ENVIRONMENTAL CONTAMINANTS ENCYCLOPEDIA

BENZO(J)FLUORANTHENE ENTRY

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Like a library or most large databases (such as EPA's national STORET water quality database), this document contains information of variable quality from very diverse sources. In compiling this document, mistakes were found in peer reviewed journal articles, as well as in databases with relatively elaborate quality control mechanisms [366,649,940]. A few of these were caught and marked with a "[sic]" notation, but undoubtedly others slipped through. The [sic] notation was inserted by the editors to indicate information or spelling that seemed wrong or misleading, but which was nevertheless cited verbatim rather than arbitrarily changing what the author said.

Most likely additional transcription errors and typos have been added in some of our efforts. Furthermore, with such complex subject matter, it is not always easy to determine what is correct and what is incorrect, especially with the "experts" often disagreeing. It is not uncommon in scientific research for two different researchers to come up with different results which lead them to different conclusions. In compiling the Encyclopedia, the editors did not try to resolve such conflicts, but rather simply reported it all.

It should be kept in mind that data comparability is a major problem in environmental toxicology since laboratory and field methods are constantly changing and since there are so many different "standard methods" published by EPA, other federal agencies, state agencies, and various private groups. What some laboratory and field investigators actually do for standard operating practice is often a unique combination of various standard protocols and impromptu "improvements." In fact, the interagency task force on water methods concluded that [1014]:

> It is the exception rather than the rule that water-quality monitoring data from different programs or time periods can be compared on a scientifically sound basis, and that...
>
> No nationally accepted standard definitions exist for water quality parameters. The different organizations may collect data using identical or standard methods, but identify them by different names, or use the same names for data collected by different methods [1014].

Differences in field and laboratory methods are also major issues related to (the lack of) data comparability from media other than water: soil, sediments, tissues, and air.

In spite of numerous problems and complexities, knowledge is often power in decisions related to chemical contamination. It is therefore often helpful to be aware of a broad universe of conflicting results or conflicting expert opinions rather than having a portion of this information arbitrarily censored by someone else. Frequently one wants to know of the existence of information, even if one later decides not to use it for a particular application. Many would like to see a high percentage of the information available and decide for themselves what to throw out, partly because they don't want to seem uniformed or be caught by surprise by potentially important information. They are in a better position if they can say: "I knew about that data, assessed it based on the following quality assurance criteria, and decided not to use it for this application." This is especially true for users near the end of long decision processes, such as hazardous site cleanups, lengthy ecological risk assessments, or complex natural resource damage assessments.

For some categories, the editors found no information and inserted the phrase "no information found." This does not necessarily mean that no information exists; it simply means that during our efforts, the editors found none. For many topics, there is probably information "out there" that is not in the Encyclopedia. The more time that passes without encyclopedia updates (none are planned at the moment), the more true this statement will become. Still, the Encyclopedia is unique in that it contains broad ecotoxicology information from more sources than many other reference documents. No updates of this document are currently planned. However, it is hoped that most of the information in the encyclopedia will be useful for some time to come even with out updates, just as one can still find information in the 1972 EPA Blue Book [12] that does not seem well summarized anywhere else.

Although the editors of this document have done their best in the limited time available to insure accuracy of quotes as being "what the original author said," the proposed interagency funding of a bigger project with more elaborate peer review and quality control steps never materialized.

> The bottom line: The editors hope users find this document useful, but don't expect or depend on perfection herein. Neither the U.S. Government nor the National Park Service make any claims that this document is free of mistakes.

The following is one chemical topic entry (one file among 118). Before utilizing this entry, the reader is strongly encouraged to read the README file (in this subdirectory) for an introduction, an explanation of how to use this document in general, an explanation of how to search for power key section headings, an explanation of the organization of each entry, an information quality discussion, a discussion of copyright issues, and a listing of other entries (other topics) covered.

See the separate file entitled REFERENC for the identity of numbered references in brackets.

HOW TO CITE THIS DOCUMENT: As mentioned above, for critical applications it is better to obtain and cite the original publication after first verifying various data quality assurance concerns. For more routine applications, this document may be cited as:

> **Irwin, R.J., M. VanMouwerik, L. Stevens, M.D. Seese**, and **W. Basham.** 1997. Environmental Contaminants Encyclopedia. National Park Service, Water Resources Division, Fort Collins, Colorado. Distributed within the Federal Government as an Electronic Document (Projected public availability

on the internet or NTIS: 1998).

Benzo(j)fluoranthene (CAS number 205-82-3)

Brief Introduction:

Br.Class: General Introduction and Classification Information:

Benzo(j)fluoranthene is a 5-ring polyaromatic hydrocarbon (PAH) [848].

Benzo(j)fluoranthene occurs ubiquitously as a product of incomplete combustion; it also occurs in fossil fuels [847].

Although benzo(j)fluoranthene is not included as a target PAH on the expanded scan list used by the Geochemical and Environmental Research Group (GERG) Laboratory at Texas A&M [828], it has been added to some expanded scans [177]. The GERG list includes most of the PAHs recommended by the NOAA's National Status and Trends program [680].

Br.Haz: General Hazard/Toxicity Summary:

The heavier (4-, 5-, and 6-ring) PAHs, such as this one, are more persistent than the lighter (2- and 3-ring) PAHs and tend to have greater carcinogenic and other chronic impact potential [796].

Acute toxicity is rarely reported in humans, fish, or wildlife, as a result of exposure to low levels of a single PAH compound such as this one. PAHs in general are more frequently associated with chronic risks. These risks include cancer and often are the result of exposures to complex mixtures of chronic-risk aromatics (such as PAHs, alkyl PAHs, benzenes, and alkyl benzenes), rather than exposures to low levels of a single compound (Roy Irwin, National Park Service, Personal Communication, 1996, based on an overview of literature on hand). See also "PAHs as a group" entry.

No specific information found; this includes an IARC search which found no available data on the toxic effects of benzo(j)fluoranthene [847].

More information is available on a closely related and more frequently analyzed compound (see entry on benzo(k)fluoranthene).

