# TOWER PACKINGS TOWER INTERNALS & TOWERS





CERAMIC

RASCHIG RING



PLASTIC

PALL RING





















AMIC METAL

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METAL PLASTIC

CASCADE MINI RING

CERAMIC

SHEET

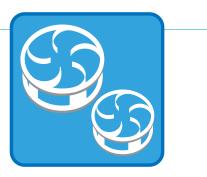
MESH

T-TYPE MC PACK CERAMIC



## **Products and Services**

#### CASCADE MINI RING®



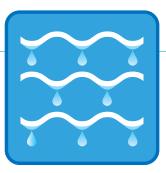
CASCADE MINI RING is a representative of random packing and has higher superiority and efficiency compared with other general packings. The configuration is cylindrical and flat. It performs confluence and segmentation of droplet in highly efficiency. We have a trademark of it in Japan.

#### **RANDOM PACKING**



Random packing is a generic name of generalized packing as typified by Pall Ring. We have a wide variety of configurations and materials for random packing. The principle of the contact by liquid and gas is said that the liquid which is collided and divided by random packing carried out continuous counter flow contact with vapor.

#### MC PACK



P.13~15 P.17~18

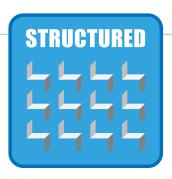
P.24

P.3~6

MC pack is a typical structured packing. Especially T-type is an optimum packing for aqueous application that has a high surface tension recognized that structured packing is inappropriate.

HETP as same as HETP of the liquid of organic use can be expected by a groundbreaking liquid film.

#### STRUCTURED PACKING



P.16、19

P.7~9

Structured packing has, unlike random packing, a regular construction.

We have not only metals but also ceramics.

The principle of the contact by liquid and gas is said that a liquid film which covers on a surface of packing is carried out continuously counter flow contact with vapor.

#### **VESSEL**



It is a vessel of a packed tower and a tray tower. We have not only metals but also resin materials such as FRP, PVC + FRP and a rubber lining. We can correspond to fabricate towers that are for facilities of from the fire laws to high-pressure gas regulation.

#### **CANDLE FILTER**



P.25

Candle filter almost eliminates a fine mist whose particle diameter is  $2\mu$  or less.

It effectively eliminates the fine mist by combined effect from colliding and diffusion which principally involves Brownian movement because of compressed cylindrically fiber.



## INTERNALS FOR RANDOM PACKING

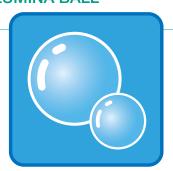
P.10



There are 70 types of internals for a random packing.

Especially, we can design and fabricate a distributor with uniformed distribution of high liquid load / about  $600m^3/H$ .

## CERAMIC BALL ALUMINA BALL



P.11~12

It is a material for catalysts.

It is sintered in a globe shape by high temperature.

The types are divided into Ceramic ball and Alumina ball.

We have many sizes of them ranging from  $\phi$ 3mm to  $\phi$ 50mm.

## INTERNALS FOR STRUCTURED PACKING

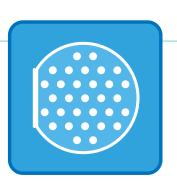




This internal is used for MC pack.

Especially, MC distributor that has groundbreaking drip points is a high-performance distributor. This distributor can be also used for random packing.

#### **TRAY**

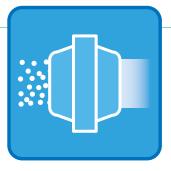


P.23

Tray is, unlike packing, a product for the contact by liquid and gas called also Plate type.

We can provide you a wide range of types such as Sieve tray, Bubble cap tray and Cartridge type.

#### MIST SEPARATOR



P.26

e-blade is a mist eliminator of blade type.

This eliminator almost completely eliminates and recovers mist more than  $20\mu$ .

It is a compact unit and has a high-performance.

## SIMULATION FLOODING CALCULATION

P.27~28



We can perform distillation and abortion calculations by using a exclusive software for them.

In the abortion calculation, we perform combined calculation including an approach from the mass transfer theory.

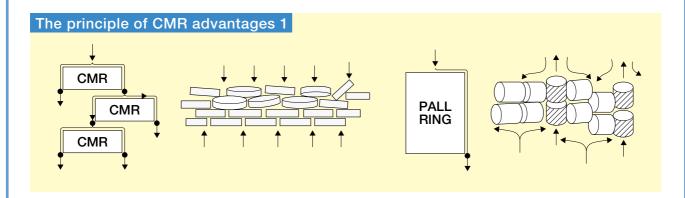




#### The concept of flowing down droplet on a surface of packing

Liquid flowing down on a surface of packing turns into droplet which flows and joins to the next packing and the droplet moves and joins together to the packing after the next packing again. Mass transfer is performed by contacting with rising vapor and the droplet. The base principle of the contact by liquid and gas for random packing is said that it is a collision surface renewal so the appearance of random packing sizes does not make relative merits of the performance. The performance is more influenced by [conditions of packing which consist of each individual packing] more than specific surface areas and the conditions

of packing educe potential of the packing. In fact, packed bed actually has the contact efficiency and it has the difference in effectiveness of the contact by liquid and gas. This becomes the relative merits of the performance. CMR can perform a surface renewal by joining and segmentation of droplet without loss. It is said that CMR has the high contact by liquid and gas. We can provide you that a size of CMR can be larger than a size of a target packings such as Pall ring when you need the alternative packing instead of the target packing and CMR has many advantages as throughput and pressure drop.



#### CMR vs Pall Ring



CMR has the good conditions of packing and the high contact efficiency by liquid and gas because CMR almost has a regular loading.

The liquid flows all over CMR. The difference in the conditions of packing which has small dry areas makes the difference in grime.



Pall ring becomes matrix condition 50% of the time in a tower because of its configuration. In result, it arises drift of liquid-vapor and has the bad contact efficiency by liquid and gas and dry areas.





#### The surface treatment of Metal CASCADE MINI RING

The surface of Metal CMR can be treated and it improves wet retention. The CMR whose surface is treated can be used in low-liquid load. It can maintain its performance because it controls the decline of the contact by liquid and gas. And also, it is effec-

tive in water use that has a high surface tension. The procedure of surface treatment made by our company's unique technology accumulated over years is a shot blasting. Originally, this idea is not shared by another packing.

Regular

Surface treatment (SST)



Surface: luster Minimum wet liquid: 3m³/m²H Surface: matte (translucent) Minimum wet liquid: 1m³/m²H Regular

Surface treatment (SST)



Surface: luster Minimum wet liquid: 3m³/m²H Surface: matte (translucent) Minimum wet liquid: 1m³/m²H



## METAL CASCADE MINI RING® [CMR]



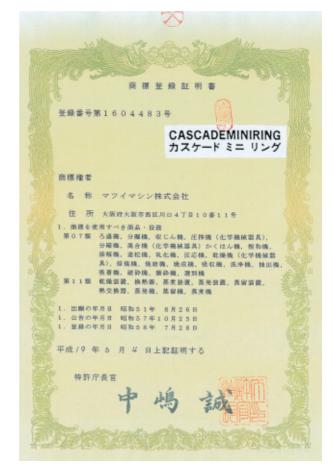
#### Metal CASCADE MINI RING size list

Size		Packing factor F (I/ft)	Bulk Density (kg/m³)	Surface (m²/m³)	Void Fraction (%)	Outline (mm, approx.)
No.	0P	55	320	435	96	17 <i>ø</i> × 15 <i>ø</i> × 6H
No.	1P	40	290	257	96.5	25φ× 22φ× 8H
No.1.	5P	29	230	199	97.2	34 <i>¢</i> × 29 <i>¢</i> ×11H
No.	2P	22	180	155	97	43 <i>¢</i> × 38 <i>¢</i> ×14H
No.2.	5P	18	165	132	97.3	51 <i>φ</i> × 44 <i>φ</i> ×17H
No. 3	3P	14	158	108	97.6	66φ× 57φ×21H
No. 4	4P	10	120	77	98.3	86φ× 76φ×28H
No. 5	5P	8	110	55	98.6	131 <i>¢</i> ×118 <i>¢</i> ×41H

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

#### Ex. materials:

SUS304, SUS304L, SUS316, SUS316L, SUS329J4L, CS. Titanium, HC-22, Monel, Pure nickel, Aluminum.



