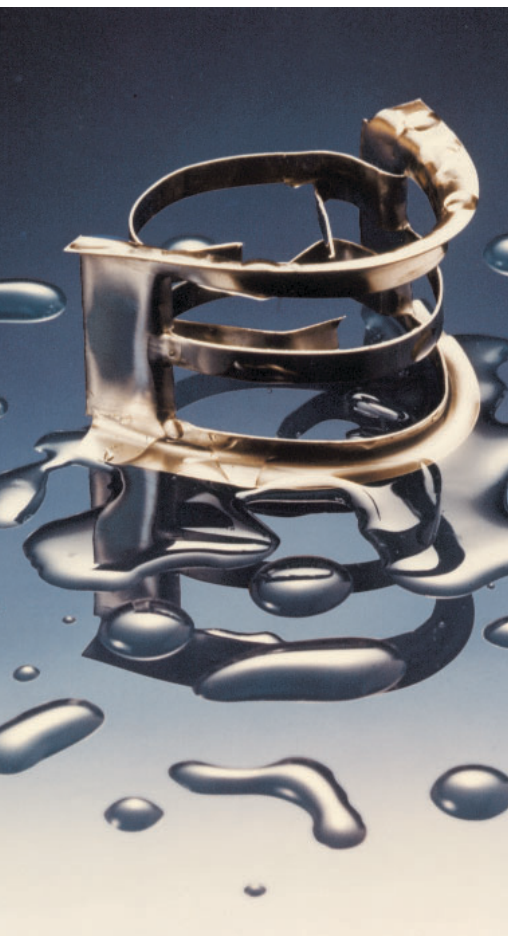
IMTP<sup>®</sup> High Performance Packing



 **KOCH-GLITSCH<sup>®</sup>**



# Introduction



Chemical processors and petroleum refiners around the world are familiar with the name **INTALOX®**. INTALOX is a "family" of tower packing designs that sets the standard wherever process towers are equipped with random or structured packing to effect heat or mass transfer. At the heart of these designs is the **INTALOX®** Metal Tower Packing or **IMTP®** High Performance Random Packing family. INTALOX metal tower packing is the first random packing designed especially for use in distillation operations. The advantages realized in distillation have been abundantly applied in absorption, stripping, liquid-liquid extraction and direct contact heat transfer operations as well. Since its introduction in the late 1970s, IMTP packing has been successfully used in thousands of mass transfer towers with diameters ranging from 6 inches to 40 feet [150 mm – 12 m]. Simultaneously, a line of high performance tower internals was developed to ensure the maximum performance of each packed tower is achieved. Koch-Glitsch engineers have extensive experience applying these technologies to a variety of processes, providing the best solution for each situation.

This booklet provides information for quick sizing of packed columns using INTALOX metal tower packing. The charts provide information for hydraulic ratings and relative packing efficiencies in terms of HETP (based on a standard hydrocarbon test system) as well as  $K_G a$  values for the absorption of  $\text{CO}_2$ . In addition, Koch-Glitsch offers the hydraulic rating program, **KG-TOWER™** Software, that may be downloaded from the website at [www.koch-glitsch.com](http://www.koch-glitsch.com).

Koch-Glitsch recognizes that not all applications require the use of IMTP high performance random packing. For those applications, Koch-Glitsch offers a wide variety of additional tower packings, such as **β-ETA RING®**, **CASCADE MINI-RINGS®**, **HY-PAK®**, **FLEXIRING®** and Raschig Ring Random Packings. For information on these packings, refer to brochure KGMRP-I.

## Emergency Delivery

In addition to IMTP packing, Koch-Glitsch has other metal or plastic random packings to provide optimum performance whatever your application. In common materials, most packings are in stock for immediate shipment to get you back on line. For emergencies, call the Hotline of your nearest Koch-Glitsch office.

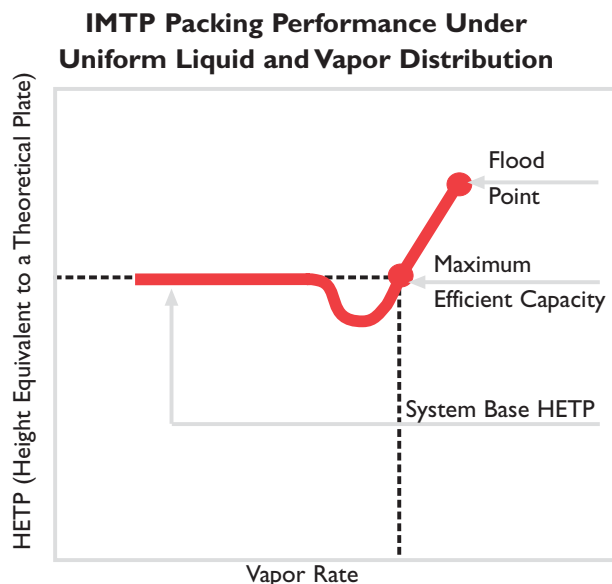
***In the US, call the Hotline at 1-888-KOCH-911.***

***In Europe, call 0044 1782 744 561 or your local Koch-Glitsch office.***

# IMTP® High Performance Random Packing

IMTP packing is applicable in as broad a range of services as any mass transfer device. It is heavily used in distillation towers: from deep vacuum towers, where low pressure drop is crucial, to high-pressure towers, where capacity easily surpasses that of conventional trays. Many absorption and stripping towers, especially those aiming for high capacity or close approach to equilibrium, rely on IMTP packing. The low pressure drop, high specific heat-transfer coefficient, as well as the fouling resistance of IMTP packing contributes to its success in heat transfer towers, such as olefin plant quench columns.

