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DISTILLATION COLUMN INTERNALS INSTALLATION AND INSPECTION

(BEST PRACTICE)

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(BEST PRACTICE)

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SCOPE

This Best Practice specifies the major requirements of tower instalation and inspection and specifically provides guidelines on some issues.

A large problem in many tower internal installations is incorrect installation, leading to loss of product quality, tower efficiency (higher energy), capacity and run length (plant reliability). Most inspectors look at mechanical issues which are important, but they do not look at issues that affect capacity, energy consumption and product purities.

Many companies may not have the expertise to review the tower internal instillation, because turnarounds only have every few years.

The importance of a properly installed column is under-appreciated in many cases. A poorly installed column can lead to inferior results. Permanent damage to the column may appear when the proper installation precautions are not taken before conditioning and use. Good column internal installation is vital for optimum tower performance, as well as trouble-free shutdowns. The mass transfer performance of a packed column is exceedingly dependent on the quality of the column internals. Optimal configuration to the tower packings as well as to the individual operating conditions demand comprehensive process engineering oversight.

Installation is immensely difficult for a tower that is out-of-round by more than the allowed trays. Out-of-roundness is most likely to happen in the nozzles and manways but can happen in other areas. Existing towers should also undergo the same pre-installation checks due to tower roundness changing over years of operations.

INTRODUCTION

A large problem in many tower internal installations is incorrect installation, leading to loss of product quality, tower efficiency (higher energy), capacity and run length (plant reliability). Many companies may not have the expertise to review the tower internal instillation, because turnarounds only have every few years. Most inspectors look at mechanical issues which are important, but they do not look at issues that affect capacity, energy consumption and product purities.

The most issues leading to low capacity and high energy usage in tower are

1. Incorrect installation
2. Operation
    a. Over refluxing
    b. High pressures
3. Low efficiency / capacity designed and purchased equipment provided by the lowest bidder

Item to Inspect in tower

1. Downcomer Clearance
2. Downcomer width
3. Weir heights
4. Inlet weir spacing – important for capacity
5. Tray spacing
6. Free area
7. Levelness – important for efficiency
8. Bolts are installed and tightened
9. Poor Manufacturing

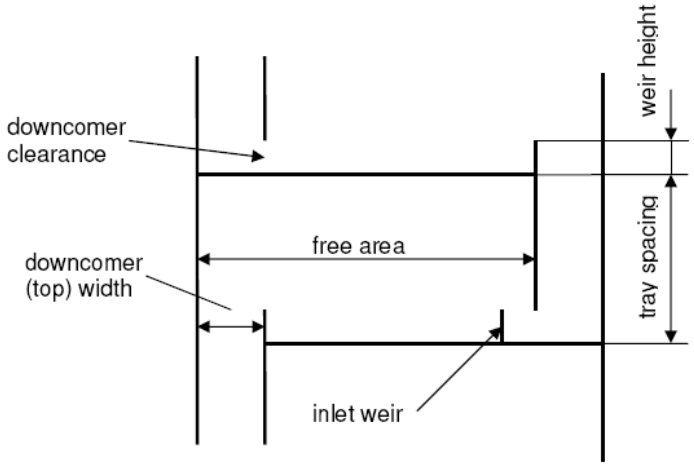

Figure 1. Item to Inspect in tower

Planning / Preparation

Good planning and preparation shortens the installation time. The following measures have to be considered:

Field installation:

- platform at level of manholes for a load of > 500 kg/m², with weather protection if necessary
- ventilation (fans)
- lighting within the column (low voltage)
- means of access
- scaffolding and platforms
- suitable working clothes, new, clean shoes or shoe covers to be worn inside the column ways and means of transport
- telephone or radio communication
- auxiliary services
- safety precautions, etc.
- hoisting facilities (lift, crane)

Preparation before the actual installation into the column

- Check in connection with the packing lists if all boxes are available.
- Lay-out boxes so as to match sequence of parts installation.
- Take out parts only as gradually needed.
- Check in connection with the packing lists if all parts are available.
- Check in connection with the packing lists and relevant drawings if all parts are available.
- Mock-up all internals on the ground adjacent to the tower before starting the installation inside the tower.
- The internal mock-up should be done in connection with the relevant internal drawings.

DEFINITIONS

Active Area (or Bubble Area) - the deck area of the tray which may either be perforated or fitted with valves or bubble caps and is the area available for vapor/liquid contacting

Accident - An event or sequence of events that results in undesirable consequences

Bottoms – The stream of liquid product collected from the reboiler at the bottom of a distillation tower

Capacity – Rate of flow through a valve under stated conditions.

