Chromatography Lesson

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Objective

To have a basic understanding of different aspects of chromatography; including different separation techniques that enable chemists to analyze their data.

Chromatographic Techniques

- History
    - Literal translation is 'color writing.'
    - Developed by Russian botanist Mikhail Tswett in 1903 (http://www.umich.edu/~orgolab/Chroma/chromahis.html).
        - He developed a separation of plant pigments.
        - Question for students?? Can you name a colorful plant pigment that is used in photosynthesis?
            - Chlorophyll is a green pigment that is vital for photosynthesis.
            - Scientists used the concept of chromatography in order to evaluate the chemical substituent's that are found in this vital pigment.
- Importance of Chromatography
    - Laboratory technique that is used to separate mixtures in order to determine the chemicals present in the mixture.
    - Chromatography can be used as a form of purification. The mixture that is being separated can contain a compound that is important for another reaction.
        - This is called preparative chromatography.
        - This is the type of chromatography that I use.
    - Chromatography can be used in a more analytical sense, in which chemists are interested in determining the proportions of different analytes in the mixture.
        - This is called analytical chromatography.
        - In order to know how much of component A, or B, C and their relative proportions to one another.

Chromatography Terms

- In order to understand the theory behind chromatography, you must first understand the terms that are used to describe the different separation techniques.
    - Analyte: Substance being separated
    - Chromatography: The method of separation that uses a stationary phase, while the other is a mobile phase (this is the phase that moves).
    - Mobile Phase: This phase is normally a solvent. Your sample is introduced into this solvent and it is moved along a column or TLC plate (stationary phase). Chromatography involves the interaction between the stationary and mobile phases.

- Stationary Phase: This component remains fixed in the procedure.
- Chromatogram: A visual output of the data that is being produced by the instrument.
- Retention Time: Time it takes for the analyte to pass through the column and reach the detector.

Chromatography Techniques

- TLC
  - **T**hin **L**ayer **C**hromatography
  - This technique has a similar theory behind the definition of chromatography, in which there is a stationary phase and a mobile phase. For each technique, the stationary phase may differ, but the mobile phase is USUALLY a solvent. This does depend on the type of chromatography technique. The solvent systems are not always the same though, and I will get into that later.
  - The stationary phase is usually silica gel (mostly because it is inexpensive!), but it can be aluminum oxide, or cellulose. The stationary phase varies depending on the chemical properties of the analyte you are trying to separate.
  - A predetermined solvent system is chosen for the experiment, and is driven up the plate by capillary action. Each analyte travels up the silica gel plate at different rates, and that is the reason separation is achieved.
  - Each analyte in the mixture has a certain affinity for the stationary phase, and that interaction along with solubility in the mobile phase will determine the extent of the separation.
  - This interaction with the silica gel plate is due to polarity differences in each analyte present in the mixture. Using a normal phase TLC plate a more polar substance will adhere to the stationary phase (silica), very strongly, which allows it to move up the plate slower than an analyte that is nonpolar in comparison.
  - We quantify a TLC by looking at its retention factor, which describes the ratio of time spent on the stationary phase compared with the time spent in the mobile phase

  *********SHOW PICTURES AND DEMONSTRATIONS OF HOW TO DO A TLC**********

- Applications of TLC
  - Monitoring Organic Reactions
    - I do this on a daily basis.
  - Forensic s Analysis
    - Many illicit drugs have distinctive Rf values, and when the plate is stained with a known mixture, can be known with some degree of certainty.
    - Analyzing dye composition in certain fibers.

Gas Chromatography

- Gas Chromatography (GC) is used to separate volatile (compounds that would easily go into the gas phase) analytes in a mixture.

- Separation also takes place in a column with GC.
    - Phases in GC
        - Mobile Phase is a carrier gas, which is usually inert, and is usually nitrogen.
        - Stationary phase is a material (usually a liquid) that is found in a column. The column is in a temperature controlled environment.
- **use website in order to demonstrate how an older GC is used***