CHAPTER 2
PURE SUBSTANCES AND MIXTURES

NOTES

PURE SUBSTANCE

Pure substance is a form of matter which cannot be separated into other kinds of matter by any physical process.

e.g. Gold

MIXTURE

A mixture contains two or more substances mixed in any proportion.

e.g. soft drink, soil

Types of mixture:

Mixtures can be divided into two types as

i) Homogeneous mixture

ii) Heterogeneous mixture

(i) **Homogeneous mixture** is a type of mixture which has uniform compositions throughout.

e.g. Mixture of salt and water(Salt solution), Mixture of sugar and water(Sugar solution).

(ii) **Heterogeneous mixture** is a mixture which has varying proportions of constituent particles and the constituents remain separated.

e.g. Mixture of sugar and sand, Petrol and water.

SOLUTION

A homogeneous mixture of two or more substances is called a solution.

e.g. Soda water, saline water.

Components of solution:

(i) Solvent and

(ii) Solute

Solvent: The component that dissolves the other component, which is present in larger amount.

Solute: The component that is dissolved in the solvent, which is present in smaller amount

e.g.

- **(i)** When sugar (solute) dissolves in water (solvent) a solid in liquid solution is formed.
- **(ii)** A solution of glycerin in water is an example of liquid in liquid solution.
- **(iii)** A solution of gas in gas – Air is a mixture of gases like nitrogen(78%), oxygen(21%) and other gases like carbon dioxide and water vapour etc. in small amount . so air is a solution of gases.
- **(iv)** Solid in solid solution – Alloys are homogeneous mixture of metals and so are solid solutions. For example, Brass contains 30% of zinc and 70% copper.

Properties of a solution:

- **i)** A solution is a homogeneous mixture.
- **ii)** The particles of a solution are extremely small, less than 1nm in diameter.
- **iii)** Particles in a solution cannot scatter light.

Solutions are very stable as the solute particles cannot be separated by filtration.

Solubility of a solution:

Solubility of a substrate is defined as the maximum number of grams of a substance that can be dissolved in 100g of a solvent at a certain temperature.

Depending upon the amount of solute present in a solution, it can be –

- **(i)** Saturated solution
- **(ii)** Unsaturated solution.

Saturated solution - It is a kind of solution in which no more solute can be dissolved in the solution at a given temperature.

Unsaturated solution - If the amount of solute present in a solution is less than the saturation level, it is unsaturated solution.

Concentration of a solution:

It is amount of solute presents in a given amount of a solution. It can also be defined as the amount of solute dissolved in a given volume of a solvent.

$$\textit{Concentration of solution} = \frac{\textit{Amount of solute}}{\textit{Amount of solution}}$$

$$= \frac{\textit{Amount of solute}}{\textit{Amount of solvent}}$$

Concentration of a solution may be expressed in terms of *mass/mass percent* as

$$\frac{\textit{Mass of solute}}{\textit{Mass of solution}} \; X\ 100\ \%$$

Or in terms of mass/volume percent as

$$\frac{\textit{Mass of solute}}{\textit{Volume of solvent}} \; X100\ \%$$

SUSPENSION

A suspension is a heterogeneous mixture in which particles of solid are spread throughout a liquid without dissolving in it.

Properties of a suspension:

- **i)** Suspension is a heterogeneous mixture.
- **ii)** The particle in a suspension is larger than 100nm in diameter and is visible.
- **iii)** The particle of a suspension scatters a beam of light passing through it and makes its path visible.
- **iv)** The particles of the suspension can settle down when kept undisturbed and can be separated by filtration.

COLLOIDS

A Colloidal dispersion or colloid is a heterogeneous system, consisting of two parts or phases, the first part dispersed phase and the other part dispersion medium (continuous matter).

When a beam of light is allowed to pass through the colloidal dispersion, the path of light beam is illuminated.

TYNDALL EFFECT

The scattering of light by colloidal particles is known as Tyndall effect.

There are eight types of colloidal system as given below:

Dispersed phase	Dispersion medium	Type	Examples
Solid	**Liquid**	**Sol**	**Mud, Starch solution**
Solid	**Gas**	**Solid aerosol**	**Smoke, Dust**
Solid	**Solid**	**Solid sol**	**Milky glass, Coloured gemstone**
Gas	**Liquid**	**Foam**	**Soap seeds, Whipped cream**
Gas	**Solid**	**Solid foam**	**Pumice, Sponge**
Liquid	**Gas**	**Liquid aerosol**	**Fog, Clouds**
Liquid	**Liquid**	**Emulsion**	**Milk, Face cream**
Liquid	**Solid**	**Gel**	**Jelly, Cheese**

CENTRIFUGATION

Centrifugation is the technique of separating particles from a solution using centrifugal force according to size, density, shape of the medium. The principle of the technique is that when the mixture is rotated rapidly the heavier particles are forced to the bottom and the lighter particles stay at the top. It is done by a machine called Centrifuge which can rotate at high speed.

