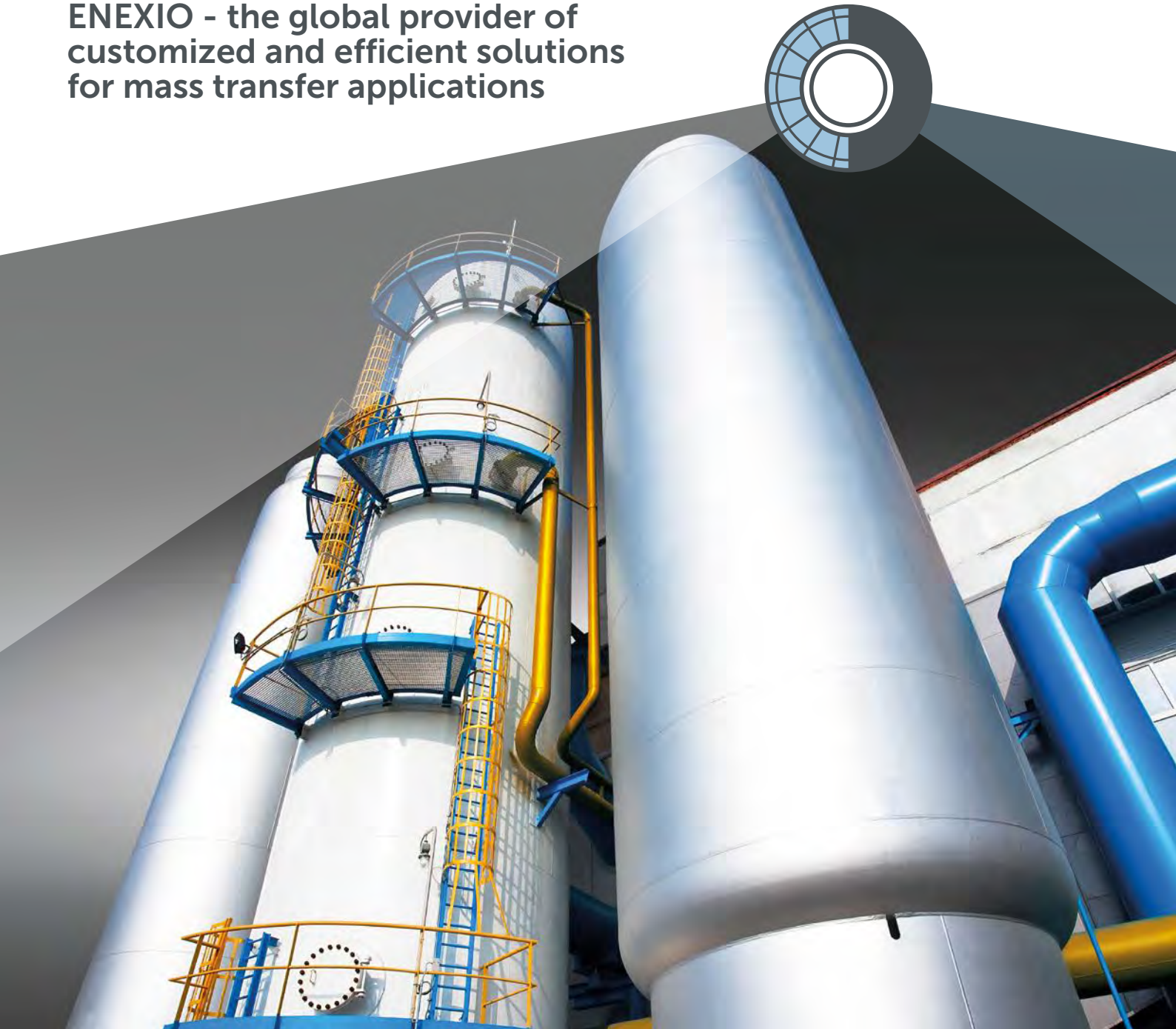
ENEXIO

ENERGY.
ENGINEERING.
EXCELLENCE.

2H COMPONENTS & SOLUTIONS

ENEXIO - the global provider of customized and efficient solutions for mass transfer applications



