ENVIRONMENTAL CONTAMINANTS ENCYCLOPEDIA

1-METHYLNAPHTHALENE ENTRY

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Like a library or many 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 without 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 or summaries 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).

Naphthalene, 1-Methyl- (1-Methylnaphthalene, CAS number 90-12-0)

NOTE: Currently there is relatively little information available on specific alkyl homologs of naphthalene. Thus many of the sections listed below contain the phrase "no information found." In such cases, until more information is available, the following data interpretation procedures are recommended:

To interpret concentrations of this particular grouping of alkyl PAHs, the reader may first total naphthalene concentrations and then compare the total to naphthalene benchmarks (see naphthalene entry). The concentration of total naphthalenes is the sum of the following concentrations: total C1 naphthalenes (including all methyl naphthalenes) + total C2 naphthalenes (including dimethylnaphthalenes) + total C3 naphthalenes (including trimethyl naphthalenes) + total C4 naphthalenes + C0 (naphthalene parent compound concentration). Such tentative comparisons are justified on the basis that alkyl PAHs often (there may be exceptions) tend to be equally or more toxic, be equally phototoxic, and be equally or more carcinogenic than the parent compound PAH (see "PAHs as a group" entry).

In the case of text discussion sections where little or no information is available on this particular grouping of alkyl PAHs, the reader is encouraged to also read the "parent" entry (in this case, the Naphthalene entry), but to keep in mind the generalizations (there may be exceptions) that alkyl PAHs often tend to be more persistent, have higher KOWs, be less volatile, be less soluble, be less mobile, bioaccumulate more, have different chemical/physical characteristics, be equally or more toxic, be equally phototoxic, and be equally or more carcinogenic than the parent compound PAH.

Brief Introduction:

Br.Class: General Introduction and Classification Information:

1-Methylnaphthalene is an alkylated naphthalene; naphthalene is a low molecular weight, 2-ring polyaromatic hydrocarbon (PAH) [697].

1-Methylnaphthalene is a C1 alkyl homolog of naphthalene, for risk assessment best analyzed by a GC/MS/SIM scan for PAHs and alkyl PAHs [828]. (such as the NOAA Protocol expanded scan [828]). This compound is included on the expanded scan of PAHs and alkyl PAHs recommended by NOAA [828]; this list includes the PAHs recommended by the NOAA's National Status and Trends program [680].

The C1-naphthalene reported quantity includes all naphthalenes with one carbon group attached (for example, the reported concentration would include 1-methylnaphthalene as well as 2-methylnaphthalene and any other naphthalene with one carbon group attached). The concentration of just 1-methylnaphthalene is also often reported on expanded scan lists [828]. Some labs report 1-Methylnaphthalene separately in addition to reporting total C1 methylnaphthalenes [697,828].

The EPA has found 1-methylnaphthalene at 31 of 1,408 hazardous waste sites on the National Priorities List (NPL) [867]. Naphthalene was found at 536 of the sites, but part of the reason it was found at more sites may be because it was looked for at more sites [867]. Many of sites reporting naphthalene from petroleum based oil contamination probably also contain alkyl napthalenes like methyl naphthalene, since the alkyl PAHs in general tend to be more persistent than the parent compounds [468] and methyl naphthalenes specifically tend to biodegrade more slowly in soil than naphthalene [867].

Br.Haz: General Hazard/Toxicity Summary:

Potential Hazards to Fish, Wildlife, and other Non-human Biota:

Probably the most important target analytes in natural resource damage assessments for oil spills are PAHs and the homologous series (alkylated) PAHs [468]. In the aquatic environment, naphthalenes are especially hazardous PAHs due to their particular combination of mobility, toxicity, and general environmental hazard (summary of details presented below). In fact, some studies have concluded that the toxicity of an oil appears to be a function of its di-aromatic hydrocarbon (that is, two-ring hydrocarbons such as naphthalene) content [770,854].

The "relatively" soluble aromatics of an oil (such as benzene, toluene, ethylbenzene, xylenes, and naphthalenes) produce the majority of its toxic effects in the marine environment [770,853].

Alkyl naphthalenes are usually found in the same petroleum products as naphthalenes, often in higher concentration than the parent compound naphthalene [796]. Since alkyl PAHs are often more abundant in fresh petroleum products than their parent compounds, and the proportion of alkyl PAHs to parent compound PAHs increases as the oil ages, it is very important to analyze oil samples for alkyl

PAHs any time that biological effects are a concern.

In general, alkyl naphthalenes pose similar hazards or worse hazards than naphthalene [851]. Within an aromatic series, acute aquatic toxicity increases with increasing alkyl substitution on the aromatic nucleus [851]. Naphthalenes are no exception to this overall generalization for PAHs, as there is an increase in toxicity as alkylation of the naphthalene structure increases [853]. For example, the order of most toxic to least in a study using grass shrimp (Palaemonetes pugio) and brown shrimp (Penaeus aztecus) was dimethylnaphthalenes > methylnaphthalenes > naphthalenes [853].

There is also an increase in toxicity to marine planktonic algae as alkylation of the naphthalene structure increases [366, Jensen K et al; Limnol 15 (2): 581-4 (1984)]. Comparing several parent compound PAHs (including naphthalene) to alkyl PAH counterparts, the methylated compounds were most toxic [366, Jensen K et al; Limnol 15 (2): 581-4 (1984)].

Although there is less toxicity information available for most of the alkyl PAHs than for their parent compounds, most alkyl PAHs appear to be at least as toxic or hazardous as the parent compound. As can be seen from the preceding paragraph, some have been documented to be more toxic.

Total naphthalenes (total NPHs): Until more complete information on the effects of all the alkyl naphthalenes is available, risk assessment experts suggest adding all alkyl naphthalene concentrations plus the parent compound concentration and comparing the sum to known toxicological effects benchmarks and criteria for the respective parent compound (Bill Stubblefield, ENSR, personal communication, 1995). In this method, naphthalenes are the sum of C0-C4 naphthalenes (total NPHs) [521]. In other words, the concentration of total naphthalenes is the sum of the following concentrations: total C1 naphthalenes (including all methyl naphthalenes) + total C2 naphthalenes (including dimethylnaphthalenes) + total C3 naphthalenes (including trimethyl naphthalenes) + total C4 naphthalenes + C0 (naphthalene parent compound concentration). C0-C4 naphthalenes are typically identified in expanded scans [828].

One study indicated that pure naphthalene and alkylnaphthalenes are from 3 to 10 times more toxic to test animals than are benzene and alkylbenzene [770]. However, another source states that naphthalene and its homologous series are less acutely toxic than benzene, but prevalent for a longer period during oil spills [773].

At the initial stages of the release of naphthalene- and benzene-derived compounds, when these compounds are present at their highest concentrations, acute toxic effects are most common. Noncarcinogenic effects include subtle changes in detoxifying enzymes and liver damage [773].

The heavier (4-, 5-, and 6-ring) PAHs are more persistent than the lighter (2- and 3-ring) PAHs, such as all naphthalenes, 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.

This compound often occurs together with other aromatics (sometimes including other alkyl PAHs), and a typical complex mixture of aromatics may be more toxic or hazardous in general than this compound would be alone (see "PAHs as a group" entry).

Potential Hazards to Humans:

The ATSDR toxicological profile for naphthalenes stressed the relative lack of human health information relating specifically only to 1 methyl-naphthalene and concluded that although some pulmonary effects had been noted, there was insufficient information on 1-methylnaphthalne to assess its risk to the public at hazardous waste sites [867]. There is some evidence that 1-methylnaphthalene, like naphthalene, has some hematological and pulmonary effects and may act somewhat like naphthalene in certain situations, but the information is mixed [867]. In certain applications, 1-naphthalene may inhibit carcinogenic effects of some of the more hazardous PAHs applied to the skin of mammals (see interactions section below).

Hazards Summary [366]: The major hazards encountered in the use and handling of 1-methylnaphthalene stem from its toxicologic properties. Toxic by all routes (ie, ingestion, inhalation, and dermal contact), exposure to this colorless liquid may occur from its use as a general solvent, as a chemical intermediate, or as a dye carrier. Effects from exposure may include flushing, headache, restlessness, fever, nausea, anorexia, diarrhea, skin irritation, corneal damage, oliguria, and anemia, hepatocellular injury, convulsions, and coma. 1-Methylnaphthalene is a moderate fire hazard. When heated to decomposition, this substance emits acrid smoke and fumes.

Additional human health issues related to the naphthalene parent compound as well as two C1 naphthalenes (2-methylnaphthalene and 1-methylnaphthalene) have been summarized by ATSDR [867].

