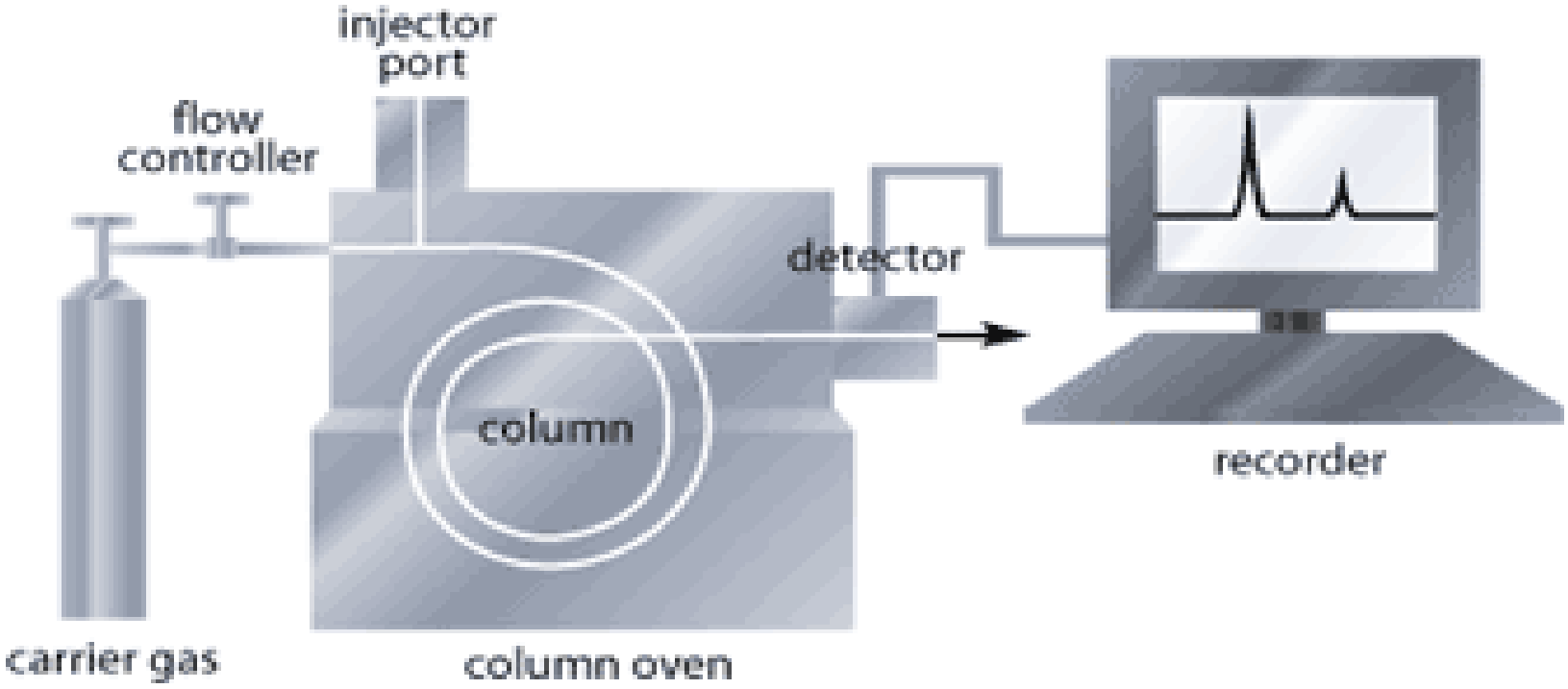
Gas Chromatography



What is Gas Chromatography?

- It is also known as…

Gas-Liquid Chromatography (GLC)

GAS CHROMATOGRAPHY

- Separation of gaseous & volatile substances
- Simple & efficient in regard to separation

GC consists of:

GSC (gas solid chromatography)

GLC (gas liquid chromatography

GSC principle is **ADSORPTION**

GLC principle is PARTITION

Sample to be separated is converted into vapour

And mixed with gaseous M.P

Component more soluble in the S.P → travels slower

Component less soluble in the S.P → travels faster

Components are separated according to their **Partition Co-efficient**

Criteria for compounds to be analyzed by G.C

1.VOLATILITY:

2.THERMOSTABILITY:

How a Gas Chromatography Machine ʕWorksʔ

– **First**, a vaporized sample is injected onto the *chromatographic column*.