Certification of trademark for CASCADE MINI RING





## PLASTIC CASCADE MINI RING® [CMR]



#### Plastic CMR size list

Size	Packing factor F(I/ft)	Bulk Density (kg/m³)	Surface (m²/m³)	Void Fraction (%)	Outline (mm, approx.)
No.0A	55	122	330	89	38 <i>¢</i> ×30 <i>¢</i> ×13H
No.1A	30	72	230	92	50 <i>¢</i> ×39 <i>¢</i> ×17H
No.2A	18	60	130	93	78 <i>¢</i> ×61 <i>¢</i> ×25H

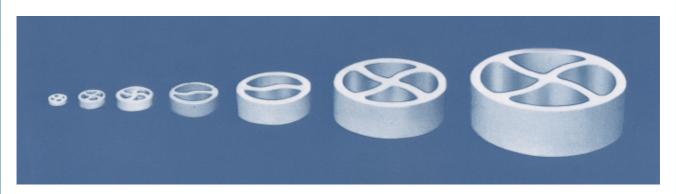
Size	Packing factor F (I/ft)	Bulk Density (kg/m³)	Surface (m²/m³)	Void Fraction (%)	Outline (mm, approx.)
No.2	15	55	118	94	$75\phi \times 61\phi \times 22H$
No.3A	12	47	79	95	$104\phi \times 84\phi \times 32H$

Bulk Density at a material specific gravity 1.0

 $\begin{array}{lll} \textbf{Ex. materials: 1) PP (s.g., 0.9)} & & 5) \ PVDF (s.g., 1.75) \\ & 2) \ HRPP (s.g., 0.9) & 6) \ ETFE (s.g., 1.74) \\ & 3) \ UPVC (s.g., 1.04) & 7) \ PFA (s.g., 2.17) \\ \end{array}$ 

4) CPVC (s.g., 1.56)

## CERAMIC CASCADE MINI RING® [CMR]



#### Ceramic CMR size list

Size	Packing factor F (I/ft)	Bulk Density (kg/m³)	Surface (m²/m³)	Void Fraction (%)	Outline (mm, approx.)
No. 0X	470	940	329	52	25 <i>ø</i> × 9H
No.0.5X	210	860	224	57	38 <i>∳</i> ×13H
No. 1X	108	840	166	63	51 <i>¢</i> ×17H
No. 1.5	80	700	121	71	60 <i>¢</i> ×20H

Bulk Density at	a specific gravity	2.29 for ceramic material
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Size	Packing factor F (I/ft)	Bulk Density (kg/m³)	Surface (m²/m³)	Void Fraction (%)	Outline (mm, approx.)
No. 2	38	630	98	73	76 <i>¢</i> ×25H
No. 3	24	670	79	78	102 <i>¢</i> ×34H
No. 5X	18	720	60	69	152 <i>¢</i> ×51H
No. 7X	15	750	_	_	203 <i>¢</i> ×68H





## **METAL RANDOM PACKING**

**Packing** 

Packing

Density

Surface

Void

Fraction

Size

## **Physical Data**

	Pac	kin	g t	ype
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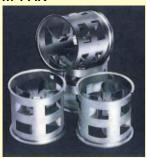
#### Raschig ring



Pall ring



M-PAK



MI-PAK



	F(I/ft)	(kg/m³)	(m²/m³)	(%)
1/2" (12mm)	300	638	401	92
5/8" (15mm)	260	592	366	91
1" (25mm)	137	480	200	94
1 <sup>1</sup> /2" (38mm)	83	423	130	95
2" (50mm)	57	329	102	96
3" (80mm)	32	286	70	96
1/2" (12mm)	81	638	415	92
5/8" (15mm)	71	592	366	91
1" (25mm)	48	480	210	94
1 <sup>1</sup> /2" (38mm)	28	423	136	95
2" (50mm)	20	329	110	96
3" (80mm)	_	286	73	96
25M-L (25mm)	43	236	192	97
38M-L (38mm)	26	170	140	98
51M-L (51mm)	19	140	99	98
# 45 /45	E4	OFF	000	00
#15 (15mm)	51	355	292	96
#25 (25mm)	41	356	210	97
#40 (38mm)	24	255	151	97
#50 (50mm) #70 (70mm)	18	165	98	98
++ /U (/UIIIII)	12	120	56	98

Ex. materials: SUS304, SUS304L, SUS316, SUS316L

 $\ensuremath{\,\times\,}$  Please feel free to contact us about special metal

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.





## **PLASTIC RANDOM PACKING**

**Packing** 

factor

F(I/ft)

137

83

Size

1" (25mm)

1<sup>1</sup>/<sub>2</sub>" (38mm)

## **Physical Data**

ac	kin	g t	ype

#### Raschig ring



#### Pall ring



Intalox saddle



Super Intalox saddle



1 /2 (0011111)	00	, 0	100	50
2" (50mm)	57	68	95	92
5/8" (15mm)	95	110	340	83
1" (25mm)	52	100	205	90
1 <sup>1</sup> /2" (38mm)	32	66	130	91
2" (50mm)	25	63	100	92
1" (25mm)	33	76	206	91
1 <sup>1</sup> /2" (38mm)	25	57	140	91
2" (50mm)	21	64	108	93
1" (25mm)	33	96	210	90
1 <sup>1</sup> /2" (38mm)	25	60	145	91
2" (50mm)	21	68	110	93
2 (3011111)	<b>4</b> 1	00	110	30

**Packing** 

Density

(kg/m³)

112

70

Surface

 $(m^2/m^3)$ 

205

130

Void

Fraction

(%)

86

90

Ex. materials: 1) PP (s.g., 0.9) 2) HRPP (s.g., 0.9) 3) UPVC (s.g., 1.04) 4) CPVC (s.g., 1.56)

5) PVDF (s.g., 1.75) 6) ETFE (s.g., 1.74) 7) PFA (s.g., 2.17)

Bulk Density at a material specific gravity.