MASS TRANSFER

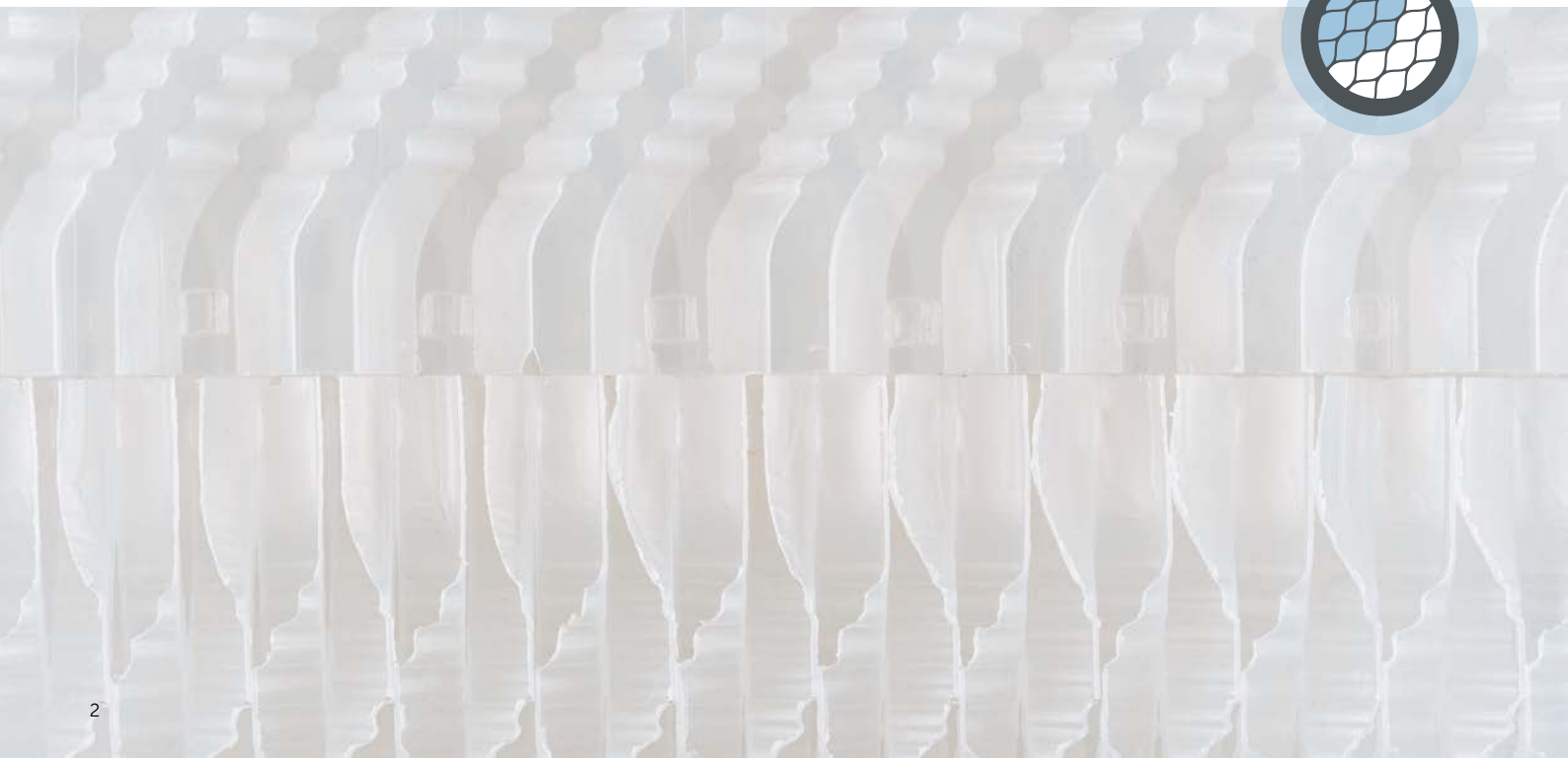
ENEXIO is a reflection of what we do and what we have accomplished as a pioneer in the field of mass transfer, water treatment and power cooling over decades. It represents a promise to our customers and business partners at the same time – we as a global provider for mass transfer, water treatment and power cooling solutions stand for **Energy. Engineering. Excellence.**

With our experience and pioneering spirit in engineering, manufacturing and service we deliver state of the art solutions for mass transfer applications, water, sewage and power plants – always affected by our deep sense of responsibility for the overall management of resources and a clean environment. We deliver excellence and achieve customer satisfaction everywhere in the world. Our worldwide employees work with a continual commitment to high quality, ecology and cost effective products and services.

Our commitment to Energy, Engineering and Excellence means for you that we are a reliable partner who is always there to meet your expectations with superior results.

In addition to our core power cooling solutions we also offer structured packings and column internals that ensure a high degree of operating safety and environmental protection. The diversity of our designs provides customers with extremely eco-friendly solutions and a minimum of operating and maintenance costs. Underlining our responsibility as a reliable partner we also offer customers comprehensive maintenance and spare parts service, developing and manufacturing all of the main components at our own production sites.

Experience ENEXIO!



2H MASSdek® PACKINGS

Effective and economical

ENEXIO Water Technologies is one of the leading manufacturers of structured PP and PVC packings for mass transfer, cooling tower construction and water treatment. In order to meet the special demands involved in mass transfer applications we have developed 2H MASSdek® packings.

For the last 100 years components with defined and optimised contact surfaces have been used in thermal process engineering, and structured packings represent the most current state of the art. They are indispensable in distillation and have almost completely replaced random packings in special applications. This process has only just begun to be used in the exhaust air treatment sector.

Experience gathered from other fields of application has convinced us that the inherent advantages of structured packings can also be exploited for thermal and chemical separation process engineering. This is why we have developed 2H MASSdek® packings.

Experiments have shown that structured packings can achieve better results compared with normal random packings and offer improved economy. Even the costs of retrofitting from random packings to structured packings can be amortised within only a short time.

Packings + Installations + Engineering = Complete offer
Your plant should provide a top level of performance. This is why we offer you ancillary equipment alongside 2H MASSdek® packings, such as support grids, liquid distributors and droplet separators. All elements are harmonised, thus enabling the desired results to be achieved.

Advice and engineering
Naturally we also offer you our advice and engineering. From the selection of the material and the most suitable type of packing to the design including internals – our experts are able to provide you with the necessary support.

Quality
Your column is only able to achieve the required separation performance over a long period of time when the efficiency and quality of the packings is optimized. 2H MASSdek® packings are exclusively manufactured in Germany and our own quality assurance process guarantees a consistent standard of quality from the raw material inspection on receipt of the material to running tests on the finished product. We will be pleased to provide you with certification related to a specific order if desired. And of course we are certified to DIN EN ISO 9001.

Areas of application of 2H MASSdek® packings

- Exhaust air scrubbing
- Absorption + desorption
- Biotrickling filters for the elimination of volatile organic compounds (VOCs), hydrogen sulphide and ammonia
- Scrubbing systems with a high level of separation performance

STRUCTURE BRINGS EFFICIENCY

Functional principle and characteristics

2H MASSdek® packings have been developed especially for thermal and chemical separation processes and are used for applications such as gas scrubbing, the cleansing of exhaust air, rectification and desorption (stripping).

Design
Structured packings are characterised by their regular form, which ensures a defined distribution of gas and liquid throughout the pack. As the channels run in opposite directions, the gas and liquid flows are separated at their intersections and then re-mixed. 2H MASSdek® packings consist of special plastic compounds from which profile-shaped sheets are manufactured using an extrusion process. The sheets are welded together to form stable packages. These packages can be individually cut and, as a result, divided into single elements which are easier to handle. Upon customer request we also manufacture circular shapes and other forms.

