GC

- GC is divided into two types

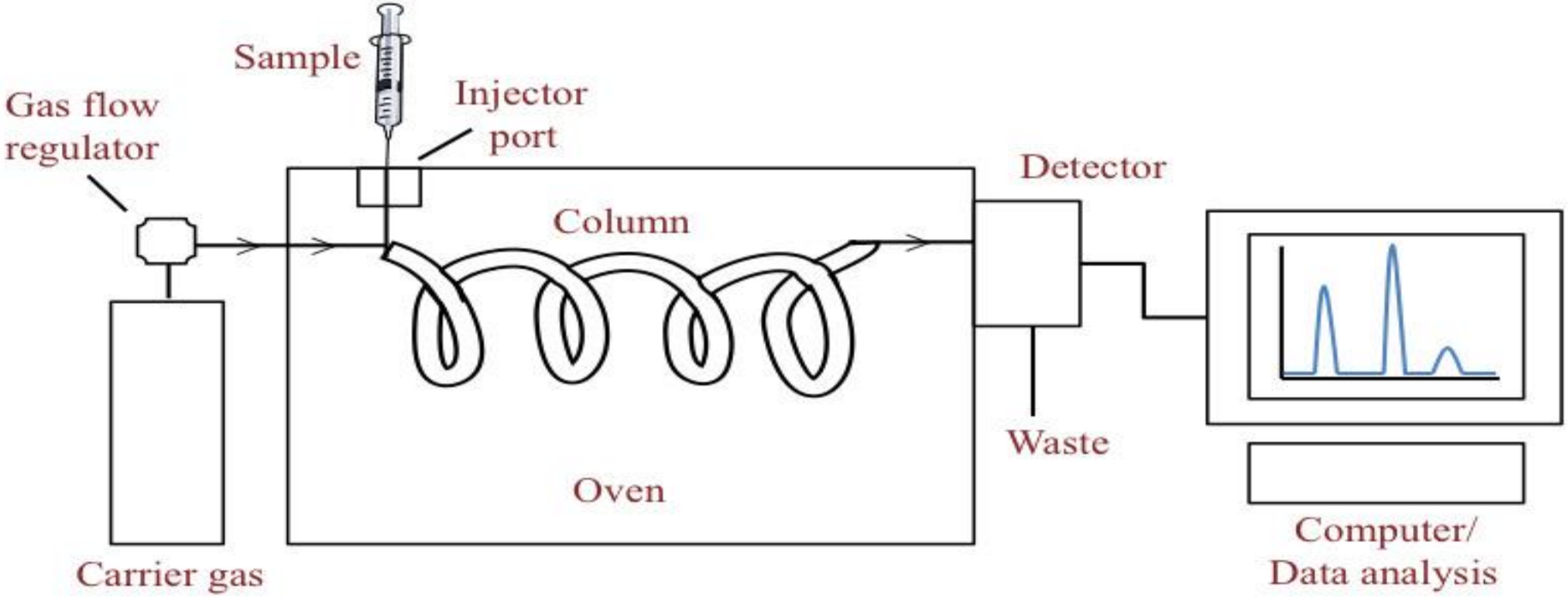
1- Gas – solid chromatography when the stationary phase is solid

2- Gas – liquid chromatography when the stationary phase is liquid

- Principle of GC

- the sample mixture is introduced as a liquid volatile at a head of a column filled with the stationary phase

Gas Chromatography



Stationary liquid phases:

Desirable properties for immobilized, liquid phase in GLC include:

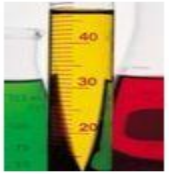
1- Low volatility; ideally the boiling point of the liquid should be at least 200^{0}C higher than the maximum operating temperature for the column.

2- Thermally stable

3-Chemically inert

4-To have a reasonable retention time in the column, a species must show some degree of solubility with the stationary phase.

- Generally, the polarity of the stationary should match that of the sample components. When the match is good, the order of elution is determined by the boiling point of the eluate.



