SRC TR 98-008

Chemical Fate Half-Lives for Toxics Release Inventory (TRI) Chemicals

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APPENDICES

Introduction

Strategy for determining environmental degradation rate constants:

Syracuse Research Corporation's (SRC) Environmental Fate Data Bases (EFDB) were searched for pertinent data. References identified in EFDB's DATALOG, CHEMFATE, BIOLOG and BIODEG files were retrieved and used as primary sources of information. In addition, both the *Handbook of Environmental Degradation Rates* (Howard et al., 1991) and the five volume *Environmental Fate and Exposure Data for Organic Pollutants* series (Volume 3, Pesticides; Howard et al., 1991) were assessed for inclusion into the summary document developed for each compound. The National Library of Medicine's Hazardous Substances Data Bank (HSDB) was also searched for useful information.

Half-lives were obtained, where available, for the environmentally relevant degradation or transformation of the compounds of interest. These compounds were reviewed due to concerns of persistence, bioaccumulation, and toxicity. In general, data were sought on the processes of biodegradation, indirect and direct photolysis, hydrolysis, and atmospheric oxidation. If a compound had very little data and information was available which was not sufficient to determine a half-life but did provide evidence for a particular process or reaction, this information was also included. Only experimental measurements were used, with the exception of atmospheric oxidation. Very little experimental data were available for the listed compounds, and therefore, use of SRC's Atmospheric Oxidation Program (AOP; http://esc.syrres.com/interkow/aop.htm) was necessary to estimate half-lives (although experimental data were used preferentially if available). AOP uses the method of Kwok and Atkinson (1995) to determine a rate constant for the reaction of the compound of interest with hydroxyl radicals in the atmosphere. Half-lives were then determined using hydroxyl radical concentrations which had been based on monitoring data for relatively pristine ($3x10^5$ hydroxyl radicals/cm^3) and polluted ($3x10^6$ hydroxyl radicals/cm^3) air.

Biodegradation data were initially screened for aerobic field and grab sample studies. No pure culture, screening, or biotreatment studies were incorporated into the summaries. Only studies conducted in soil, sediment, marine or fresh water, or groundwater were included. The polychlorinated biphenyls (PCBs) do have some anaerobic data included and this was marked as such under the heading "Anaerobic" in the biodegradation section. The attempt was not to summarize all available studies which would come under the biodegradation heading but to locate studies which would provide a range of values for that particular environmental process. Long-term field and grab studies were also preferred. The details of the biodegradation studies used for each chemical (if available) were entered into a database and are included in the appendices to this report. Appendix 1 contains field study data and appendix 2 contains grab study data. The individual compounds are alphabetically listed in the table found within each appendix.

Half-lives for direct and indirect photolysis were determined from studies which used either sunlight or artificial light which had been filtered (wavelengths >290 nm) to irradiate a compound in solution (aqueous or organic), on a soil surface, or dried in a thin film on glass, etc.

Hydrolysis data in water was collected for those compounds where data were available. However, very few of the chemicals examined had hydrolyzable functional groups.

Half-life summary sections:

Air: In general, the value for the reaction of the hydroxyl radical in the vapor phase with the compound of interest, whether estimated or experimental, was the only information available. In many cases, the compound existed partially or mainly in the particulate phase. In these instances, the half-lives which were determined are unlikely to be very accurate and have been qualified, but are included as the only indication of possible degradation in the atmosphere. Several of the polycyclic aromatic hydrocarbons (PAHs) and polychlorinated dibenzofurans and dioxins were studied using emissions from wood smoke or other similar systems which were exposed to sunlight. These experiments were given greater weight than the hydroxyl radical reaction in the vapor phase, particularly when the compound was thought to exist mainly in the particulate phase, and were included in the air summary statement. However, if the analytical method of these experiments was unable to distinguish two compounds and provided only a joint response, this information was not placed in the air summary statement, although it was summarized in the direct photolysis section under "air".

Surface Water: In general, unless the compound was susceptible to hydrolysis, biodegradation results were used to determine half-lives. Half-lives from field studies were given preference as were the longer term laboratory studies. Unless a good field study was available, a range of half-lives was provided given the available data. While half-lives determined from photolysis (both direct and indirect) were considerably lower in almost every case, many of these compounds were expected to adsorb to particulate and suspended material in the water and thus, would be removed from the surface where photolysis would occur. Half-lives were not recommended unless aquatic studies were available.

Soil: In general, unless the compound was susceptible to hydrolysis, biodegradation results were used to determine half-lives. Half-lives from field studies were given preference as were the longer term laboratory studies. Field study data were not qualified with photolysis or hydrolysis data as it was assumed that the study plot had been exposed to all relevant environmental processes simultaneously. If only grab study results were available, then a range was obtained from these data and a qualification regarding the possibility of photolysis on the soil surface was added. Many of these compounds are expected to adsorb strongly to soil and may be directly photolyzed on the surface. However, rates of photolysis in aqueous solution is rarely similar to those found on soil surfaces.

References:

Howard, P.H., Jarvis, W.F., Sage, G.W., Basu, D.K., Gray, D.A., Meylan, W. and Crosbie, E.K. Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Volume 1. Large Production and Priority Pollutants. Lewis Publishers: Chelsea, MI. 1989.

Howard, P.H., Jarvis, W.F., Sage, G.W. and Gray, D.A. Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Volume 2. Solvents. Lewis Publishers: Chelsea, MI. 1990.

Howard, P.H., Michalenko, E.M., Jarvis, W.F., Basu, D.K., Sage, G.W., Meylan, W., Beauman, J.A. and Gray, D.A. Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Volume 3. Pesticides. Lewis Publishers: Chelsea, MI. 1991.

Howard, P.H., Boethling, R.S., Jarvis, W.F., Meylan, W.M. and Michalenko, E.M. Handbook of Environmental Degradation Rates. Lewis Publishers: Chelsea, MI. 1991.

Howard, P.H., Michalenko, E.M., Basu, D.K., Sage, G.W., Meylan, W., Beauman, J.A., Jarvis, W.F. and Gray, D.A. Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Volume 4. Solvents 2. Lewis Publishers: Chelsea, MI. 1993.

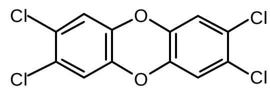
Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Howard, P.H., Michalenko, E.M., Basu, D.K., Hill, A. and Aronson, D. Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Volume 5. Solvents 3. Lewis Publishers: Chelsea, MI. 1997.

2,3,7,8-Tetrachlorodibenzo-p-dioxin

CAS Registry Number: 1746-01-6

Structure:



Half-lives:

- **Air:** High: 9.6 hours; Low: 1.2 hours

Comment: Emissions containing a mixture of tetrachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives were given for the mixture of tetrachlorodibenzofurans and not for the individual 2,3,7,8-tetrachlorodibenzo-p-dioxin isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). 2,3,7,8-Tetrachlorodibenzo-p-dioxin is expected to photodegrade in surface waters (Podoll et al., 1986; Dulin et al., 1986); however, this compound should adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** High: ~7300 days (~20 years); Low: 563 days (1.5 years)

Comment: The low $t_{1/2}$ is based upon soil die-away test data (Kearney et al., 1971) while the high $t_{1/2}$ was reported for 2,3,7,8-tetrachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** High: 2567 days (7 years); Low: 563 days (1.5 years)

Comment: The low $t_{1/2}$ is based upon soil die-away test data (Kearney et al., 1971). Extraction of about 50% of the radioactively labeled 2,3,7,8-tetrachlorodibenzo-p-dioxin from soil after one year of incubation was obtained while combustion revealed the presence of about 80% of the label still present in the soil after this time. The high $t_{1/2}$ is taken from a soil die-away study (Young et al., 1981).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 2,3,7,8-tetrachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic soil:** >4 years

Comment: No degradation, by either photolysis or biodegradation, was seen in soil samples collected from the Times Beach, MO site which were exposed to environmental conditions for 4 years (Yanders et al., 1989).

- **Aerobic water:** High:
  Low:

Comment:

- **Anaerobic:** High:
  Low:

Comment:

<u>Photolysis half-life:</u>

- **Air:** High: 9.6 hours
  Low: 1.2 hours

Comment: Values are for mixed tetrachlorodibenzo-p-dioxins. Emissions containing tetrachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

- **Water:** High: 21 hours (1 day)
  Low: 118 hours (5 days)

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined for photolysis in surface waters at 40 EN latitude during the winter and summer, respectively (Podoll et al., 1986).

- **Water:** 6 days

Comment: The $t_{1/2}$ was determined, based upon a measured rate constant for photolysis in a 90:10 mixture of distilled water and acetonitrile under summer sunlight, for photolysis in surface waters at 40 EN latitude during the summer (Dulin et al., 1986).

- **Soil:** High: 70 days
  Low: 14 days

Comment: Soil samples were irradiated under a light bank of sunlamps (310 nm 8_{max}) at temperatures from 31 to 33 EC in two different soils. Low $t_{1/2}$ and high $t_{1/2}$ for soil with 0.8%

and 2.2% organic matter, respectively. The soil with the higher organic matter content also had a much greater clay fraction (Kleatiwong et al., 1990). Both photoreduction and carbon-oxygen cleavage occurred during this degradative process.

Soil: >4 years

Comment: No degradation, by either photolysis or biodegradation, was seen in soil samples collected from the Times Beach, MO site which were exposed to environmental conditions for 4 years (Yanders et al., 1989).

Photooxidation half-life:

Air: High: 13 days
Low: 1.3 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2,3,7,8-tetrachlorodibenzo-p-dioxin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 2,3,7,8-tetrachlorodibenzo-p-dioxin in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase based on a vapor pressure of $4x10^{-9}$ mm Hg (Rordorf, 1989).

Water:

Comment: 2,3,7,8-Tetrachlorodibenzo-p-dioxin is not expected to react significantly with photochemically-produced singlet oxygen or peroxy radicals in water (Mabey et al., 1981).

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment: 2,3,7,8-Tetrachlorodibenzo-p-dioxin does not hydrolyze in environmental waters (Mabey et al., 1981).

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Dulin, D., Drossman, H. and Mill, T. Products and quantum yields for photolysis of chloroaromatics in water. Environ. Sci. Technol. 20: 72-77. 1986.

Kearney, P.C., Isensee, A.R., Helling, C.S., Woolsen, E.A. and Plimmer, J.R. Environmental significance of chlorodioxins. In: Chlorodioxins - Origin and Fate. Adv. Chem. Ser. 120: 105-111. 1971.

Kleatiwong, S., Nguyen, L.V., Herbert, V.R., Flackett, M., Miller, G.C., Mille, M.J. and Mitzel, R. Photolysis of chlorinated dioxins in organic solvents and on soils. Environ. Sci. Technol. 24: 1575-1580. 1990.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Mabey, W.R., Smith, J.H., Podoll, R.T., Johnson, H.L., Mill, T., Chou, T.W, Gates, J., Partridge, I.W. and Vandenberg, D. Aquatic fate process data for organic priority pollutants. EPA-440/4-81-014. Washington, DC: U.S. EPA. 1981.

McLachlan, M.S., Sewart, A.P., Bacon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Podoll, R.T., Jaber, H.M. and Mill, T. Tetrachlorodibenzodioxin: rates of volatilization and photolysis in the environment. Environ. Sci. Technol. 20: 490-492. 1986.

Rordorf, B.F. Prediction of vapor pressures, boiling points and enthalpies of fusion for twenty-nine halogenated dibenzo-p-dioxins and fifty-five dibenzofurans by a vapor pressure correlation method. Chemosphere. 18: 783-788. 1989.

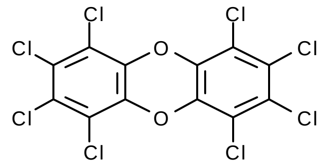
Yanders, A.F., Orazio, C.E., Puri, R.K. and Kapila, S. On translocation of 2,3,7,8-tetrachlorodibenzo-p-dioxin: Time dependent analysis at the times beach experimental site. Chemosphere. 19: 429-432. 1989.

Young, A.L., Cockerham, L.G. and Thalken, C.E. A long-term study of ecosystem contamination with 2,3,7,8-tetrachlorodibenzo-p-dioxin. Chemosphere. 16: 1791-1815. 1987.

1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin

CAS Registry Number: 3268-87-9

Structure:



Half-lives:

- **Air:** High: 20.4 hours; Low: 4.8 hours

Comment: Emissions containing 1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996).

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). 1,2,3,4,5,6,7,8-Octachlorodibenzo-p-dioxin may photolyze in surface waters based on laboratory studies in aqueous solution (Choudhry and Webster, 1986). However, this compound should adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996). Photolytic degradation of 1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin may occur on soil surfaces based on results from laboratory studies using two soils (Miller and Herbert, 1989).

Biodegradation half-life:

- **Aerobic soil:** >260 days

Comment: No biodegradation was reported over 260 days for a sludge-amended soil field study (Wilson et al., 1997).

- **Aerobic soil:** >450 days

Comment: No biodegradation was reported over 15 months in a water-saturated soil column study (Orazio, 1992).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High: 20.4 hours
Low: 4.8 hours

Comment: Emissions from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Water: High: 50 days
Low: 18 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were estimated for photolysis in surface waters at 40 °N latitude during the winter and the summer, respectively, using data obtained from a photochemical reactor with an energy output of 90% between 290 and 310 nm, using Pyrex cuvettes, along with solar intensity and other values published in the literature (Choudhry and Webster, 1986). Water/acetonitrile solution was used. Chlorine atoms present in the peri position (1-, 4-, 6-, and 9-position) are less readily photolyzed than those present in the lateral position (2-, 3-, 7-, and 8-position).

Soil: High: 33 days
Low: 25 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined for photolytic degradation in Montana and Tajunga soils, respectively. A light bank of 16 Westinghouse FS40 sunlamps were used, which produced a maximum intensity of 310 nm (Miller and Hebert, 1989).

Other: 3.6 hours

Comment: Atmospheric modeling experiment performed in a Freon 113 solution at wavelengths $300 nm during a 23.5 hour period (Kloppffer and Kohl, 1993).

Other: 72.6 hours (3 days)

Comment: Irradiated at 313 nm in a decane:butanol solution with a xenon arc lamp. 1,2,3,4,6,7,9-Heptachlorodibenzo-p-dioxin and 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin were reported as photoproducts (Yan et al., 1995).

Photooxidation half-life:

- **Air:** High: 63 days
  Low: 6 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of $8.25x10^{-13}$ mm Hg (Rordorf, 1989).

- **Air:** 1.5 days

Comment: In the presence of the hydroxy radical, indirect photolysis was seen during a 23.5 hour period. This atmospheric modeling study was conducted in Freon 113 solution at wavelengths $300 nm (Kloppffer and Kohl, 1993).

- **Water:** High:
  Low:

Comment:

Hydrolysis:

- **First-order half-life:** No hydrolyzable groups

Comment:

- **Acid rate constant:**

Comment:

- **Base rate constant:**

Comment:

References:

Choudhry, G.G. and Webster, G.R.B. Photochemical quantum yields and sunlight half-lives of polychlorodibenzo-p-dioxins in aquatic systems. Chemosphere. 15: 1935-1940. 1986.

Klopffer, W. and Kohl, E.G. Bimolecular OH rate constants of organic compounds in solution. 2. Measurements in 1,2,2-trichlorotrifluoroethane using hydrogen peroxide as an OH source. Ecotoxicol. Environ. Safety. 26: 346-356. 1993.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase

organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

McLachlan, M.S., Sewart, A.P., Bacon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

Miller, G.C. and Hebert, V.R. Photolysis of octachlorodibenzo-p-dioxin on soils: Production of 2,3,7,8-TCDD. Chemosphere. 18: 1265-1274. 1989.

Orazio, C.E., Kapila, S., Puri, R.K. and Yanders, A.F. Persistence of chlorinated dioxins and furans in the soil environment. Chemosphere. 25: 1469-1474. 1992.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Rordorf, B.F. Prediction of vapor pressures, boiling points and enthalpies of fusion for twenty-nine halogenated dibenzo-p-dioxins and fifty-five dibenzofurans by a vapor pressure correlation method. Chemosphere. 18: 783-788. 1989.

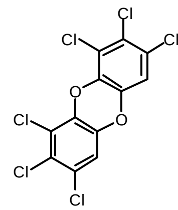
Wilson, S.C., Alcock, R.E., Sewart, A.P. and Jones, K.C. Persistence of organic contaminants in sewage sludge-amended soil: a field experiment. J. Environ. Qual. 26: 1467-1477. 1997.

Yan, Q., Kapila, S., Silvils, L.D. and Elseewi, A.A. Effects of sensitizers and inhibitors on phototransformation of polychlorinated dibenzo-p-dioxins (PCDDs). Chemosphere. 31: 3627-3634. 1995.

1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin

<u>CAS Registry Number:</u> 19408-74-3

<u>Structure:</u>



<u>Half-lives:</u>

- **Air:** High: 12.4 hours
  Low: 2.7 hours

Comment: Emissions containing a mixture of hexachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives were given for the mixture of hexachlorodibenzo-p-dioxins and not for the individual 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin may photolyze in surface waters based on a laboratory study for a structurally-similar compound, 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin, in an aqueous solution (Choudhry and Webster, 1986). However, this compound should adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

<u>Biodegradation half-life:</u>

- **Aerobic soil:** >260 days

Comment: No biodegradation was reported over 260 days for a sludge-amended soil field study (Wilson et al., 1997).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic water:** High:
  Low:

Comment:

• Anaerobic: High:
Low:

Comment:

Photolysis half-life:

• Air: High: 12.4 hours
Low: 2.7 hours

Comment: Values are for mixed hexachlorodibenzo-p-dioxins. Emissions containing hexachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

• Water: High: 22.0 days
Low: 6.3 days

Comment: No data were located on the photolysis of 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin. The half-lives above were determined for a structurally-similar compound, 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin. The high $t_{1/2}$ and low $t_{1/2}$ were estimated for photolysis in surface waters at 40 EN latitude during the winter and summer, respectively, using data obtained from a photochemical reactor with an energy output of 90% between 290 and 310 nm, using Pyrex cuvettes, along with solar intensity and other values published in the literature (Choudhry and Webster, 1986). Water/acetonitrile solution used. Chlorine atoms present in the peri position (1-, 4-, 6-, and 9-position) are less readily photolyzed than those present in the lateral position (2-, 3-, 7-, and 8-position).

• Soil: High:
Low:

Comment:

Photooxidation half-life:

• Air: High: 19 days
Low: 2 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of $9.47 x 10^{-8}$

mm Hg (Neely and Blau, 1985).

- **Water:** High:
  Low:

Comment:

Hydrolysis:

- **First-order half-life:** No hydrolyzable groups

Comment:

- **Acid rate constant:**

Comment:

- **Base rate constant:**

Comment:

References:

Choudhry, G.G. and Webster, G.R.B. Photochemical quantum yields and sunlight half-lives of polychlorodibenzo-p-dioxins in aquatic systems. Chemosphere. 15: 1935-1940. 1986.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

McLachlan, M.S., Sewart, A.P., Bacoon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

Neely,W.B. and Blau,G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, Fla: CRC Press. 245pp. 1985.

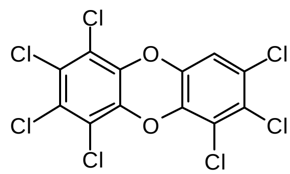
Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Wilson, S.C., Alcock, R.E., Sewart, A.P. and Jones, K.C. Persistence of organic contaminants in sewage sludge-amended soil: a field experiment. J. Environ. Qual. 26: 1467-1477. 1997.

1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin

CAS Registry Number: 35822-46-9

Structure:



Half-lives:

- **Air:** High: 12.2 hours
  Low: 4.2 hours

Comment: Emissions containing a mixture of heptachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives were given for the mixture of heptachlorodibenzo-p-dioxins and not for the individual 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin may photolyze in surface waters based on laboratory studies in aqueous solution (Choudhry and Webster, 1986; Friesen et al., 1990). However, this compound should adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** >260 days

Comment: No biodegradation was reported over 260 days for a sludge-amended soil field study (Wilson et al., 1997).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic water:** High:
  Low:

Comment:

- **Anaerobic:** High:
  Low:

Comment:

<u>Photolysis half-life:</u>

- **Air:** High: 12.2 hours
  Low: 4.2 hours

Comment: Values are for mixed heptachlorodibenzo-p-dioxins. Emissions containing heptachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

- **Water:** High: 156 days
  Low: 47 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were estimated for photolysis in surface waters at 40 EN latitude during the winter and the summer, respectively, using data obtained from a photochemical reactor with an energy output of 90% between 290 and 310 nm, using Pyrex cuvettes, along with solar intensity and other values published in the literature (Choudhry and Webster, 1986). Water/acetonitrile solution used. Chlorine atoms present in the peri position (1-, 4-, 6-, and 9-position) are less readily photolyzed than those present in the lateral position (2-, 3-, 7-, and 8-position).

- **Water:** High: 36 days
  Low: 2.5 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were estimated for photolysis in surface waters at 50 EN latitude in distilled water:acetonitrile and in filter-sterilized natural water, respectively. Samples were exposed to natural sunlight during mid-July (Friesen et al., 1990). The higher rate of photolysis in natural water may indicate indirect or sensitized photolytic mechanisms.

- **Soil:** High:
  Low:

Comment:

Photooxidation half-life:

- **Air:** High: 29 days
  Low: 3 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase based on a vapor pressure of 7.68×10^{-9} mm Hg (Eitzer and Hites, 1988).

- **Water:** 2.5 days

Comment: A half-life for photolysis in surface waters at 50 °N latitude in filter-sterilized natural water, based on laboratory studies, was reported. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). When compared to photolysis in a distilled water:acetonitrile mixture, the faster rate in natural water may indicate indirect or sensitized photolytic mechanisms.

Hydrolysis:

- **First-order half-life:** No hydrolyzable groups

Comment:

- **Acid rate constant:**

Comment:

- **Base rate constant:**

Comment:

References:

Choudhry, G.G. and Webster, G.R.B. Photochemical quantum yields and sunlight half-lives of polychlorodibenzo-p-dioxins in aquatic systems. Chemosphere. 15: 1935-1940. 1986.

Eitzer, B.D. and Hites, R.A. Vapor pressure of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Friesen, K.J., Muir, D.C.G. and Webster, G.R.B. Evidence of sensitized photolysis of polychlorinated dibenzo-p-dioxins in natural waters under sunlight conditions. Environ. Sci. Technol. 24: 1739-1744. 1990.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase

organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

McLachlan, M.S., Sewart, A.P., Bacon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

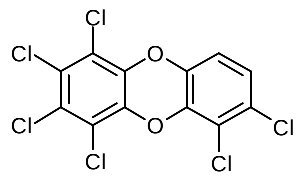
Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Wilson, S.C., Alcock, R.E., Sewart, A.P. and Jones, K.C. Persistence of organic contaminants in sewage sludge-amended soil: a field experiment. J. Environ. Qual. 26: 1467-1477. 1997.

1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin

CAS Registry Number: 39227-28-6

Structure:



Half-lives:

- **Air:** High: 12.4 hours
  Low: 2.7 hours

Comment: Emissions containing a mixture of hexachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives were given for the mixture of hexachlorodibenzo-p-dioxins and not for the individual 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin may photolyze in surface waters based on a laboratory study in aqueous solution (Choudhry and Webster, 1986). However, this compound should adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic water:** High:
  Low:

Comment:

- **Anaerobic:** High:
  Low:

Comment:

Photolysis half-life:

- **Air:** High: 12.4 hours
  Low: 2.7 hours

Comment: Values are for mixed hexachlorodibenzo-p-dioxins. Emissions containing hexachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

- **Water:** High: 22.0 days
  Low: 6.3 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were estimated for photolysis in surface waters at 40 EN latitude during the winter and summer, respectively, using data obtained from a photochemical reactor with an energy output of 90% between 290 and 310 nm, using Pyrex cuvettes, along with solar intensity and other values published in the literature (Choudhry and Webster, 1986). Water/acetonitrile solution used. Chlorine atoms present in the peri position (1-, 4-, 6-, and 9-position) are less readily photolyzed than those present in the lateral position (2-, 3-, 7-, and 8-position).

