RALU-FLOW®

A modern high effective packing with excellent performance data

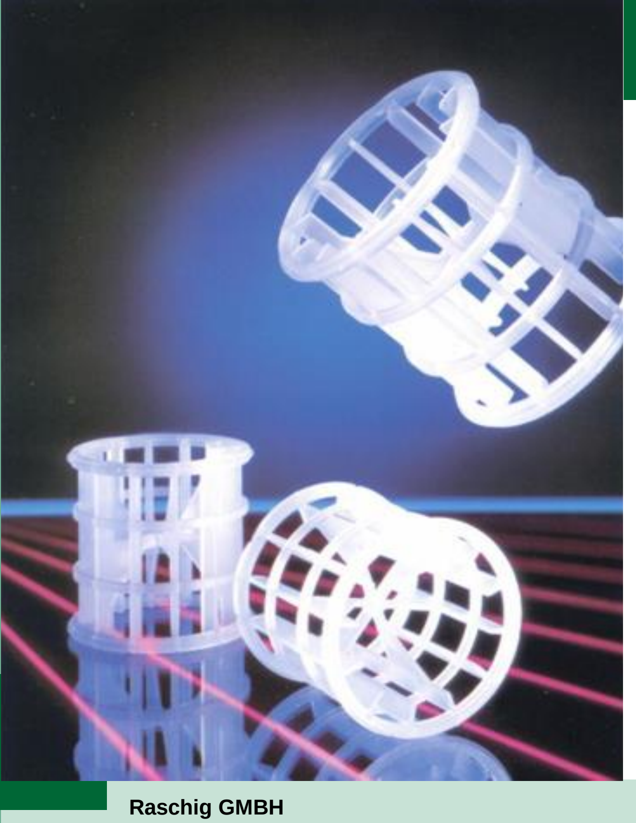
Product Bulletin 550

Nowadays plastic packings are often taken the place of ceramic materials in mass transfer columns. Owing to the good chemical and thermal stability of modern heavy-duty plastics, they are also gaining ground in many other areas of application which would otherwise be dominated by metallic materials.

Superior performance by design™

RASCHIG GMBH

RASCHIG USA Inc.



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For many years now, plastic packings have been an integral part of thermal mass transfer technology. Owing to the large range of possible shapes of injection-molded plastic packings, not only geometries with optimized flow properties can be achieved but also effective shapes for mass transfer can be designed. The Ralu-Flow® was designed according to the most recent principles.

With modern packings, the pressure drop for the gas flow in mass transfer columns is minimal, see Fig. 2a and 2b. This is ensured by the Ralu-Flow®'s extremely open geometry. Its large loading capacities, see Fig. 1, even phase distribution and high flow turbulence enable cost-effective column dimensions and effective mass transfer efficiency. The Ralu-Flow®'s geometry was optimized with particular consideration for these aspects. Figures 1 and 2 show clearly the decisive advantages of using the size I or II Ralu-Flow® in comparison with plastic Pall rings.

In raised process temperatures, a modern packing must possess a high deformation stability despite its low inherent weight, since it is only with these factors that large column loads and high dumped layers can be ensured together with reliable operation. Owing to the Ralu-Flow®'s excellent stability and its low edge pass ability, it can be used without difficulty to achieve bed heights of over 10 m.

Liquids containing solid particles must flow over modern dumped packings so as to leave as few as possible flow spaces containing static liquid where deposits are formed. Not only does the Ralu-Flow® have an extremely low liquid content, the liquid film is very evenly distributed over the packing shape in the form of thin liquid films.