Br.Car: Brief Summary of Carcinogenicity/Cancer Information:

The International Agency for Research on Cancer (IARC) has determined that benzo(j)fluoranthene is possibly carcinogenic to humans [788]. The Department of Health and Human Services (DHHS) has determined that benzo(j)fluoranthene may reasonably be anticipated to be a carcinogen [788].

No data are available in humans. Sufficient evidence of carcinogenicity in animals. Overall evaluation: Group 2B: The agent is possibly carcinogenic to humans [609].

EPA classification 1996 IRIS: under review [893].

Previously, both EPA and the Department of Health and Human Services (DHHS) had determined that this compound may reasonably be anticipated to be a carcinogen (Class B2, probable human carcinogen) [788,881].

Carcinogenic [40].

Phototoxicity to Daphnia magna (zooplankton) has been documented for a related compound benzo(k)fluoranthene [887]. However, no specific information could be found on carcinogenicity or phototoxicity of benzo(j)floranthene.

The debates on which PAHs and alkyl PAHs to classify as carcinogens, and the details of exactly how to perform both ecological and human risk assessments on the complex mixtures of PAHs typically found at contaminated sites, are likely to continue. There are some clearly wrong ways to go about it, but defining clearly right ways is more difficult. PAHs such as this one usually occur in complex mixtures rather than alone. Benzo(j)fluoranthene is present as a component of the total component of polynuclear aromatic compounds of the environment [609]. Perhaps the most unambiguous thing that can be said about complex PAH mixtures is that such mixtures are often carcinogenic and possibly phototoxic. One way to approach site specific risk assessments would be to collect the complex mixture of PAHs and other lipophilic contaminants in a semipermeable membrane device (SPMD, also known as a fat bag) [894,895,896], retrieve the contaminant mixture from the SPMD, then test the mixture for carcinogenicity, toxicity, and phototoxicity (James Huckins, National Biological Service, and Roy Irwin, National Park Service, personal communication, 1996).

Br.Dev: Brief Summary of Developmental, Reproductive, Endocrine, and Genotoxicity Information:

Benzo(j)fluoranthene was reported to induce mutations in Salmonella typhimurium strain TA100 (his-/his+) at a concn of 10 ug/plate in the presence of an exogenous metabolic system (a postmitochondrial supernatant from

Aroclor induced rat liver). [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V32 158 (1983).

The 9,10-dihydrodiol ... metabolite ... has been found to be mutagenic to bacterial cells in the presence of an exogenous metabolic system & to have tumor initiating activity in mouse skin. /Benzo(j)fluoranthene 9,10-dihydrodiol/ [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V32 158 (1983).

No other information found; this includes an IARC search which found no available data on the effects of benzo(j)fluoranthene on reproduction, prenatal toxicity, or teratogenicity [847].

Br.Fate: Brief Summary of Key Bioconcentration, Fate, Transport, Persistence, Pathway, and Chemical/Physical Information:

The heavier (4-, 5-, and 6-ring) PAHs, such as this one, are more persistent than the lighter (2- and 3-ring) PAHs [796].

Summary Environmental Fate/Exposure [609]:

Benzo(j)fluoranthene is a component of crude oil and a product of combustion which may be produced and released to the environment during natural fires. Emissions from petroleum refining, coal tar distillation, and the combustion of wood, coal, oil, gasoline and diesel fuels are major contributors of benzo(j)fluoranthene to the environment. Benzo(j)fluoranthene is not commercially produced in the US; however, it may be released to the environment through industrial effluents, municipal waste water treatment facilities and waste incinerators. Benzo(j)fluoranthene is expected to biodegrade very slowly and is not expected to hydrolyze in the environment. A calculated Koc range of 51,000 to 68,000, indicates benzo(j)fluoranthene will be highly immobile in soil. In aquatic systems, benzo(j)fluoranthene partitions from the water column to organic matter contained in sediments and suspended solids. Benzo(j)fluoranthene also has the potential to bioconcentrate in aquatic systems. A Henry's Law constant of 7.39X10-7 atm-cu m/mole at 25 deg C, suggests volatilization of benzo(j)fluoranthene from environmental waters will be slow. The volatilization half-lives from a model river and model pond, the latter considers the effect of adsorption, have been estimated to be 70 days and over 400 years, respectively. In the atmosphere, the vapor phase reaction with photochemically produced hydroxyl radicals (half-life of 7 hr) may be an important fate process. However, benzo(j)fluoranthene is expected to exist almost entirely in the particulate phase in ambient air. Nevertheless, benzo(j)fluoranthene may undergo direct photolysis in the atmosphere. Otherwise, washout by precipitation and gravitational settling may be important atmospheric removal mechanisms for benzo(j)fluoranthene. The most probable human exposure would be occupational exposure, which may occur through dermal contact or inhalation at places where benzo(j)fluoranthene is produced as a product of combustion. Non-occupational exposures would most likely occur via urban atmospheres, cigarette smoking, smoked and barbecued food, contaminated drinking water supplies and recreational activities at contaminated waterways. (SRC)

Synonyms/Substance Identification:

10,11-Benzofluoranthene [609,848]
Benzo-12,13-fluoranthene [609]
Dibenzo(a,jk)fluorene [609]
7,8-Benzofluoranthene [609,848]
Benz(j)fluoranthene [617]
Benzo(l)fluoranthene [617]
B(j)F [617]

Molecular Formula [609]:
C20-H12

Associated Chemicals or Topics (Includes Transformation Products):

See also individual entry:

PAHs as a group
Petroleum, General

Metabolism/Metabolites [609]:

The 9,10-dihydrodiol has been detected as a metabolite of benzo(j)fluoranthene in rat liver preparations. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT.

(Multivolume work).,p. V32 158 (1983).