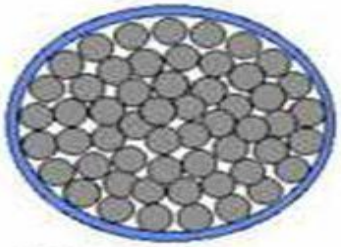
Gas Chromatography

COLUMNS

- GC column nomenclature can be confusing.
- Carbowax, DB-1, DB-5, PDMS …..
- Columns are often referred to by their polarity, like most things with chromatography. The most non-polar stationary phase is polydimethyl siloxane (PDMS).
- Polarity of a column is increased by adding phenyl groups to PDMS (1% = DB-1; 5% = DB-5).
- For more polar analytes, polyethylene glycol (carbowax) is used as the stationary phase

Types of columns

Packed



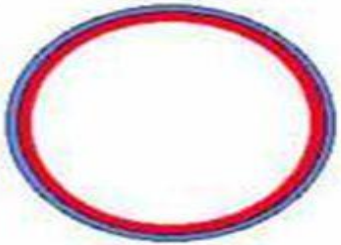
bead column

porous layer

conventional

open (capillary)

Porous
Layer
Open
Tube



Wall
Coated
Open
Tube

Capillary Column
Liquid stationary Phase
Porous solid Support
Porous Solid Support Coated with Stationary Phase

Packed columns	Capillary columns
Stationary phase is coated directly in the column	Stationary phase is coated with the inner wall of the column
Applicable for both GSC and GLC	Applicable only for GLC
Liquid phase is adsorbed onto the surface of the beads in a thin layer or onto the solid inert packing	Liquid stationary phase is immobilized on the capillary tubing walls

Carrier gas:-

- The cylinder/ gas tank is fitted with a pressure controller to control the pressure of gas, a pressure gauge that indicates the pressure, a molecular sieve to transfer filtered dry gas and a flow regulator to ensure a constant rate of flow of mobile phase to the column.
- It should meet the following criteria:

✓ Should be chemically inert

✓ Should be cheap and readily available

✓ Should be of high quality and not cause any fire accidents

✓ Should give best possible results

✓ Should be suitable for the sample to be analyzed and for the detector

Detectors used in GC:

Detection devices for a GC must respond rapidly and reproducibility to the low concentrations of the solutes emitted from the column.

Concentration dependent detectors:

- Thermal conductivity detector(TCD)
- Electron capture detector(ECD)
- Argon ionization detector
- Helium ionization detector

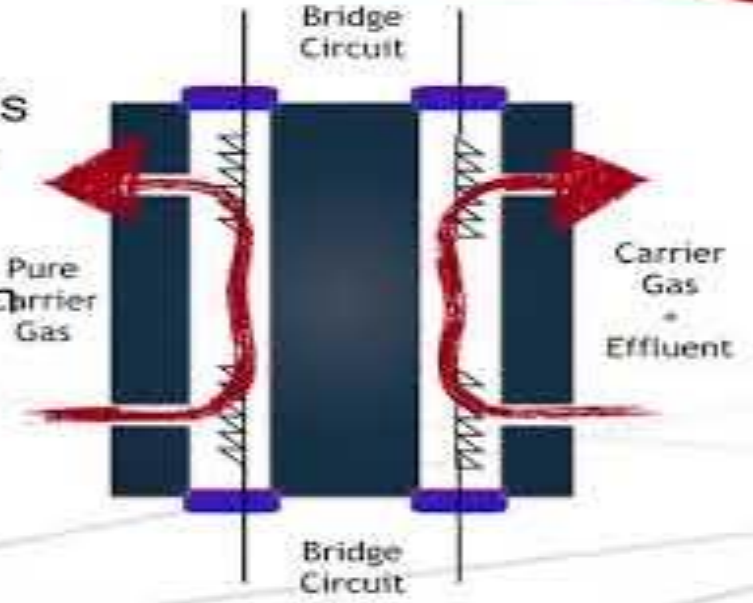
Mass flow dependent detectors:

- Flame ionization detector(FID)
- Nitrogen phosphorous detector(NPD)
- Flame photometric detector(FPD)

Write a Note on Thermal Conductivity Detector.