## **CERAMIC RANDOM PACKING**

## **Physical Data**

•					
Packing type	Size	Packing factor F(I/ft)	Packing Density (kg/m³)	Surface (m²/m³)	Void Fraction (%)
Raschig ring			_	( / /	(707
	1" (25mm)	155	620	235	78
	1 <sup>1</sup> /2" (38mm)	103	580	195	76
	2" (50mm)	65	530	150	81
	3" (80mm)	37	870	110	68
Intalox saddle					
	1" (25mm)	98	620	250	74
	1 <sup>1</sup> /2" (38mm)	52	610	164	75
	2" (50mm)	40	600	142	76
	3" (80mm)	22	560	92	78
Super Intalox saddle					
	1" (25mm)	60	600	260	74
	2" (50mm)	30	560	140	76
	3″ (80mm)	15	510	120	77
Cross ring					
CD	<i>φ</i> 100	_	1100	105	53
THE S	<i>φ</i> 120	_	1040	90	55
	<i>φ</i> 150	_	1040	72	58

Bulk Density at a specific gravity 2.29 for ceramic material

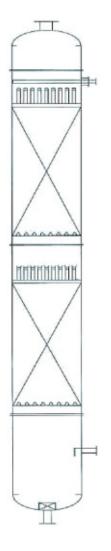
#### Chemical Physicality list (%)

SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	MgO	CaO	K <sub>2</sub> O	Na <sub>2</sub> O	Leachable iron
68-72	18-22	≦1.0	0.6	0.6	3.5-4.5	0.1-0.3	< 0.01





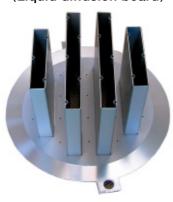
## **INTERNALS FOR RANDOM PACKING**



Feed pipe (Liquid supply pipe)



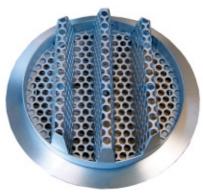
Distributor (Liquid diffusion board)



Hold down grid (Fixing packing)



Packing support (Support packing



[Materials]
US304, SUS304L, SUS316, SUS316L, SUS329J4L, CS. Titanium, Hastelloy,
PVC, PP, PVDF, FRP, Rubber lining, Carbon, Special metal

## Distributor for high liquid load (600m<sup>3</sup>/H)







## **CERAMIC BALL**

## Ceramic Ball

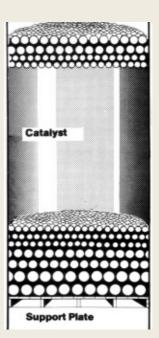
#### **Chemical Composition**

SiO <sub>2</sub>	68-72	MgO	0.6-1.2		
Al <sub>2</sub> O <sub>3</sub>	17—23	CaO	0.6-0.9		
Fe <sub>2</sub> O <sub>3</sub>	0.4-0.8	K <sub>2</sub> O	2.3-3.0		
TiO <sub>2</sub>	0.5-0.8	Na <sub>2</sub> O	0.5-0.8		
Soluble Fe:<0.01%					



#### **Physical Properties**

Density	g/cm³	2.3-2.4
Water Absorption	%	0.1-0.5
Compressive Strength	N/mm²	400
Elasticity Modulus	GPa	60
Mohs Hardness	Scale	7-8
Specific heat, 20℃ -100℃	J/kgK	840
Thermal Conductivity 30℃ —100℃	W/mK	1-1.5
Coefficient of thermal expansion	(20°C−600°C) 10 <sup>-6</sup> K <sup>-1</sup>	4.7
Heat Resistance	Up to ℃	1000



## Size, Packing Density, Specific Surface, Void Fraction and Compressive Strength

Size (inch) — (mm)	Packing Density (kg/m³)	Spec. Surface (m²/m³)	Void Fraction (%)	Compressive Strength per ball (kg)
1/8" — 3mm	1400	720	44	30
1/4" — 6mm	1400	520	44	50
3/8" — 9mm	1400	360	44	120
1/2" — 13mm	1350	275	45	180
3/4" — 19mm	1350	190	45	300
1" — 25mm	1350	144	45	400
1 <sup>1</sup> / <sub>4</sub> " — 32mm	1350	120	45	520
1 <sup>1</sup> / <sub>2</sub> " — 38mm	1350	100	45	600
2" — 50mm	1350	75	45	720





## **ALUMINA BALL**

## Alumina Ball

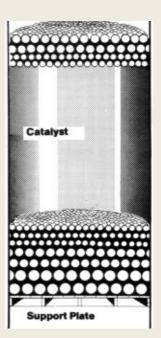
#### **Chemical Composition**

SiO <sub>2</sub>	0.15-0.2	MgO	0.03-0.05		
Al <sub>2</sub> O <sub>3</sub>	99-99.2	CaO	0.04-0.07		
Fe <sub>2</sub> O <sub>3</sub>	0.05-0.2	K <sub>2</sub> O	0.1-0.15		
TiO <sub>2</sub>	0.15-0.2	Na <sub>2</sub> O	0.2-0.25		
Soluble Fe:<0.01%					



**Physical Properties** 

Density	g/cm³	3.5-3.6
Water Absorption	%	2-3
Compressive Strength	N/mm²	3K
Elasticity Modulus	GPa	60
Mohs Hardness	Scale	9
Specific heat, 20℃ -100℃	J/kgK	840
Thermal Conductivity 30℃ —100℃	W/mK	1-1.5
Coefficient of thermal expansion	(20℃—600°C) 10 <sup>-6</sup> K <sup>-1</sup>	4.7
Heat Resistance	Up to ℃	1500



## Size, Packing Density, Specific Surface, Void Fraction and Compressive Strength

Size (inch) — (mm)	Packing Density (kg/m³)	Spec. Surface (m²/m³)	Void Fraction (%)	Compressive Strength per ball (kg)
1/8" — 3mm	2200	720	44	60
1/4" — 6mm	2200	520	44	160
3/8" — 9mm	2200	360	44	240
1/2" — 13mm	2100	275	45	450
3/4" — 19mm	2000	190	45	520
1" — 25mm	2000	144	45	800
1 <sup>1</sup> / <sub>4</sub> " — 32mm	2000	120	45	850
1 <sup>1</sup> / <sub>2</sub> " — 38mm	2000	100	45	920
2" — 50mm	2000	80	45	1000



## **MC PACK**

# Sheet MC250S

Sheet 250S can be used in any environmental from low to high gas load (F factor). Pressure drop is low and NTSM is high due to its embossed decoration over the surface of the sheet layer.

Especially, MC250S can achieve high NTSM and very low pressure drop in a high-load environment under the ordinary pressure.

#### **CHARACTERISTICS**

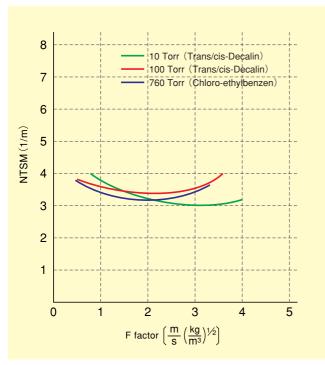
- High NTSM
- Pressure drop for single theoretical step -- 0.1 to 1 mmHg
- Proper liquid load range --- 0.2 to 60m³/m²H
- Maximum F factor --- 3.0



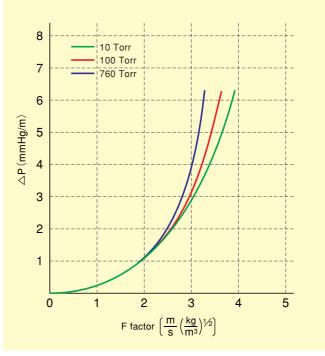
Name	Surface m <sup>2</sup> /m <sup>3</sup>	Void space %	Weight kg/m³	Height per mm	Substance
MC250S	250	98	87	180	Sheet

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

#### NTSM DATA



#### PRESSURE-DROP DATA



Ex. Materials: SUS304, SUS316L, SUS329J4L, Titanium, Hastelloy, Aluminum, Nickel, Copper





## **MC PACK**

# Sheet MC350S

Sheet 350S like the sheet 250S can be used in the environment from low to high gas load (F factor). Performance is steadily high due to its embossed decoration over the surface of the sheet layer.

Note that sheet 350S can achieve high NTSM and very low pressure drop in a high-load environment under the ordinary pressure.