Varied and powerful
2H MASSdek® packings are currently available in PE, PP, electrically-conductive PP, PVC and PVDF (further plastics available on request), with specific surfaces of between 80 and 240 m^2/m^3. The standard packings are suitable for gas capacity factors of up to 4.0 Pa^0.5 at a typical liquid loading rate of approx. 25 m^3/m^2*h. We offer special types of packings for higher hydraulic loadings.

Stable and yet adaptable
A patented procedure for reinforcing the sheets ensures that 2H MASSdek® packings have particularly high stability. They can withstand extreme mechanical loads of several tonnes per square metre and can be accessed without external aids, which simplifies their handlin and installation.

2H MASSdek® packings have high levels of compressive strength and do not settle, even when deposits are formed or at high temperatures - a significant advantage compared with random packings. Bed heights in excess of 10 m can thus be achieved.

However, the sheets in our 2H MASSdek® packings are also flexible and fit easily onto the column wall. The water does not leak down the interior wall of the tower but is fed back into the packing. Thus edge deflectors can be eliminated and the wall effect is nevertheless minimised.

Advantages of 2H MASSdek® packings

- Improved throughput capacity
- Lower pressure drop
- Higher effective mass transfer surface
- Reduced tendency to clogging
- Bed heights significantly higher than 10 m possible
- Extremely high mechanical stability
- Less prone to contamination
- More efficient operation
- Can be used for revamps and retrofits
- Can be mounted at the vessel manufacturer's site

TECHNICALLY OUTSTANDING – FINANCIALLY CONVINCING

Energy saving through reduced pressure drop

Due to their optimised design 2H MASSdek® packings have proven to be outstanding compared with other mass transfer equipment – in particular random packings. This technical superiority also has its financial effects.

For the same separation performance 2H MASSdek® packings achieve better results in all cases with regard to throughput capacity and pressure drop than random packings. Depending on which random media is taken for comparison, 2H MASSdek® packings reach considerably higher values.

The use of special recipes optimises the packing's surface structure. In this way the separation performance of the 2H MASSdek® product range is highly increased. Even with relatively low specific liquid loadings 2H MASSdek® packings achieve a comparatively high share of effective mass transfer area.

The excellent performance levels in separation, throughput capacity and pressure drop are supported by a low tendency to blocking. The special sheet structure of 2H MASSdek® packings makes channels more resistant to deposits of solid materials and they remain hydraulically resilient for longer. This advantage particularly applies when compared with random media.

Savings potential
It has been shown that exhaust air scrubbers with structured packings can be constructed in a significantly more compact manner and can be operated more energy-efficiently. The lower specific pressure drop enables savings in fan power. Even a retrofit is amortised in a few years.

Surface and structure
The structure of our products forces the liquids to take a complex path through the separation column and together with the large contact surface this provides energy-efficient mass transfer performance.

2H MASSdek®
AT A GLANCE

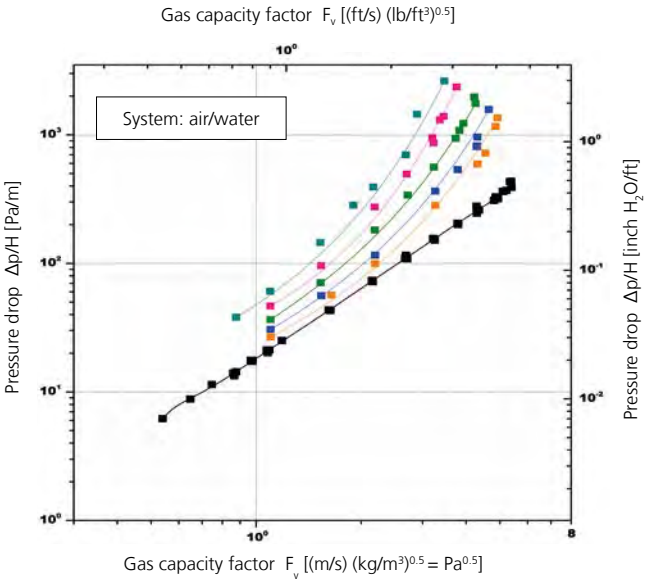
Data and facts

Types							
Type	**Structure**	**Specific surface**	**Hydraulic capacity / specific pressure drop**	**Mass transfer performance**	**Resistance to scaling and fouling**	**Spec. pressure drop/ number of transfer units**	**Typical applications**
2H MASSdek® 250 HTE	cross	240 m^2/m^3	+	+++	+	++	Scrubbing systems with the highest levels of demand on separation performance
2H MASSdek® 250 HTC	cross	240 m^2/m^3	++	++(+)	+	++	Chemical high per-formance scrubber, biotrickling filter with low concentration load
2H MASSdek® 150 HTC	cross	150 m^2/m^3	+++	++	++	+++	Standard uses for absorption and desorption
2H MASSdek® 125 HTC	cross	125 m^2/m^3	+++	+	+++	++	Stripper, exhaust air scrubber, biotrickling filter
2H MASSdek® 80 Grid	grid	80 m^2/m^3	+++	+	+++	+++	Exhaust air scrubber and biotrickling filter, desulphurisation columns