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

Most of the information available is about the parent compound naphthalene itself rather than trimethylnaphthalenes. Alkyl substitution often confers or enhances carcinogenic potential of PAHs. A few examples:

Very few alkyl PAHs have been broadly tested for carcinogenicity, but it is known that both dimethylbenzo(a)anthracene and its parent compound benzo(a)anthracene are carcinogenic [40,793,788,881]. Methylbenzo(a)anthracene is actually more carcinogenic than its parent compound benzo(a)anthracene, and dimethylbenzo(a)anthracene is still more carcinogenic [40].

Both cholanthrene and its 3 methyl alkyl cholanthrene counterpart are carcinogenic [40,793]. It is also known that alkylation does not significantly change phototoxicity [888] and that there are some relationships between phototoxicity and potential carcinogenicity (see discussion above). Thus it would not be surprising to discover that a notable number of alkyl PAHs are carcinogenic although they are not now typically added to the list of "carcinogenic PAHs" considered in risk assessments.

These alkyl PAHs often occur together with other PAHs, in complex mixtures possibly more carcinogenic than the individual components (see "PAHs as a group" entry). The debates on 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 these usually occur in complex mixtures rather than alone. One of the few things that seems clear is that complex PAH mixtures in water, sediments, and organism internal tissues may be carcinogenic and/or phototoxic (Roy Irwin, National Park Service, personal communication, 1996; see also "PAHs as a group" entry and Arfsten et al [911]).

One way to approach site specific risk assessments is to collect the complex mixture of PAHs and other lipophilic organic contaminants in a semipermeable membrane device (SPMD, also known as a fat bag) [894,895,896], retrieve the organic contaminant mixture from the SPMD, then test the mixture for carcinogenicity, toxicity, and phototoxicity (James Huckins, National Biological Survey, and Roy Irwin, National Park Service, personal communication, 1996).

Since alkyl PAHs may be equally or more carcinogenic than the parent compound PAH (see "PAHs as a group" entry), the following information about naphthalene itself is presented:

EPA 1996 IRIS Database [893]:

Evidence for classification as to human carcinogenicity; weight-of-evidence classification:

Classification: D; not classifiable as to human carcinogenicity

BASIS: Based on no human data and inadequate data from animal bioassays.

HUMAN CARCINOGENICITY DATA: None.

ANIMAL CARCINOGENICITY DATA: Inadequate.

However, according to information in IRIS [893], naphthalene may soon be upgraded to "possible carcinogen." status (confirmed by Robert McGaughy, EPA, personal communication, 1996). Further details:

> EPA IRIS Note ADDED IN JULY 1995 [893]: Subsequent to the verification of this cancer assessment in 1990, the National Toxicology Program completed a two-year cancer bioassay (1991); its results suggest that naphthalene may be more appropriately classified as a possible human carcinogen (Group C under current EPA guidelines) [893]. The NTP concluded, "Under the conditions of these 2-year studies, there was no evidence of carcinogenic activity of naphthalene in male B6C3F1 mice exposed by inhalation to concentrations of 10 or 30 ppm for 6 hours daily, 5 days per week, for 103 weeks [893]. There was some evidence of carcinogenic activity of naphthalene in female B6C3F1 mice, as indicated by the increased incidences of pulmonary alveolar/bronchiolar adenomas [893]."

The IARC and EPA carcinogenic classifications for naphthalene are group 3 and group D, respectively (both stand for "not classifiable as to its carcinogenicity to humans") [766,893]. This rating was given by EPA in 1990 and may change [893] (see below discussions for details):

Formerly, naphthalene has not been considered carcinogenic [773]. This compound has not been treated as a carcinogen for model calculation purposes in some EPA risk-based (RBC and PRG) models [868,903], but this tentative distinction was made for the purpose of choosing a modeling scenario based on current (often inadequate) knowledge rather than for the purpose of strongly stating that this compound is definitely not a carcinogen; the non-carcinogenic benchmarks are sometimes nearly as low as the carcinogenic benchmarks (Stan Smucker, personal communication, EPA, 1996).

EPA Historical (modeling purposes only) Classification: Not a Carcinogen [302,446].

There is some (mixed) evidence of naphthalene carcinogenicity to mice exposed by inhalation [867,893] as well as some indications that naphthalene may act as a promoter for lung tumors started by other carcinogens [766]. Since naphthalenes often occur in petroleum hydrocarbon mixtures which contain strong carcinogens, a carcinogenic promoter role may prove environmentally significant.

Data available from animal studies do not agree regarding the carcinogenic effects resulting from naphthalene exposure. There is some evidence that naphthalene causes lung cancer in female mice but not in male mice, or rats of either sex [867]. The EPA has determined that naphthalene is not classifiable as to its human carcinogenicity based on the absence of animal data [766].

The observations of Adkins et al. (1986) that there was an increased incidence of tumors in each tumor-bearing mouse, but not in the numbers of mice with tumors, supports classifying naphthalene as a promoter for lung tumors rather than a carcinogen. If this hypothesis is correct, naphthalene may be of greatest environmental concern when exposure to naphthalene is accompanied by exposure to pulmonary carcinogens [766]. This is of interest because naphthalene occurs in various petroleum fuel mixtures which also contain know carcinogens such as benzene, 1,3 butadiene, and various carcinogenic PAHs.

Naphthalene was predicted not to be phototoxic using QSAR estimates [891].

Some interactions are known for certain naphthalenes. For example, when either naphthalene, 1-methylnaphthalene, of 2-methylnaphthalene was applied dermally in combination with benzo(a)pyrene (BaP), there was an inhibitory effect on the induction of skin tumors in female mice. The authors suggested that it is likely that certain naphthalenes compete with BaP for the same enzyme site, resulting in alteration of the BaP metabolic pathway and decreased production of the active BaP metabolite [766].

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

The little information available is about naphthalene itself rather than methylnaphthalenes [867]:

No endocrine information found on 1-methylnaphthalene, but the parent compound naphthalene is an endocrine disrupter [883,884].

When elevated to 10 ppm in water, naphthalene caused crawfish ovaries to shrink, resulting in fewer eggs and smaller offspring [883,884] (Naphthalene confirmed as an endocrine disrupter by Milton Fingerman, Tulane University, personal communication, 1996).

Noncarcinogenic effects of naphthalene exposure include interference with reproductive behavior [773].

One study suggested that naphthalene metabolites are responsible for its embryotoxicity; decreased naphthalene bioavailability may reduce its toxicity during the early stages of reproduction [766].

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

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

Most of the fate information available is about naphthalene itself rather than methylnaphthalenes [867].

Naphthalene does not have a strong tendency to accumulate in the flesh of animals that humans eat [867]. However, methyl and other alkyl naphthalenes accumulate to a greater degree in fish than naphthalene [366] (see bio.detail section below for more detail).

In some media, methylnaphthalenes are suspected to act somewhat like naphthalene [867]. However, several differences have been documented since:

1) Alkyl naphthalenes tend to be less volatile (lower vapor pressure and Henry's Law Constant), less soluble, and have a higher log KOW and bioconcentration factors than naphthalene [867], and

2) Alkylated PAHs are more abundant, persist for a longer time than the parent PAHs [468]. Alkyl naphthalenes are no exception, as they tend to persist longer in sediments or amphipod tissues [885] and to bioaccumulate faster in tissues [786,851,885] than naphthalene.

3) Naphthalene does not have a strong tendency to accumulate in the flesh of animals that humans eat [867]. However, methyl and other alkyl naphthalenes bioaccumulate to a greater degree than naphthalene [347,366,885].

4) Naphthalene is a solid, while 1-methylnaphthalene is a liquid [867].

Low molecular weight PAHs (naphthalenes through phenanthrenes) are removed from the water column primarily by evaporation, microbial oxidation, and sedimentation [851]. Naphthalene and methylnaphthalenes are degraded in water by photolysis and biological processes [766].

PAH Alkyl naphthalenes were more persistent in sediments [521,885] and amphipod tissues [885] than naphthalene. Persistence increases with increasing alkyl substitution, with methyl naphthalene being more persistent than naphthalene and dimethyl naphthalene being still more persistent in sediments and amphipod tissues [885]. Alkyl naphthalenes tend to bioaccumulate faster in tissues [851] than naphthalene.

The crude oil aromatic compounds that are most resistant to weathering, include highly alkylated naphthalenes, phenanthrenes, and dibenzothiophenes [521,523]. In one study, the proportions of the C0-C2 naphthalenes are much smaller and proportions of the highly alkylated (C3-C4) naphthalenes, phenanthrenes, and dibenzothiophenes are larger in weathered Prudhoe Bay Crude Oil than in fresh Prudhoe Bay Crude Oil [521].