Application of Centrifugation:

(i) It is used in diagnostic laboratories for blood and urine test.

(ii) Used in dairies and home to separate butter from milk.

(iii) Used in drying clothes in washing machines.

Separation by sublimation:

Sublimation can also be used to separate volatile substance from its mixture containing non-volatile components.

Sublimation can be used to separate ammonium chloride, naphthalene, camphor and Anthracene from their mixtures containing salt, sand and earthly materials as shown in figure below:

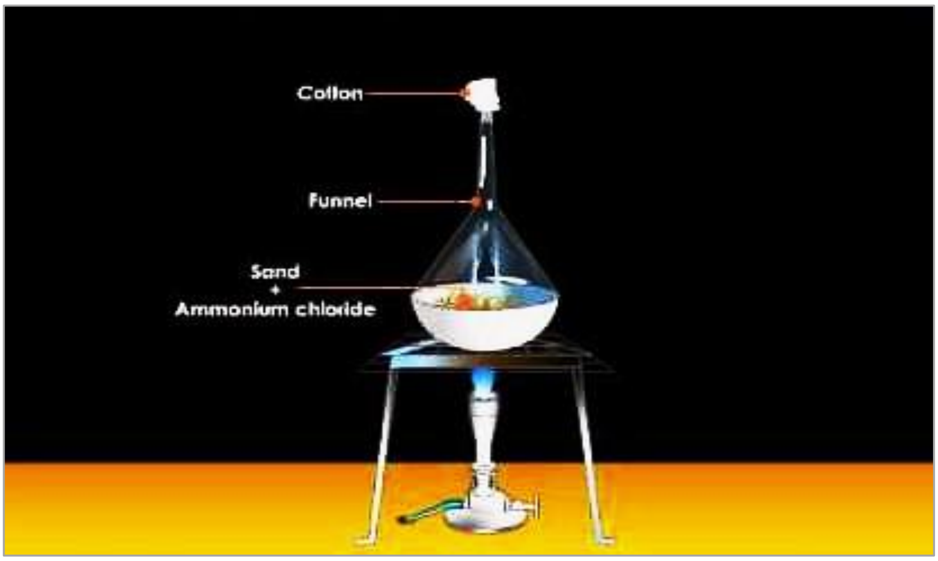


Fig. Separation of salt and ammonia

Separation by Chromatography:

Chromatography is a technique used for identification and separation of solutes present in a solution in small quantities.

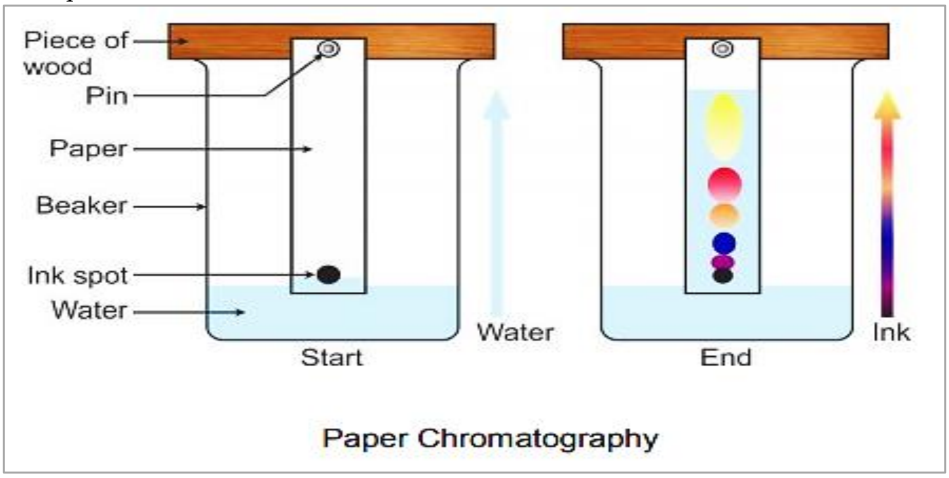


Fig. Separation of dyes in ink by paper chromatography

Application of chromatography:

(i) It is used in the separation of colour substances (dyes and pigments) in solution.

