

Separation of Mixtures

- Many of the materials around us are mixtures. These mixtures have two or more than two substances mixed in them. It may not be possible to use a mixture as such in homes and in industries. We may require only one (or two) separate constituents of a mixture for our use. So, we have to separate the various mixtures into their individual constituents to make them useful in our daily life.

Separation of mixture of two solids

All the mixtures containing two solid substance can be separated by one of the following methods:

- Separation by a suitable solvent :** In some cases, one constituent of a mixture is soluble in a particular liquid solvent whereas the other constituent is insoluble in it. This difference in the solubilities of the constituents of a mixture can be used to separate them.

Ex. Sugar is soluble in water whereas sand is insoluble in it, so a mixture of sugar and sand can be separated by using water as solvent.

- Separation by sublimation :** The changing of a solid directly into vapours on heating, and of vapours into solid on cooling is called sublimation. The solid substance which undergoes sublimation is said to 'sublime'. The process of sublimation is used to separated those substances from a mixture which sublime on heating. The solid substance obtained by cooling the vapour is known as sublimate.

Ex. Ammonium chloride, Iodine, Camphor,. can be separated from a mixture by sublimation.

- Separation by a magnet :** Iron is attracted by a magnet. This property of iron is used to separate it from a mixture. So, if a mixture contains iron as one of the constituents, it can be separated by using a magnet.

Ex. A mixture of iron filings and sulphur power can be separated by using a magnet. This is because iron filings are attracted by a magnet but sulphur is not attracted by a magnet.

Separation of mixture of a solid and a liquid

All the mixtures containing a solid and a liquid are separated by one of the following processes:

- Separation by filtration :** The process of removing insoluble solids from a liquid by using a filter paper is known as filtration. Filtration is used separating insoluble substances from a liquid. The liquid passes through the filter paper and collected in the beaker kept below the funnel. The solid particles do not pass through the filter paper and remain behind on the filter paper. The solid substance left behind on the filter paper is called residue. The clear liquid obtained is called filtrate.

Ex. A mixture of chalk and water is separated by filtration.

❑ **Separation by centrifugation** : We can separate the suspended particles of a substance in a liquid very rapidly by using the method of centrifugation. Centrifugation is done by using a machine called centrifuge. Centrifugation is a method for separating the suspended particles of a substance from a liquid in which the mixture is rotated at a high speed in a centrifuge.

❑ In the method of centrifugation, the mixture of fine suspended particles in a liquid is taken in a test-tube. The test-tube is placed in a centrifuge machine and rotated rapidly for some time. As the mixture rotates round rapidly, a force acts on the heavier suspended particles in it and brings them down to the bottom of the test-tube. The clear liquid, being lighter, remains on top

Ex. We can separate the clay particles suspended in water very rapidly by the method of centrifugation. The suspension of clay particles in water is taken in a test tube and rotated very fast in a centrifuge machine. the clay particles settle down at the bottom of the test-tube and clear water remains at the top.

❑ **Separation by Evaporation** : The changing of liquid into vapours is called evaporation. Evaporation is used to separate a solid substance that has dissolved in water (or any other liquid). The dissolved substance is left as a solid residue when all the water (or liquid) has evaporated. The use of process of evaporation for separating a mixture is based on the fact that liquids vapourise easily whereas solids do not vapourise easily. Though evaporation of a liquid can take place even at room temperature but it is very slow at room temperature. Evaporation can be made quicker by heating the solution.

❑ If we have a mixture of common salt and water, then we cannot separate common salt from water by filtration or centrifugation. This is because common salt is completely dissolved in water and not insoluble in it. We can recover common salt from salt-water mixture (or salt solution) by the process of evaporation.

Ex. The common salt dissolved in water can be separated by the process of evaporation. The solution of common salt and water is taken in a china dish and heated gently by using a burner. The water present in salt solution will form water vapours and escape into atmosphere. When all the water present in the solution of common salt and water gets evaporated, then common salt is left behind in the china dish as a white solid.

The process of evaporation is used on a large scale to obtain common salt from sea-water.

❑ **Purification by crystallisation** : The process of cooling a hot, concentrated solution of a substance to obtain crystals is called crystallisation. The process of crystallisation is used for obtaining a pure solid substance from impure sample.

(a) The impure solid substance is dissolved in the minimum amount of water to form a solution.

(b) The solution is filtered to remove insoluble impurities.

