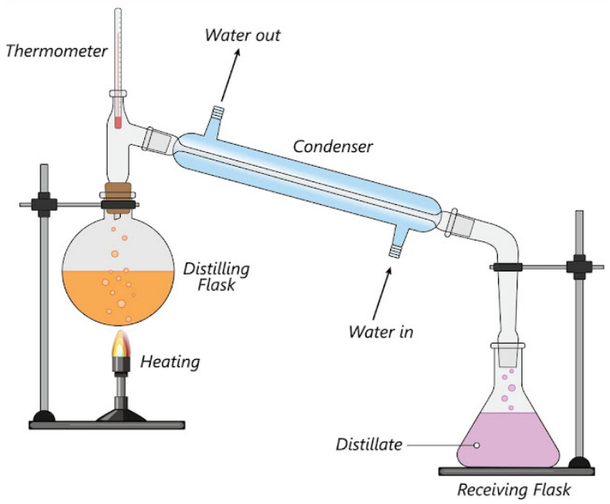
Basic knowledge
DISTILLATION

Distillation is a process of evaporation of a liquid followed by cooling and condensation of vapors to separate mixture components based on their boiling point differences. This method is widely used for purifying substances, for example, to obtain distilled water, as well as in various industries: in petroleum refining for oil separation, in metallurgy for metal extraction, and in the production of alcoholic beverages. It utilises the different volatility of the components of the mixture to be separated.
Volatility refers to the tendency of a substance to pass from the liquid phase into the gas phase. Examples of volatile liquids include acetone, alcohol and petrol.



Principle of distillation

To achieve separation, the liquid mixture is brought to boiling point.

The resulting vapour phase is made up of several components, mainly the more volatile components of the mixture.

The vapour phase is separated from the liquid phase and condensed (distillate).

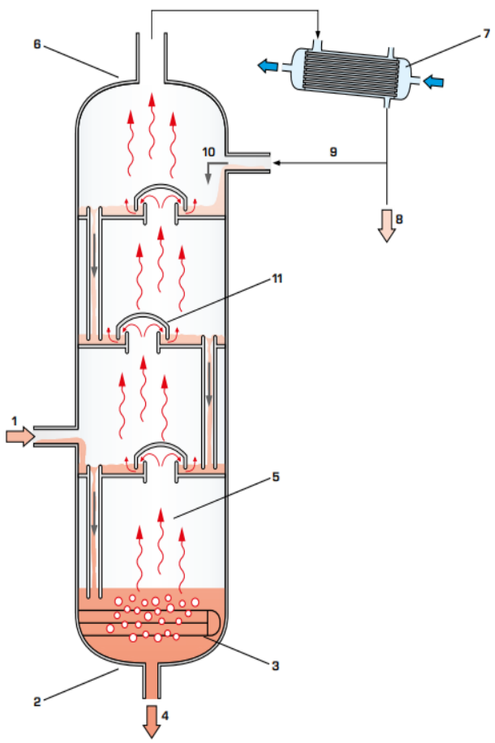
The less volatile components predominantly remain in the liquid phase. Distillation does not result in complete separation of the liquid mixture, but rather its division into two mixtures with different contents of volatile and less volatile components.

The separating principle is based on the fact that the content of volatile components is greater in the vapour phase than in the liquid phase.

Basic knowledge
RECTIFICATION

Rectification is an application of distillation. It is used for substances that are required in high purity and/or large quantities, for example to fractionate crude oil.
If the distillate obtained during distillation is distilled again, a new distillate is btained with an even higher concentration of volatile components. As the procedure is repeated, the concentration of volatile components in the distillate increases on each occasion.
In practice, this multi-stage distillation process is carried out in the form of countercurrent distillation (rectification) in a column.

Simplified illustration of a rectification column



1 - feed, 2 - bottom of column, 3 - bottom heating, 4 - bottom product, 5 - upward-moving vapour phase, 6 - top of column, 7 - condenser, 8 - top product, 9 - reflux, 10 - downward-moving liquid phase, 11 - tray (here: bubble cap tray)

The liquid mixture to be separated (feed) is fed to the column and partially evaporates on its way to the bottom of the column where it is heated to boiling.

The vapour produced moves upwards inside the column, exits it at the top and is condensed. Part of the condensate is carried away as top product.
The remainder flows back into the column and moves downwards as liquid phase. Due to column internals, such as bubble cap trays or random packings, the downwardmoving liquid phase is subjected to an intensive exchange of heat and material with the upward-moving vapour phase.

The less volatile components of the vapour phase condense and increase in concentration in the liquid phase. At the same time, the condensation heat released evaporates the more volatile components of the liquid phase. These processes in the column increase the vapour phase concentration of volatile components moving from the bottom to the top of the column.

The liquid phase concentration of less volatile components increases in the opposite direction, from the top of the column to the bottom.