

Chemistry Study Materials for Class 11

(NCERT Based Notes of Chapter- 12)

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SOME BASIC PRINCIPLES AND TECHNIQUES

5. Chromatography

This method is used to separate mixtures into their components, to purify compounds and to test the purity of compounds. Here the mixture to be separated is passed through a stationary phase, which may be a solid or a liquid. A pure solvent (sometimes a mixture of solvents or a gas) is allowed to move slowly over the stationary phase. The moving phase is called the mobile phase. The components of the mixture get gradually separated from one another.

Based on the principle involved, there are mainly two types of chromatography:

(a) Adsorption chromatography, and

(b) Partition chromatography

a) Adsorption Chromatography: Adsorption chromatography is based on the fact that different compounds are adsorbed on an adsorbent in different degrees. Commonly used adsorbents are silica gel and alumina.

Here a mobile phase is allowed to move over a stationary phase (adsorbent). Based on the adsorbing power, the components of the mixture are adsorbed at different places over the stationary phase. Following are two main types of chromatographic techniques based on the principle of differential adsorption.

(i) Column chromatography, and

(ii) Thin layer chromatography.

(i) Column Chromatography:

It involves the separation of a mixture over a column of adsorbent (stationary phase) packed in a glass tube. The column is fitted with a stopcock at its lower end. The mixture to be separated is passed through the column. Based on the adsorbing power, the components are adsorbed at different places over the column.

The most readily adsorbed substances are retained near the top and others come down to various distances in the column. Then an appropriate eluant (solvent) is allowed to flow down the column slowly. Different solvents are used to separate different components. So the components can be collected separately and they can be separated.

(ii) Thin Layer Chromatography (TLC):

It is another type of adsorption chromatography. It involves separation of substances of a mixture over a thin layer of an adsorbent coated on a glass plate. A thin layer (about 0.2mm thick) of an adsorbent (silica gel or alumina) is spread over a glass plate of suitable size. The plate is known as *thin layer chromatography plate* or *chromaplate*. The solution of the mixture to be separated is applied as a small spot about 2 cm above one end of the TLC plate. The glass plate is then placed in a closed jar containing the eluant. As the eluant rises up the plate, the components of the mixture move up along with the eluant to different distances depending on their degree of adsorption and separation takes place. The relative adsorption of each component of the mixture is expressed in terms of its **retardation factor (R_f value)**.

$$R_f = \frac{\text{Distance moved by the substance from base line (x)}}{\text{Distance moved by the solvent from base line (y)}}$$

The spots of coloured compounds are visible on TLC plate due to their original colour. The spots of colourless compounds can be detected by putting the plate under ultraviolet light. Another detection technique is to place the plate in a covered jar containing a few crystals of iodine. Spots of compounds, which adsorb iodine, will show up as brown spots. Sometimes an appropriate reagent may also be sprayed on the plate.

b) Partition Chromatography:

It is based on continuous differential partitioning of components of a mixture between stationary and mobile phases. Paper chromatography is a type of partition chromatography. In paper chromatography, a special quality paper known as chromatography paper is used. Chromatography paper contains water trapped in it, which acts as the stationary phase.

A strip of chromatography paper, spotted at the base with the solution of the mixture, is suspended in a suitable solvent or a mixture of solvents. This solvent acts as the mobile phase. The solvent rises up the paper by capillary action and flows over the spot. The paper selectively retains different components according to their differing partition in the two phases. The paper strip is known as a chromatogram. The spots of the separated coloured compounds are visible at different heights from the position of initial spot on the chromatogram. These spots can be visible by u.v. light or by spraying suitable reagents.

QUALITATIVE ANALYSIS OF ORGANIC COMPOUNDS

An organic compound mainly contains carbon and hydrogen. Some compounds may also contain oxygen, nitrogen, sulphur, halogens and phosphorus.

Detection of Carbon and Hydrogen

Organic compound is heated with copper (II) oxide [CuO]. Carbon present in the compound is oxidised to carbon dioxide and hydrogen to water. CO₂ can be tested by passing through lime-water, which turns milky and water can be tested with anhydrous copper sulphate, which turns blue.