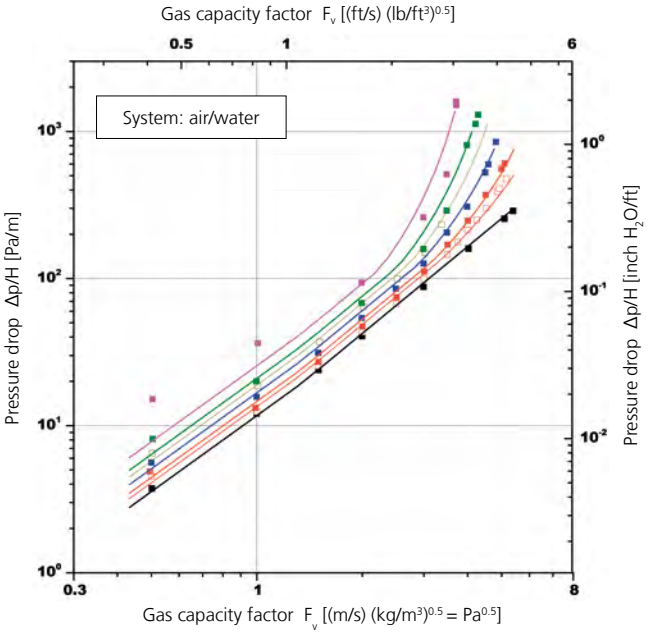
2H MASSdek® – Liquid rate

System: air / water

2H MASSdek® 250 HTE



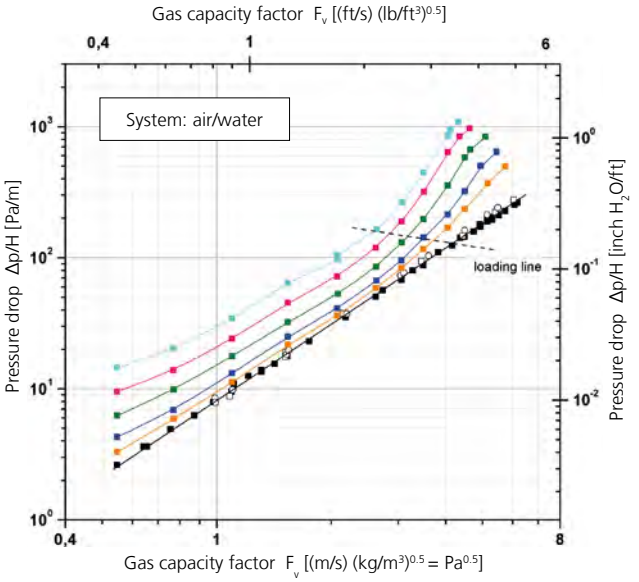
2H MASSdek® 250 HTC



MASSdek® 250 HTC (PP)
a = 240 m²/m³ (73.2 ft²/ft³)
ε = 95.7 %

Liquid rate u_L [m³/m²h]	[gpm/ft²]
0	0
5	2.0
10	4.1
20	8.2
30	12.3
40	16.4
60	24.6

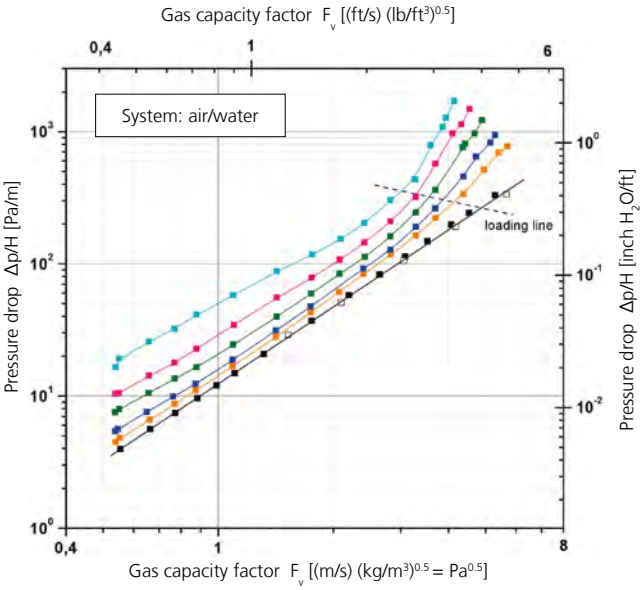
2H MASSdek® 150 HTC



MASSdek® 150 HTC (PP)
a = 150 m²/m³ (45.8 ft²/ft³)
ε = 94.5 %

Liquid rate u_L [m³/m²h]	[gpm/ft²]
0 (H=3.0 m)	0 (H=10 ft)
0 (H=1.2 m)	0 (H=4 ft)
0 (H=1.5 m)	0 (H=5 ft)
10	4.1
20	8.2
40	16.4
60	24.6
80	32.8

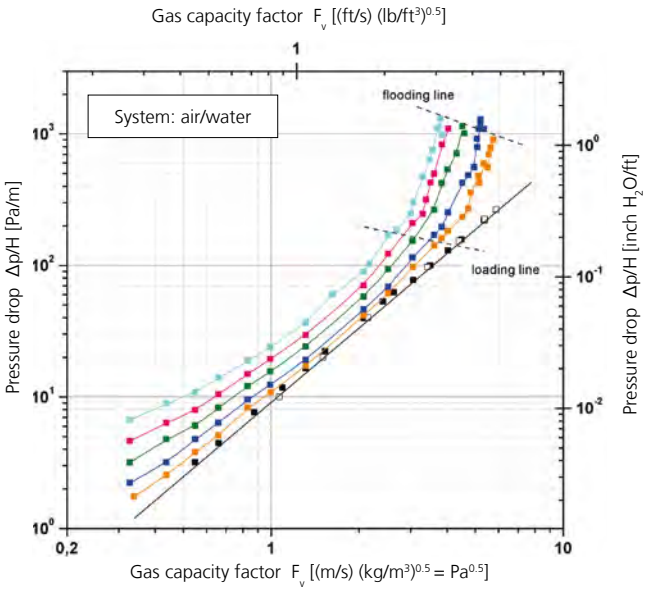
2H MASSdek® 125 HTC



MASSdek® 125 HTC (PP)
a = 125 m²/m³ (38.1 ft²/ft³)
ε = 94.5 %

Liquid rate u_L [m³/m²h]	[gpm/ft²]
0 (H=3.0 m)	0 (H=10 ft)
0 (H=1.5 m)	0 (H=5 ft)
10	4.1
20	8.2
40	16.4
60	24.6
80	32.8