Condenser - Is a heat exchanger which condenses a substance from its gaseous to its liquid state.

Distillate – The vapor from the top of a distillation column is usually condensed by a total or partial condenser. Part of the condensed fluid is recycled into the column (reflux) while the remaining fluid collected for further separation or as final product is known as distillate or overhead produc

Downcomer clearance - The distance between the bottom edge of the downcomer apron and the tray deck

Downcomer Area - is the area available for the transport of liquid from one tray to the next tray below.

Downcomer Back-up Flood - occurs when the head of liquid in the downcomer backs up onto the tray deck. The head of clear liquid in the downcomer is a balance of the pressure drop across the tray plus the head loss through the downcomer clearance.However an aeration factor must be applied to estimate the actual height of aerated liquid in the downcomer

Downcomer Clearance – is the space below the downcomer apron allowing liquid to flow from the downcomer to the tray deck below. This must be sized to provide a balance between the minimum head loss required for good liquid distribution across the tray deck and avoiding excessive downcomer back-up.

Downcomer clear liquid - the measure of the amount of liquid in the downcomer.

Explosion - A release of energy that causes a pressure discontinuity or blast wave.

Failure - An unacceptable difference between expected and observed performance.

Grid packing - Systematically arranged packing use an open-lattice structure

Hold down plates - Equipment in packing column is used where flow conditions and the packing characters might be such that the packing would move about with possible injurious effects

Installation - the act of putting furniture, a machine, or a piece of equipment into position and making it ready to use

Inspection - the act of looking at something carefully, or an official visit to a building or organization to check that everything is correct and legal

Installation inspection - The process of inspecting components of the commissioned systems to determine if they are installed properly and ready for systems performance testing.

Liquid distributor – Equipment in packing column to maintaining a uniform flow of liquid throughout the column.

Liquid holdup - The fraction of liquid held up in packed column.

Liquid redistributors - Equipment in packing column to collect liquid that has migrated to the column walls and redistribute it evenly over the packing and also out any mal-distribution

Mal-distribution – Fault distribution of vapor liquid in packing column. Maldistribution can affect in efficiency column.

Mass transfer - The relative motion of species in a mixture due to concentration gradients.

Reboiler – Is a heat exchanger typically used to provide heat to the bottom of industrial distillation columns. They boil the liquid from the bottom of a distillation column to generate vapors which are returned to the column to drive the distillation separation.

Open Area (or Hole Area) - is the aggregate area available for vapor passage through the tray deck via perforations or valve and bubble cap slots. This is a critical factor in the tray operating range since high vapor velocity hrough the open area (hole velocity) will nduce heavy liquid entrainment (as well as high pressure drop), but low hole velocitymay allow liquid to "weep" or even "dump" through the tray deck to the tray below.

Operating area - the range of vapor and liquid rates over which the plate will operate satisfactorily (the stable operating range).

Outlet Weir Height - The outlet weir is used to maintain a head of liquid on the tray deck as well as to ensure a positive vapor seal to the bottom of the downcomer.

Tray Pressure Drop - may also be a limiting criterion particularly in low pressure services. The operating tray pressure drop is the su'm of the dry pressure drop caused by the resistance to vapor flow through the tray open area and the head of clear liquid on the tray deck.

Tray Spacing - is the vertical distance between adjacent tray decks. This effects both the height of spray that may be generated on the tray deck before liquid carryover and also the allowable head of liquid in the downcomers

Trim - The internal components of a valve that modulate the flow of the controlled fluid. In a globe valve body, trim would typically include closure member, seat ring, cage, stem, and stem pin.

Vapor pressure – The pressure exerted by the vapor phase that is in equilibrium with the liquid phase in a closed system. For moderate temperature ranges, the vapor pressure at a given temperature can be estimated using the Antoine equation.

Weir loading – The normalized liquid flow rate leaving a tray pass divided by the length of the outlet weir of the same pass.

Open area - The ratio of the hole area divided by the bubbling area

Random packing - Packing of specific geometrical shapes which are dumped into the tower and orient themselves randomly

Structure Packing - Crimped layers or corrugated sheets which is stacked in the column

Safety - A general term denoting an acceptable level of risk of, relative freedom from and low probability of harm.

Spacing and Layout - A well laid-out plant (including adequate equipment spacing, adequate drainage, “fire breaks" to establish separation between fire risk areas), limits the geographical extent of a fire and allows effective fire fighting access.

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