preparation of ion exchange column

The column is prepared by filling the solid material (resin) inside the column by adding it to a column filled with solvent and left until it precipitates. The column can be mechanically shaken or the solvent is crushed by a long piston during filling. The air bubbles formed in the column should be expelled and made less efficient.

A glass wool or perforated glass disc is placed in the bottom of the column to support the stationary phase and we can be use the burette as a column.

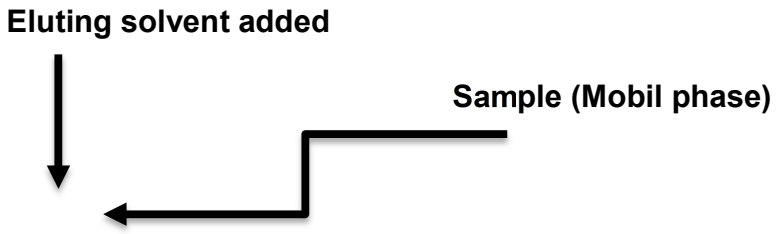
The dimensions of column depend on:

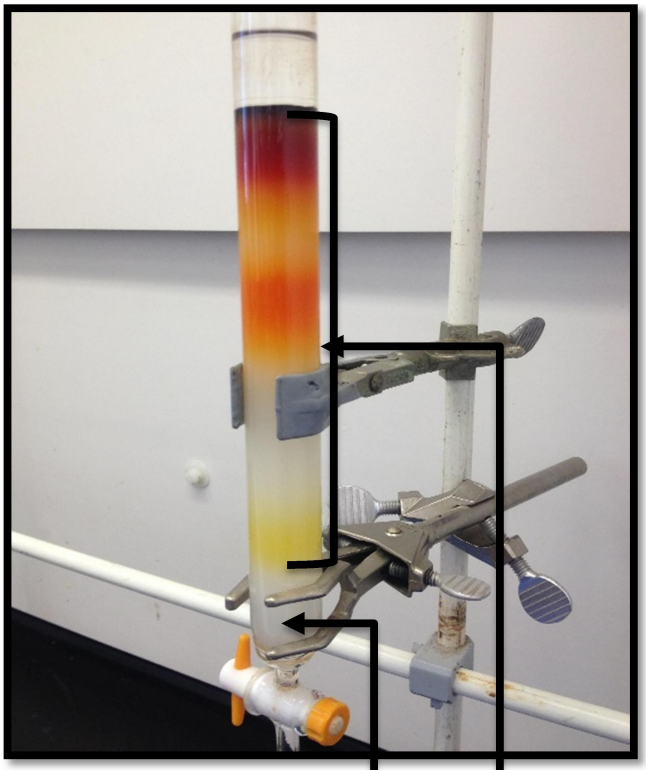
1- **Separation efficiency required .**

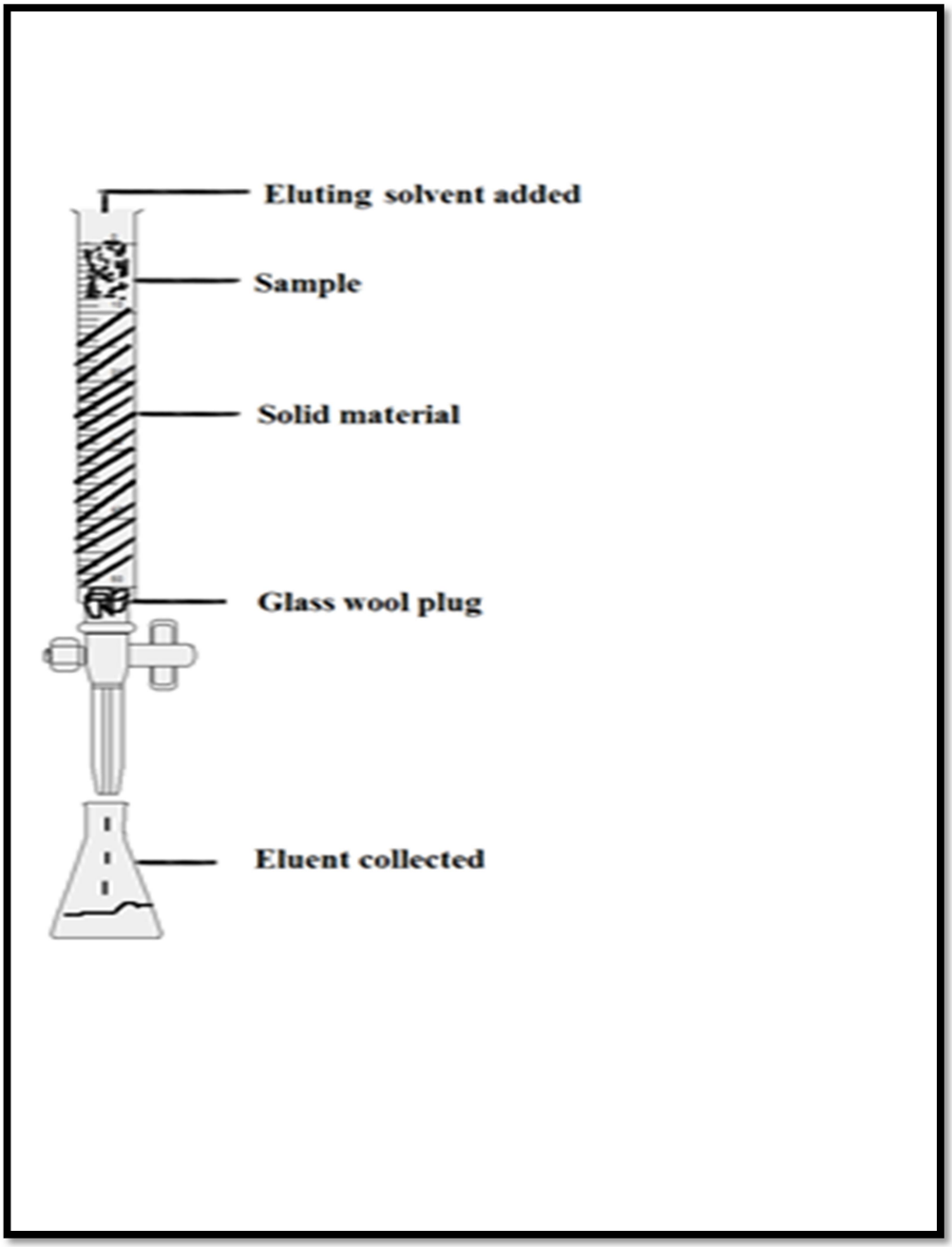
2- **The size of the sample**

3- **The type of the chromatography separation method.**

The dimensions of the ion exchanger column are range from a few millimeters in diameter and a few centimeters in length to a few centimeters in diameter and several tens of centimeters in length.




Solid material(Stationary phase)
Glass wool plug



Cation exchanger resins

These resins contain acid groups linked to the aromatic ring, The positive ions exchangers (strong acid) are sulfonic acid groups (SO_3H^+)and it's a very strong acid similar to sulfuric acid while The positive ion exchangers (weak acid) are carboxylic groups ($COOH^+$) , They partially ionize so that protons of these groups can be exchanged with other cations.

$$n\ Rr\_\ SO_3H^+ + M^+ \rightleftharpoons (\ Rr\_\ SO_3^-)_n\ M^{+n} + nH^+$$ (strong acid)

$$n\ Rr\ \_\ COOH^+ + M^+ \rightleftharpoons (\ Rr\ \_COO^-)_n\ M^{+n} + nH^+$$ (weak acid)

Note

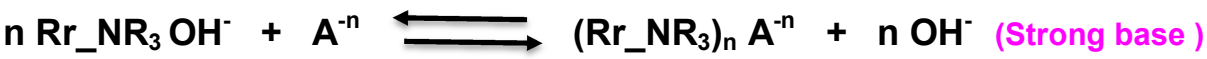
Rr → the resin

n → the number of moles

M^+ → the positive ions

Anion Exchanger Resins

These resins contain basic groups (hydroxyl ions OH-) can be exchanged with the other anions. The (Quaternary ammonium groups) are very strong base while the Amine groups are a weak base groups.



Note

Rr → the resin

n → the number of moles

A^{-n} → the negative ions

Properties of Exchangers

Ion exchangers must have certain properties in order to be use several times. Some of these properties that must be known and controlled are :

1- The size of the exchanger granules must be large.

2- Degree of branching .

1- Degree of inflation .
2- Capacity .

Capacity

It is the number of the (M.eq) of (H^+ or OH^-) per gram of solid resin.

Or It is the number of the (M.eq) of (H^+ or OH^-) In the one ml volume of the wet resin .

$$\text{Capacity} = \frac{\text{Meq.}(OH^- \text{ or } H^+)}{\text{g (Solid R.)}}$$

$$\text{Capacity} = \frac{\text{Meq.}(OH^- \text{ or } H^+)}{\text{ml (Liquid R.)}}$$

The ion- exchanger activated