2H MASSdek® 80 GRID



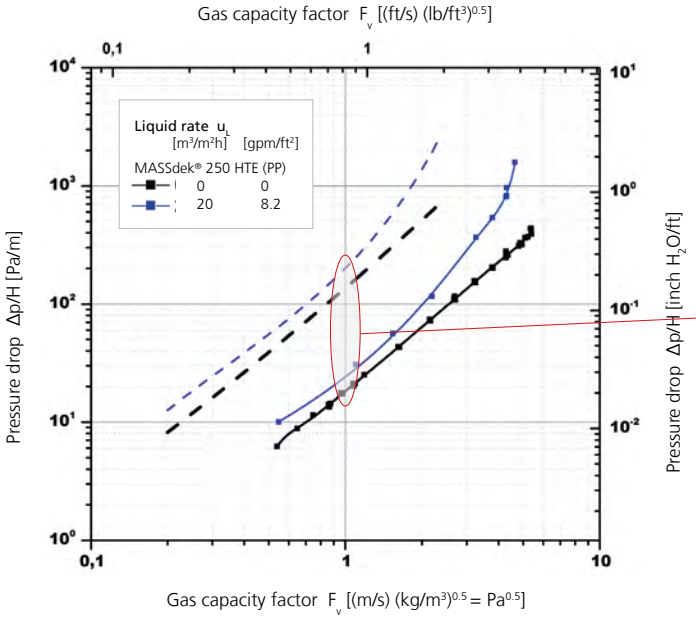
MASSdek® 80 GRID (PP)
a = 80 m²/m³ (24.4 ft²/ft³)
ε = 95.9 %

Liquid rate u_L [m³/m²h]	[gpm/ft²]
0 (H=3.2 m)	0 (H=10.5 ft)
0 (H=1.8 m)	0 (H=6 ft)
10	4.1
20	8.2
40	16.4
60	24.6
80	32.8

2H MASSdek® – Pressure drop

System: air / water

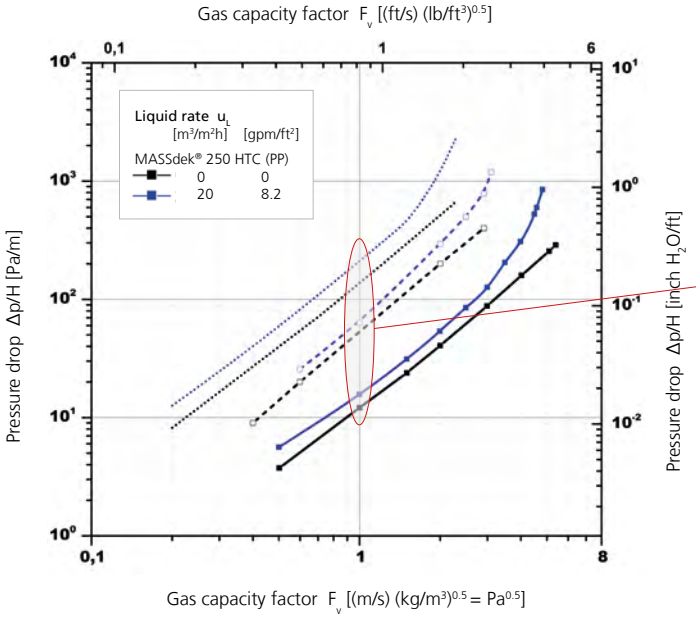
Currently no random packing is able to achieve a similarly high throughput or such a low pressure drop for the same mass transfer performance.



2H MASSdek® 250 HTE

Pressure drop of 2H MASSdek® 250 HTE in comparison to 50 mm Pall rings.

87 % reduction in pressure drop

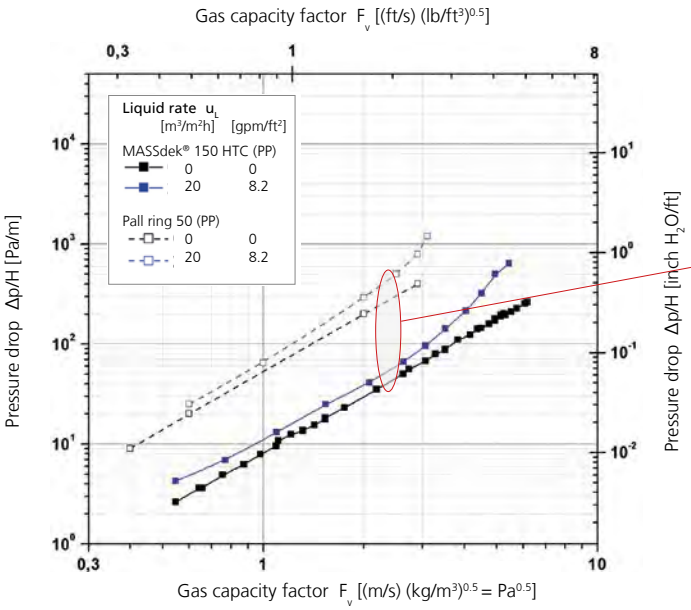


2H MASSdek® 250 HTC

Pressure drop of 2H MASSdek® 250 HTC in comparison to 50/25 mm Pall rings.

Pall ring 50 mm
90 % reduction in pressure drop

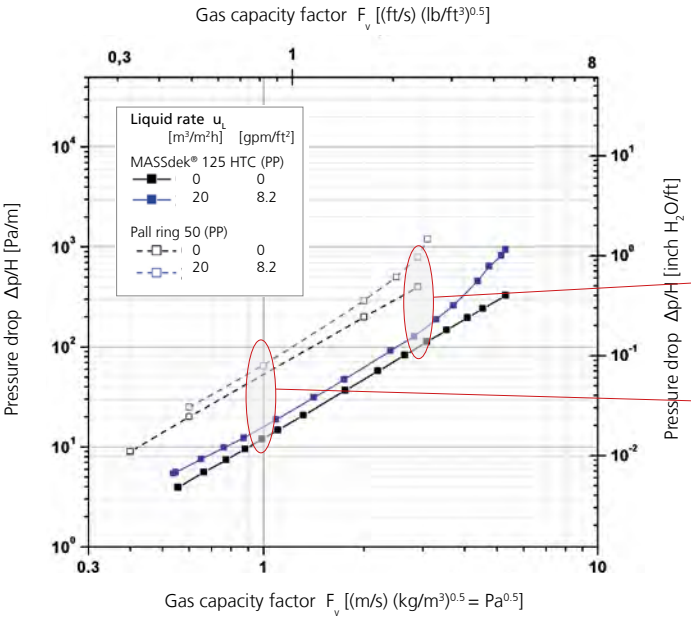
Pall ring 25 mm
67 % reduction in pressure drop



2H MASSdek® 150 HTE

Pressure dop of 2H MASSdek® 150 HTC in comparison to 50 mm Pall rings.