- **Soil:** High:
  Low:

Comment:

- **Other:** 55.4 hours (2.3 days)

Comment: The $t_{1/2}$ was obtained by irradiation at 313 nm in an alkane/alcohol solvent without added photosensitizers (Yan et al., 1995).

Photooxidation half-life:

- **Air:** High: 21 days
  Low: 2 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase based on a vapor pressure of 2.97×10^{-8} mm Hg (Eitzer and Hites, 1988).

- **Water:** High:
  Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups
Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Choudhry, G.G. and Webster, G.R.B. Photochemical quantum yields and sunlight half-lives of polychlorodibenzo-p-dioxins in aquatic systems. Chemosphere. 15: 1935-1940. 1986.

Eitzer, B.D. and Hites, R.A. Vapor pressure of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

McLachlan, M.S., Sewart, A.P., Bacon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

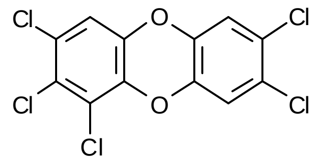
Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Yan, Q., Kapila, S., Sivils, L.D. and Elseewi, A.A. Effects of sensitizers and inhibitors on phototransformation of polychlorinated dibenzo-p-dioxins (PCDDS). Chemosphere. 31: 3627-3634. 1995.

1,2,3,7,8-Pentachlorodibenzo-p-dioxin

CAS Registry Number: 40321-76-4

Structure:



Half-lives:

- **Air:** High: 14.8 hours
  Low: 2.0 hours

Comment: Emissions containing a mixture of pentachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives were given for the mixture of heptachlorodibenzofurans and not for the individual 1,2,3,7,8-pentachlorodibenzo-p-dioxin isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). 1,2,3,7,8-Pentachlorodibenzo-p-dioxin may photolyze in surface waters based on a laboratory study in hexadecane (Mamantov, 1984). However, this compound should adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,7,8-pentachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** >450 days (1.2 years)

Comment: No biodegradation was reported over 15 months in a water-saturated soil column study (Orazio, 1992).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,7,8-pentachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic water:** High:
  Low:

Comment:

• **Anaerobic:** High:
Low:

Comment:

Photolysis half-life:

• **Air:** High: 14.8 hours
Low: 2.0 hours

Comment: Values are for mixed pentachlorodibenzo-p-dioxins. Emissions containing pentachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

• **Water:** 456 minutes (7.6 hours)

Comment: The experimental photolysis half-life was determined in n-hexadecane solution; however, the experimental parameters used to determine this half-life were not discussed (Mamantov, 1984).

• **Soil:** High:
Low:

Comment:

Photooxidation half-life:

• **Water:** High:
Low:

Comment:

• **Air:** High: 16 days
Low: 2 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,7,8-pentachlorodibenzo-p-dioxin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,7,8-pentachlorodibenzo-p-dioxin in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate phase in the atmosphere based on a vapor pressure of 1.31×10^{-7} mm Hg (Eitzer and Hites, 1988).

Hydrolysis:

First-order half-life: No hydrolyzable groups
Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Eitzer, B.D. and Hites, R.A. Vapor pressures of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Mamantov, A. Linear correlation between photolysis rates and toxicity of polychlorinated dibenzo-p-dioxins. Environ. Sci. Technol. 18: 808-810. 1984.

McLachlan, M.S., Sewart, A.P., Bacon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

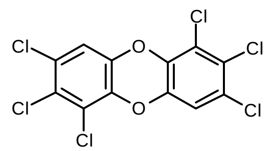
Orazio, C.E., Kapila, S., Puri, R.K. and Yanders, A.F. Persistence of chlorinated dioxins and furans in the soil environment. 25: 1469-1474. 1992.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin

CAS Registry Number: 57653-85-7

Structure:



Half-lives:

- **Air:** High: 12.4 hours
  Low: 2.7 hours

Comment: Emissions containing a mixture of hexachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives were given for the mixture of hexachlorodibenzo-p-dioxins and not for the individual 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin may photolyze in surface waters based on a laboratory study in hexadecane (Mamantov, 1984). However, this compound should adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** >260 days

Comment: No biodegradation was reported over 260 days for a sludge-amended soil field study (Wilson et al., 1997).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic water:** High:
  Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High: 12.4 hours
Low: 2.7 hours

Comment: Values are for mixed hexachlorodibenzo-p-dioxins. Emissions containing hexachlorodibenzo-p-dioxins, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Other: 379 minutes (6.3 hours)

Comment: This experimental photolysis half-life was determined in n-hexadecane solution, however, the experimental parameters used to determine this half-life were not discussed (Mamantov, 1984).

Photooxidation half-life:

Air: High: 19 days
Low: 2 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of $9.47x10^{-8}$ mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

- **First-order half-life:** No hydrolyzable groups
  Comment:

- **Acid rate constant:**
  Comment:

- **Base rate constant:**
  Comment:

References:

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Mamantov, A. Linear correlation between photolysis rates and toxicity of polychlorinated dibenzo-p-dioxins. Environ. Sci. Technol. 18: 808-810. 1984.

McLachlan, M.S., Sewart, A.P., Bacoon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

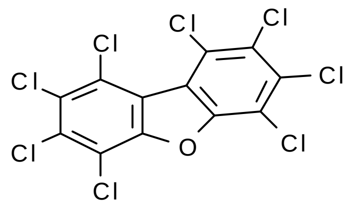
Neely,W.B. and Blau,G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, Fla: CRC Press. 245pp. 1985.

Wilson, S.C., Alcock, R.E., Sewart, A.P. and Jones, K.C. Persistence of organic contaminants in sewage sludge-amended soil: a field experiment. J. Environ. Qual. 26: 1467-1477. 1997.

1,2,3,4,6,7,8,9-Octachlorodibenzofuran

CAS Registry Number: 39001-02-0

Structure:



Half-lives:

- **Air:** High: 29.4 hours
  Low: 13.7 hours

Comment: Emissions containing octachlorodibenzofuran, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996).

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). Based on results published for a structurally-similar compound (2,3,4,7,8-pentachlorodibenzofuran), octachlorodibenzofuran should photolyze in surface waters (Friesen et al., 1996). However, this compound is expected to adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for octachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** >260 days

Comment: No biodegradation was reported over 260 days for a sludge-amended soil field study (Wilson et al., 1997).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for octachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic soil:** >450 days

Comment: No biodegradation was reported over 15 months in a water-saturated soil column study (Orazio, 1992).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High: 29.4 hours
Low: 13.7 hours

Comment: Emissions containing octachlorodibenzofuran, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Water: High: 46.2 days
Low: 4.56 hours (0.19 days)

Comment: No data were located for octachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had reported half-lives for photolysis in surface waters at 50 °N latitude in distilled water:acetonitrile (high $t_{1/2}$) and in filter-sterilized natural water (low $t_{1/2}$), respectively. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). The faster rate of photolysis in natural water may indicate indirect or sensitized photolytic mechanisms.

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 891 days (2.4 years)
Low: 89 days

Comment: The rate constant for the reaction of octachlorodibenzofuran with hydroxyl radicals was modeled using a measured rate constant for 1,2,3,4-tetrachlorodibenzo-p-dioxin in a gas-phase system. Hydroxyl radicals were provided by ozone at a concentration between 0.8 and $3x10^{-16}$ cm^{-3} and 10 Fl of a 200:1 or 2000:1 $H_2O:H_2O_2$ solution (Brubaker and Hites, 1997).

Air: High: 11 years
Low: 1 year

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with octachlorodibenzofuran. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with octachlorodibenzofuran in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 3.75×10^{-12} mm Hg (Rordorf, 1989).

Water: 4.56 hours (0.19 days)

Comment: No data were located for octachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had a reported half-life for photolysis in surface waters at 50 °N latitude in filter-sterilized natural water based on laboratory studies. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). When compared to photolysis in a distilled water:acetonitrile mixture, the faster rate in natural water may indicate indirect or sensitized photolytic mechanisms.

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Brubaker, W.W. and Hites, R.A. Polychlorinated dibenzo-p-dioxins and dibenzofurans: Gas-phase hydroxyl radical reactions and related atmospheric removal. Environ. Sci. Technol. 31: 1805-1810. 1997.

Friesen, K.J., Foga, M.M. and Loewen, M.D. Aquatic photodegradation of polychlorinated dibenzofurans: Rates and photoproduct analysis. Environ. Sci. Technol. 30: 2504-2510. 1996.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

McLachlan, M.S., Sewart, A.P., Bacoon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

Orazio, C.E., Kapila, S., Puri, R.K. and Yanders, A.F. Persistence of chlorinated dioxins and furans in the soil environment. 25: 1469-1474. 1992.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

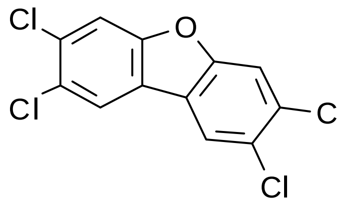
Rordorf, B.F. Prediction of vapor pressures, boiling points and enthalpies of fusion for twenty-nine halogenated dibenzo-p-dioxins and fifty-five dibenzofurans by a vapor pressure correlation method. Chemosphere. 18: 783-788. 1989.

Wilson, S.C., Alcock, R.E., Sewart, A.P. and Jones, K.C. Persistence of organic contaminants in sewage sludge-amended soil: a field experiment. J. Environ. Qual. 26: 1467-1477. 1997.

2,3,7,8-Tetrachlorodibenzofuran

CAS Registry Number: 51207-31-9

Structure:



Half-lives:

- **Air:** High: 11.5 hours
  Low: 2.1 hours

Comment: Emissions containing a mixture of tetrachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives were given for the mixture of tetrachlorodibenzofurans and not for the individual 2,3,7,8-tetrachlorodibenzofuran isomer.

- **Surface Water:**

Comment: 2,3,7,8-Tetrachlorodibenzofuran is expected to be resistant to biodegradation based on a soil field study (McLachlan et al., 1996). Photolysis of this compound in surface waters is likely (Friesen et al., 1996); however, this compound should adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 2,3,7,8-tetrachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 2,3,7,8-tetrachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic water:** High:
  Low:

Comment:

- **Anaerobic:** High:
  Low:

Comment:

<u>Photolysis half-life:</u>

- **Air:** High: 11.5 hours
  Low: 2.1 hours

Comment: Values are for mixed tetrachlorodibenzofurans. Emissions containing tetrachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

- **Water:** High: 6.3 days
  Low: 1.2 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were estimated for photolysis in surface waters at 50 °N latitude in distilled water:acetonitrile and in filter-sterilized natural water, respectively. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). The higher rate of photolysis in natural water may indicate indirect or sensitized photolytic mechanisms.

- **Soil:** High:
  Low:

Comment:

<u>Photooxidation half-life:</u>

- **Air:** High: 163 days
  Low: 16 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2,3,7,8-tetrachlorodibenzofuran. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 2,3,7,8-tetrachlorodibenzofuran in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 9.21×10^{-7} mm Hg (Eitzer and Hites, 1988).

- **Water:** 4.56 hours (0.19 days)

Comment: This half-life was estimated for photolysis in surface waters at 50 °N latitude in filter-sterilized natural water. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). When compared to photolysis in a distilled water:acetonitrile mixture, the faster rate in natural water may indicate indirect or sensitized photolytic mechanisms.

<u>Hydrolysis:</u>

- **First-order half-life:** No hydrolyzable groups

Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

<u>References:</u>

Eitzer, B.D. and Hites, R.A. Vapor pressures of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Friesen, K.J., Foga, M.M. and Loewen, M.D. Aquatic photodegradation of polychlorinated dibenzofurans: Rates and photoproduct analysis. Environ. Sci. Technol. 30: 2504-2510. 1996.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

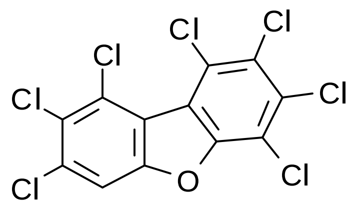
McLachlan, M.S., Sewart, A.P., Bacoon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

1,2,3,4,7,8,9-Heptachlorodibenzofuran

CAS Registry Number: 55673-89-7

Structure:



Half-lives:

- **Air:** High: 25.0 hours
  Low: 4.3 hours

  Comment: Emissions containing a mixture of heptachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives were given for the mixture of heptachlorodibenzofurans and not for the individual 1,2,3,4,7,8,9-heptachlorodibenzofuran isomer.

- **Surface Water:**

  Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). Based on results published for a structurally-similar compound (2,3,4,7,8-pentachlorodibenzofuran), 1,2,3,4,7,8,9-heptachlorodibenzofuran should photolyze in surface waters (Friesen et al., 1996). However, this compound is expected to adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

  Comment: This $t_{1/2}$ was reported for 1,2,3,4,7,8,9-heptachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** ~7300 days (~20 years)

  Comment: This $t_{1/2}$ was reported for 1,2,3,4,7,8,9-heptachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic water:** High:
  Low:

  Comment:

- **Anaerobic:** High:
  Low:

Comment:

Photolysis half-life:

Air: High: 25.0 hours
Low: 4.3 hours

Comment: Values are for mixed heptachlorodibenzofurans. Emissions containing heptachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Water: High: 46.2 days
Low: 4.56 hours (0.19 days)

Comment: No data were located for 1,2,3,4,7,8,9-heptachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had reported half-lives for photolysis in surface waters at 50 °N latitude in distilled water:acetonitrile (high $t_{1/2}$) and in filter-sterilized natural water (low $t_{1/2}$), respectively. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). The faster rate of photolysis in natural water may indicate indirect or sensitized photolytic mechanisms.

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 5 years
Low: 178 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,4,7,8,9-heptachlorodibenzofuran. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,4,7,8,9-heptachlorodibenzofuran in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 9.79×10^{-9} mm Hg (Eitzer and Hites, 1988).

Water: 4.56 hours (0.19 days)

Comment: No data were located for 1,2,3,4,7,8,9-heptachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had a reported half-life for photolysis in surface waters at 50 °N latitude in filter-sterilized natural water based on laboratory studies. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). When compared to photolysis in a distilled water:acetonitrile mixture, the faster rate in natural water may indicate indirect or sensitized photolytic mechanisms.

Hydrolysis:

- **First-order half-life:** No hydrolyzable groups

Comment:

- **Acid rate constant:**

Comment:

- **Base rate constant:**

Comment:

References:

Eitzer, B.D. and Hites, R.A. Vapor pressures of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Friesen, K.J., Foga, M.M. and Loewen, M.D. Aquatic photodegradation of polychlorinated dibenzofurans: Rates and photoproduct analysis. Environ. Sci. Technol. 30: 2504-2510. 1996.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

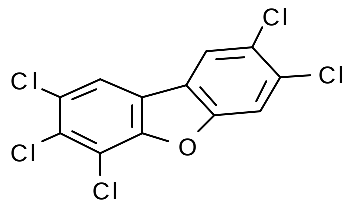
McLachlan, M.S., Sewart, A.P., Bacoon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

2,3,4,7,8-Pentachlorodibenzofuran

CAS Registry Number: 57117-31-4

Structure:



Half-lives:

- **Air:** High: 11.6 hours
  Low: 1.2 hours

Comment: Emissions containing a mixture of pentachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives were given for the mixture of pentachlorodibenzofurans and not for the individual 2,3,4,7,8-pentachlorodibenzofuran isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). 2,3,4,7,8-Pentachlorodibenzofuran is expected to photolyze in surface waters (Friesen et al., 1996). However, this compound should adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This half-life was reported for 2,3,4,7,8-pentachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996). Based on data in water, this compound may be photolytically degraded on soil surfaces (Friesen et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 2,3,4,7,8-pentachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic water:** High:
  Low:

Comment:

- **Anaerobic:** High:
  Low:

Comment:

Photolysis half-life:

- **Air:** High: 11.6 hours
  Low: 1.2 hours

Comment: Values are for mixed pentachlorodibenzofurans. Emissions containing pentachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

- **Water:** High: 46.2 days
  Low: 4.56 hours (0.19 days)

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were estimated for photolysis in surface waters at 50 °N latitude in distilled water:acetonitrile and in filter-sterilized natural water, respectively. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). The faster rate of photolysis in natural water may indicate indirect or sensitized photolytic mechanisms.

- **Soil:** High:
  Low:

Comment:

Photooxidation half-life:

- **Air:** High: 356 days
  Low: 36 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2,3,4,7,8-pentachlorodibenzofuran. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 2,3,4,7,8-pentachlorodibenzofuran in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate phase in the atmosphere based on a vapor pressure of $1.63x10^{-7}$ mm Hg (Eitzer and Hites, 1988).

- **Water:** 4.56 hours (0.19 days)

Comment: This half-life was estimated for photolysis in surface waters at 50 °N latitude in filter-sterilized natural water. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). When compared to photolysis in a distilled water:acetonitrile mixture, the faster rate in natural water may indicate indirect or sensitized photolytic mechanisms.

Hydrolysis:

- **First-order half-life:** No hydrolyzable groups

Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Eitzer, B.D. and Hites, R.A. Vapor pressures of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Friesen, K.J., Foga, M.M. and Loewen, M.D. Aquatic photodegradation of polychlorinated dibenzofurans: Rates and photoproduct analysis. Environ. Sci. Technol. 30: 2504-2510. 1996.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

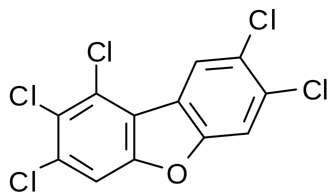
McLachlan, M.S., Sewart, A.P., Bacon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

1,2,3,7,8-Pentachlorodibenzofuran

CAS Registry Number: 57117-41-6

Structure:



Half-lives:

- **Air:** High: 11.6 hours; Low: 1.2 hours

Comment: Emissions containing a mixture of pentachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives were given for the mixture of pentachlorodibenzofurans and not for the individual 1,2,3,7,8-pentachlorodibenzofuran isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). 1,2,3,7,8-Pentachlorodibenzofuran is expected to photolyze in surface waters based on results for 2,3,4,7,8-pentachlorodibenzofuran (Friesen et al., 1996). However, this compound should adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This half-life was reported for 2,3,4,7,8-pentachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996). Based on data in water for 2,3,4,7,8-pentachlorodibenzofuran, this compound may be photolytically degraded on soil surfaces (Friesen et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,7,8-pentachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic water:** High: ; Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis:

Air: High: 11.6 hours
Low: 1.2 hours

Comment: Values are for mixed pentachlorodibenzofurans. Emissions containing pentachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Water: High: 46.2 days
Low: 4.56 hours (0.19 days)

Comment: No data measuring the rate of photolysis of 1,2,3,7,8-pentachlorodibenzofuran in solution were located. The half-lives reported above are from a study using 2,3,4,7,8-pentachlorodibenzofuran. The high $t_{1/2}$ and low $t_{1/2}$ were estimated for photolysis in surface waters at 50 °N latitude in distilled water:acetonitrile and in filter-sterilized natural water, respectively. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). The faster rate of photolysis in natural water may indicate indirect or sensitized photolytic mechanisms.

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 356 days
Low: 36 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,7,8-pentachlorodibenzofuran. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,7,8-pentachlorodibenzofuran in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 2.73×10^{-7} mm Hg (Eitzer and Hites, 1988).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Eitzer, B.D. and Hites, R.A. Vapor pressures of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Friesen, K.J., Foga, M.M. and Loewen, M.D. Aquatic photodegradation of polychlorinated dibenzofurans: Rates and photoproduct analysis. Environ. Sci. Technol. 30: 2504-2510. 1996.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

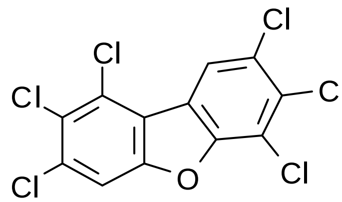
McLachlan, M.S., Sewart, A.P., Bacoon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

1,2,3,6,7,8-Hexachlorodibenzofuran

CAS Registry Number: 57117-44-9

Structure:



Half-lives:

- **Air:** High: 13.3 hours; Low: 3 hours

Comment: Emissions containing a mixture of hexachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives given for the mixture of hexachlorodibenzofurans and not for the individual 1,2,3,6,7,8-hexachlorodibenzofuran isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). Based on results published for a structurally-similar compound (2,3,4,7,8-pentachlorodibenzofuran), 1,2,3,6,7,8-hexachlorodibenzofuran should photolyze in surface waters (Friesen et al., 1996). However, this compound is expected to adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,6,7,8-hexachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996). Based on data in water for a structurally-similar compound (2,3,4,7,8-pentachlorodibenzofuran), 1,2,3,6,7,8-hexachlorodibenzofuran may be photolytically degraded on soil surfaces (Friesen et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** >260 days

Comment: No biodegradation was reported over 260 days for a sludge-amended soil field study (Wilson et al., 1997).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,6,7,8-hexachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High: 13.3 hours
Low: 3.3 hours

Comment: Half-lives were determined for mixed hexachlorodibenzofurans. Emissions containing hexachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Water: High: 46.2 days
Low: 4.56 hours (0.19 days)

Comment: No data were located for 1,2,3,6,7,8-hexachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had reported half-lives for photolysis in surface waters at 50 °N latitude in distilled water:acetonitrile (high $t_{1/2}$) and in filter-sterilized natural water (low $t_{1/2}$), respectively. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). The faster rate of photolysis in natural water may indicate indirect or sensitized photolytic mechanisms.

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 74 days
Low: 7 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,6,7,8-hexachlorodibenzofuran. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,6,7,8-hexachlorodibenzofuran in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 6.07×10^{-8} mm Hg (Eitzer and Hites, 1988).

Water: 4.56 hours (0.19 days)

Comment: No data were located for 1,2,3,6,7,8-hexachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had a reported half-life for photolysis in surface waters at 50 °N latitude in filter-sterilized natural water based on laboratory studies. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). When compared to photolysis in a distilled water:acetonitrile mixture, the faster rate in natural water may indicate indirect or sensitized photolytic mechanisms.

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Eitzer, B.D. and Hites, R.A. Vapor pressures of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Friesen, K.J., Foga, M.M. and Loewen, M.D. Aquatic photodegradation of polychlorinated dibenzofurans: Rates and photoproduct analysis. Environ. Sci. Technol. 30: 2504-2510. 1996.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

McLachlan, M.S., Sewart, A.P., Bacoon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

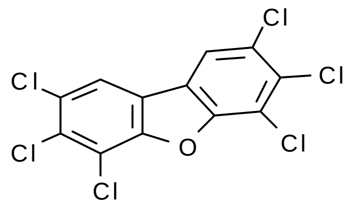
Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Wilson, S.C., Alcock, R.E., Sewart, A.P. and Jones, K.C. Persistence of organic contaminants in sewage sludge-amended soil: a field experiment. J. Environ. Qual. 26: 1467-1477. 1997.