(ii) Used in forensic science to detect and identify trace amount of drugs in the urinary bladder or stomach and blood.

(iii) To separate small amounts of products of chemical reactions.

CRYSTALLIZATION

Crystallization is a technique of separating a pure solid in the form of crystal from a solution. Process of separating potash alum from an impure sample:

- **(i)** The impure solid is dissolved in minimum quantity of water.
- **(ii)** The impurities are filtered out.
- **(iii)** The clear solution is heated gently to get a saturated solution in a china disc.
- **(iv)** The hot saturated solution is cooled down.
- **(v)** The crystals of pure solid can be separated by filtration and dried.

SEPARATION AND PURIFICATION OF LIQUID

Immiscible liquids: Liquids which do not mix each other and form separate layers when put in a container are called immiscible liquids.

e.g. mustard oil and water, kerosene and water etc.

Separation by using a separating funnel: A separating funnel can be used to separate immiscible liquids as shown in figure below:

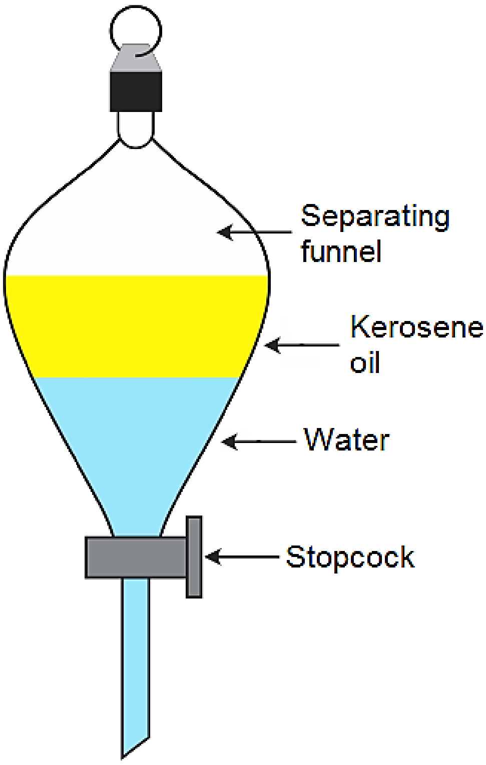


Fig. Separating funnel

SIMPLE DISTILLATION

This technique can be used to purify liquids which boil under ordinary pressure without decomposition. Alcohol and water are miscible and the mixture of these two can be separated by distillation as alcohol boils at 78.5^{o}C and water boils at 100^{o}C.

