ENVIRONMENTAL CONTAMINANTS ENCYCLOPEDIA

o-XYLENE ENTRY

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COMPILERS/EDITORS:

ROY J. IRWIN, NATIONAL PARK SERVICE

WITH ASSISTANCE FROM COLORADO STATE UNIVERSITY
STUDENT ASSISTANT CONTAMINANTS SPECIALISTS:

MARK VAN MOUWERIK
LYNETTE STEVENS
MARION DUBLER SEESE
WENDY BASHAM

NATIONAL PARK SERVICE
WATER RESOURCES DIVISIONS, WATER OPERATIONS BRANCH
1201 Oakridge Drive, Suite 250
FORT COLLINS, COLORADO 80525

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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).

Xylene, o- (o-Xylene, ortho-xylene, CAS number 95-47-6)

NOTE: The majority of the information in this entry is on the o- isomer of xylene. However, "xylene or xylenes" are often a mixture of ortho-, meta-, and para- isomers. The information on isomers is sometimes difficult to separate and the information on mixed xylenes or total xylenes is of some interest in considering o-xylene. Where information on o-xylene is lacking, consult corresponding sections in the more general "Xylenes, Total" entry.

Brief Introduction:

Br.Class: General Introduction and Classification Information:

Xylenes (mixed) are considered volatile organic compounds (VOCs) [868,903]. Xylenes are C2 Benzenes, one class of alkyl benzenes.

Xylene, a widely used industrial solvent, is a mixture of ortho-, meta-, and para- isomers [366].

Xylene produced from petroleum ... contains approx 20% o-xylene, 44% m-xylene, 20% p-xylene, and 15% ethylbenzene. Xylene from coal tar generally consists of 10-15% ortho-xylene, 45-70% meta-xylene, 23% para-xylene, and 6-10% ethylbenzene [366].

While o-xylene is recognized as a distinct product in chemical analyses, the m- and p- isomers are generally not separated during most routine analyses. Therefore, results of analyses of xylenes in environmental samples are usually presented as the concentration of the o-isomer and the total concentration of the combined m- and p- isomers [602].

Designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. These regulations apply to discharges of this substance. [366, 40 CFR 116.4 (7/1/88)].

Br.Haz: General Hazard/Toxicity Summary:

This compound often occurs together with other aromatic compounds, some possibly more hazardous than this compound alone (see entries for Benzene and "PAHs as a group").

Except for short term hazards from concentrated spills, this compound has been more frequently associated with risk to humans than with risk to non-human species such as fish and wildlife. This is partly because only very small amounts are taken up by plants, fish, and birds and because this volatile compound tends to evaporate into the atmosphere rather than persisting in surface waters or soils [764]. However, volatiles such as this compound have can pose a drinking water hazard when they accumulate in ground water. Exposure to humans may arise from contaminated drinking water such as well water near leaking underground storage tanks [609].

Humans are exposed to o-xylene primarily from the air, particularly in areas with heavy traffic, near filling stations, near industrial sources such as refineries or where o-xylene is used in solvents.

Information on Xylenes in general:

> In animals, large amounts of xylene can cause changes in the liver and harmful effects on the kidneys, heart, lungs, and nervous system [764].
>
> Long term exposures of animals to low doses of xylene have not been well studied [764].
>
> The Canadian government (1993) concluded that xylenes are not ordinarily entering the Canadian environment in concentrations that might be expected to cause adverse effects to aquatic biota, terrestrial wildlife, humans, or to depletion of stratospheric ozone (exceptions might be spills or other direct releases) [602].
>
> Additional human health issues related to xylenes have been summarized by ATSDR (not all the highlights from ATSDR have been summarized in this entry) [764].

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

This compound often occurs together with other aromatic compounds, some possibly more carcinogenic than this compound alone (see entries for Benzene and "PAHs as a group").

See entry entitled "Xylenes, Total."

Information on Xylenes in general:

> EPA 1996 IRIS database information [893]:
>
> > Evidence for classification as to human carcinogenicity; weight-of-evidence classification:

Classification: D; not classifiable as to human carcinogenicity

BASIS: Orally administered technical xylene mixtures did not result in significant increases in incidence in tumor responses in rats or mice of both sexes.

HUMAN CARCINOGENICITY DATA

None.

ANIMAL CARCINOGENICITY DATA

Inadequate.

Xylenes (mixed) have not been treated as carcinogens 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 xylene (mixed) is definitely not a carcinogen; the non-carcinogenic benchmarks are sometimes nearly as low as the carcinogenic benchmarks (Stan Smucker, personal communication, EPA, 1996).

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

Cod eggs were exposed to seawater solutions of xylenes. Treatment during fertilization with o-xylene had no significant effect upon fertilization capacity. [366, Kjoersvik E et al; Sarsia 67 (4): 299-308 (1982)].

Information on Xylenes in general:

In limited studies thus far, the individual isomers were not found to be genotoxic when tested in a number of short-term tests [366].

Some information on immunological, reproductive, fetotoxic, and developmental effects points towards some negative effects of xylene, but the information is limited and mixed [764]. Xylene does not appear to be particularly genotoxic [764].

See also entry entitled "Xylenes, Total."

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

Environmental Fate/Exposure Summary [609]:

o-Xylene will enter the atmosphere primarily from fugitive emissions and exhaust connected with its use in gasoline. Industrial sources include emissions from petroleum refining, coal tar and coal gas distillation and from its use as a solvent. Discharges and spills on land and in waterways result from its use in diesel fuel and gasoline. Most of the o-xylene is released into the atmosphere where it may photochemically degrade by reaction with hydroxyl radicals (half-life 1.5-15 hr). The dominant removal process in water is volatilization. o-Xylene is moderately mobile in soil and may leach into groundwater where it has been known to be detectable for several years, although there is some evidence that it biodegrades in both soil and groundwater. Bioconcentration is not expected to be significant. The primary source of exposure is from the air, especially in areas with high traffic.

Information on Xylenes in general:

Like benzene and toluene, xylenes are fairly volatile, and significant xylenes tend to quickly evaporate if exposed to the atmosphere [764]. However, xylenes can be more persistent when in groundwater, sediment, or soil media not directly exposed to atmosphere. Xylenes tend to migrate to groundwater, and persistence is an issue in groundwater, where in some cases, they may persist for months or years [764].

Most xylene in surface water evaporates into the air in less than a day. The rest of it biodegrades slowly into other chemicals. Only very small amounts are taken up by plants, fish, and birds. We do not know exactly how long xylene stays in water, but we do know that it stays longer in groundwater than in lakes and rivers, probably because it can evaporate from the latter [764].

Xylene evaporates from soil surfaces. Xylene below the soil surface stays there for several days and may travel down through the soil and enter groundwater. In the soil and groundwater it may be slowly biodegraded into less harmful compounds. It is not clearly known how long xylene trapped deep underground in soil or groundwater persists, but it may be months or years. Xylene stays longer in wet soil than in dry soil [764].