1/8 of the pressure drop of a 50 mm pall ring packing (this represents a reduction of ~88 %).

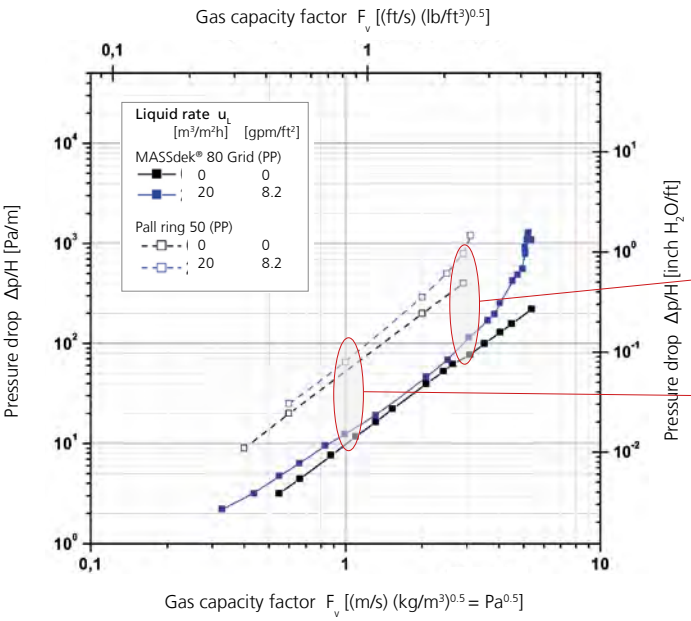


2H MASSdek® 125 HTC

Pressure drop 2H MASSdek® 125 HTC in comparison to 50 mm Pall ring.

84 % reduction in pressure drop

76 % reduction in pressure drop



2H MASSdek® 80 Grid

Pressure drop of 2H MASSdek® 80 Grid in comparison to 50 mm Pall ring.

80 % reduction in pressure drop

75 % reduction in pressure drop

DESIGN AND ENGINEERING

Individuality and attention to detail guaranteed

The principle is always the same: Gas and liquid should come into close contact across an exchange area as large as possible. However, there are considerably varied detailed requirements which have to be taken into consideration in order to successfully and economically carry out the separation process in each case. For this, it helps to not just have the correct packings but also the associated equipment and the necessary technical design.

Our experts cover this range of tasks perfectly. Extensive experience in the engineering of structured plastic packings and plastic or metal installations enable us to advise our customers in the dimensioning of packed bed towers. This covers in particular the areas of mechanics, hydraulics and separation processes.

We refer to ideal systems and calculate the main column dimensions. Based on these values, we assume a warranty for the column hydraulics. Our advice also includes recommendations for additional column internals, which are perfectly adjusted to the packings. Upon request, we will also take on the static inspection of constructional interfaces, such as support rings or beams. We design and construct using the most modern 3D CAD software. This enables smooth communication with our customers right from the draft design stage.

Hydraulics
We carry out extensive product tests, in part in our own test facility, but also under academic supervision at universities or in private companies. As such we have access to an extensive data pool which gives us reliable information on scale-up, flooding characteristics and pressure drop in a very wide load range.

Mechanics
Information about mechanical properties is continuously enhanced through regular monitoring of production. An individual design can thus be offered, while taking into account German DVS guidelines. As required, we verify the mechanical load bearing capacity of our packings for the various materials and packing densities through German TÜV inspection certificates.

Separation processes
Our tests also include the separation performance of newly developed 2H MASSdek® types. The results are evaluated according to recognised methods and enable a reliable design to be created. In individual cases we can also issue a warranty for this.

The most important planning specifications are

- the selection of the material
- the selection of the packing type
- the load bearing capacity
- the pressure drop
- further hydraulic key data
- and the minimum required bed height

OPTIMIZATION OF INDIVIDUAL DESIGN

Design software 2H MASSdek® Pro

For the individual design of our 2H MASSdek® packings we use software developed by our own IT specialists. It permits the hydraulic design of water-air systems and also freely defined systems. In addition, calculations on absorption and desorption for approx. 400 components are possible.

The simple operation and extensive data base of the software enables an experienced technician to quickly optimise the process design. On request, we will be happy to provide you with this planning tool.

Product development – also for tailor-made solutions
Our Engineering, Quality Assurance and Research & Development departments work closely together. The properties of our packings are constantly checked and improved where necessary.

For quality inspection we do not just use our own testing equipment but also have inspections carried out externally by independent institutes. Ideas for new products arise from the knowledge gained accordingly and these are tested out in our own pilot plant and developed until they are ready to go into production.

Where requested, we are pleased to work out tailor-made solutions for specific applications together with our customers. If necessary, we also include our raw materials suppliers in this work.

2H MASSdek®
COLUMN INTERNALS

One-stop solution

Column internals

Efficient mass transfer performance can only be achieved when all column internals perfectly fit together. Our 2H MASSdek® packings, droplet separators, liquid distributors, retention systems and support grids are well matched and assure an optimized separation.

Structured packings can only make full use of their technical benefits compared with a random packing when all installations, the apparatus and the components have been precisely coordinated with each other and harmonised to the appropriate process at the planning and basic engineering stage. The aim must be to find a successful and profitable solution for the separation task in question.

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In addition to our support in the process engineering planning of the basic design, we are also happy to review an overall concept which has already been drawn up. We can offer tips and information regarding points in the process that we think could be optimised and which special types of packing and internals can be used most effectively. Upon request, we will also take on the static inspection of constructional interfaces, such as support rings or supports.