2,3,4,6,7,8-Hexachlorodibenzofuran

CAS Registry Number: 60851-34-5

Structure:



Half-lives:

- **Air:** High: 13.3 hours
  Low: 3 hours

Comment: Emissions containing a mixture of hexachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives given for the mixture of hexachlorodibenzofurans and not for the individual 2,3,4,6,7,8-hexachlorodibenzofuran isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). Based on results published for a structurally-similar compound (2,3,4,7,8-pentachlorodibenzofuran), 2,3,4,6,7,8-hexachlorodibenzofuran should photolyze in surface waters (Friesen et al., 1996). However, this compound is expected to adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 2,3,4,6,7,8-hexachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996). Based on data in water for a structurally-similar compound (2,3,4,7,8-pentachlorodibenzofuran), 2,3,4,6,7,8-hexachlorodibenzofuran may be photolytically degraded on soil surfaces (Friesen et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** >260 days

Comment: No biodegradation was reported over 260 days for a sludge-amended soil field study (Wilson et al., 1997).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 2,3,4,6,7,8-hexachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

- **Aerobic water:** High:
Low:

Comment:

- **Anaerobic:** High:
Low:

Comment:

<u>Photolysis half-life:</u>

- **Air:** High: 13.3 hours
Low: 3.3 hours

Comment: Half-lives were determined for mixed hexachlorodibenzofurans. Emissions containing hexachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

- **Water:** High: 46.2 days
Low: 4.56 hours (0.19 days)

Comment: No data were located for 2,3,4,6,7,8-hexachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had reported half-lives for photolysis in surface waters at 50 °N latitude in distilled water:acetonitrile (high $t_{1/2}$) and in filter-sterilized natural water (low $t_{1/2}$), respectively. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). The faster rate of photolysis in natural water may indicate indirect or sensitized photolytic mechanisms.

- **Soil:** High:
Low:

Comment:

<u>Photooxidation half-life:</u>

- **Air:** High: 89 days
Low: 9 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2,3,4,6,7,8-hexachlorodibenzofuran. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 2,3,4,6,7,8-hexachlorodibenzofuran in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 3.74×10^{-8} mm Hg (Eitzer and Hites, 1988).

Water: 4.56 hours (0.19 days)

Comment: No data were located for 2,3,4,6,7,8-hexachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had a reported half-life for photolysis in surface waters at 50 °N latitude in filter-sterilized natural water based on laboratory studies. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). When compared to photolysis in a distilled water:acetonitrile mixture, the faster rate in natural water may indicate indirect or sensitized photolytic mechanisms.

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Eitzer, B.D. and Hites, R.A. Vapor pressures of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Friesen, K.J., Foga, M.M. and Loewen, M.D. Aquatic photodegradation of polychlorinated dibenzofurans: Rates and photoproduct analysis. Environ. Sci. Technol. 30: 2504-2510. 1996.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

McLachlan, M.S., Sewart, A.P., Bacoon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

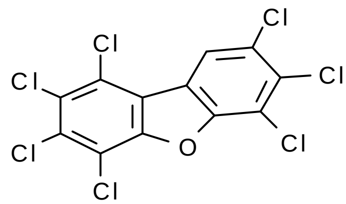
Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Wilson, S.C., Alcock, R.E., Sewart, A.P. and Jones, K.C. Persistence of organic contaminants in sewage sludge-amended soil: a field experiment. J. Environ. Qual. 26: 1467-1477. 1997.

1,2,3,4,6,7,8-Heptachlorodibenzofuran

CAS Registry Number: 67562-39-4

Structure:



Half-lives:

- **Air:** High: 25.0 hours
  Low: 4.3 hours

Comment: Emissions containing a mixture of heptachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives were given for the mixture of heptachlorodibenzofurans and not for the individual 1,2,3,4,6,7,8-heptachlorodibenzofuran isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). Based on results published for a structurally-similar compound (2,3,4,7,8-pentachlorodibenzofuran), 1,2,3,4,6,7,8-heptachlorodibenzofuran should photolyze in surface waters (Friesen et al., 1996). However, this compound is expected to adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,4,7,8,9-heptachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).
Comment:

Biodegradation half-life:

- **Aerobic soil:** >260 days

Comment: No biodegradation was reported over 260 days for a sludge-amended soil field study (Wilson et al., 1997).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,4,6,7,8-heptachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High: 25.0 hours
Low: 4.3 hours

Comment: Values are for mixed heptachlorodibenzofurans. Emissions containing heptachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Water: High: 46.2 days
Low: 4.56 hours (0.19 days)

Comment: No data were located for 1,2,3,4,6,7,8-heptachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had reported half-lives for photolysis in surface waters at 50 °N latitude in distilled water:acetonitrile (high $t_{1/2}$) and in filter-sterilized natural water (low $t_{1/2}$), respectively. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). The faster rate of photolysis in natural water may indicate indirect or sensitized photolytic mechanisms.

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 5 years
Low: 178 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,4,6,7,8-heptachlorodibenzofuran. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,4,6,7,8-heptachlorodibenzofuran in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 1.68×10^{-8} mm Hg (Eitzer and Hites, 1988).

Water: 4.56 hours (0.19 days)

Comment: No data were located for 1,2,3,4,6,7,8-heptachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had a reported half-life for photolysis in surface waters at 50 °N latitude in filter-sterilized natural water based on laboratory studies. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). When compared to photolysis in a distilled water:acetonitrile mixture, the faster rate in natural water may indicate indirect or sensitized photolytic mechanisms.

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Eitzer, B.D. and Hites, R.A. Vapor pressures of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Friesen, K.J., Foga, M.M. and Loewen, M.D. Aquatic photodegradation of polychlorinated dibenzofurans: Rates and photoproduct analysis. Environ. Sci. Technol. 30: 2504-2510. 1996.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

McLachlan, M.S., Sewart, A.P., Bacoon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

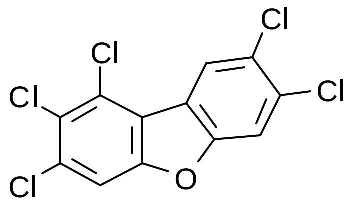
Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Wilson, S.C., Alcock, R.E., Sewart, A.P. and Jones, K.C. Persistence of organic contaminants in sewage sludge-amended soil: a field experiment. J. Environ. Qual. 26: 1467-1477. 1997.

1,2,3,4,7,8-Hexachlorodibenzofuran

CAS Registry Number: 70648-26-9

Structure:



Half-lives:

- **Air:** High: 13.3 hours
  Low: 3 hours

Comment: Emissions containing a mixture of hexachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives given for the mixture of hexachlorodibenzofurans and not for the individual 1,2,3,4,7,8-hexachlorodibenzofuran isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). Based on results published for a structurally-similar compound (2,3,4,7,8-pentachlorodibenzofuran), 1,2,3,4,7,8-hexachlorodibenzofuran should photolyze in surface waters (Friesen et al., 1996). However, this compound is expected to adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,4,7,8-hexachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996). Based on data in water for a structurally-similar compound (2,3,4,7,8-pentachlorodibenzofuran), 1,2,3,4,7,8-hexachlorodibenzofuran may be photolytically degraded on soil surfaces (Friesen et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** >260 days

Comment: No biodegradation was reported over 260 days for a sludge-amended soil field study (Wilson et al., 1997).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for 1,2,3,4,7,8-hexachlorodibenzofuran in a sludge-amended soil field study (McLachlan et al., 1996).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

<u>Photolysis half-life:</u>

Air: High: 13.3 hours
Low: 3.3 hours

Comment: Half-lives were determined for mixed hexachlorodibenzofurans. Emissions containing hexachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Water: High: 46.2 days
Low: 4.56 hours (0.19 days)

Comment: No data were located for 1,2,3,4,7,8-hexachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had reported half-lives for photolysis in surface waters at 50 °N latitude in distilled water:acetonitrile (high $t_{1/2}$) and in filter-sterilized natural water (low $t_{1/2}$), respectively. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). The faster rate of photolysis in natural water may indicate indirect or sensitized photolytic mechanisms.

Soil: High:
Low:

Comment:

<u>Photooxidation half-life:</u>

Air: High: 89 days
Low: 9 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,4,7,8-hexachlorodibenzofuran. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,4,7,8-hexachlorodibenzofuran in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 6.07×10^{-8} mm Hg (Eitzer and Hites, 1988).

Water: 4.56 hours (0.19 days)

Comment: No data were located for 1,2,3,4,7,8-hexachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had a reported half-life for photolysis in surface waters at 50 °N latitude in filter-sterilized natural water based on laboratory studies. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). When compared to photolysis in a distilled water:acetonitrile mixture, the faster rate in natural water may indicate indirect or sensitized photolytic mechanisms.

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Eitzer, B.D. and Hites, R.A. Vapor pressures of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Friesen, K.J., Foga, M.M. and Loewen, M.D. Aquatic photodegradation of polychlorinated dibenzofurans: Rates and photoproduct analysis. Environ. Sci. Technol. 30: 2504-2510. 1996.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

McLachlan, M.S., Sewart, A.P., Bacoon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

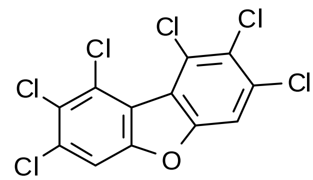
Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Wilson, S.C., Alcock, R.E., Sewart, A.P. and Jones, K.C. Persistence of organic contaminants in sewage sludge-amended soil: a field experiment. J. Environ. Qual. 26: 1467-1477. 1997.

1,2,3,7,8,9-Hexachlorodibenzofuran

CAS Registry Number: 72918-21-9

Structure:



Half-lives:

- **Air:** High: 13.3 hours
  Low: 3 hours

Comment: Emissions containing a mixture of hexachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Half-lives given for the mixture of hexachlorodibenzofurans and not for the individual 1,2,3,7,8,9-hexachlorodibenzofuran isomer.

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation based on soil studies (McLachlan et al., 1996). Based on results published for a structurally-similar compound (2,3,4,7,8-pentachlorodibenzofuran), 1,2,3,7,8,9-hexachlorodibenzofuran should photolyze in surface waters (Friesen et al., 1996). However, this compound is expected to adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** High: ~7300 days (~20 years)
  Low: >260 days

Comment: The low $t_{1/2}$ was reported for a sludge-amended soil field study where no biodegradation of 1,2,3,7,8,9-hexachlorodibenzofuran was seen in 260 days (Wilson et al., 1997). The high $t_{1/2}$ was reported for other hexachlorodibenzofurans from another, longer term, sludge-amended soil field study (McLachlan et al., 1996). Based on data in water for a structurally-similar compound (2,3,4,7,8-pentachlorodibenzofuran), 1,2,3,7,8,9-hexachlorodibenzofuran may be photolytically degraded on soil surfaces (Friesen et al., 1996).

Biodegradation half-life:

- **Aerobic soil:** >260 days

Comment: No biodegradation was reported over 260 days for a sludge-amended soil field study (Wilson et al., 1997).

- **Aerobic soil:** ~7300 days (~20 years)

Comment: This $t_{1/2}$ was reported for several hexachlorodibenzofurans in a sludge-amended soil field study (McLachlan et al., 1996). 1,2,3,7,8,9-Hexachlorodibenzofuran was not included in this study.

- **Aerobic water:** High:
  Low:

Comment:

- **Anaerobic:** High:
  Low:

Comment:

Photolysis half-life:

- **Air:** High: 13.3 hours
  Low: 3.3 hours

Comment: Half-lives were determined for mixed hexachlorodibenzofurans. Emissions containing hexachlorodibenzofurans, from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol, were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

- **Water:** High: 46.2 days
  Low: 4.56 hours (0.19 days)

Comment: No data were located for 1,2,3,7,8,9-hexachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had reported half-lives for photolysis in surface waters at 50 °N latitude in distilled water:acetonitrile (high $t_{1/2}$) and in filter-sterilized natural water (low $t_{1/2}$), respectively. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). The faster rate of photolysis in natural water may indicate indirect or sensitized photolytic mechanisms.

- **Soil:** High:
  Low:

Comment:

Photooxidation half-life:

- **Air:** High: 891 days (2.4 years)
  Low: 89 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1,2,3,7,8,9-hexachlorodibenzofuran. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 1,2,3,7,8,9-hexachlorodibenzofuran in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of $3.74x10^{-8}$ mm Hg (Eitzer and Hites, 1988).

Water: 4.56 hours (0.19 days)
Comment: No data were located for 1,2,3,7,8,9-hexachlorodibenzofuran. A structurally-similar compound, 2,3,4,7,8-pentachlorodibenzofuran, had a reported half-life for photolysis in surface waters at 50 °N latitude in filter-sterilized natural water based on laboratory studies. Samples were exposed to natural sunlight during midsummer (Friesen et al., 1996). When compared to photolysis in a distilled water:acetonitrile mixture, the faster rate in natural water may indicate indirect or sensitized photolytic mechanisms.

Hydrolysis:

First-order half-life: No hydrolyzable groups
Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Eitzer, B.D. and Hites, R.A. Vapor pressures of chlorinated dioxins and dibenzofurans. Environ. Sci. Technol. 22: 1362-1364. 1988.

Friesen, K.J., Foga, M.M. and Loewen, M.D. Aquatic photodegradation of polychlorinated dibenzofurans: Rates and photoproduct analysis. Environ. Sci. Technol. 30: 2504-2510. 1996.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

McLachlan, M.S., Sewart, A.P., Bacon, J.R. and Jones, K.C. Persistence of PCDD/Fs in a sludge-amended soil. Environ. Sci. Technol. 30: 2567-2571. 1996.

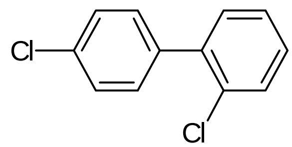
Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Wilson, S.C., Alcock, R.E., Sewart, A.P. and Jones, K.C. Persistence of organic contaminants in sewage sludge-amended soil: a field experiment. J. Environ. Qual. 26: 1467-1477. 1997.

Dichlorobiphenyls

CAS Registry Number:

Structure:



Representative compound

Half-lives:

- **Air:** High: 15 days
  Low: 1 day

Comment: Estimated half-lives for the reaction of hydroxyl radicals with 2,3'-dichlorobiphenyl (1 and 10 days) and 2,4'-dichlorobiphenyl (1.5 and 15 days) in air are given above (Kwok and Atkinson, 1995). These compounds are expected to also exist in the particulate phase in the air.

- **Surface Water:**

Comment: According to a 5-year soil study, dichlorobiphenyls are not readily biodegraded (Gan and Berthouex, 1994).

- **Soil:** High: 330 days
  Low: 210 days

Comment: Half-life range reported for 4 dichlorobiphenyls in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin (low $t_{1/2}$ for 2,2'- and 2,6-dichlorobiphenyl ; high $t_{1/2}$ for 2,3- and 2,4'-dichlorobiphenyl).

Biodegradation half-life:

- **Aerobic soil:** High: 330 days
  Low: 210 days

Comment: Half-life range reported for 4 dichlorobiphenyls in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin (low $t_{1/2}$ for 2,2'- and 2,6-dichlorobiphenyl ; high $t_{1/2}$ for 2,3- and 2,4'-dichlorobiphenyl). 2,4-Dichlorobiphenyl and 2,3'-dichlorobiphenyl had greater half-lives of 1920 and 1230 days, respectively; however the authors report that disappearance of these two biphenyls was reported at a 95% statistical confidence level and not at the 99% confidence level shown for the other chlorinated biphenyls. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded more quickly than those containing the same number of chlorines on both rings. Preferential ring fission of the molecules occurred with non- and less chlorinated ring structures (Gan and Berthouex, 1994).

- **Aerobic water:**

Comment: Up to 1.25 Fmol of the *ortho-, meta*-polychlorinated biphenyls per kg was aerobically biodegraded in the first 28 days of a 140-day aerobic river sediment:water laboratory study where Aroclor 1242 was initially added (Fish and Principe, 1994).

- **Anaerobic:** High:
  Low:

Comment:

<u>Photolysis half-life:</u>

- **Air:** High:
  Low:

Comment:

- **Water:** High:
  Low:

Comment:

- **Soil:** High:
  Low:

Comment:

<u>Photooxidation half-life:</u>

- **Air:** High: 15 days
  Low: 1 day

Comment: Hydroxyl radical reactions are expected to be important in the atmospheric degradation of these compounds in the vapor phase. Estimated half-lives for the reaction of hydroxyl radicals with 2,3'-dichlorobiphenyl (1 and 10 days) and 2,4'-dichlorobiphenyl (1.5 and 15 days) in air are given above (Kwok and Atkinson, 1995). These compounds are expected to exist partially in the particulate phase in the atmosphere based on a vapor pressure of 1.9×10^{-4} mm Hg (Neely and Blau, 1985).

- **Water:** High:
  Low:

Comment:

<u>Hydrolysis:</u>

- **First-order half-life:** No hydrolyzable groups

Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Fish, K.M. and Principe, J.M. Biotransformations of Aroclor 1242 in Hudson River test tube microcosms. Appl. Environ. Microbiol. 60: 4289-4296. 1994.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

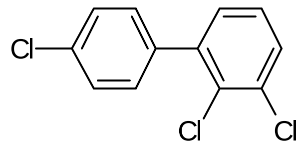
Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-activity relationship: an update. Atmos. Environ. 29: 1685-95. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, FL: CRC Press. 1985.

Trichlorobiphenyls

CAS Registry Number:

Structure:



Representative compound

Half-lives:

- **Air:** High: 24.5 days; Low: 2 days

Comment: Estimated half-lives for the reaction of hydroxyl radicals with 2,3,4-trichlorobiphenyl (2 and 21 days) and 2,2',3-trichlorobiphenyl (2.5 and 24.5 days) in air are given above (Kwok and Atkinson, 1995). These compounds are expected to also exist in the particulate phase in the air.

- **Surface Water:**

Comment: According to a 5-year soil study, trichlorobiphenyls are not readily biodegraded (Gan and Berthouex, 1994).

- **Soil:** High: 510 days (1.4 years); Low: 150 days

Comment: Half-life range reported for 13 trichlorobiphenyls in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin (low $t_{1/2}$ for 2,3',4'-trichlorobiphenyl ; high $t_{1/2}$ for 2,2',6-trichlorobiphenyl). The average half-life for this group of 13 trichlorobiphenyls is 285 days (Gan and Berthouex, 1994).

Biodegradation half-life:

- **Aerobic soil:** High: 510 days (1.4 years); Low: 150 days

Comment: Half-life range reported for 13 trichlorobiphenyls in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin (low $t_{1/2}$ for 2,3',4'-trichlorobiphenyl ; high $t_{1/2}$ for 2,2',6-trichlorobiphenyl). The average half-life for this group of 13 trichlorobiphenyls is 285 days. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded more quickly than those containing the same number of chlorines on both rings. Preferential ring fission of the molecules occurred with non- and less chlorinated ring structures (Gan and Berthouex, 1994).

- **Aerobic soil:**

Comment: 2,3,4-Trichlorobiphenyl was resistant to degradation by soil microorganisms based on a soil die-away study in three different soils. After 183 days, only 0.047 to 0.071% was degraded (Krogmann et al., 1985).

- **Aerobic water:**

Comment: Up to 1.25 Fmol of the *ortho*-, *meta*-polychlorinated biphenyls per kg was aerobically biodegraded in the first 28 days of a 140-day aerobic river sediment:water laboratory study where Aroclor 1242 was initially added (Fish and Principe, 1994).

- **Anaerobic:** High:
  Low:

Comment:

Photolysis half-life:

- **Air:** High:
  Low:

Comment:

- **Water:** High:
  Low:

Comment:

- **Soil:** High:
  Low:

Comment:

Photooxidation half-life:

- **Air:** High: 24.5 days
  Low: 2 days

Comment: Hydroxyl radical reactions are expected to be important in the atmospheric degradation of these compounds in the vapor phase. Estimated half-lives for the reaction of hydroxyl radicals with 2,3,4-trichlorobiphenyl (2 and 21 days) and 2,2',3-trichlorobiphenyl (2.5 and 24.5 days) in air are given above (Kwok and Atkinson, 1995). However, these compounds are expected to exist partially in the particulate phase in the atmosphere based on a vapor pressure of $4.0x10^{-5}$ mm Hg (Neely and Blau, 1985).

- **Water:** High:
  Low:

Comment:

Hydrolysis:

- **First-order half-life:** No hydrolyzable groups

  Comment:

- **Acid rate constant:**

  Comment:

- **Base rate constant:**

  Comment:

References:

Fish, K.M. and Principe, J.M. Biotransformations of Aroclor 1242 in Hudson River test tube microcosms. Appl. Environ. Microbiol. 60: 4289-4296. 1994.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Krogmann, H., Maass, V. and Scharpenseel, H.W. Radiometric analyses of sorption and degradation of 14C-PCB and 14C-picloram in different soils. Z. Pflanzenernaehr. Bodenkd. 148: 248-259. 1985.

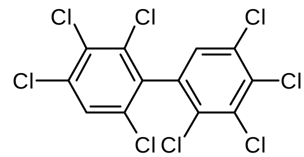
Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-activity relationship: an update. Atmos. Environ. 29: 1685-95. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, FL: CRC Press. 1985.

Octachlorobiphenyls

CAS Registry Number:

Structure:



Representative compound

Half-lives:

Air: High: 477 days
Low: 22 days

Comment: Estimated half-lives for the reaction of hydroxyl radicals with 2,2',3,3',4,4',5,5'-octachlorobiphenyl (48 and 477 days) and 2,3,3',4,4',5,5',6-octachlorobiphenyl (22 and 217 days) in air are given above (Kwok and Atkinson, 1995). These compounds are expected to mainly exist in the particulate phase in the air.

Surface Water:

Comment: According to a 5-year soil study, octachlorobiphenyls are resistant to biodegradation (Gan and Berthouex, 1994).

Soil: >5 years

Comment: No biodegradation of 4 octachlorobiphenyl compounds was seen in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin (Gan and Berthouex, 1994).

Biodegradation half-life:

Aerobic soil: >5 years

Comment: No biodegradation of 4 octachlorobiphenyl compounds was seen in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded more quickly than those containing the same number of chlorines on both rings. Preferential ring fission of the molecules occurred with non- and less chlorinated ring structures (Gan and Berthouex, 1994).

Aerobic water: High:
Low:

Comment:

- **Anaerobic:** High:
  Low:

Comment:

Photolysis half-life:

- **Air:** High:
  Low:

Comment:

- **Water:** High:
  Low:

Comment:

- **Soil:** High:
  Low:

Comment:

Photooxidation half-life:

- **Air:** High: 477 days
  Low: 22 days

Comment: Hydroxyl radical reactions are expected to be important in the atmospheric degradation of these compounds in the vapor phase. Estimated half-lives for the reaction of hydroxyl radicals with 2,2',3,3',4,4',5,5'-octachlorobiphenyl (48 and 477 days) and 2,3,3',4,4',5,5',6-octachlorobiphenyl (22 and 217 days) in air are given above (Kwok and Atkinson, 1995). These compounds are expected to exist mainly in the particulate phase in the atmosphere based on a vapor pressure of 2.87×10^{-8} mm Hg (Neely and Blau, 1985).

- **Water:** High:
  Low:

Comment:

Hydrolysis:

- **First-order half-life:** No hydrolyzable groups

Comment:

- **Acid rate constant:**

Comment:

- **Base rate constant:**

Comment:

References:

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

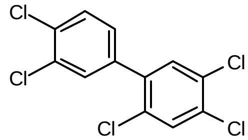
Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-activity relationship: an update. Atmos. Environ. 29: 1685-95. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, FL: CRC Press. 1985.

2,3',4,4',5-Pentachlorobiphenyl

CAS Registry Number: 31508-00-6

Structure:



Half-lives:

Air:	High:	80 days
	Low:	8 days

Comment: Based upon an estimated rate constant for the reaction of 2,3',4,4',5-pentachlorobiphenyl with hydroxyl radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives.

Surface Water:	>56 days

Comment: Based upon analogy to Arochlor 1254; no biodegradation was noted after 8 weeks in water samples (Shiaris et al., 1980) or in a terrestrial aquatic (surface sediment and water mixture) laboratory model ecosystem (Larsson and Lemkemeier, 1989). According to longer term soil studies, pentachlorobiphenyls are very resistant to biodegradation (Gan and Berthouex, 1994). Photolysis of 2,3',4,4',5-pentachlorobiphenyl in surface waters may occur (Lin et al., 1995); however, this compound is expected to adsorb to sediment and particulate matter and may be removed from the surface.

Soil:	High:	7.25 years
	Low:	0.91 years

Comment: Based upon analogy to a range of half-lives of other pentachlorobiphenyl isomers in a 5-year field study in sludge-amended farmland (Gan and Berthouex, 1994).

