Random Packing

OVERVIEW

Packed beds formed by dumping bulk random packing elements of consistent shape and size will provide the consistent surface and voidage characteristics necessary for predictable mass transfer operations. To achieve optimum performance benefits from a packed bed, proper consideration of the design, specification and installation of the random packing and associated column internals is required.

SPECIFICATION OF RANDOM PACKING

HAT manufactures a comprehensive range of **AlphaPACK™** standard and high performance random packings as listed below.

Standard Types:

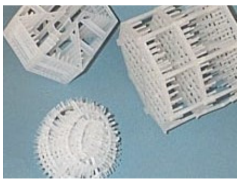
R+ Raschig Rings
(Ceramic, Glass, Metal, Carbon, Plastic)

P+ Pall Rings
(Ceramic, Metal, Plastic)

S+, S++ Saddles
(Ceramic)

High Performance Types:

C+ Rings
(Metal, Plastic)
I+ Rings
(Metal)



L+, Q+, N+ Packings
(Plastic)

Random Packing

The above packings are available in several sizes as indicated on our design sheets to suit most commercial applications. They range in size from 6mm to 90mm or equivalent. It is an essentially a design consideration in specifying a packing size based on capacity and efficiency requirements. The nominal packing size specified should however not be greater than 1/10th of the column diameter.

The packing is usually specified in the lowest cost material of manufacture that will satisfy temperature and corrosion requirements. Some of the most common materials listed in order of relative cost are:

Polypropylene	(mainly aqueous systems up to 100 deg. C)
Carbon steel	(non-corrosive hydrocarbon systems)
Ceramic	(sulphuric acid & nitric acid absorbers)
Stainless steels	(most hydrocarbon systems)
PVDF, PFA	(corrosive aqueous systems up to 150 deg. C)
PVC / C-PVC	(corrosive aqueous systems up to 90 deg. C)

Other more exotic materials that may be specified include aluminium, Monel, titanium and carbon.

Random Packing

PACKED BED DESIGN

Hydraulic operation of packed beds can be accurately rated using correlations that have been developed from actual performance data. Design data for standard "generic" random packing is widely available in the public domain.

The "Generalised Pressure Drop Correlation" is the most frequently published design tool for calculating packed bed diameter and determining the operating capacity for most "generic" random packings based upon a characteristic "Packing Factor" for each packing.

Where reliable performance is required in high pressure hydrocarbon systems, more specific design models should be employed. HAT are able to provide hydraulic rating sheets indicating the calculated pressure drop, liquid hold-up and % flood for any packed bed providing that sufficient process data is made available. As a minimum, we would require a profile of internal vapour and liquid loads and actual densities as well as liquid surface tension and viscosity.

HAT have computer programs to predict mass transfer efficiency and calculate the packed bed height for the most common absorption, stripping and heat transfer systems where sufficient, reliable data is available from which to compile design models. Multicomponent distillation systems should be simulated to evaluate the number of theoretical trays required as well as providing tray by tray vapour and liquid loads and physical properties. In most cases we can predict suitable HETP's and calculate packed bed height from this data. For most "generic" type packings in distillation service, separating efficiency will deteriorate when the bed height exceeds the lower of 6 x column diameter or 6 metres due to the effects of liquid maldistribution.

Performance data used to develop the design models used by HAT are in most cases sourced from well engineered operating columns with associated internals properly designed to be compatible with the duty.

Random packing has had wide application throughout the industry for several decades. As a result, performance characteristics are well known and design data readily accessible from public domain sources. Most generic column packings can be manufactured in a wide range of commercially available materials. The **AlphaPACK** range manufactured by HAT conforms to accepted industry standards as listed below:

Random Packing

PACKING TYPE	MATERIAL	SIZE	MASS (kg/m^3)	SURFACE (m^2/m^3)	VOIDAGE %
R+ Raschig Ring	Ceramic	3mm	1160	1350	49
		5mm	1020	1000	55
		6mm	980	940	57
		8mm	850	550	63
		10mm	760	440	65
		12mm	740	360	68
		15mm	720	310	69
		20mm	690	240	70
		25mm	670	195	71
		38mm	620	135	73
		50mm	600	98	75
		60mm	560	78	76
		70mm	530	72	77
		80mm	500	60	78
		100mm	470	44	80
R+ Raschig Ring	Carbon	12mm	670	360	60
		20mm	545	246	66
		25mm	510	195	74
		40mm	525	125	95
		50mm	450	98	68
P+ Pall Ring	Stainless Steel	16mm	535	316	93
		25mm	315	208	94
		38mm	200	122	95
		50mm	195	100	96
		90mm	235	55	97
P+ Pall Ring	Polypropylene	16mm	110	320	88
		25mm	71.1	209	91
		38mm	49	127	95
		50mm	44.4	100	94.9
		90mm	41.5	59	96
P+ Pall Ring	Ceramic	25mm	670	220	71
		38mm	620	165	73
		50mm	600	120	75
		80mm	500	80	78
		100mm	470	55	80
S+ Saddle	Ceramic	12mm	770	430	66
		19mm	730	380	68
		25mm	700	260	69
		38mm	630	200	72
		50mm	600	120	73
		75mm	560	92	75
SS+ Super Saddle	Ceramic	25mm	590	260	74
		38mm	560	210	75
		50mm	550	140	76
		75mm	520	120	77
Q+ Pack	Polypropylene	No.4	33.7	98.4	96.3

Random Packing

SF+ Pack	Polypropylene	90mm	56	102	97
C+ Ring	Stainless Steel	No.2 No.3	170 165	145 103	97 97
I+ Ring	Stainless Steel	No.25 No.40 No.50 No.70	246 185 164 120	230 148 97 59	96.7 97 97.7 98.1

Note: Weight will vary depending on the thickness required. The data above is based on standard thicknesses.