In a distillation system, uniform liquid and vapor distribution causes the HETP to be nearly independent of liquid and vapor rates. However, at higher vapor rates, the packing exhibits a region of improved efficiency (low HETP) where high vapor turbulence influences the liquid surfaces and improves the mass transfer.



Koch-Glitsch defines two packing properties from a performance curve:

1. The System Base HETP is the constant HETP value produced by uniform distribution.
2. The Maximum Efficient Capacity is at the highest vapor rate where the packing maintains the System Base HETP.



*Note: Efficient Capacity is not the same as the hydraulic capacity or flood point. Koch-Glitsch rates high performance packings by both Efficient Capacity and Hydraulic Flood.*

The System Base HETP concept raises important questions:

- What is the System Base HETP of a packing in a given system? (Refer to page 4.)
- How much does liquid distribution quality affect HETP? (Refer to page 5.)
- Which liquid distributors should be chosen to make a tower perform near its System Base HETP? (Refer to the Tower Internals Guide, KGMTIG-1.)

## Materials of Construction

INTALOX metal tower packings are offered in various materials of construction.

- Carbon steel
- Stainless steels, including Austenitic, Ferritic, Martensitic; types 409/410/430, 304 and 316 are readily available
- Duplex stainless steel
- Nickel and nickel alloys
- Aluminum
- Copper and copper alloys
- Titanium and zirconium

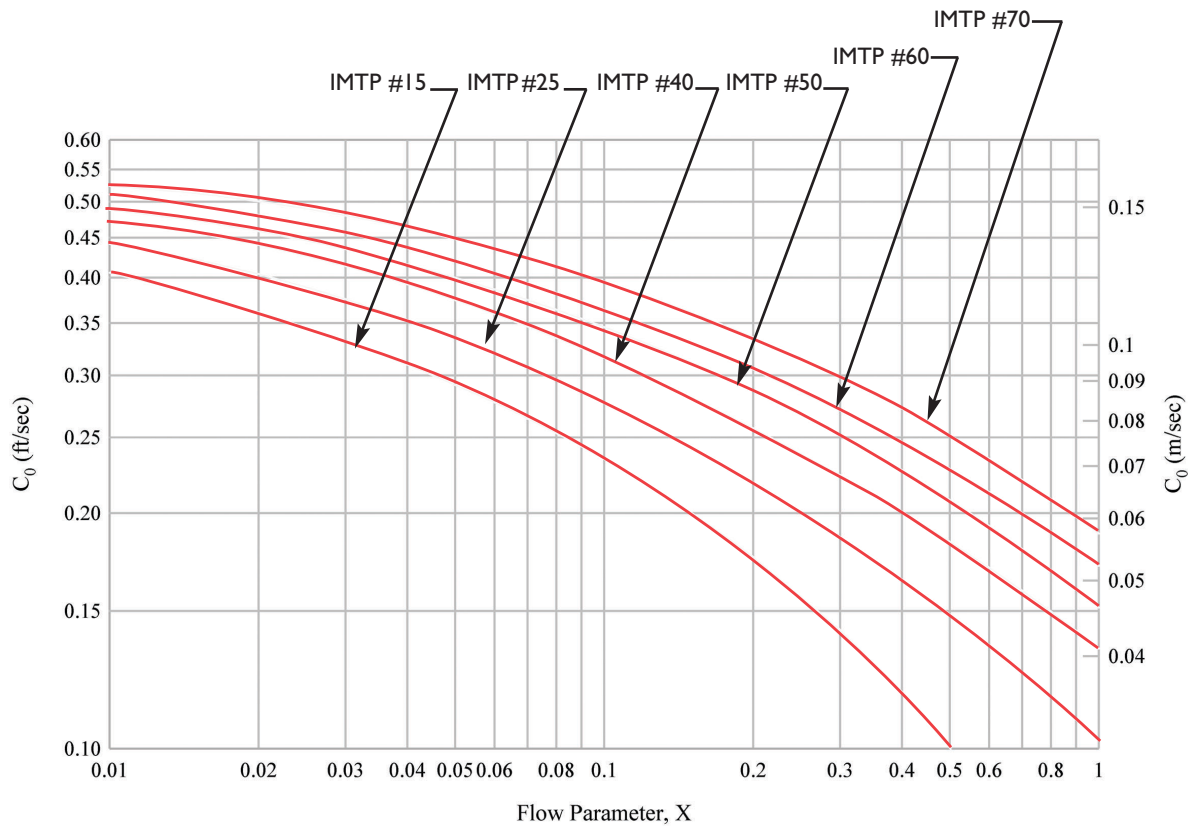
# Packing Capacity

The Maximum Efficient Capacity of IMTP packing in a non-foaming system can be estimated as:

$$\text{Maximum Efficient Capacity, } C_{sc} = C_o \left[ \frac{\sigma}{20} \right]^{0.16} \left[ \frac{\mu}{0.2} \right]^{-0.11}$$

$$\text{If } \left[ \frac{\sigma}{20} \right]^{0.16} \left[ \frac{\mu}{0.2} \right]^{-0.11} \geq 1.03, \text{ use } 1.03$$

## Capacity Correlation



## Nomenclature and Definitions

$L$  : Liquid mass rate  
 $G$  : Gas mass rate  
 $\rho_L$  : Liquid density  
 $\rho_G$  : Gas density  
 $V$  : Superficial gas velocity, ft/s or m/s

$$X = \frac{L}{G} \sqrt{\frac{\rho_G}{\rho_L}} \quad \text{Flow Parameter}$$

$$C_s = V \sqrt{\frac{\rho_G}{\rho_L - \rho_G}} \quad \text{Capacity Factor, ft/s or m/s}$$

$$F_s = V \sqrt{\rho_G} \quad \text{F-Factor, ft/s} \cdot (\text{lb/ft}^3)^{1/2} \text{ or } \text{m/s} \cdot (\text{kg/m}^3)^{1/2}$$

### Correlation Limits

If  $\mu < 0.07$ , use,  $\mu = 0.07$

### Data Range

$$3 \leq \sigma \leq 73$$

$$0.07 \leq \mu \leq 3.0$$

$\sigma$  : Surface tension, dyne/cm

$\mu$  : Liquid viscosity, cP

Koch-Glitsch routinely designs towers up to 90% Maximum Efficient Capacity. This limit leaves an estimated 11% turn-up before the packing loses its design efficiency.

