Technical Factsheet on: POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

List of Contaminants

As part of the Drinking Water and Health pages, this fact sheet is part of a larger publication:
National Primary Drinking Water Regulations

Drinking Water Standards
MCLG: zero mg/L
Mcl: 0.0002 mg/L
HAL(child): none

Health Effects Summary

Acute: EPA has found polycyclic aromatic hydrocarbons (PAHs) similar to benzo(a)pyrene to potentially cause the following health effects from acute exposures at levels above the MCL: red blood cell damage, leading to anemia; suppressed immune system.

Drinking water levels which are considered "safe" for short-term exposures have not been established at this time.

Chronic: Benzo(a)pyrene has the potential to cause the following health effects from long-term exposures at levels above the MCL: developmental and reproductive effects.

Cancer: There is some evidence that benzo(a)pyrene has the potential to cause cancer from a lifetime exposure at levels above the MCL.

Usage Patterns

Benzo(a)pyrene is one of a group of compounds called polycyclic aromatic hydrocarbons (PAHs), or polynuclear aromatic hydrocarbons (PNAs). They are not produced or used commercially but are ubiquitous in that they are formed as a result of incomplete combustion of organic materials.

Release Patterns

PAHs are found in exhaust from motor vehicles and other gasoline and diesel engines, emission from coal-, oil-, and wood-burning stoves and furnaces, cigarette smoke; general soot and smoke of industrial, municipal, and domestic origin, and cooked foods, especially charcoal-broiled; in incinerators, coke ovens, and asphalt processing and use.

There are two major sources of PAHs in drinking water: 1) contamination of raw water supplies from natural and man-made sources, and 2) leachate from coal tar and asphalt linings in water storage tanks and distribution lines. PAHs in raw water will tend to adsorb to any particulate matter and be removed by filtration before reaching the tap.

PAHs in tap water will mainly be due to the presence of PAH-containing materials in water storage and distribution systems. Though few data are available for estimating the potential for PAH release to water from these materials, there are reports that levels can reach 0.01 mg/L with optimum leaching conditions.

Environmental Fate

Released benzo(a)pyrene is largely associated with particulate matter, soils, and sediments. Although environmental concentrations are highest near sources, its presence in places distant from primary sources indicates that it is reasonably stable in the atmosphere and capable of long distance transport.

When released to air it may be subject to direct photolysis, although adsorption to particulates apparently can retard this process. It may also be removed by reaction with ozone (half-life 37 min) and NO2 (half-life 7 days), and an estimated half-life for reaction with photochemically produced hydroxyl radicals is 21.49 hr.

If released to water, it will be expected to adsorb very strongly to sediments and particulate matter. It will not hydrolyze. It has been shown to be susceptible to significant metabolism by microorganisms in some natural waters without use as carbon or energy source, but in most waters and in sediments it is stable towards biodegradation. BaP will be expected to undergo significant photodegradation near the surface of waters. Evaporation may be significant with a predicted half-life of 43 days. However, adsorption to sediments and particulates may significantly retard biodegradation, photodegradation, and evaporation.

If released to soil it will be expected to adsorb very strongly and will not be expected to leach to the groundwater. However, its presence in some groundwater samples indicates that it can be transported there by some mechanism. It will not hydrolyze, and evaporation from soils and surfaces is not expected to be significant. Biodegradation tests in soils have resulted in a wide range of reported half-lives: 2 days to 1.9 yr. Based on these values and the apparent lack of a significant competing fate process, biodegradation may be an important process in soils.

Benzo(a)pyrene is expected to bioconcentrate in aquatic organisms that can not metabolize it. Reported BCFs include: Oysters, 3000; Rainbow trout, 920; Bluegills, 2,657; zooplankton, 1000 to 13,000. The presence of humic acid in solution has been shown to decrease bioconcentration. Those organisms which lack a metabolic detoxification enzyme system, tend to accumulate polycyclic aromatic hydrocarbons. For example, BCFs have been found to be very low (<1) for mudsuckers, sculpins and sand dabs.

Human exposure will be from inhalation of contaminated air and consumption of contaminated food and water. Especially high exposure will occur through the smoking of cigarettes and the ingestion of certain foods (eg smoked and charcoal broiled meats and fish).

Chemical/ Physical Properties

CAS Number: 50-32-8

Color/ Form/Odor: Pale yellow needlelike crystals, faintly aromatic

M.P.: 179-179.3 C B.P.: >360 C

Vapor Pressure: >1 mm Hg at 20 C

Density/Spec. Grav.: 1.35 at 15 C

Octanol/Water Partition (Kow): Log Kow = 6.04

Solubility: 0.0038 mg/L of water at 25 C; very low solubility in water

Soil sorption coefficient: Log Koc =6.6 to 6.8; very low mobility in soil

Odor/Taste Thresholds: N/A

Bioconcentration Factor: BCFs range from <1 to 2675 in fish; expected to bioconcentrate in aquatic organisms which are unable to metabolize it.

Henry's Law Coefficient: N/A; volatilization not significant

Trade Names/Synonyms: 3,4-Benz(a)pyrene; BaP; BP

Other Regulatory Information

Monitoring For Ground/Surface Water Sources:

Initial Frequency- 4 quarterly samples every 3 years
Repeat Frequency- If no detections during initial round:
2 quarterly per year if serving >3300 persons;
1 sample per 3 years for smaller systems
Triggers - Return to Initial Freq. if detect at > 0.00002 mg/L

Analysis:

Reference Source	Method Numbers
EPA 600/4-88-039	525.1; 550; 550.1

Treatment- Best Available Technologies:
Granular Activated Charcoal

For Additional Information:

EPA can provide further regulatory and other general information:
EPA Safe Drinking Water Hotline - 800/426-4791

Other sources of toxicological and environmental fate data include:
Toxic Substance Control Act Information Line - 202/554-1404
Toxics Release Inventory, National Library of Medicine - 301/496-6531
Agency for Toxic Substances and Disease Registry - 404/639-6000