Xylenes are bioconcentrated in aquatic organisms to a limited extent. Although more information on bioconcentration would be helpful, the phenomenon of biomagnification is not expected to be important for xylene [764].

Synonyms/Substance Identification:

o-Dimethylbenzene [607].
1,2-Dimethylbenzene [607].
o-Methyltoluene [607].
UN1307 (DOT) [607].
1,2-Xylene [607].
o-Xylene (ACGIH,DOT,OSHA) [607].
o-Xylol [607].
Benzene, 1,2-dimethyl- [609].
AI3-08197 [609].
2-Xylene [609].

Molecular Formula [609]:
C8-H10

Associated Chemicals or Topics (Includes Transformation Products):

See also individual entries:

Xylenes, Total
Xylene, m-
Xylene, p-
BTEX
Ethylbenzene

Metabolism/Metabolites [609]:

Major urinary metabolite of o-xylene in rats was o-toluic acid glucuronide, whereas that in humans was o-methylhippuric acid, (o-toluic acid glucuronide was a minor metabolite). [Ogata M et al; Ind Health 17 (2): 123-5 (1979)].

0.4 ML/KG/DAY OF O-Xylene admin to rabbit by stomach tube for 1 wk was excreted as the o-toluic acid glucuronide ... However, a further metabolite 3,4-dimethylphenol ... Glucuronide, was identified by ether hydrolysis, elemental & infrared analysis. The same metabolites were isolated ... In the rat & guinea pig. [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3298].

Generally, the xylenes are metabolized to corresponding o-, m-, p-toluic acids, & excreted in urine free or conjugated with glycine as methylhippuric acid. ... A linear relationship was found between atmospheric xylene concn & excreted toluic acid. [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial

Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3296

/When 100 mg/kg was admin to rats/ ... O-xylene /was/ metabolized to 3,4-dimethylphenol (0.1% Of dose) & 2,3-dimethylphenol (0.03% Of dose) ... 2-Methylbenzyl alcohol was also reported as metabolite. ... [National Research Council. Drinking Water & Health Volume 1. Washington, DC: National Academy Press, 1977.,p. 787

The involvement of sequential side-chain oxidation, sulfation & glutathione conjugation in formation of mercapturic acids from xylenes was investigated. The position of methyl groups attached to the aromatic nucleus affected metabolism. Factors that are involved in high yield of mercapturic acids after admin of o-xylene as compared to m- & p-xylenes incl relatively low apparent affinity of o-methylbenzyl alcohol for cytosolic alcohol dehydrogenase, the relatively high apparent affinity of o-methylbenzyl alcohol for cytosolic sulfotransferase, & the high electrophilic reactivity of the o-methylbenzyl sulfate. [Van Doorn R et al; J Appl Toxicol 1 (4): 236-42 (1981)].

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

W.Low (Water Concentrations Considered Low):

No information found. See entry entitled "Xylenes, Total."

W.High (Water Concentrations Considered High):

The highest concentrations of xylenes in groundwater in Canada have been recorded near waste disposal sites, including beneath landfill sites (from less than 0.2 to 123 ug/L o-xylene), near deep injection wells formerly used for the disposal of liquid industrial waste, and near an active industrial chemical waste disposal lagoon (up to 1700 ug/L o-xylene) [602].

W.Typical (Water Concentrations Considered Typical):

o-Xylene concentrations of 21 ug/L were measured in eight test wells in Ontario, Canada. The xylene was most likely a result of natural bituminous deposits [602].

Water Concentrations [609]:

DRINKING WATER: In treated water from 30 Canadian water treatment facilities in which o- or m-xylene combined were measured, 27% and 20% were positive in summer and winter respectively, with max values of 7 and 2 ppb respectively, and mean values below 1 ppb(1). In 12 Great Lake municipalities tested on one or two days, 5 communities were free of m- and o-xylene combined with median community levels being 1.0 ppb and the highest sample of combined isomers being 12 ppb(2). o-Xylene was detected but not quantified in drinking water from Philadelphia, PA(3), Washington, DC(4), Tuscaloosa, AL(5), and Houston, TX(5). In 3 New Orleans treatment plants, the avg concn of water collected over 2 days was 3.4 ppb(6). Bank filtered drinking water in the Netherlands contained a max of 30 parts per trillion o-xylene(7). In 5 drinking water wells near and down gradient from a landfill - 0.2-1.5 ppb, control well upstream - 0.8 ppb(8). In a survey of organics in drinking water derived from groundwater sources, o- and p-xylene combined were found in 2.1% of 280 sample sites supplying <10,000 persons and 1.1% of 186 sites supplying >10,000 persons. The maximum combined concn were 0.59 and 0.91 ppb, respectively(9). Detected in all 14 drinking water supplies studies, 10 from surface sources and 4 from ground sources in the lowland of Great Britain(10). [(1) Otson R et al; J Assoc Off Analyt Chem 65: 1370-4 (1982) (2) Williams DT et al; Chemosphere 11: 263-76 (1982) (3) Suffet IH et al; p 875-97 in Identification and Analysis of Organic Pollutants in Water. Keith LH ed. Ann Arbor Science (1976) (4) Saunders RA et al; Water Res 9: 1143-5 (1975) (5) Bertsch W et al; J Chromatogr 112: 701-18 (1975) (6) Keith LH et al; p 329-73 in Identification and Analysis of Organic Pollutants in wWter. Keith LH ed. Ann Arbor,MI: Ann Arbor Science (1976) (7) Piet GJ, Morra CF p 31-42 in Artificial Groundwater Recharge (Water Res Eng Ser) Huisman L, Olsthorn TN eds Pitman Publ (1983) (8) DeWalle FB, Chian ESK; J Amer Water Works Assoc 73: 206-11 (1981) (9) Westrick JJ; J Amer Water Works Assoc 76: 52-9 (1984) (10) Fielding M et al; Organic Micropollutants in Drinking Water. TR-159. Medmenham, UK. Water Res Cent (1981) [609].

GROUNDWATER: In the Chalk Aquifer in England, 1550 ppb o-xylene was measured 10 m from the tank and 0.02 ppb was found in a public water supply 210 m from the tank(1). At the How Creek coal gasification site in Wyoming, 260-590 ppb was found 15 months after gasification was completed(2). 6 ppb was found in landfill groundwater(3). Detected in recovery well from landfill 7 years after closure(4). [(1) Tester DJ, Harker RJ; Water Pollut Control 80: 614-31 (1981) (2) Stuermer DH et al; Environ Sci Technol 16: 582-7 (1982) (3) Dunlap WJ et al; Organic Pollutants Contributed to

Groundwater by a Landfill p 96-110 USEPA-600/9-76-004 (1976) (4) DeWalle FB, Chian ESK; J Amer Water Works Assoc 73: 206-11 (1981) [609].