The metabolites of benzo(j)fluoranthene (BjF) as formed in vitro using the 9000 from Aroclor-pretreated rats have been identified. Two dihydrodiols, trans-4,5-dihydroxybenzo(j)fluoranthene and trans-9,10-dihydro-9,10-dihydroxybenzo(j)fluoranthene have been identified as major metabolites by comparison of their spectral and chromatographic properties with those of pure synthetic standards. There was no evidence that any of the isomeric 2,3-dihydrodiol was formed as a metabolite of benzo(j)fluoranthene under these conditions. Neither of the metabolic dihydrodiols of benzo(j)fluoranthene were formed with a high degree of steroselectivity. The enantiomeric purity of te 4,5-dihydrodiol was 20% while that of the 9,10-dihydrodiol was 46%. At least four phenols were detected among the metabolites of benzo(j)fluoranthene These were identified as 3-,4-,6- and 10-hydroxybenzo(j)fluoranthene based upon comparison of their UV spectra and HPLC retention times with those of synthetic reference standards. Benzo(j)fluoranthene-4,5-dione was also identified as a metabolite under these incubation conditions. [Rice JE et al; Chem-Biol Interact 63 (3) 227-38 (1987).

The metabolism of benzo(j)fluoranthene (BjF) in vivo in mouse skin was investigated, trans-4,5-dihydro-4,5-dihydroxybenzo(j)fluoranthene (BjF-4,5-diol) and trans-9,10-dihydro-9,10-dihydroxybenzo(j)fluoranthene (BjF-9,10-diol) have been identified as major metabolites. In addition, 4- and 0-hydroxybenzol(j) fluoranthene and benzo(j)fluoranthene-4,5-dione have been tentatively identified among the metabolites formed in vivo in mouse skin. The enantiomeric purity of the metabolic dihydrodiols of benzo(j)fluoranthene as formed in vivo in mouse skin was determined. The major enantiomeric of benzo(j)fluoranthene-4,5-diol was present in 57-62% enantiomeric excess while that of benzo(j)fluoranthene-9,10-diol was present in 66-71% enantiomeric excess. In each case the later-eluting enantiomer on chiral stationary-phase high performance liquid chromatography predominated. The tumor-initiating activity of trans-2,3-dihydro-2,3-dihydroxybenzol(j) fluoranthene (BjF-2,3-diol), trans-4,5-Dihydro-4,5-dihydroxybenzol(j) fluoranthene, trans-9,10-dihydro-9,10-dihydroxybenzol(j)fluoranthene, and benzo(j)fluoranthene was evaluated on the skin of female CD-1 mice. As a total initiation dose of 3 mumol/mouse trans-4,5-Dihydro-4,5-dihydroxybenzo(j)fluoranthene resulted in a 100% incidence of tumor-bearing mice with 5.0 tumors/mouse. In comparison, benzo(j)fluoranthene-9,10-diol elicited a 60% incidence of tumor-bearing mice with 1.7 tumors/mouse, while benzo(j)fluoranthene-2,3-diol was inactive. At the same dose, benzo(j)fluoranthene gave rise to a 90% incidence of tumor-bearing mice with 7.8 tumors/mouse. At a 1 mumol dose, trans-4,5-Dihydro-4,5-dihydroxybenzo(j) fluoranthene induced a 78% incidence of tumor-bearing mice with 4.5 tumors/mouse while benzo(j)fluoranthene gave rise to a 70% tumor incidence with 3.4 tumors/mouse. These studies indicate that while trans-9,10-dihydro-9,10-dihydroxybenzo(j) fluoranthene could contribute to the overall tumorigenic activity of benzo(j)fluoranthene in mouse skin, trans-4,5-Dihydro-4,5-dihydroxybenzol(j)fluoranthene is a more potent tumor initiator in the target tissue. [Rice JE et al; Cancer Res 47 (23) 6166-70 (1987).

Water Data Interpretation, Concentrations and Toxicity (All Water Data Subsections Start with "W."):

W.Low (Water Concentrations Considered Low):

No information found.

More information is available on a closely related and more frequently analyzed compound (see entry on benzo(k)fluoranthene).

W.High (Water Concentrations Considered High):

No information found.

More information is available on a closely related and more frequently analyzed compound (see entry on benzo(k)fluoranthene).

W.Typical (Water Concentrations Considered Typical):

Benzo(j)fluoranthene concentrations are 0.6-1.2 ng/L in surface water, 2.6-11.1 ng/L in rainwater, 0.6-1.3 ng/L in subterranean water, 0.07 ng/L in tap water, and 0.02-29.6 ug/L in waste water [847].

Water Concentrations [609]:

> In drinking-water, concn ... 1.0-14.0 Ug/cu m b(j)f. In river & lake water ... (53-17,840 ug/cu m) ... Depending on kind of water tested (whether or not it contained industrial effluents or bituminous contamination); while in surface water 4.6-150 Ug/cu m have been found. ... 29.6 mg/cu m ... In sewage water ... [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V3 85 (1973).

GROUNDWATER: Benzo(j)fluoranthene was detected in a coal tar contaminated aquifer in St Louis Park, MN(1). [(1) Rostad CE et al; Chemosphere 14: 1023-36 (1985) (2) Zoeteman BCJ et al; Sci Total Environ 21: 187-202 (1981).

RAIN/SNOW: Rain water in Portland, OR contained benzo(j)fluoranthene at concn of 0.26 and 2.9 ng/L for 2 of 7 samples collected between Feb 12 and April 12, 1984(1). [(1) Ligocki MP et al; Atmos Environ 19: 1609-17 (1985).

Effluents Concentrations [609]:

Benzo(j)fluoranthene was identified as a stack emission and a component of fly ash from municipal waste incinerators(6). Effluent from the Bekkelaget sewage treatment plant benzo(j)fluoranthene was at a concn less than 3 ng/L after dry and rainy days in Nov 1979(1). Residential coal and oil burning emits benzo(j)fluoranthene(2). Gasoline fueled vehicles also emit benzo(j)fluoranthene(2). A carbon black combustion product and coal tar contained benzo(j)fluoranthene at a concn of 20 ug/g and 5.7 mg/g, respectively(3). The effluent channel from a coking plant contained benzo(j)fluoranthene in the sediments at concn of 23 ug/g(4). Domestic fire soot from wood and coal contained benzo(j)fluoranthene at concn ranging from 6 to 117 ug/cu m with an average of 60 ng/cu m for 12 samples collected at Christchurch, New Zealand(5). [(1) Kveseth K et al; Chemosphere 11: 623-639 (1982) (2) Daisey JM et al; J Air Pollut Control Assoc 36: 17-33 (1986) (3) Nishioka M et al; Environ Sci Technol 20: 1023-7 (1986) (4) Griest WH; pp. 173-83 in Hydrocarbon Halo Hydrocarbon Aquatic Environ Afghan BK, Mackay D (ed) NY, NY Plenum Press (1980) (5) Cretney JR et al; Environ Sci Technol 19: 397-404 (1985) (6) Eiceman GA et al; Anal Chem 51: 2343-50 (1979).