Naphthalene and methylnaphthalenes are degraded in water by photolysis and biological processes [766].

The above discussions confirm that alkyl naphthalenes are not exceptions to the differences between PAHs and alkyl PAHs in general:

> Some alkyl PAHs tend to be less volatile than parent compound PAHs [867]. Alkyl substitution usually also decreases water solubility [754].
>
> Introduction or extension of an alkyl group increases not only persistence but also lipophilicity; increased lipophilicity is often associated with increased absorption [856]. Alkyl PAHs tend to bioaccumulate to a greater degree than parent compound PAHs [347,885].
>
> Alkylated PAHs are often more abundant than parent compounds [468], at least those alkyl PAHs originating from petrogenic sources [942]. For several PAH families (naphthalenes, fluorenes, phenanthrenes, dibenzothiophenes, and chrysenes) if the unsubstituted parent PAH is less abundant than the sum of its counterpart alkyl homologues, the source is more likely petrogenic (from crude oil or other petroleum sources) rather than pyrogenic (from high temperature sources) [942].

Alkyl PAHs also tend to persist for a longer time than the parent PAHs [468,856]. PAH persistence tends to increase with increasing alkyl substitution; for example, methyl naphthalene is more persistent than naphthalene (the parent compound) and dimethyl naphthalene is still more persistent than methyl naphthalene in sediments and amphipod tissues [885].

Comparing PAHs and alkyl PAHs, the parent compound is typically the first to degrade. Thus, as mixed composition petroleum products age, the percentage of alkyl PAHs vs. PAHs increases, yet most standard EPA scans (even 8270) do not pick up alkyl PAHs [796]. This, coupled with the need for lower detection limits and the general hazards presented by alkyl PAHs, is one reason the NOAA protocol expanded scan [828] or other rigorous scans using Selected Ion Monitoring (SIM) [942] are often recommended rather than the older standard EPA scans.

Environmental Fate/Exposure Summary from the HSDB [366]:

1-Methylnaphthalene is a component of crude oil and a product of combustion which is produced and released to the environment during natural fires. Emissions from petroleum refining, coal tar distillation, and gasoline and diesel fueled engines are major contributors of 1-methylnaphthalene to the environment. 1-Methylnaphthalene is also used as a chemical intermediate and a general solvent. Consequently, 1-methylnaphthalene is released to the environment via manufacturing effluents and the disposal of waste byproducts.

Because of the widespread use of 1-methylnaphthalene in a variety of products, 1-methylnaphthalene is also released to the environment through landfills, municipal waste water treatment facilities and waste incinerators. 1-Methylnaphthalene should biodegrade rapidly in the environment where micro- organisms have acclimated to PAHs and at a moderate rate in unacclimated soils and aquatic systems. Hydrolysis and bioconcentration of 1-methylnaphthalene should not be important fate processes in the environment. The direct photolysis half-life for 1-methylnaphthalene in sunlit waters at midday, midsummer and 40 deg N latitude was predicted to be 22 hr. Photolysis is also likely to occur in air and on sunlit soil surfaces. A calculated Koc range of 730 to 3035 indicates a low to slight mobility class for 1-methylnaphthalene in soil.

In aquatic systems, 1-methylnaphthalene may partition from the water column to organic matter contained in sediments and suspended solids. A Henry's Law constant of 2.60X10-4 atm-cu m/mole at 25 deg C suggests volatilization of 1-methylnaphthalene from environmental waters may be important. The volatilization half-lives from a model river and a model pond, the latter considers the effect of adsorption, have been estimated to be 7.5 hr and 11.8 days, respectively. 1-Methylnaphthalene is expected to exist entirely in the vapor phase in ambient air. Reactions with photochemically produced hydroxyl radicals (half-life of 7.3 hr) and ozone (half-life of 88.2 days) in the atmosphere are likely to be important fate processes. Nighttime reactions with dinitrogen pentoxide (half-life of 12.2 days) may contribute to the atmospheric transformation of 1-methylnaphthalene. The most probable human exposure would be occupational exposure, which may occur through dermal contact or inhalation at places where 1-methylnaphthalene is produced or used. Atmospheric workplace exposures have been documented. Non-occupational exposures would most likely occur via urban atmospheres, contaminated drinking water supplies and recreational activities at contaminated waterways.

Synonyms/Substance Identification:

Alpha-methylnaphthalene [366,766]
Naphthalene, 1-methyl- [366]
Naphthalene, alpha-methyl [366,867]
FEMA NUMBER 3193 [366]

Molecular Formula [366,766]:
C11-H10

Associated Chemicals or Topics (Includes Transformation Products):

See also individual entries:

Naphthalene
Naphthalene, 2-Methyl
Naphthalene, C1-
PAHs as a group
PAHs, Alkyl Homologs of
Petroleum, General

Transformation Products:

ATSDR: Most information is on naphthalene, with up to 21 metabolites having been identified in animal urine; little information is available on methyl naphthalenes, especially on 1-methyl naphthalene [867].

The bacteria Pseudomonas putida and P. multivorans isolated from an oil-polluted estuary metabolized 1-methylnaphthalene into 3-methylsalicylic acid [851].

Metabolism/Metabolites [366] (some of this information is about naphthalene parent compound):

Yields 1,2-dihydro-1,2-dihydroxy-8-methylnaphthalene in pseudomonas. /From table/ [Goodwin, B.L. Handbook of Intermediary Metabolism of Aromatic Compounds. New York: Wiley, 1976.,p. M-32.

The fungal metabolism of aromatic hydrocarbons has been studied using naphthalene and biphenyl as model compounds. Using (14)C naphthalene and the fungus Cunninghamella elegans, the major free metabolites were trans-1,2-dihydroxy-1,2-dihydro-naphthalene, 4-hydroxy-l-tetralone and 1-naphthol. The sulfate and glucuronic acid conjugates of 1-naphthol were the major water soluble metabolites which were isolated by thin layer chromatography and ion pair high pressure liquid chromatography. Field Desorption Mass Spectrometry was used to identify the sulfate conjugate whereas the trimethylsilyl derivative of the glucuronic acid conjugate was characterized by Electron Impact Mass Spectrometry. Analogous metabolites were formed from biphenyl which was hydroxylated at the 4 position and then conjugated. /Naphthalene/ [Hutson DH, Roberts TR (eds); Progress in Pesticide Biochemistry & Toxicology Vol# 4 p.156 (1985).

The metabolism of naphthalene in mammals has been extensively studied. Naphthalene is first metabolized by hepatic mixed function oxidases to the epoxide, naphthalene-1,2-oxide. ... The epoxide can be enzymatically converted into the dihydrodiol, 1,2-dihydroxy-1,2-dihydronaphthalene or conjugated with glutathione. The dihydrodiol can then be conjugated to form a polar compound with glucuronic acid or sulfate or be further dehydrogenated to form the highly reactive 1,2-dihydroxynaphthalene. This too can be enzymatically conjugated with sulfate or glucuronic acid or spontaneously oxidized to form another highly reactive compound, 1,2-naphthoquinone. /Naphthalene/ [USEPA; Ambient Water Quality Criteria Doc: Naphthalene p.30 (1980) EPA 440/5-80-059.

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

W.Low (Water Concentrations Considered Low):

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

W.High (Water Concentrations Considered High)

1-Methylnaphthalene was reported in process sewage and production water samples from coal gasification plants at concentrations ranging from 78 to 278 ug/L [766].

Methylnaphthalene (isomer not specified) concentration reported at a municipal landfill was 0.033 mg/L (33 ug/L) [766].

W.Typical (Water Concentrations Considered Typical)

1-Methylnaphthalene was reported in an urban snowpack in Michigan at concentrations ranging from less than 0.05 to 0.177 ug/L [766].

Information from HSDB [366]:

SURFACE WATER: 1-Methylnaphthalene was detected in coastal waters at Vineyard Sound, MA at concn ranging from 0.5 to 14.0 ng/L with an average concn of 4.4 ng/L(1). 1-Methylnaphthalene is also listed as a contaminant of coastal waters off Narragansett Bay, RI(2), Los Angeles River stormwaters(3) and Lake Ontario(4). [(1) Gschwend PM et al; Environ Sci Technol 16: 31-8 (1982) (2) Wakeham SG et al; Can J Fish Aquat Sci 40: 304-21 (1983A) (3) Eaganhouse RP et al; Environ Sci Technol 15: 315-26 (1981) (4) Great Lakes Water Quality Board; Report on Great Lakes Water Quality p 195 (1983).