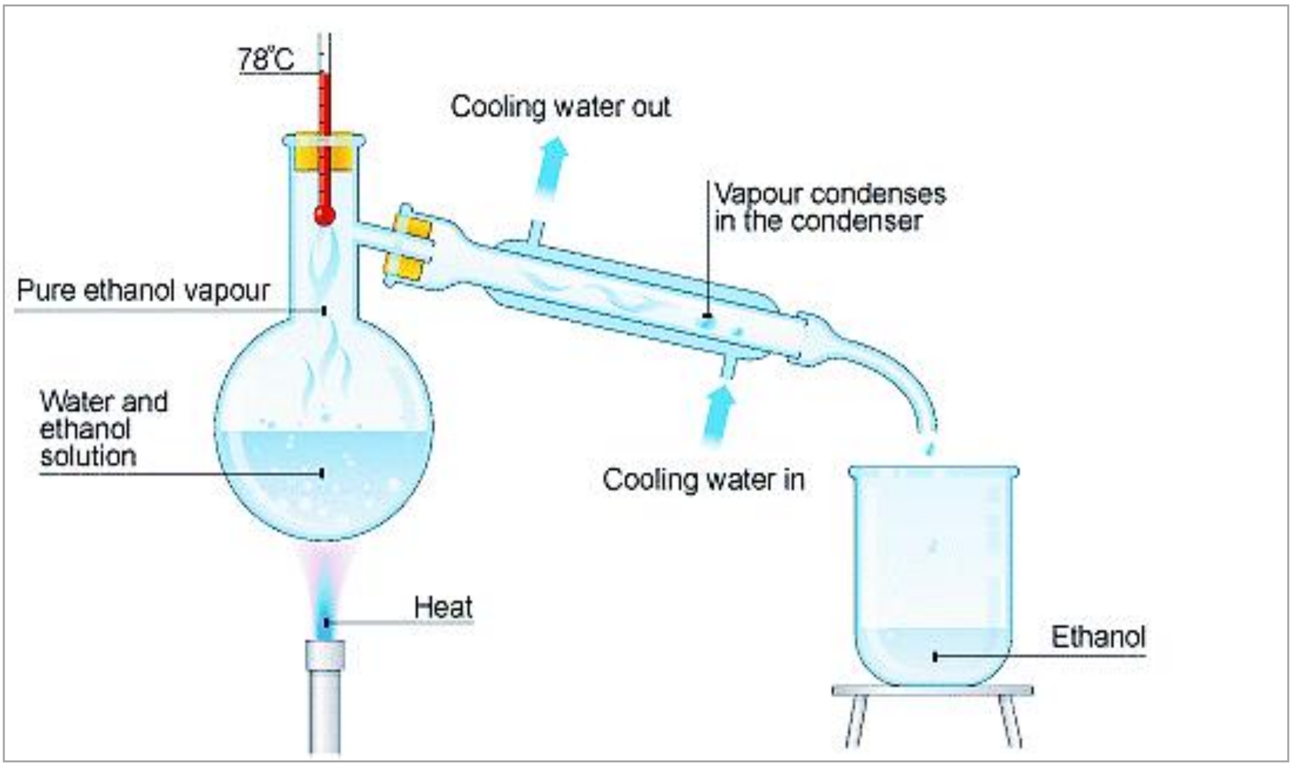


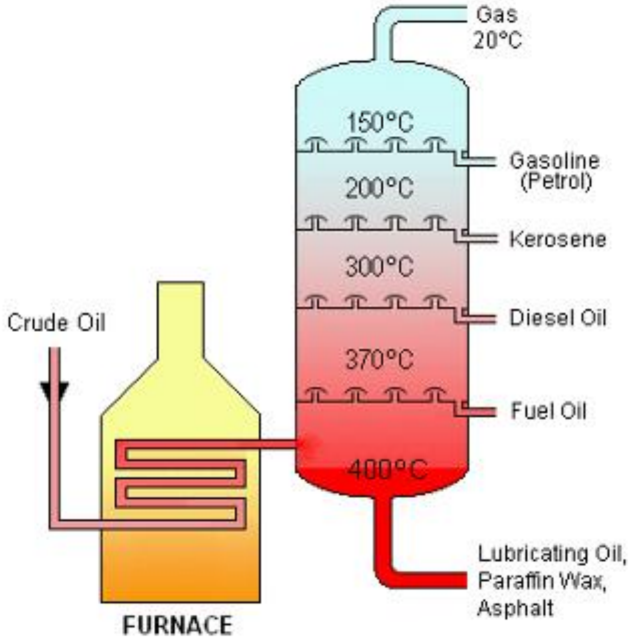
Fig. Simple Distillation

FRACTIONAL DISTILLATION

Fractional distillation is a method employed to separate a mixture of two or more miscible liquids which have a boiling point difference of less than 30^{o}C.

It is used in the separation of different fractions from petroleum. It is also used for separation of different gases from air.

In fractional distillation, a fractionating column is fitted over the distilling flask. This fractionating column provides a temperature gradient i.e. higher temperature at the bottom and lower temperature at the top. Fractional distillation of crude petroleum results to products such as - Petroleum gas, petrol, kerosene, diesel, lubricating oil, asphalt etc.