W.Concern Levels, Water Quality Criteria, LC50 Values, Water Quality Standards, Screening Levels, Dose/Response Data, and Other Water Benchmarks:

W.General (General Water Quality Standards, Criteria, and Benchmarks Related to Protection of Aquatic Biota in General; Includes Water Concentrations Versus Mixed or General Aquatic Biota):

No information found.

More information is available on a closely related and more frequently analyzed compound (see entry on benzo(k)fluoranthene).

W.Plants (Water Concentrations vs. Plants):

No information found.

W.Invertebrates (Water Concentrations vs. Invertebrates):

No information found.

W.Fish (Water Concentrations vs. Fish):

No information found.

W.Wildlife (Water Concentrations vs. Wildlife or Domestic Animals):

No information found.

W.Human (Drinking Water and Other Human Concern Levels):

Drinking Water Health Advisories in IRIS: empty [893].

W.Misc. (Other Non-concentration Water Information):

No information found.

Sediment Data Interpretation, Concentrations and Toxicity (All Sediment Data Subsections Start with "Sed."):

Sed.Low (Sediment Concentrations Considered Low):

No information found.

Sed.High (Sediment Concentrations Considered High):

No information found.

Sed.Typical (Sediment Concentrations Considered Typical):

Sediment Concentrations [609]:

Sediment from the Duwamish River delta, WA contained benzofluoranthenes at an average concn of 2440 ng/g(1). Sediments from three sites in Eagle Harbor and one at President Point, WA contained benzofluoranthenes at an average concn of 1800, 3000, 290 and 100 ng/g for 4, 9, 2 and 1 sample(s) respectively(2). Benzo(j)fluoranthene was also detected in sediments from the Elizabeth River, VA(3,4) and the Black River, OH(5). Benzo(j)fluoranthene was detected in the sediments of 5 small lakes in Southern Finland(6). Sediments from Saguenay Fjord, Canada also contained benzo(j)fluoranthene(7). Two of 3 sediment samples from the NY, NY harbor contained benzo(j)fluoranthene concn of 60 and 70 ng/g(8). [(1) Varanasi U et al; Environ Sci Technol 4: 721-6 (1985) (2) Malins DC et al; Carcinogenesis 6: 1463-9 (1985) (3) Merrill EG, Wade TL; Eviron Sci Technol 19: 597-603 (1985) (4) Bieri R et al; Intern J Environ Anal Chem 26: 97-113 (1986) (5) West WR et al; Environ Sci Technol 22: 224-8 (1988) (6) Wickstrom K, Tolonen K; Water Air Soil Pollut 32: 155-75 (1987) (7) Martel L: Bull Environ Contam Toxicol 37: 133-40 (1986) (8) Farrington JW, Westall J; NATO ASI Ser C 172: 361-425 (1986).

Sed.Concern Levels, Sediment Quality Criteria, LC50 Values, Sediment Quality Standards, Screening Levels, Dose/Response Data and Other Sediment Benchmarks:

Sed.General (General Sediment Quality Standards, Criteria, and Benchmarks Related to Protection of Aquatic Biota in General; Includes Sediment Concentrations Versus Mixed or General Aquatic Biota):

AET: The apparent effects threshold (AET) concentrations for benzofluoranthenes (as a group) in sediments proposed for Puget Sound ranged from 3.2 mg/kg dry weight (microtox) to 9.9 mg/kg dry weight (benthic) [416]. Although the authors of the Puget Sound AETs have cautioned that Puget Sound AETs may not be appropriate for comparison with data from other geographic areas, so few concern levels for this chemical have been published that the proposed Puget Sound concern level is included in this text as a reference item.

NOTE: Even lower concentrations of this PAH may be of concern related to its contribution to "total or total carcinogenic PAH" sums (see "PAHs as a group" entry).

St. Lawrence River Interim Freshwater Sediment Criteria for for benzofluoranthenes (as a group), 1992. No effect level: 300 ug/kg dry weight [761].

Sed.Plants (Sediment Concentrations vs. Plants):

No information found.

Sed.Invertebrates (Sediment Concentrations vs. Invertebrates):

No information found.

Sed.Fish (Sediment Concentrations vs. Fish):

No information found.

Sed.Wildlife (Sediment Concentrations vs. Wildlife or Domestic Animals):

No information found.

Sed.Human (Sediment Concentrations vs. Human):

No information found.

Sed.Misc. (Other Non-concentration Sediment Information):

No information found.

Soil Data Interpretation, Concentrations and Toxicity (All Soil Data Subsections Start with "Soil."):

Soil.Low (Soil Concentrations Considered Low):

No information found.

Soil.High (Soil Concentrations Considered High):

No information found.

Soil.Typical (Soil Concentrations Considered Typical):

No information found.

Soil.Concern Levels, Soil Quality Criteria, LC50 Values, Soil Quality Standards, Screening Levels, Dose/Response Data and Other Soil Benchmarks:

Soil.General (General Soil Quality Standards, Criteria, and Benchmarks Related to Protection of Soil-dwelling Biota in General; Includes Soil Concentrations Versus Mixed or General Soil-dwelling Biota):

No information found.

More information is available on a closely related and more frequently analyzed compound (see entry on benzo(k)fluoranthene).

Soil.Plants (Soil Concentrations vs. Plants):

No information found.

Soil.Invertebrates (Soil Concentrations vs. Invertebrates):

No information found.

Soil.Wildlife (Soil Concentrations vs. Wildlife or Domestic Animals):

No information found.

Soil.Human (Soil Concentrations vs. Human):

No information found.

Soil.Misc. (Other Non-concentration Soil Information):

No information found.

Tissue and Food Concentrations (All Tissue Data Interpretation Subsections Start with "Tis."):

Note: More information is available on a closely related and more frequently analyzed compound (see entry on benzo(k)fluoranthene).

