جامعة المستقبل
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كلية العلـــوم
قـسـم الادلة الجنائية

المحاضرة التاسعة

Analytical Chemistry

المادة : كيمياء تحليلية
المرحلة :الثانية
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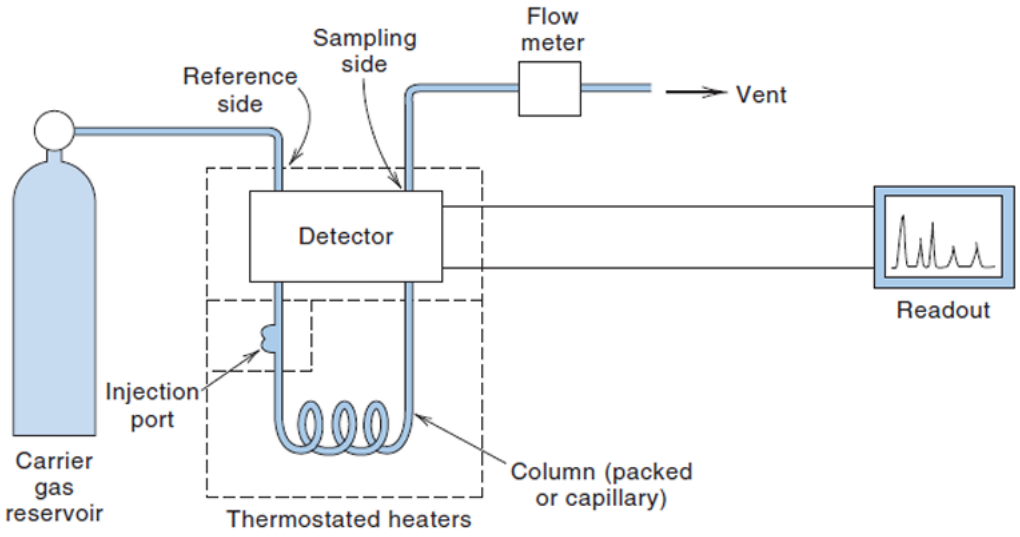
Gas Chromatography

- **Gas chromatography** (GC) is a common type of chromatography used in analytical chemistry for separating and analyzing compounds that can be vaporized without decomposition.
- **Gas chromatography** is a term used to describe the group of analytical separation techniques used to analyze volatile substances in the gas phase.
- In gas chromatography, the components of a sample are dissolved in a solvent and vaporized in order to separate the analytes by distributing the sample between two phases: a stationary phase and a mobile phase.
- **The mobile phase** is a chemically inert gas or an unreactive gas such as helium, argon, nitrogen or hydrogen. that serves to carry the molecules of the analyte through the heated column.
- **The stationary phase** is either a solid adsorbant, termed gas-solid chromatography (GSC), or a liquid on an inert support, termed gas-liquid chromatography (GLC)
- **The stationary phase** is a microscopic layer of viscous liquid on a surface of solid particles on an inert solid support inside a piece of glass or metal tubing called a column.
- the mobile gas phase, commonly called the carrier gas.
- The mobile phase carries the sample through a packed or capillary column that separates the sample components based on their ability to partition between the mobile phase and the stationary phase.



The figure above illustrates an example of a typical gas chromatograph, which consists of several components as follows:

1. Carrier gas system
2. Sample injection port
3. Column configurations
4. Column ovens
5. Detection systems
6. Microprocessors or recorder (data processor)

Why use Gas Chromatograph (GC)?

1- Short Analysis Time

2- Wide Choice of Stationary Phase

3- Wide Choice of Detectors

4- Ease of Operation

What are the types of gas chromatography?

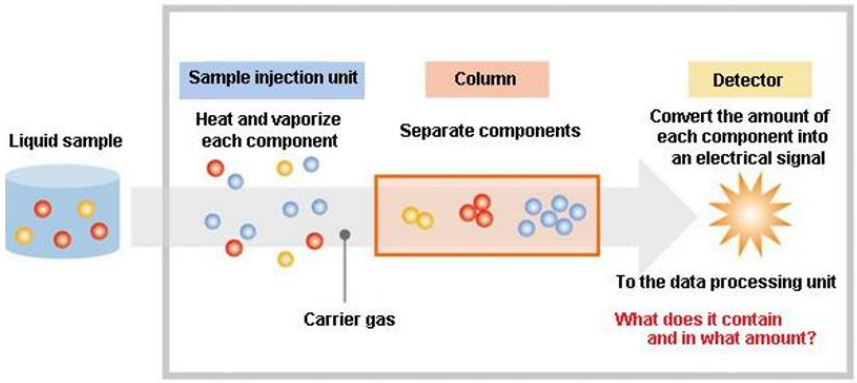
Two types of gas chromatography are encountered.