(c) The clear solution is heated gently on a water bath till a concentrated solution or saturated solution is obtained (This can be tested by dipping a glass rod in hot solution from time to time. When small crystals form on the glass rod, the solution is saturated). Then stop heating.

(d) Allow the hot, saturated solution to cool slowly.

(e) Crystals of pure solid are formed. Impurities remain dissolved in solution.

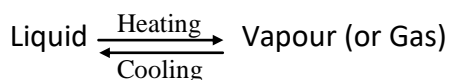
(f) Separate the crystals of pure solid by filtration and dry.

❑ **Separation by chromatography :**

Chromatography is a technique of separating two (or more) dissolved solids which are present in a solution in very small quantities. By using paper chromatography, we can separate two (or more) different substance present in the same solution. This separation is based on the fact that though two (or more) substances are soluble in the same solvent but their solubilities may be different. Some may be more soluble than the others.

Ex. Black ink is a mixture of several coloured substances which can be separated by paper chromatography.

❑ **Separation by distillation :** Distillation is the process of heating a liquid to form vapour, and then cooling the vapour to get back liquid. Distillation can be represented as :



The liquid obtained by condensing the vapour is called 'distillate'. When the homogeneous mixture of solid and a liquid is heated in a closed distillation flask, the liquid, being volatile, forms vapour. the vapours of liquid are passed through a 'condenser' where they get cooled and condense to form pure liquid. This pure liquid is collected in a separate vessel. The solid, being non-volatile, remains behind in the distillation flask.

Ex. Salt-solution can be separated into salt and water by distillation.

Separation of mixture of two or more liquid

All the mixtures containing two (or more) liquids can be separated by the following two methods:

(i) By the process of fractional distillation.

(ii) By using a separating funnel.

(A) Miscible liquids :

❑ Those liquids which mix together in all proportions and form a single layer are called miscible liquids.

Ex. Alcohol and water are miscible liquids because they mix together in all proportions and form a single layer on mixing. A mixture of miscible liquids is separated by the process of fractional distillation.

(B) Immiscible liquids :

Those liquids which do not mix with each other and form separate layers are called immiscible liquids.

Ex. Oil and water are immiscible liquids because they do not mix with each other., and form separate layers on mixing. Water being heavier forms the lower layer, and oil being lighter forms the upper layer. A mixture of immiscible liquids is separated by using an apparatus called separating funnel.

(i) Separation by fractional distillation :

Fractional distillation is the process of separating two (or more) miscible liquids by distillation, the distillate being collected in fractions boiling at different temperatures. A mixture of two miscible liquids can be separated by the process of fractional distillation. The separation of two liquids by fractional distillation depends on the difference in their boiling points. Fractional distillation is carried out by using a fractionating column.

Ex. Alcohol and water are miscible liquids. The boiling point of alcohol is 78°C and the boiling point of water is 100°C. Since the boiling points of alcohol and water different, therefore, a mixture of alcohol and water can be separated by fractional distillation. The mixture of alcohol and water is heated in a distillation flask fitted with a fractionating column. When the mixture is heated, both alcohol and water form vapours as their boiling points approach. The alcohol vapour and water vapour rise up in the fractionating column. The upper part of the fractionating column is cooler, so as the hot vapours rise up in the column, they get cooled, condense and trickle back into the distillation flask.

The more volatile liquid distils over first, and the less volatile liquid distils over later. A mixture of alcohol and water can be separated by fractional distillation.

(ii) Separation by a separating funnel :

A mixture of two immiscible liquids can be separated by using a separating funnel. A separating funnel is a special type of funnel which has a stop-cock in its stem to allow the flow of a liquid from it, or to stop the flow of liquid from it. The separation of two immiscible liquids by a separating funnel depends on the difference in their densities.

The mixture of two immiscible liquids is put in a separating funnel and allowed to stand for some time. The mixture separates into two layers according to the densities of the liquids in it. The heavier liquid or denser liquid forms the lower layer whereas the lighter liquid forms the upper layer. On opening the stop-cock of separating funnel, the lower layer of heavier liquid comes out first and collected in a beaker. When the lower layer of heavier liquid has completely run off, the stop-cock is closed. The lighter liquid in the upper layer is collected in a separate beaker by opening the stop-cock again.

Ex. Water and kerosene oil are two immiscible liquids. So, a mixture of water and kerosene can be separated by using a separating funnel.