Tis.Plants:

A) As Food: Concentrations or Doses of Concern to Living Things Which Eat Plants:

No information found.

B) Body Burden Residues in Plants: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

No information found.

Tis.Invertebrates:

A) As Food: Concentrations or Doses of Concern to Living Things Which Eat Invertebrates:

No information found.

B) Concentrations or Doses of Concern in Food Items Eaten by Invertebrates:

No information found.

C) Body Burden Residues in Invertebrates: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

No information found.

Tis.Fish:

A) As Food: Concentrations or Doses of Concern to Living Things Which Eat Fish (Includes FDA Action Levels for Fish and Similar Benchmark Levels From Other Countries):

No information found.

B) Concentrations or Doses of Concern in Food Items Eaten by Fish:

No information found.

C) Body Burden Residues in Fish: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

No information found.

Tis.Wildlife: Terrestrial and Aquatic Wildlife, Domestic Animals and all Birds Whether Aquatic or not:

A) As Food: Concentrations or Doses of Concern to Living Things Which Eat Wildlife, Domestic Animals, or Birds:

No information found.

B) Concentrations or Doses of Concern in Food Items Eaten by Wildlife, Birds, or Domestic Animals (Includes LD50 Values Which do not Fit Well into Other Categories, Includes Oral Doses Administered in Laboratory Experiments):

No information found.

C) Body Burden Residues in Wildlife, Birds, or Domestic Animals: Typical, Elevated, or of Concern Related to the Well-being of the Organism Itself:

No information found.

Tis.Human:

A) Typical Concentrations in Human Food Survey Items:

Food Survey Results [609]:

In gas-broiled fish traces of up to 0.5 ug/kg b(j)f could be found ... while smoked or dried fish (wood smoke) could contain as much as 23 ug/kg ... In the smoke of gas- & electric-broiled fish b(j)f was also detected ... Fresh sausages contained 0.18 Ug/kg, & when grilled or fried, up to 15 ug/kg. In olive oil, plant cooking fat, plant oil & coconut oil, concn ranged from 0.8-4.4 Ug/kg, & in margarine from 2.3-10.5 ug/kg, the concn being reduced by treatment with activated charcoal & steam. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V3 85 (1973).

Twenty-one of 25 samples of margarines, butter and vegetable oils contained benzo(j)fluoranthene at concn ranging from 0.05 to 91.0 ug/kg with an average of 5.9 ug/kg(1). Japanese horse mackerel contained benzo(j)fluoranthene for 3 different methods of preparation at concn of 5-23, 5 and 2 ppb(2). Benzo(j)fluoranthene was contained in smoke beef patties at concn ranging from 5 to 24 ug/kg(3). [(1) Hopia A et al; JAOCS 63: 889-93 (1986) (2) Lo M, Sandi E; Res Rev 69: 35- 86 (1978) (3) Maga JA; J Agric Food Chem 34: 249-51 (1986).

B) Concentrations or Doses of Concern in Food Items Eaten by Humans (Includes Allowable Tolerances in Human Food, FDA, State and Standards of Other Countries):

No information found. No slope or RfD data in IRIS [893].

C) Body Burden Residues in Humans: Typical, Elevated, or of Concern Related to the Well-being of Humans:

No information found.

Tis.Misc. (Other Tissue Information):

No information found.

Bio.Detail: Detailed Information on Bioconcentration, Biomagnification, or Bioavailability:

Bioconcentration factor, log BCF: 0.914 for a polychaete [848].

Bioconcentration [609]:

Based on an estimated water solubility of 6.76X10-3 mg/L at 25 deg C(1) and an estimated log Kow of 6.12(2), the log BCF of benzo(j)fluoranthene has been calculated to range from 4.01 to 4.42 from various regression-derived equations(3,SRC). These log BCF values suggest benzo(j)fluoranthene has the potential to bioconcentrate in aquatic systems(SRC). [(1) PCCHEM; PCGEMS Graphical Exposure Modeling System USEPA (1987) (2) CLOGP; PCGEMS Graphical Exposure Modeling System USEPA (1986) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods NY: McGraw-Hill p. 5-4, 5-10 (1982).

Interactions:

No information found.

Uses/Sources:

See Chem.Detail section below for some benzo(j)fluoranthene concentrations in petroleum products.

There is no commercial production or known use of this compound [609].

Major Uses [609]:

Experimental carcinogen
Biochemical research

Natural Occurring Sources [609]:

/Benzo(j)fluoranthene/ occurs in fossil fuels. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V32 156 (1983).

Benzo(j)fluoranthene is a natural component of crude oil(1) and coal tar(2). Benzo(j)fluoranthene is also a product of combustion and can be released to the environment via natural fires associated with lightening, volcanic activity, and spontaneous combustion(SRC). [(1) Elliott JJ, Melchior MT; Kirk-Othmer Encycl Chem Tech 3rd NY,NY: Wiley 17: 119-31 (1982) (2) Gaydos RM; Kirk-Othmer Encylc Chem Tech 3rd NY,NY: Wiley 15: 698-719 (1981).

Artificial Sources [609]:

Benzo(J)fluoranthene is formed by pyrolysis of naphthalene at 750-770 deg c, of anthracene at 700-850 deg c, of tobacco constituents dotriacontane & stigmasterol at 700 deg c, & of carbohydrates, amino acids & fatty acids at 700 deg c (400-3200 ug/kg), but not at 500 deg c. [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V3 84 (1973).

... /Include/ soot ... Coal-tar ... & ... Creosote oil ... [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V3 84 (1973).

Benzo(j)fluoranthene occurs ubiquitously as a product of incomplete combustion ... exhaust from gasoline engines (11-27 ug/l fuel). [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V32 156 (1983).

An annual emission of 1850 kg benzo(a)pyrene from petrol engine vehicles has been calculated in West Germany. The PAH contents of exhaust condesate incl benzo(j)fluoranthene: 94 ug/g. [Grimmer G; IARC SCI Publ, Vol 16, ISS Air pollut cancer man, proc hanover int carcinog meet, 2nd, 1977, Pages 29-39.

