Name: _____

Ink Chromatography Lab

Students use paper chromatography and calculate the retention factor of ink to match what type of marker wrote a sample.

Background

Every black marker is the same, right? Not exactly. When a company creates an ink mixture, they find a particular combination of different pigments to make their desired color. Each brand is going to have a particular color mixture that they patent so another company cannot reproduce the same exact color. We will be using chromatography as a way to match brands of markers to written samples.

Chromatography is a method for analyzing mixtures by separating them into the chemicals from which they are made. It can be used to separate mixtures like ink, blood, gasoline, and lipstick. In ink chromatography, you are separating the colored pigments that make up the color of the pen. Even though a pen will only write in one color, the ink is actually made from a mixture of different colored pigments.

In paper chromatography, porous paper (like filter paper, coffee filters, chromatography paper, paper towels or even newspaper) is called the stationary phase. Water or another solvent, like rubbing alcohol, is called the mobile phase. The ink will bond or stick to the mobile phase for different amounts of time based on the color. Using that fact, we can separate out the different colored pigments based on the time each pigment spends in the mobile phase.

Materials

Filter paper strips	Scissors	Ruler	Rubbing alcohol
Beakers - 2	Stirring rod	Water	Writing samples

Procedure

1. Cut two filter paper strips for every sample you will be testing.
2. About .75 inches from the bottom of each strip of filter paper, make a line across the paper with pencil to mark the starting point for each sample. Near the top, mark the filter paper with the kind of sample you are testing.
3. Use the glass stirring rod to place a dot of each writing sample prepared on the middle of the pencil line on the filter paper strip.
4. With the two beakers, place a small amount of water or rubbing alcohol in the bottom of each beaker.
5. Place the sample to be tested into the beaker and ensure that the liquid doesn't go above the pencil line of the filter paper.
6. The solvent should begin moving up the filter paper and carrying the pigment with it. The color should begin to separate out in either the water or the alcohol solvent, but may not do so for both.
7. When the solvent has finished moving up the paper strip or before the solvent reaches the top of the filter paper strip, pull the test out of the beaker and lay flat on the lab table to dry. Immediately mark with a pencil the highest point that the solvent traveled on the strip. Take a picture of the testing strip before it starts to dry.
8. Repeat with each of the other samples to be tested.
9. When completed, dump the alcohol and water in the waste container and wash and rinse out each of the beakers and set to dry.

Retention Factor (Rf) Value

1. You have probably noticed that each brand uses different pigments to produce their black colors. After testing all of the unknown ink samples, you will use your data to match color combinations and determine which writing utensil was used to write each unknown sample.
2. Look closely at each marker's chromatography strip. How many different colors are present in each ink sample? Record the Total Number of Colored Pigments number for each ink sample in your data table.
3. Look closely at each marker's chromatography strip. Record the colors in the order that they appear in your data table. Each color represents a different pigment present in the ink. (Ex. Colored Pigment #1 = pink, Colored Pigment #2 = orange, etc.)
4. To prove that an ink sample is a certain brand, you will also need to calculate the Rf (retention factor) values of the different colored chemicals present in the marker. Rf is a calculation that compares the distance the solvent traveled up the paper strip to the distance a pigment traveled up the same strip. First, look at a chromatography strip and measure the distance in millimeters from the original color dot to the final point the solvent traveled. That distance is the solvent distance measurement. Record it in your data table.
5. Next, measure in millimeters from the original color dot to the highest point the first colored pigment (Colored Pigment #1) traveled up the strip. This is the pigment distance measurement for Colored Pigment #1. Record this measurement in your data table.
6. If there is a Colored Pigment #2 on the strip, measure in millimeters the distance from the original color dot to the highest point this colored pigment (Colored Pigment #2) traveled up the strip. This is the pigment distance measurement for Colored Pigment #2. Record this in your data table.
7. Repeat the measurement for any other colored pigments and record in your data table.
8. Calculate the Rf value for each colored pigment using the formula below:

$$\text{Rf Value} = \frac{\text{Distance traveled by solute (pigments in ink)}}{\text{Distance traveled by solvent (water)}}$$

9. Record the Rf values for each colored pigment in your data table.
10. Repeat these measurements and Rf calculations for each of the markers tested.
11. Use the data table to determine what kind of marker was used to write each of the written samples.

Data Table

Writing Sample (Suspect)						
Solvent Used						
Total Number of Pigments Found						
Solvent Distance Measured (mm)						
Colored Sample 1	Color					
	Distance Measured					
	Rf Value					
Colored Sample 2	Color					
	Distance Measured					
	Rf Value					
Colored Sample 3	Color					
	Distance Measured					
	Rf Value					
Colored Sample 4	Color					
	Distance Measured					
	Rf Value					
Colored Sample 5	Color					
	Distance Measured					
	Rf Value					

Data Table (cont.)

Writing Sample (Suspect)						
Solvent Used						
Total Number of Pigments Found						
Solvent Distance Measured (mm)						
Colored Sample 1	Color					
	Distance Measured					
	Rf Value					
Colored Sample 2	Color					
	Distance Measured					
	Rf Value					
Colored Sample 3	Color					
	Distance Measured					
	Rf Value					
Colored Sample 4	Color					
	Distance Measured					
	Rf Value					
Colored Sample 5	Color					
	Distance Measured					
	Rf Value					

Conclusions

What is the purpose of the water or rubbing alcohol in this experiment?

Do you think linking a brand of marker or pen to the crime is enough evidence to convict a suspect? Why or why not?

Claim, Evidence, Reasoning

Write a final conclusion in the claim, evidence, reasoning format for what this test tells us about our evidence, being sure to reference your data table to provide evidence for your conclusion.