Liquid distributors

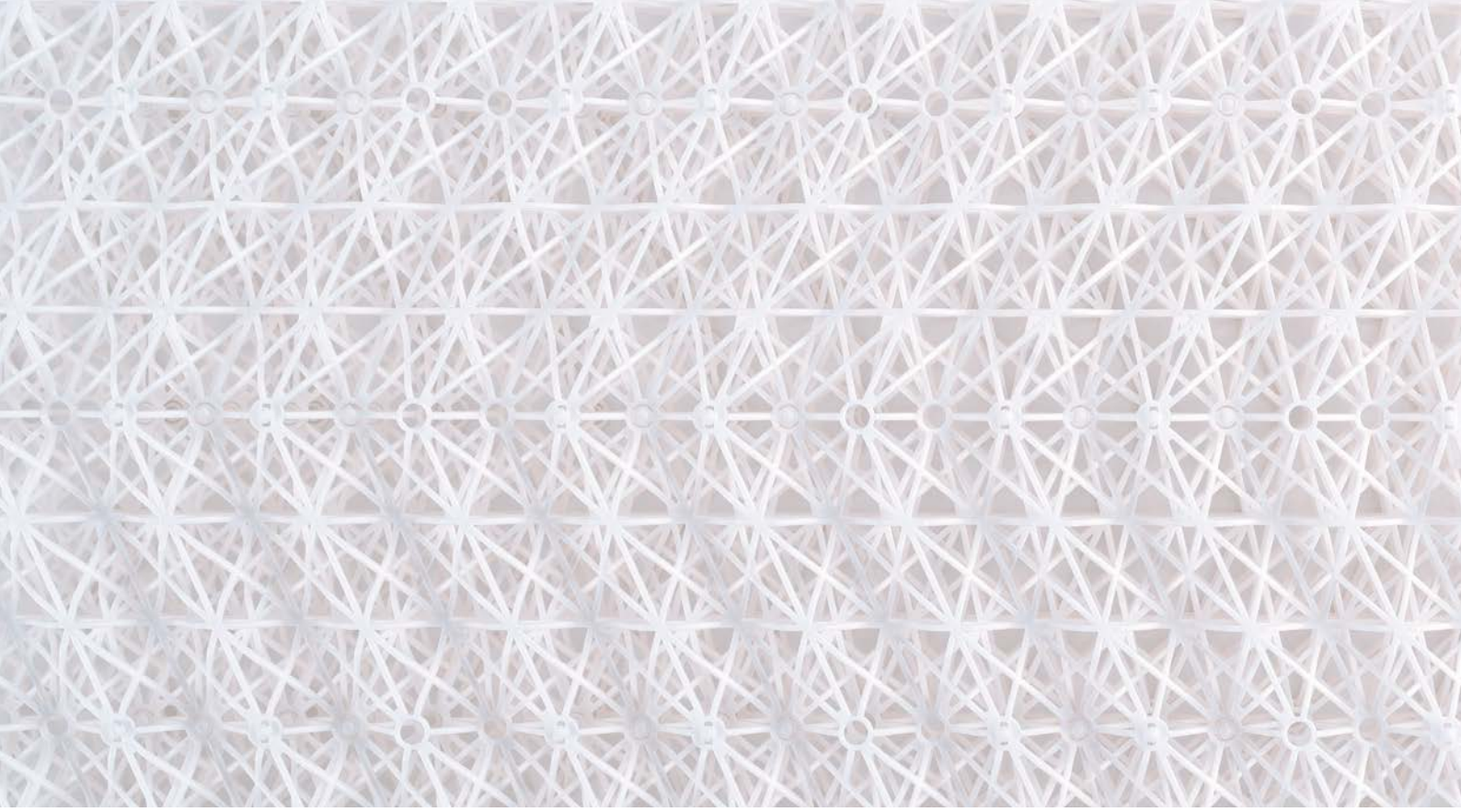
The structured packing only reaches its full level of performance if the liquid is optimally distributed onto the packing. After the packing bed itself, the liquid distributor is the second most important component for the separation process in an installation assembly in a column. Because poor initial distribution can only be compensated for by a larger bed height to a limited degree, selecting the right distributor and an individual design are of utmost importance.

The liquid distributor must be designed in a way that ensures an even distribution of liquid. Selecting the right design and material depends on process parameters such as the column diameter, the load range, the way that soiling is dealt with, the irrigation density and the drip point density. Further factors, such as the packing geometry dependent spread factor, the speed profile of the gas flow and the geometric restrictions resulting from the on-site supports and support rings, have an impact on the performance and must be taken into account when dimensioning the bed.

Of course, economic factors also influence the design. As such, the costs of the liquid distributor have to be compared to the bed height costs and operating costs.

We can assist you in the selection of a suitable distributor and design a solution especially for your application.

You will find an overview of our liquid distributors on pages 14 and 15.



Droplet separators
Installations and turbulences in the packing bed cause droplets which are carried with the exhaust gas flow where there is no separator. Installation of droplet separators at suitable positions prevents the droplets from being carried away. The 2H MASSdek® droplet separators are capable of separating up to 99.9% of the droplet entrainment with a limiting droplet diameter of approx. 35 µm.

We can adjust our droplet separator modules individually to suit the existing container geometry and can calculate the perfect inflow cross-section for you as part of the process design. If necessary, we can also calculate the required distances from the upstream or downstream components.

Support grids
Frequently the transition from the support system to the fill involves a hydraulic bottleneck. Where elaborately constructed, and therefore expensive, multi-beam supports have to be used for random packings in these cases, even gratings are sufficient for structured packings. Depending on the temperature and load, a system made up of parallel bars can also be used to support the packing. For packings that operate above the loading point, the required free gas cross-section must be checked.

We will assist you in the selection of a suitable support system. In addition to the hydraulic conditions for the design we also take into account the influence of temperature and mechanical load. On request, we can provide the necessary constructional support design. We can also create individual solutions for special or difficult applications.