Benzo(j)fluoranthene may be emitted to the environment by effluents from petroleum refining and coal tar distillation(1-2). The combustion of wood, coal, oil, gasoline and diesel fuels can release benzo(j)fluoranthene to the atmosphere(3). The smoking of cigarettes also releases benzo(j)fluoranthene to the air(3). Benzo(j)fluoranthene is not commercially produced in the US(3); however, benzo(j)fluoranthene may be released to the environment through industrial effluents(4), municipal waste water treatment facilities(5) and waste incinerators(6). [(1) Gaydos RM; Kirk-Othmer Encycl Chem Tech 3rd NY, NY: Wiley 15: 698-719 (1981) (2) Snider EH, Manning FS; Environ Int 7: 237-58 (1982) (3) IARC; Polynuclear Aromatic Compounds. Part 1 32: 155-61 (1972) (4) Griest WH; pp. 173-83 in Hydrocarbon Halo Hydrocarbon Aquatic Environ Afghan BK, Mackay D (ed) NY NY Plenum Press (1980) (5) Kveseth K et al; Chemosphere 11: 623-639 (1982) (6) Eiceman GA et al; Anal Chem 51: 2343-50 (1979).

Forms/Preparations/Formulations:

No information found.

Chem.Detail: Detailed Information on Chemical/Physical Properties:

Solubilities:

In water: 0.0025 mg/L at 25 degrees C [848].

Insol in water; slightly sol in alc, acetic acid [Weast, R.C. (ed.). Handbook of Chemistry and Physics. 60th ed. Boca Raton, Florida: CRC Press Inc., 1979.,p. C-180] [609].

Sol in hydrogen sulfide on heating [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V3 83 (1973)] [609].

Vapor Pressure:

1.50X10-8 mm Hg at 25 deg C [Eisenreich SJ et al; Environ Sci Technol 15: 30-8 (1981)] [609].

Melting Point:

166 DEG C [Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. C-126] [609].

Boiling Point: 480 degrees C [848].

Molecular Weight:

252.32 [Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. C-126] [609].

Octanol/Water Partition Coefficient:

Estimated log Kow of 6.12. [CLOGP; PCGEMS Graphical Exposure Modeling System USEPA (1986)] [609].

log Kow: 6.44 [848]

Color/Form:

Yellow plates from alcohol, needles from acetic acid [Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. C-126] [609].

Orange needles from benzene & alc [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V3 83 (1973)] [609].

Benzo(j)fluoranthene concentrations in South Louisiana crude and Kuwait crude were <0.9 and <1 mg/kg (ppm), respectively [177].

Benzo(j)fluoranthene concentration is 9.95 mg/kg in used motor oils and 7.4 mg/kg in crude oils [847].

Benzofluoranthenes concentration in Used Engine Oil [519]: 46.0 ppm. Reprinted with permission from "Environmental Toxicology and Chemistry", Volume 12(11), C. Upshall, J.F. Payne, and J. Hellou, "Induction of MFO Enzymes and Production of Bile Metabolites in Rainbow Trout (Oncorhynchus mykiss) Exposed to Waste Crankcase Oil." Copyright 1993 SETAC.

Fate.Detail: Detailed Information on Fate, Transport, Persistence, and/or Pathways:

Environmental Fate [609]:

Terrestrial fate: Limited soil grab sample data suggests the biodegradation of benzo(j)fluoranthene will be very slow(1). Benzo(j)fluoranthene is not expected to undergo hydrolysis in soils. Yet, benzo(j)fluoranthene absorbs UV light in the environmentally relevant range (>290 nm), with lambda max of 291, 306, 317, 331, 362, 373 and 382 nm in cyclohexane(2). Therefore, benzo(j)fluoranthene may potentially undergo photolysis in sunlit media. A calculated Koc range of 51000 to 68000(3), indicates benzo(j)fluoranthene will be highly immobile in soil(4). An estimated Henry's Law constant of 7.39X10-7 atm-cu m/mole at 25 deg C(5), suggests the volatilization of benzo(j)fluoranthene from moist soils will not be important(3). [(1) Bossert ID et al; Applied Environ Microbial 47: 763-7 (1984) (2) IARC; Polynuclear Aromatic Compounds. Part 1 32: 155-61 (1972) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods NY: McGraw-Hill p. 4-9 (1982) (4) Swann RL et al; Res Rev 85: 16-28 (1983) (5) Hine J, Mookerjee PK; J Org Chem 40: 292-8 (1975).

AQUATIC FATE: Benzo(j)fluoranthene is not expected to undergo hydrolysis in environmental waters. Yet, benzo(j)fluoranthene absorbs UV light in the environmentally relevant range (>290 nm), with lambda max of 291, 306, 317, 331, 362, 373 and 382 nm in cyclohexane(1). Therefore, benzo(j)fluoranthene may potentially undergo photolysis in sunlit water. Monitoring data and an estimated Koc ranging in the highly immobile class for soil(2), indicates benzo(j)fluoranthene will partition from the water column to organic matter contained in sediments and suspended solids. Benzo(j)fluoranthene also has the potential to bioconcentrate in aquatic systems. A Henry's Law constant of 7.39X10-7 atm-cu m/mole at 25 deg C(3) suggests volatilization of benzo(j)fluoranthene from environmental waters will be slow(4). Based on this Henry's Law constant, the volatilization half-life from a model river has been estimated to be 79 days(4,SRC).

The volatilization half-life from an model pond, which considers the effect of adsorption, has been estimated to be over 400 years(5,SRC). [(1) IARC; Polynuclear Aromatic Compounds. Part 1 32: 155-61 (1972) (2) Swann RL et al; Res Rev 85: 16-28 (1983) (3) Hine J, Mookerjee PK; J Org Chem 40: 292-8 (1975) (4) Lyman WJ et al; Handbook of Chemical Property Estimation Methods NY: McGraw-Hill p. 15-15 to 15-29 (1982) (5) USEPA; EXAMS II Computer Simulation (1987).

