Substances, Mixtures, & Separations

Prelab Lecture to accompany paper chromatography experiment.

Pure Substances versus Mixtures

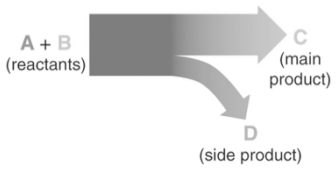
- **Substance:** An element or compound of elements. It can only be separated to its elements by a chemical reaction
  - *Examples:* Oxygen gas, Copper, Water, Salt, Sucrose
- **Mixture:** A combination of two or more substances that can be separated by physical means.
  - *Examples:* Salt water, Kool-Aid, Lasagna

Homogeneous vs. Heterogeneous Mixtures

- **Homogeneous:** A mixture that is uniform in its composition and properties throughout, down to the particle level. Also called a **SOLUTION**.
  - Salt water
  - Kool-Aid
  - Air
- **Heterogeneous:** A mixture that has physically distinct parts with properties varying throughout.
  - Pond Water
  - Chunky Soup

Separation of mixtures

- In nature, some materials are mixtures and we wish to extract only one part of the mixture.
- In the chemistry laboratory, some reactions create a mixture of products. You may be interested in isolating a single product from that mixture.



Separation (& purification) of mixtures

- *Homogenous* and *heterogeneous* mixtures are generally separated by different means. Some common means of separations in chemistry include:
  - Crystallization
  - Distillation
  - Chromatography
  - Extraction
  - Filtration
  - Exploiting of other physical properties

Paper Chromatography

Prelab Lecture to accompany paper chromatography experiment.

Chromatography

- Chromatography is the separation of a mixture based on differing affinities for a *stationary phase* and a *mobile phase*.
- In paper chromatography, the cellulose fibers in the paper act as the stationary phase. In our experiment, we will use a solution of hydrochloric acid (HCl) in acetone (CH_3COCH_3) as the mobile phase.

Separation of Metal Ions

- We will spot 5 solutions containing one KNOWN metal ion each onto the paper.
- We will also spot 3 UNKNOWN solutions each containing 2-3 of the 5 metal ions.
- After the solutions have dried, the paper will be placed into the eluting chamber, containing the acetone/HCl mixture.
- The mobile phase will move up through the paper by capillary action.

Separation of Metal Ions (continued)

- Some of the metal ions will have a stronger attraction for the stationary phase than others. These metal ions will move up the paper more slowly.
- We will remove the paper from the eluting chamber before the solvent front reaches the top of the paper.
- Once it dries, we will place it in an ammonia chamber to help us visualize the metal ions.

R_f and Identification of Metal Ions

- The **R_f** (retention factor) is the ratio of the distance from the **baseline** (where the ions were spotted) to the **solvent front** (the greatest distance the mobile phase moved up the paper).
- The R_f for a particular ion is unique and will be the same, as long as the conditions of the experiment do not change. We will use the R_f and the color of the known metal ions to determine the identify of our unknowns.

Calculating R_f

$$R_f = \frac{\text{distance from baseline to spot}}{\text{distance from baseline to solvent front}}$$

$$R_f = \frac{d_{spot}}{d_{solvent\ front}}$$

Other Types of Chromatography

- TLC – Thin Layer Chromatography
- GC – Gas Chromatography
- Silica or Alumina Gel (liquid chromatography)
- HPLC – High Pressure Liquid Chromatography
- Ion-Exchange