Chromatography Centrifuge

Introduction

Use spinning (radial) paper chromatography to separate the components of an ink mixture from a water-soluble, felt-tip pen. The chromatography centrifuge device allows separations to be performed faster and easier than traditional methods and results in amazingly beautiful radial chromatograms.

Concepts

- Chromatography
- Separation of mixtures
- Physical properties

Background

Chromatography works on the principle that the compounds to be separated are slightly soluble in the *eluent* (or solvent) and will spend some of the time in the eluent and some of the time on the *absorbent*. A good absorbent is usually a solid material that will attract and absorb the materials to be separated. Paper, silica gel, or alumina are all very good absorbents. When the components of a mixture have varying solubilities in the eluent, they can then be separated from one another. The polarity of the molecules to be separated and the polarity of the eluent are very important. This affinity for the eluent versus the absorbent is what separates the molecules.

Paper chromatography is commonly used as a simple separation technique. In paper chromatography, the absorbent is the paper itself. In this demonstration, the eluent is water. Water is a very polar molecule. The organic pigments in the inks, which will be "spotted" onto the filter paper, separate out as they are carried with the water at different rates. Those molecules that have a polarity closest to the polarity of the water will be the most soluble, and will move outward on the radial chromatogram the fastest.

Many materials, such as the ink in felt-tip pens, are actually mixtures made up of several different organic compounds, or pigments. Each of these pigments has a different molecular structure and, usually, a different polarity. Many of these pigments can be easily separated using paper chromatography, because even when mixed together, they tend to maintain their characteristic physical properties.

In centrifugal chromatography, the speed at which the solvent migrates is increased greatly. The water spreads out quickly when dropped onto a spinning piece of filter paper, just as in the spin cycle of a washing machine. Through "normal" capillary action a chromatography pattern will develop in about 30 minutes. With a chromatography centrifuge, results are obtained in less than 30 seconds!

Materials

Beaker or small container (for water)
Chromatography centrifuge device
Filter paper, 12.5-cm diameter
Markers, water-soluble
Pencil tip (or sharp object such as a push pin)
Pipets, Beral-type
Plastic rotating disk
Tap water

Safety Precautions

Wear protective eyewear and an apron, as water may be thrown from the spinning platform. Do not touch the motor axle while the rotor is spinning. Remove the battery from the centrifuge device when not in use and during storage.

Procedure

1. Obtain a piece of filter paper. Determine the center of the piece of filter paper. To do this, set the plastic disk onto the motor axle of the centrifuge device. Set the piece of filter paper onto the plastic disk and mark the center hole. Use a sharp pencil tip or push pin to puncture a small hole into the center of the piece of filter paper.
2. Using a black (or dark-colored) water-soluble marker, draw four to six small dots in a circular or random pattern around the center hole in the filter paper. (*Note:* You may wish to use two different markers and alternate the dots in a circle around the center hole.) See Figure 1.

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3. Place the plastic rotating disk (with a center hole) onto the exposed motor axle of the chromatography centrifuge. Set the filter paper on the disk. The axle should penetrate the center hole of the filter paper to secure the paper to the rotating disk. (See Figure 2.) *Note:* This avoids the use of tape to hold the filter paper, although that is an option if necessary.
4. Start the motor running and watch the disk rotate around in a circle. Using a Beral-type pipet, add a few drops of water on the center of the rotating piece of filter paper. Add additional (yet minimal) drops of water if necessary. See Figure 3. (*Note:* If water is added too quickly, water and ink can be thrown from the disk.)
5. Watch carefully and make observations as the filter paper rotates on the centrifuge.

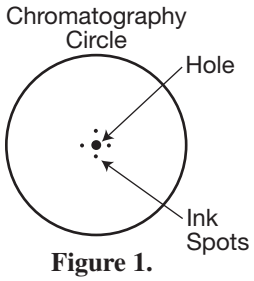

Figure 1.

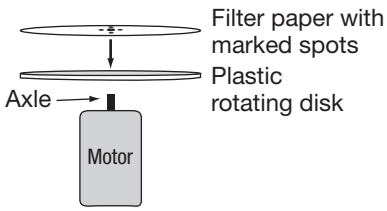

Figure 2.

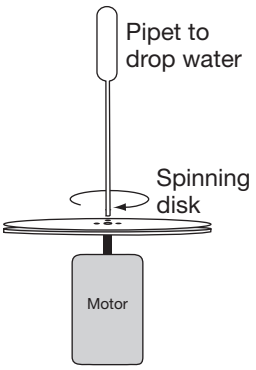

Figure 3.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Used filter paper may be disposed of in the trash.

Tips

- Use water-soluble markers or felt tip pens. Many different brands are available at local stores. Have students bring in their own markers to try. A set of eight water-soluble marking pens is available through Flinn Scientific, Catalog No. AP8466. Experiment with a variety of different black water-soluble markers to determine the composition of each. Also try different-colored markers other than black to see the pigments in each.
- The radial chromatogram is complete when the water line is near the edge of the filter paper (about 1–2 cm away). Lay the disks flat to dry.
- Coffee filters can be used as a suitable substitute for the filter paper. The "ruffled" sides of the coffee filter should be removed with scissors. The water is quickly absorbed by the coffee filter, which reduces the separation quality of the pigments.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Systems, order, and organization
Evidence, models, and explanation

Content Standards: Grades 5–8
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, properties and changes of properties in matter, understanding of motions and forces

Content Standards: Grades 9–12
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, structure and properties of matter, motions and forces

Acknowledgments

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Materials for the *Chromatography Centrifuge* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP5992	Chromatography Centrifuge Kit
AP1425	Replacement battery, Size D
AP8466	Marking Pen Set (8 pens)
AP8467	Marking Pen, Black
AP8468	Marking Pen, Red

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.