#### **CHARACTERISTICS**

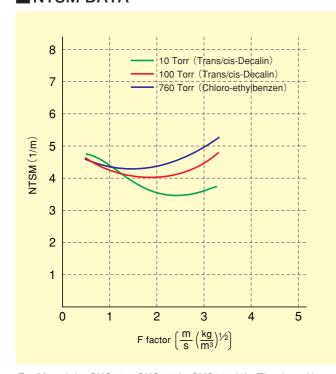
- High NTSM
- Pressure drop for single theoretical step ---0.1 to 1 mmHq
- Proper liquid load range --- 0.2 to 30m³/m²H
- Maximum F factor --- 2.5



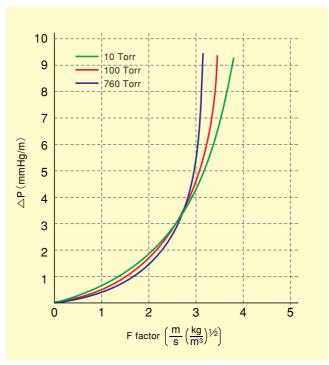
Name	Surface m <sup>2</sup> /m <sup>3</sup>	Void space %	Weight kg/m³	Height per mm	Substance
MC350S	350	98	120	183	Sheet

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

#### ■ NTSM DATA



#### ■ PRESSURE-DROP DATA



Ex. Materials: SUS304, SUS316L, SUS329J4L, Titanium, Hastelloy, Aluminum, Nickel, Copper





## **MC PACK**

# Sheet MC500S

Sheet 500S can be used in the environment from low to high gas load (F factor), and achieve overall high NTSM due to its unique structure design.

Note that sheet 500S can achieve high NTSM and very low pressure drop in a high-load environment under the ordinary pressure.

#### **CHARACTERISTICS**

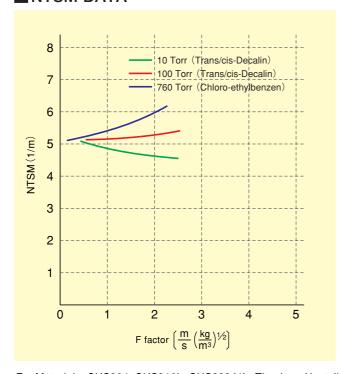
- High NTSM
- Pressure drop for single theoretical step -- 0.1 to 1 mmHg
- Proper liquid load range --- 0.2 to 20m³/m²H
- Maximum F factor --- 2.0



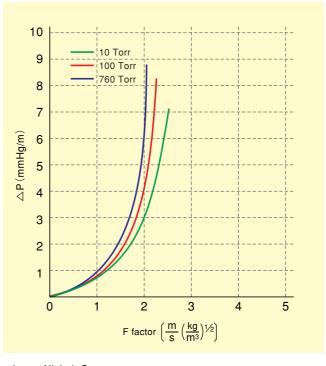
Name	Surface m <sup>2</sup> /m <sup>3</sup>	Void space %	Weight kg/m³	Height per mm	Substance
MC500S	500	97	170	178	Sheet

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

#### ■ NTSM DATA

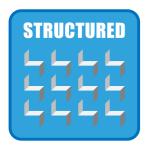


#### ■ PRESSURE-DROP DATA



Ex. Materials: SUS304, SUS316L, SUS329J4L, Titanium, Hastelloy, Aluminum, Nickel, Copper





## STRUCTURED PACKING

## **MC-Y PACK**

## Mesh

## BY-W500X/ W700Y/W1000Y

BY-W500YX/W700Y/W1000Y are mesh type of special structured wire mesh. These are achieving a low pressure drop and high NTSM compared with sheet type.

These are appropriate for the process required NTS under decompression.

#### **CHARACTERISTICS**

- High NTSM
- Pressure drop single theoretical step ---0.1 to 0.5mmHg
- Proper liquid load range --- 0.05 to 20m³/m²H
- Maximum F factor --- BY-W500X :2.5

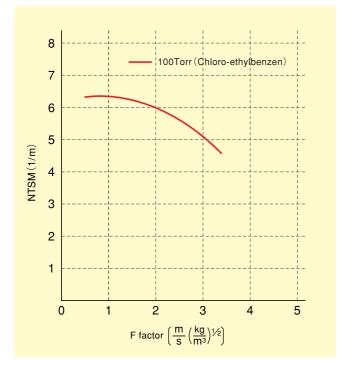
BY-W700Y:1.8 BY-W1000Y:1.0



Name	Surface m <sup>2</sup> /m <sup>3</sup>	Void space %	Weight kg/m³	Height per mm	Substance
BY-W500X	500	94	266	175	Wire mesh
BY-W700Y	700	91	370	145	Wire mesh
BY-W1000Y	1000	88	531	145	Wire mesh

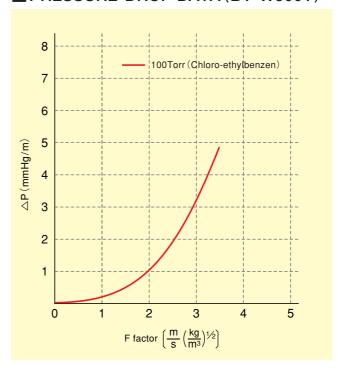
Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

#### ■ NTSM DATA (BY-W500Y)

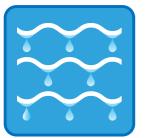


Ex. Materials: SUS304, SUS316L, Copper

#### ■ PRESSURE-DROP DATA (BY-W500Y)







## MC PACK

## Mesh-Sheet-Mesh

## MC250T/350T/ 500T

250T type consists of three layers: metal mesh layer, sheet layer, and metal mesh layer. Using 250T type, water with a high surface tension can spread well and maintain a suitable gas-liquid contact surface.

Structured Packing is usually ineffective for use with water with a high surface tension but 250T can properly maintain a liquid hold and liquid-gas surface, achieving a low pressure drop and high NTSM. 250T can be used in a wide range of environments from low to high load. It also achieves steady, high NTSM.

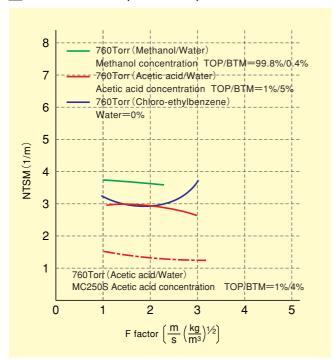
#### **CHARACTERISTICS**

- High NTSM under water-use (over 40 dyne/cm of surface tension)
- Pressure drop for single theoretical step --- 0.1 to 1 mmHg
- Proper liquid load range --- 0.2 to 70m³/m²H
- Maximum F factor --- MC250T: 3.0
   MC350T: 2.5
   MC250T: 2.0

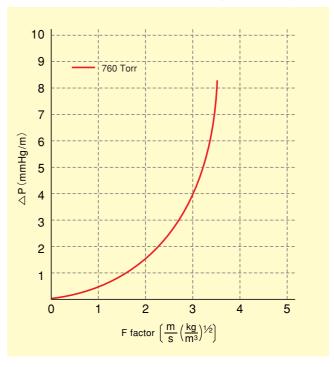
Void Height Surface Weight Name Substance space % per  $m^2/m^3$ kg/m<sup>3</sup> mm MC250T 250 97 150 182 Mesh-Sheet-Mesh MC350T 350 227 183 Mesh-Sheet-Mesh MC500T 500 293 178 Mesh-Sheet-Mesh

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

#### ■NTSM DATA (MC250T)



#### PRESSURE-DROP DATA (MC250T)



Ex. Materials: SUS304, SUS316L





#### Characteristic of the packing for water use. (T-type)

[Comparison of HETP with the packing for water use (MC250T) and the packing of regular sheet. (MC250S) ]

The following is examples of acetic acid/water use.

When MC250S is used for acetic acid or water use, HETP decreases more than twice of HETP for organic liquid.

