

CHALK CHROMATOGRAPHY

A Method to Separate the Components of a Mixture

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INTRODUCTION

In 1906, Mikhail Tswett, a Russian botanist, published a paper in which he described the separation of pigments, extracted from green leaves, by washing the mixture with petroleum ether (similar to lighter fluid) through a glass tube packed with powdered calcium carbonate (chalk). As the mixture of pigments passed down the CaCO_3 -filled tube, they separated into distinctly colored zones. Tswett gave the name *chromatography* (the graphing of colors) to this separation technique.

The method that Tswett used is known today as column chromatography. Column chromatography is a rather slow and sometimes difficult process to carry out compared with more recent developments known as paper chromatography, thin layer chromatography, gas chromatography, high pressure liquid chromatography, and ion chromatography.

The method of column chromatography can be carried out in the classroom using calcium carbonate in the form of sticks of chalk. A mixture containing two or more components is deposited on a stick of chalk, a solid adsorbing substance. The components are adsorbed (i.e., held on the surface of the solid substance) to varying degrees which depend on the nature of the component, the nature of the adsorbant, and the temperature. Then the wash solvent (liquid) is added to the adsorbant and allowed to flow through it by capillary effect. As the solvent passes the deposited mixture, the components tend to be dissolved to varying extents and are swept along the solid adsorbant. The rate at which a component will move along the solid depends on its relative tendency to be dissolved in the solvent and its tendency to be adsorbed on the solid. The net effect is that, as the solvent passes slowly through the solid adsorbant, the components of the mixture -separate from each other and move along with the solvent forming rather diffuse zones or spots. With the proper choice of solvent and adsorbant, it is possible to resolve many complex mixtures into their components.

SAFETY PRECAUTIONS

Wear safety goggles or glasses at all times in the laboratory.

The alcohol used in this experiment is poisonous and flammable. Keep it covered to minimize fumes and do not attempt to drink any of it. There should be no flames in the laboratory.

DISPOSAL

Dispose of any remaining alcohol solution in special containers provided in the laboratory. In some areas, the alcohol solution can be poured down the drain with running water.

MATERIALS NEEDED

3 ounce cup (plastic cups are reusable)
chalk, porous NOTE: Do not use dustless chalk. (i.e., use cheap [dusty] chalk, available at toy stores)
ruler
felt tip pens or markers
graduated cylinder, 10-mL or 25-mL (or other measuring device)

water

rubbing alcohol (there are two types: ethyl alcohol and isopropyl alcohol, either can be used), 25% by volume (mix 36 mL of 70% rubbing alcohol with 64 mL water).

PROCEDURE

Obtain a stick of chalk.

Using a felt-tip pen or marker, draw a line around the chalk about 1 to 1.5 cm from the end. NOTE: It may be necessary to draw the line as a series of small dots as the chalk may clog the tip of the felt-tip pen.

If the felt-tip pens are a “washable” type, then the inks are water soluble. Obtain 5 mL of water in a 3 ounce cup.

If the felt-tip pens contain a permanent-type ink, then an alcohol or alcohol-water solvent must be used. Obtain 5 mL of 25% alcohol solution in a 3 ounce cup.

NOTE: If you are not sure of the type of ink used in the felt-tip pen, try using water as the solvent. Then repeat the procedure using a water-alcohol solution. Different results may occur when using water and alcohol-water solvents with the same felt-tip pens.

Stand the chalk in the cup with the end containing the marker line down. Allow this to remain undisturbed for 15 to 30 minutes. The liquid should rise up the chalk to within 1 cm of the top.

Remove the chalk from the cup. Using a pencil mark the position on the chalk that the solvent (liquid) has reached. Let the chalk dry.

Examine the ink from the felt-tip pen on the chalk. Describe what has happened to the ink.

Repeat the procedure using different felt tip pens. Record the identity of the felt tip pen used. For example, you might use a “red Flair” marker.

What brand of felt tip pens are you using? _____

Variation: Instead of using a felt-tip marker and drawing a single line around the chalk, try using several different markers and placing a series of short lines or spots around the chalk.

QUESTIONS

1. What color felt-tip pens did you use?

2. Did the ink line move from its original position?

3. Did the ink separate into two or more different colors? Which ones?

4. What colors did the ink separate into? Tell for each color of felt tip pen used.

5. Compare the colors of the different felt tip pens. Do any of the inks contain the same color?

6. What does this experiment tell you about the inks used in this brand felt tip pens?