Chromatography Background

Separation of a Dye Mixture Using Chromatography

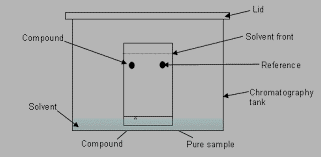
Introduction

The entire palette of artificial food colors is derived from just seven dyes certified by the FDA for use in food, durgs and cosmetics. How can these FD&C dyes be identified in a mixture? How do the molecular structures of the dye molecules influence their properties, relative solubility or affinity for different solvents?

Background

Color additives were initially used to make food more visually appealing to the consumer and, in some cases, to mask poor quality, inferior or imitation foods. For example, meat was colored to appear fresh long after it would have naturally turned brown. Jams and jellies were colored to give the impression of higher fruit content than they actually contained. Some food was colored to look like something else—imitation crab meat, for example. Many of the food colorings and additives were later discovered to be harmful or toxic.

Chromatography is one of the most useful methods of separating organic compounds for identification or purification. There are many different types of chromatography but most work on the concept of adsorption. The two important components of chromatography are the adsorbent and the eluent. A good adsorbent is usually a solid material that will attract and adsorb the materials to be separated. The eluent is the solvent which carries the materials to be separated through the adsorbent.



Chromatography works on the concept that the compounds to be separated are slightly soluble in the eluent and will spend some of the time in the eluent (or solvent) and some of the time on the adsorbent. When the components of a mixture have varying affinities for 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. Changing the polarity of the eluent will only slightly affect the solubility of the molecules but may greatly change the relative attraction for the adsorbent. Affinity for a substance for the eluent versus the adsorbent allows molecules to be separated by chromatography.

Paper chromatography is often used as a simple separation technique. In paper chromatography, the adsorbent is the paper itself, while the eluent can be any number of solvents. When the paper is placed in a chromatography chamber the eluent moves up the strip by capillary action. Organic molecules that are “spotted” onto the paper strip separate as they are carried with the eluent at different rates. Those molecules that have a polarity closest to the polarity of the eluent will move up the strip the fastest.

The choice of the eluent is the most difficult task in chromatography. Choosing the right polarity is critical because this determines the level of separation that will be achieved. Different samples will spend varying amounts of time interacting with the paper. The distance a sample moves along the chromatography paper is compared to the overall distance the solvent travels—this ratio is called the Rf value or rate of flow.