Biodegradation half-life:

Aerobic soil:	High:	87 months	(7.25 years)
	Low:	11 months	(0.91 years)

Comment: No data were located for the aerobic soil biodegradation of 2,3',4,4',5-pentachlorobiphenyl. However, the above half-lives are based on 2,2',4,4',6-pentachlorobiphenyl (low $t_{1/2}$) and 2,2',3,5',6-pentachlorobiphenyl (high $t_{1/2}$) in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded faster than those containing the same number of chlorines on both rings; and preferential ring fission of the molecules occurred with non- and less chlorinated rings (Gan and

Berthouex, 1994).

Aerobic soil:
Comment: No data were located for the aerobic soil biodegradation of 2,3',4,4',5-pentachlorobiphenyl. However, the total residue amount of another penta isomer, 2,2',4,4',6-pentachlorobiphenyl, remained similar (0.486 ppm vs. 0.457 ppm) after the radiolabeled compound was applied to soil under outdoor conditions; soil was tested after two growing seasons (first year, carrots; second year with no PCB retreatment, sugar beets; exact study duration not stated). The total recovery of the compound was 58.5%; 41.5% was lost due to volatilization and 1.4% was crop uptake (Moza et al., 1979).

Aerobic water: >56 days
Comment: No data were located for aerobic water biodegradation for 2,3',4,4',5-pentachlorobiphenyl. However, no apparent biodegradation of ^{14}C-labeled Aroclor 1254 after 8 weeks in water samples from Center Hill Reservoir, TN was noted as compared to controls (Shiaris et al., 1980).

Aerobic water: >57 days
Comment: No data were located for aerobic water biodegradation for 2,3',4,4',5-pentachlorobiphenyl. However, no significant aerobic microbial mineralization of ^{14}C-labeled Aroclor 1254 occurred in 57 days in a model ecosystem of water and surface sediments from high (Frejen Lake; pH 5.4) and low (Fiolen Lake; pH 6.3) humic content lakes in Sweden (Larsson and Lemkemeier, 1989).

Anaerobic: 85 days
Comment: Based on a 141-day grab sample study in Housatonic River sediment acclimated with a more degradable compound, 2,3,4,5,6-pentachlorobiphenyl (to prime degradation) (Van Dort et al., 1997).

Photolysis half-life:

Air: High:
Low:
Comment:

Water: High:
Low:
Comment:

Soil: High:
Low:
Comment:

Other:

Comment: After 10 minutes of exposure to UV lamps at 300 nm in a merry-go-round adaptor, 60% of 2,3',4,4',5-pentachlorobiphenyl in cyclohexane lost a chlorine atom; 99.9% of the loss was at the ortho position (Lepine et al., 1991).

Other: 9.19 days

Comment: No data were located for 2,3',4,4',5-pentachlorobiphenyl. However, the above half-life is for another isomer, 2,2',4,4',6-pentachlorobiphenyl, adsorbed onto silica gel and irradiated with simulated sunlight at >290 nm for 17 hours (Freitag et al., 1985).

Photooxidation half-life:

Air: High: 80 days
Low: 8 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2,3',4,4',5-pentachlorobiphenyl. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 2,3',4,4',5-pentachlorobiphenyl in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate phase in the atmosphere based on a vapor pressure of $8.97x10^{-6}$ mm Hg (Bidleman, 1984).

Air: High: 34 days
Low: 14 days

Comment: No data were located for 2,3',4,4',5-pentachlorobiphenyl. However, the above calculated atmospheric half-lives are based on rate constants for the gas-phase reaction of 2,3,4,5,6-pentachlorobiphenyl (low $t_{1/2}$) and 2,2,3,5',6-pentachlorobiphenyl (high $t_{1/2}$) with OH radicals over the temperature range of 323-363 EK in simulated sunlight (Anderson and Hites, 1996).

Water: High: 4.4 hours
Low: 4.2 hours

Comment: 2,3',4,4',5-Pentachlorobiphenyl was dissolved initially in hexane and acetone, diluted into distilled water and exposed to simulated natural sunlight (>300 nm) in glass vials with diethylamine (as a sensitizer) for 24 hours (high $t_{1/2}$ = 50 ng/L, low $t_{1/2}$ = 100 ng/L) (Lin et al., 1995).

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:
Comment:

References:

Anderson, P.N. and Hites, R.A. OH Radical reactions: The major removal pathway for polychlorinated biphenyls from the atmosphere. Environ. Sci. Technol. 30: 1756-1763. 1996.

Bidleman, T.F. Estimation of vapor pressures for nonpolar organic compounds by capillary gas chromatography. Anal. Chem. 56:2490-2496. 1984.

Freitag, D., Ballhorn, L., Geyer, H. and Korte, F. Environmental hazard profile of organic chemicals: An experimental method for the assessment of the behavior or organic chemicals in the ecosphere by means of simple laboratory tests with 14C labeled chemicals. Chemosphere. 14: 1589-1616. 1985.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Larsson, P. and Lemkemeier, K. Microbial mineralization of chlorinated phenols and biphenyls in sediment-water systems from humic and clear-water lakes. Wat. Res. 23: 1081-1085. 1989.

Lepine, F.L., Milot, S.M., Vincent, N.M. and Gravel, D. Photochemistry of higher chlorinated PCBs in cyclohexane. J. Agric. Food Chem. 39: 2053-2056. 1991.

Lin, Y., Gupta, G. and Baker, J. Photodegradation of polychlorinated biphenyl congeners using simulated sunlight and diethylamine. Chemosphere. 31: 3323-3344. 1995.

Moza, F., Scheunert, I., Klein, W. and Korte, F. Studies with 2,4',5-trichlorobiphenyl-^{14}C and 2,2',4,4',6-pentachlorobiphenyl-^{14}C in carrots, sugar beets, and soil. J. Agric. Food Chem. 27: 1120-1124. 1979.

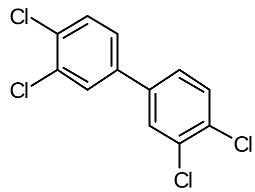
Shiaris, M.P., Sherrill, T.W. and Sayler, G.S. Tenax-GC extraction technique for residual polychlorinated biphenyl and polyaromatic hydrocarbon analysis in biodegradation assays. Appl. Environ. Microbiol. 39: 165-171. 1980.

Van Dort, H.M., Smullen, L.A., May, R.J. and Bedard, D.L. Priming microbial meta-dechlorination of polychlorinated biphenyls that have persisted in Housatonic River sediments for decades. Environ. Sci. Technol. 31:3300-3307. 1997.

3,3',4,4'-Tetrachlorobiphenyl

CAS Registry Number: 32598-13-3

Structure:



Half-lives:

● **Air:** High: 37 days
Low: 4 days

Comment: Based upon an estimated rate constant for the reaction of 3,3',4,4'-tetrachlorobiphenyl with hydroxyl radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives.

● **Surface Water:** >98 days

Comment: Based upon analogy to 2,2',4,4'-tetrachlorobiphenyl; no primary degradation in river water was noted in a 98-day study (Bailey et al., 1983). According to longer term soil studies, tetrachlorobiphenyls are very resistant to biodegradation (Gan and Berthouex, 1994). Photolysis of tetrachlorobiphenyls in surface waters may occur (Lin et al., 1995); however, these compounds are expected to adsorb to sediment and particulate matter and may be removed from the surface.

● **Soil:** High: 4.83 years
Low: 0.91 years

Comment: Based upon analogy to the half-life range of other tetrachlorobiphenyl isomers in a 5-year field study in sludge-amended farmland (Gan and Berthouex, 1994).

Biodegradation half-life:

● **Aerobic soil:** High: 1.73 years
Low: 1.46 years

Comment: No data were located on the aerobic soil biodegradation of 3,3',4,4'-tetrachlorobiphenyl. However, the above data corresponds to calculated half-lives for ^{14}C-labeled 2,2',5,5'-tetrachlorobiphenyl (low $t_{1/2}$) and 2,2',4,4'-tetrachlorobiphenyl (high $t_{1/2}$) in Flanagan silt loam (mineralization measured) at 28 EC for 98 days (Fries and Marrow, 1984).

● **Aerobic soil:** High: 58 months (4.83 years)
Low: 11 months (0.91 years)

Comment: No data were located for the aerobic soil biodegradation of 3,3',4,4'-tetrachlorobiphenyl. However, the above data is for the isomers 2,4,4',5-tetrachlorobiphenyl (low $t_{1/2}$), and 2,2',5,5'-tetrachlorobiphenyl and 2,2',4,5'-tetrachlorobiphenyl (high $t_{1/2}$) from a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded faster than those containing the same number of chlorines on both rings; and preferential ring fission of the molecules occurred with non- and less chlorinated rings (Gan and Berthouex, 1994).

Aerobic water: >98 days

Comment: No data were located on the aerobic water degradation of 3,3',4,4'-tetrachlorobiphenyl. However, no primary degradation of another tetra isomer (^{14}C-radiolabeled 2,2',4,4'-tetrachlorobiphenyl) was observed over 98 days in river water from the Tittabawassee River in Midland, MI (initial concentration 10 or 1 Fg/L at 20 EC) (Bailey et al., 1983).

Anaerobic: High:
Low:

Comment:

<u>Photolysis half-life:</u>

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Other:

Comment: After 10 minutes of exposure to UV lamps at 300 nm in a merry-go-round adaptor, 1.1% of 3,3',4,4'-tetrachlorobiphenyl in cyclohexane lost a chlorine atom; 83% of the loss was at the meta position (Lepine et al., 1991).

Other: 17.42 days

Comment: No data were located for 3,3',4,4'-tetrachlorobiphenyl. However, the above half-life is based on a study of another tetra isomer, 2,2',4,6-tetrachlorobiphenyl, adsorbed onto silica gel and irradiated with simulated sunlight at >290 nm for 17 hours (Freitag et al., 1985).

Photooxidation half-life:

- **Air:** High: 37 days
  Low: 4 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 3,3',4,4'-tetrachlorobiphenyl. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 3,3',4,4'-tetrachlorobiphenyl in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 1.64×10^{-5} mm Hg (Bidleman, 1984).

- **Water:** 7.1 hours

Comment: 2,3',4,4'-Tetrachlorobiphenyl was dissolved initially in hexane and acetone, diluted into distilled water and exposed to simulated natural sunlight (>300 nm) in glass vials with diethylamine (as a sensitizer) for 24 hours (Lin et al., 1995).

Hydrolysis:

- **First-order half-life:** No hydrolyzable groups

Comment:

- **Acid rate constant:**

Comment:

- **Base rate constant:**

Comment:

References:

Bailey, R.E., Gonsoir, S.J. and Rhinehart, W.L. Biodegradation of the monochlorobiphenyls and biphenyl in river water. Environ. Sci. Technol. 17: 617-621. 1983.

Bidleman, T.F. Estimation of vapor pressures for nonpolar organic compounds by capillary gas chromatography. Anal. Chem. 56:2490-2496. 1984.

Freitag, D., Ballhorn, L., Geyer, H. and Korte, F. Environmental hazard profile of organic chemicals: An experimental method for the assessment of the behavior of organic chemicals in the ecosphere by means of simple laboratory tests with 14C labeled chemicals. Chemosphere. 14: 1589-1616. 1985.

Fries, G.F. and Marrow, G.S. Metabolism of chlorobiphenyls in soil. Bull. Environ. Contam. Toxicol. 33: 6-12. 1984.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

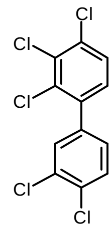
Lepine, F.L., Milot, S.M., Vincent, N.M. and Gravel, D. Photochemistry of higher chlorinated PCBs in cyclohexane. J. Agric. Food Chem. 39: 2053-2056. 1991.

Lin, Y., Gupta, G. and Baker, J. Photodegradation of polychlorinated biphenyl congeners using simulated sunlight and diethylamine. Chemosphere. 31: 3323-3344. 1995.

2,3,3',4,4'-Pentachlorobiphenyl

CAS Registry Number: 32598-14-4

Structure:



Half-lives:

Air: High: 80 days
Low: 8 days

Comment: Based upon an estimated rate constant for the reaction of 2,3,3',4,4'-pentachlorobiphenyl with hydroxyl radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives.

Surface Water: >56 days

Comment: Based upon analogy to Arochlor 1254; no biodegradation was noted after 8 weeks in water samples (Shiaris et al., 1980) or in a terrestrial aquatic (surface sediment and water mixture) laboratory model ecosystem (Larsson and Lemkemeier, 1989). According to longer term soil studies, pentachlorobiphenyls are very resistant to biodegradation (Gan and Berthouex, 1994). Photolysis of pentachlorobiphenyls in surface waters may occur (Lin et al., 1995); however, these compounds are expected to adsorb to sediment and particulate matter and may be removed from the surface.

Soil: High: 7.25 years
Low: 0.91 years

Comment: Based upon analogy to a range of the half-lives for other pentachlorobiphenyl isomers in a 5-year field study in sludge-amended farmland (Gan and Berthouex, 1994).

Biodegradation half-life:

Aerobic soil: High: 87 months (7.25 years)
Low: 11 months (0.91 years)

Comment: No data were located for the aerobic soil biodegradation of 2,3,3',4,4'-pentachlorobiphenyl. However, the above half-lives are based on 2,2',4,4',6-pentachlorobiphenyl (low $t_{1/2}$) and 2,2',3,5',6-pentachlorobiphenyl (high $t_{1/2}$) in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded faster than those containing the same number of chlorines on both rings; and preferential ring fission of the molecules occurred with non- and less chlorinated rings (Gan and

Berthouex, 1994).

Aerobic soil:
Comment: No data were located for the aerobic soil biodegradation of 2,3,3',4,4'-pentachlorobiphenyl. However, the total residue amount of another penta isomer, 2,2',4,4',6-pentachlorobiphenyl, remained similar (0.486 ppm vs. 0.457 ppm) after the radiolabeled compound was applied to soil under outdoor conditions; soil was tested after two growing seasons (first year, carrots; second year with no PCB retreatment, sugar beets; exact study duration not stated). The total recovery of the compound was 58.5%; 41.5% was lost due to volatilization and 1.4% was crop uptake (Moza et al., 1979).

Aerobic water: >56 days
Comment: No data were located for aerobic water biodegradation for 2,3,3',4,4'-pentachlorobiphenyl. However, no apparent biodegradation of ^{14}C-labeled Aroclor 1254 after 8 weeks in water samples from Center Hill Reservoir, TN was noted as compared to controls (Shiaris et al., 1980).

Aerobic water: >57 days
Comment: No data were located for aerobic water biodegradation for 2,3,3',4,4'-pentachlorobiphenyl. However, no significant aerobic microbial mineralization of ^{14}C-labeled Aroclor 1254 occurred in 57 days in a model ecosystem of water and surface sediments from high (Frejen Lake; pH 5.4) and low (Fiolen Lake; pH 6.3) humic content lakes in Sweden (Larsson and Lemkemeier, 1989).

Anaerobic: 39 days
Comment: Based on a 141-day grab sample study in Housatonic River sediment acclimated with a more degradable compound, 2,3,4,5,6-pentachlorobiphenyl (to prime biodegradation) (Van Dort et al., 1997).

Photolysis half-life:

Air: High:
Low:
Comment:

Water: High:
Low:
Comment:

Soil: High:
Low:
Comment:

Other:

Comment: No data were located for 2,3,3',4,4'-pentachlorobiphenyl. However, after 10 minutes of exposure to UV lamps at 300 nm in a merry-go-round adaptor, 3.3% and 67% of 2,2',4,5,5'-pentachlorobiphenyl and 2,3',4,4',5'-pentachlorobiphenyl, respectively, in cyclohexanone lost a chlorine atom (Lepine et al., 1991).

Other: 9.19 days

Comment: No data were located for 2,3,3',4,4'-pentachlorobiphenyl. However, the above half-life is for another isomer, 2,2',4,4',6-pentachlorobiphenyl, adsorbed onto silica gel and irradiated with simulated sunlight at >290 nm for 17 hours (Freitag et al., 1985).

Photooxidation half-life:

Air: High: 80 days
Low: 8 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2,3,3',4,4'-pentachlorobiphenyl. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 2,3,3',4,4'-pentachlorobiphenyl in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 6.53×10^{-6} mm Hg (Bidleman, 1984).

Air: High: 34 days
Low: 14 days

Comment: No data were located for 2,3,3',4,4'-pentachlorobiphenyl. However, the above calculated atmospheric half-lives are based on rate constants for the gas-phase reaction of 2,3,4,5,6-pentachlorobiphenyl (low $t_{1/2}$) and 2,2,3,5',6-pentachlorobiphenyl (high $t_{1/2}$) with OH radicals over the temperature range of 323-363 EK in simulated sunlight (Anderson and Hites, 1996).

Water: High: 14.5 hours
Low: 3.4 hours

Comment: No data were located for 2,3,3',4,4'-pentachlorobiphenyl. However, the above half-lives are for 2,2',4,5,5'-pentachlorobiphenyl dissolved initially in hexane and acetone, diluted into distilled water and exposed for 24 hours in glass vials with diethylamine (as a sensitizer) to artificial sunlight >300 nm (low $t_{1/2}$) or to natural sunlight (high $t_{1/2}$) (Lin et al., 1995).

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Anderson, P.N. and Hites, R.A. OH Radical reactions: The major removal pathway for polychlorinated biphenyls from the atmosphere. Environ. Sci. Technol. 30: 1756-1763. 1996.

Bidleman, T.F. Estimation of vapor pressures for nonpolar organic compounds by capillary gas chromatography. Anal. Chem. 56:2490-2496. 1984.

Freitag, D., Ballhorn, L., Geyer, H. and Korte, F. Environmental hazard profile of organic chemicals: An experimental method for the assessment of the behavior or organic chemicals in the ecosphere by means of simple laboratory tests with 14C labeled chemicals. Chemosphere. 14: 1589-1616. 1985.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Larsson, P. and Lemkemeier, K. Microbial mineralization of chlorinated phenols and biphenyls in sediment-water systems from humic and clear-water lakes. Wat. Res. 23: 1081-1085. 1989.

Lepine, F.L., Milot, S.M., Vincent, N.M. and Gravel, D. Photochemistry of higher chlorinated PCBs in cyclohexane. J. Agric. Food Chem. 39: 2053-2056. 1991.

Lin, Y., Gupta, G. and Baker, J. Photodegradation of polychlorinated biphenyl congeners using simulated sunlight and diethylamine. Chemosphere. 31: 3323-3344. 1995.

Moza, F., Scheunert, I., Klein, W. and Korte, F. Studies with 2,4',5-trichlorobiphenyl-^{14}C and 2,2',4,4',6-pentachlorobiphenyl-^{14}C in carrots, sugar beets, and soil. J. Agric. Food Chem. 27: 1120-1124. 1979.

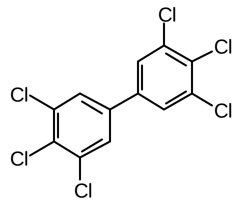
Shiaris, M.P., Sherrill, T.W. and Sayler, G.S. Tenax-GC extraction technique for residual polychlorinated biphenyl and polyaromatic hydrocarbon analysis in biodegradation assays. Appl. Environ. Microbiol. 39: 165-171. 1980.

Van Dort, H.M., Smullen, L.A., May, R.J. and Bedard, D.L. Priming microbial meta-dechlorination of polychlorinated biphenyls that have persisted in Housatonic River sediments for decades. Environ. Sci. Technol. 31:3300-3307. 1997.

3,3',4,4',5,5'-Hexachlorobiphenyl

CAS Registry Number: 32774-16-6

Structure:



Half-lives:

- **Air:** High: 88 days
  Low: 9 days

Comment: Based upon an estimated rate constant for the reaction of 3,3',4,4',5,5'-hexachlorobiphenyl with hydroxyl radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:** >56 days

Comment: Based upon analogy to Arochlor 1254; no biodegradation was noted after 8 weeks in water samples (Shiaris et al., 1980) or in a terrestrial aquatic (surface sediment and water mixture) laboratory model ecosystem (Larsson and Lemkemeier, 1989). According to longer term soil studies, hexachlorobiphenyls are very resistant to biodegradation (Gan and Berthouex, 1994). Photolysis of hexachlorobiphenyls in surface waters may occur (Lin et al., 1995); however, these compounds are expected to adsorb to sediment and particulate matter and may be removed from the surface.

- **Soil:** High: >5 years
  Low: 3.42 years

Comment: Based upon analogy to other hexachlorobiphenyl isomers in a 5-year field study in sludge-amended farmland (Gan and Berthouex, 1994).

Biodegradation half-life:

- **Aerobic soil:** >260 days

Comment: No significant biodegradation of 3,3',4,4',5,5'-hexachlorobiphenyl was noted in a sludge-amended field study (as compared to a control plot) over 260 days (Wilson et al., 1997).

- **Aerobic soil:** High: 3.17 years
  Low: 1.31 years

Comment: No data were located for aerobic soil biodegradation of 3,3',4,4',5,5'-hexachlorobiphenyl. However, the above half-lives are calculated based on ^{14}C-radiolabeled 2,2',3,3',5,5'-hexachlorobiphenyl (low $t_{½}$) and 2,2',4,4',5,5'-hexachlorobiphenyl (high $t_{½}$) in

Flanagan silt loam at 28 EC for 98 days (Fries and Marrow, 1984).

• **Aerobic soil:** High: >5 years
Low: 41 months (3.42 years)
Comment: No data were located for aerobic soil biodegradation of 3,3',4,4',5,5'-hexachlorobiphenyl. However, although 2,2',3,3',4,5-hexachlorobiphenyl had a half-life of 3.42 years based on a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin, the other 6-Cl PCB isomers remained stable over the 5 year period. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded faster than those containing the same number of chlorines on both rings; and preferential ring fission of the molecules occurred with non- and less chlorinated rings (Gan and Berthouex, 1994).

• **Aerobic water:** >56 days
Comment: No data were located for aerobic water biodegradation for 3,3',4,4',5,5'-hexachlorobiphenyl. However, no apparent biodegradation of ^{14}C-labeled Aroclor 1254 after 8 weeks in water samples from Center Hill Reservoir, TN (initial concentration 10 Fg/L, 25 EC, GC) was noted as compared to controls (Shiaris et al., 1980).

• **Aerobic water:** >57 days
Comment: No data were located for aerobic water biodegradation for 3,3',4,4',5,5'-hexachlorobiphenyl. However, no significant aerobic microbial mineralization of ^{14}C-labeled Aroclor 1254 occurred in 57 days in a model ecosystem of water and surface sediments from high (Frejen Lake; pH 5.4) and low (Fiolen Lake; pH 6.3) humic content lakes in Sweden (Larsson and Lemkemeier, 1989).

• **Anaerobic:** High:
Low:
Comment:

Photolysis half-life:

• **Air:** High:
Low:
Comment:

• **Water:** High:
Low:
Comment:

• **Soil:** High:

Low:

Comment:

Other:

Comment: No data were located for 3,3',4,4',5,5'-hexachlorobiphenyl. However, after 10 minutes of exposure to UV lamps at 300 nm in a merry-go-round adaptor, 8.1% and 48% of 2,2',4,4',5,5'-hexachlorobiphenyl and 2,2',3,4,4',5'-hexachlorobiphenyl, respectively, in cyclohexanone lost a chlorine atom (Lepine et al., 1991).

Photooxidation half-life:

Air: High: 88 days
Low: 9 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 3,3',4,4',5,5'-hexachlorobiphenyl. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 3,3',4,4',5,5'-hexachlorobiphenyl in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 5.81×10^{-7} mm Hg (Neely and Blau, 1985)

Water: 8.2 hours

Comment: No data were located for 3,3',4,4',5,5'-hexachlorobiphenyl. However, another hexa isomer, 2,2',3,4,4',5'-hexachlorobiphenyl, was dissolved initially in hexane and acetone, diluted into distilled water and exposed to simulated natural sunlight (>300 nm) in glass vials with diethylamine (as a sensitizer) for 24 hours (Lin et al., 1995).

