

3. Evaporation is another separation-concentration method. The TCDD in the chloroform solution from the preceding sample is further separated and concentrated by evaporating the volatile chloroform, leaving a solid residue of the non-volatile TCDD along with any other chloroform soluble non-acidic impurities in the starting sample. The solid is redissolved in a small amount of chloroform to give a purified concentrated solution suitable for analyses using a gas chromatograph such as will be described later.
4. Adsorption is a separation technique used in many analytical methods. It makes use of the fact that different kinds of molecules in solution or in gas mixtures have widely different affinities for solid surfaces of material called adsorbents. Materials such as powdered activated carbon, alumina and silica gel are good adsorbents. Activated adsorbents have a porous structure which gives them a very high surface area per unit weight so that they can adsorb much larger amounts of material per gram of adsorbent than the same materials in unactivated form. Heat treatment can be used to make adsorbents more active. Their activity can be reduced or they can be made more selective by treating the surface with water vapor or high boiling liquids, or with chemical reagents such as acids or bases.

Adsorption is most efficiently carried out when the solid adsorbent is placed in a tube and the gas mixture or solution to be separated is passed through.

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The mass sorting function of a mass spectrometer must take place in a high vacuum to avoid scattering of the focused ion beams used to separate the ions according to their M/e. Mass spectrometers were originally developed by physicists to study the mass numbers of the chemical elements. Chemists had determined atomic weights as precisely as they could by wet chemical analysis. Their work led to the development of the periodic table of the elements but raised questions which required more precise mass numbers for the elements. Using the mass spectrometer, physicists discovered that all the atoms of many elements were not identical. The atoms of a chemical element all have the same configurations of electrons surrounding the nucleus. This means that all of them have the same chemical properties. But the masses of the nuclei may differ by one or more mass numbers. Atoms with the same extranuclear electronic configuration but different masses are called isotopes. Isotopes all have the same chemical properties in spite of the fact that the mass numbers are different.

Some isotopes are radioactive, some are stable. For our purposes, the stable ones are more important. The two most abundant isotopes of chlorine have mass numbers 35 and 37. The most plentiful isotope of carbon has mass number 12, but there is a small fraction of an isotope of mass number 13. It is now possible to separate the isotopes of the elements and to produce samples of chemical compounds, such as dioxins, in which all the chlorine

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will mention only two liquid chromatography detectors because this technique is not widely used for TCDD analysis.

1. Differences in refractive index between the solvent and the sample in solution are the basis for one of the simplest LC detectors. These are completely non-specific and not extremely sensitive, but are used because of their relatively low cost and simplicity.
2. Ultraviolet absorption of sample components is often much greater than that of the solvent system. Simple ultraviolet absorption detectors measure at one wavelength chosen so that the sample components have high absorption and the solvent low absorption. These can be much more sensitive than refractive index detectors. More elaborate ones permit a choice of wavelengths, making them more widely useful and more specific.

Data Recording and Calculations As mentioned earlier, the output from various chromatography detectors is a voltage which is proportional to the concentration of the sample component exiting from the separation column at that time. This can be recorded using a strip chart recording potentiometer to give a chromatogram, a record of sample component concentrations as a function of time after sample injection. Figure (3) is an example of such a record. Visual inspection of such a record usually shows a peak caused by flow disturbances at the time of sample injection and then a peak for each resolved component of

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