SURFACE WATER: In the raw water for 30 Canadian water treatment facilities, 7% and 17% of plants contained combined o- and m-xylene in summer and winter, respectively with max levels being under 1 ppb(1). Detected, not quantified, in the Mississippi R(2), the Black Warrior R in Tuscaloosa, AL(3), and the Glatt R in Switzerland(4). [(1) Otson R et al; J Assoc Off Analyt Chem 65: 1370-4 (1982) (2) Dowty BJ et al; Environ Sci Technol 9: 762-5 (1975) (3) Bertsch W et al; J Chromatogr 112: 701-18 (1975) (4) Zuercher F, Giger W; Vom Wasser 47: 37-55 (1976) [609].

SEAWATER: In Vineyard Sound, MA samples taken from March through June ranged from 1.8 to 25 parts per trillion and avg 9.4 parts per trillion(1). In open ocean and coastal sections of the Gulf of Mexico, 1-30 parts per trillion(2). [(1) Gschwend PM et al; Environ Sci Technol 16: 31-8 (1982) (2) Sauer TC Jr; Org Geochem 3: 91-101 (1981) [609].

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):

The Netherlands' Maximum Permissable Concentration (MPC) for o-xylene for the protection of all species in an aquatic ecosystem is 400 ug/L [655].

The Netherlands' Negligible Concentration (NC) for o-xylene is 1% of the MPC, or 4.0 ug/L [655].

NOTE: Above values are based on ecotoxicological data.

The Netherlands' Harmonized (between media) Maximum Permissible Concentration (MPC) for either 0-xylene, m-xylene, or p-xylene in water is 380 ug/L [655].

Note: Harmonization takes into account whether or not the MPC in one media (such as soil) would lead to exceeding the MPC in another media (such as air, water, or sediment) [655].

The Netherlands' Harmonized (between media) Negligible Concentration (NC) for either 0-xylene, m-xylene, or p-xylene in water is 1% of the MPC, or 3.8 ug/L [655].

W.Plants (Water Concentrations vs. Plants):

No information found. See entry entitled "Xylenes, Total."

W.Invertebrates (Water Concentrations vs. Invertebrates):

The most sensitive freshwater organism was the water flea (Daphnia magna) with a 24-hour LC50 of 1.0 mg/L for o-xylene. Among marine organisms, the most sensitive species was the bay shrimp (Crago franciscorum) with a 96-hour LC50 of 1.1 mg/L for o-xylene [602].

LC50 Cancer magister (crab larvae stage I) 6 ppm/96 hr /Conditions of bioassay not specified/ [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 1190] [609].

LC50 Crangon franciscorum (shrimp) 1.3 ppm/96 hr /Conditions of bioassay not specified/ [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 1190] [609].

W.Fish (Water Concentrations vs. Fish):

The most sensitive freshwater fish was the rainbow trout (Oncorhynchus mykiss) with a 96-hour LC50 of 7.6 mg/L for the o- isomer. The most sensitive marine species tested was the young of the striped bass (Morone saxatilis) with a 96-hour LC50 of 8.0 mg/L for the o- isomer [602].

LC50 Poecilia reticulata (guppy) 35 ppm/7 days /Conditions of bioassay not specified/ [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 1191] [609].

LC50 Morone saxatilis (bass) 11.0 ppm/96 hr /Conditions of bioassay not specified/ [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 1191] [609].

LC50 Carassius auratus (goldfish) 16.9 ppm/96 hr.

/Conditions of bioassay not specified/ [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 1191] [609].

Cod eggs were exposed to seawater solutions of xylenes. Treatment during fertilization with o-xylene had no significant effect upon fertilization capacity. [Kjoersvik E et al; Sarsia 67 (4): 299-308 (1982)] [609].

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

No information found. See entry entitled "Xylenes, Total."

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

EPA Region 9 Preliminary remediation goal (PRG) for Tap Water, 1995 [868]: 1.4E+03 ug/L.

EPA Region 3 risk based concentration (RBC) value for drinking water: 1400 ug/L [903].

California's Action Limit for o-xylene in drinking water is 0.620 mg/L [859].

See also entry entitled "Xylenes, Total."

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

No information found. See entry entitled "Xylenes, Total."

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

Sed.Low (Sediment Concentrations Considered Low):

No information found. See entry entitled "Xylenes, Total."

Sed.High (Sediment Concentrations Considered High):

No information found. See entry entitled "Xylenes, Total."

Sed.Typical (Sediment Concentrations Considered Typical):

Detected, not quantified in sediment in lake 8 km downstream from Napawin, Saskatchewan source of agricultural, mining, petrochemical, pulp and paper and municipal wastes(1). In unspecified sediment 500 ppb(2). [(1) Samolloff MR; Envron Sci Technol 17: 329-34 (1983) (2) Storet Data Base] [609].

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):

Based on equilibrium partitioning, the Netherlands' Maximum Permissable Concentration (MPC) for o-xylene for the protection of all sediment-dwelling organisms is 26 mg/kg dry weight [655].

Based on equilibrium partitioning, the Netherlands' Negligible Concentration (NC) for m-xylene is 1% of the MPC, or 0.26 mg/kg dry weight [655].

The Netherlands' Harmonized (between media) Maximum Permissible Concentration (MPC) for either 0-xylene, m-xylene, or p-xylene in sediments is 14 mg/kg [655].

> Note: Harmonization takes into account whether or not the MPC in one media (such as soil) would lead to exceeding the MPC in another media (such as air, water, or sediment) [655].

The Netherlands' Harmonized (between media) Negligible Concentration (NC) for either 0-xylene, m-xylene, or p-xylene in sediments is 1% of the MPC, or 0.14 mg/kg [655].

Sed.Plants (Sediment Concentrations vs. Plants):

No information found. See entry entitled "Xylenes, Total."

Sed.Invertebrates (Sediment Concentrations vs. Invertebrates):

No information found. See entry entitled "Xylenes, Total."

Sed.Fish (Sediment Concentrations vs. Fish):

No information found. See entry entitled "Xylenes, Total."

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

No information found. See entry entitled "Xylenes, Total."

Sed.Human (Sediment Concentrations vs. Human):

No information found. See entry entitled "Xylenes, Total."

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

No information found. See entry entitled "Xylenes, Total."

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

Soil.Low (Soil Concentrations Considered Low):

No information found. See entry entitled "Xylenes, Total."

Soil.High (Soil Concentrations Considered High):

Preliminary remediation goals (PRGs), 1995 [868]:

Residential Soil: 9.9E+02 mg/kg wet wt.
Industrial Soil: 9.9E+02 mg/kg wet wt.

NOTE:
1) PRGs focus on the human exposure pathways of ingestion, inhalation of particulates and volatiles, and dermal absorption. Values do not consider impact to groundwater or ecological receptors.
2) Values are based on a non-carcinogenic hazard quotient of one.
3) PRGs for residential and industrial landuses are slightly lower concentrations than EPA Region III RBCs, which consider fewer aspects [903].