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Fries, G.F. and Marrow, G.S. Metabolism of chlorobiphenyls in soil. Bull. Environ. Contam. Toxicol. 33: 6-12. 1984.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Larsson, P. and Lemkemeier, K. Microbial mineralization of chlorinated phenols and biphenyls in sediment-water systems from humic and clear-water lakes. Wat. Res. 23: 1081-1085. 1989.

Lepine, F.L., Milot, S.M., Vincent, N.M. and Gravel, D. Photochemistry of higher chlorinated PCBs in cyclohexane. J. Agric. Food Chem. 39: 2053-2056. 1991.

Lin, Y., Gupta, G. and Baker, J. Photodegradation of polychlorinated biphenyl congeners using simulated sunlight and diethylamine. Chemosphere. 31: 3323-3344. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, FL: CRC Press. 1985.

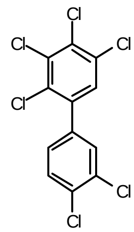
Shiaris, M.P., Sherrill, T.W. and Sayler, G.S. Tenax-GC extraction technique for residual polychlorinated biphenyl and polyaromatic hydrocarbon analysis in biodegradation assays. Appl. Environ. Microbiol. 39: 165-171. 1980.

Wilson, S.C., Alcock, R.E., Sewart, A.P. and Jones, K.C. Persistence of organic contaminants in sewage-amended soil: A field experiment. J. Environ. Qual. 26: 1467-1477. 1997.

2,3,3',4,4',5-Hexachlorobiphenyl

CAS Registry Number: 38380-08-4

Structure:



Half-lives:

- **Air:** High: 127 days
  Low: 13 days

Comment: Based upon an estimated rate constant for the reaction of 2,3,3',4,4',5-hexachlorobiphenyl with hydroxyl radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:** >56 days

Comment: Based upon analogy to Arochlor 1254; no biodegradation was noted after 8 weeks in water samples (Shiaris et al., 1980) or in a terrestrial aquatic (surface sediment and water mixture) laboratory model ecosystem (Larsson and Lemkemeier, 1989). According to longer term soil studies, hexachlorobiphenyls are very resistant to biodegradation (Gan and Berthouex, 1994). Photolysis of hexachlorobiphenyls in surface waters may occur (Lin et al., 1995); however, these compounds are expected to adsorb to sediment and particulate matter and may be removed from the surface.

- **Soil:** High: >5 years
  Low: 3.42 years

Comment: Based upon analogy to other hexachlorobiphenyl isomers in a 5-year field study in sludge-amended farmland (Gan and Berthouex, 1994).

Biodegradation half-life:

- **Aerobic soil:** High: 3.17 years
  Low: 1.31 years

Comment: No data were located for aerobic soil biodegradation of 2,3,3',4,4',5-hexachlorobiphenyl. However, the above half-lives are calculated based on ^{14}C-radiolabeled 2,2',3,3',5,5'-hexachlorobiphenyl (low $t_{½}$) and 2,2',4,4',5,5'-hexachlorobiphenyl (high $t_{½}$) in Flanagan silt loam at 28 EC for 98 days (Fries and Marrow, 1984).

- **Aerobic soil:** High: >5 years
  Low: 41 months (3.42 years)

Comment: No data were located for aerobic soil biodegradation of 2,3,3',4,4',5-

hexachlorobiphenyl. However, although 2,2',3,3',4,5-hexachlorobiphenyl had a half-life of 3.42 years based on a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin, the other 6-Cl PCB isomers remained stable over the 5 year period. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded faster than those containing the same number of chlorines on both rings; and preferential ring fission of the molecules occurred with non- and less chlorinated rings (Gan and Berthouex, 1994).

● **Aerobic water:** >56 days
Comment: No data were located for aerobic water biodegradation for 2,3,3',4,4',5-hexachlorobiphenyl. However, no apparent biodegradation of ^{14}C-labeled Aroclor 1254 after 8 weeks in water samples from Center Hill Reservoir, TN (initial concentration 10 Fg/L, 25 EC, GC) was noted as compared to controls (Shiaris et al., 1980).

● **Aerobic water:** >57 days
Comment: No data were located for aerobic water biodegradation for 2,3,3',4,4',5-hexachlorobiphenyl. However, no significant aerobic microbial mineralization of ^{14}C-labeled Aroclor 1254 occurred in 57 days in a model ecosystem of water and surface sediments from high (Frejen Lake; pH 5.4) and low (Fiolen Lake; pH 6.3) humic content lakes in Sweden (Larsson and Lemkemeier, 1989).

● **Anaerobic:** 103 days
Comment: Based on a 141-day grab sample study in Housatonic River sediment acclimated with a more degradable compound, 2,3,4,5,6-pentachlorobiphenyl (to prime biodegradation) (Van Dort et al., 1997).

<u>Photolysis half-life:</u>

● **Air:** High:
Low:
Comment:

● **Water:** High:
Low:
Comment:

● **Soil:** High:
Low:
Comment:

Other:

Comment: No data were located for 2,3,3',4,4',5-hexachlorobiphenyl. However, after 10 minutes of exposure to UV lamps at 300 nm in a merry-go-round adaptor, 8.1% and 48% of 2,2',4,4',5,5'-hexachlorobiphenyl and 2,2',3,4,4',5'-hexachlorobiphenyl, respectively, in cyclohexanone lost a chlorine atom (Lepine et al., 1991).

Photooxidation half-life:

Air: High: 127 days
Low: 13 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2,3,3',4,4',5-hexachlorobiphenyl. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 2,3,3',4,4',5-hexachlorobiphenyl in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 1.61×10^{-6} mm Hg (Bidleman, 1984).

Water: 8.2 hours

Comment: No data were located for 2,3,3',4,4',5-hexachlorobiphenyl. However, another hexa isomer, 2,2',3,4,4',5'-hexachlorobiphenyl, was dissolved initially in hexane and acetone, diluted into distilled water and exposed to simulated natural sunlight (>300 nm) in glass vials with diethylamine (as a sensitizer) for 24 hours (Lin et al., 1995).

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Bidleman, T.F. Estimation of vapor pressures for nonpolar organic compounds by capillary gas chromatography. Anal. Chem. 56:2490-2496. 1984.

Fries, G.F. and Marrow, G.S. Metabolism of chlorobiphenyls in soil. Bull. Environ. Contam. Toxicol. 33: 6-12. 1984.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Larsson, P. and Lemkemeier, K. Microbial mineralization of chlorinated phenols and biphenyls in sediment-water systems from humic and clear-water lakes. Wat. Res. 23: 1081-1085. 1989.

Lepine, F.L., Milot, S.M., Vincent, N.M. and Gravel, D. Photochemistry of higher chlorinated PCBs in cyclohexane. J. Agric. Food Chem. 39: 2053-2056. 1991.

Lin, Y., Gupta, G. and Baker, J. Photodegradation of polychlorinated biphenyl congeners using simulated sunlight and diethylamine. Chemosphere. 31: 3323-3344. 1995.

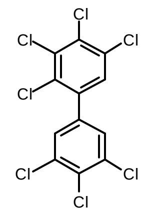
Shiaris, M.P., Sherrill, T.W. and Sayler, G.S. Tenax-GC extraction technique for residual polychlorinated biphenyl and polyaromatic hydrocarbon analysis in biodegradation assays. Appl. Environ. Microbiol. 39: 165-171. 1980.

Van Dort, H.M., Smullen, L.A., May, R.J. and Bedard, D.L. Priming microbial meta-dechlorination of polychlorinated biphenyls that have persisted in Housatonic River sediments for decades. Environ. Sci. Technol. 31:3300-3307. 1997.

2,3,3',4,4',5,5'-Heptachlorobiphenyl

CAS Registry Number: 39635-31-9

Structure:



Half-lives:

- **Air:** High: 191 days
  Low: 19 days

Comment: Based upon an estimated rate constant for the reaction of 2',3,3',4,4',5,5'-heptachlorobiphenyl with hydroxyl radicals in air. This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:** >56 days

Comment: Based upon analogy to Arochlor 1254; no biodegradation was noted after 8 weeks in water samples (Shiaris et al., 1980) or in a terrestrial aquatic (surface sediment and water mixture) laboratory model ecosystem (Larsson and Lemkemeier, 1989). According to longer term soil studies, heptachlorobiphenyls are very resistant to biodegradation (Gan and Berthouex, 1994). Heptachlorobiphenyls are expected to adsorb to sediment and particulate matter and may be removed from the surface.

- **Soil:** High: >5 years
  Low: 3.92 years

Comment: Based upon analogy to other heptachlorobiphenyl isomers in a 5-year field study in sludge-amended farmland (Gan and Berthouex, 1994).

Biodegradation half-life:

- **Aerobic soil:** High: >5 years
  Low: 3.92 years

Comment: No data were located on the aerobic soil biodegradation of 2,3,3',4,4',5,5'-heptachlorobiphenyl. However, the above low half-life is for 2,2',3,3',4,5',6-heptachlorobiphenyl in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin; many of the other heptachlorobiphenyl isomers tested were stable over the 5-year period (high $t_{½}$) (Gan and Berthouex, 1994).

- **Aerobic water:** >56 days

Comment: No data were located on the aerobic water biodegradation of 2,3,3',4,4',5,5'-

heptachlorobiphenyl. However, no apparent biodegradation of ^{14}C-labeled Aroclor 1254 after 8 weeks in water samples from Center Hill Reservoir, TN (initial concentration 10 Fg/L, 25 EC, GC) was noted as compared to controls (Shiaris et al., 1980).

- **Aerobic water:** >57 days

Comment: No data were located on the aerobic water biodegradation of 2,3,3',4,4',5,5'-heptachlorobiphenyl. However, no significant aerobic microbial mineralization of ^{14}C-labeled Aroclor 1254 occurred in 57 days in a model ecosystem of water and surface sediments from high (Frejen Lake; pH 5.4) and low (Fiolen Lake; pH 6.3) humic content lakes in Sweden (Larsson and Lemkemeier, 1989).

- **Anaerobic:** 174 days

Comment: Based on a 141-day grab sample study in Housatonic River sediment acclimated with a more degradable compound, 2,3,4,5,6-pentachlorobiphenyl (to prime biodegradation) (Van Dort et al., 1997).

Photolysis half-life:

- **Air:** High:
  Low:

Comment:

- **Water:** High:
  Low:

Comment:

- **Soil:** High:
  Low:

Comment:

- **Other:**

Comment: No data were located for 2,3,3',4,4',5-heptachlorobiphenyl. However, after 10 minutes of exposure to UV lamps at 300 nm in a merry-go-round adaptor, 14% and 68.7% of 2,2',3,4,4',5,5'-heptachlorobiphenyl and 2,2',3,4,4',5',6-heptachlorobiphenyl, respectively, in cyclohexanone lost a chlorine atom (Lepine et al., 1991).

Photooxidation half-life:

- **Air:** High: 191 days
  Low: 19 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2,3,3',4,4',5,5'-heptachlorobiphenyl. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{½}$ for the reaction of hydroxyl radicals with 2,3,3',4,4',5,5'-heptachlorobiphenyl in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of $1.3x10^{-7}$ mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Larsson, P. and Lemkemeier, K. Microbial mineralization of chlorinated phenols and biphenyls in sediment-water systems from humic and clear-water lakes. Wat. Res. 23: 1081-1085. 1989.

Lepine, F.L., Milot, S.M., Vincent, N.M. and Gravel, D. Photochemistry of higher chlorinated PCBs in cyclohexane. J. Agric. Food Chem. 39: 2053-2056. 1991.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, FL: CRC Press. 1985.

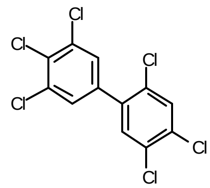
Shiaris, M.P., Sherrill, T.W. and Sayler, G.S. Tenax-GC extraction technique for residual polychlorinated biphenyl and polyaromatic hydrocarbon analysis in biodegradation assays. Appl. Environ. Microbiol. 39: 165-171. 1980.

Van Dort, H.M., Smullen, L.A., May, R.J. and Bedard, D.L. Priming microbial meta-dechlorination of polychlorinated biphenyls that have persisted in Housatonic River sediments for decades. Environ. Sci. Technol. 31:3300-3307. 1997.

2,3',4,4',5,5'-Hexachlorobiphenyl

CAS Registry Number: 52663-72-6

Structure:



Half-lives:

- **Air:** High: 114 days
  Low: 11 days

Comment: Based upon an estimated rate constant for the reaction of 2,3',4,4',5,5'-hexachlorobiphenyl with hydroxyl radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:** >56 days

Comment: Based upon analogy to Arochlor 1254; no biodegradation was noted after 8 weeks in water samples (Shiaris et al., 1980) or in a terrestrial aquatic (surface sediment and water mixture) laboratory model ecosystem (Larsson and Lemkemeier, 1989). According to longer term soil studies, hexachlorobiphenyls are very resistant to biodegradation (Gan and Berthouex, 1994). Photolysis of hexachlorobiphenyls in surface waters may occur (Lin et al., 1995); however, these compounds are expected to adsorb to sediment and particulate matter and may be removed from the surface.

- **Soil:** High: >5 years
  Low: 3.42 years

Comment: Based upon analogy to other hexachlorobiphenyl isomers in a 5-year field study in sludge-amended farmland (Gan and Berthouex, 1994).

Biodegradation half-life:

- **Aerobic soil:** High: 3.17 years
  Low: 1.31 years

Comment: No data were located for aerobic soil biodegradation of 2,3',4,4',5,5'-hexachlorobiphenyl. However, the above half-lives are calculated based on ^{14}C-radiolabeled 2,2',3,3',5,5'-hexachlorobiphenyl (low $t_{1/2}$) and 2,2',4,4',5,5'-hexachlorobiphenyl (high $t_{1/2}$) in Flanagan silt loam at 28 EC for 98 days (Fries and Marrow, 1984).

- **Aerobic soil:** High: >5 years
  Low: 41 months (3.42 years)

Comment: No data were located for aerobic soil biodegradation of 2,3',4,4',5,5'-

hexachlorobiphenyl. However, although 2,2',3,3',4,5-hexachlorobiphenyl had a half-life of 3.42 years based on a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin, the other 6-Cl PCB isomers remained stable over the 5 year period. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded faster than those containing the same number of chlorines on both rings; and preferential ring fission of the molecules occurred with non- and less chlorinated rings (Gan and Berthouex, 1994).

Aerobic water: >56 days
Comment: No data were located for aerobic water biodegradation for 2,3',4,4',5,5'-hexachlorobiphenyl. However, no apparent biodegradation of ^{14}C-labeled Aroclor 1254 after 8 weeks in water samples from Center Hill Reservoir, TN (initial concentration 10 Fg/L, 25 EC, GC) was noted as compared to controls (Shiaris et al., 1980).

Aerobic water: >57 days
Comment: No data were located for aerobic water biodegradation for 2,3',4,4',5,5'-hexachlorobiphenyl. However, no significant aerobic microbial mineralization of ^{1}4C-labeled Aroclor 1254 occurred in 57 days in a model ecosystem of water and surface sediments from high (Frejen Lake; pH 5.4) and low (Fiolen Lake; pH 6.3) humic content lakes in Sweden (Larsson and Lemkemeier, 1989).

Anaerobic: 85 days
Comment: Based on a 141-day grab sample study in Housatonic River sediment acclimated with a more degradable compound, 2,3,4,5,6-pentachlorobiphenyl (to enrich biodegradation) (Van Dort et al., 1997).

Photolysis half-life:

Air: High:
Low:
Comment:

Water: High:
Low:
Comment:

Soil: High:
Low:
Comment:

Other:
Comment: No data were located for 2,3',4,4',5,5'-hexachlorobiphenyl. However, after 10 minutes of exposure to UV lamps at 300 nm in a merry-go-round adaptor, 8.1% and 48% of 2,2',4,4',5,5'-hexachlorobiphenyl and 2,2',3,4,4',5'-hexachlorobiphenyl, respectively, in cyclohexanone lost a chlorine atom (Lepine et al., 1991).

Photooxidation half-life:

Air: High: 114 days
Low: 11 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2,3',4,4',5,5'-hexachlorobiphenyl. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 2,3',4,4',5,5'-hexachlorobiphenyl in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 5.81×10^{-7} mm Hg (Neely and Blau, 1985).

Water: 8.2 hours
Comment: No data were located for 2,3',4,4',5,5-hexachlorobiphenyl. However, another hexa isomer, 2,2',3,4,4',5'-hexachlorobiphenyl, was dissolved initially in hexane and acetone, diluted into distilled water and exposed to simulated natural sunlight (>300 nm) in glass vials with diethylamine (as a sensitizer) for 24 hours (Lin et al., 1995).

Hydrolysis:

First-order half-life: No hydrolyzable groups
Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Fries, G.F. and Marrow, G.S. Metabolism of chlorobiphenyls in soil. Bull. Environ. Contam. Toxicol. 33: 6-12. 1984.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Larsson, P. and Lemkemeier, K. Microbial mineralization of chlorinated phenols and biphenyls in sediment-water systems from humic and clear-water lakes. Wat. Res. 23: 1081-1085. 1989.

Lepine, F.L., Milot, S.M., Vincent, N.M. and Gravel, D. Photochemistry of higher chlorinated PCBs in cyclohexane. J. Agric. Food Chem. 39: 2053-2056. 1991.

Lin, Y., Gupta, G. and Baker, J. Photodegradation of polychlorinated biphenyl congeners using simulated sunlight and diethylamine. Chemosphere. 31: 3323-3344. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, FL: CRC Press. 1985.

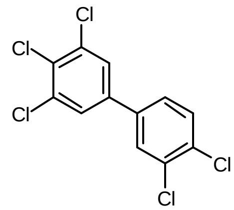
Shiaris, M.P., Sherrill, T.W. and Sayler, G.S. Tenax-GC extraction technique for residual polychlorinated biphenyl and polyaromatic hydrocarbon analysis in biodegradation assays. Appl. Environ. Microbiol. 39: 165-171. 1980.

Van Dort, H.M., Smullen, L.A., May, R.J. and Bedard, D.L. Priming microbial meta-dechlorination of polychlorinated biphenyls that have persisted in Housatonic River sediments for decades. Environ. Sci. Technol. 31:3300-3307. 1997.

3,3',4,4',5-Pentachlorobiphenyl

<u>CAS Registry Number:</u> 57465-28-8

<u>Structure:</u>



<u>Half-lives:</u>

- **Air:** High: 57 days
  Low: 6 days

Comment: Based upon an estimated rate constant for the reaction of 3,3',4,4',5-pentachlorobiphenyl with hydroxyl radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:** >56 days

Comment: Based upon analogy to Arochlor 1254; no biodegradation was noted after 8 weeks in water samples (Shiaris et al., 1980) or in a terrestrial aquatic (surface sediment and water mixture) laboratory model ecosystem (Larsson and Lemkemeier, 1989). According to longer term soil studies, pentachlorobiphenyls are very resistant to biodegradation (Gan and Berthouex, 1994). Photolysis of pentachlorobiphenyls in surface waters may occur (Lin et al., 1995); however, these compounds are expected to adsorb to sediment and particulate matter and may be removed from the surface.

- **Soil:** High: 7.25 years
  Low: 0.91 years

Comment: Based upon analogy to the range of half-lives of other pentachlorobiphenyl isomers in a 5-year field study in sludge-amended farmland (Gan and Berthouex, 1994).

<u>Biodegradation half-life:</u>

- **Aerobic soil:** High: 87 months (7.25 years)
  Low: 11 months (0.91 years)

Comment: No data were located for the aerobic soil biodegradation of 3,3',4,4',5-pentachlorobiphenyl. However, the above half-lives are based on 2,2',4,4',6-pentachlorobiphenyl (low $t_{1/2}$) and 2,2',3,5',6-pentachlorobiphenyl (high $t_{1/2}$) in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded faster than those containing the same number of chlorines on both rings; and preferential ring fission of the molecules occurred with non- and less chlorinated rings (Gan and

Berthouex, 1994).

Aerobic soil:
Comment: No data were located for the aerobic soil biodegradation of 3,3',4,4',5-pentachlorobiphenyl. However, the total residue amount of another penta isomer, 2,2',4,4',6-pentachlorobiphenyl, remained similar (0.486 ppm vs. 0.457 ppm) after the radiolabeled compound was applied to soil under outdoor conditions; soil was tested after two growing seasons (first year, carrots; second year with no PCB retreatment, sugar beets; exact study duration not stated). The total recovery of the compound was 58.5%; 41.5% was lost due to volatilization and 1.4% was crop uptake (Moza et al., 1979).

Aerobic water: >56 days
Comment: No data were located for aerobic water biodegradation for 3,3',4,4',5-pentachlorobiphenyl. However, no apparent biodegradation of ^{14}C-labeled Aroclor 1254 after 8 weeks in water samples from Center Hill Reservoir, TN was noted as compared to controls (Shiaris et al., 1980).

Aerobic water: >57 days
Comment: No data were located for aerobic water biodegradation for 3,3',4,4',5-pentachlorobiphenyl. However, no significant aerobic microbial mineralization of ^{14}C-labeled Aroclor 1254 occurred in 57 days in a model ecosystem of water and surface sediments from high (Frejen Lake; pH 5.4) and low (Fiolen Lake; pH 6.3) humic content lakes in Sweden (Larsson and Lemkemeier, 1989).

Anaerobic: High:
Low:
Comment:

<u>Photolysis half-life:</u>

Air: High:
Low:
Comment:

Water: High:
Low:
Comment:

Soil: High:
Low:
Comment:

Other:
Comment: No data were located for 3,3',4,4',5-pentachlorobiphenyl. However, after 10 minutes of exposure to UV lamps at 300 nm in a merry-go-round adaptor, 3.3% and 67% of 2,2',4,5,5'-pentachlorobiphenyl and 2,3',4,4',5'-pentachlorobiphenyl, respectively, in cyclohexanone lost a chlorine atom (Lepine et al., 1991).

Other: 9.19 days
Comment: No data were located for 3,3',4,4',5-pentachlorobiphenyl. However, the above half-life is for another isomer, 2,2',4,4',6-pentachlorobiphenyl, adsorbed onto silica gel and irradiated with simulated sunlight at >290 nm for 17 hours (Freitag et al., 1985).

<u>Photooxidation half-life:</u>

Air: High: 57 days
Low: 6 days
Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 3,3',4,4',5-pentachlorobiphenyl. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 3,3',4,4',5-pentachlorobiphenyl in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of $2.22x10^{-6}$ mm Hg (Neely and Blau, 1985).

Air: High: 34 days
Low: 14 days
Comment: No data were located for 3,3',4,4',5-pentachlorobiphenyl. However, the above calculated atmospheric half-lives are based on rate constants for the gas-phase reaction of 2,3,4,5,6-pentachlorobiphenyl (low $t_{1/2}$) and 2,2,3,5',6-pentachlorobiphenyl (high $t_{1/2}$) with OH radicals over the temperature range of 323-363 EK in simulated sunlight (Anderson and Hites, 1996).

Water: High: 14.5 hours
Low: 3.4 hours
Comment: No data were located for 3,3',4,4',5-pentachlorobiphenyl. However, the above half-lives are for 2,2',4,5,5'-pentachlorobiphenyl dissolved initially in hexane and acetone, diluted into distilled water and exposed for 24 hours in glass vials with diethylamine (as a sensitizer) to artificial sunlight >300 nm (low $t_{1/2}$) or to natural sunlight (high $t_{1/2}$) (Lin et al., 1995).

<u>Hydrolysis:</u>

First-order half-life: No hydrolyzable groups
Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Anderson, P.N. and Hites, R.A. OH Radical reactions: The major removal pathway for polychlorinated biphenyls from the atmosphere. Environ. Sci. Technol. 30: 1756-1763. 1996.

