Waters
Lab Highlights
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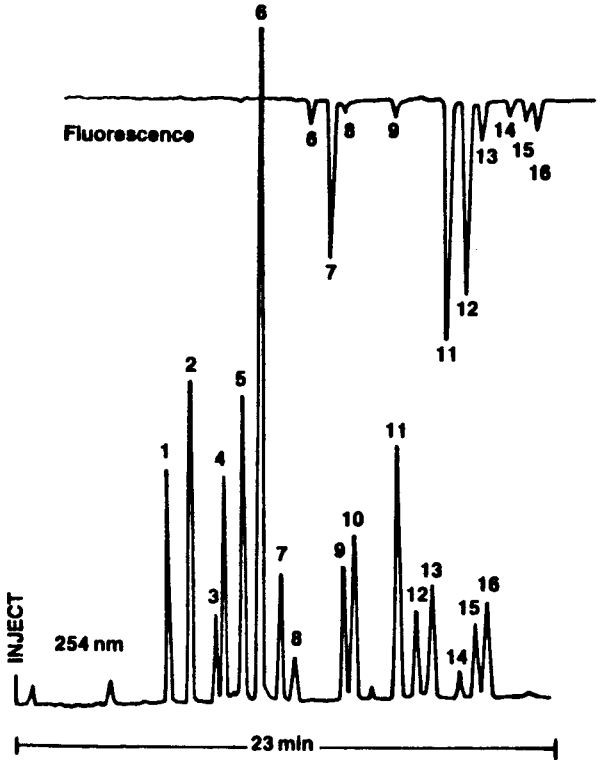
ANALYSIS OF POLYNUCLEAR AROMATIC HYDROCARBONS IN AQUEOUS SAMPLES

Polynuclear aromatic hydrocarbons, also known as PAH's or PNA's, are non-polar compounds which contain two or more fused aromatic rings. Although they have limited solubility in water, some PAH's have been found to be toxic and in some cases carcinogenic in µg/l concentrations. In 1971, the World Health Organization (W.H.O.) set a limit on the total concentration of six PAH's allowable in drinking water at 200 ng/l. These six PAH's are fluoranthene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Benzo(g,h,i)perylene and Indeno(1,2,3-cd)pyrene. The countries of the E.E.C. (European Economic Community) have subsequently adopted these W.H.O. limits for PAH's in surface drinking water. In 1976, the U.S. Environmental Protection Agency (E.P.A.) issued a list of organic compounds considered to be health hazards and which should be monitored in the environment. Among these priority pollutants are 16 PAH's.

FIGURE 1



SAMPLE: PAH Standards
COLUMN: PAH Radial-PAK™ Cartridge
GRADIENT: 40–100% CH_3CN, Hold 1 min, then linear gradient for 19 min.
FLOW RATE: 2 ml/min
DETECTOR: M 440, 254 nm
M 420, ex) 328 nm, em) 425 nm

1. Naphthalene
2. Acenaphthylene
3. Acenaphthene
4. Fluorene
5. Phenanthrene
6. Anthracene
7. Fluoranthene
8. Pyrene
9. Benzo (a) Anthracene
10. Chrysene
11. Benzo (b) Fluoranthene
12. Benzo (k) Fluoranthene
13. Benzo (a) Pyrene
14. DiBenzo (a,h) Anthacene
15. Benzo (g,h,i) Perylene
16. Indeno (1,2,3-cd) Pyrene

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The W.H.O. has a recommended method for the analysis of the six PAH's which is based on a two-dimensional, thin-layer chromatographic method. This procedure lacks precision and accuracy, involves the extraction of large volumes of water and is very time consuming. Various HPLC methods have been developed for the analysis of PAH's primarily using C_{18} type stationary phases. Waters offers a column designed specifically for the analysis of PAH's which provides improved resolution and decreased analysis time over conventional C_{18} columns. Figure 1 illustrates the separation of the 16 E.P.A. priority pollutant PAH's on a PAH Radial-PAK™ cartridge. The PAH's can be detected by UV absorbance at 254 or 280 nm or by fluorescence using a 328 nm excitation filter and a 425 nm emission filter. Several PAH's exhibit a strong fluorescence which allows their measurement in the low picogram range. Helium sparging of the mobile phase will increase fluorescent response by eliminating quenching, thus increasing some PAH peak heights by up to 3X.

Most of the problems associated with the analysis of PAH's in water are associated with the extraction step. Low recoveries can result from adsorption of some PAH's onto suspended solids in the water sample. Liquid-liquid extraction techniques using such solvents as cyclohexane and pentane can in most cases give recoveries of over 90%. SEP-PAK® C_{18} cartridges can also be used to concentrate and extract PAH's from water samples. The addition of 15% v/v isopropyl alcohol to the sample prior to SEP-PAK® cartridge extraction will help to overcome adsorption onto suspended solids and can result in recoveries of greater than 90%.

For additional informaton, see the following references:

1. Polyaromatic Hydrocarbon Analysis, Waters Associates, J89
2. Sorrell, R. K., Dressman, R. C. and McFarren, E. F., High Pressure Liquid Chromatography for the Measurement of Polynuclear Aromatic Hydrocarbons in Water. Paper presented at the Water Quality Technology Conference, Kansas City, MO, Dec 5/6, 1977.
3. "International Standards for Drinking Water," 3rd ed., World Health Organization, Geneva, Switzerland, 1971.
4. "Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants," U. S. Environmental Protection Agency, Environment Monitoring and Support Laboratory, Cincinnati, OH, April, 1977.