SELECTION OF INTERNALS OF PACKED TOWER

Internals of **packed tower** are *packings, packing support, liquid distributor, liquid redistributors, mist eliminator, hold – down plates* etc…

Tower Packings: Suitable packings must be selected before the determination of tower diameter.

Regular Packings are grids, structured packings, stacked rings etc…

Grids are used for high gas rates as they offer very low pressure drop and are used in **cooling towers**.

These types of packings are widely used in chemical process industries and are made from corrugated sheets with some perforations or wire mesh screen.

They provide **high surface area** with high **void** fraction.

Random Packings are of various types; but most commonly used are pall rings, berl saddles, raschig rings, hypac etc…

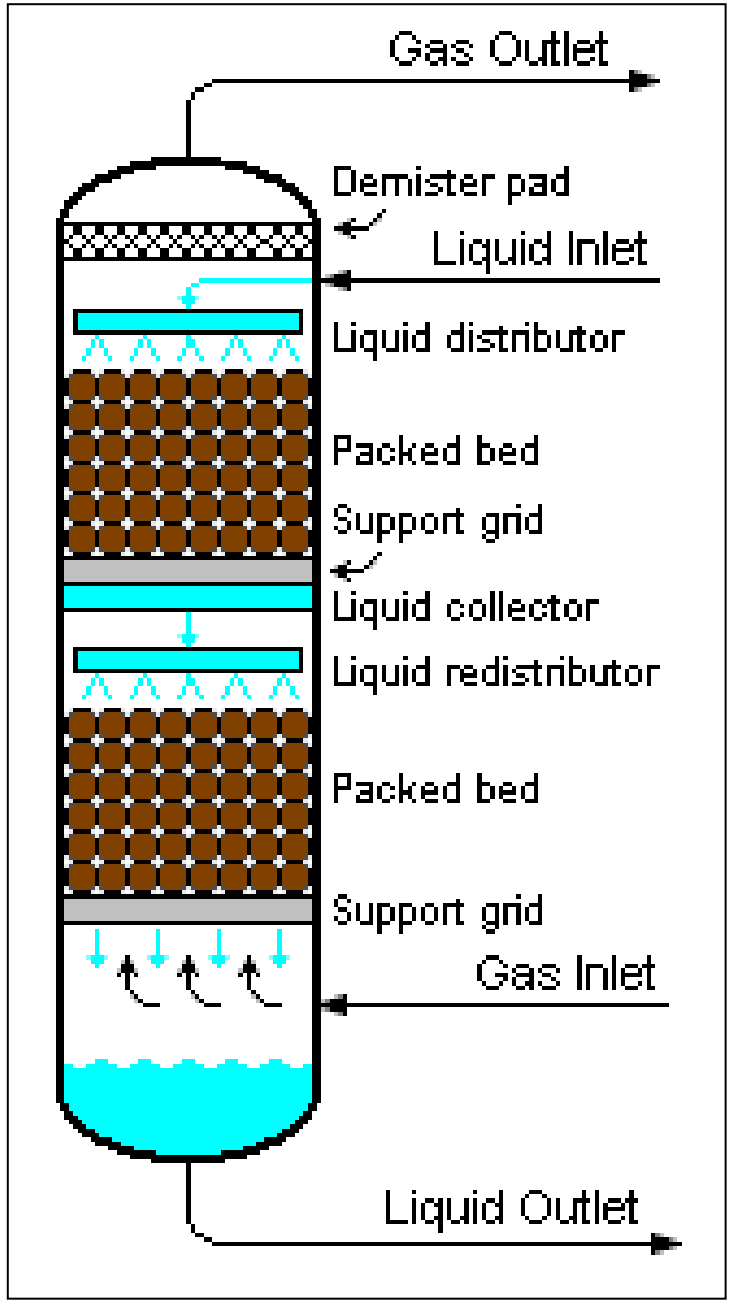
Pall rings are preferred and commonly used in random packings but their cost per unit volume is high.