EPA Risk based concentration (RBC) to protect from transfers to groundwater:

150 mg/Kg dry weight [903].

Soil.Typical (Soil Concentrations Considered Typical):

No information found. See entry entitled "Xylenes, Total."

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):

Based on equilibrium partitioning, the Netherlands' Maximum Permissable Concentration (MPC) for o-xylene for the protection of all soil-dwelling organisms is 26 mg/kg dry weight [655].

Based on equilibrium partitioning, the Netherlands' Negligible Concentration (NC) for o-xylene is 1% of the MPC, or 0.26 mg/kg dry weight [655].

The Netherlands' Harmonized (between media) Maximum Permissible Concentration (MPC) for either 0-xylene, m-xylene, or p-xylene in soil is 14 mg/kg [655].

> Note: Harmonization takes into account whether or not the MPC in one media (such as soil) would lead to exceeding the MPC in another media (such as air, water, or sediment) [655].

The Netherlands' Harmonized (between media) Negligible Concentration (NC) for either 0-xylene, m-xylene, or p-xylene in soil is 1% of the MPC, or 0.14 mg/kg [655].

Soil.Plants (Soil Concentrations vs. Plants):

No information found. See entry entitled "Xylenes, Total."

Soil.Invertebrates (Soil Concentrations vs. Invertebrates):

No information found. See entry entitled "Xylenes, Total."

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

No information found. See entry entitled "Xylenes, Total."

Soil.Human (Soil Concentrations vs. Human):

EPA 1996 National Generic Soil Screening Level

(SSL) designed to be conservative and protective at the majority of sites in the U.S. but not necessarily protective of all known human exposure pathways, land uses, or ecological threats [952]:

SSL = 1.6E+05 mg/kg for ingestion pathway [952].

SSL = 410 mg/kg for inhalation pathway [952].

SSL = 9 to 190 mg/kg for protection from migration to groundwater at 1 to 20 Dilution-Attenuation Factor (DAF) [952].

EPA Region 9 Preliminary remediation goals 1995 (PRGs), 1995 [868]:

Residential Soil: 9.9E+02 mg/kg wet wt.
Industrial Soil: 9.9E+02 mg/kg wet wt.

NOTE:

1) PRGs focus on the human exposure pathways of ingestion, inhalation of particulates and volatiles, and dermal absorption. Values do not consider impact to groundwater or ecological receptors.
2) Values are based on a non-carcinogenic hazard quotient of one.
3) PRGs for residential and industrial landuses are slightly lower concentrations than EPA Region III RBCs, which consider fewer aspects [903].

EPA 1995 Region 3 Risk based concentration (RBC) to protect from transfers to groundwater:

150 mg/Kg dry weight [903].

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

No information found. See entry entitled "Xylenes, Total."

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. See entry entitled "Xylenes, Total."

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

No information found. See entry entitled "Xylenes, Total."

Tis.Invertebrates:

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

No information found. See entry entitled "Xylenes, Total."

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

No information found. See entry entitled "Xylenes, Total."

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

No information found. See entry entitled "Xylenes, Total."

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. See entry entitled "Xylenes, Total."

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

Past oral Rfd (safe level) estimates have varied from 0.2 to 2.0 mg/kg/day [868]. No information in IRIS 1996 (EPA Database) [893].

For risk to human adults eating fish, separate carcinogenic and non-carcinogenic risk-based fish tissue concentrations were calculated [903]. The following EPA Region III fish tissue risk-based concentration (RBC) benchmark utilizes the lower of the two (carcinogenic vs. non-carcinogenic) concentrations, rounded to two significant figures [903]:

RBC Benchmark = 2700 mg/Kg wet weight. However, the reader should keep in mind that the concentrations would seldom get this high even in polluted areas.

See also entry entitled "Xylenes, Total."

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

No information found. See entry entitled "Xylenes, Total."

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. See entry entitled "Xylenes, Total."

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. See entry entitled "Xylenes, Total."

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

Following exposure of rabbits to atmosphere of about 3,000 mg/cu m for 8 hr/day, 6 days/wk, for 130 days, xylene was found at slightly higher avg concentrations in the adrenal (148 ppm), bone marrow (130 ppm), spleen (115 ppm), & brain (100 ppm) than in blood (91 ppm) or in other organs. /Xylenes/ [Hayes, Wayland J., Jr. Pesticides Studied in Man. Baltimore/London: Williams and Wilkins, 1982. 123] [609].

Tis.Human:

A) Typical Concentrations in Human Food Survey Items:

No information found. See entry entitled "Xylenes, Total."

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):

Past oral Rfd (safe level) estimates have varied from 0.2 to 2.0 mg/kg/day [868]. No information in IRIS 1996 of EPA [893].

For risk to human adults eating fish, separate carcinogenic and non-carcinogenic risk-based fish tissue concentrations were calculated [903]. The following EPA Region III fish tissue risk-based concentration (RBC) benchmark utilizes the lower of the two (carcinogenic vs. non-carcinogenic) concentrations, rounded to two significant figures [903]:

> RBC Benchmark = 2700 mg/Kg wet weight. However, the reader should keep in mind that the concentrations would seldom get this high even in polluted areas.

See also entry entitled "Xylenes, Total."

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

No information found. See entry entitled "Xylenes, Total."

Tis.Misc. (Other Tissue Information):

No information found. See entry entitled "Xylenes, Total."

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

Bioconcentration Factors (log BCF) for o-xylene [902]:

1.15 for goldfish,
1.15, 1.33, and 1.58 for fish,
2.34 for Selenastrum capricornutum (green alga)

Bioconcentration [609]:

Little bioconcentration has been observed; log BCF= 1.33 and 0.79 for eels(1) and clams(2), respectively. Based on the measured octanol/water partition coefficient (log Kow= 3.12(3)) one would estimate that the log BCF in fish would be 2.12(4,SRC). [(1) Ogata M, Miyaka Y; Water Res 12: 1041-4

(1978) (2) Nunes P, Benville PE JR; Bull Environ Contam Toxicol 21: 719-24 (1979) (3) Hansch C, Leo AJ; Substituted Constants for Correlation Analysis in Chemistry and Biology. NY, NY John Wiley and Sons p 233 (1979) (4) Lyman WJ et al; p 5-5 in Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds New York, NY McGraw Hill (1982)].

Interactions:

When consumed prior to exposure, ethanol decreases the metabolic clearance of xylene by approximately one-half. /Xylenes/ [Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988. 963] [609].

Uses/Sources:

Major Uses [609]:

Raw material for production of plasticizers; alkyd resins, glass-enforced polyesters, manufacture of phthalic anhydride [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3291].

Vitamin and pharmaceutical syntheses; dyes; insecticides; motor fuels. [Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 1243].