Freitag, D., Ballhorn, L., Geyer, H. and Korte, F. Environmental hazard profile of organic chemicals: An experimental method for the assessment of the behavior or organic chemicals in the ecosphere by means of simple laboratory tests with 14C labeled chemicals. Chemosphere. 14: 1589-1616. 1985.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Larsson, P. and Lemkemeier, K. Microbial mineralization of chlorinated phenols and biphenyls in sediment-water systems from humic and clear-water lakes. Wat. Res. 23: 1081-1085. 1989.

Lepine, F.L., Milot, S.M., Vincent, N.M. and Gravel, D. Photochemistry of higher chlorinated PCBs in cyclohexane. J. Agric. Food Chem. 39: 2053-2056. 1991.

Lin, Y., Gupta, G. and Baker, J. Photodegradation of polychlorinated biphenyl congeners using simulated sunlight and diethylamine. Chemosphere. 31: 3323-3344. 1995.

Moza, F., Scheunert, I., Klein, W. and Korte, F. Studies with 2,4',5-trichlorobiphenyl-^{14}C and 2,2',4,4',6-pentachlorobiphenyl-^{14}C in carrots, sugar beets, and soil. J. Agric. Food Chem. 27: 1120-1124. 1979.

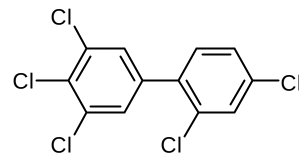
Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, FL: CRC Press. 1985.

Shiaris, M.P., Sherrill, T.W. and Sayler, G.S. Tenax-GC extraction technique for residual polychlorinated biphenyl and polyaromatic hydrocarbon analysis in biodegradation assays. Appl. Environ. Microbiol. 39: 165-171. 1980.

2',3,4,4',5-Pentachlorobiphenyl

CAS Registry Number: 65510-44-3

Structure:



Half-lives:

- **Air:** High: 50 days
  Low: 5 days

Comment: Based upon an estimated rate constant for the reaction of 2',3,4,4',5-pentachlorobiphenyl with hydroxyl radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:** >56 days

Comment: Based upon analogy to Arochlor 1254; no biodegradation was noted after 8 weeks in water samples (Shiaris et al., 1980) or in a terrestrial aquatic (surface sediment and water mixture) laboratory model ecosystem (Larsson and Lemkemeier, 1989). According to longer term soil studies, pentachlorobiphenyls are very resistant to biodegradation (Gan and Berthouex, 1994). Photolysis of pentachlorobiphenyls in surface waters may occur (Lin et al., 1995); however, these compounds are expected to adsorb to sediment and particulate matter and may be removed from the surface.

- **Soil:** High: 7.25 years
  Low: 0.91 years

Comment: Based upon analogy to the range of half-lives of other pentachlorobiphenyl isomers in a 5-year field study in sludge-amended farmland (Gan and Berthouex, 1994).

Biodegradation half-life:

- **Aerobic soil:** High: 87 months (7.25 years)
  Low: 11 months (0.91 years)

Comment: No data were located for the aerobic soil biodegradation of 2',3,4,4',5-pentachlorobiphenyl. However, the above half-lives are based on 2,2',4,4',6-pentachlorobiphenyl (low $t_{1/2}$) and 2,2',3,5',6-pentachlorobiphenyl (high $t_{1/2}$) in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded faster than those containing the same number of chlorines on both rings; and preferential ring fission of the molecules occurred with non- and less chlorinated rings (Gan and

Berthouex, 1994).

Aerobic soil:
Comment: No data were located for the aerobic soil biodegradation of 2',3,4,4',5-pentachlorobiphenyl. However, the total residue amount of another penta isomer, 2,2',4,4',6-pentachlorobiphenyl, remained similar (0.486 ppm vs. 0.457 ppm) after the radiolabeled compound was applied to soil under outdoor conditions; soil was tested after two growing seasons (first year, carrots; second year with no PCB retreatment, sugar beets; exact study duration not stated). The total recovery of the compound was 58.5%; 41.5% was lost due to volatilization and 1.4% was crop uptake (Moza et al., 1979).

Aerobic water: >56 days
Comment: No data were located for aerobic water biodegradation for 2',3,4,4',5-pentachlorobiphenyl. However, no apparent biodegradation of ^{14}C-labeled Aroclor 1254 after 8 weeks in water samples from Center Hill Reservoir, TN was noted as compared to controls (Shiaris et al., 1980).

Aerobic water: >57 days
Comment: No data were located for aerobic water biodegradation for 2',3,4,4',5-pentachlorobiphenyl. However, no significant aerobic microbial mineralization of ^{14}C-labeled Aroclor 1254 occurred in 57 days in a model ecosystem of water and surface sediments from high (Frejen Lake; pH 5.4) and low (Fiolen Lake; pH 6.3) humic content lakes in Sweden (Larsson and Lemkemeier, 1989).

Anaerobic: High:
Low:
Comment:

Photolysis half-life:

Air: High:
Low:
Comment:

Water: High:
Low:
Comment:

Soil: High:
Low:
Comment:

- **Other:**

Comment: No data were located for 2',3,4,4',5-pentachlorobiphenyl. However, after 10 minutes of exposure to UV lamps at 300 nm in a merry-go-round adaptor, 3.3% and 67% of 2,2',4,5,5'-pentachlorobiphenyl and 2,3',4,4',5'-pentachlorobiphenyl, respectively, in cyclohexanone lost a chlorine atom (Lepine et al., 1991).

- **Other:** 9.19 days

Comment: No data were located for 2',3,4,4',5-pentachlorobiphenyl. However, the above half-life is for another isomer, 2,2',4,4',6-pentachlorobiphenyl, adsorbed onto silica gel and irradiated with simulated sunlight at >290 nm for 17 hours (Freitag et al., 1985).

<u>Photooxidation half-life:</u>

- **Air:** High: 50 days
  Low: 5 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2',3,4,4',5-pentachlorobiphenyl. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 2',3,4,4',5-pentachlorobiphenyl in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate phase in the atmosphere based on a vapor pressure of $2.22x10^{-6}$ mm Hg (Neely and Blau, 1985).

- **Air:** High: 34 days
  Low: 14 days

Comment: No data were located for 2',3,4,4',5-pentachlorobiphenyl. However, the above calculated atmospheric half-lives are based on rate constants for the gas-phase reaction of 2,3,4,5,6-pentachlorobiphenyl (low $t_{1/2}$) and 2,2,3,5',6-pentachlorobiphenyl (high $t_{1/2}$) with OH radicals over the temperature range of 323-363 EK in simulated sunlight (Anderson and Hites, 1996).

- **Water:** High: 14.5 hours
  Low: 3.4 hours

Comment: No data were located for 2',3,4,4',5-pentachlorobiphenyl. However, the above half-lives are for 2,2',4,5,5'-pentachlorobiphenyl dissolved initially in hexane and acetone, diluted into distilled water and exposed for 24 hours in glass vials with diethylamine (as a sensitizer) to artificial sunlight >300 nm (low $t_{1/2}$) or to natural sunlight (high $t_{1/2}$) (Lin et al., 1995).

<u>Hydrolysis:</u>

- **First-order half-life:** No hydrolyzable groups

Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Anderson, P.N. and Hites, R.A. OH Radical reactions: The major removal pathway for polychlorinated biphenyls from the atmosphere. Environ. Sci. Technol. 30: 1756-1763. 1996.

Freitag, D., Ballhorn, L., Geyer, H. and Korte, F. Environmental hazard profile of organic chemicals: An experimental method for the assessment of the behavior or organic chemicals in the ecosphere by means of simple laboratory tests with 14C labeled chemicals. Chemosphere. 14: 1589-1616. 1985.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Larsson, P. and Lemkemeier, K. Microbial mineralization of chlorinated phenols and biphenyls in sediment-water systems from humic and clear-water lakes. Wat. Res. 23: 1081-1085. 1989.

Lepine, F.L., Milot, S.M., Vincent, N.M. and Gravel, D. Photochemistry of higher chlorinated PCBs in cyclohexane. J. Agric. Food Chem. 39: 2053-2056. 1991.

Lin, Y., Gupta, G. and Baker, J. Photodegradation of polychlorinated biphenyl congeners using simulated sunlight and diethylamine. Chemosphere. 31: 3323-3344. 1995.

Moza, F., Scheunert, I., Klein, W. and Korte, F. Studies with 2,4',5-trichlorobiphenyl-^{14}C and 2,2',4,4',6-pentachlorobiphenyl-^{14}C in carrots, sugar beets, and soil. J. Agric. Food Chem. 27: 1120-1124. 1979.

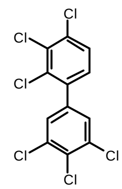
Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, FL: CRC Press. 1985.

Shiaris, M.P., Sherrill, T.W. and Sayler, G.S. Tenax-GC extraction technique for residual polychlorinated biphenyl and polyaromatic hydrocarbon analysis in biodegradation assays. Appl. Environ. Microbiol. 39: 165-171. 1980.

2,3,3',4,4',5'-Hexachlorobiphenyl

CAS Registry Number: 69782-90-7

Structure:



Half-lives:

- **Air:** High: 114 days
  Low: 11 days

Comment: Based upon an estimated rate constant for the reaction of 2,3,3',4,4',5'-hexachlorobiphenyl with hydroxyl radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:** >56 days

Comment: Based upon analogy to Arochlor 1254; no biodegradation was noted after 8 weeks in water samples (Shiaris et al., 1980) or in a terrestrial aquatic (surface sediment and water mixture) laboratory model ecosystem (Larsson and Lemkemeier, 1989). According to longer term soil studies, hexachlorobiphenyls are very resistant to biodegradation (Gan and Berthouex, 1994). Photolysis of hexachlorobiphenyls in surface waters may occur (Lin et al., 1995); however, these compounds are expected to adsorb to sediment and particulate matter and may be removed from the surface.

- **Soil:** High: >5 years
  Low: 3.42 years

Comment: Based upon analogy to other hexachlorobiphenyl isomers in a 5-year field study in sludge-amended farmland (Gan and Berthouex, 1994).

Biodegradation half-life:

- **Aerobic soil:** High: 3.17 years
  Low: 1.31 years

Comment: No data were located for aerobic soil biodegradation of 2,3,3',4,4',5'-hexachlorobiphenyl. However, the above half-lives are calculated based on ^{14}C-radiolabeled 2,2',3,3',5,5'-hexachlorobiphenyl (low $t_{½}$) and 2,2',4,4',5,5'-hexachlorobiphenyl (high $t_{½}$) in Flanagan silt loam at 28 EC for 98 days (Fries and Marrow, 1984).

- **Aerobic soil:** High: >5 years
  Low: 41 months (3.42 years)

Comment: No data were located for aerobic soil biodegradation of 2,3,3',4,4',5'-

hexachlorobiphenyl. However, although 2,2',3,3',4,5-hexachlorobiphenyl had a half-life of 3.42 years based on a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin, the other 6-Cl PCB isomers remained stable over the 5 year period. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded faster than those containing the same number of chlorines on both rings; and preferential ring fission of the molecules occurred with non- and less chlorinated rings (Gan and Berthouex, 1994).

- **Aerobic water:** >56 days

Comment: No data were located for aerobic water biodegradation for 2,3,3',4,4',5'-hexachlorobiphenyl. However, no apparent biodegradation of ^{14}C-labeled Aroclor 1254 after 8 weeks in water samples from Center Hill Reservoir, TN (initial concentration 10 Fg/L, 25 EC, GC) was noted as compared to controls (Shiaris et al., 1980).

- **Aerobic water:** >57 days

Comment: No data were located for aerobic water biodegradation for 2,3,3',4,4',5'-hexachlorobiphenyl. However, no significant aerobic microbial mineralization of ^{14}C-labeled Aroclor 1254 occurred in 57 days in a model ecosystem of water and surface sediments from high (Frejen Lake; pH 5.4) and low (Fiolen Lake; pH 6.3) humic content lakes in Sweden (Larsson and Lemkemeier, 1989).

- **Anaerobic:** High:
  Low:

Comment:

Photolysis half-life:

- **Air:** High:
  Low:

Comment:

- **Water:** High:
  Low:

Comment:

- **Soil:** High:
  Low:

Comment:

- **Other:**

Comment: No data were located for 2,3,3',4,4',5'-hexachlorobiphenyl. However, after 10 minutes of exposure to UV lamps at 300 nm in a merry-go-round adaptor, 8.1% and 48% of 2,2',4,4',5,5'-hexachlorobiphenyl and 2,2',3,4,4',5'-hexachlorobiphenyl, respectively, in cyclohexanone lost a chlorine atom (Lepine et al., 1991).

Photooxidation half-life:

- **Air:** High: 114 days
  Low: 11 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2,3,3',4,4',5'-hexachlorobiphenyl. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{½}$ for the reaction of hydroxyl radicals with 2,3,3',4,4',5'-hexachlorobiphenyl in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of $5.81x10^{-7}$ mm Hg (Neely and Blau, 1985).

- **Water:** 8.2 hours

Comment: No data were located for 2,3,3',4,4',5'-hexachlorobiphenyl. However, another hexa isomer, 2,2',3,4,4',5'-hexachlorobiphenyl, was dissolved initially in hexane and acetone, diluted into distilled water and exposed to simulated natural sunlight (>300 nm) in glass vials with diethylamine (as a sensitizer) for 24 hours (Lin et al., 1995).

Hydrolysis:

- **First-order half-life:** No hydrolyzable groups

Comment:

- **Acid rate constant:**

Comment:

- **Base rate constant:**

Comment:

References:

Fries, G.F. and Marrow, G.S. Metabolism of chlorobiphenyls in soil. Bull. Environ. Contam. Toxicol. 33: 6-12. 1984.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-

1695. 1995.

Larsson, P. and Lemkemeier, K. Microbial mineralization of chlorinated phenols and biphenyls in sediment-water systems from humic and clear-water lakes. Wat. Res. 23: 1081-1085. 1989.

Lepine, F.L., Milot, S.M., Vincent, N.M. and Gravel, D. Photochemistry of higher chlorinated PCBs in cyclohexane. J. Agric. Food Chem. 39: 2053-2056. 1991.

Lin, Y., Gupta, G. and Baker, J. Photodegradation of polychlorinated biphenyl congeners using simulated sunlight and diethylamine. Chemosphere. 31: 3323-3344. 1995.

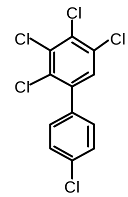
Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, FL: CRC Press. 1985.

Shiaris, M.P., Sherrill, T.W. and Sayler, G.S. Tenax-GC extraction technique for residual polychlorinated biphenyl and polyaromatic hydrocarbon analysis in biodegradation assays. Appl. Environ. Microbiol. 39: 165-171. 1980.

2,3,4,4',5-Pentachlorobiphenyl

CAS Registry Number: 74472-37-0

Structure:



Half-lives:

- **Air:** High: 67 days; Low: 7 days

Comment: Based upon an estimated rate constant for the reaction of 2,3,4,4',5-pentachlorobiphenyl with hydroxy radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:** >56 days

Comment: Based upon analogy to Arochlor 1254; no biodegradation was noted after 8 weeks in water samples (Shiaris et al., 1980) or in a terrestrial aquatic (surface sediment and water mixture) laboratory model ecosystem (Larsson and Lemkemeier, 1989). According to longer term soil studies, pentachlorobiphenyls are very resistant to biodegradation (Gan and Berthouex, 1994). Photolysis of pentachlorobiphenyls in surface waters may occur (Lin et al., 1995); however, these compounds are expected to adsorb to sediment and particulate matter and may be removed from the surface.

- **Soil:** High: 7.25 years; Low: 0.91 years

Comment: Based upon analogy to the range of half-lives of other pentachlorobiphenyl isomers in a 5-year field study in sludge-amended farmland (Gan and Berthouex, 1994).

Biodegradation half-life:

- **Aerobic soil:** High: 87 months (7.25 years); Low: 11 months (0.91 years)

Comment: No data were located for the aerobic soil biodegradation of 2,3,4,4',5-pentachlorobiphenyl. However, the above half-lives are based on 2,2',4,4',6-pentachlorobiphenyl (low $t_{1/2}$) and 2,2',3,5',6-pentachlorobiphenyl (high $t_{1/2}$) in a 5-year field study of sludge-amended farmland (Plano silt/loam soil) at the University of Madison, Wisconsin. It is stated that PCBs containing two chlorines in the ortho positions of a single ring or in each ring showed resistance to biodegradation; PCBs with all chlorines on a single ring were degraded faster than those containing the same number of chlorines on both rings; and preferential ring fission of the molecules occurred with non- and less chlorinated rings (Gan and

Berthouex, 1994).

Aerobic soil:
Comment: No data were located for the aerobic soil biodegradation of 2,3,4,4',5-pentachlorobiphenyl. However, the total residue amount of another penta isomer, 2,2',4,4',6-pentachlorobiphenyl, remained similar (0.486 ppm vs. 0.457 ppm) after the radiolabeled compound was applied to soil under outdoor conditions; soil was tested after two growing seasons (first year, carrots; second year with no PCB retreatment, sugar beets; exact study duration not stated). The total recovery of the compound was 58.5%; 41.5% was lost due to volatilization and 1.4% was crop uptake (Moza et al., 1979).

Aerobic water: >56 days
Comment: No data were located for aerobic water biodegradation for 2,3,4,4',5-pentachlorobiphenyl. However, no apparent biodegradation of ^{14}C-labeled Aroclor 1254 after 8 weeks in water samples from Center Hill Reservoir, TN was noted as compared to controls (Shiaris et al., 1980).

Aerobic water: >57 days
Comment: No data were located for aerobic water biodegradation for 2,3,4,4',5-pentachlorobiphenyl. However, no significant aerobic microbial mineralization of ^{14}C-labeled Aroclor 1254 occurred in 57 days in a model ecosystem of water and surface sediments from high (Frejen Lake; pH 5.4) and low (Fiolen Lake; pH 6.3) humic content lakes in Sweden (Larsson and Lemkemeier, 1989).

Anaerobic: High:
Low:
Comment:

<u>Photolysis half-life:</u>
Air: High:
Low:
Comment:

Water: High:
Low:
Comment:

Soil: High:
Low:
Comment:

Other:
Comment: No data were located for 2,3,4,4',5-pentachlorobiphenyl. However, after 10 minutes of exposure to UV lamps at 300 nm in a merry-go-round adaptor, 3.3% and 67% of 2,2',4,5,5'-pentachlorobiphenyl and 2,3',4,4',5'-pentachlorobiphenyl, respectively, in cyclohexanone lost a chlorine atom (Lepine et al., 1991).

Other: 9.19 days
Comment: No data were located for 2,3,4,4',5-pentachlorobiphenyl. However, the above half-life is for another isomer, 2,2',4,4',6-pentachlorobiphenyl, adsorbed onto silica gel and irradiated with simulated sunlight at >290 nm for 17 hours (Freitag et al., 1985).

<u>Photooxidation half-life:</u>

Air: High: 67 days
Low: 7 days
Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 2,3,4,4',5-pentachlorobiphenyl. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 2,3,4,4',5-pentachlorobiphenyl in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 2.22×10^{-6} mm Hg (Neely and Blau, 1985).

Air: High: 34 days
Low: 14 days
Comment: No data were located for 2,3,4,4',5-pentachlorobiphenyl. However, the above calculated atmospheric half-lives are based on rate constants for the gas-phase reaction of 2,3,4,5,6-pentachlorobiphenyl (low $t_{1/2}$) and 2,2,3,5',6-pentachlorobiphenyl (high $t_{1/2}$) with OH radicals over the temperature range of 323-363 EK in simulated sunlight (Anderson and Hites, 1996).

Water: High: 14.5 hours
Low: 3.4 hours
Comment: No data were located for 2,3,4,4',5-pentachlorobiphenyl. However, the above half-lives are for 2,2',4,5,5'-pentachlorobiphenyl dissolved initially in hexane and acetone, diluted into distilled water and exposed for 24 hours in glass vials with diethylamine (as a sensitizer) to artificial sunlight >300 nm (low $t_{1/2}$) or to natural sunlight (high $t_{1/2}$) (Lin et al., 1995).

<u>Hydrolysis:</u>

First-order half-life: No hydrolyzable groups
Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Anderson, P.N. and Hites, R.A. OH Radical reactions: The major removal pathway for polychlorinated biphenyls from the atmosphere. Environ. Sci. Technol. 30: 1756-1763. 1996.

Freitag, D., Ballhorn, L., Geyer, H. and Korte, F. Environmental hazard profile of organic chemicals: An experimental method for the assessment of the behavior or organic chemicals in the ecosphere by means of simple laboratory tests with 14C labeled chemicals. Chemosphere. 14: 1589-1616. 1985.

Gan, D.R. and Berthouex, P.M. Disappearance and crop uptake of PCBs from sludge-amended farmland. Water Environ. Res. 66: 54-69. 1994.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Larsson, P. and Lemkemeier, K. Microbial mineralization of chlorinated phenols and biphenyls in sediment-water systems from humic and clear-water lakes. Wat. Res. 23: 1081-1085. 1989.

Lepine, F.L., Milot, S.M., Vincent, N.M. and Gravel, D. Photochemistry of higher chlorinated PCBs in cyclohexane. J. Agric. Food Chem. 39: 2053-2056. 1991.

Lin, Y., Gupta, G. and Baker, J. Photodegradation of polychlorinated biphenyl congeners using simulated sunlight and diethylamine. Chemosphere. 31: 3323-3344. 1995.

Moza, F., Scheunert, I., Klein, W. and Korte, F. Studies with 2,4',5-trichlorobiphenyl-^{14}C and 2,2',4,4',6-pentachlorobiphenyl-^{14}C in carrots, sugar beets, and soil. J. Agric. Food Chem. 27: 1120-1124. 1979.

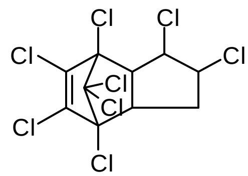
Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, FL: CRC Press. 1985.

Shiaris, M.P., Sherrill, T.W. and Sayler, G.S. Tenax-GC extraction technique for residual polychlorinated biphenyl and polyaromatic hydrocarbon analysis in biodegradation assays. Appl. Environ. Microbiol. 39: 165-171. 1980.

Chlordane

CAS Registry Number: 57-74-9

Structure:



Half-lives:

- **Air:** High: 5 days; Low: 12 hours

Comment: An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with chlordane in air is given above (Kwok and Atkinson, 1995). This compound is also expected to exist in the particulate phase in the atmosphere, which may result in longer half-lives. This compound may be susceptible to direct photolysis as shown by laboratory studies where chlordane was photolyzed as either a film or dissolved in an organic solvent (Podowski et al., 1979; Baker and Applegate, 1974).

- **Surface Water:** 239 days

Comment: Half-life given for a river die-away study (Eichelberger and Lichtenstein, 1971). Photolysis of chlordane in surface waters may occur based on photolysis studies in acetone (Podowski et al., 1979); however, this compound is expected to adsorb to particulates and suspended material in the water and may be removed from the surface where photolysis will occur.

- **Soil:** High: 2920 days (8 years); Low: 146-183 days (0.4-0.5 years)

Comment: The half-life range was chosen from several field and laboratory studies. The high $t_{1/2}$ was given for a 14-year field study in Congaree sandy loam soil (Nash and Woolson, 1967). The low $t_{1/2}$ range was given in a paper for three soils; other study details were not published (Adams, 1967).

Biodegradation half-life:

- **Aerobic soil:** 1214 days (3.3 years)

Comment: Half-life is given in a review for a field study (Rao and Davidson, 1982).

- **Aerobic soil:** 146-183 days (0.4-0.5 years)

Comment: Half-life range was given in a paper for three soils; other study details were not published (Adams, 1967).

Aerobic soil: High: 1460 days (4 years)
Low: 365 days (1 year)
Comment: Soil half-lives at pH values of 7.4 to 8.0 were published in a review; no other data was given (Matthess, 1994).