# Packing Efficiency

The efficiency of packing in most distillation towers is expressed as HETP or height equivalent to a theoretical plate.

The mass transfer efficiency of all mass transfer devices is dependent on the system properties of liquid viscosity and surface tension. The efficiency of a packed system also depends on the uniformity of liquid and vapor distribution.

The concept of System Base HETP assumes that a specific separation receives uniform liquid and vapor distribution. This concept is useful because it isolates the system's effect on HETP from the distribution considerations.

As a first approach in projecting HETP values, Koch-Glitsch has developed a correlation for estimating HETP from the system properties. It is desirable to confirm the projected HETP values with test data in columns having uniform vapor and liquid distribution in the same system or a system having very similar properties. Koch-Glitsch has an extensive bank of operating data from a wide variety of systems and can provide reference data to confirm final HETP values upon request.

The efficiency correlation applies to systems which:

- are non-aqueous
- are non-reacting and non-ionizing
- have low to moderate relative volatility (less than three)

In these systems, the System Base HETP of IMTP packing for distillation and reboiled stripping services can be estimated by:

$$\text{System Base} = A \left[ \frac{\sigma}{20} \right]^{-0.16} [1.78]^\mu \quad \text{for } \mu \leq 0.4 \text{ cP}$$

$$\text{System Base} = B \left[ \frac{\sigma}{20} \right]^{-0.19} \left[ \frac{\mu}{0.2} \right]^{0.21} \quad \text{for } \mu > 0.4 \text{ cP}$$

The packing efficiency in other services or other systems must be estimated by other methods.

Non-uniform liquid and vapor distribution will cause actual HETP values to be substantially greater than the System Base HETP value. However, commercial towers with proper liquid and vapor distribution consistently approach the System Base HETP within 13%. For this reason, Koch-Glitsch designs often use HETP values 13% above the System Base HETP.

What represents proper liquid distribution for a commercial tower? In towers requiring few theoretical stages, traditional distributors can approach the System Base HETP value. Conversely, in towers requiring many theoretical stages, Koch-Glitsch INTALOX distributors are required to approach the System Base HETP value.

## Values of A and B for the HETP Correlation

IMTP Packing Size	No. 15	No. 25	No. 40	No. 50	No. 60	No. 70
<b>A-mm</b>	272	330	401	526	616	758
<b>A-in.</b>	10.7	13.0	15.8	20.7	24.2	29.9
<b>B-mm</b>	296	366	439	579	678	827
<b>B-in.</b>	11.7	14.4	17.3	22.8	26.7	32.6

### Correlation Limits

Relative Volatility < 3  
If  $\sigma > 27$ , use,  $\sigma = 27$

### Data Range

$2.0 \leq \sigma \leq 26.6$

$0.06 \leq \mu \leq 0.83$

$\sigma$  : Surface tension, dyne/cm

$\mu$  : Liquid viscosity, cP

# INTALOX® Packed Tower Systems

Koch-Glitsch **INTALOX® Packed Tower Systems** are predictable and reliable separation columns containing well-matched high performance packing and state-of-the-art liquid and vapor distributors. Koch-Glitsch's global experience is second to none and includes thousands of columns in distillation, absorption, stripping, liquid-liquid extraction and heat transfer applications.

The combination of INTALOX high performance internals and IMTP high performance random packing provides the highest random packing performance available in the industry.

Koch-Glitsch has developed a series of liquid distributors with attributes to maximize packed tower performance. These attributes are well understood and have been incorporated into INTALOX high performance distributors. Koch-Glitsch introduced a distributor rating system for quantifying distribution quality and performance. Distribution uniformity is rated as a percentage, where 100% indicates ideal uniform distribution. A low percentage rating indicates a high variation of liquid flow over the cross sectional area of the tower. In addition, the distributor must provide a sufficient gas passage area to avoid a high pressure drop or liquid entrainment.

INTALOX distributors aim towards 100% distribution quality by applying the following criteria:

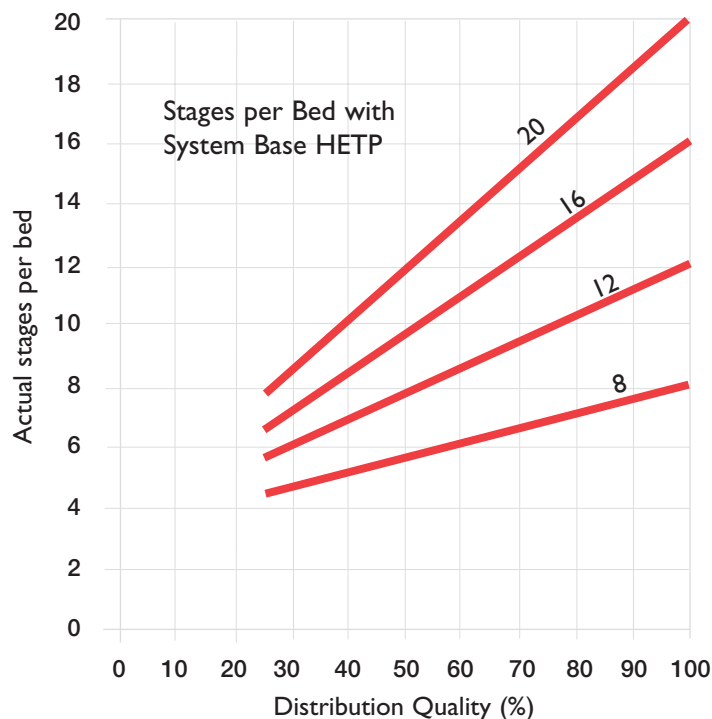
- A) Drip points are preferable on a uniform triangular pattern, or alternatively on a square pattern
- B) Drip points are uninterrupted by gas chimneys or mechanical supports
- C) Drip points are properly spaced to the vessel wall
- D) Equal liquid flow from each drip point

The significance of the Koch-Glitsch distribution quality rating system is the accurate prediction of tower performance.