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Size	Surface m^2/m^3	Free Vol. %
1	165	95
2	100	95

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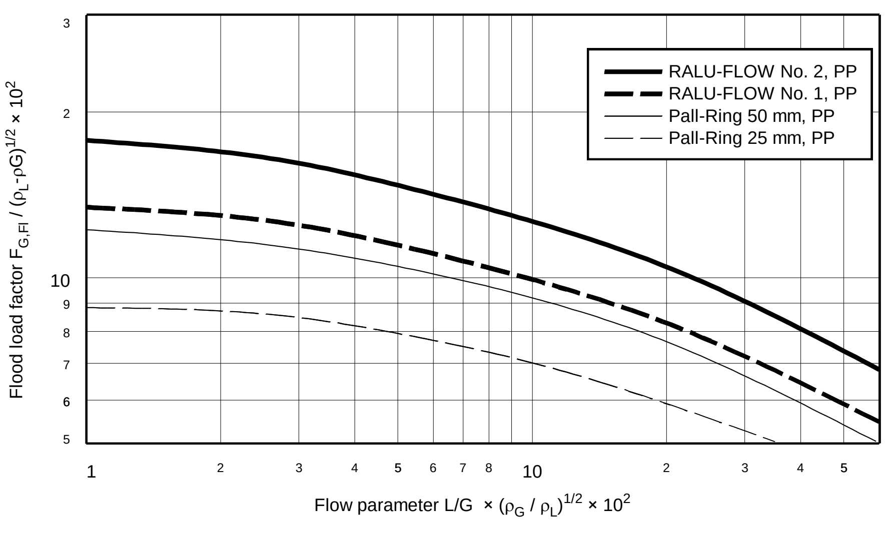
The advantages of this heavy-duty packing can be summarized as follows:

- very small pressure drop
- large specific surface
- high degree of stability
- small inherent weight
- large void volume
- good mass transfer properties
- high gas- and liquid-side loading capacity
- low edge pass ability
- keeps relatively clean

Fig. 1: Comparison of loading limits for Ralu-Flow® No. 1 and No. 2 to 25 and 50 mm Pall Ring



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Column for the absorption of NH_3 from air in water

Operating data:	Air	60.000 kg/h	
	Steam	5.000 kg/h	
	Ammonia	200 kg/h	
	Temperature	20 °C	
	Pressure	1 bar (abs.)	
Design target:	Gas concentration	< 20 mg/m³	
	Freshwater quantity	70 m³/h	
Results:	Packing Size	RALU-FLOW® No. 2	PALL RING 50 mm
	Column diameter	2.8 m	3.3 m
	Dumping height	4.7 m	4.7 m
	Gascapacity-factor	2.7 Pa0.5	1.9 Pa0.5
	Irrigation density	11.4 m³/m²h	8.2 m³/m²h
	Pressure drop	8.2 mbar	10.1 mbar
	Necessary quantity of packings	28.9 m³	40.2 m³

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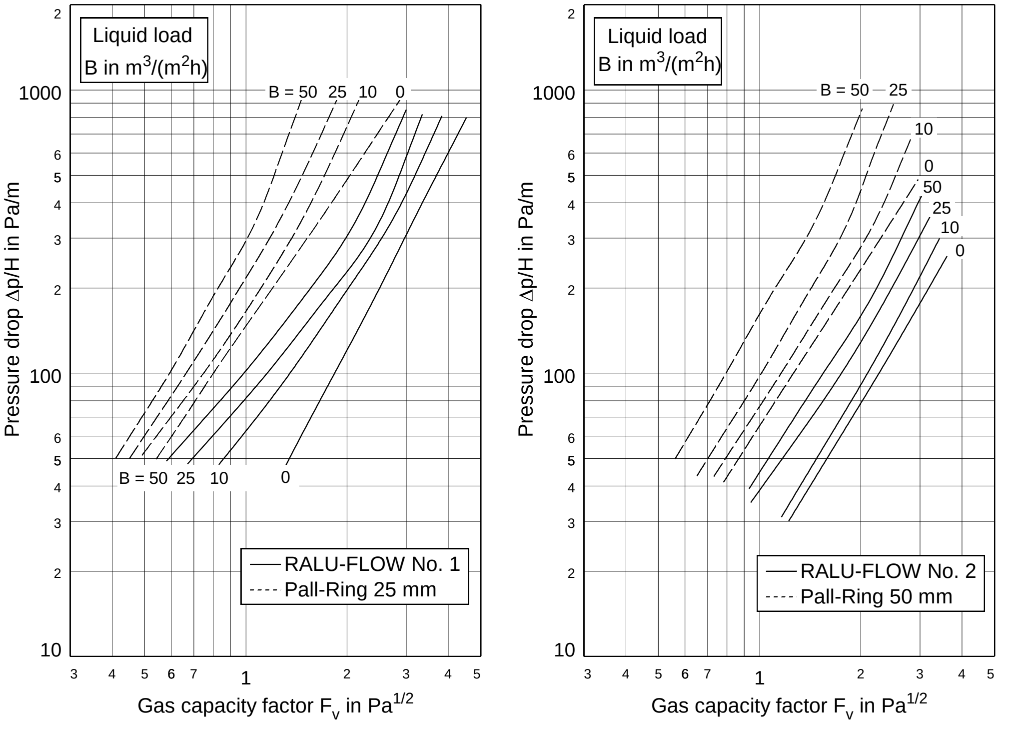
The above calculation demonstrates impressively that the use of the Ralu-Flow entails considerably less investment for new systems than the Pall ring.

