

## Topic Page: [Separation \(Chemistry\)](#)

Definition: **separation** from *Hawley's Condensed Chemical Dictionary*

A collective term including a large number of unit operations that, in one way or another, isolate the various components of a mixture. Chief among these are evaporation, distillation, drying, gas absorption, sedimentation, solvent extraction, press extraction, adsorption, and filtration. Specialized methods include centrifugation, electromagnetic separation (mass spectrograph), gaseous diffusion, and various types of chromatography.

Summary Article: **separation**

From *The Hutchinson Unabridged Encyclopedia with Atlas and Weather Guide*

In chemistry, a process that separates mixtures into individual substances. It may be used to obtain a pure material or determine the chemical properties of a mixture. Techniques include filtration, evaporation, distillation, fractional distillation, chromatography, and separation by centrifuge. The method used will depend on the physical properties of the substances in the mixture.

**Solid–liquid mixtures** Mixtures of solids and liquids may be separated in a number of ways, depending on the solubility of the solid. If the solid cannot dissolve in the liquid, as in muddy water where the clay particles are suspended in the water, the mixture can be filtered. Filter paper contains tiny microstructure pores (holes) that allow a liquid to pass through while trapping the larger insoluble particles. In medical blood transfusion, an infusion set consists of a sterile filter which traps any larger particles which may be present in the blood. Natural rainwater is filtered through sand beds and pebbles, trapping larger unwanted matter.

A liquid suspension can also be separated by using a centrifuge. By spinning the centrifuge at fast speeds (from 5,000 to 20,000 rpm), large particles in a suspension settle to the bottom of the liquid first. This method is used to separate blood; the red blood cells sink to the bottom of the container and a clear plasma liquid remains at the top.

When the solid does dissolve, such as salt in water, the solid can be recovered by evaporating off the liquid. Evaporation of salt from seawater is done on a large scale to make 'sea salt' for use on food. The salty sea water is left to evaporate in large shallow lagoons, and the salt is skimmed off periodically.

To recover the pure liquid from a solution the mixture is distilled. The pure liquid boils off and the condensed vapour, or distillate, is recovered and collected. To obtain pure water from salt water the salty water is distilled. Fresh water can be made on a large scale by a process known as desalination. This process is used mainly in the hot desert countries of the Middle East, where there is a shortage of fresh water. In these countries, the heat of the Sun is used to boil the water, saving on energy costs.

**Liquid mixtures** Mixtures of liquids may also be separated by distillation, as each substance in the mixture has a different boiling point. The distillation of complex mixtures of liquids is called fractional distillation, or fractionation. The liquids are distilled in a fractionating column. The substance with the lowest boiling point boils first, and its vapour is condensed and collected. Once this has separated then the temperature will rise until the next liquid boils; the process continues until all the different parts (fractions) of the mixture are distilled. Fractional distillation is used to separate the components of

crude oil (unrefined petroleum) into its different fractions such as petrol, kerosene, fuel oils, and lubricating oils.

As each substance has a known boiling point, the contents of a mixture can be identified. For example, in a mixture of ethanol and water, the ethanol can be identified as it has a boiling point of 78°C while the water boils at 100°C.

Distillation is used to obtain alcohol from water in the whiskey-making industry. Whiskey is produced by distilling fermented malt, a type of beer. The beer is distilled forming a liquid which is 70% alcohol by volume. This is diluted with water to make a product that is drinkable, containing about 43% alcohol by volume.

**Solid mixtures** Forensic scientists and analytical chemists often use a technique called chromatography to analyse mixtures such as inks, paints, or medicinal preparations. A small quantity of a mixture is placed on a piece of chromatography paper; this is similar to filter paper only more absorbent. The chromatography paper is placed in a solvent with just the bottom edge of the paper in contact with the liquid. The paper soaks up the solvent like a sponge. As the solvent rises up the paper it carries with it the substances in the mixture. Each will dissolve differently in the solvent and move at a different speed up the paper. Gradually a series of spots will appear along the chromatography paper. If the spots are invisible, the paper or chromatogram can be sprayed with a locating agent, a chemical that reveals the spots. By measuring the distance each spot has moved and referring to data tables, each substance can be identified. Often the chromatogram is produced to include samples of pure substances to use as reference points. The unknown spots will match the position of the known pure substance.

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