However, when MC250T that is the packing for water use is used, HETP is the same as HETP for organic liquid

HETP (m) (CASE: F-factor=2)

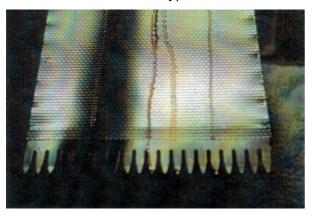
Experiment data of total reflex operation for 200A column.

	Acetic acid / Water use Acetic acid concentration TOP/BTM=1%/4%	Organic liquid (Chlorobenzen/Ethylbenzen)
Packing for water use (MC250T)	0.33	0.33
Packing of regular sheet (MC250S)	0.77	0.31

In a case of water use, the numerical value of HETP varies enormously depending on what the object liquid is used except water, so please do not hesitate to contact us about individual numerical of HETP.

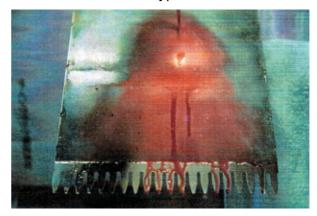
#### [Aspect of experiment for liquid expansion with using colored water]

Sheet type

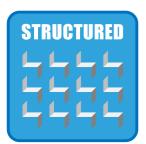


Spreading liquid on a surface of stainless sheet does not spread so much because of a high surface tension.

T-type



Spreading liquid on a surface of stainless sheet is good because colored water spreads on a wire mesh surface attached to stainless sheet.

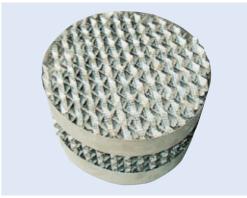


## **STRUCTURED PACKING**

## **MC-Y PACK**

## Sheet

Parameter	BY-M64X	BY-M64Y	BY-125X	BY-M125Y
Specific Area m <sup>2</sup> /m <sup>3</sup>	6	4	125	
Void Space %	99.5	99.5	99.2	99.2
MIN liquid load m³/m²/hr	0.5	0.5	0.5	0.5
MAX liquid load m³/m²/hr	100	100	100	100
Max F factor m/s[kg/m <sup>3</sup> ] <sup>1/2</sup>	4.2	3.7	4.0	3.5
Standard HETP mm	2000	1500	1200	800
Weight kg/m³	40	40	64	64
Height per Element mm	200	200	200	200
MAX Packing Height per Layer* mm	8000	8000	8000	8000



Ex. Materials: SUS304, SUS316L, SUS329J4L, Titanium, Hastelloy, Aluminum, copper, Nickel

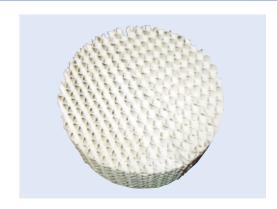
Parameter	BY-M200X	BY-M200Y	BY-M250X	BY-M250Y	BY-M350X	BY-M350Y	BY-M500X	BY-M500Y	BY-M750Y
Specific Area m <sup>2</sup> /m <sup>3</sup>	20	00	250		350		50	00	750
Void Space %	98.8	98.8	98.5	98.5	98	98	97.2	97.2	95.9
MIN liquid load m³/m²/hr	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
MAX liquid load m³/m²/hr	100	80	75	80	40	30	25	20	10
Max F factor m/s[kg/m <sup>3</sup> ] <sup>1/2</sup>	3.7	3.2	3.4	3.0	2.8	2.5	2.3	2.0	1.6
Standard HETP mm	700	500	550	450	430	360	370	280	230
Weight kg/m³	96	84	105	105	144	144	210	210	300
Height per Element mm	200	200	200	200	200	200	200	200	200
MAX Packing Height per Layer* mm	7000	7000	6000	6000	4500	4500	3500	3500	3000

3000mm when using a tower with 300  $\phi$  or less diameter

Bulk Density at a material specific gravity 7.93 for stainless steel type 304.

## **MC-C PACK**

## Ceramic



Parameter	125X	125Y	160X	250X	250Y	350Y	450X	450Y	700Y
Specific Area m <sup>2</sup> /m <sup>3</sup>	125	125	160	250	250	350	450	450	700
Void Space %	90	90	85	80	80	78	72	72	68
Oblique Angle °	30	45	45	30	45	45	30	45	45
Liquid Load m <sup>3</sup> /m <sup>2</sup> /hr	0.2~100	0.2~100	0.2~70	0.2~65	0.2~50	0.2~30	0.2~20	0.2~15	0.2~7
MAX F factor m/s[kg/m <sup>3</sup> ] <sup>1/2</sup>	3.2	3.0	2.7	2.8	2.4	2.0	1.7	1.5	1.2
NTSM I/m	1.5	1.7	1.9~2.2	2.3~2.7	2.5~3.0	2.8~3.2	3~4	3.5	6~8
Packing Density kg/m <sup>3</sup>	320	320	370	420	420	500	550	550	730
Sheet Pressure mm	2.0~3.0	2.0~3.0	2.0~2.5	1.7~2.0	1.7~2.0	1.3~1.6	1.0~1.2	1.0~1.2	0.9~1.1
Height per Element mm	15	50	150	15	50	100	10	00	100

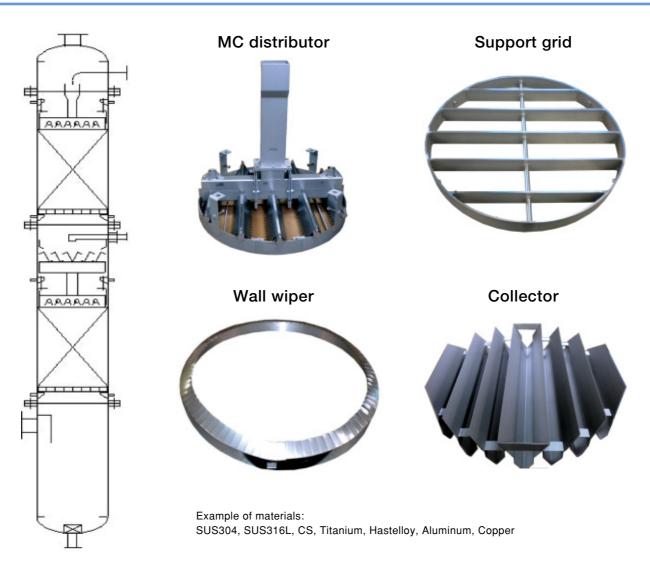
<sup>\*</sup>Ceramic plates manufactured can be porous or non-porous ones.

Bulk Density at a specific gravity 2.29 for ceramic material



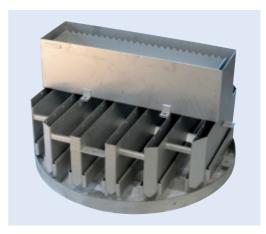


# INTERNALS FOR STRUCTURED PACKING



## Open channel type Distributor







## INTERNALS FOR STRUCTURED PACKING

## MC DISTRIBUTOR



#### **NOZZLE OVERFLOW TYPE**



- 1.A hole is located on the upper surface of a pipe, through which a liquid flows out. It prevents an absence of liquid and helps maintain the constant volume of flow under extremely low load.
- 2.A diffuser plate and clicks on a lower side allow a liquid to spread more through a groundbreaking number of drip points.
- 3.A thin film of a reflux flow flowing over the diffuser plate is in a direct contact with steam nearby, so that the temperature rises up to a boiling point.

Туре	Nozzle Overflow Type
Manageable range of liquid amount	MIN 0.05m³/m²H MAX 80m³/m²H
Variable range of liquid amount	1~10
Drip point	1000~2000 points/m <sup>2</sup>
Aperture ratio	50~70%

#### **OPEN TROUGH TYPE**



- Notches on the upper side are sloping to divide the outflow liquid.
- 2.A diffuser plate and clicks on a lower side allow a liquid to spread more through a groundbreaking number of drip points.
- 3. Nozzle overflow type is suitable for a liquid that may block a hole.