1. Gas-solid chromatography (GSC):It based upon a stationary phase on witch retention of analysis consequence of physical adsorption

2. Gas-liquid chromatography (GLC):Is useful for separating ions or molecules that are dissolved at absolvent.

Separation of compounds:

- ✓ When analytes are introduced into the column, the molecules distribute between the stationary and mobile phases .
- ✓ Those in the stationary phase are temporarily immobile and do not move down the the phase .
- ✓ All molecules of the same compound travel through the column at nearly the same rate and appear as a band of molecules (called sample band)
- ✓ Sample band of compound which is less ‘soluble’ in the stationary phase moves faster, because more of the molecules spend time in the mobile phase (carrier gas).



Principle:

1- The analyte is loaded over the silica bed (packed in the column) and allowed to adhere to the silica. Here, silica acts as the stationary phase.

2- Solvent (mobile phase) is then made to flow through the silica bed(under gravity or pressure).

3- The different components of the analyte exhibit varying degrees of adhesion to the silica and as a result they travel at different speeds through the stationary phase as the solvent flows through it, indicated by the separation of the different bands.

4- The components that adhere more strongly to the stationary phase travel more slowly compared to those with a weaker adhesion.

5- Analytical chromatography can be used to purify compounds ranging from milligram to gram scale.

principle of separation of different components:

1- Higher the adsorption to the stationary phase, the slower the molecule will move through the column.

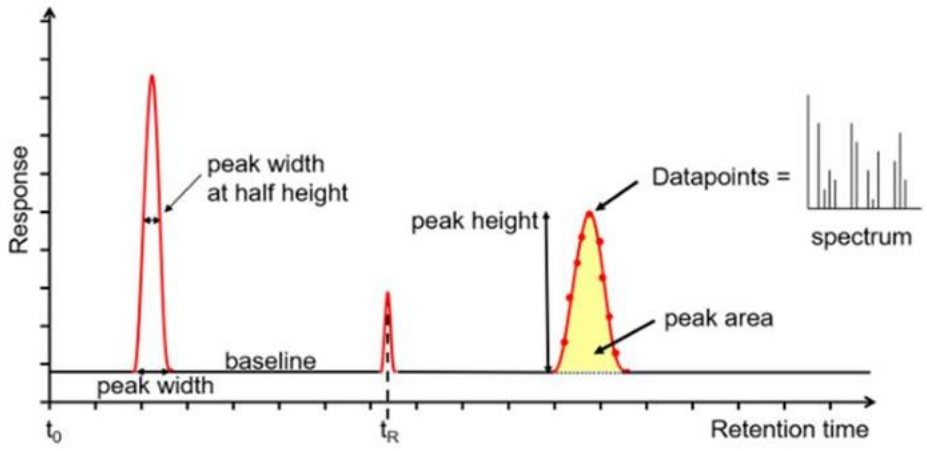
2- Higher the solubility in the mobile phase, the faster the molecule will move through the column.

3- So, the interplay between the above two factors determines the differential rates at which the different components of the analyte will move through the column.

4- Adsorption and solubility of a molecule can be manipulated by choosing the appropriate stationary phase and mobile phase.

How do you read a chromatogram and what does it tell you?

1. The x-axis is the retention time, taken from the time the sample was injected into the GC (t_0) to the end of the GC run .
2. Each analyte peak has a retention time measured from the apex of the peak, for example t_R .
3. The y-axis is the measured response of the analyte peak in the detector. The baseline shows the signal from the detector when no analyte is eluting from the column, or it is below the detection limit .
4. The baseline response is a mix of electrical noise (usually low) and chemical noise, such as impurities in the carrier gas, column stationary phase bleed and system contamination .
5. Hence, if the baseline is higher than it should be, it is an indication of a problem or that maintenance is required .
6. Various measurements can be taken from the peak, such as width at the baseline, width at half height, total height and area.



Narrower, sharper peaks give better sensitivity (signal to noise ratio) and better resolution (peak separation).

Migration rate of compounds in column depend on:

1. Compound chemical structure.
2. Stationary phase chemical structure .
3. Column temperature.

GC Applications:

1) Food Analysis: Analysis of foods is concerned with confirming the presence and determination the quantities of the analytes (lipids, proteins, carbohydrates, preservatives, flavours, colorants, and vitamins, steroids, and pesticide residues).
2) Drug Analysis: GC is widely applied to identification of the active components, possible impurities as well as the metabolites.
3) Environmental Analysis: The environmental contaminants; e.g. (DDT) is present in the environment at very low concentrations and are found amongmany of other compounds. GC, with its high sensitivity and high separating power, is mostly used in the analysis of environmental samples.
4) Forensic Analysis: In forensic cases, very little sample is available, and the concentration of the sample components may be very low. GC is a useful due to its high sensitivity and separation efficiency.