Aerobic soil: 2811 days (7.7 years)
Comment: Half-life is given for a study where soil was sampled from a site where chlordane was applied to the outer foundation of a house. 15% remained in the soil after 21 years (Bennett et al., 1974).

Aerobic soil: 1606 days (4.4 years)
Comment: Half-life is from a 12-year field study; 15% of the chlordane remained 12 years after application to turf plots (Lichtenstein, 1959).

Aerobic soil: 2920 days (8 years)
Comment: Half-life given for a field study in Congaree sandy loam soil; 40% of the initially applied chlordane remained after 14 years (Nash and Woolson, 1967).

Aerobic soil: 2074 days (5.7 years)
Comment: Half-life given for a field study in Nova Scotia; 16% of the initially applied chlordane remained after 15 years (Stewart and Chisholm, 1971). Residues were mainly alpha- and gamma-chlordane.

Aerobic water: 239 days
Comment: Half-life given for a river die-away study. 85% of the added chlordane was present after 56 days incubation (Eichelberger and Lichtenstein, 1971).

Anaerobic: High:
Low:
Comment:

Photolysis half-life:

Air: High:
Low:
Comment:

Water: High:
Low:
Comment:

Soil: High:
Low:

Comment:

Other: 23 days

Comment: Petri dishes containing 75 mg samples of chlordane were exposed to 410 hours of summer sunlight. 40% was lost; 3% of the photoisomer was produced (Benson et al., 1971).

Other: 6.8 hours

Comment: Analytical reagent grade chlordane, dissolved in acetone and dried in a thin layer in petri dishes, was placed under light banks (blacklight lamps) with a maximum UV output at 350 nm. After 24 hours, only 5.8% of the initial concentration remained while in a dark control, 67.9% remained (Baker and Applegate, 1974).

Other: High: 22 days
Low: 12 days

Comment: cis-Chlordane in acetone (in Kimax tubes) was exposed to a 30-watt source of UV light. 25% photo-cis-chlordane was produced in 216 hours (high $t_{1/2}$) and 50% in 384 hours (low $t_{1/2}$) (Podowski et al., 1979).

Other: 8 days

Comment: cis-Chlordane, exposed as a film to a 96 watt UV source, resulted in 25% isomerization to photo-cis-chlordane in 80 hours (Podowski et al., 1979).

<u>Photooxidation half-life:</u>

Air: High: 5 days
Low: 12 hours

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with chlordane. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with chlordane in air is given above (Kwok and Atkinson, 1995). This compound is expected to exist partially in the particulate phase based on a vapor pressure of 9.8×10^{-6} mm Hg (Worthing and Walker, 1983).

Water: High: 3.7 years
Low: 47 days

Comment: A rate constant of 6 to $170 \times 10^{+8}$ $M^{-1}s^{-1}$ was measured for the reaction of toxaphene with hydroxyl radicals in aqueous solution (Haag and Yao, 1992). Based on an average concentration of hydroxyl radicals found in natural water (1×10^{-17} M hydroxyl radicals), the measured half-lives were determined.

Hydrolysis:

● **First-order half-life:** >197000 years

Comment: Based upon base rate constant ($4.3X10^{-3}$ M^{-1} hr^{-1}) at pH 7 and 25 EC (Ellington et al., 1987).

● **Acid rate constant:**

Comment:

● **Base rate constant:** $4.3x10^{-3}$ M^{-1} hr^{-1}

Comment: At pH 9 and 25 EC (Ellington et al., 1987).

References:

Adams, R.S. Jr. The fate of pesticide residues in soil. J. Minn. Acad. Sci. 34: 44-48. 1967.

Baker, R.D. and Applegate, H.G. Effect of ultraviolet radiation on the persistence of pesticides. Tex. J. Sci. 25: 53-59. 1974.

Bennett, G.W., Ballee, D.L., Hall, R.C., Fahey, J.E., Butts, W.L. and Osmun, J.V. Persistence and distribution of chlordane and dieldrin applied as termiticides. Bull. Environ. Contam. Toxicol. 11: 64. 1974.

Benson, W.R., Lombardo, P., Ergy, I.J., Ross, R.D. Jr. and Barron, R.P. Chlordane and photoalteration products: their preparation and identification. J. Agric. Food Chem. 19: 857-862. 1971.

Eichelberger, J.W. and Lichtenberg, J.J. Persistence of pesticides in river water. Environ. Sci. Technol. 5: 541-544. 1971.

Ellington, J.J., Stancil, F.E., Payne, W.D., and Trusty, C. Measurement of hydrolysis rate constants for evaluation of hazardous waste land disposal. Volume 2. Data on 54 chemicals. U.S. EPA-600/53-87-/019. Washington, DC: USEPA. 1987.

Haag, W.R. and Yao, C.C.D. Rate constants for reaction of hydroxyl radicals with several drinking water contaminants. Environ. Sci. Technol. 26: 1005-1013. 1992.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lichtenstein, E.P. Factors affecting insecticide persistence in various soils. Pest Control. 27: 40-42.

1959.

Matthess, G. Fate of pesticides in aquatic environments. In: Chemistry of Plant Protection. Berlin, Germany: Springer-Verlag. 9(Pesticides in Ground and Surface Water): 191-246. 1994.

Nash, R.G. and Woolson, E.A. Persistence of chlorinated hydrocarbon insecticides in soils. Science. 157: 924-927. 1967.

Podowski, A.A., Banerjee, B.C., Feroz, M., Dudek, M.A., Willey, R.L. and Khan, M.A.Q. Photolysis of heptachlor and cis-chlordane and toxicity of their photoisomers to animals. Arch. Environ. Contam. Toxicol. 8: 509-518. 1979.

Rao, P.S.C. and Davidson, J.M. Retention and transformation of selected pesticides and phosphorus in soil-water systems.: a critical review. EPA-600/S3-82-060. Athens, GA: U.S. EPA. 1982.

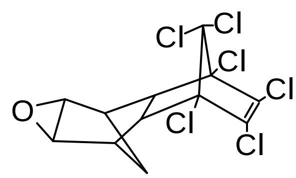
Stewart, D.K.R. and Chisholm, D. Long-term persistence of BHC, DDT, and chlordane in a sandy loam soil. Can. J. Soil Sci. 61: 379-383. 1971.

Worthing, C.R. and Walker, S.B. Pesticide Manual. 7th Edition. British Crop Protection Council. Lavenham, Suffolk, England: Lavenham Press Ltd. 1983.

Dieldrin

CAS Registry Number: 60-57-1

Structure:



Half-lives:

- **Air:** High: 30 days
  Low: 3 days

Comment: Based upon an estimated rate constant for the reaction of dieldrin with hydroxyl radicals in air (Kwok and Atkinson, 1995). This compound is also expected to exist in the particulate phase in the atmosphere, which may result in longer half-lives. Dieldrin may be susceptible to direct photolysis based on results showing photolysis in aqueous solution (Callahan et al., 1979).

- **Surface Water:** >56 days

Comment: No biodegradation was reported in a river water die-away test run for 56 days (Eichelberger and Lichtenberg, 1971). Photolysis in surface waters may occur (Callahan et al., 1979); however, this compound is expected to adsorb to sediment and particulate material in water and may be removed from the surface.

- **Soil:** High: 1080 days (3 years)
  Low: 175 days

Comment: Based upon non-acclimated aerobic soil grab data (low $t_{1/2}$; Castro and Yoshida, 1971) and a reported half-life in soil based on field data (high $t_{1/2}$: Kearney et al., 1969).

Biodegradation half-life:

- **Aerobic soil:** High: 1080 days (3 years)
  Low: 175 days

Comment: Based upon non-acclimated aerobic soil grab data (low $t_{1/2}$: Castro and Yoshida, 1971) and a reported half-life in soil based on field data (high $t_{1/2}$: Kearney et al., 1969).

- **Aerobic water:** >56 days

Comment: No biodegradation was reported in a river water die-away test run for 56 days (Eichelberger and Lichtenberg, 1971).

- **Anaerobic:** High:
  Low:

Comment:

Photolysis half-life:

- **Air:**

Comment: A laboratory study showed that dieldrin was photolyzed in the vapor phase using a sunlamp. Photodieldrin was the only photoproduct. No data are available to determine the rate of this reaction (Callahan et al., 1979).

- **Water:** High: 201 days
  Low: 145 days

Comment: Photodieldrin was formed by exposure of dieldrin to sunlight for 3 weeks (high $t_{1/2}$) and 2 months (low $t_{1/2}$) (Benson et al., 1971).

- **Water:** High: 63 days
  Low: 54 days

Comment: A saturated solution of dieldrin in distilled water was exposed to sunlight for 3 months. Photodieldrin was the major photoproduct. The half-life was calculated from the concentration of dieldrin in a dark control (high $t_{1/2}$) and from a mass balance (low $t_{1/2}$) (Callahan et al., 1979).

- **Soil:** High:
  Low:

Comment:

Photooxidation half-life:

- **Air:** High: 30 days
  Low: 3 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with dieldrin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with dieldrin in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 5.89×10^{-6} mm Hg (Grayson and Fosbraey, 1982).

- **Water:** High:
  Low:

Comment:

Hydrolysis:

- **First-order half-life:** 10.5 years

Comment: Based upon a first order rate constant (7.5×10^{-6} hr^{-1}) at pH 7 and 25EC (Ellington et al., 1987).

Acid rate constant:
Comment:

Base rate constant:
Comment:

<u>References:</u>

Benson, W.R. Photolysis of solid and dissolved dieldrin. J. Agric. Food Chem. 19: 66-72. 1971.

Callahan, M.A., Slimak, M.W., Gabel, N.W., May, I.P., Fowler, C.F., Freed, J.R., Jennings, P., Durfee, R.L., Whitmore, F.C., Maestri, B., Mabey, W.R., Holt, B.R. and Gould, C. Water-related environmental fate of 129 priority pollutants. Volume I: Introduction and technical background, metals and inorganics, pesticides and PCBs. EPA-440/4-79-029a. U.S. EPA, Washington, DC. 1979.

Castro, T.F. and Yoshida, T. Degradation of organochlorine insecticides in flooded soils in the Phillippines. J. Agric. Food Chem. 19: 1168-1170. 1971.

Eichelberger, J.W. and Lichtenberg, J.J. Persistence of pesticides in river water. Environ. Sci. Technol. 5: 541-544. 1971.

Ellington, J.J., Stancil, F.E. and Payne, W.D. Measurement of hydrolysis rate constants for evaluation of hazardous waste land disposal. Volume 1. Data on 32 chemicals. U.S. EPA-600/3-86-043. NTIS PB87-140 349/GAR. 1987.

Grayson, B.T. and Fosbraey, L.A. Determination of the vapour pressure of pesticides. Pestic. Sci. 13: 269-278. 1982.

Kearney, P.C., Nash, R.G. and Isensee, A.R. Persistence of pesticides in soil. Chemical Fallout: Current Research on Persistent Pesticides. Miller, M.W. and Derg, C.C., Eds. Springfield, IL: Charles C. Thomas. Chpt.3., pp. 54-67. 1969.

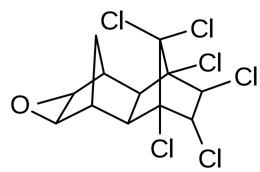
Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Maule, A., Plyte, S. and Quirk, A.V. Dehalogenation of organochlorine insecticides by mixed anaerobic microbial populations. Pestic. Biochem. Physiol. 277: 229-236. 1987.

Endrin

CAS Registry Number: 72-20-8

Structure:



Half-lives:

- **Air:** High: 3 days
  Low: 7 hours

Comment: Based upon an estimated rate constant for the reaction of endrin with hydroxyl radicals (Kwok and Atkinson, 1995). This compound is also expected to exist in the particulate phase in the atmosphere, which may result in longer half-lives. Direct photolysis may occur based on laboratory studies showing that endrin dried onto glass disks was photodegraded (Burton and Pollard, 1974).

- **Surface Water:** >112 days

Comment: No biodegradation of endrin was measured in natural water over 112 days (Sharom et al., 1980). Photolysis in surface waters may occur; however, this compound is expected to adsorb to sediment and particulate material in water and may be removed from the surface.

- **Soil:** High: 4300 days
  Low: 333 days

Comment: Range of half-lives from several aerobic soil studies (high $t_{1/2}$ from Laskowski et al., 1983; low $t_{1/2}$ from Castro and Yoshida, 1971).

Biodegradation half-life:

- **Aerobic soil:** 4300 days

Comment: Information from a review, original paper not in XREF (Laskowski et al., 1983).

- **Aerobic soil:** 3972 days

Comment: The $t_{1/2}$ is given for a 14-year field study which used two soil concentrations (Nash and Woolson, 1967).

- **Aerobic soil:** 462 days

Comment: The $t_{1/2}$ is given for a field study under non-flooded conditions (Rao and Davidson, 1982). Information from a review; original paper not in XREF.

Aerobic soil: 333 days

Comment: Endrin was degraded in only one of four soils treated under upland conditions for 2 months (Castro and Yoshida, 1971).

Aerobic water: >56 days

Comment: No biodegradation of endrin was measured over 56 days during a river die-away test (Eichelberger and Lichtenberg, 1971).

Aerobic water: >112 days

Comment: No biodegradation of endrin was measured in natural water over 112 days (Sharom et al., 1980).

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Other: High: 1.8 days
Low: 0.77 days

Comment: Endrin which had been dried onto a glass dish was exposed to a light bank with a maximum UV output at 350 nm (Baker and Applegate, 1974). Net primary and secondary peak losses were 32.3% (high $t_{1/2}$) and 59.4% (low $t_{1/2}$), respectively, over 24 hours irradiation.

Other: High: ~17 days
Low: ~7 days

Comment: Endrin was dried onto individual glass disks and exposed to natural sunlight for 20 days in June (low $t_{1/2}$) and 30 days in October (high $t_{1/2}$) (Burton and Pollard, 1974). The main photoproduct was the pentacyclic ketone. Endrin aldehyde was also present.

Photooxidation half-life:

- **Air:** High: 3 days
  Low: 7 hours

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with endrin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with endrin in air is given above (Kwok and Atkinson, 1995). However, this compound is also expected to exist partially in the particulate phase based on a vapor pressure of $3x10^{-6}$ mm Hg (Nash, 1983).

- **Water:** High:
  Low:

Comment:

Hydrolysis:

- **First-order half-life:**

Comment: Endrin added to sterile distilled water was not degraded over 112 days (Sharom et al., 1980).

- **Acid rate constant:**

Comment:

- **Base rate constant:**

Comment:

References:

Baker, R.D. and Applegate, H.G. Effect of ultraviolet radiation on the persistence of pesticides. Tex. J. Sci. 25: 53-59. 1974.

Burton, W.B. and Pollard, G.E. Rate of photochemical isomerization of endrin in sunlight. Bull. Environ. Contam. Toxicol. 12: 113-116. 1974.

Castro, T.F. and Yoshida, T. Degradation of organochlorine insecticides in flooded soils in the Philippines. J. Agric. Food Chem. 19: 1168-1170. 1971.

Eichelberger, J.W. and Lichtenberg, J.J. Persistence of pesticides in river water. Environ. Sci. Technol. 5: 541-544. 1971.

Laskowksi, D.A., Swann, R.L., McCall, P.J. and Bidlack, H.D. Soil degradation studies. Res. Rev. 85: 127-147. 1983.

Nash, R.G. and Woolson, E.A. Distribution of chlorinated insecticides in cultivated soil. Science. 157: 924-927. 1967.

Nash, R.G. Comparative volatilization and dissipation rates of several pesticides from soil. J. Agric. Food Chem. 31: 210-217. 1983.

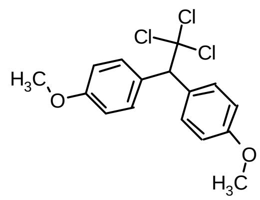
Rao, P.S.C. and Davidson, J.M. Retention and transformation of selected pesticides and phosphorus in soil-water systems: a critical review. EPA-600/S3-82-060. Athens, GA: U.S.EPA. 1982.

Sharom, M.S., Miles, J.R.W., Harris, C.R. and McEwen, F.L. Persistence of 12 insecticides in water. Wat. Research. 54: 1089-1093. 1980.

Methoxychlor

CAS Registry Number: 72-43-5

Structure:



Half-lives:

- **Air:** High: 12 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of methoxychlor with hydroxyl radicals (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. Methoxychlor may be susceptible to direct photolysis based on laboratory study results in water (Wolfe et al., 1976; Zepp et al., 1976).

- **Surface Water:** High: 15.2 days
  Low: 5 days

Comment: Range of half-lives given for the biodegradation of methoxychlor in water. High $t_{1/2}$ from a sediment:water mixture (Cripe et al., 1987); low $t_{1/2}$ from a water die-away study (Paris and Rogers, 1986). Photolysis of methoxychlor may occur based on laboratory studies in water (Zepp et al., 1976; van Noort et al., 1988). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

- **Soil:** High: 136 days
  Low: 81 days

Comment: Range of half-lives determined from a soil die-away test using 4 different soils (Castro and Yoshida, 1971). However, in a second die-away test measuring the mineralization of methoxychlor, the rate of CO_2 production was very slow. Over 410 days, less than 0.4% of the radioactive label was recovered as $^{14}CO_2$ (Fogel et al., 1982). Photolysis on soil surfaces may occur based on laboratory studies in water (Wolfe et al., 1976; Zepp et al., 1976; van Noort et al., 1988).

Biodegradation half-life:

- **Aerobic soil:**

Comment: In a soil die-away test using radiolabeled methoxychlor, 0.09% of the radioactive label was released as $^{14}CO_2$ over 100 days; over 410 days, less than 0.4% of the radioactive label was recovered as $^{14}CO_2$ (Fogel et al., 1982).

Aerobic soil: High: 136 days
Low: 81 days

Comment: Range of half-lives determined from a soil die-away test using 4 different soils (Castro and Yoshida, 1971).

Aerobic water: 365 hours (15.2 days)

Comment: Half-life determined based on a water/sediment system, corrected for adsorption (Cripe et al., 1987).

Aerobic water: High: 213 days
Low: 17 days

Comment: Half-lives given for shake-flask tests completed in estuarine water only (high $t_{1/2}$) or in a water:sediment mixture (low $t_{1/2}$) (Walker et al., 1988).

Aerobic water: High: 29 days
Low: 5 days

Comment: Half-life range given for unamended river die-away tests completed in 4 different natural waters (Paris and Rogers, 1986).

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High: 86.3 days
Low: 12.5 days

Comment: Scientific judgement based upon measured photolysis rates in distilled water under midday summer sunlight (low $t_{½}$) (Wolfe et al., 1976); high $t_{½}$ based upon measured photolysis rates in distilled water under midday summer sunlight (Zepp et al., 1976) and adjusted for approximate winter sunlight intensity (Lyman et al., 1982). 1,1-bis(p-methoxyphenyl)-2,2-dichloroethylene was reported as the major reaction product of photolysis in distilled water (Wolfe et al., 1976).

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 12 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with methoxychlor. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with methoxychlor in air is given above (Kwok and Atkinson, 1995). This compound is also expected to exist partially in the particulate phase based on a vapor pressure of $2.58x10^{-6}$ mm Hg (Neely and Blau, 1985).

Water: High: 5.4 hours
Low: 2.2 hours

Comment: Based upon measured photooxidation in river water exposed to midday May sunlight (Zepp et al., 1976). Two other river water samples showed no degradation in 2 hours.

Water: >6 hours

Comment: Methoxychlor was irradiated at 350 nm in deionized water plus humic acids. No degradation was seen over a 6 hour irradiation period (van Noort et al., 1988).

Water: 40 days

Comment: A rate constant of $2x10^{+10}$ $M^{-1}s^{-1}$ was measured for the reaction of methoxychlor with hydroxyl radicals in aqueous solution (Haag and Yao, 1992). The measured half-life was determined based on an average concentration of hydroxyl radicals found in natural water ($1x10^{-17}$ M hydroxyl radicals).

Hydrolysis:

First-order half-life: 383 days

Comment: Half-life at pH 7 and 25EC. Rate constant is 0.657 $year^{-1}$. Based upon neutral- and base-catalyzed hydrolysis rate constants (Kollig et al., 1987). At pH 7, anisoin and anisil are the major hydrolysis products.

Acid rate constant: 0.0 M^{-1} $year^{-1}$

Comment: Based on a study by Kollig et al., 1987.

Base rate constant: $1.23X10^{4}$ M^{-1} $year^{-1}$

Comment: Half-life was 324 days at pH 9 and 25EC, based upon neutral- and base-catalyzed hydrolysis rate constants (Kollig et al., 1987). The major reaction product at pH 13 is 1,1-bis(p-methoxyphenyl)-2,2-dichloroethylene (Wolfe et al., 1976).

References:

Castro, T.F. and Yoshida, T. Degradation of organochlorine insecticides in flooded soils in the Philippines. J. Agric. Food Chem. 19: 1168-1170. 1971.

Cripe, C.R., Walker, W.W., Pritchard, P.H. and Bourquin, A.W. Shake-flask test for estimation of biodegradability of toxic organic substances in the aquatic environment. Ecotox. Environ. Safety. 14: 239-251. 1987.

Fogel, S., Lancione, R.L. and Sewall, A.E. Enhanced biodegradation of methoxychlor in soil under enhanced environmental conditions. Appl. Environ. Microbiol. 44: 113-20. 1982.

Haag, W.R. and Yao, C.C.D. Rate constants for reaction of hydroxyl radicals with several drinking water contaminants. Environ. Sci. Technol. 26: 1005-1013. 1992.

Kollig, H.P., Ellington, J.J., Hamrick, K.J., Jafverts, C.T., Weber, E.J. and Wolfe, N.L. Hydrolysis rate constants, partition coefficients, and water solubilities for 129 chemicals. A summary of fate constants provided for the concentration-based Listing Program, 1987. Athens, GA: USEPA. Environ. Res. Lab., Off. Res. Devel. Prepublication. 1987.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lyman, W.J., Reele, W.F. and Rosenblatt, D.H. Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds. McGraw-Hill. New York, NY. pp. 960. 1982.

Neely, W.B. and Blau, G.E. Environmental exposure from chemicals. Volume 1. Boca Raton, LA: CRC Press. 1985.

Paris, D.F. and Rogers. J.E. Kinetic concepts for measuring microbial rate constants: effects of nutrients on rate constants. Appl. Environ. Microbiol. 51: 221-225. 1986.

Van Noort, P., Smit, R., Zwaan, E. and Zijlstra, J. Pitfalls in the aquatic photochemistry testing of chlorinated aromatic compounds. Chemosphere. 17: 395-398. 1988.

Walker, W.W., Cripe, C.R., Pritchard, P.H. and Bourquin, A.W. Biological abiotic degradation of xenobiotic compounds in in vitro estuarine water and sediment/water systems. Chemosphere. 17: 2255-2270. 1988.

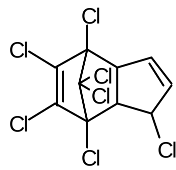
Wolfe, N.L., Zepp, R.G., Baughman, G.L., Fincher, R.C. and Gordon, J.A. Chemical and photochemical transformation of selected pesticides in aquatic environments. U.S. EPA-600/3-76-067. U.S. EPA, Athens, GA. 153 pp. 1976.

Zepp, R.G., Wolfe, N.L., Gordon, J.A. and Fincher, R.C. Light-induced transformation of methoxychlor in aquatic systems. J. Agric. Food Chem. 24: 727-33. 1976.

Heptachlor

<u>CAS Registry Number:</u> 76-44-8

<u>Structure:</u>



<u>Half-lives:</u>

- **Air:** High: 10.5 hours; Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of heptachlor with hydroxyl radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the atmosphere, which may result in longer half-lives. Heptachlor may be susceptible to direct photolysis based on laboratory studies showing its photolytic degradation as a film (Callahan et al., 1979).