GROUNDWATER: 1-Methylnaphthalene was detected in a coal tar contaminated aquifer in St. Louis Park, MN(1) at concn ranging from less than 0.01 to 32 mg/kg sediment(2). Stored wastes from a former pine-tar manufacturing site in Gainesville, FL have contaminated surrounding ground waters with concn of 1-methylnaphthalene ranging from 0.9 to 130 ug/l(3). Wood preserving chemicals at Pennsacola, FL are responsible for 1-methylnaphthalene concn of 0.79, 0.30 and 0.46 mg/l at ground water depths of 6, 12 and 18 m, respectively(4). At Conroe, TX a creosote waste facility has contaminated groundwater with 1-methylnaphthalene at concn ranging from 2.3 to 180.7 ug/l(5). 1-Methylnaphthalene was identified in the ground water leachate from the Waterloo and Northbay landfills, Ontario, Canada at concn ranging from 0.1 to 13 ug/l(6). [(1) Rostad CE et al; Chemosphere 14: 1023-36 (1985) (2) Ehrlich GG et al; Ground Water 20: 703-10 (1982) (3) McCreary JJ et al; Chemosphere 12: 1619-32 (1983) (4) Goerlitz DF et al; Environ Sci Technol 19: 995-61 (1985) (5) Bedient PB et al; Ground Water 22: 318-29 (1984) (6) Reinhard M, Goodman NL; Environ Sci Technol 18: 953-61 (1984).

RAIN/SNOW: Rain water in Portland, OR contained 1-methylnaphthalene at concn ranging from 13 to 48 ng/l between Feb 12 and April 12, 1984(1). Snow pack from the city of St. Marie, Canada contained 1-methylnaphthalene at concn ranging from less than 0.050 to 0.169 ug/l(2). [(1) Ligocki MP et al; Atmos Environ 19: 1609-17 (1985) (2) Boom A, Marsalek J; Sci Total Environ 74: 133-48 (1988).

Effluents Concentrations [366]:

1-Methylnaphthalene was detected in the leachate from an unspecified number of 58 municipal landfills at an average concn of 0.033 mg/l(1). Coal tar leachate was found to contain 1-methylnaphthalene(2,3). Secondary effluent at Fort Polk, LA contained 1-methylnaphthalene at a concn of 0.29 ug/l on Nov 4, 1980(4). 1-Methylnaphthalene was also detected in the municipal wastewaters from 4 major treatment plants in Southern CA(5) and in Los Angeles County effluent at a concn of 10 ug/l(6). Urban runoff to the Narragansett Bay, RI contained 1-methylnaphthalene at concn of 4.234, 5.076, 6.563 and 5.909 ug/cm/sq km from residential, commercial, industrial and highway land uses, respectively(7). 1-Methylnaphthalene was also identified as a stack emission(8) and a component of fly ash(9) from waste incinerators. Data from Aug 25 to Sept 7 1979 showed for a speed of 80 km/hr on straight and level highway, gasoline powered vehicles emitted 1-methylnaphthalene at an average rate of 1.8 mg/km and diesel trucks emitted 1-methylnaphthalene at an average of 1.3 mg/km(10). [(1) Brown KW, Donnelly KC; Haz Waste Haz Mater 5: 1-30 (1988) (2) Alben K; Ana Chem 52: 1825-8 (1980) (3) Alben K; Environ Sci Technol 14: 468-70 (1980) (4) Hutchins SR et al; Environ Toxicol Chem 2: 195-216 (1983) (5) Eaganhouse RP, Kaplan IR; Environ Sci Technol 16: 541-51 (1982) (6) Gossett RW et al; Mar Pollut Bull 14: 387-92 (1983) (7) Hoffman EJ et al; Environ Sci Technol 18: 580-7 (1984) (8) Junk GA, Ford CS; Chemosphere 9: 187-230 (1980) (9) Tong, HY et al; J Chrom 285: 423-41 (1984) (10) Hampton CV et al; Environ Sci Technol 17: 699-708 (1983).

Motorboats were shown to emit 1-methylnaphthalene to canal water with resultant concn of 1 to 92 ng/L(1). 1-Methylnaphthalene was detected in the water discharged from a hydrocarbon vent of an offshore oil platform at a concn of 20 ug/L(2). The dissolved air floatation effluent of a Class B oil refinery contained 1-methylnaphthalene at a concn of 448 ng/g(3). Effluents from refineries, petrochemical industry, metallurgic industry and municipal wastewater treatment plants in Norway contained 1-methylnaphthalene with a 68% frequency of appearance(4). Reactor tar from a coal gasification plant contained 1-methylnaphthalene at a concn of 29.6 mg/g(5). Effluent from a textile finishing operation also contained 1-methylnaphthalene(6). [(1) Juttner F; Z Wasser-Abwasser-Forrsch 21: 36-9 (1988) (2) Sauer TC Jr; Environ Sci Technol 15: 917-23 (1981) (3) Snider EH, Manning FS; Environ Int 7: 237-58 (1982) (4) Sporstoel S et al; Intern J Environ Anal Chem 21: 129-38 (1985) (5) Stetter JR et al; Environ Sci Technol 19: 924-8 (1985) (6) Gordon AW, Gordon M; Trans Ky Acad Sci 42: 149-57 (1981).

DRINKING WATER [366]: 1-Methylnaphthalene was detected in drinking water supplies where coal tar was employed on underground storage tanks to prevent corrosion(1). Four of five samples of Nordic tap water contained 1-methylnaphthalene at concn ranging from 0.40 to 5.1 ng/L(2). 1-Methylnaphthalene was listed as a contaminant found in drinking water(3,4) for a survey of US cities including Pomona, Escondido, Lake Tahoe and Orange Co, CA and Dallas, Washington, DC, Cincinnati, Philadelphia, Miami, New Orleans, Ottumwa, IA, and Seattle(7) and groundwater wells of WI(5). For a survey of drinking water supplies in the UK, 1-methylnaphthalene was detected in the treated water at 14 of 14 water treatment facilities(6). [(1) Alben K; Environ Sci Technol 14: 468-70 (1980) (2) Kveseth K et al; Chemosphere 11: 623-639 (1982) (3) Kool HJ et al; Crit Rev Env Control 12: 307-57 (1982) (4) Fawell JK, Fielding M; Sci Total Environ 47: 317-41 (1985) (5) Krill RM, Sonzogni WC; J Am Water Works Assoc 78: 70-5 (1986) (6) Fielding M et al; Organic Pollutants in Drinking Water, TR-159 Water Res Cent p. 49 (1981) (7) Lucas SV; GC/MS Anal of Org in Drinking Water Concentrates and Advanced Treatment Concentrates Vol 1 EPA-600/1-84-020A (NTIS PB85-128239) p. 397 (1984).

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):

Oak Ridge National Lab, 1994: Ecological Risk Assessment Freshwater Screening Benchmarks for concentrations of contaminants in water [649]. For a definition of meaning of each benchmark, see entry entitled: Benchmarks, Ecological Risk Assessment Screening Benchmarks. To be considered unlikely to represent an ecological risk, field concentrations should be below all of the following benchmarks [649]:

NOTE: Although most of the lab tests done to develop water quality criteria and other benchmarks were originally based on "total" values rather than "dissolved" values, the lab settings were typically fairly clean and the numbers generated by the lab tests are therefore often even more comparable to field "dissolved" values than to field "total" values (Glen Suter, Oak Ridge National Lab, Personal Communication, 1995).

METHYL NAPHTHALENE, 1- (micrograms per liter, ug/L):

37.2 = SECONDARY ACUTE VALUE
2.08 = SECONDARY CHRONIC VALUE
526 = ESTIMATED LOWEST CHRONIC VALUE - FISH
500 = ESTIMATED LOWEST TEST EC20 - FISH
31.62 = POPULATION EC2O

W.Plants (Water Concentrations vs. Plants):

Note from HSDB [366]: The toxic effect of aromatic hydrocarbons, benzene, toluene, naphthalene, 1-methylnaphthalene, anthracene, 9-methylanthracene, phenanthrene, on the productivity of various marine planktonic algae (Dunaliela biocula, Phaeodactylum tricornutum, and Isochysis galbaya) increased with increasing number of aromatic rings. The methylated compounds were most toxic.

W.Invertebrates (Water Concentrations vs. Invertebrates):

In a toxicity study of petroleum oils on postlarvae of brown shrimp, grass shrimp, & sheepshead minnow, refined oils were more toxic than crude oils due to presence of naphthalene & alkylnaphthalene, incl 1-methylnaphthalene. The different naphthalenes were toxic @ levels between 0.08 & 5-1 PPM [366].