– **Second**, the sample moves through the column through the flow of inert gas.

– **Third**, the components are recorded as a sequence of peaks as they leave the column.

Chromatographic Separation

– Deals with both the *stationary*
the *mobile phase*. *phase* and

- **Mobile** – inert gas used as carrier.
- **Stationary** – liquid coated on a solid

within a column. or a solid

Chromatographic Separation

Chromatographic Separation
– **In the mobile phase**, components of the sample are uniquely drawn to the stationary phase and thus, enter this phase at different times
–
The parts of the sample are separated within the column.
Compounds used at the stationary phase reach the detector at unique times and produce a series of peaks along a time sequence.

The peaks can then be read and analyzed by a forensic scientist to determine the exact components of the mixture.

– Retention time is determined by each component reaching the detector at a characteristic time.

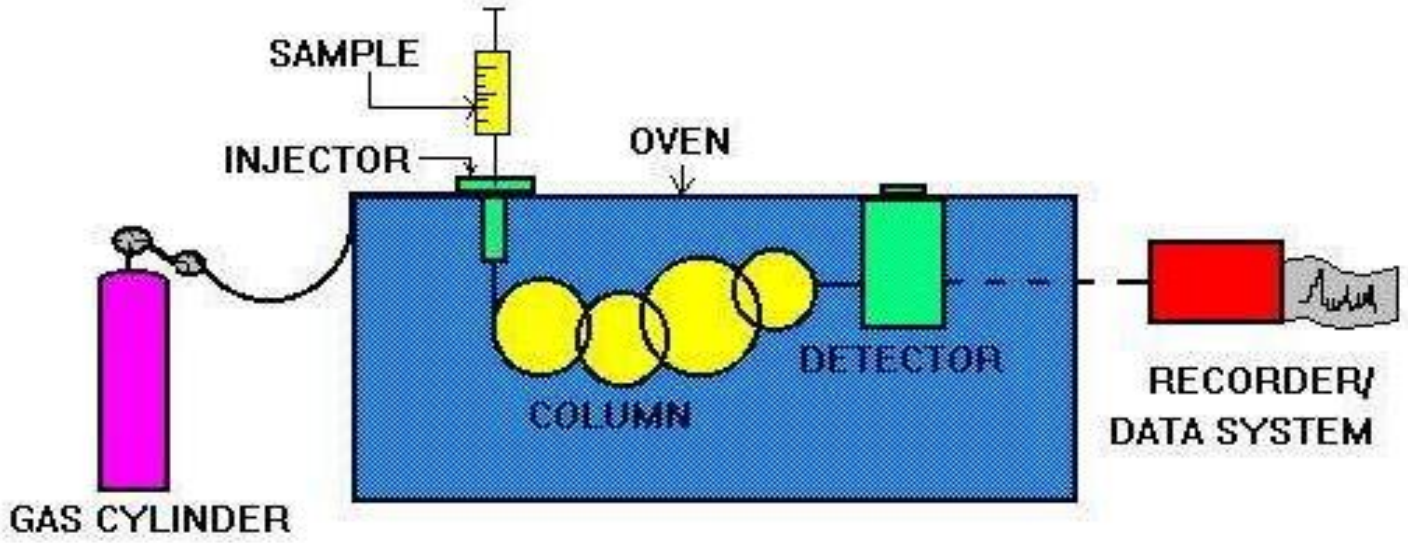
Chromatographic Analysis

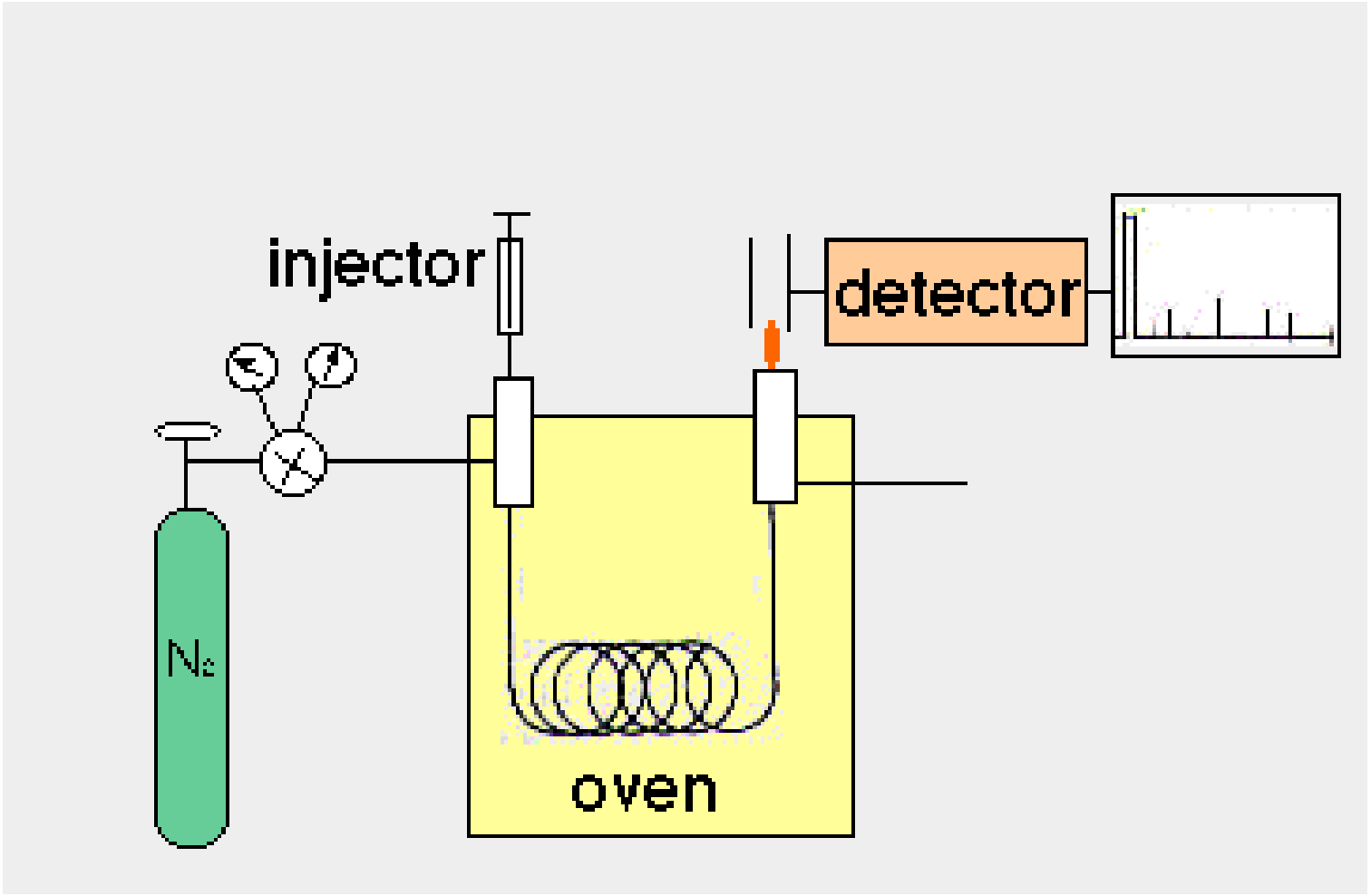
The number of components in a sample is determined by the number of peaks.

– The amount of a given component in a sample is determined by the area under the peaks.

– The identity of components can be determined by the given retention times.

GAS CHROMATOGRAPHY




injector
detector
N_2
oven

PRACTICAL REQUIREMENTS

Carrier gas

- Flow regulators & Flow meters
- **Injection devices**
- **Columns**
- **Temperature control devices**
- **Detectors**
- **Recorders & Integrators**

Requirements of a carrier gas

- Inertness
- Suitable for the detector
- High purity
- Easily available
- Cheap
- Should not cause the risk of fire
- Should give best column performance

How to select a Carrier gas

Depending on

- Availability
- Purity
- Coast
- Type of Detector
- consumption

priority

- first
- Second
- Third
- Fourth
- Fifth

Required Gases Purities

Helium For carrier gas: 99.995% high purity, with less than 1.0 ppm each of

- water, oxygen, and total hydrocarbons after purification.
- Use water, oxygen, and hydrocarbon traps.

Hydrogen For carrier or detector fuel gas: 99.995% high purity, with <

- 1.0 ppm of total hydrocarbons after purification.
- Use water, oxygen and hydrocarbon traps.

Required Gases Purities

Air For detector fuel gas: 99.995% high purity.

