Exp 20 – Analysis of Pigments Using Paper Chromatography

Introduction: Chromatography is a technique used to analyze and purify chemical mixtures. Besides being widely used in the chemical and pharmaceutical industries, chromatography is also applied to environmental monitoring, food processing, and forensic science applications. The separation of the mixture occurs because the components are not equally soluble in a solvent. The mixture that is to be separated is placed on a special medium. A solvent is allowed to travel (solvent = mobile phase) across the medium (medium = stationary phase). As the solvent moves across the medium, the components of the mixture separate. The components of the mixture that travel the farthest are the ones that are most soluble in the solvent and least attracted to the medium. The components of the mixture that travel the shortest distance are the ones that are the least soluble in the solvent and most attracted to the medium. Substances such as proteins can also be separated by other characteristics such as molecular weight or affinity (attraction) to other substances.

In today's activity, you will be analyzing black, water-soluble markers. These markers contain a number of different pigments which make the ink black. You will be separating the different pigments by taking advantage of the fact that different pigments have different solubilities in water. Please set up your experiment using the following diagram 1 and then answer the analysis questions that follow.

Procedure:

1. Draw a line with a black, wet-erase marker about 1/2 in. from one end of the chromatography paper.
2. Tape the chromatography paper to a pencil so that the paper just touches the bottom of the beaker.
3. Remove the pencil-chromatography paper and add water to the beaker to a depth of about 1/4 in.
4. Place the pencil-chromatography paper back into the beaker so that the bottom of the paper is slightly submerged in the water. IMPORTANT! The marker line should NOT be below the water!!
5. As the water travels up the paper, it will carry the water soluble pigments with it.

To calculate the Rf value for different pigments

$$Rf = \frac{\text{Distance traveled by the pigment}}{\text{Distance traveled by the mobile phase}}$$

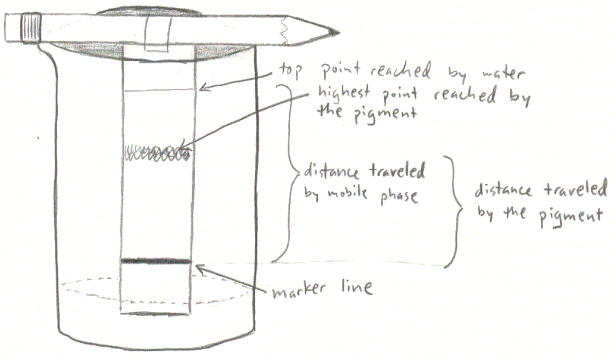

Figure 1. Paper chromatography experimental setup.

Analysis Questions:

1. Make a drawing of your paper chromatography experiment labeling the different color pigments you found.

2. Stationary phase = _____

   Mobile phase = _____

3. Calculate the Rf values for each different color pigment. Make sure you use the highest point reached by that pigment for the distance traveled by that pigment. Show a sample calculation for one of the pigments and report all the Rf values.

4. If you could set up this experiment to run the mobile phase all the way through the stationary phase so that no pigment was left in the stationary phase, what would be the first pigment to travel all the way through the stationary phase?

5. If you collected the water from such an experiment in multiple samples of just a few drops, how would the samples differ from each other?

6. What property of the water and pigments allows this experiment to work? Explain.

7. Could you do this experiment with permanent markers? Why or why not?

8. Compare data with other groups as time allows, how do your calculated Rf values compare with those found by your classmates?