Туре	Open Trough Type
Manageable range of liquid amount	MIN 0.2m³/m²H MAX 80m³/m²H
Variable range of liquid amount	1~5
Drip point	1000~2000 points/m <sup>2</sup>
Aperture ratio	50~70%

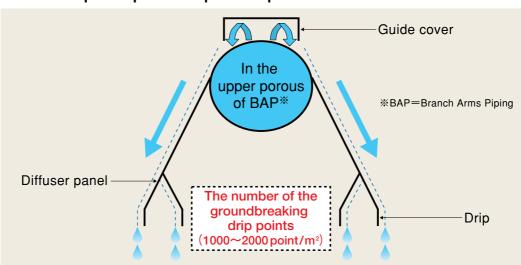
\*Variable range of liquid amount will correspond to the demand more than the above-mentioned value. Please feel free to contact me.





# INTERNALS FOR STRUCTURED PACKING

## The principle of liquid dispersal for MC distributor





Aspect of flowing down liquid from a diffuser panel.



Aspect of liquid dispersal

#### Example of dispersal of low liquid load.







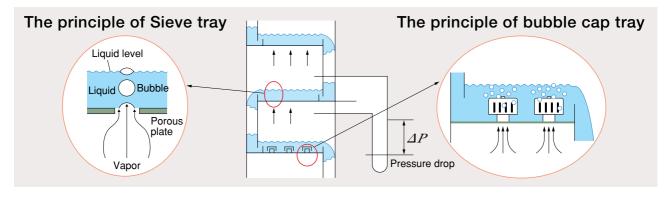




Bubble cap tray



Materials: SUS304, SUS304L, SUS316, SUS316L, SUS329J4L, CS. Titanium, Hastelloy, Special metal Design: Tray detailed design, Tray dynamics calculation, Performance chart, Installation procedure, Mechanical strength calculation.







## **VESSEL**

Metal FRP





PVC + FRP

Rubber lining





 $Materials: Metal (SUS, CS) \,, \, FRP, \, PVC + FRP, \, Rubber \, lining, \, Teflon \, lining, \, Flake \, lining$ 

Regulation : Facilities of the fire regulation, First pressure container, Second pressure container, Specialized high pressure gas



## **CANDLE FILTER**

This equipment is researched and developed by ICI PLC and Begg. Cousland & Co., Ltd. It is intended primarily for the removal of very fine mist particle of less than  $2\mu$ .

A combination of impingent and diffusion for finer particles where Brownian motion that is compressed and formed in a cylindrical housing eliminates effectively small particles.

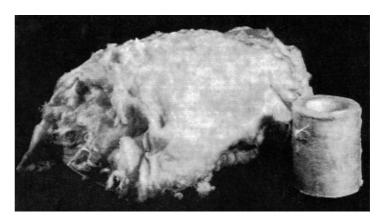












Materials : SUS304, SUS304L, SUS316, SUS316L, PP, PVC, PVDF, FRP

Main body: Filter, Glass wool, PP fiber, PE fiber, PTFE fiber





#### MIST SEPARATOR

The high-performing blade type eliminator that has an excellent property of eliminating mist utilizing a technology of TOYO TIRE & RUBBER CO., LTD.



The high-performing blade type eliminator eTn Mist Eliminator

Large numbers of delivery records

## e-blade (Series of E922)

e-blade that has an excellent property to eliminate mist by technology of TOYO TIRE & RUBBER CO., LTD. is an equipment which has a large number of delivery records.

#### ■ Property of e-blade

Becoming more compact and higher-performing

## High efficiency and low pressure drop

e-blade has a performing to eliminate more than 99.9% of mist and recovery it

Eliminating 99.9% of mist

by using an eliminator blade in a special form. It has low pressure drop and the maximum wind of the eliminator is 800Pa.

#### Standardized Units

e-blade is a compact equipment so that we can design e-blade which correspond to Low cost, Shortening a delivery date

the mist whose current speed is 8m/sec. And also It is a low cost for special designs and we can shorten a delivery date because the liquid flow is standardized to 4500m<sup>3</sup>/min.



## Light weight, High corrosion resistance, Thermal resistance

e-blade has an excellent corrosion resistance because all of e-blade are manufactured by using corrosion-resisting FPR and Plastic.

depending on specifications

And also the type of plastic is selected from thermal re-

Long working life



across section of high corrosion and thermal resisting.

sistance and corrosion resistance. (We can manufacture e-blade made from SUS depending on conditions)

## eTn Mist Eliminator (Series of E922)



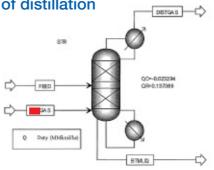






## **SIMULATION**

#### Example of the calculations of distillation



Stage	Temperature	Pressure	Heat duty	Liquid flow	Vapor flow	Liquid feed	Vapor feed
	C	bar	MMksal/hr	knolfer	knol/hr	knolftr	knothr
Condenser	32.4	5.01	-0.0233	2.79	18.86		
1	54.1	5.08		2.85	21.65		
2	57.3	5.11		2.82	21.71		
3	58.8	5,16		2.79	21,68		3.04
4	60.1	5.21		55.35	18.61	53,89	
- 5	62.8	5.26		55.78	17.28		
6	65.3	5.31		58,35	17,70		
7	67.2	5.36		56.81	18.27		
8	69.0	5.41		57.19	18.73		
9	71.1	5.46		57.58	19.11		
10	73.8	5.51		58.01	19,49		
11	77.2	5.56		58.58	19,93		
12	81.3	5.61		59.28	20.50		
13	85.5	5.66		60.07	21.21		
14	89.4	5.71		60.84	22.00		
15	92.4	5.76		61.50	22.77		
16	94.7	5.81		62.02	23,43		
17	96.3	5.86		62.39	23,94		
18	97.5	5.91		62.66	24.32		
19	98.7	5.96		63.00	24.59		10.27
Reboller	124.0	6.01	0.1371	48.34	14.66		

Stream			ED				GAS				GAS				/ILIQ	
Phase		MD	ŒD			VAP	OR			VAP	OR			LIO	UID	
Flow Rate	kgmeithr	not free.	kgfr	wifrec.	kgracithr	mol frac.	kgér	wifre.	kgmolftr	mol frac.	kg/hr	wit frac.	kgmol/hr	molifiac.	kg/hr	wit frac.
	0.166	0.00291	2.66	0.00044	10,118	0.98540	162.32	0.96315	10.277	0.54492	164.88	0.26806	0.008	0.00013	0.10	0.00002
	2,216	0.03882	111.87	0.01836					2,208	0.11707	111.48	0.18124	0.008	0.00016	0.39	0.00007
	13,748	0.24147	1167.64	D.19159					1,272	0.06742	108.00	0.17558	12,476	0.25808	1059.64	0.18761
	27,394	0.48116	3270.26	0.53659					0.486	0.02576	58.00	0.09429	25.909	0.55653	3212.25	0.56875
	8,973	0.15790	1380.24	0.22647					0.030	0.00161	4.68	0.00760	8.943	0.18498	1375.56	0.24388
	3.57E-04	6.27E-08	1.00E-02	1.64E-06	0.022	0.00219	0.63	0.00374	0.023	0.00121	0.64	0.00104	3.09E-06	7.83E-06	1.03E-04	1,83E-08
					0.002	0.00021	0.07	0.00042	0.002	0.00012	0.07	0.00011	5.50E-07	1.14E-08	1.76E-05	3.12E-00
	0,009	0.00015	0.40	0.00007	0.125	0.01219	5.51	0.03299	0.134	0.00709	5.89	0.00657	5.54E-04	1.15E-05	0.02	4.31E-06
	4,428	0.07777	161.45	0.02649					4,428	0.23479	161.45	0.26249	4.89E-15	1.01E-16	1.78E-13	3.16E-17
Total	56,934	1.00000	6094.53	1,00000	10.258	1.00000	168.53	1.00000	18,860	1.00000	615.08	1.00000	48.342	1.00000	5647.58	1,00000
Total Flow cum/hr		15.				36.5				95.				4.4	14	
Temperature C		60				30.				32				124		
Pressure bar		6.				7.1				5.				5.	0	
Vapor Frac		0.04			1,0000				1.00							
Enthalpy MMkcal/hr		-1.6				-0.1	91		-0.377				-1,360			
Density kg/cum		401				4.9				6.			1271.7			
Average MW		107	.04			16.4	41			32.	61		116.83			