*INTALOX distributors are applied in:*

- Distillation services with high stage counts per bed
- Distillation services with low relative volatility
- High purity product distillation services
- Distillation services operating near the minimum reflux or close to a pinch point
- Absorption and stripping applications with close approach to equilibrium
- Heat transfer services with close approach temperatures

The effect of liquid distribution quality on tower performance is illustrated below:



A tower containing deep beds of IMTP high efficiency random packing, designed to achieve many theoretical stages or transfer units, is very sensitive to liquid distribution quality.

Feed devices are critical to the performance of the liquid distributor and the packed column. Depending on the specific service, Koch-Glitsch offers a wide range of INTALOX liquid, vapor, mixed phase and flashing feed devices.

- INTALOX liquid phase feed pipes are designed to prevent excessive liquid velocity in the distributor to minimize liquid gradients and momentum effects.
- INTALOX vapor phase feed devices are designed to reduce the kinetic energy of the vapor feed before entering the packed bed.
- INTALOX mixed phase feed devices are designed to provide sufficient disengagement of vapor from the liquid prior to feeding the distributor.
- INTALOX suppressed flashing feed devices are designed to avoid vaporization inside the pipe system and to provide sufficient disengagement of vapor from the liquid prior to feeding the distributor.



Vapor distribution is an important part of INTALOX packed tower systems. A tower with poor vapor distribution will experience an unequal liquid-to-vapor ratio over the tower cross-sectional area, resulting in a reduction of tower performance. Koch-Glitsch can supply a variety of vapor distributors to ensure that the high efficiency packing meets its separation performance objectives.

For more detailed information and descriptions regarding Koch-Glitsch INTALOX high performance distributors as well as all other tower internals, refer to our brochure, KGMTIG-1.

Koch-Glitsch goes a step further by offering single supplier/installer benefits of turnkey solutions. At your request, the KOCH-GLITSCH FIELD SERVICE™ team is always available to provide faster, safer revamps with minimum down time.

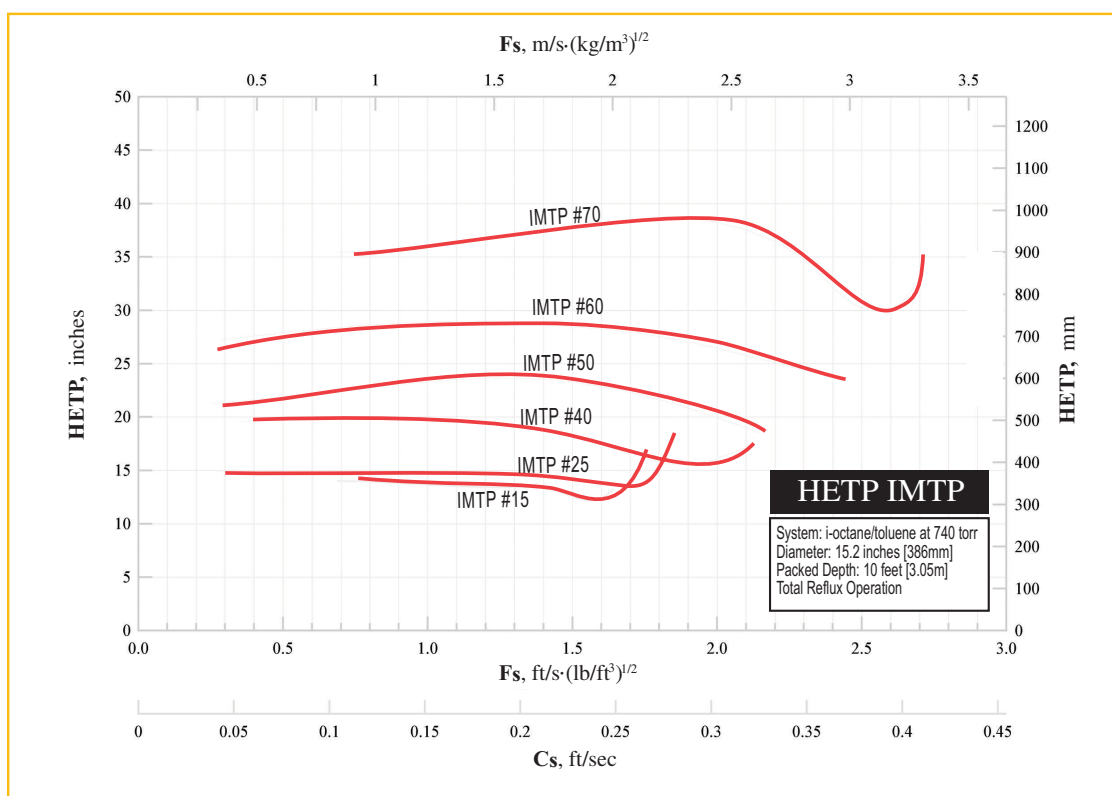
## IMTP® Packing Characteristics

IMTP® Packing Size		15	25	40	50	60	70
Nominal Size		15	25	40	50	60	70
	mm	15	25	40	50	60	70
	inch	$\frac{5}{8}$	1	$1\frac{1}{2}$	2	$2\frac{3}{8}$	$2\frac{3}{4}$
Void Fraction	%	96	97	98	98	98	98
Bulk Weight*	kg/m <sup>3</sup>	283	224	153	166	137	141
	lb/ft <sup>3</sup>	17.7	14.0	9.6	10.3	8.6	8.8