LC50s for Cancer magister (Dungeness or edible crab) were 8.2 and 1.9 mg/L (ppm) for 48- and 96-hr exposures, respectively [998].

LC50 for Nitocra spinipes (Harpacticoid copepod) was 13.0 mg/L for a 96-hr exposure [998].

W.Fish (Water Concentrations vs. Fish):

LC50 for Cyprinodon variegatus (sheepshead minnow) was 3.4 mg/L (ppm) for a 24-hr exposure [998].

LC50s for Pimephales promelas (fathead minnow) were 9.0, 9.0, 9.0 and 9.0 mg/L for 24-, 48-, 72- and 96-hr exposures, respectively [998].

See also the W.Invertebrate section.

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

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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

No concern levels found; for information on drinking water supply levels, see W.Typical Section above.

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

The toxic effect of aromatic hydrocarbons, benzene, toluene, naphthalene, 1-methylnaphthalene, anthracene, 9-methylanthracene, phenanthrene, on the productivity of various marine planktonic algae (Dunaliela biocula, Phaeodactylum tricornutum, and Isochysis galbaya) increased with increasing number of aromatic rings. The methylated compounds were most toxic. Taxonomic differences in sensitivity to aromatic hydrocarbons /was investigated/. [366, Jensen K et al; Limnol 15 (2): 581-4 (1984)].

Naphthalene was predicted not to be phototoxic using QSAR estimates [891]. Alkyl PAHs often (there may be exceptions) tend to be equally phototoxic compared to the parent compound PAH (see "PAHs as a group" entry).

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

Sed.Low (Sediment Concentrations Considered Low):

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

Sed.High (Sediment Concentrations Considered High):

Methylnaphthalene (isomer not specified) was detected in contaminated and non-contaminated estuarine sediments. Reported average concentrations were 50.4 and 55.3 ppb (ug/kg) methylnaphthalenes at 10 and 25 miles from an offshore coastal multiwell drilling platform. The concentration in nearby uncontaminated estuarine sediments was 1.9 ppb (ug/kg) [766].

1-Methylnaphthalene was detected in 93.8 percent of urban-bay samples in the Puget Sound area. The mean concentration was 52.06 ug/kg dry weight (ppb), while the median concentration was 52 ug/kg (ppb) [852].

> NOTE: The above values are not normalized for total organic carbon (TOC) content.

Sed.Typical (Sediment Concentrations Considered Typical):

The concentration methylnaphthalene (isomer not specified) in a uncontaminated estuarine sediments was 1.9 ppb (ug/kg) [766].

1-Methylnaphthalene was detected in 57.1 percent of non-urban-bay samples in the Puget Sound area. The mean concentration was 6 ug/kg dry weight (ppb), while the median concentration was 6.5 ug/kg (ppb) [852]. Note: these values based on only four samples where 1-methylnaphthalene was detected.

> NOTE: The above [852] values are not normalized for total organic carbon (TOC) content.

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):

The information presented below is for one representative C1 naphthalene, 1-methylnaphthalene:

NOAA 1990: After studying its own data from the National Status and Trends Program as well as many literature references concerning different approaches to determining sediment criteria, NOAA suggested that there was too little data available to ascertain firm concern levels, but that effects in the two marine studies which were available were associated with the range of 192 ppb dry weight to 500 ppb dry weight and one non-toxic sample was 36.2 + or - 65.6 ppb [233] (see entry entitled ERL).

Sed.Plants (Sediment Concentrations vs. Plants):

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

Sed.Invertebrates (Sediment Concentrations vs. Invertebrates):

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

Sed.Fish (Sediment Concentrations vs. Fish):

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

Sed.Human (Sediment Concentrations vs. Human):

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

Soil.High (Soil Concentrations Considered High):

Methylnaphthalenes (isomer not specified) were reported at a concentration of 2.9 ug/g in coal tar contaminated soil [766].

Soil.Typical (Soil Concentrations Considered Typical):

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

Soil.Plants (Soil Concentrations vs. Plants):

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

Soil.Invertebrates (Soil Concentrations vs. Invertebrates):

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

Soil.Human (Soil Concentrations vs. Human):

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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

See sections related to fate.

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

Tis.Plants:

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

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

Tis.Invertebrates:

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

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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

Methylnaphthalenes were detected in oysters in Australia at less than 0.3 to 2 ug/g [766].

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. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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

Fish/Seafood Concentrations [366]:

1-Methylnaphthalene was identified by gas chromatography/mass spectrometry in flesh extract of eels (anguilla japonica temminck et schlegel) maintained in controlled laboratory environment of water with suspension of crude oil. [OGATA M ET AL; WATER RES 13 (7): 613-8 (1979).

In 1978, fishes from the central Gulf of Mexico contained 1-methylnaphthalene at concn ranging from 30 to 630 ng/g wet weight(1). Paper scallop, Brown shrimp, and Texas venus from the central Gulf of Mexico contained 1-methylnaphthalene at concn of 220, 10 and 70 ng/g wet weight, respectively(1). In Nigeria, African mudfish (C. lazera) averaged 19.52, 25.31, 16.22 and 37.45 ng of 1-methylnaphthalene/g of dry weight; Tilapia sp. (S. niloticus) averaged 25.92, 24.43, 24.26 and 22.92 ng of 1- methylnaphthalene/g of dry weight; Tilapia sp. (S. galileus) averaged 23.32, 22.16, 24.24 and 20.15 ng of 1-methylnaphthalene/g of dry weight; Tilapia sp. (T. zilli) averaged 20.66, 22.82, 21.33 and 21.96 ng of 1-methylnaphthalene/g of dry weight; and H. fasiatus averaged 29.20, 2.76, 3.02 and 3.66 ng of 1-methylnaphthalene/g of dry weight for the preservation methods of traditionally smoked, traditionally solar dried, oven dried and the University of Ife solar drying technique, respectively(2). The level of 1-methylnaphthalene in the same digestive gland oil of lobsters ranged from 8.8 to 65.3 according to 4 different laboratories(3). [(1) Nulton CP, Johnson DE; J Environ Sci Health, Part A 16: 271-88 (1981) (2) Afolabi OA et al; J Agric Food Chem 31: 1083-90 (1983) (3) Uthe JF, Musial CJ; J Assoc Off Anal Chem 71: 363-8 (1988).

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. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

Tis.Human:

A) Typical Concentrations in Human Food Survey Items:

See also Tis.Fish section C).

Food Survey Results [366]:

1- Methylnaphthalene was identified as a volatile component of cassava(1), roasted filberts(2) and nectarines(3). Assorted types of lima, pinto, red kidney, black, navy and mung beans, soybeans, split peas and lentils were found to contain 1-methylnaphthalene at concn ranging from 2.8 to 49.2 ppb(4). [(1) Dougan J et al; J Sci Food Agric 34: 874-84 (1983) (2) Kinlin TE et al; J Agric Food Chem 20: 1021 (1972) (3) Takeoka GR et al; J Agric Food Chem 36: 553-60 (1988) (4) Lovegren NV et al; J Agric Food Chem 27: 851-3 (1978).

Non-alcoholic beverages: 1.0 ppm; ice creams, ices: 1.0 Ppm; candy: 1.0 Ppm; gelatins & puddings: 1.0 Ppm. [Fenaroli's Handbook of Flavor Ingredients. Volume 2. Edited, translated, and revised by T.E. Furia and N. Bellanca. 2nd ed. Cleveland: The Chemical Rubber Co., 1975. 385

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. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

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

No information found. Compare concentration of total naphthalenes to concentration in the naphthalene entry.

Tis.Misc. (Other Tissue Information):

Naphthalene was predicted not to be phototoxic using QSAR estimates [891]. Alkyl PAHs often (there may be exceptions) tend to be equally phototoxic to the parent compound PAH (see "PAHs as a group" entry).

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

Alkyl PAHs tend to bioaccumulate to a greater degree than parent compound PAHs [347,885]. Introduction or extension of an akyl group increases lipophilicity, which often appears as increased absorption [856].

Alkyl naphthalenes tend to persist longer in amphipod tissues [885] and to bioaccumulate faster in tissues [851] than naphthalene. Bioconcentration of naphthalenes by amphipods was greatest (about 1000 times) in flow through systems. In the sediment exposure system, no naphthalene was present in amphipod tissues after four days and by the 18th day only dimethyl naphthalenes were present [885].