Chem intermediate for phthalonitrile [SRI].

Chem intermediate for other derivatives [SRI].

Reacts with hexafluoroacetone to produce 4,4'-(Trifluoro-1-(trifluoromethyl)ethylidene) diphthalic anhydride, an intermediate in the preparation of high-performance polyimide polymers [Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984.,p. 10(80) 887].

Natural Occurring Sources [609]:

Coal tar, petroleum(1), forest fire(2), plant volatile(2). [(1) Verschueren K; Handbook on Environmental Data on Organic Chemicals 2nd ed New York NY, Van Nostrand Reinhold Co p 118-91 (1983) (2) Graedel TE; Chemical Compounds in the Atmosphere New York NY Academic Press p 108 (1978)].

Artificial Sources [609]:

Emissions from petroleum refining, coal tar and coal gas distillation, emissions from its use as a chemical intermediate(1,3). Emissions from its use as a solvent, evaporative losses during the transport and storage of gasoline and from carburetors(1-3). Auto emissions, tobacco smoke(2,3). Gasoline spills on land or in waterways during transport or from boats and other vehicles(SRC). Agricultural spraying(3). [(1) Verschueren K; Handbook on Environmental Data on Organic Chemicals 2nd ed New York NY, Van Nostrand Reinhold Co p 118-91 (1983) (2) Graedel TE; Chemical Compounds in the Atmosphere New York NY Academic Press p 108 (1978) (3) NAS; The Alkyl Benzenes page I-1 to I-99 (1980)].

Other Environmental Concentrations [609]:

High octane gasoline 6.27% (wt)(1). Composite gasoline sample from Los Angeles 2.86% (wt)(2); cigarette smoke <6-48 ug/cigarette(2). [(1) Verscheuren K; Handbook on Environmental Data on Organic Chemicals 2nd ed New York, NY Van Nostrand Reinhold p 1188-91 (1983) (2) NAS; The Alkyl Benzenes page I-1 to I-99 (1980)].

Forms/Preparations/Formulations:

Grades: 99%, Free of hydrogen sulfide & sulfur dioxide; Technical 95%; Research 99.9%. [Sax, N.I. and R.J. Lewis, Sr. (eds.). Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. 1243] [609].

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

Solubilities:

167 to 655 mg/L at 25 degrees C (most values 175 to 221) [902].

Miscible with acetone, benzene, alcohol, ether [Weast, R.C. (ed.) Handbook of Chemistry and Physics, 68th ed. Boca Raton, Florida: CRC Press Inc., 1987-1988.,p. C-549] [609].

Vapor Pressure:

871 to 933 Pa at 25 degrees C (most values near 882) [902].

760 mm Hg at 144.4 deg C [Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. D-204] [609].

Henry's Law Constant:

436 to 895 Pa m(3)/mol (most values 493 to 535) [902].

Molecular Weight:

106.16 [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 1448] [609].

Density/Specific Gravity:

0.8801 @ 20 deg C/4 deg C [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 1448] [609].

Octanol/Water Partition Coefficient, log Kow:

2.12 to 3.42 (most values near 3.14) [902].

log Kow= 3.12 [Hansch, C., A. Leo. Substituent Constants for Correlation Analysis in Chemistry and Biology. New York, NY: John Wiley and Sons, 1979. 232] [609].

Sorption Partition Coefficients, log Koc:

1.68 to 2.73 [902].

Color/Form:

Colorless liquid [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 1448] [609].

Odor:

Sweet [U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5] [609].

Boiling Point:

144.4 deg C @ 760 mm Hg [Weast, R.C. (ed.) Handbook of Chemistry and Physics. 69th ed. Boca Raton, FL: CRC Press Inc., 1988-1989.,p. C-549] [609].

Melting Point:

-25 DEG C [The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983. 1448] [609].

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

Xylenes can be degraded by micro-organisms in the water. Half-lives for biodegradation by unacclimated organisms in water have been estimated to be between 7 and 28 days for each of the three isomers in aerobic systems, and between 180 and 360 days for o-xylene in anaerobic systems [602].

In one study, under denitrifying conditions (that is, nitrate was present in the substrate), biodegradation of m- and p-xylene occurred within 40 days. Although o-xylene was resistant to degradation when it was the sole carbon source, it was slowly removed in the presence of other hydrocarbons [764].

Half-lives of o-xylene in surface water [902]: 5.18 hours, based on rate of disappearance for the reaction with hydroxy radicals; 168-672 hours, based on estimated aqueous aerobic biodegradation half-life; volatilization to be the dominant removal process with a half-life of 1-5 days.

Half-lives of o-xylene in groundwater [902]: 336-8640 hours based on estimated aqueous aerobic and anaerobic biodegradation half-life; estimated half-life from observed persistence in groundwater of the Netherlands, 0.3 years.

Environmental Fate [609]:

TERRESTRIAL FATE: When spilled on land, o-xylene will volatilize and leach into the ground. o-Xylene may be degraded during its passage through the soil(1). The extent of the degradation will undoubtedly depend on its concentration, residence time in the soil, the nature of the soil and whether resident microbial populations have been acclimated(SRC). [(1) Kappeler T, Wuhrmann K; Water Res 12: 327-33 (1978)].

AQUATIC FATE: In surface waters, volatilization appears to be the dominant removal process (half-life 1-5 days(1,SRC)). Some adsorption to sediment will occur. Although o-xylene is biodegradable and has been observed to degrade in seawater, there is insufficient data to access the rate of this process in natural aquatic systems. Although it has been observed to degrade in groundwater, it is known to persist for many years in groundwater, at least at sites where the concentration might have been quite high.(SRC) [(1)Lyman WJ et al; Handbook of Chemical Property Estimation Methods. New York, NY: McGraw-Hill p 15-1 to 15-34 (1982)].

ATMOSPHERIC FATE: When released into the air, o-xylene may degrade by reaction with photochemically produced hydroxyl radicals (half-life 1.5 hr - summer, 15 hr - winter(1)). However, ambient levels are detected because of large emissions (SRC). [(1) Ravishankara AR et al; Int J Chem Kinet 10: 783-30 (1979)].

Biodegradation [609]:

o-Xylene is degraded in standard biodegradability tests using various inoculum including sewage, activated sludge and sea water(1-4). It was completely degraded in 8 days in groundwater in a gas-oil mixture; the acclimation period was 3-4 days(5). [(1) Bridie AL et al; Water Res 13: 627-30 (1979) (2) Kitano M; Biodegradation and Bioaccumulation Test on Chemical Substances. OECD Tokyo Mtg TSU-No. 3 (1978) (3) Malaney GW, McKinney RE; Water Sewage Works 113: 302-9 (1966) (4) Van der Linden AC; Dev Biodeg Hydrocarbons 1: 165-200 (1978) (5) Kappeler T, Wuhrmann K; Water Res 12: 327-33 (1978)].

