Chromatography

Purpose of experimental

1- Determine the number of components in a mixture via paper chromatography
2- Verify a substance's identity
3- Monitor the progress of a reaction

Theory part of experimental

The name *chromatography* (Greek "color") comes from a technique used by the Russian botanist Michael Tswett in 1903 to separate plant pigments from green leaves. Chromatography is the separation of two or more compounds or ions by the distribution between two phases, one which is moving and the other which is stationary. These two phases can be solid-liquid, liquid-liquid or gas-liquid. Chromatography divided into :

1) plate Chromatography , 2) column Chromatography.

The plate Chromatography divided into:

A) Paper Chromatography, B) Thin Layer Chromatography (TLC).

TLC is normally done on a small glass or plastic plate coated with a thin layer of a solid — the most common are *silica* (SiO_2) or *alumina* (Al_2O_3), this is the stationary phase. TLC, is a solid-liquid form of chromatography where the stationary phase is normally a polar absorbent and the mobile phase (the eluent) can be a single solvent or solvent mixture.

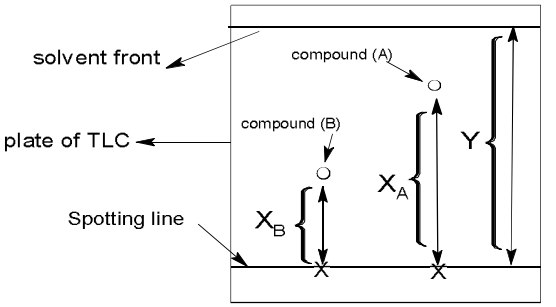
For silica gel-coated TLC plates, the solvent (eluent) polarity strength increases in the following order: perfluoroalkane **(weakest)**, hexane , pentane, carbontetrachloride, benzene/toluene, dichloromethane, diethyl ether, ethyl acetate, acetonitrile, acetone, 2-propanol/*n*-butanol , water , methanol, triethylamine, acetic acid, formic acid **(strongest)**.

Polar compounds are adsorbed strongly and therefore move along the plate slowly, while non-polar compounds are absorbed only weakly and are therefore carried along the plate more quickly. Of course, solvent polarity also affects how fast compounds travel. Polar compounds are carried along quickly by polar solvents, but move slowly or not at all with non-polar solvents. Because non-polar compounds don't adhere strongly to the silica, they tend to move more quickly in most solvents.

The sample mixture is applied near the bottom of the plate as a small spot, then placed in a jar containing a few ml of solvent. A solvent (the moving phase) is allowed to travel across the paper by capillary action. As the solvent front moves, the components of the mixture separate.. Each compound in the mixture moves at a different rate, depending on it's : a) solubility in the mobile phase and, b) the strength of its absorption to the stationary phase. The ratio of the distance a compound moves to the distance the solvent moves is the **Rf** value (retention factor). This value is characteristic of the compound, the solvent, and the stationary phase.

$$R_f = \frac{\text{distance traveled by a component of the mixture}}{\text{distance traveled by the solvent}}$$

Experimental No. (15) Chromatography



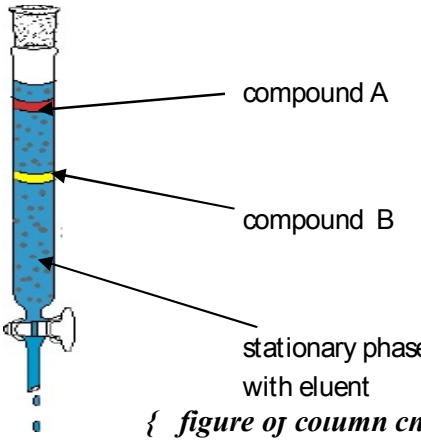
$$Rf_A = \frac{X_A}{Y}$$

$$Rf_B = \frac{X_B}{Y}$$

X_A : distance of compound (A)
X_B : distance of compound (B)
Y : distance of solvent

{Figure of paper chromatography}

Column chromatography is used most conveniently for preparative purposes, when one deals with a relatively large amount of the mixture and the components need to be isolated in milligrams or grams quantities.