Coho salmon were exposed to a dilute water soluble fraction (WSF) of Prudhoe Bay crude oil for five weeks. They accumulated the more highly alkylated naphthalenes in muscle tissue faster than the less-substituted aromatics [851]:

HYDROCARBON	CONCENTRATION (PPB) Water	CONCENTRATION (PPB) Muscle Tissue	BIOACCUMULATION FACTOR
Naphthalene	4	240	60
1-Methyl-naphthalene	4	400	100

Log Kow values for alkyl naphthalenes [971]:

Naphthalene:	3.37
C1-Naphthalene:	3.87
C2-Naphthalene:	4.37
C3-Naphthalene:	5.0
C4-Naphthalene:	5.55

During the Exxon Valdez spill, bioconcentration explained the buildup of PAHs in tissues better than biomagnification; most accumulation was of an equilibrium partitioning nature across the gills rather than from the food chain [971]. Immature fish seem have higher bioconcentration of PAHs than adults, perhaps because their PAH breakdown systems are not fully developed and at times perhaps because of a higher percentage of lipid tissues (yolk tissues, etc) [971] (confirmed by Jerry Neff, Battelle Ocean Sciences, Duxbury, MA, personal communication 1996).

HSDB information [366]:

English sole were exposed to oiled (Alaskan north slope crude oil) sediments over 4 mo to assess bioavailability & tissue hydrocarbon distribution kinetics in flatfish. Crude oil was mixed with aromatic hydrocarbon free sediments to a concn of 700 ug/g dry wt at the beginning of the experiment. During the first mo, this concn decr to 400 ug/g dry wt, and remained relatively stable during the remainder of the 4 mo period. Flatfish accum alkane & aromatic hydrocarbons in skin, muscle & liver. 1- & 2-Methylnaphthalene was accumulated to greater extent than other aromatic hydrocarbons. Tissue levels decr with time: after 27 day continuous exposure, only liver contained detectable levels. [MCCAIN BB ET AL; J FISH RES BOARD CAN 35 (5): 657-64 (1978) [366].

After 2, 3, 5 and 6 weeks exposure, the bioconcentration factor of 1-methylnaphthalene in the muscle tissue of Coho salmon (Onchorhynchus kisutch) was 30, 70, 130 and 50, respectively(1). After 2 weeks exposure, the average bioconcentration factor of 1-methylnaphthalene in the muscle tissue of Starry flounder (Platichthys stellatus) was 680(1). The bioconcentration factor of 1-methylnaphthalene in sheepshead minnow was 205 after 4 hr exposure(2). [(1) Roubal WT et al; Arch Environ Contam Toxicol 7: 237-44 (1978) (2) Carlson RM et al; Implication to the Aquatic Environ of PAHs Liberated from No Great Plains Coal EPA-600/3-79-093 (1979) [366,849].

Interactions:

When either naphthalene, 1-methylnaphthalene, of 2-methylnaphthalene was applied dermally in combination with benzo(a)pyrene (BaP), there was an inhibitory effect on the induction of skin tumors in female mice. The authors suggested that it is likely that certain naphthalenes compete with BaP for the same enzyme site, resulting in alteration of the BaP metabolic pathway and decreased production of the active BaP metabolite [766].

Uses/Sources:

1-Methylnaphthalene is used to make other chemicals such as dyes and resins. It is present in cigarette smoke, wood smoke, tar, and asphalt [766].

Although PAHs, particularly heavy PAHs, do not make up a large percentage of diesel fuels by weight, there are some PAHs in diesel fuels, including naphthalene and alkyl naphthalenes [497,661,796,822,824].

Natural Sources [366]:

> Identification of org cmpd, incl 1-methylnaphthalene, contained in crude oil was performed. [OGATA ET AL; WATER RES 13 (7): 613-8 (1979).
>
> 1-Methylnaphthalene is a natural component of crude oil(1). 1- Methylnaphthalene 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) Gaydos RM; Kirk-Othmer Encycl Chem Tech 3rd NY,NY: Wiley 15: 698-719 (1981).

Artificial Sources [366]:

> Twenty cmpd eg indene, alpha-methylnaphthalene, fluorene, carbazole, & pyrene, were identified in wastewater from coking operations. [ANDREIKOVA LG; KOGAN LA, KOKS KHIM 8: 47 (1977).
>
> Exposure of naphthalene acetic acid to uv light & sunlight produced ... 1-Methyl naphthalene under aerobic ... /& Anaerobic conditions/. [Menzie, C.M. Metabolism of Pesticides. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife, Publication 127. Washington, DC: U.S. Government Printing Office, 1969. 257.
>
> 1-Methylnaphthalene is emitted to the environment by effluents from petroleum refining and coal tar distillation(1). The combustion of gasoline and diesel fuels releases 1-methylnaphthalene to the atmosphere(2). 1-Methylnaphthalene is used as a chemical intermediate and a general solvent(1). Consequently, 1-methylnaphthalene is released to the environment via manufacturing effluents and the disposal of waste byproducts(3-7). Because of the widespread use of 1-methylnaphthalene in a variety products, 1-

methylnaphthalene is also released to the environment through landfills(8,9), municipal waste water treatment facilities(10-12) and waste incinerators(13,14). [(1) Gaydos RM; Kirk-Othmer Encycl Chem Tech 3rd NY, NY: Wiley 15: 698-719 (1981) (2) Hampton CV et al; Environ Sci Technol 17: 699-708 (1983) (3) Rostad CE et al; Chemosphere 14: 1023-36 (1985) (4) Ehrlich GG et al; Ground Water 20: 703-10 (1982) (5) McCreary JJ et al; Chemosphere 12: 1619-32 (1983) (6) Goerlitz DF et al; Environ Sci Technol 19: 995-61 (1985) (7) Bedient PB et al; Ground Water 22: 318-29 (1984) (8) Reinhard M, Goodman NL; Environ Sci Technol 18: 953-61 (1984) (9) Brown KW, Donnelly KC; Haz Waste Haz Mater 5: 1-30 (1988) (10) Hutchins SR et al; Environ Toxicol Chem 2: 195-216 (1983) (11) Eaganhouse RP, Kaplan IR; Environ Sci Technol 16: 541-51 (1982) (12) Gossett RW et al; Mar Pollut Bull 14: 387-92 (1983) (13) Junk GA, Ford CS; Chemosphere 9: 187-230 (1980) (14) Tong, HY et al; J Chrom 285: 423-41 (1984).

/1-Methylnaphthalene is a component of cigarette smoke condensate/. [Curvall M et al; Mutat Res 157 (2/3): 169-80 (1985).

Forms/Preparations/Formulations:

No information found.

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

Alkylation of PAHs tends to increase Kow and significantly or drastically change other physical/chemical parameters (for more detailed discussions, see Chem.detail section of "PAHs as a group" entry). Gasolines, including unleaded gasolines [746], contain a small but significant amount of PAHs including naphthalene and alkyl naphthalenes [797]. Naphthalenes make up from 0.09 to 0.49 weight percent of gasoline and from 0.08 to 0.5 volume percent of various gasolines [796]. Methyl naphthalenes constituted the single largest class of chemicals in soils contaminated by no. 6 fuel oil [814].

Many lab methods have been used to determine PAHs [861], with the NOAA protocol expanded scan [828] being recommended by many risk assessment experts in 1996.

Concentrations of 1-methylnaphthalene in South Louisiana crude, Kuwait crude, No. 2 fuel oil, and Bunker C residual were 800, 500, 8200, and 2800 mg/kg (ppm), respectively [177].

Details of naphthalene content (mg/kg or ppm) in one fresh sample of Exxon Valdez Crude Oil [971]:

Note: these values are wet weight (Jerry Neff, Battelle Ocean Sciences, Duxbury, MA, personal communication 1996):

Naphthalene: 622 mg/kg = ppm
C1-Naphthalene: 1400 mg/kg = ppm
C2-Naphthalene: 1780 mg/kg = ppm
C3-Naphthalene: 1410 mg/kg = ppm
C4-Naphthalene: 696 mg/kg = ppm

Details of naphthalene content (mg/kg or ppm) in salmon carcass (fatty viscera removed, so the concentrations may have been higher from whole body samples) from Snug Harbor, Alaska, an area heavily oiled by the Exxon Valdez Crude Oil, 4/15/89 [971]:

Note: Concurrent measurements of water quality, as well as equilibrium partitioning estimates of water quality based on concentrations in fish and mussels, both confirm that PAH concentrations did not exceed water quality criteria at the time these concentrations were measured in fish tissues [971]. These values are wet weight (Jerry Neff, Battelle Ocean Sciences, Duxbury, MA, personal communication 1996):

Naphthalene: 7.15 ug/kg = ppb
C1-Naphthalene: 65.11 ug/kg = ppb
C2-Naphthalene: 29.75 ug/kg = ppb
C3-Naphthalene: 93.95 ug/kg = ppb
C4-Naphthalene: 36.63 ug/kg = ppb