#### Example of the calculations in base of the mass transfer theory



NW		70,61	19.04	50.48	84.83	119.38	183.82	195.83	236.74	32.00	28.01	44.01	36.46
To	18	417.2	190.6	416.3	\$10.0	536.4	550.4	0.039	065.0	154.6	126.2	304.2	334.7
Pa	909	79.1	45.4	95.9	60.0	54.0	45.0	44.3	23.0	40.0	33.6	72.6	62.5

Solute		
V <sub>1</sub>	oxignet	45.51
Solvent		
¥		1.6

		CAS	E-1	CAS	E-2	CAS	E-3
		TOP	BTM	TOP	STM	TOP	BTM
Diameter	200	650	683	650	650	650	660
Packing material		Pall Ring	1" Metal	Pall Ring	1" Metal	Pall Ring	1" Metal
a,	mile.	224	224	224	224	224	224
E		0.95	6.65	0.95	0.95	0.95	0.65
d <sub>a</sub>	m	0.0171	0.0171	0.0171	0.0171	0.0171	0.0171
G		0.710	0.719	0.710	0,718	0.710	0.719
G.		1.440	1.443	1.440	1.640	1.440	1.440
C <sub>a</sub>		0.336	0.339	0.330	0.336	0.330	0.354
Temperature	75	61.4	95.8	60.6	96.7	60,7	97.1
Pressure	abm.	6.1	5.8	8.1	5.9	6.1	5.1
Gas phase		43.10	80.88	42.27	67,77	42.31	93.88
Flow	Rgftr .	741	1686	728	19982	727	1090
9	lagrer"-the	2232	5002	2194	5068	2190	5000
Pa .	light <sup>2</sup>	8.840	13,115	7.829	13,160	7,931	13,216
Fo	rip.	0.0126	0.0133	0.0126	0.0134	0.0126	0.0134
Liquid phase Avera	ige MW	111.34	112,89	110.90	112.62	111.23	115,44
Flow	kgibr	6377	7522	6827	7281	6310	7282
L .	Agrico" for	19216	22067	10067	21941	19042	21944
PL.	Name .	1380.5	1515.1	1379.9	1315.4	1381.0	1315.5
P.	- 10	0.35	0.29	0.85	0.29	0.36	0.29
a .	dyneion	21.08	16.64	21.13	16.63	21.13	16.81
Mol Franc.							
N.		0.00126	2.645-07		4.79E-07		3.02E-0
		0.54882	0.42352	0.54875	0.42274	0.54415	0.42253
		0.06806	0.80004	0.07942	0.00059	0,07920	0.00044
		0.12017	0.30234	0.12390	0.31024	0.11914	0.30044
		0.06763	0.21961	0.07877	0.20043	0.08250	0.21183
		0.01965	0.04772	0.02678	0.05149	0.02942	0.05024
		3.355-06	1,245-05	3.116-08	1,17E-05	8.195-06	3,115-0
		9.39E-07	2.146-06	5.945-07	2.04E-00	1.495-06	5.08E-0
		0.00011	0.00093	0.00011	0.00009	0.00011	6.00006
		0.00122	0.50000	0.00121	0.00000	0.00121	6.00093
		0.00678	0.00549	0.00673	0.00548	0.00674	0.00548
		0.14832	8.60E-15	0.14490	1.266-14	0.14556	9.74E-1
4		3.685-04	4.27E-08	4.445-04	8,125-08	3,725-04	5.05E-0
B.	67	4.49E-03	1.68E-06	7.885-03		6.435-03	1,765-0



		TOP	BTM	TOP	BTM	TOP	BTM
D <sub>E</sub>	amilian	0.0360	0.0413	0.0388	0.0429	0.0368	0.0410
	an//sec	0.0212	0.0225	0.0211	0.0223	0.0211	0.0923
	an/hea	0.0159	0.0160	0.0158	0.0167	0.0158	0.0167
	confrace	0.0136	0.0144	0.0135	0.0143	0.0135	0.0143
	om*/sec	0.0115	0.0122	0.0115	0.0121	0.0115	0.0121
	ow/sec	0.0106	0,0112	0.0106	0.0111	0.0106	0.0112
	em/sex	0.0079	0.0084	0.0076	0.0083	0.0079	0,0083
	and/sex	0.0345	0.0366	0.0344	0.0983	0.0344	0.0363
	saffaes	0.0331	0.0351	0.0030	0.0346	0.0000	0.0349
	antitus	0.0271	0.0267	0.0270	0.0285	0.0270	0.0285
	and here	0.0266	0.0313	0.0294	0.0810	0.0204	0.0311
D <sub>2</sub>	40070000	0.0201	0.0240	0.0250	0.0298	6.0250	0.0266

5. The diffusivity in liquid phase

0,1	1.4×10*	VÇ4					
		TOP	BTM	TOP	BTM	TOP	BTM
D <sub>11</sub>	onfree.	7.729E-00	1,0536-04	7,691E-05	1,0535-04	7,687E-05	1,0555-04
6. The effect	ctive surface a	area	-02/.27	-0.05 /	a jen	4 =	

7. The volumetric mass transfer coefficient in gas hase  $k_0 \in \mathbb{R} = c_0 \cdot (a - k_0)^{-3/5} \left(\frac{k_0}{a}\right)^{3/5} \left(\frac{k_0 \cdot p \cdot p_0}{a \cdot p_0}\right)^{3/5} \left(\frac{n_0}{p_0}\right)^{3/5} \left(\frac{$  $He_i \geqq S \xrightarrow{\frac{1}{N_{r_i}}} = 0.85 \cdot G_s \cdot Ho_t^{0.11} \cdot Fr_t^{0.1}$ 

	TOP	MTB	TOP	BTM	TOP	BIM
	5T.44	95.42	66.75	94.93	66,60	94.99
	0.768	0.882	0.768	0.890	0.784	0.890
in National Section 1999	0.0336	0.0367	0.0384	0.0586	0.0333	0.0366
Agendan trades	0.661	0.797	0.656	6.790	0.656	0.791
	p Nation beloning	67.44 0,768 s/saturn/solution 0,0006	67.44 95.42 0.768 0.882 in hatter for in the C. \$335 0.0087	67.44 95.42 66.75 0.768 0.862 0.765 orbitalistical 0.0335 0.0367 0.0364	67.44 95.42 65.75 94.93 0.768 0.892 0.765 0.890 p-hatem-brinks 0.0305 0.0367 0.0304 0.0366	0.768 0.862 0.768 0.890 0.784

8. The volumetric mass transfer coefficient in liquid phase  $s_k=c_k \sin^{1/4}\left(\frac{a_kQ_k}{a_kq_k}\right)^{k/4}$ 

$$b_{ij} = G_{ij}(12)^{1/2} \left(\frac{1}{h_{ij} d_{ij}}\right)$$
TOP all TOP all TOP all TOP all TOP all  $i_{ij}$ 
 $b_{ij}$  mare 1.700 2.194 1.700 2.192 1.704 2.194

