C34   Benzofluorene/Methylpyrene Ratios as a Source Identification Tool

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The objective of this paper is to present data in support of the use of benzofluorenes and methylpyrenes as a means of tracing environmental contamination to its source.

This presentation will impact the forensic community and/or humanity by describing how to improve the accuracy and reproducibility of environmental source identification.

Polycyclic aromatic hydrocarbons (PAHs) often drive costly site investigation and remediation work. Former manufactured gas plant (MGP) sites frequently are contaminated by PAHs from one or more sources depending on their operational histories, and in many cases the nature of environmental work at MGP sites can depend on identifying the sources of the PAHs. However, identifying the sources of PAH contamination at MGP sites is complicated by the numerous possible PAH origins. Common anthropogenic sources of PAHs include coal tar and coal tar products, refined petroleum products, MGP wastes, exhaust from heating systems, vehicular emissions, and others. PAHs also are created naturally by forest fires and, in some cases, synthetically by bacteria and algae. As PAHs weather and commingle with PAHs of other origins, as is typically the case in industrial soils and urban sediments, identifying their sources proves increasingly difficult.

Current approaches for identifying sources of PAHs in soil, groundwater, sediments, and surface water at former MGP sites have largely relied on the molecular fingerprint or the relative abundance of individual PAHs or groups of PAHs[1]. However, this approach suffers from two major problems: first, there are many sources of PAHs and their PAH patterns can be very similar, and second, environmental weathering (dissolution, evaporation, and chemical and biological transformations) can alter the PAH patterns and confound their interpretation. Recent studies have shown that certain ratios of PAHs and alkylated PAHs are relatively insensitive to environmental weathering processes and can be used to distinguish separate sources with similar PAH patterns even in weathered samples. For example, the ratio of benzo(b+c)fluorene to total monomethylpyrenes was found to vary little in coal tar-contaminated sediments that had weathered to various degrees (unpublished). The benzofluorenes/methylpyrenes ratio (BF/MP) depends on PAH formation conditions and is measurably different among different PAH sources. For example, the BF/MP ratio of a coal tar sample was found to be approximately 3.9 while that of a former MGP tar was about 1.5.
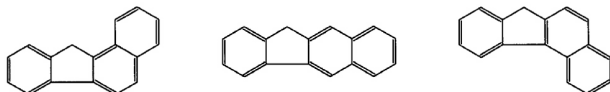
This presentation reports some of the results of research to identify effective environmental forensic methods for application at former MGP sites.[1] The application of extended PAH profiles (EPA 8270 modified) and the use of various PAH ratios, especially BF/MP ratios for the determination of PAH sources in non-aqueous phase liquids (NAPLs), soil, and sediment will be discussed.

Reference:

1.   "Chemical Source Attribution at Former MGP Sites," EPRI Technical Report 1000728, December 2000.

PAHs, Environmental Forensics, Source Identification