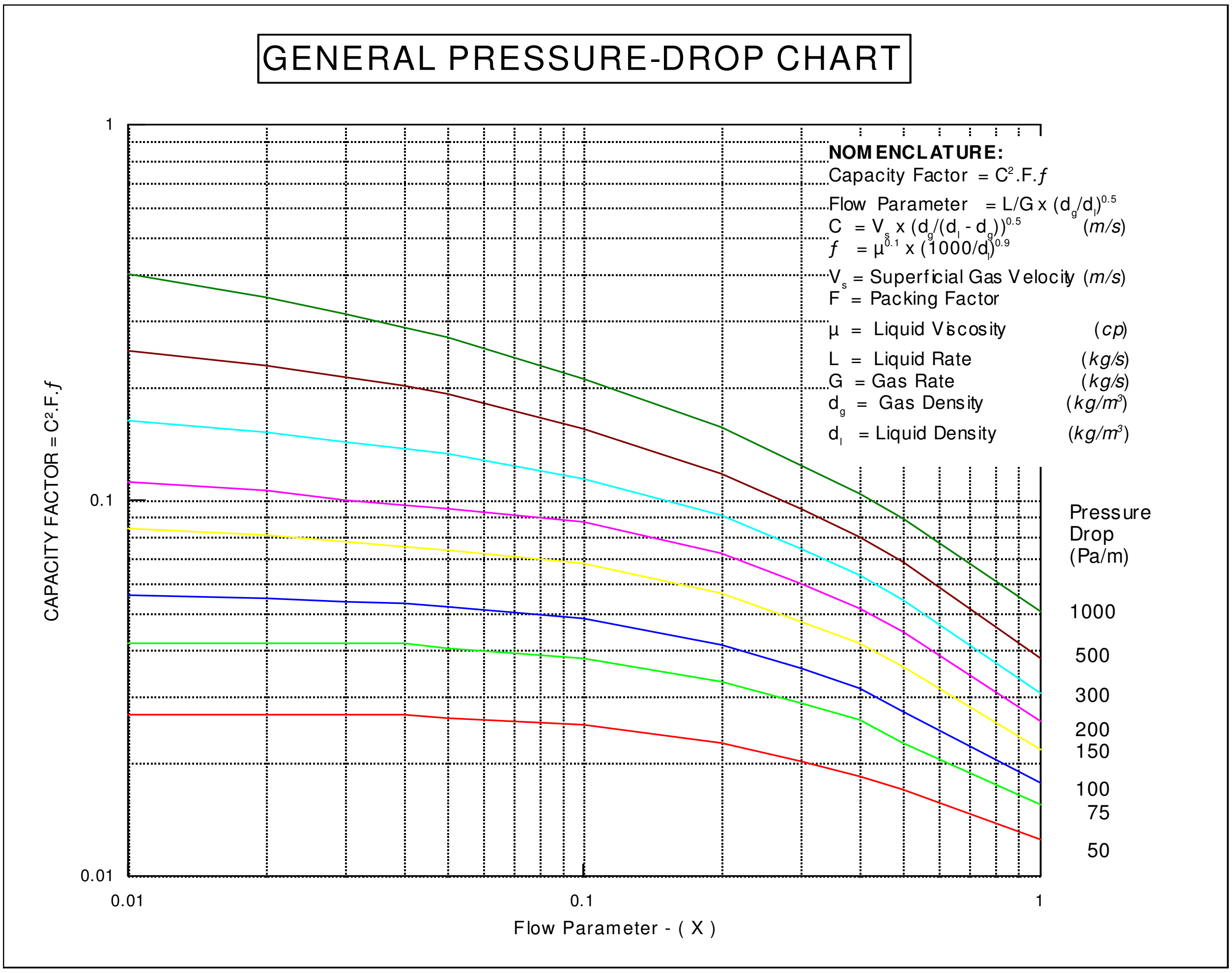
Random Packing

ESTIMATION OF PRESSURE DROP

The restriction to vapour flow across a packed bed causes a pressure drop which is normally relatively low. Nevertheless the effect of pressure loss on overall plant design and operating costs will often need to be evaluated and so it is necessary to be able to estimate this pressure loss over the expected range of operating conditions.

Pressure drop is a function of vapour and liquid rates as well as the packing shape and size. Pressure drop curves for most packings are widely published. For estimating purposes it is usually more convenient to use a "Generalised Pressure Drop Correlation" as shown below which applies a characteristic "Packing Factor" to the ordinate value to provide a set of pressure drop curves which are accurate to within 20% for most random packings.

GENERALISED PRESSURE DROP CORRELATION



DELIVERY AND INSTALLATION

An advantage of random column packing is that being mass produced standard elements, delivery times are relatively short. Since the same packing can be used in many applications irrespective of column size, HAT holds a substantial inventory of most **AlphaPACK** random column packings for immediate shipment at its warehouses.

Random column packing is packaged and shipped by volume. A volume adjustment factor must be applied to the calculated column geometric volume to estimate the shipping volume required to properly fill a packed bed to account for edge and settling effects. The volume adjustment factor depends upon the packing shape and size and the bed diameter.

A contingency allowance for installation losses, typically around 5%, should be added to the shipping volume calculated above.

Strict conformity with recommended installation procedure is necessary to ensure consistent duplication of design performance. Installation techniques that result in installation crew walking on or raking the packing must never be employed. Incorrect installation procedures can result in substantial packing shortfall (i.e. installed volume not sufficient for the required bed height resulting in performance losses).