It requires minimum diameter and minimum height for the given absorption or distillation duty as compared to other types of random packings.

These types of rings are available in **metals** and **plastics**.

For ***high temperature*** services polyethylene or polypropylene pall rings cannot be used.

Plastic packings are also attacked by some organic solvents.



Berl saddles are **cheaper** than metallic pall rings.

Ceramics are **brittle** in nature and have poor strength at high temperature.

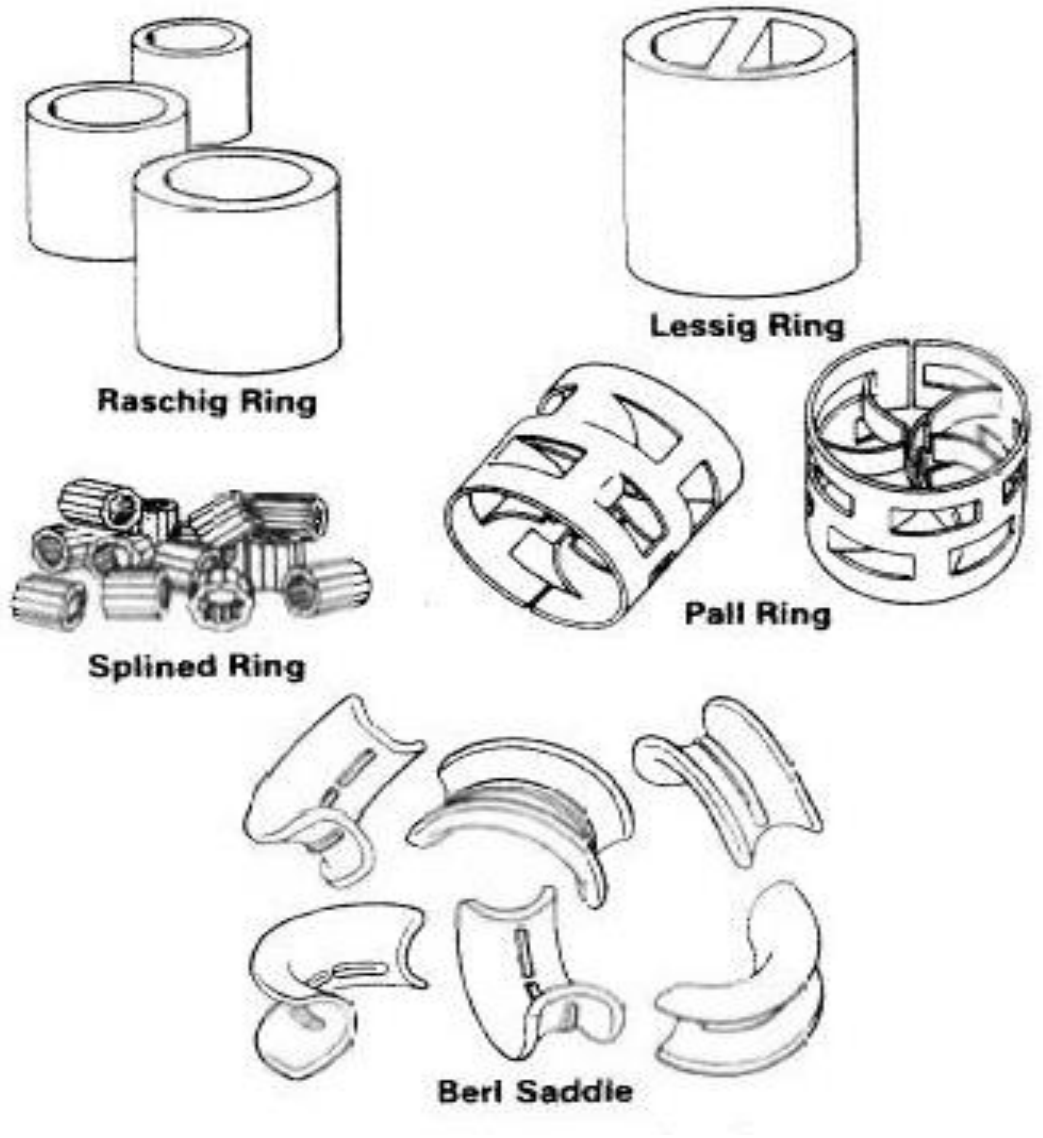
For very **high temperature** and **corrosive services** glass packed column with glass *raschig rings* are preferred against packed column of special alloys.

