Crime scene investigation lab-

Identification of Inks in Felt Tip Pens Using Paper Chromatography

Background

A crime has been committed.

A wealthy celebrity's prize winning Poodle 'Fluffy' has been kidnapped. At the scene of the crime was a handwritten ransom note. In it the kidnapper demands $1 million dollars or

"**The pooch gets it!!**!"

The celebrity believes that a disgruntled former employee is behind the kidnapping.

Due to your well known expertise in such matters, she has hired your services to find out who the culprit is. You sneak into the three suspects' offices late at night. You then 'borrow' pens/markers from these three suspects' desks. You will compare the ink in these markers to that of the ransom-note's. You will use paper chromatography to determine who wrote the note.

Theory

During its development over the last 40 years, chromatography has revolutionized modern analytical chemistry. Chromatography is a group of techniques used to separate colored mixtures into their component parts. Many types of chromatography are now routinely used in laboratories around the world to separate and identify components in mixtures. The analyses of blood and urine samples for drugs and the analyses of drinking and ground water for hazardous chemicals are two common procedures involving chromatographic separations.

All chromatography techniques involve a **stationary phase** and a **mobile phase**. The stationary phase can be either liquid or solid. The mixture to be separated is usually placed on the stationary phase. The mobile phase can be either liquid or gas. The mobile phase moves along the stationary phase, carrying some or all of the mixture with it, resulting in the separation of the mixture components.

In liquid chromatography, separation is based on the preferential attraction of each component in the mixture to either the mobile or stationary phase. The attraction is due to particular intermolecular interactions.

Paper chromatography is the simplest form of chromatography. Although paper chromatography is not used for drug or hazardous chemical analyses, it is extremely useful for separation and identification of ink dyes. In paper chromatography, a sample of the mixture to be separated is placed on a piece of chromatography paper, which acts as the stationary phase. One edge of the paper is placed in a solvent, such as water, alcohol, or a mixture of both, which acts as the mobile phase. Many different solvent systems are possible, depending on the components to be separated.

The chromatography paper acts like a wick, drawing the solvent up the paper by capillary action. The wicking occurs because the solvent is attracted to water molecules that are permanently bound to cellulose fibers of the paper. The water molecules bound to the paper and the paper itself forms the stationary phase.

A sample is applied, or spotted, on an area of the paper near the bottom edge, known as the origin line. The

bottom edge of the paper is then placed in a solvent, and solvent is drawn up the paper. When the leading edge of the mobile phase, the solvent front, reaches the sample, the sample components are preferentially attracted to either the stationary or mobile phase.

We characterize this movement in terms of a retention factor (R_f) defined by Equation 2.

$$R_f = \frac{\text{distance traveled by component, cm}}{\text{distance traveled by solvent front, cm}} \qquad \text{(Eq. 2)}$$

If a component moves with the solvent front, its R_f value can be as high as 1.0. If the component does not move at all, its R_f value can be as low as 0.0. The R_f value for a component is reproducible for a particular component-solvent system, if the experimental conditions are closely controlled.

LAB SETUP

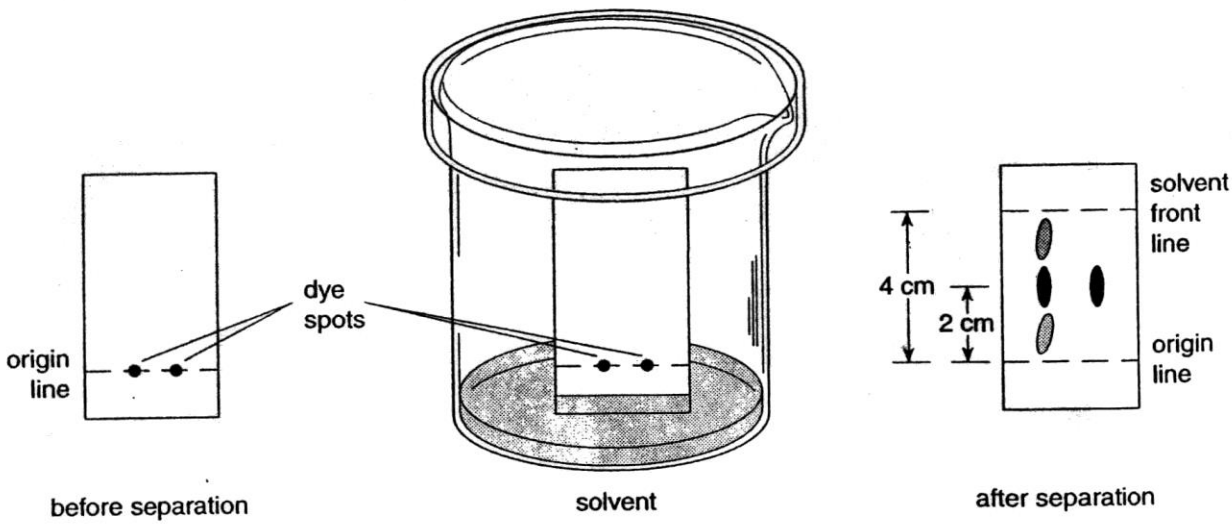

Figure 1 illustrates the preparation of a chromatogram. Spots of the sample to be resolved are placed on the origin line of the chromatography paper and the bottom edge of the paper is placed in the solvent. Solvent moves up the paper separating the components. The distance a component has moved is determined by measuring the distance from the origin line to the center of the component spot.