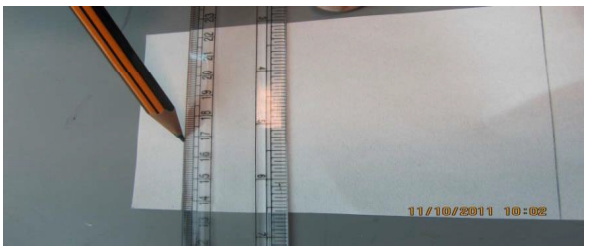
{ figure of column chromatography }

Chemical and Apparatus

Gar or beaker , watch glass, solvents

Procedure of Experimental

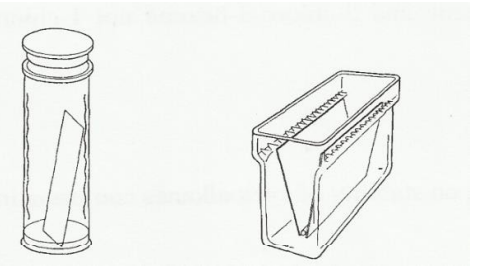
1- Draw a light pencil line 1-2cm from the bottom of the paper.



2- Place a single drop of compound at intervals 2cm.

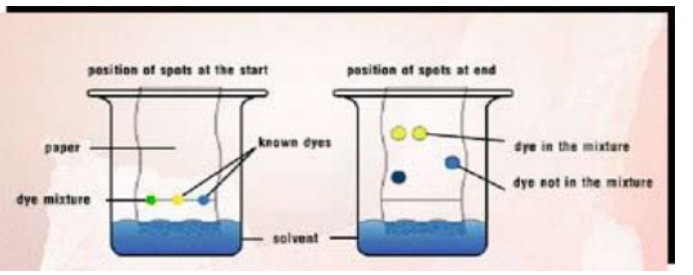
3- Dry with hair dryer.

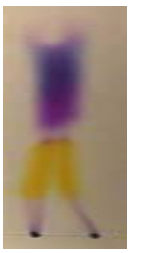
4- Dip the paper in the jar. Do not disturb the beaker while the chromatograms are developing.



{Figure of Gar}

5- Allow to run until the solvent has nearly reached the top of the paper.

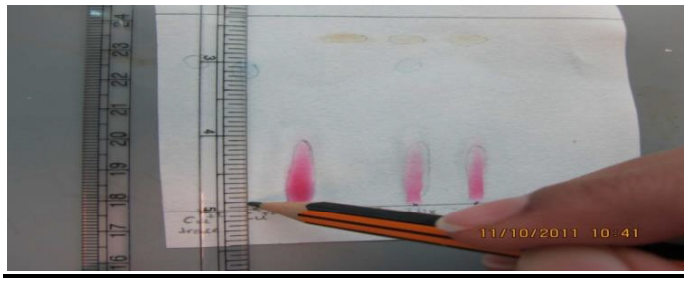




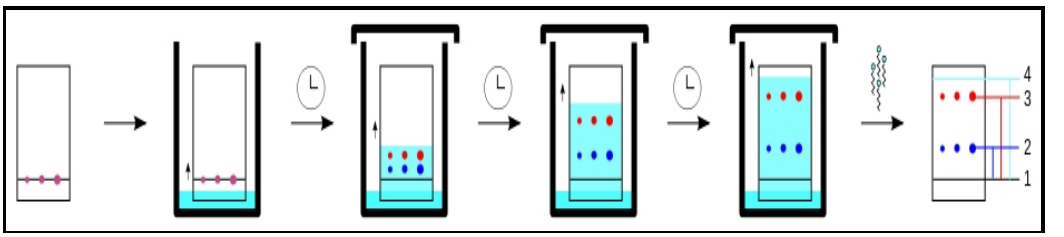
6- Remove the paper.

7- Dry the paper.

8- Measure distances from the start line to the solvent front and to the middle of each spot.(Rf) Write down results in your work sheet.



Steps of paper chromatography



Questions for discussion

1- Why use a pencil and not a pen to mark where to put the compound coloring spots?

2- Why do you think some pigments moved farther than others?

References

1- Bettelheim and Landesberg, Laboratory experiments for general, organic and biochemistry, fourth addition, 1998.

2- Vogel's, Textbook of practical organic chemistry, fifth edition, 1989

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4- Sonia Ratnani and Shriniwas Gurjar, Experimental organic chemistry, New Delhi, 2012

5- Supawan Tantayanon, Small Scale Laboratory:Organic Chemistry at University Level, Department of Chemistry, Faculty of Science Chulalongkorn University, Bangkok, THAILAND, 2010