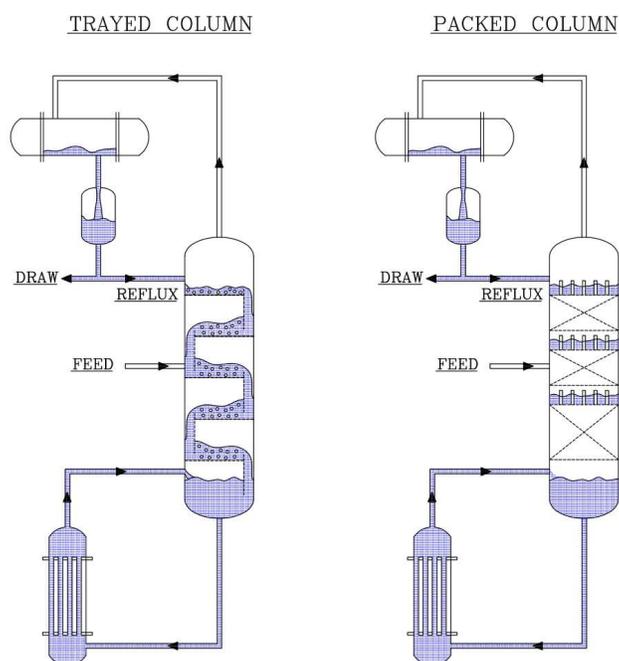


## Troubleshooting Columns

### How holdup affects performance

Column holdup is the liquid retained inside a column system when it is in operation. It is drained only after shutdown. It consists of the liquid present in associated heat exchangers, reflux drum, column bottom segment and pipelines. For trayed columns, it also includes liquid present on trays and downcomers, and for packed columns, liquid film on packings and on internals such as distributors.



This article discusses the holdup during normal operation, but not during abnormal situations such as flooding. Higher holdup can significantly impact column's performance in several ways. Some of them are given below.

#### Longer cycle times

At startup, some amount of time passes in -

- First filling the column holdup with liquid, and,
- Operating the column under total reflux until the required concentration profile is established and column stabilises.



While these initial steps are being performed, distillate/bottom product cannot be taken. If holdup is higher, these 'unproductive' steps take more time. Therefore, higher holdup means less time available for actual distillation and overall cycle time increases.

### **Lower product recovery**

Holdup not only remains inside the column during operation, but also contains all feed components, including top and bottom products, 'locked' up within it. Therefore, more holdup means more unrecovered product - hence lower recovery. This can be significant in dilute feeds, where much of the distillate product remains locked up.

### **Dampening effect on input fluctuations**

During operation, operating parameters like feed flowrate, feed composition, steam/heat input etc. can fluctuate. Holdup has a dampening effect on such changes. That is, they will not immediately affect product purity or flowrate. As a result, column operates in more stable manner. On the other hand, column responds slowly to change, which can be undesirable, especially in case of close-boiling components.

### **Higher residence time**

Higher holdup implies higher residence time of liquid in the column, which has its own effect

- It allows more time for vapour-liquid contacting, and thus increase separation efficiency.
- In some distillations (such as esterification) reaction and distillation take place simultaneously. Such reactions may need certain minimum residence time, for which higher holdup may be necessary.

### **Impact on hydraulics**

Excess holdup can increase column pressure drop, cause liquid to back up on trays and even cause flooding. However, in packed columns, moderate holdup is necessary to ensure wetting of packings in packed columns. Furthermore, moderate holdup is necessary to reduce entrainment and prevent coning on trays.

### **Energy Consumption**

Higher holdup may require more reboiler heat to maintain the required vaporization rate. This increases energy consumption.