Raschig rings are the **cheapest** packing material but are less effective and efficient.

They require **maximum diameter** and **height** for the given absorption or distillation duty compared to other types of random packings.

Hence, **total fixed cost** of packed column is higher.

Diameter of tower is recommended to be more than ***10 times*** the packing size.



LIQUID DISTRIBUTOR: Used with packed tower for **initial uniform distribution** of liquid at the **top** of packed bed is essential for the **efficient** mass transfer operation.

For **small diameter**, less than 0.3 m, single point liquid distributor like **one** spray nozzle is adequate.

For **large diameter**, multi point distributor like **perforated pipe distributor**, **trough type distributor**, **orifice distributors** are used.

For one distribution point, 194 cm^2 area is required for each liquid distributor.

Perforated pipe distributors are preferred for **column diameter** ranging from **0.3** to **1 m**.

It is used with **clean liquids** and **offer minimum restriction** to gas flow and is preferred with **reasonably** constant flow rate.

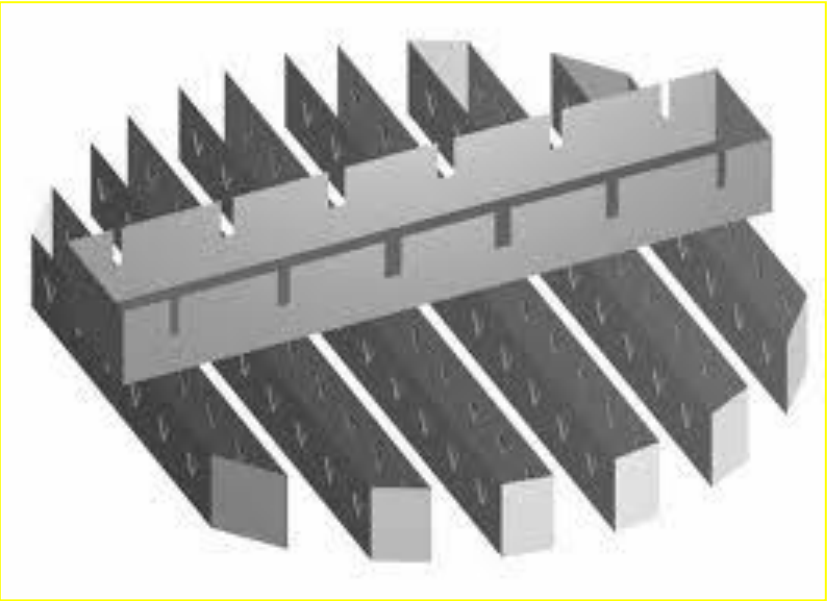
Trough type distributors are preferred for **column diameter** greater than or equal to **1.2 m**.

It is used with **liquids** having **solid** in suspension.

They are fabricated from metal sheets, plastics or ceramics and consist of a series of troughs containing side notches and provide **good liquid distribution** with a **large area** for gas flow.

Orifice type liquid distributor is also preferred for **large diameter** packed column.

This consists of flat perforated tray equipped with a number of **risers** or **short stand pipes**.



Ideally gas **rises upward** through risers, while liquid **maintain** the certain level over the perforated plate and **flows down** through perforations.

The riser should be sized to give **sufficient area** for gas flow without creating a **significant** pressure drop.