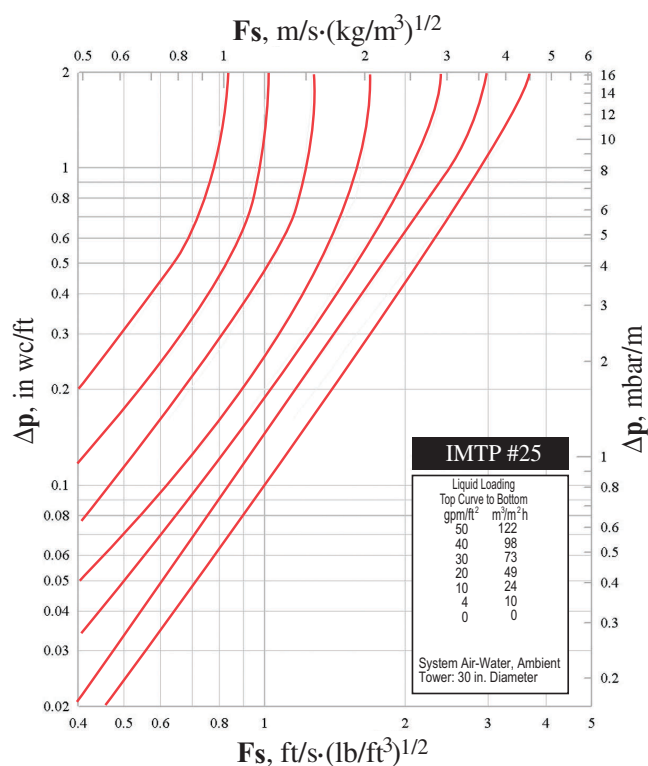
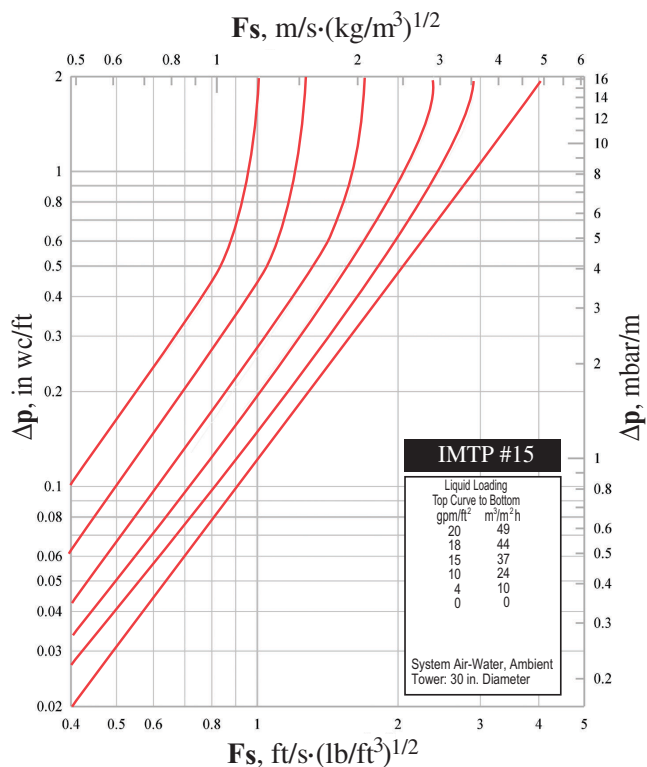
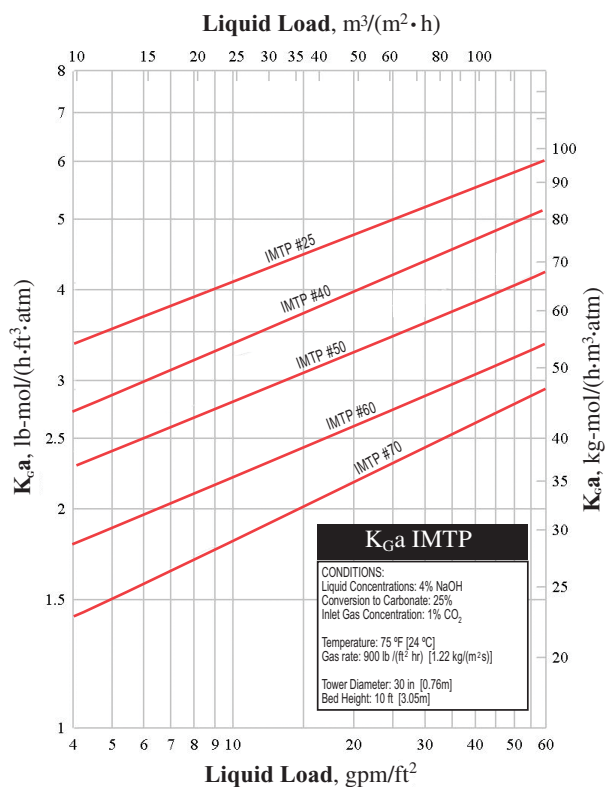