Details of naphthalene content (ug/kg or ppb) in whole body samples of mussels) from Snug Harbor, Alaska, an area heavily oiled by the Exxon Valdez Crude Oil, 4/15/89 [971]:

Note: Concurrent measurements of water quality, as well as equilibrium partitioning estimates of water quality based on concentrations in fish and mussels, both confirm that PAH concentrations did not exceed water quality criteria at the time these concentrations were measured in mussel tissues [971]. These values are wet weight (Jerry Neff, Battelle Ocean Sciences, Duxbury, MA, personal communication 1996):

Naphthalene: 12.9 ug/kg = ppb
C1-Naphthalene: 17.3 ug/kg = ppb
C2-Naphthalene: 247 ug/kg = ppb
C3-Naphthalene: 905 ug/kg = ppb
C4-Naphthalene: 850 ug/kg = ppb

For comparison, the following table lists some of the specific naphthalene contents (ppm) of water soluble fraction (WSF) from 10% oil-in-water solution of four test oils (measured by gas chromatography) [770]:

COMPOUNDS	SOUTH LA CRUDE	KUWAIT CRUDE	NO. 2 FUEL OIL	BUNKER C RESIDUAL

Di-aromatics				
Naphthalene	0.12	0.02	0.84	0.21
1-Methylnaphthalene	0.06	0.02	0.34	0.19

Aromatic hydrocarbons concentrations (ug/g, ppb) measured in a study using Prudhoe Bay Crude oil [854]:

COMPOUNDS	CONCENTRATION (ppb)
Naphthalene	777
1-Methylnaphthalene	1,197

For comparison, capillary gas chromatograph analyses of aromatic hydrocarbon concentrations (uL/L, ppb) in the water soluble fractions (WSF) of a fresh Prudhoe Bay Crude oil [854]:

COMPOUNDS	CONCENTRATION (ppb)
Naphthalene	118.38
1-Methylnaphthalene	39.13

Solubilities [366,766]:

Water solubility= 25.8 ppm [Yalkowsky SH et al; Arizona Data Base of Water Solubility (1987)

SOL IN ALCOHOL, ETHER, & BENZENE [Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. C-361

Water Solubility (mg/L at 25 degrees C) [848]: 25.8 - 30.4

Vapor Pressure:

6.31 to 8.84 Pa at 25 degrees C [848].

0.054 mmHg [766].

Henry's law constant;

16 to 62 Pa M3/mol [848].

Density/Specific Gravity:

1.022 to 1.6125 cubic cm/mol [848].

1.0202 mg/L @ 20 DEG C/4 DEG C [366,766, from Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. C-361.

Color/Form [366,766]:

COLORLESS LIQUID [Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 775.

Odor Threshold [766]:

0.0075 mg/L (7.5 ppb) in water.

Boiling Point [366,766]:

244.6 DEG C [Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. C-361.

Melting Point [366,766]:

-22 DEG C [Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. C-361.

Molecular Weight [366,766]:

142.2 [Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. C-361.

Octanol/Water Partition Coefficient:

log Kow= 3.87 [366,766, from Hansch, C. and A. Leo. The Log P Database. Claremont, CA: Pomona College, 1987. 398].

Log Kow [848]: 3.87 - 5.08

Log Koc (Sorption Partition Coefficient) [848]: 2.96 - 3.83

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

The half-life for photolysis of 1-methylnaphthalene is estimated to be about 22 hours [766].

Of 14 PAHs studied in two soils, volatilization was found to account for about 20% of the loss of 1-methylnaphthalene and 30% of the loss of naphthalene; volatilization was not an important loss mechanism for the other compounds. Lower molecular weight compounds may also volatilize from sediments; this process is not significant for the higher molecular weight compounds [788].

Environmental Fate [366]:

TERRESTRIAL FATE: Data regarding the biodegradation of 1-methylnaphthalene in soil were not available. However, based upon aqueous screening test data and die-away tests for ground and marine water, 1-methylnaphthalene should biodegrade rapidly in soils acclimated to PAHs and at a moderate rate in unacclimated soils. 1-Methylnaphthalene is not expected to undergo hydrolysis in soils; yet, should undergo direct photolysis in sunlit surface soils. A calculated Koc range of 730 to 3035(1) indicates a low to slight mobility class in soils for 1-methylnaphthalene(2). A Henry's Law constant of 2.6X10-4 atm-cu m/mole at 25 deg C(3) suggests volatilization of 1-methylnaphthalene from moist soils with a low organic matter content may be important. [(1) Lyman WJ et al; Handbook of Chemical Property Estimation Methods NY: McGraw-Hill p. 4-9 (1982) (2) Swann RL et al; Res Rev 85: 16-28 (1983) (3) Mackay D et al; Volatilization of Org Pollutants from Water USEPA-600/53-82-019 (NTIS PB 82-230 939) (1982).

AQUATIC FATE: The biodegradation of 1-methylnaphthalene in marine water and waters acclimated to PAHs is expected to be rapid. For unacclimated aquatic systems, 1-methylnaphthalene should biodegrade at a moderate rate. 1-Methylnaphthalene is not expected to undergo hydrolysis in environmental waters. The direct photolysis half-life for 1-methylnaphthalene in sunlit waters at midday, midsummer and 40 deg N latitude was predicted to be 22 hr(1). Bioconcentration of 1-methylnaphthalene is not expected to be important in aquatic systems. Limited monitoring data and an estimated Koc ranging from the low to slightly mobile class(2) suggests 1- methylnaphthalene may partition from the water column to organic matter contained in sediments and suspended solids. A Henry's Law constant of 2.6X10-4 atm-cu m/mole at 25 deg C(3) suggests volatilization of 1-methylnaphthalene from environmental waters may be important(4). Based on this Henry's Law Constant, the volatilization half-life from a model river has been estimated to be 7.5 hr(4,SRC). The volatilization half-life from a model pond, which considers the effect of adsorption, has been estimated to be 11.8 days(5,SRC). [(1) Zepp RG, Schlotzhauer PF; pp 141-58 in PAH. Jones PW, Leber P (ed) Ann Arbor Sci Pub Inc (1979) (2) Swann RL et al; Res Rev 85: 16-28 (1983) (3) Mackay D et al; Volatilization of Org Pollutants from Water USEPA-600/53-82-019 (NTIS PB 82-230 939) (1982A) (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: Based upon a vapor pressure of 5.4X10-2 mm Hg at 25 deg C(1), 1-methylnaphthalene is expected to exist entirely in the vapor phase in ambient air(2). In the atmosphere, direct photolysis of 1-methylnaphthalene is likely to occur; however, only aqueous photolysis data was available. Reactions of 1-methylnaphthalene with photochemically produced hydroxyl radicals and ozone are likely to be important fate processes in ambient air. Measured rate constants at 25 deg C of 5.30X10-11 and 1.3X10-19 cu cm/molecule-sec for vapor phase reactions with hydroxyl radicals and ozone correspond to half-lives of 7.3 hours and 88.2 days at atmospheric concn of 5X10+5 hydroxyl radicals and 7X10+11 ozone molecules, respectively(3). A rate constant of 3.3X10-17 cu cm/molecule-sec at 25 deg C for the vapor-phase reaction of 1-methylnaphthalene with dinitrogen pentoxide corresponds to an atmospheric half-life of about 12.2 days at an atmospheric concn of 2X10+10 molecules per cu cm(3). Therefore, the formation of nitro derivatives in night-time air is also an important fate process for 1-methylnaphthalene(3). [(1) Boublik T et al; Vapor Pressures of Pure Substances. Elsevier NY p. 607 (1984) (2) Eisenreich SJ et al; Environ Sci Technol 15: 30-8 (1981) (3) Atkinson R, Aschmann SM; Atmos Environ 21: 2323-6 (1987).

Biodegradation [366]:

Aerobic aqueous screening test data showed an 84 and 95% loss of 0.1 ppm methylnaphthalene in 1 and 5.6 days, respectively, for acclimated sewage inoculum and did not degrade with unacclimated sewage(1). Zero loss of 1-methylnaphthalene was also observed for a 5 day BOD test with sewage seed at 20 deg C(2). When marine water was used as inoculum, 1-methylnaphthalene at a concn of 0.045 ppm disappeared within 10 days under aerobic conditions at 25 deg C(3). Less than 5% degradation of 1-methylnaphthalene occurred in 28 days using the Japanese MITI I procedure; however, for the MITI II test with a freshwater inoculum, 49% was lost in 28 days under aerobic conditions at 25 deg C(4). [(1) Gaffney PE; J Water Pollut Control Fed 48: 2731-7 (1976) (2) Heukelekian H, Rand MC; J Water Pollut Control Assoc 29: 1040-53 (1955) (3) Vanderlinden AC; Dev Biodegrad Hydrocarbons 1: 165-200 (1978) (4) Yoshida K et al; Aromatikkusu 35: 287-92 (1983).