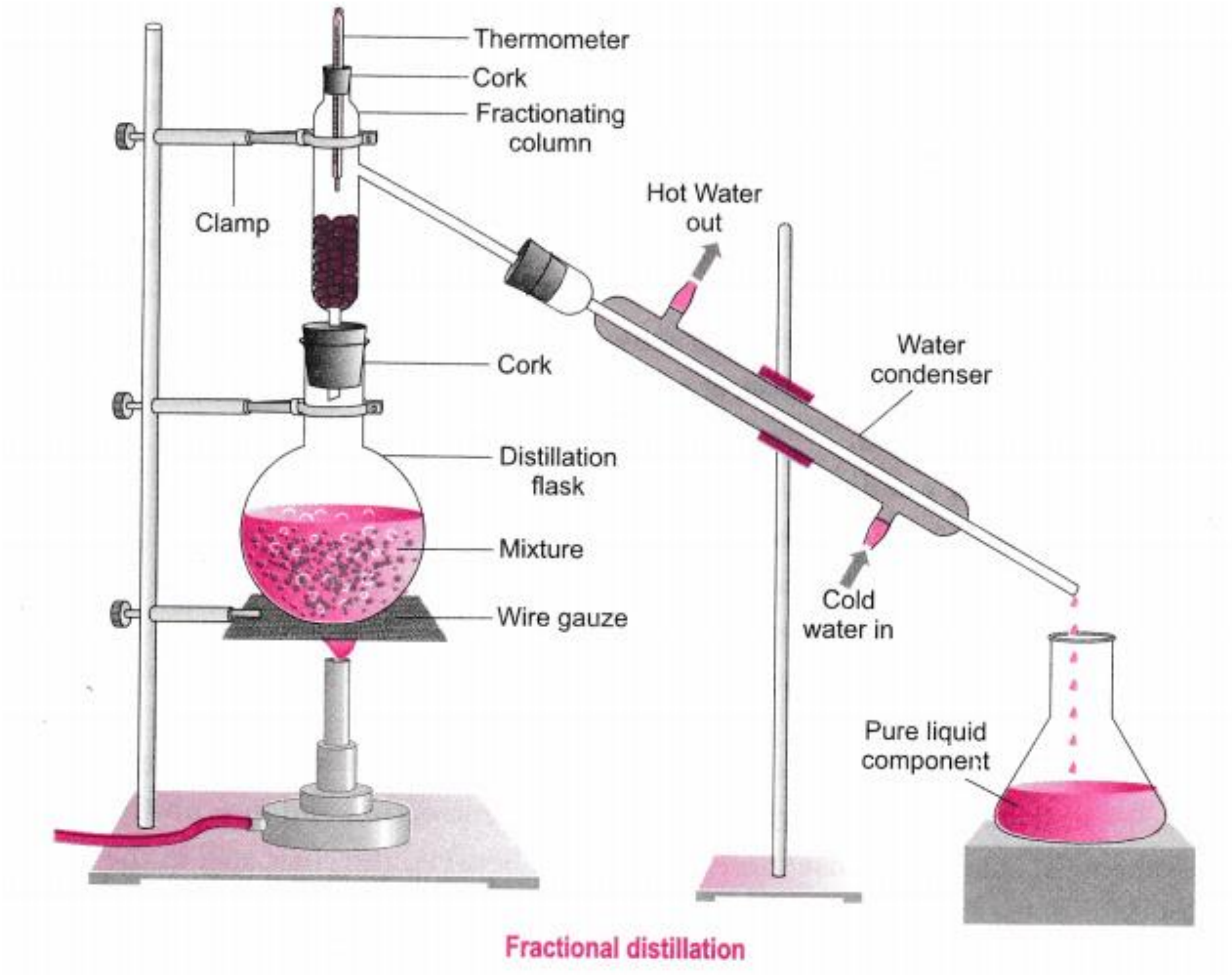


Fig. Fractional Distillation

Physical and Chemical changes:

Physical changes are the changes in the physical properties such as texture, shape, size and the state of substances.The changes are usually reversible.

e.g. Dissolving sugar in water, freezing of water etc.

Chemical changes are the changes that result in the formation of new substances due to changes in the internal composition of the original substances. These changes are irreversible in nature.

e.g. Burning of incense stick, rusting of iron etc.

Types of pure substances

ELEMENTS	COMPOUNDS
➤ A pure substance which cannot be further splitted up into any substance. ➤ Eg. Sodium (Na), Potassium (K) etc.	➤ A compound is a pure substance form by combination of two or more elements in a fixed proportion. ➤ Eg. Water(H_2O), Carbon dioxide(CO_2) etc.

Classification of Elements:

i) Metals **ii)** Non-metals **iii)** metalloids

Some of the properties of metals are:

(a) They show shining appearance called metallic lustre.

(b) They are good conductors of heat and electricity.

(c) They are malleable that is they can be beaten into sheets.

(d) They are ductile i.e. they can be drawn into wires. **Examples:** Iron (Fe), Copper (Cu), Silver (Ag), etc.

(e) They have high melting and boiling points.

(f) They are sonorous.

Some properties of non-metals are:

(a) They are not lustrous, sonorous and malleable.

(b) They are non-ductile

(c) They are poor conductors of heat and electricity.

(d) They have low melting and boiling points. **Examples:** Hydrogen (H), Oxygen (O), Nitrogen(N) etc.

(e) Metalloids: Elements that have intermediate properties between those of metals and non-metals.eg., Arsenic (As), Antimony (Sb), Silicon (Si), etc.

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