Perforations should be **small** enough to ensure that the level of liquid on the plate at the **lowest liquid** rate but **large** enough to prevent the distributor **over flowing** at the highest rate.

Weir type distributor, in which gas and liquids are flowing through the same stand pipes.

Notched weirs are provided in upper section of stand pipes.

Certain **level** of liquid is maintained over the tray and liquid flows over the notched weirs and **falling down** through the same pipes from which gas rises upward.

This type is preferred with **fluctuating** liquid flow rates.

LIQUID REDISTRIBUTOR: After traveling certain distance in a packed tower, considerable fraction of liquid is **migrated** to the column wall and flows down in the **vicinity** of column wall while the gas rises upward through the central portion.

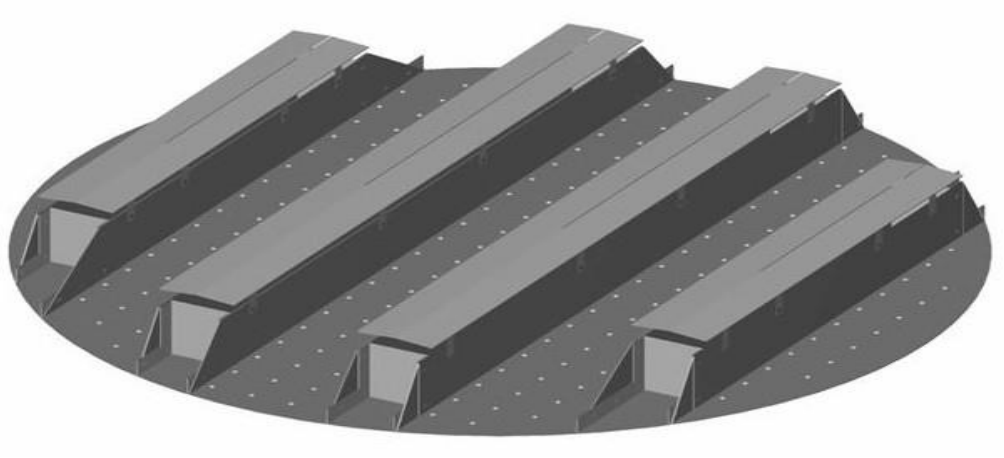
This phenomenon is called as **CHANNELING**.

Liquid redistributors **collect** the liquid that has migrated to the column wall and **redistributes** it evenly over the next bed of the packing.

For a small diameter column, $D \leq 0.6$ m, **wall wiper** type liquid redistributor is preferred.

It collects liquid from the **column wall** and **redistributes** it into the **central** portion.

Sometimes, **packing support** plate itself acts as liquid redistributor.