What is more, if greater capacity of an existing system equipped with Pall rings is desired, a decisive increase in the mass throughputs, without a drop in mass transfer efficiency, can be achieved by using the Ralu-Flow®.

Fig. 2a and 2b: Comparison of pressure drop for Ralu-Flow® No. 1 and Ralu-Flow® No. 2 to 25 and 50 mm Pall-Ring



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As numerous studies have already shown, plastic surfaces are generally more difficult to wet than metal or ceramic geometries. Raschig has therefore developed a procedure that greatly improves the poor wettability of commercial plastics. By means of a hydrophilization process the surface of the plastic packing can be coated with a moisture-active layer which guarantees a dependable wettability like that of ceramic materials. Since the mass transfer efficiency of dumped-packing columns is directly proportional to the interface, this brings about a considerable improvement in mass transfer efficiency.

The following table summarizes the characteristic operating data of the plastic Ralu-Flow®

Characteristic operating data

RALU-FLOW® 1

Spec. surface:	approx. 165 m³/m²
Void fraction:	approx. 95 %

RALU-FLOW® 2

Spec. surface:	approx. 100 m³/m²
Void fraction:	approx. 95 %

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Nomenclature

Latin symbols

a	m^2/m^3	specific surface area of packing
a_{Ph}	m^2/m^3	specific effective surface area of packing
C_S	m/s	$= u_V (\rho_V /(\rho_L - \rho_V))^{1/2}$ capacity factor
D_S, d_S	m	column diameter
F_V, F_G	$m/s\ (kg/m^3)^{1/2}$	$= u_V (\rho_V)^{1/2}$ gas capacity factor
F	-	Packing factor
g	m/s^2	$= 9.81\ m/s^2$, acceleration
H	m	section height
HETP	m	height equivalent to a theoretical plate
HTU_{OV}	m	overall gas side height of a transfer unit
$k_G a_{Ph}$	1/s	volumetric mass transfer coefficient in gas phase
$k_L a_{Ph}$	1/s	volumetric mass transfer coefficient in liquid phase
L	kg/h	Liquid mass flow rate
h_L	m^3/m^3	superficial liquid hold-up
n_{th}	-	number of theoretical stages
p	bar	pressure
u_L	m^3/m^2h	superficial liquid velocity
u_V	m/s	superficial gas velocity
V, G	kg/h	Vapor mass flow rate

Greek symbols

$\beta_V a_{Ph}$	1/s	volumetric mass transfer coefficient in gas phase
$\beta_L a_{Ph}$	1/s	volumetric mass transfer coefficient in liquid phase
ρ_L	kg/m^3	liquid density
ρ_V	kg/m^3	gas density
$\Delta p/H$	mbar/m	specific pressure drop
η	Pas, kg/(ms)	dynamic viscosity

Subscripts

Fl	flooding condition
L	liquid phase
V	vapour phase