\* for stainless steel with standard material thickness

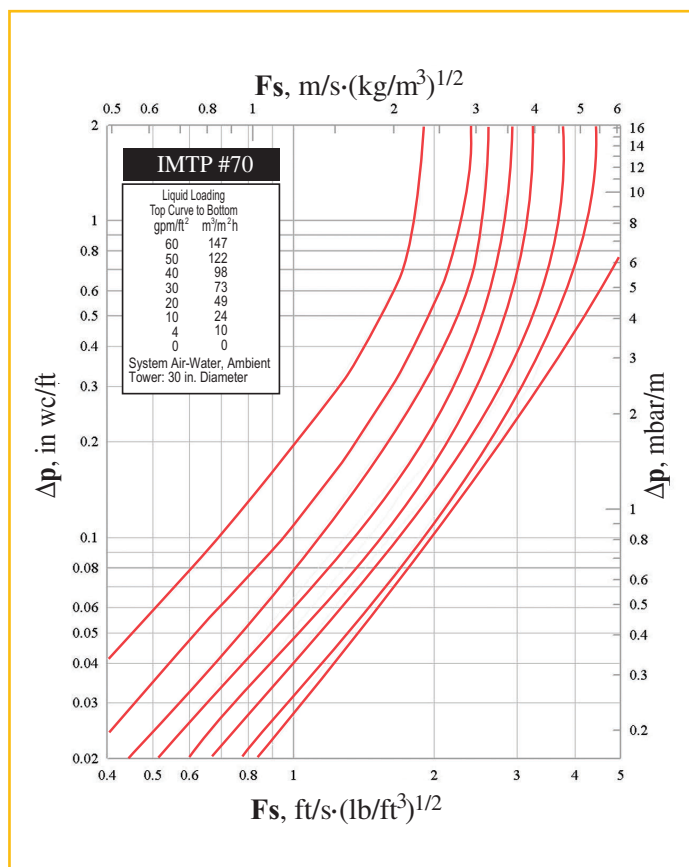
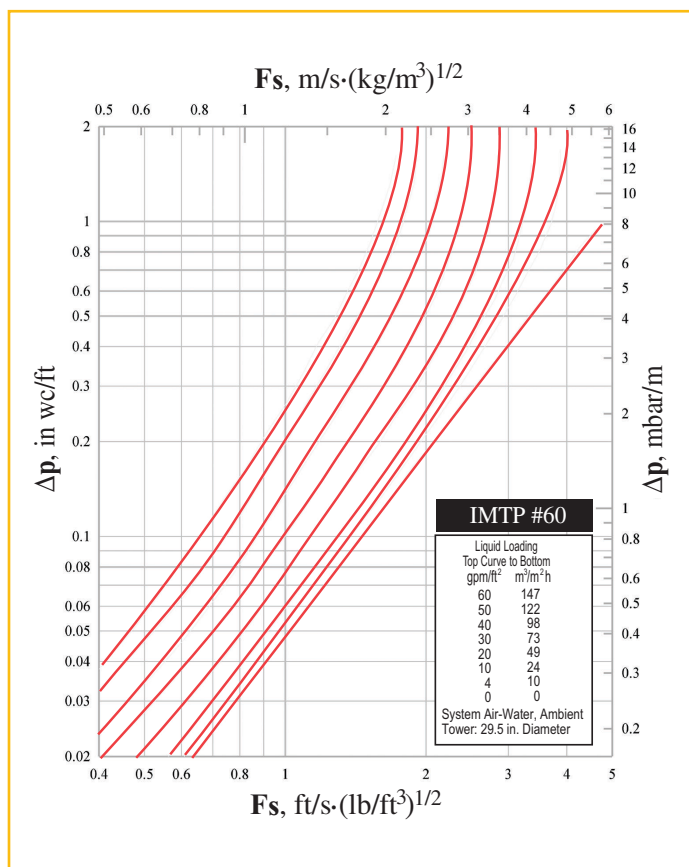
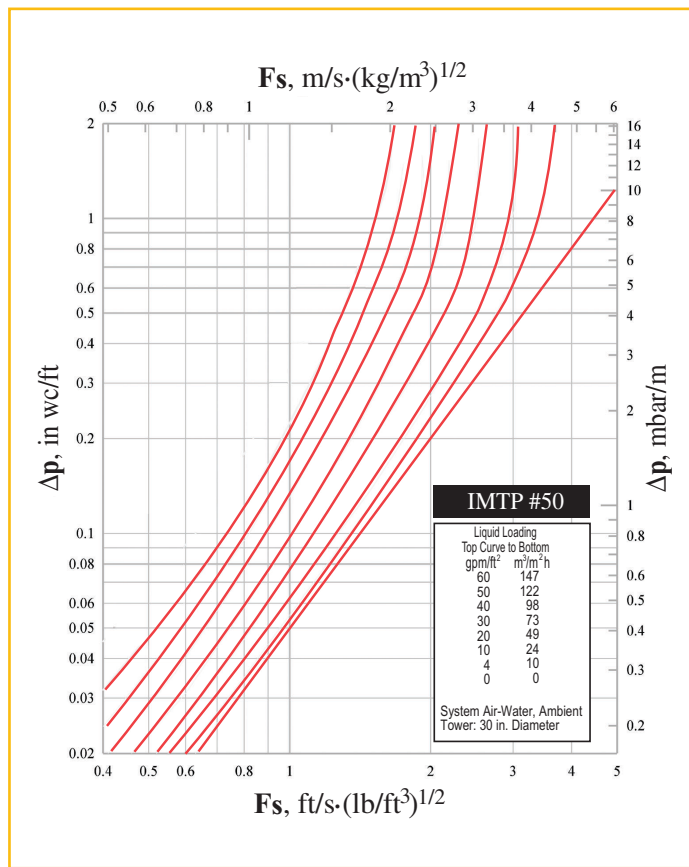
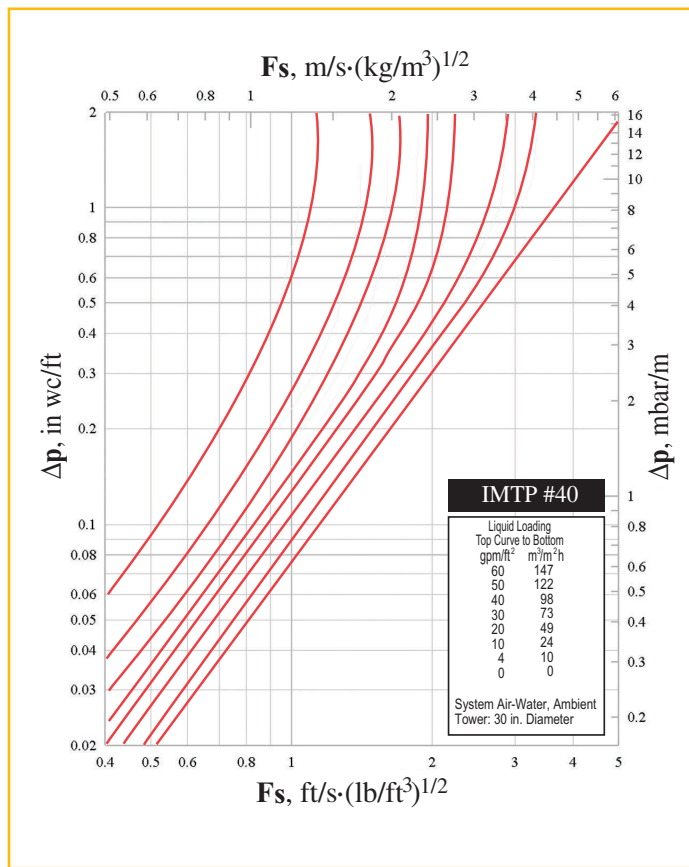
## IMTP® Packing Efficiency