Abiotic Degradation [609]:

o-Xylene reacts with hydroxyl radicals in the troposphere(1-4) with a half-life ranging from 1.5 hr in summer to 15 hr in winter(1) or a typical loss of 71%/day(4). Many investigators have measured the degradation of o-xylene alone or in mixtures of hydrocarbons typical of auto exhaust and have obtained loss rates ranging from 6%-24% per hr(5-11), rates typical for reaction with hydroxyl radicals(7,12). [(1) Ravishankara AR et al; Int J Chem Kinetics 10: 783-804 (1978) (2) Cox RA et al; Environ Sci Technol 14: 57-61 (1980) (3) Hansen DA et al; J Phys Chem 79: 1763-6 (1975) (4) Singh HB et al; Atmos Environ 15: 601-12 (1981) (5) Farley FF; Inter Conf Photochem Oxid Pollut Control Dimitriades B ed p 713-27 USEPA 600/3-77-001b (1977) (6) Heuss JM, Glasson WA; Environ Sci Technol 2: 1109-16 (1968) (7) Doyle GJ et al; Environ Sci Technol 9: 237-41 (1975) (8) Altshuller AP et al; Environ Sci Technol 4: 503-6 (1970) (9) Kopczynski SL et al; Environ Sci Technol 6: 342 (1972) (10) Washida N et al; Bull Chem Soc Japan 51: 2215-21 (1978) (11) Yanagihara S et al; 4th Clean Air Congress p 472-7 (1977) (12) Hustert K, Parlar H; Chemosphere 10: 1045-50 (1981)].

Calculated half-life time based on evaporative loss for a water depth of 1 m at 25 deg C: 5.62 hr. [Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983. 1190].

Soil Adsorption/Mobility [609]:

o-Xylene has a low to moderate adsorption to soil and the Koc for these soils ranged from 48 to 68(1). Although the permeability of xylene is lower than for less hydrophobic solvents, the permeability in fire clay has been observed to sharply increase over a 4-day period after 24 days of normal behavior. This has been attributed to slow shrinkage of the clay which was responsible for the breakthrough(2). This type of breakthrough in clay would be a problem unless such materials are co-disposed with materials with higher dielectric constants(2). Concentration enhancement has been observed for o-xylene in a dune-infiltration project on the Rhine River(3); however, no o-xylene reached groundwater under a rapid infiltration site(4). [(1) Nathwani JS, Phillip CR; Chemosphere 6: 157-62 (1977) (2) Green WJ et al; J Water Pollut Control Fed 53: 1347-54 (1981) (3) Piet GJ et al; Quality of groundwater Van Dwjvenbooden W et al eds; Studies in Environ Sci 17: 557-64 (1981) (4) Tomson MB et al; Water Res 15: 1109-16 (1981)].

Volatilization from Water/Soil [609]:

The half-life for the evaporation of o-xylene from water with a wind speed of 3 m/sec, a current of 1 m/sec and a depth of 1 m is 3.2 hours(1). The evaporation rate is much more sensitive to the mixing conditions in the water than in the air(2). An experiment which measured the rate of evaporation of o-xylene from a mixed 1:1000 fuel:water mixture found that it averaged 0.59 times the oxygen reaeration rate(3). Combining this ratio with oxygen reaeration rates for typical bodies of water(1) one estimates that its half-life for evaporation from a typical river or pond is 31 and 125 hr, respectively(SRC). [(1) Lyman WJ et al; Handbook of Chemical Property Estimation Methods. New York, NY McGraw-Hill p 15-1 to 15-34 (1982) (2) Mackay D, Leinonen PJ; Environ Sci Technol 9: 1178-80 (1975) (3) Smith JH, Harper JC; 12th Conf on Environ Toxicol Airforce Aerospace Med Res Lab OH p 336-53 (1982)].

Absorption, Distribution and Excretion [609]:

For exposure to xylene at concn averaging 100 ppm, the mean methyl hippuric acid concn should average 1.5 to 2 g/g creatinine (range 1.0-3.0) in a sample collected during the second part of the exposure period. Almost total urinary excretion of xylene occurs by 24 hours. The rapid xylene clearance from blood (plasma half-life of 4 hours) prevents adequate biological monitoring of serum samples. ... /Xylenes/ [Ellenhorn, M.J. and D.G. Barceloux. Medical Toxicology - Diagnosis and Treatment of Human Poisoning. New York, NY: Elsevier Science Publishing Co., Inc. 1988. 963

Xylenes have been reported to cross the human placenta. /Xylenes/ [National Research Council. Drinking Water and Health. Volume 3. Washington, DC: National Academy Press, 1980. 180

Xylene, when ingested, is readily absorbed by the human system, as has been shown in accidental ingestions. Absorption through intact & broken skin occurs readily. ... Xylene is absorbed mainly through mucous membranes & pulmonary system. ... Absorbed xylene is translocated through the vascular system ... . /Xylenes/ [Clayton, G. D. and F. E. Clayton (eds.). Patty's Industrial Hygiene and Toxicology: Volume 2A, 2B, 2C: Toxicology. 3rd ed. New York: John Wiley Sons, 1981-1982. 3296

The penetration rate of o-xylene through abdominal skin of rats was relatively low. [Tsuruta H; Sangyo Igaku 22 (2): 128 (1980)

Penetration rates of o-xylene through excised abdominal rat skin were quantitatively determined. There was a good correlation between penetration rates & solubility of solvents in water. The log-log plot of the penetration rate versus the solubility in water showed a linear relation. [Tsurata H; Ind Health 20 (4): 335-45 (1982)

CFY rats were exposed by inhalation to ortho-xylene at 150, 1500, or 3000 mg/cu m for 24 hr from days 7-14 of pregnancy. Additional groups were exposed to the same concn for 2 hr only on 18th day of gestation. The solvent crossed the placenta & was present in fetal blood & amniotic fluid. [Ungvary G et al; Toxicol 18: 61-74 (1980)

Humans exposed to 46 or 92 ppm of o-, m-, p-xylene or a mixture (1:1:1) of the three for 8 hr absorbed approx 64% of the inhaled xylene. No difference in the absorption rate was reported due to level of exposure, length of exposure, or the type and/or mixture of the xylene isomers. The absorption of xylene appeared to vary among individuals due to differences in ventilation rate. ... Individuals with an incr ventilation rate retained less xylene. [NCI; Monograph on Human Exposure to Chemicals in the Workplace: Xylene p.4-2 (July/1985)

Personal air monitors and breath samples were used to monitor o-xylene and other volatile compounds in the breath of 200 smokers and 322 nonsmokers in New Jersey and California during 12-hr sampling periods. The monitor measured only sidestream and exhaled mainstream smoke. Concentrations were also measured in a subsample of homes and outdoor air. Compared to nonsmokers, o-xylene was significantly higher in the breath of persons who had smoked tobacco the day they were monitored ($p < 0.001$). Unweighed geometric mean breath concentrations for smokers in NJ (fall); NJ (summer); NJ (winter); Los Angeles, CA (winter); Los Angeles (spring); Antioch/Pittsburg, CA (spring) were 2.4, 1.2, 1.6, 1.5, 1.6, and 1.0 ug/cu m, respectively; values for nonsmokers were 1.9, 0.6, 1.0, 0.6, 0.4, and 0.3 ug/cu m, respectively. Values from personal air samplers were only occasionally significantly higher. Indoor air concentrations in homes with smokers were significantly higher in fall and winter. Median breath concentrations of nonsmokers exposed to tobacco smoke at work but not at home were significantly higher than those not exposed at work. [Wallace L et al; Arch Environment Health 42 (5): 272-9 (1987)].