1-Methylnaphthalene at a concn of 0.5 ppm was completely removed within 14 days from acclimated fresh-wellwater grab samples from Tuffenwies and Zurich, Switzerland, with a pH of 8.0, at 10 and 25 deg C and microbial populations of 300-400 cells/mL(1). Grab samples of groundwater aquifer soil that had acclimated to creosote wastes containing 1-methylnaphthalene were able to degrade 1-methylnaphthalene at concn between 0.02 and 0.12 ppm under aerobic conditions at 25 deg C for a 56 day period at an average rate of 160% per week(2). An average loss of 5.6% per week was observed for autoclaved controls(2). Unacclimated material from the same aquifer degraded 1-methylnaphthalene at an average rate of 3.6% per week; however autoclaved controls lost 1-

methylnaphthalene at an overall rate of 10.9% per week(2). A marine water die-away study with sediment inoculum from Dunstaffnage Bay, Oban, Scotland showed a 92% loss of 1-methylnaphthalene contained in crude oil after 7 days at 20 deg C(3). After standardization to controls, the measure of C14 C02 evolution from radiolabeled 1-methylnaphthalene contained in crude oil was 0.8, 2.2 and 0.8% for marine water grab samples from Saanich Inlet, Canada incubated at 12 deg C for 1, 2 and 3 days, respectively(4). [(1) Kappeler T, Wuhrmann K; Water Res 12: 327-33 (1978) (2) Wilson JT et al; Environ Toxicol Chem 4: 721-6 (1985) (3) Rowaland SJ et al; Org Geochem 9: 153-61 (1986) (4) Lee RF, Anderson JW; Bull Mar Sci 27: 127-34 (1977).

Abiotic Degradation [366]:

Polycyclic aromatic hydrocarbon are generally resistant to hydrolysis(1). Therefore, 1-methylnaphthalene probably will not undergo hydrolysis in the environment. 1-Methylnaphthalene absorbs a maximum amount of sunlight at 312 nm(3). The direct aqueous photolysis half-life for midday, midsummer sunlight at 40 deg N latitude was predicted to be 71 hr(3). Data regarding direct photolysis of 1-methylnaphthalene in air were not available. The rate constant for the vapor-phase reaction of 1-methylnaphthalene with photochemically produced hydroxyl radicals was measured to be 5.30X10-11 cu cm/molecule-sec at 25 deg C; which corresponds to an atmospheric half-life of about 7.3 hours at an atmospheric concn of 5X10+5 hydroxyl radicals per cu cm(2). The rate constant for the vapor-phase reaction of 1-methylnaphthalene with ozone has been measured to be less than 1.3X10-19 cu cm/molecule-sec at 25 deg C which corresponds to an atmospheric half-life of about 88.2 days at an atmospheric concn of 7X10+11 molecules per cu cm(2). The rate constant for the vapor-phase reaction of 1-methylnaphthalene with dinitrogen pentoxide has been measured to be 3.3X10-17 cu cm/molecule-sec at 25 deg C which corresponds to an atmospheric half-life of about 12.2 days at an atmospheric concn of 2X10+10 molecules 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, Aschmann SM; Atmos Environ 21: 2323-(1987) (3) Zepp RG, Schlotzhauer PF; pp. 141-58 in PAH. Jones PW, Leber P (ed) Ann Arbor Sci Pub Inc (1979).

Soil Adsorption/Mobility [366]:

An average log Kp for 1-methylnaphthalene of 1.96 was determined from 17 measurements(1). Based on a water solubility of 25.8 ppm(2) and a log Kow of 3.87(3), the Koc of 1-methylnaphthalene has been calculated to range from 730 to 3035 from various regression-derived equations(4,SRC). These Koc values indicate 1-methlnaphthalene will be low to slightly mobile in soil(4). A measured Koc of 8500 for the 2-methylnaphthalene suggest 1-methyl will have a strong adsorption to organic matter(5). [(1) Vowles PD, Mantoura RFC; Chemosphere 16: 109-16 (1987) (2) Yalkowsky SH et al; Arizona Data Base of Water Solubility (1987) (3) Hansch C, Leo AJ; Medchem Project Issue No 26. Claremont CA: Pomona College (1985) (4) Lyman WJ et al; Handbook of Chemical Property Estimation Methods NY: McGraw-Hill p. 4-9 (1982) (5) Swann RL et al; Res Rev 85: 16-28 (1983).

Volatilization from Water/Soil [366]:

A Henry's Law Constant of 2.60X10-4 atm-cu m/mole(1) indicates volatilization of 1-methylnaphthalene from environmental waters should be important(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 7.5 hr(2,SRC). The volatilization half-life from a model pond, which considers the effect of adsorption, has been estimated to be 11.8 days(3,SRC). [(1) Mackay D et al; Volatilization of Org Pollutants from Water EPA-600/53- 82-019 (NTIS PB 82-230 939) (1982) (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).

Absorption, Distribution and Excretion [366]:

Injection of aerotex 3470 into rats (250 mg/kg, ip) resulted in rapid uptake & subsequent release of component aromatic hydrocarbons incl 1-methylnaphthalene from liver, brain, muscle, & kidney. Adipose tissue took up more, but rapidly released it 24-48 hr after admin. [sparling j et al; chemosphere 7 (7): 607-14 (1978).

1-methylnaphthalene was identified by gas chromatography/mass spectrometry in flesh extract of eels (anguilla japonica temminck et schlegel) maintained in controlled laboratory environment of water with suspension of crude oil. [ogata m et al; water res 13 (7): 613-8 (1979).

Postlarvae brown shrimp, grass shrimp, & sheepshead minnow rapidly accumulated 1-methylnaphthalene when placed into seawater medium containing the hydrocarbon. The animals eliminated the hydrocarbon equally rapidly when replaced into uncontaminated seawater medium. [anderson jw et al; pollut physiol mar org 285-310 (1974).

Laboratory and/or Field Analyses:

In the past, many methods have been used to analyze for PAHs [861,1010,1013], but most do not cover C1 naphthalenes such as this one. Parent compound semi-volatile PAHs have often been analyzed using routine monitoring methods EPA 8270 for solid waste/RCRA purposes [1013] or by EPA NPDES method 610 as specified in 40 CFR Part 136 [1010]. However, the standard EPA methods 8270, 610, and 625 are all inadequate for generating scientifically defensible information for Natural Resource Damage Assessments [468]. For risk, or damage assessment, or biological impact studies, or drinking water purposes, or to determine if biodegradation has occurred, the NOAA expanded scan for PAHs and alkyl PAHs [828], or equivalent improvements, should be used since such scans generally give more rigorous and comprehensive results than the unmodified EPA scans. The NOAA scan also covers C1 naphthalenes such as this one.

Most of the historically used methods for PAHs, including EPA standard semi-volatile scan numbers 8270 and 610, do not cover important alkyl PAHs and do not utilize low-enough detection limits.

> Recommended detection limits: 10 ppt for water, 0.3 to 1 ppb for 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, and these lower detection limits are far better for risk or hazard assessment, but in all cases detection limits for these media should not be above 10 ppb.

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].

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 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 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.

Some labs use screening HPLC fluorescence methods to screen for alkylated naphthalenes and dibenzothiophenes that fluoresce at naphthalene wavelengths and the alkylated phenanthrenes that fluoresce at phenanthrene wavelengths [521]. Other HPLC/fluorescence scans are used to examine fish bile directly for the presence of metabolites of PAHs such as naphthalene [523].

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 SIM detection limits (10 ppt for water, 0.3 to 1 ppb for solids) and additional alkyl PAH analytes; or alternative rigorous scans; rather than many of the standard EPA parent compound PAH scans which are prone to false negatives (Roy Irwin, National Park Service, Personal Communication, 1997).

For a much more detailed discussion of lab methods for naphthalenes, see the naphthalene entry. In the lab section of the naphthalene (general) entry, the reader will find much more detailed discussions of lab methods, holding times, containers, comparability of data from different methods, field methods, quality assurance procedures, the relationship of various methods to each other, the various EPA standard methods for various EPA programs, and 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 naphthalene entry. Other details, such as pros and cons of various lab and field methods for PAHs, may be found in the separate PAHs entry. Due to the length of these discussions, they are not repeated here (see naphthalene and PAHs entries).