# IMTP® Packing Performance

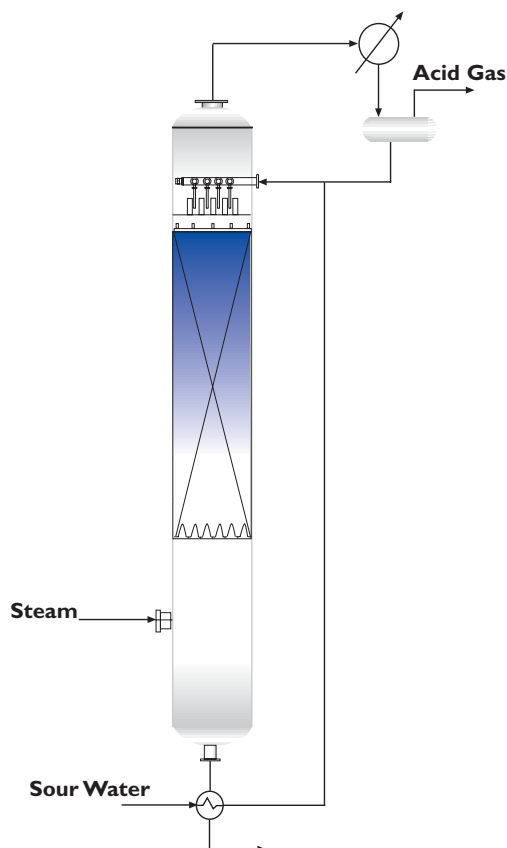
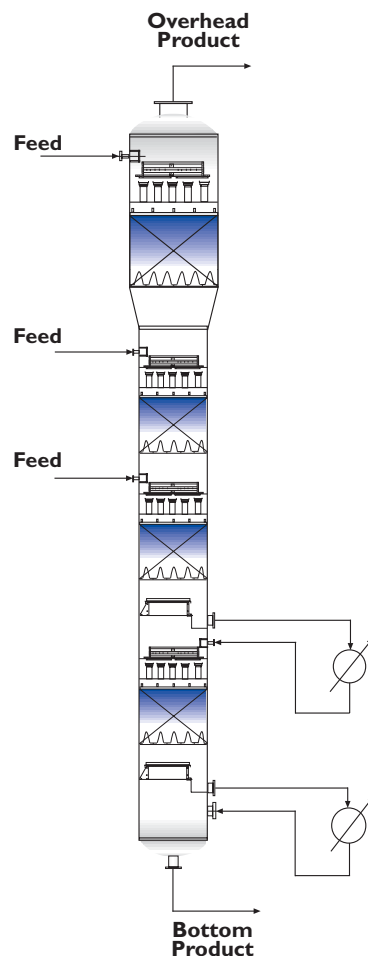






## Demethanizer

One application that is common to both natural gas plants and olefins plants is the separation of methane from heavier hydrocarbons. Generally, these columns are operated at high pressure and low (cryogenic) temperature. Installation of INTALOX Packed Tower Systems in demethanizer columns provides several benefits. Well-designed INTALOX Packed Tower Systems take into account the close liquid and vapor densities and low surface tensions of this system. High performance Intalox tower internals in combination with IMTP high performance packing provide maximum separation efficiency. Increased efficiency permits operation at lower reflux ratios, reducing the condenser refrigeration requirement. In addition, IMTP packing provides increased capacity or throughput with low pressure drop. For new construction, the column diameter is minimized, reducing the required capital investment. In revamp projects, the use of IMTP packing allows maximum throughput for the existing column. IMTP packing is available in a wide range of materials, including aluminum, and in sizes ranging from #15 to #70. In some cases, the benefits of INTALOX Packed Tower Systems can be extended to deethanizer columns as well. Koch-Glitsch has extensive experience packing hundreds of light hydrocarbon distillation towers to maximize performance.