Atmospheric fate: Benzo(j)fluoranthene absorbs UV light in the environmentally relevant range (>290 nm), with lambda max of 291, 306, 317, 331, 362, 373 and 382 nm in cyclohexane(1). Therefore, benzo(j)fluoranthene may potentially undergo photolysis in ambient air. If released to the atmosphere as a gas, the vapor phase reaction of benzo(j)fluoranthene with photochemically produced hydroxyl radicals is likely to be an important fate process. The rate constant for the vapor-phase reaction of benzo(j)fluoranthene with photochemically produced hydroxyl radicals has been estimated to be 58.4X10-12 cu cm/molecule-sec at 25 deg C; which corresponds to an atmospheric half-life of about 7 hours at an atmospheric concn of 5X10+5 hydroxyl radicals per cu cm(2). However, based upon a calculated vapor pressure of 1.50X10-8 mm Hg at 25 deg C(SRC), benzo(j)fluoranthene is expected to exist almost entirely in the particulate phase in ambient air(3). Consequently, washout by precipitation and gravitational settling may be important atmospheric removal mechanisms for benzo (j)fluoranthene(SRC). [(1) IARC; Polynuclear Aromatic Compounds. Part 1 32: 155-61 (1972) (2) Atkinson R; Intern J Chem Kin 19: 799-828 (1987) (3) Eisenreich SJ et al; Environ Sci Technol 15: 30-8 (1981).

Environmental Transformations
Biodegradation [609]:

After 1,280 days in soil treated with oil sludge, 79% of the original benzo(j)fluoranthene was recovered(1). [(1) Bossert ID et al; Applied Environ Microbial 47: 763-7 (1984).

Abiotic Degradation [609]:

Polycyclic aromatic hydrocarbons are generally resistant to hydrolysis(1). Therefore, benzo(j)fluoranthene probably will not undergo hydrolysis in the environment. Benzo(j)fluoranthene absorbs UV light in the relevant range (>290 nm), with lambda max of 291, 306, 317, 331, 362, 373 and 382 nm in cyclohexane(3). Therefore, benzo(j)fluoranthene may potentially undergo photolysis in sunlit media. The rate constant for the vapor-phase reaction of benzo(j)fluoranthene with photochemically produced hydroxyl radicals has been estimated to be 58.4X10-12 cu cm/molecule-sec at 25 deg C; which corresponds to an atmospheric half-life of about 7 hours at an atmospheric concn of 5X10+5 hydroxyl radicals per cu cm(2). [(1) Lyman WJ et al; Handbook of Chemical Property Estimation Methods NY: McGraw-Hill p. 7-4 (1982) (2) Atkinson R; Intern J Chem Kin 19: 799-828 (1987) (3) IARC; Polynuclear Aromatic Compounds. Part 1 32: 155-61 (1972).

Soil Adsorption/Mobility [609]:

Based on an estimated water solubility of 6.76X10-3 mg/L at 25 deg C(1) and an estimated log Kow of 6.12(2), the Koc of benzo(j)fluoranthene has been calculated to range from 51,000 to 68,000 from various regression-derived equations(4,SRC). These Koc values indicate benzo(j)fluoranthene will be highly immobile in soil(4). [(1) PCCHEM; PCGEMS Graphical Exposure Modeling System USEPA (1987) (2) CLOGP; PCGEMS Graphical Exposure Modeling System USEPA (1986) (3) Lyman WJ et al; Handbook of Chemical Property Estimation Methods NY: McGraw-Hill p. 4-9 (1982) (4) Swann RL et al; Res Rev 85: 16-28 (1983).

Volatilization from Water/Soil [609]:

The Henry's Law constant of 7.39X10-7 atm-cu m/mole at 25 deg C for benzo(j)fluoranthene has been estimated using a bond contribution method(1). Based upon this Henry's Law constant, volatilization of benzo(j)fluoranthene from environmental waters should be very slow(2). The volatilization half-life from a model river (1 meter deep flowing 1 m/sec with a wind speed of 3 m/sec) has been estimated to be 79 days(3,SRC). The volatilization half-life from a model pond, which considers the effect of adsorption, has been estimated to be over 400 years(3,SRC). [(1) Hine J, Mookerjee PK; J Org Chem 40: 292-8 (1975) (2) Lyman WJ et al; Handbook of Chemical Property Estimation Methods NY: McGraw-Hill p. 15-15 to 15-29 (1982) (3) USEPA; EXAMS II Computer Simulation (1987).

Laboratory and/or Field Analyses:

Recommended detection limits:

Most of the PAH methods which have been commonly used historically for routine monitoring, including PAH parent compound standard methods:

EPA 8270 (8270 includes several PAH parent compounds along with a long list of other organics) for solid waste/RCRA applications [1013], and

EPA NPDES method 610 as specified in 40 CFR Part 136 (method 610 includes 16 PAH parent compounds) [1010],

EPA method 625 for Base/Neutral Extractables (method 625 includes several PAH parent compounds along with a long list of other organics) as specified in 40 CFR Part 136 [1010],

are all inadequate for generating scientifically defensible information for Natural Resource Damage Assessments [468]. These standard EPA scans do not cover important alkyl PAHs and do not utilize low-enough detection limits. When biological effects, ecological risk assessment, damage assessment, or bio-remediation are being considered, detection limit should be no higher than 1-10 ng/L (ppt) for water and 1 ug/kg (ppb) dry weight for solids such as tissues, sediments, and soil.

Note: Utilizing up to date techniques, many of the better labs can use detection limits of 0.3 to 1 ppb for tissues, sediments, and soils. When no biological resources are at risk, detection limits for solids should nevertheless generally not be above 10 ppb. One reason that low detection limits are needed for PAHs is that so many of the criteria, standards, and screening benchmarks are in the lower ppb range (see various entries on individual PAHs).

In the past, many methods have been used to analyze for PAHs [861,1010,1013]. However, recent (1991) studies have indicated that EPA approved methods used for oil spill assessments (including total petroleum hydrocarbons method 418.1, semivolatile priority pollutant organics methods 625 and 8270, and volatile organic priority pollutant methods 602, 1624, and 8240) are all inadequate for generating scientifically defensible information for Natural Resource Damage Assessments [468]. These general organic chemical methods are deficient in chemical selectivity (types of constituents analyzed) and sensitivity (detection limits); the deficiencies in these two areas lead to an inability to interpret the environmental significance of the data in a scientifically defensible manner [468].

