CHEMISTRY LAB: INTRODUCTION TO CHROMATOGRAPHY

WHAT TO TURN IN, PER GROUP:
SET OF TWO PAPER STRIPS (ONE SET PER GROUP) labeled in pencil
WHAT TO TURN IN, PER PERSON:
SKETCHES of each paper, showing colors as accurately as possible
SAMPLE CALCULATION OF R_f
DATA TABLE
QUESTIONS #1-4

Introduction

Chromatography is a process of separating small quantities of a substance in a mixture (often a solution) through *selective adsorption*. For example, the components of solutions of metals, dyes, blood, urine, and antibiotics are separated effectively by chromatography. Once separated, the components can be identified. The process is fast, simple, and generally yields good results.

In conducting a separation, a small amount of the mixture is placed on a strip of adsorbent paper. The solvent, as the carrier, is allowed to pass through the substance. As the carrier passes through the mixture, those particles held loosely on the adsorbent will be picked up by the solvent and be moved away from the point of application. Colors or colorbands will appear if the mixture was colored. The paper can also be treated with certain chemicals that will produce characteristic colorbands on the adsorbent.

The ratio or quotient R_f ("representative fraction") compares the distance traveled by an ion in solution to the distance traveled by the solvent. R_f is calculated for each ion by dividing the distance traveled by each substance, D_s by the distance traveled by the solvent, D_f.

$$R_f = \frac{D_s}{D_f}$$

Objectives

In this experiment, you will

- perform paper chromatography separations
- measure the distance traveled and calculate R_f values
- compare the travel rates

Materials

chromatography paper, or filter paper cut into strips
125 mL Erlenmeyer flasks
stoppers
metric ruler
pencil
small graduated cylinder
colored marker pens, not permanent or washable
acetic acid-water solution
colored pencils and plain white paper (for drawing)

Procedure

1) Rinse out the flask:(s).
2) Pour approximately 10 mL of acetic acid-water solution in each flask used. The solution must cover the bottom of the flask completely. If shorter strips of paper are used, use 50 mL.
3) Stopper each flask and set aside.
4) Obtain two strips of chromatography paper.

5) You must do two separate types of ink: one black and one dark color of your choice. Label the top of each strip in pencil; specify which type of ink is to be used.
6) Put a small dot of ink (from one of the pens selected) on a strip of paper at least 5 mm from the bottom of the paper. The placement of the ink dot is important: the dot must not be immersed directly in the solvent in the flask! Draw a pencil line across the ink dot. Let dry.
7) Remove the stopper from the flask. Carefully place the strip of paper spot-down in the flask. The paper must not sag downward below the water level. Stopper the flask again with a small portion of the paper held by the stopper.
8) Observe the behavior of the spot as it travels upward. The solvent may take 3-5 minutes to travel a sufficient distance.
9) When the solvent is near the stopper, remove the strip of paper. Mark the solvent line (wet-dry line) with a pencil. Lay on a paper towel to dry.
10) Rinse flask, and add new solution.
11) Repeat procedure for the other type of ink.

Calculations

1) Measure the distance traveled by the solvent for each paper, in mm. This value will be used for all colors on the same paper.
2) Measure the distance traveled by each color band (the top of each region), in mm.
3) Calculate the R_f values for each pigment color.

Sketches

1) Sketch each paper with colored pencils on white paper, showing colors as accurately as possible.
2) Label all measurements.

Sample Data Table

Trial #	Brand name of felt ball-point marker	Developed color of spot(s)	Distance moved by spot (s) Ds (mm)	Distance moved by solvent Df (mm)	Rf (Ds / Df)
1	_____	_____	_____	_____	_____
		_____	_____	_____	_____
		_____	_____	_____	_____
2	_____	_____	_____	_____	_____
		_____	_____	_____	_____
		_____	_____	_____	_____
3	_____	_____	_____	_____	_____
		_____	_____	_____	_____
		_____	_____	_____	_____

Questions

1) In which common substance is acetic acid found?
2) Why do colorbands appear at different positions on the paper?
3) Why is it advantageous to let the flasks sit stoppered before inserting the paper?
4) Give two practical applications for this type of chromatography.