Laboratory and/or Field Analyses:

For optimum risk or hazard assessment work, volatile compound lab methods with very low detection limits [such as EPA Method 8260 modified for Selective Ion Mode (SIM) Enhanced Detection Limits] should be used. The investigator should also specify the addition of any relevant compounds (such as related alkyl volatiles) suspected of being present but not typically found on the standard EPA scans. In concert with need to compare values with low benchmark concentrations, the regulatory requirements of States such as Wisconsin and the capabilities of better labs, detection limits should be as low as possible and in all cases no higher than 25 ppb [913] in soil, sediment, or tissue, and if possible no higher than 1 ppb (better labs can achieve 0.3 ppb) in water. Wisconsin requires a detection limit of 0.5 ug/L for all VOCs

[923].

For drinking water, in the past, EPA has recommended the following less rigorous methods for analyses of certain volatiles: Purge and trap capillary gas chromatography (EPA 502.2); gas chromatographic/mass spectrometry (EPA 524.2); purge and trap gas chromatography (EPA 503.1); gas chromatography/mass spectrometry (EPA 524.1); PQL= 0.005 mg/L [893].

Regardless of what lab methods are used, the investigator must take special precautions to prevent the escape of volatiles during sample shipment, storage, extraction, and cleanup [798].

See xylenes entry for much greater detail on methods for xylenes, how to prevent escape of volatiles in the field and lab, when to choose various BTEX methods, etc.

Contaminants data from different labs, different states, and different agencies, collected by different people, are often not very comparable (see also, discussion in the disclaimer section at the top of this entry, and the more detailed discussions in the xylenes entry).

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 in response to oil spills. Alkyl PAHs are more persistent and less volatile than xylenes. Thus, rigorous low-detection-limit scans for alkyl PAHs are less prone to false negatives than many of the standard EPA high-detection-limit analyses for xylenes (Roy Irwin, National Park Service, Personal Communication, 1997).

Description of EPA standard methods 8240 and 8260 from EPA EMMI Database on Lab methods [861]:

EPA Method 8240 for Volatile Organics [861]:

Note: 8240 is being replaced by 8260 in third update of SW-846 [1013].

OSW 8240A S Volatile Organics - Soil, GCMS 73 SW-846 GCMS ug/kg EQL Method 8240A "Volatile Organics by Gas Chromatography/Mass Spectrometry (GC/MS): Packed Column Technique" The volatile compounds are introduced into the gas chromatograph by the purge and trap method or by direct injection (in limited applications) [861]. The components are separated via the gas chromatograph and detected using a mass spectrometer, which is used to provide both qualitative and quantitative information [861]. The chromatographic conditions, as well as typical mass spectrometer operating parameters, are given

[861]. If the above sample introduction techniques are not applicable, a portion of the sample is dispersed in methanol to dissolve the volatile organic constituents [861]. A portion of the methanolic solution is combined with organic-free reagent water in a specially designed purging chamber [861]. It is then analyzed by purge and trap GC/MS following the normal water method [861]. The purge and trap process - An inert gas is bubbled through the solution at ambient temperature, and the volatile components are efficiently transferred from the aqueous phase to the vapor phase [861]. The vapor is swept through a sorbent column where the volatile components are trapped [861]. After purging is complete, the sorbent column is heated and backflushed with inert gas to desorb the components, which are detected with a mass spectrometer [861].

OSW 8240A W Volatile Organics - Water, GCMS 73 SW-846 GCMS ug/L EQL Method 8240A "Volatile Organics by Gas Chromatography/Mass Spectrometry (GC/MS): Packed Column Technique" The volatile compounds are introduced into the gas chromatograph by the purge and trap method or by direct injection (in limited applications) [861]. The components are separated via the gas chromatograph and detected using a mass spectrometer, which is used to provide both qualitative and quantitative information [861]. The chromatographic conditions, as well as typical mass spectrometer operating parameters, are given [861]. If the above sample introduction techniques are not applicable, a portion of the sample is dispersed in methanol to dissolve the volatile organic constituents [861]. A portion of the methanolic solution is combined with organic-free reagent water in a specially designed purging chamber [861]. It is then analyzed by purge and trap GC/MS following the normal water method [861]. The purge and trap process - An inert gas is bubbled through the solution at ambient temperature, and the volatile components are efficiently transferred from the aqueous phase to the vapor phase [861]. The vapor is swept through a sorbent column where the volatile components are trapped [861]. After purging is complete, the sorbent column is heated and backflushed with inert gas to desorb the components, which are detected with a mass spectrometer [861].

EPA Method 8260 (for GC/MS Volatile Organics):

Note: 8240 is being replaced by 8260 in third update of SW-846 [1013].

EPA description [861]:

> OSW 8260 Volatile Organics - CGCMS 58 SW-846 CGCMS ug/L MDL Method 8260 "Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS): Capillary Column Technique" The volatile compounds are introduced into the gas chromatograph by the purge and trap method or by direct injection (in limited applications) [861]. Purged sample components are trapped in a tube containing suitable sorbent materials [861]. When purging is complete, the sorbent tube is heated and backflushed with helium to desorb trapped sample components [861]. The analytes are desorbed directly to a large bore capillary or cryofocussed on a capillary precolumn before being flash evaporated to a narrow bore capillary for analysis [861]. The column is temperature programmed to separate the analytes which are then detected with a mass spectrometer interfaced to the gas chromatograph [861]. Wide capillary columns require a jet separator, whereas narrow bore capillary columns can be directly interfaced to the ion source [861]. If the above sample introduction techniques are not applicable, a portion of the sample is dispersed in solvent to dissolve the volatile organic constituents [861]. A portion of the solution is combined with organic- free reagent water in the purge chamber [861]. It is then analyzed by purge and trap GC/MS following the normal water method [861]. Qualitative identifications are confirmed by analyzing standards under the same conditions used for samples and comparing resultant mass spectra and GC retention times [861]. Each identified component is quantified by relating the MS response for an appropriate selected ion produced by that compound to the MS response for another ion produced by an internal standard [861].