- Air compressors are not acceptable because they do not
- meet pressure, water, and hydrocarbon requirements.

Nitrogen For carrier or make-up gas: 99.995% high purity, with less than 1.0

- ppm of total hydrocarbons after purification.

Argon 5% Methane For ECD make-up gas: 99.995% high purity.

Carrier Gas Control

The Flow mode has four options for the carrier gas control:

- Constant flow
- Constant pressure
- Programmed flow
- Programmed pressure

Flow regulators & Flow meters

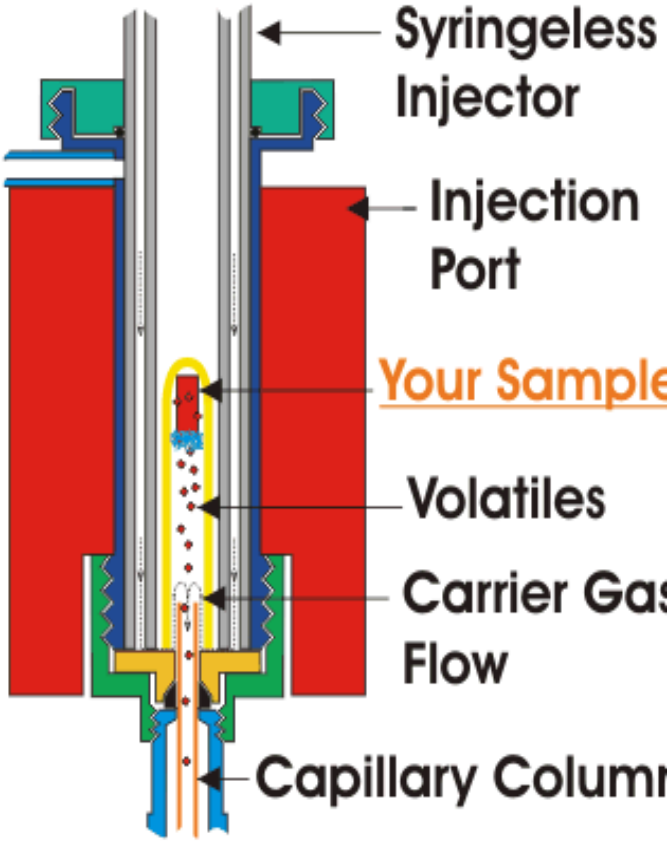
X deliver the gas with uniform pressure/flow rate

X **flow meters:-** Rota meter & Soap bubble **flow meter**

Injection Devices

Gases can be introduced into the column by valve devices

- liquids can be injected through loop or septum devices



COLUMNS

- Important part of GC
- Made up of glass or stainless steel
- Glass column- inert , highly fragile

COLUMNS can be classified

 Depending on its use

1. Analytical column

1-1.5 meters length & 3-6 mm d.m

2. Preparative column

3-6 meters length, 6-9mm d.m

Depending on its nature

1.Packed column: columns are available in a packed manner

S.P for GLC: polyethylene glycol, esters, amides, hydrocarbons, polysiloxanes…

2.Open tubular or Capillary column or Golay column

- Long capillary tubing 30-90 M in length
- Uniform & narrow d.m of 0.025 - 0.075 cm
- Made up of stainless steel & form of a coil
- Disadvantage: more sample cannot loaded

2. Column

The column

- **Is where the chromatographic separation of the sample occurs.**
- Several types of columns are available for different chromatographic applications:
- The heart of the system.
- It is coated with a stationary phase which greatly influences the separation of the compounds.

Factors Affecting Column Separations

- **Volatility of compound**: Low boiling (volatile) components will travel faster through the column than will high boiling components
- **Polarity of compounds**: Polar compounds will move more slowly, especially if the column is polar.
- **Column temperature**: Raising the column temperature speeds up All the compounds in a mixture, “Columns have lower and upper temperature limits”.

Factors Affecting Column Separations

- **Column packing polarity**: Usually, all compounds will move slower on polar columns, but polar compounds will show a larger effect.
- **Flow rate of the gas through the column**: Speeding up the carrier gas flow increases the speed with which all compounds move through the column.
- **Length of the column**: The longer the column, the longer it will take all compounds to elute. Longer columns are employed to obtain better separation.

GLC

Carrier gas

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- **Injection devices**
- **Columns**
- **Temperature control devices**

- **Detectors**
- **Recorders & Integrators**