To converting the resin (exchanger) to the desired shape depends on the type of exchanger (cationic or anionic) and it depends on the purpose of the experiment. In the process of water desalination (deionized water, removing the ions from the water), the cationic exchanger is converted into (H^+- form) by adding a suitable dilute acid to the column containing the cation resin.

The anionic exchanger is converted into (OH^-- Form) by adding a suitble dilute base to the column containing the anionic resin and then wash the column with the distilled water to remove the trace of acid or base. The washing process is done by adding distilled water to the column with the opening of the column faucet and maintaining the flowing speed. The cation exchanger activates by

added an acid like HCl (3M) , then added of distilled water as a few batches, for example (10 ml) and then we get rid of the solution in the column to the conical flask and then check it by using silver nitrate ($AgNO_3$) .

If the solution is turbid ,that is mean the solution is contain salts that is formed by the reaction of the added acid with the ions in the resin, then we remove of the solution and washing the resin by distilled water . The solution must be remove from column again and check the solution by silver nitrate , if solution are not turbidity this refer of the absence of salts and complete the check by adding a drop of the methyl orange indicator. when the color of the solution is pink that is mean the presence of the acid in the column while if the solution is yellow color that is mean no more acid in the column.

The separation by the ion exchanger

Is one of the types of chromatography (liquid - solid) which are separated all similar ions in the charge .

Types of ion exchangers

1- **Natural exchangers such as zeolite , soil**
2- **Structural exchangers: can be divided into :**

A- Non-organic ion exchangers

These exchangers are divided into two parts :

1- **Aluminum silicate**

It is a cation exchange consist from the mixing of aluminum sulphate and sodium silicate to produce a gel containing aluminum ions that can be replaced with calcium ions or ammonium or other ions. Although these exchanges have a high exchange capacity but it's easily decomposed by acids and base. The most important use of these exchanges in the estimation of ammonium ion.

2- **Hydroxyl Oxides**

The precipitate (iron oxide or aluminum oxide) which have a positive charge (as a cationic exchanger) and their ability to ions exchange are small, While the hydroxyl oxides of quaternary metals (Sn, Tn) are more useful in the ion exchange.

B- **Organic exchangers**

are industrial resin have a high molecular weight containing an effective group of organic polymers that are insoluble in water and can combine with a large number of electrically charged groups and are used in analytical chemistry and are available in the granules form ranging from (0.02 - 0.04 mm)