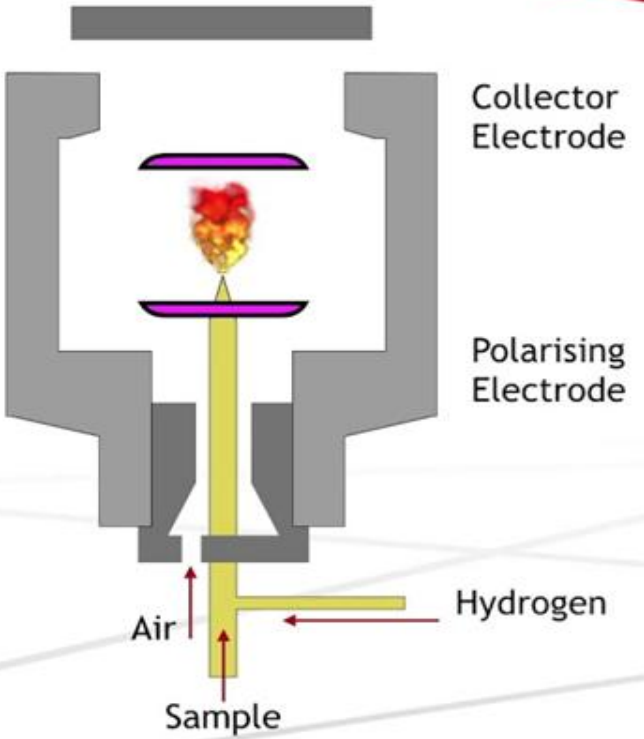
Carrier gas is passed over one pair (reference) while a mixture of carrier gas and column effluent is passed over the other pair (sample) of thermistors.

When pure carrier gas passes over both the pairs of thermistors, the bridge is balance



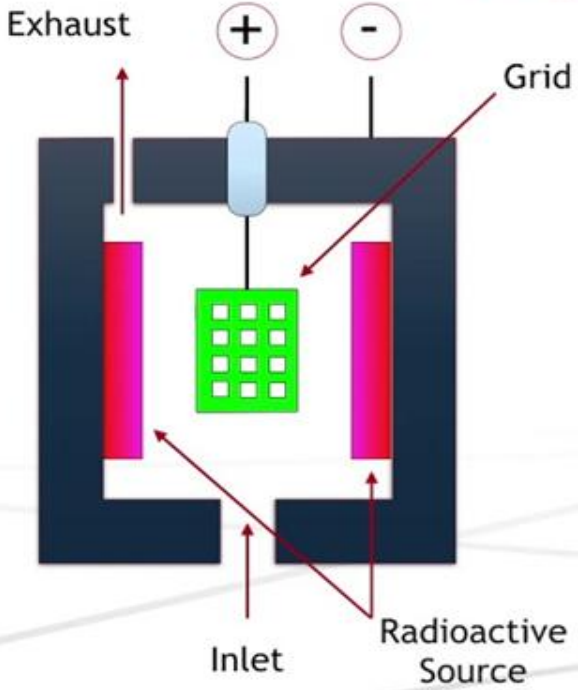
Write a Note on Flame Ionization Detector.

The detector has inlets for hydrogen which is the carrier gas, air or oxygen to burn the hydrogen and the effluent gas from the chromatograph. Hydrogen emerges through a hollow needle and is burnt as it emerges giving a colorless flame. The effluent gas is mixed with hydrogen



Write a Note on Electron Capture Detector.

The ECD is a modification of the ionization chamber used for detection of radiations. The effluent from the chromatographic column is exposed to slow electrons generated by the ionization of the carrier gas (which is either argon or nitrogen) by a constant flux of beta rays from a radioisotope.



APPLICATION OF GC

- Gas chromatography (GC) continues to play an important role in the identification and quantification of ubiquitous pollutants in the environment.
- GC in the analysis of various classes of persistent organic contaminants in air, water, soils, sediments. Special attention is given to sample-preparation techniques.
- The organic pollutant groups are: volatile organic compounds (VOCs) , polycyclic aromatic hydrocarbons (PAHs) , pesticides and halogenated compounds.
- Trends and future perspectives of capillary GC in the field of environmental analysis.