Retention Systems
Structured packings are significantly more insusceptible in high gas loads than random packings. Lifting of individual blocks can be prevented by a single bar running straight across the blocks. As this method is independent of the surface in question, the retention system never forms a bottleneck in a column with structured packings.

This method also ensures a large, free gas cross-section, little interference with the liquid distributor and fewer costs.

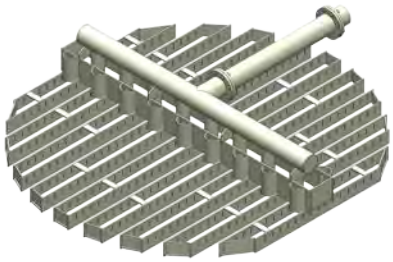
Gas inlet and outlet nozzles
A uniform distribution of the gas flow speeds across the cross-section of the column also plays a critical role. As a plug-flow profile should be reached for ideal separation, we also take care of checking the hydraulics of the gas inlet and outlet nozzles in terms of size and position.

Optimum and efficient system solutions for the industry

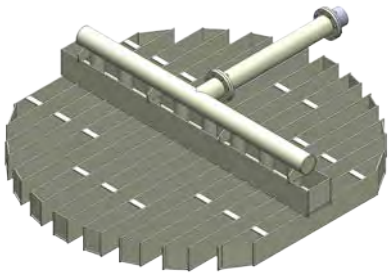
- individual design
- state-of-the-art manufacturing methods
- variety of products
- permanent quality controls
- highly motivated team
- many years of experience
- continuous improvements

2H MASSdek®
LIQUID DISTRIBUTOR
AT A GLANCE

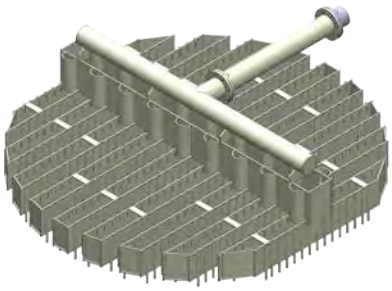
Technical specifications



TDP 410 (Overflow weir distributor)	
Application	
Diameter range	>1,000 mm
Irrigation density range	15 to 40 (80) m^3/m^2h
Standard turn down	2.5 : 1 (for triangular slots 4 : 1)
Range of the maximum gas capacity	2.25 $Pa^{0.5}$
Susceptibility to fouling	low



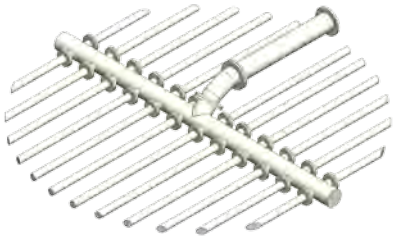
TDP 400 (Trough distributor with base holes, 2-stage)	
Application	
Diameter range	>1,000 mm
Irrigation density range	12.5 to 60 (120) m^3/m^2h
Standard turn down	2,1 : 1
Range of the maximum gas capacity	2.75 $Pa^{0.5}$
Susceptibility to fouling	average to high



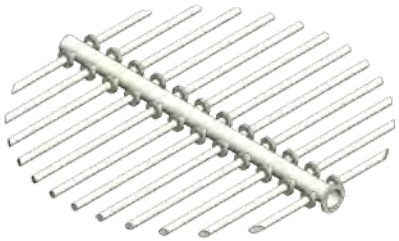
TDP 420 (Trough distributor with side-wall holes and guide pipes, 2-stage)	
Application	
Diameter range	>1,000 mm
Irrigation density range	12.5 to 50 (100) m^3/m^2h
Standard turn down	2.1 : 1 (with multiple rows of holes: 10 : 1)
Range of the maximum gas capacity	3.60 $Pa^{0.5}$
Susceptibility to fouling	low to average

TDP 430 (Trough distributor with splash plate, 2-stage)	
Application	
Diameter range	>800 mm
Irrigation density range	3 to 30 (60) m^3/m^2h
Standard turn down	2.1 : 1
Range of the maximum gas capacity	3.90 $Pa^{0.5}$
Susceptibility to fouling	average

LDP 200 (Closed pipe distributor with a central feed)	
Application	
Diameter range	>800 mm
Irrigation density range	8 to 30 (60) m^3/m^2h
Standard turn down	1.7 : 1
Range of the maximum gas capacity	3.90 $Pa^{0,5}$
Susceptibility to fouling	average

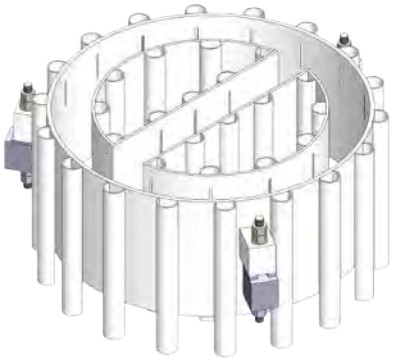


LDP 220 (Closed pipe distributor with a central feed)	
Application	
Diameter range	>800 mm
Irrigation density range	8 to 30 (60) m^3/m^2h
Standard turn down	1.7 : 1
Range of the maximum gas capacity	3.90 $Pa^{0,5}$
Susceptibility to fouling	average



NDP 310 (Spray nozzle distributor)	
Application	
Diameter range	>2,100 mm
Irrigation density range	3 to 180 m^3/m^2h
Standard turn down	1.5 : 1
Range of the maximum gas capacity	3.25 $Pa^{0,5}$
Susceptibility to fouling	high for low irrigation densities

PDP 350 (Pan distributor with guide pipes, single-stage Trough distributor with side wall holes and guide pipes, 2-stage)	
Application	
Diameter range	>500 mm
Irrigation density range	12.5 to 80 m^3/m^2h
Standard turn down	2.1 : 1 (with multiple rows of holes: 10 : 1)
Range of the maximum gas capacity	3.25 $Pa^{0,5}$
Susceptibility to fouling	low to average



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