## Sour Water Stripper

Sour water stripping is an important part of integrated industrial aqueous waste management, particularly in petroleum refineries. The sour water stripper is designed to remove  $\text{H}_2\text{S}$  and  $\text{NH}_3$  from process water. This can be achieved by contacting the sour water with stripping steam in a packed bed. IMTP packing provides very high stripping efficiency, which allows shorter packed bed depths or the use of less stripping steam. Revamping a sour water stripper from trays or conventional random packing to IMTP packing can help refineries meet today's increasingly stringent effluent water quality regulations. Process water may contain contaminants that can cause scaling, fouling or foaming problems. The very high void fraction and low pressure drop of IMTP packing help to alleviate these problems. In addition, the wider operating range of IMTP packing provides the flexibility required to meet the additional stripping requirements during peak operation.

# Applications

IMTP tower packing has been used in a wide range of applications from very low liquid rate services, such as DMT purification and glycol separation, to high liquid rate applications, such as hot carbonate absorbers and demethanizers. IMTP tower packing's lower pressure drop, combined with high mass transfer efficiency, provides superior performance in low liquid rate vacuum systems.

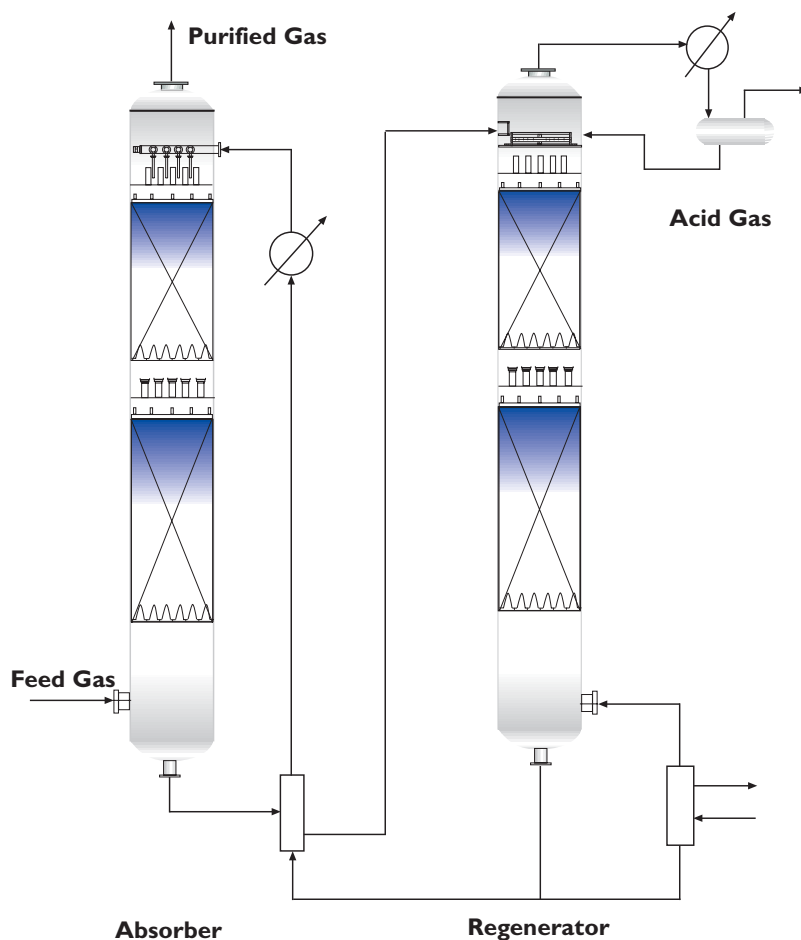
The low pressure drop provided by IMTP tower packing makes it a good choice for foaming systems. The presence of foam in a packed bed results in a significant pressure drop increase. The foam represents a very low density liquid phase that significantly reduces the void fraction and capacity within the packed bed. High pressure drop

increases the amount of foam generation due to the resistance of the vapor on the liquid phase. Therefore, it is desirable to design the packed bed with low pressure drop in foaming systems. IMTP tower packing offers the lowest pressure drop per theoretical stage of any random packing available.

IMTP tower packing has a high void fraction compared to other random packings of similar size. Large void fractions provide superior high liquid rate capacity as well as a lower pressure drop. Lower pressure drop in combination with the unique, self-draining shape reduces liquid holdup on the packing, which reduces the areas where solids could deposit.

## Acid Gas Removal

One of the most widely used commercial absorption processes is the removal of  $\text{CO}_2$  and  $\text{H}_2\text{S}$  from a gas stream by contacting it with an amine solution, such as MEA, DEA, or MDEA. The activated forms of MDEA solutions, such as Ucarsol®, GAS/SPEC® and aMDEA®, have also been widely used in this process. Installation of INTALOX metal tower packing in these towers offers lower pressure drop which provides several benefits. This system is moderately foaming and the lower pressure drop provided by IMTP packing reduces foam generation and the use of costly anti-foam agents. Lower pressure drop also reduces energy consumption and solvent degradation due to higher operating temperatures. The predictable performance of IMTP packing, when used with INTALOX high performance distributors, and the packing's high mechanical strength allow the use of very deep beds. Koch-Glitsch has successfully packed amine absorbers and regenerators with beds well over 40 feet [12 m] deep. Column height normally occupied by a redistribution system can be utilized by additional packing. This reduces the cost of additional tower internals when replacing existing trays. These benefits can be extended to other gas treating systems, such as hot carbonate (e.g. Benfield) and physical solvent (e.g. Selexol®) systems. Koch-Glitsch has installed IMTP packing in practically all of the amine, hot carbonate, and physical solvent systems, as well as many other gas treating systems. This vast experience can be used to ensure maximal performance of any gas treating system.



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GAS/SPEC® is a registered trademark of Dow Chemical Company.  
aMDEA® is a registered trademark of BASF Aktiengesellschaft.  
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