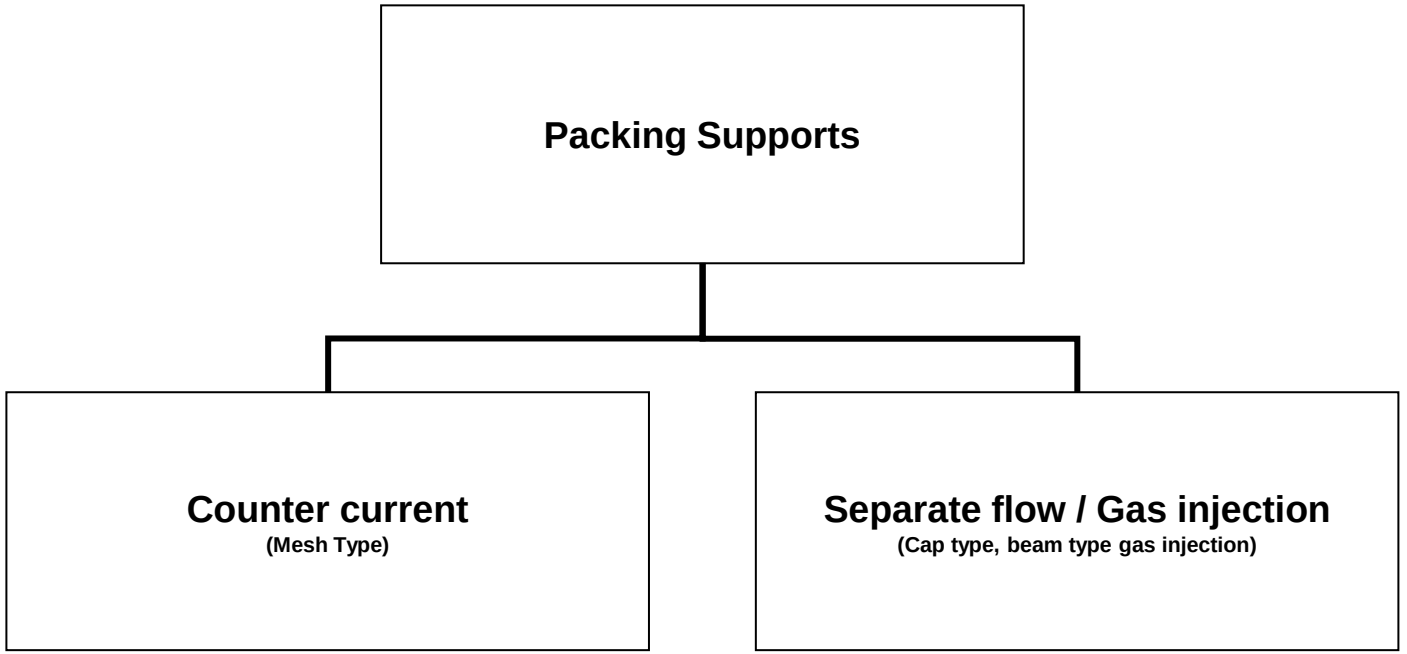


PACKING SUPPORT: The **function** of packing support is to **carry** the load of wet packing bed **without** providing excessive restriction to gas and liquid flow.

It also acts as **distributor** for both streams.

Poor design of packing support provides **higher pressure drop** and can cause **premature local flooding**.

Generally, **two types** of packing supports are used:



In **counter current** type packing support, liquid and gas both are flowing through the **same openings** in counter current direction.

Major open area of **counter current type** packing support is occluded by packing pieces resting on it.

Column diameter is decided based on the **characteristics** of **packing material**.

Berl saddles, Rasching rings etc provides the lesser free area for flow of gas, hence with such packings; this type of support can be used.

But for other packings this type of support cannot be used as it provides higher % of net free area (85% or more).

- **Gas injection** type can be designed for **free area upto 90%** and because of their geometry there will have very little occlusion by the packing.
- In this type of packing support **separate** *flow passages* or *openings* are provided for gas and liquid streams.
- Gas inlets are provided **above** the liquid level.
- For packing material like **pall rings**, **structured packings** etc… gas injection type packing support is recommended.

HOLD DOWN PLATE is required to **prevent damage** to the packing which can result due to **break down** in normal operating conditions.

At **high** vapor / gas flow rates, packing at the top can be **fluidized**.

This may **result** in **breaking** or **deshaping** of packing.

Ceramic packing can easily be **broken** which may settle in the **voids** of packed bed and **plug** the flow channels.

In case of *metal packings*, **deshaping** may take place and deshaped pieces can **plug** the flow channels.

In case of *plastic packings*, they may **fly away** with gas or vapor and **seat** at the various **locations** in the column.

Plastic packings may break and seat **randomly** in the column.

This plate generally in the form of **grid** or **screen** form can be used to **prevent** such **fluidization**.

While **heavier** hold down plates are used for **ceramic** and **metal** packings, **lighter** hold down plates of similar construction are used for packed tower with **plastic packings**.

However, size of opening in the grid / plate are fixed in such manner that **fly off** of the **packing material** can be **prevented**.