For risk, damage assessment, drinking water, or to determine if biodegradation has occurred, the NOAA expanded scan for PAHs and alkyl PAHs [828], or equivalent rigorous and comprehensive scans. (such as SW-846 method 8270 modified for Selective Ion Mode detection limits and an equivalent list of parent compound and alkyl PAH analytes), are recommended.

If a Park Service groundwater investigation at Colonial National Historical Park performed in response to contamination by Fuel Oil 5 had utilized EPA semi-volatile scan 8270 or any of the other typical EPA scans (625, etc.) all of which only include parent compounds and typically utilize detection limits in the 170-600 ppb range, the false conclusion reached would have been that no PAHs were present in significant (detection limit) amounts. This false negative conclusion would have been made because the parent compound PAHs present constituted only 7.6% of the PAHs detected in groundwater by the expanded scan [828], and the highest concentration found for any parent compound was 8.4 ppb, far below the detection limits used on the older standard EPA scans. Utilizing the NOAA protocol expanded scan [828], it was determined that 92.4% of the total concentration values of the PAHs detected in groundwater were alkyl PAHs, and that all 39 PAHs and alkyl PAHs were present. Of course, all 39 PAHs were also present in the fresh product, in much higher concentrations, and also having alkyl compounds with the highest percentage of higher values compared to parent compounds (see Chem.Detail section in separate "PAHs as a group" entry for more details).

In a similar vein, if the Park Service sediment investigation at Petersburg National Historical Battlefield (see Chem.Detail section in separate "PAHs as a group" entry; this study was performed in response to contamination by Diesel) had utilized EPA semi-volatile scan 8270 or any of the other typical EPA scans (625, etc.), all of which only include parent compounds and often utilize detection limits no lower than the 170-600 ppb range, the false conclusion reached would have been that only one PAH was present in significant (detection limit) amounts. This false negative conclusion would have been made because the parent compound PAHs present constituted only 2.4% of the PAHs detected in sediments, and the highest concentration found for any parent compound except pyrene was 85.5 ppb, far below the detection limits used on the older standard EPA scans. Pyrene was 185 ppb, which would have been non-detected on many of the EPA scans, but not all. However, utilizing the NOAA protocol expanded scan [828], it was determined that 97.6% of total quantity of PAHs detected in sediments were alkyl PAHs, and that all 39 PAHs and alkyl PAHs were present in these sediments.

When taking sediment samples for toxic organics such as PCBs, PAHs, and organochlorines, one should also routinely ask for total organic carbon analyses so that sediment values may be normalized for carbon. This will allow comparison with the newer EPA interim criteria [86,127]. TOC in sediments influences the dose at which many compounds are toxic (Dr. Denny Buckler, FWS Columbia, personal communication).

In some cases (where the expanded scans are too expensive) an alternative recommendation is that one screen sediments with a size-exclusion high-performance liquid chromatography (HPLC)/fluorescence method. The utility and practicality of the HPLC bile and sediment screening analyses were demonstrated on board the NOAA R/V Mt. Mitchell during the Arabian Gulf Project. Estimates of petroleum contamination in sediment and fish were available rapidly, allowing modification of the sampling strategy based on these results [522].

Variation in concentrations of organic contaminants may sometimes be due to the typically great differences in how individual investigators treat samples in the field and in the lab rather than true differences in environmental concentrations. This is particularly true for volatiles and for the relatively lighter semi-volatiles such as the naphthalene PAHs, which are so easily lost at various steps along the way. Contaminants data from different labs, different states, and different agencies, collected by different people, are often not very comparable. In fact, as mentioned in the disclaimers section at the top of this entry, the interagency task force on water methods concluded that [1014]:

> It is the exception rather than the rule that water-quality monitoring data from different programs or time periods can be compared on a scientifically sound basis, and that...
>
> No nationally accepted standard definitions exist for water quality parameters. The different organizations may collect data using identical or standard methods, but identify them by different names, or use the same names for data collected by different methods [1014].

As of 1997, the problem of lack of data comparability (not only for water methods but also for soil, sediment, and tissue methods) between different "standard methods" recommended by different agencies seemed to be getting worse, if anything, rather than better. The trend in quality assurance seemed to be for various agencies, including the EPA and others, to insist on quality assurance plans for each project. In addition to quality control steps (blanks, duplicates, spikes, etc.), these quality assurance plans call for a step of insuring data comparability [1015,1017]. However, the data comparability step is often not given sufficient consideration. The tendency of agency guidance (such as EPA SW-846 methods and some other new EPA methods for bio-concentratable substances) to allow more and more flexibility to select options at various points along the way, makes it harder in insure data comparability or method validity. Even volunteer monitoring programs are now strongly encouraged to develop and use quality assurance project plans [1015,1017].

At minimum, before using contaminants data from diverse sources, one should determine that field collection methods, detection limits, and lab quality control techniques were acceptable and comparable. The goal is that the analysis in the concentration range of the comparison benchmark concentration should be very precise and accurate.

It should be kept in mind that quality control field and lab blanks and duplicates will not help in the data quality assurance goal as well as intended if one is using a method prone to false negatives. Methods may be prone to false negatives due to the use of detection limits that are too high, the loss of contaminants through inappropriate handling, or the use of an inappropriate methods such as many of the EPA standard scans. This is one reason for using the NOAA expanded scan for PAHs [828]; or method 8270 [1013] modified for Selective Ion Mode (SIM) detection limits (10 ppt for water, 0.3 to 1 ppb for solids) and additional alkyl PAH analytes; or alternative rigorous scans. These types of rigorous scans are less prone to false negatives than many of the standard EPA scans for PAH parent compounds (Roy Irwin, National Park Service, Personal Communication, 1997).

For a much more detailed discussion of the great many different lab and field methods for PAHs in general, see the entry entitled PAHs as a group (file name starting with letter string: PAHS). There the reader will find much more detailed discussions of lab methods, holding times, containers, comparability of data from different methods, field sampling methods, quality assurance procedures, the relationship of various methods to each other, the various EPA standard methods for various EPA programs, the pros and cons of various methods, and additional documentation concerning why many standard EPA methods are inadequate for certain applications. A decision tree key for selecting the most appropriate methods for oil or oil products spills is also provided in the lab section of the PAHs entry. Due to the length of these discussions, they are not repeated here (see PAHs entry).