Other Misc. (mostly less rigorous) lab methods which have been used in the past in media such as drinking water for volatiles [893] (lab method description from EPA [861]):

EMSLC 502.2 ELCD VOA's - P&T/CGCELCD/CGCPID 44 DRINKING_WATER CGCELD ug/L MDL "Volatile Organic Compounds in Water by Purge and Trap Capillary Column Gas Chromatography with

Photoionization and Electrolytic Conductivity Detectors in Series" This method is used for the identification and measurement of purgeable volatile organic compounds in finished drinking water, raw source water, or drinking water in any treatment stage [861]. The method is applicable to a wide range of organic compounds, including the four trihalomethane disinfection by-products, that have sufficiently high volatility and low water solubility to be efficiently removed from water samples with purge and trap procedures [861]. An inert gas is bubbled through a 5 mL water sample [861]. The volatile compounds with low water solubility are purged from the sample and trapped in a tube containing suitable sorbent materials [861]. When purging is complete, the tube is heated and backflushed with helium to desorb trapped sample components onto a capillary gas chromatography (GC) column [861]. The column is temperature programmed to separate the analytes which are then detected with photoionization detector (PID) and halogen specific detectors in series [861]. Analytes are identified by comparing retention times with authentic standards and by comparing relative responses from the two detectors [861]. A GC/MS may be used for further confirmation [861].

EMSLC 502.2 PID VOA's - P&T/CGCELCD/CGCPID 33 DRINKING_WATER CGCPID ug/L MDL "Volatile Organic Compounds in Water by Purge and Trap Capillary Column Gas Chromatography with Photoionization and Electrolytic Conductivity Detectors in Series" This method is used for the identification and measurement of purgeable volatile organic compounds in finished drinking water, raw source water, or drinking water in any treatment stage [861]. The method is applicable to a wide range of organic compounds, including the four trihalomethane disinfection by-products, that have sufficiently high volatility and low water solubility to be efficiently removed from water samples with purge and trap procedures [861]. An inert gas is bubbled through a 5 mL water sample [861]. The volatile compounds with low water solubility are purged from the sample and trapped in a tube containing suitable sorbent materials [861]. When purging is complete, the tube is heated and backflushed with helium to desorb trapped sample components onto a capillary gas chromatography (GC) column [861]. The column is temperature programmed to separate the analytes which are then detected with photoionization detector (PID) and halogen specific detectors in series [861]. Analytes are identified by comparing retention times with authentic standards and by comparing relative responses from the two detectors [861]. A GC/MS may be used for further confirmation [861].

EMSLC 503.1 Volatile Aromatics in Water 28 DRINKING_WATER GCPID ug/L MDL "Volatile Aromatic and Unsaturated Organic Compounds in Water by Purge and Trap Gas Chromatography" This method is applicable for the determination of various volatile aromatic and unsaturated compounds in finished drinking water, raw source water, or drinking water in any treatment stage [861]. Highly volatile organic compounds with low water solubility are extracted (purged) from a 5-ml sample by bubbling an inert gas through the aqueous sample [861]. Purged sample components are trapped in a tube containing a suitable sorbent material [861]. When purging is complete, the sorbent tube is heated and backflushed with an inert gas to desorb trapped sample components onto a gas chromatography (GC) column [861]. The gas chromatograph is temperature programmed to separate the method analytes which are then detected with a photoionization detector [861]. A second chromatographic column is described that can be used to help confirm GC identifications or resolve coeluting compounds [861]. Confirmation may be performed by gas chromatography/mass spectrometry (GC/MS) [861].

APHA 6230 D Volatile Halocarbons - CGCELCD STD_METHODS GCELCD "6230 Volatile Halocarbons" GCPID 6230 D [861]. Purge and Trap Capillary-Column Gas Chromatographic Method: This method is similar to Method 6230 C., except it uses a wide-bore capillary column, and requires a high-temperature photoionization detector in series with either an electrolytic conductivity or microcoulometric detector [861]. This method is equivalent to EPA method 502.2; see EMSLC\502.2 [861]. Detection limit data are not presented in this method, but the method is identical to 502.2; therefore, see EMSLC\502.2 for detection limit data [861]. Method 6230 B., 17th edition, corresponds to Method 514, 16th edition [861]. The other methods listed do not have a cross-reference in the 16th edition [861].

EMSLC 524.1 Purgeable Organics - GCMS 48 DRINKING_WATER GCMS ug/L MDL "Measurement of Purgeable Organic Compounds in Water by Packed Column Gas Chromatography/Mass Spectrometry" This is a general purpose method for the identification and simultaneous measurement of purgeable volatile organic compounds in finished drinking water, raw source water, or drinking water in any treatment stage [861]. Volatile organic compounds and surrogates with low water solubility are extracted (purged) from the sample matrix by bubbling an inert gas through the aqueous sample [861]. Purged sample components are trapped in a tube containing suitable sorbent materials [861]. When purging is complete, the trap is backflushed with helium to desorb the trapped sample components into a packed gas chromatography (GC) column interfaced to a mass spectrometer (MS) [861]. The column is temperature programmed to separate the method analytes which are then detected with the MS [861]. Compounds eluting from the GC column are identified by comparing their measured mass spectra and retention times to reference spectra and retention times in a data base [861]. Reference spectra and retention times for analytes are obtained by the measurement of calibration standards under the same conditions used for samples [861]. The concentration of each identified component is measured by relating the MS response of the quantitation ion produced by that compound to the MS response of the quantitation ion produced by a compound that is used as an internal standard [861]. Surrogate analytes, whose concentrations are known in every sample, are measured with the same internal standard calibration procedure [861].

EMSLC 524.2 Purgeable Organics - CGCMS 60 DRINKING_WATER CGCMS ug/L MDL "Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry" This is a general purpose method for the identification and simultaneous measurement of purgeable volatile organic compounds in finished drinking water, raw source water, or drinking water in any treatment stage [861]. Volatile organic compounds and surrogates with low water solubility are extracted (purged) from the sample matrix by bubbling an inert gas through the aqueous sample [861]. Purged sample components are trapped in a tube containing suitable sorbent materials [861]. When purging is complete, the sorbent tube is heated and backflushed with helium to desorb the trapped sample components into a capillary gas chromatography (GC) column interfaced to a mass spectrometer (MS) [861]. The column is temperature programmed to separate the method analytes which are then detected with the MS [861]. Compounds eluting from the GC column are identified by comparing their measured mass spectra and retention times to reference spectra and retention times in a data base [861]. Reference spectra and retention times for analytes are obtained by the measurement of calibration standards under the same conditions used for samples [861]. The concentration of each identified component is measured by relating the MS response of the quantitation ion produced by that compound to the MS response of the quantitation ion produced by a compound that is used as an internal standard [861]. Surrogate analytes, whose concentrations are known in every sample, are measured with the same internal standard calibration procedure [861].