9. The overall volumetric mass transfer coefficient in base of liquid side  $\frac{1}{K_L} = \frac{H}{k_G} + \frac{1}{k_L}$ 

		TOP	BTM	TOP	8TM	TOP	8TM
C.	Agms/in <sup>2</sup>	4.56E-03	4.885-07	6.68E-63	9.496-07	4.62E-03	5.79540
H	legenstates-se <sup>2</sup>	0.706	0.336	0.722	0.337	0.718	4.326
K,	MAV	0.616	1,140	0.602	1.133	0.604	1.152
K,a	186	107.34	235.54	104.66	233.85	104,92	238.18

The overall number of transfer unit in base of liquid side
 The case that both of operating line and equilibrium line are straight lines

 $\Delta x_1 = x_2 = x_1^2$  $H_{GL} = \frac{x_1 - x_2}{\underline{\triangle} x_1 - \underline{\triangle} x_2}$   $h_1 \underline{\triangle} x_2 / \underline{\triangle} x_3$ 

12. Calculation of Packing height

		TOP	BTM	TOP	STM	TOP	БТМ
Average H <sub>OL</sub>	Di	0,10		0.10		0.10	
Calculation height	-	7.34		6.78		6.00	
Surplus ratio	76	50				- 6	0
Design height	- 100	11.00		10	.17	6.7	85

13. Packing materials

Service featur of Pall Ring is higher so that the pressure drop be

Selected a packing material	CMR 2P III	Hall (PF-22)	CMP 3F M	Hall (FF: 22)	CMRIPHE	del PT 22
Packing materials which have a performance of calculated value in the same material	1" PR Neal (PF:45)		(MR 3P Netal (PF 32) 1" PR Netal (PF 48)		CMR 39 Mess (9F 32) 1" PR Mess (9F 45)	
	TOP	RTM	TOP	RTM	TOP	RTM
Packing factor of Pall Ring is	s higher s	o that the	pressure	drop becoi	mes highe	r





## **FLOODING CALCULATION**

#### FLOODING CALCULATION FOR STRUCTURED PACKING







High-performance liquid distributor MC DISTRIBUTOR

MC PACK
Packed Tower Design

MATSUI MACHINE LTD.

Job No. Customer Tower Item

Date

		RECTI	FY SEC.	STRI	P SEC.			
		TOD	FE	ED	DOTTOM			
		TOP	ABOVE	BELOW	ВОТТОМ			
Pressure	kPaA	101,3	101.98	101.98	102.26			
Temperature	°C	64.53	91.01	91.08	100.27	199		
Vapor Lord	kg/H	1700	1068	933	888	( 100 %)		
Vapor Density	kg/m3	1.16	0.76	0.63	0.59		Load in column	
Vapor Viscosity	mPa·s	0.011	0.012	0.013	0.013	450 200		
Liquid Load	kg/H	1274	643	1132	1087	( 100 %)	(Input data)	
Liquid Density	kg/m3	750	897	896	916			
Liquid Viscosity	mPa*s	0.35	0.31	0.31	0.28			
Surface Tension	mN/m	19.03	57.11	57.12	58.16	_		
Packed Height	mm	4368		2548				
Number of Layer			1		1			
Packing Type		MC250T		MC250T				
Tower Diameter	mm		00		500			
Vapor Velocity	m/s	2.08	1.99	2.09	2.12	System Fac	ctor	
F-factor	m/s(kg/m3) <sup>0.5</sup>	2.24	1.73	1.66	1.63	1.0		
Flooding %	%	67.1	41.96	46.59	44.87			
Sp. Liquid Lord	m3/(m2·H)	8.66	3.65	6.44	6.04			
Packing ⊿P	kPa/m	0.2	0.097	0.094	0.09	245		
Packing Total ⊿P	kPa		0	.88		2963	dec .	
Internals Total ⊿P	kPa		0.	076		MATSUI MA	CHINE LTD.	
Tower ⊿P	kPa		0	.96		treasures teamwork with custmers.		

#### FLOODING CALCULATION FOR RANDOM PACKING

#### \*\* Matsui Machine COMPUTER DESIGN OPTIMIZATION WITH CMR \*\*

DESIGN CONDITIONS		100% LOAD		50% LOAD		120% LOAD		
		TOP	BTM	TOP	BTM	TOP	BTM	
OPERATING PRESSURE	( mmHg )	530	536	530	536	530	536	7
OPERATING TEMPERATURE	(Deg. C)	89.3	90.5	89.3	90.5	89.3	90.5	
VAPOR RATE	(Kghr)	970	1,123	485	562	1,164	1,348	Load in
LIQUID RATE	(Kg/hr)	9,000	9,000	4,500	4,500	10,800	10,800	
VAPOR DENSITY	(Kg/mi)	0.42	0.42	0.42	0.42	0.42	0.42	— column
LIQUID DENSITY	(Kg/m²)	940	940	940	940	940	940	(Input data
LIQUID VISCOSITY	( C.P. )	1.0	1.0	1.0	1.0	1.0	1.0	
FOAMING FACTOR(take)	( - )	1.0	1.0	1.0	1.0	1.0	1.0	
DESIGN RECOMMENDATION	ı							
	(Number of Layer)	1	1	1	1	1	1	
TOWER PACKING NAME &		CMR No.1P						
SIZE & MATERIAL		SUS304	SUS304	SUS304	SUS304	SUS304	SUS304	
TOWER DIAMETER	(mm)	700	700	700	700	700	700	
PACKED HEIGHT	(mm)	5,000	5,000	5,000	5,000	5,000	5,000	
CAPACITY FACTOR	( (Kg/m) 10/S)	1.08	1.25	0.54	0.62	1.29	1.50	
PACKING FACTOR	(1/81)	40	40	40	40	40	40	
FLOODING APPROACH	(%)	43.3	48.0	21.7	24.0	52.0	57.6	
PRESSURE DROP	(mmH <sub>2</sub> Q/m )	15.6	21.2	4.6	5.4	25.3	36.7	
TOTAL PRESSURE DROP	(mmH <sub>2</sub> O)	77.9	105.9	23.0	27.2	126.4	183.7	
VAPOR MASS VELOCITY	(Kg/ml/hr)	2,521.8	2,919.5	1,260.9	1,459.8	3,026.1	3,503.4	
LIQUID MASS VELOCITY	(Kg/ml/hr)	23,397.9	23,397.9	11,698.9	11,698.9	28,077.5	28,077.5	
VAPOR LINEAR VELOCITY	(m/sec)	1.66	1.92	0.83	0.96	1.99	2.31	
Internals Pressure Drop	(mmH <sub>2</sub> O/Layer)	6.49	8.36	2.37	2.84	8.91	11.60	
Total Pressure Drop	(mmH <sub>2</sub> O)	84.4	114.3	25.4	30.0	135.3	195.3	
	(mmHg)	6.2	8.4	1.9	2.2	10.0	14.4	
Design Factor (×1.5)	(mmHg)	9.3	12.6	2.8	3.3	14.9	21.6	
LIQUID VOL VELOCITY	(m/m/hr)	24.9	24.9	12.4	12.4	29.9	29.9	
LIQUID HOLD - UP	(m <sup>3</sup> -Lig/m <sup>3</sup> -Packing)	0.0487	0.0490	0.0297	0.0297	0.0559	0.0568	



## **PACKING FOR SHIPPING**

#### Package for Random packing

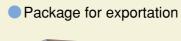


#### Package for Structured packing



#### Internal =







Wooden case (Flitch)



## **TRADING**