- **Surface Water:** High: 129.4 hours (5.4 days); Low: 23.1 hours

Comment: Based upon experimental hydrolysis half-lives (low $t_{1/2}$: Kollig et al., 1987; high $t_{1/2}$: Chapman and Cole, 1982). Photolysis of heptachlor on the water surface may occur based on laboratory results (Callahan et al., 1979); however, this compound is expected to adsorb to particulate matter and may be removed from the surface where photolysis occurs.

- **Soil:** High: 4 years; Low: 8.3 days

Comment: Based upon data from an aerobic grab sample study (low $t_{1/2}$: Diaz Diaz et al., 1995) and a 14-year field study (high $t_{1/2}$: Nash and Woolson, 1967).

<u>Biodegradation half-life:</u>

- **Aerobic soil:** High: 68 days; Low: 56 days

Comment: Based upon unacclimated aerobic soil grab sample data collected for 4 soils over 90 days (Castro and Yoshida, 1971).

- **Aerobic soil:** High: 222 days; Low: 8.3 days

Comment: Heptachlor was added to an organic-rich orchard soil (high $t_{1/2}$) and a Pliocene sand (low $t_{1/2}$) and incubated in a greenhouse at 23-26 EC for 50 days; half-lives represent data corrected for volatilization (Diaz Diaz et al., 1995).

Aerobic soil: High: 4 years
Low: 2 years

Comment: Based on the disappearance of 100 (high $t_{1/2}$) and 50 ppm (low $t_{1/2}$) heptachlor in a 14-year field study in sandy loam soil (Nash and Woolson, 1967).

Aerobic water: 3.5 days

Comment: In a river die-away test, 75 and 100% of the initial heptachlor in raw water in capped glass jars under sunlight had disappeared after 1 and 2 weeks, respectively; degradation products were 1-hydroxy chlordene and heptachlor epoxide (Eichelberger and Lichtenberg, 1971).

<u>Photolysis half-life:</u>

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Other:

Comment: Heptachlor film exposed to artificial light >290 nm produced heptachlor epoxide and dechlorinated heptachlor isomers; heptachlor film exposed to sunlight over 4 months photolyzed (Callahan et al., 1979).

Other:

Comment: After 32 hours of exposure to artificial sunlight >300 nm, heptachlor in acetone photolyzed predominantly to photoheptachlor (Benson et al., 1971).

<u>Photooxidation half-life:</u>

Air: High: 10.5 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with heptachlor. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with heptachlor in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of $4x10^{-4}$ mm Hg (Worthing and Walker, 1983).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: 23.1 hours

Comment: Based upon reported rate constant that is independent of pH ($2.97x10^{-2}$ hr^{-1}) at pH 7 and 25 EC (Kollig et al., 1987).

First-order half-life: 5.4 days

Comment: Based upon reported rate constant ($5.36x10^{-3}$ hr^{-1}) at pH 4.5 and 25 EC (Chapman and Cole, 1982).

Acid rate const $(M(H+)-hr)^{-1}$:

Comment:

Base rate const $(M(OH-)-hr)^{-1}$:

Comment:

References:

Benson, W.R., Lombardo, P., Egry, I.J., Ross, R.D., Barron, R.P., Mastbrook, D.W. and Hansen, E.A. Chordane photoalteration products: Their preparation and identification. J. Agric. Food. Chem. 19: 857-862. 1971.

Callahan, M.A., Slimak, M.W., Gabel, N.W., May, I.P., Folwer, C.R., Freed, J.R., Jennings, P., Durfee, R.L., Whitmore, F.C., Maestri, B. et al. Water-related environmental fate of 129 priority pollutants - Volume 1. USEPA-440/4-79-029a. Washington, DC. U.S. EPA. 1979.

Castro, T.F. and Yoshida, T. Degradation of organochlorine insecticides in flooded soils in the Phillippines. J. Agric. Food Chem. 19: 1168-1170. 1971.

Chapman, R.A. and Cole, C.M. Observations on the influence of water and soil pH on the persistence of insecticides. J. Environ. Sci. Health. B17: 487. 1982.

Diaz Diaz, R., Gaggi, C., Sanchez-Hernandez, J.C. and Bacci, E. The role of soil and active ingredient properties in degradation of pesticides: A preliminary assessment. Chemosphere. 30: 2375-2386. 1995.

Eichelberger, J.W. and Lichtenberg, J.J. Persistence of pesticides in river water. Environ. Sci. Technol. 56: 541-544. 1971.

Kollig, H.P., Ellington, J.J., Hamrick, K.J., Jafverts, C.T., Weber, E.J. and Wolfe, N.L. Hydrolysis rate constants, partition coefficients, and water solubilities for 129 chemicals. A summary of fate constants provided for the concentration-based Listing Program, 1987. Athens, GA: USEPA. Environ. Res. Lab., Off. Res. Devel. Prepublication. 1987.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

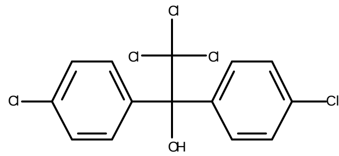
Nash, R.G. and Woolson, E.A. Persistence of chlorinated hydrocarbon insecticides in soils. Science. 157: 924-927. 1967.

Worthing, C.R. and Walker, S.B. Pesticide Manual, 7th Edition. British Crop Protection Council. Lavenham Suffolk, England: Lavenham Press, Ltd. 1983.

Dicofol

CAS Registry Number: 115-32-2

Structure:



Half-lives:

- **Air:** High: 8 days
  Low: 19 hours

Comment: Based upon an estimated rate constant for the reaction of dicofol with hydroxyl radicals in air (Kwok and Atkinson, 1995). This compound is expected to exist mainly in the particulate form in the atmosphere, which may result in longer half-lives. Dicofol may be susceptible to direct photolysis based on results showing photolysis on glass slides (Chen et al., 1984).

- **Surface Water:** High: 8.2 days
  Low: 13 hours

Comment: Half-lives for the alkaline hydrolysis of dicofol to 4,4'-dichlorobenzophenone (DBP) in aqueous solutions at pH 7.5, in filtered (high $t_{1/2}$) and unfiltered (low $t_{1/2}$) river water (Walsh and Hites, 1979). Photolysis in surface waters may occur based on laboratory experiments on glass slides (Chen et al., 1984); however, this compound is expected to adsorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** High: 348 days
  Low: 259 days

Comment: Based on an open bottle with mixed soil in a room and an open bottle with surface soil outdoors, respectively (Matsui et al., 1977). Hydrolysis in moist soils based on results in aqueous solution (Walsh and Hites, 1979) and photolysis on soil surfaces based on laboratory results on glass slides (Chen et al., 1984) may occur.

Biodegradation half-life:

- **Aerobic soil:** High: 348 days
  Low: 259 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were approximated from a 300 day open bottle with mixed soil, in a room and 300 day open bottle with surface soil, outdoors, respectively (Matsui et al., 1977). Hydrolysis may also be a loss mechanism in moist soils.

- **Aerobic soil:**

Comment: In the soils of 2 orchards treated with DDT and dicofol between 1946 and 1967, concentrations of dicofol and its metabolite, DBP were found to have increased, while the concentrations of DDT and its metabolites decreased (Kiigemagi and Terriere, 1972). It was suggested that either these compounds are more stable than DDT or that they are metabolites or degradation products of DDT.

Aerobic water: High:
Low:
Comment:

Anaerobic: High:
Low:
Comment:

Photolysis half-life:

Air: High:
Low:
Comment:

Water: High:
Low:
Comment:

Soil: High:
Low:
Comment:

Other: 6 hours
Comment: Half-life for direct photolysis for thin films of dicofol on glass slides exposed to a light source with a maximum output at 300 nm (Chen et al., 1984).

Other: 359 days
Comment: Half-life for direct photolysis of dicofol on Pyrex-filtered apple pomace exposed to UV irradiation greater than 290 nm for 13 days (Archer, 1974).

Photooxidation half-life:

Air: High: 8 days
Low: 18 hours
Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with dicofol. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the

reaction of hydroxyl radicals with dicofol in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of $1.21x10^{-8}$ mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: High: 8.2 days
Low: 13 hours

Comment: Half-lives for the alkaline hydrolysis of dicofol to 4,4'-dichlorobenzophenone (DBP) in aqueous solutions at pH 7.5, in filtered (high $t_{1/2}$) and unfiltered (low $t_{1/2}$) river water (Walsh and Hites, 1979). The percent hydrolysis conversions of dicofol to DBP for 2 trials in filtered Charles River water at pH 7.5 in 24 hours 94% and 88% percent conversion to DBP and 60% and 28% percent dicofol recovery (half-lives of 1.4 days and 13 hours, respectively). The percent hydrolysis conversions of dicofol to DBP for 2 trials in filtered Charles River water at pH 7.5 in 24 hours were 58% and 47% percent conversion to DBP and 36% and 43% percent dicofol recovery (half-lives of 16 hours and 8.2 days, respectively). The conversion to DBP is greater for the filtered water and may indicate that in the unfiltered samples, some of the soluble dicofol adsorbs onto suspended particulates. Poor recovery for both the filtered and unfiltered samples was noted.

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Archer, T.E. The effect of ultraviolet radiation filtered through Pyrex glass upon residues of dicofol (kelthane; 1,1'-bis-(p-chlorophenyl) 2,2,2-trichloroethanol) on apple pomace. Bull. Environ. Contam. Toxicol. 12: 202-203. 1974.

Chen, Z.M., Zabik, M.J. and Leavitt, R.A. Comparative study of thin film photodegradative rates for 36 pesticides. Ind. Eng. Chem. Prod. Res. Dev. 23: 5-11. 1984.

Kiigemagi, U. and Terriere, L.C. Persistence of DDT in orchard soils. Bull. Environ. Contam. Toxicol. 7: 348-352. 1972.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Matsui, M., Matano, O. and Goto, S. Disappearance of dicofol and chlorthiamid in soil under various test conditions. J. Pest. Sci. 2: 169-172. 1977.

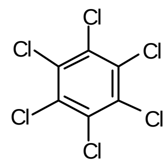
Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, Fla: CRC Press. 245pp. 1985.

Walsh, P.R. and Hites, R.A. Dicofol solubility and hydrolysis in water. Bull. Environ. Contam. Toxicol. 22: 305-311. 1979.

Hexachlorobenzene

CAS Registry Number: 118-74-1

Structure:



Half-lives:

- **Air:** High: 1582 days (4.3 years)
  Low: 158 days

Comment: Based upon an estimated rate constant for the reaction of hexachlorobenzene with hydroxyl radicals in the vapor phase (Kwok and Atkinson, 1995). This compound is also expected to exist partially in the particulate phase in the atmosphere, which may result in longer half-lives. Hexachlorobenzene may be susceptible to direct photolysis based on laboratory studies showing its photolytic degradation in aqueous solution (Hirsch and Hutzinger, 1989; Sugiura et al., 1984; Choudhry et al., 1986).

- **Surface Water:**

Comment: Data on the aerobic biodegradation of hexachlorobenzene in water were not located. Based on soil biodegradation data, this compound is expected to be persistent (Beck and Hansen, 1974; Isensee et al., 1976). An aquatic ecosystem study shows that hexachlorobenzene will be mainly adsorbed onto particulate matter in the water and transported to the bottom sediment. After 145 weeks (2.8 years), a considerable concentration of hexachlorobenzene remained (10-20%) in the upper sediment layers (0-10 cm) (Schauerte et al., 1982). Photolysis of hexachlorobenzene on the water surface may occur based on laboratory results (Hirsch and Hutzinger, 1989; Sugiura et al., 1984); however, as this compound is expected to adsorb to particulate matter, it may be removed from the surface where photolysis occurs.

- **Soil:** High: 2089 days (5.7 years)
  Low: 969 days (2.7 years)

Comment: Half-lives reported above are from non-acclimated aerobic soil grab sample data, two replicates (Beck and Hansen, 1974). Slow photolysis on soil surfaces may occur as well based on laboratory studies showing photolysis of hexachlorobenzene in aqueous solution (Hirsch and Hutzinger, 1989; Sugiura et al., 1984; Choudhry et al., 1986).

Biodegradation half-life:

- **Aerobic soil:** High: 2089 days (5.7 years)
  Low: 969 days (2.7 years)

Comment: Half-lives reported above are from non-acclimated aerobic soil grab sample data, two replicates (Beck and Hansen, 1974).

Aerobic soil: >365 days

Comment: No biodegradation of hexachlorobenzene added to soil at concentrations from 0.1 to 100 ppm was seen over a one year period (Isensee et al., 1976).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: 70 days

Comment: Half-life was determined for hexachlorobenzene in a water:acetonitrile (4:1) solution exposed to sunlight (from May 17 to June 13 at Menlo Park, CA) (Mill and Haag, 1986). Some volatilization may have occurred.

Water: 13.6 hours

Comment: Hexachlorobenzene in an acetonitrile:water mixture was irradiated for 8 hours at wavelengths >290 nm; 33.5% loss of the parent was reported with the formation of 1,2,3,4,5-pentachlorobenzene (76.8%), 1,2,3,5-tetrachlorobenzene (1.2%), 1,2,4,5-tetrachlorobenzene (1.7%), and 1,2,4-trichlorobenzene (0.2%) (Choudhry et al., 1986).

Water: 6.17 days

Comment: First order rate constant ($1.3x10^{-6}$ sec^{-1}) reported for the photolysis of hexachlorobenzene in distilled water in a photochemical reactor equipped with mercury arc lamps (used Pyrex tubes) (Hirsch and Hutzinger, 1989).

Water: 43.7 days

Comment: Rate constant measured for hexachlorobenzene in distilled water (in a Pyrex tube) following irradiation with a mercury arc lamp. This was used to calculate the above photolysis half-life for 40 EN at noon in the fall (Sugiura et al., 1984).

Soil: High:

Low:

Comment:

Other: 110 days

Comment: Half-life was determined for hexachlorobenzene in hexane exposed to sunlight (from May 17 to June 13 at Menlo Park, CA) (Mill and Haag, 1986).

Other: 11 days

Half-life was determined for hexachlorobenzene in methanol after 15 days in sunlight; pentachlorobenzene and pentachlorobenzyl alcohol were reported as reaction products (Plimmer and Klingebiel, 1976).

Other:

Comment: A layer of solid hexachlorobenzene placed on a glass plate was exposed for 5 months to ambient laboratory illumination or a sunlamp; no degradation was seen by GLC (Plimmer and Klingebiel, 1976).

Other: 38.5 days

Comment: Solid hexachlorobenzene in a borosilicate glass flask was exposed to summer sunlight for 56 days in Kochi, Japan. 64% degradation was reported with the formation of tetra- or pentachlorobiphenyls (Uyeta et al., 1976).

Photooxidation half-life:

Air: High: 1582 days (4.3 years)
Low: 158 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with hexachlorobenzene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with hexachlorobenzene in air is given above (Kwok and Atkinson, 1995). This compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 1.8×10^{-5} mm Hg (Schoene et al., 1984).

Water: 12 hours

Comment: Hexachlorobenzene in a water:acetonitrile solution with added phenol (4.911 mM/L) was photolyzed for 7 hours, at wavelengths >290 nm, giving a 32.42% loss of the initial compound. This system was used to model the reaction of hexachlorobenzene with phenolic compounds found in natural water. Reaction products include 1,2,3,4-tetrachlorodibenzofuran and trichlorodibenzofuran (Choudhry et al., 1983).

Water: 32 hours (1.3 days)

Comment: Hexachlorobenzene in a water:acetonitrile solution with acetone added as a sensitizer was photolyzed for 16 hours, at wavelengths >290 nm, giving a 29.1% loss of the initial compound. Reaction products include pentachlorobenzene (71%), 1,2,3,4-tetrachlorobenzene (0.6%), 1,2,3,5-tetrachlorobenzene (2.2%), and 1,2,4,5-tetrachlorobenzene (3.7%) (Choudhry et al., 1986).

• **Water:**	High:	32 hours	(1.3 days)
	Low:	11 hours	

Comment: Hexachlorobenzene in a water:acetonitrile solution, with either benzoic acid (low $t_{1/2}$) or benzaldehyde (high $t_{1/2}$) added as a model humic acid monomer, was photolyzed for 16 to 16.5 hours at wavelengths >290 nm, giving 64.7 and a 29.0% loss of the initial compound, respectively (Choudhry et al., 1987).

• **Water:**	High:	6.6 hours
	Low:	16 minutes

Comment: High $t_{1/2}$ is given for hexachlorobenzene in pond water. Low $t_{1/2}$ was reported for hexachlorobenzene in the presence of diphenylamine as a sensitizer (1 mg/L). Other sensitizers such as skatole, a pond protein extract, and tryptophan gave intermediate 1st order rate constants. Irradiation was conducted in Pyrex tubes in a photochemical reactor equipped with mercury arc lamps (Hirsch and Hutzinger, 1989). Pentachlorobenzene was the major reaction product.

<u>Hydrolysis:</u>

• **First-order half-life:** Not expected to be important

Comment: Zero hydrolysis was observed after 13 days for pH values of 3, 7 and 11 at 85 EC (Ellington et al., 1987).

• **Acid rate constant:**

Comment: Zero hydrolysis was observed after 13 days at 85 EC at a pH of 3 (Ellington et al., 1987).

• **Base rate constant:**

Comment: Zero hydrolysis was observed after 13 days at 85 EC at a pH of 11 (Ellington et al., 1987).

<u>References:</u>

Beck, J. and Hansen, K.E. The degradation of quintozene, pentachlorobenzene, hexachlorobenzene, and pentachloroaniline in soil. Pestic. Sci. 5: 41-8. 1974.

Choudhry, G.G., Vandenbroecke, J.A. and Hutzinger, O. Formation of polychlorodibenzofurans (PCDFs) by the photolysis of polychlorobenzenes (PCBs) in aqueous acetonitrile containing phenols.

Chemosphere. 12: 487-492. 1983.

Choudhry, G.G., Webster, G.R.B. and Hutzinger, O. Environmentally significant photochemistry of chlorinated benzenes and their derivatives in aquatic systems. Toxicol. Environ. Chem. 13: 27-84. 1986.

Choudhry, G.G., Vandenbroecke, J.A., Webster, G.R.B. and Hutzinger, O. Environmental photoincorporations of polychlorobenzenes into several humic model monomers. Chemosphere. 16: 495-504. 1987.

Ellington, J.J., Stancil, F.E., Payne, W.D., and Trusty, C. Measurement of hydrolysis rate constants for evaluation of hazardous waste land disposal. Volume 2. Data on 54 chemicals. U.S. EPA-600/53-87-/019. Washington, DC: USEPA. 1987.

Hirsch, M. and Hutzinger, O. Naturally occurring proteins from pond water sensitize hexachlorobenzene photolysis. Environ. Sci. Technol. 23: 1306-1307. 1989.

Isensee, A.R., Holden, E.R., Woolson, E.A. and Jones, G.E. Soil persistence and aquatic bioaccumulation potential of hexachlorobenzene (HCB). J. Agric. Food Chem. 24: 1210-1214. 1976.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-95. 1995.

Mill, T. and Haag, W. The environmental fate of hexachlorobenzene. In: Hexachlorobenzene Proceedings of an International Symposium. Morris, C.R. and Cabral, J.R.P. (Eds.). IARC 77: 61-66. 1986.

Plimmer, J.R. and Klingebiel, U.I. Photolysis of hexachlorobenzene. J. Agric. Food Chem. 24: 721-723. 1976.

Schauerte, W., Lay, J.P., Klein, W. and Korte, F. Long-term fate of organochlorine xenobiotics in aquatic ecosystems. Ecotox. Environ. Safety. 6: 560-569. 1982.

Schoene, K., Boehmer, W. and Steinhanses, J. Determination of vapor pressures down to 0.01 Pa by headspace gas-chromatography. Fresenius' Z. Anal. Chem. 319: 903-906. 1984.

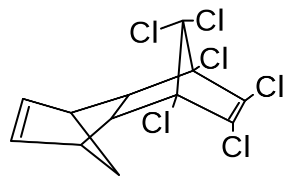
Sugiura, K., Aoki, M., Kaneko, S., Daisaku, I, Komatsu, Y, Shibuya, H., Suzuki, H. and Goto, M. Fate of 2,4,6-trichlorophenol, pentachlorophenol, p-chlorobiphenyl, and hexachlorobenzene in an outdoor experimental pond: comparison between observations and predictions based on laboratory data. Arch. Environ. Contam. Toxicol. 13: 745-758. 1984.

Uyeta, M., Tau, S., Chikasawa, K. and Mazaki, M. Photoformation of polychlorinated biphenyls from chlorinated benzenes. Nature. 264:583-584. 1976.

Aldrin

CAS Registry Number: 309-00-2

Structure:



Half-lives:

- **Air:** High: 10 hours; Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of aldrin with hydroxyl radicals in air (Kwok and Atkinson, 1995). This compound is also expected to exist in the particulate phase in the atmosphere, which may result in longer half-lives. Aldrin may be susceptible to direct photolysis based on results showing photolysis when present as a thin film on glass (Rosen, 1971) and when applied to silica gel (Korte et al., 1978).

- **Surface Water:** 24 days

Comment: Half-life was reported for a non-acclimated river die-away test (Eichelberger and Lichtenberg, 1971). Biodegradation half-lives in soil are much greater (Nash and Woolson,1967; Lichtenstein and Schulz, 1959) than those reported in water. Photolysis at the water surface is also likely to occur (Ross and Crosby, 1975; Draper and Crosby, 1984) ; however, aldrin is expected to adsorb to sediment and particulate material in water and may be removed from the surface.

- **Soil:** High: 9 years; Low: 291 days

Comment: Soil half-lives given as range from field test data (high $t_{1/2}$, Nash and Woolson, 1967; low $t_{1/2}$, Lichtenstein and Schulz, 1959).

Biodegradation half-life:

- **Aerobic soil:** High: 9 years; Low: 5 years

Comment: Half-lives determined from soil field test data. Low $t_{1/2}$ is for the application of purified aldrin while the high $t_{1/2}$ is for the application of the technical aldrin mixture (Nash and Woolson,1967).

- **Aerobic soil:** High: 630 days (1.7 years); Low: 592 days (1.6 years)

Comment: Low half-life determined from soil field test data (Lichtenstein et al., 1971). High $t_{1/2}$ is reported in a review of work by Bollen, Roberts, and Morrison, 1958 (original article not in

XREF; Wiese and Basson, 1966). Degrades relatively rapidly into dieldrin which is also persistent.

Aerobic soil: High: 113 and 390 days
Low: 72 and 291 days

Comment: High $t_{1/2}$ values are for aldrin applied to a muck soil under field conditions (113 days is the half-life for the first half year while 390 days is the half-life for the following 3 years). Low $t_{1/2}$ values are for aldrin applied to a loam soil under field conditions (72 days is the half-life for the first half year while 291 days is the half-life for the following 3 years) (Lichtenstein and Schulz, 1959).

Aerobic soil: High: 63 days
Low: 43 days

Comment: Half-lives reported as 95% confidence intervals for loss of aldrin in a sandy loam soil during a soil die-away test (McLean et al., 1988).

Aerobic water: 24 days

Comment: Half-life was reported for a non-acclimated river die-away test (low $t_{\frac{1}{2}}$: Eichelberger and Lichtenberg, 1971).

Anaerobic: High:
Low:

Comment:

<u>Photolysis half-life:</u>

Air: High:
Low:

Comment:

Water: >10 hours

Comment: Aldrin in distilled water was stable in the presence of UV light at wavelengths above 300 nm over a 10 hour period (Ross and Crosby, 1975).

Water: High: 3.1 hours
Low: 2 hours

Comment: In a 0.1% acetone solution, 20% loss of aldrin was seen in 1 hour with the formation of dieldrin. In a 0.1% acetaldehyde solution, 29% loss of aldrin was seen with the formation of dieldrin (Ross and Crosby, 1975).

Soil: High:
Low:

Comment:

✎ **Other:** High: 6.5 days
Low: 5.7 days

Comment: High $t_{1/2}$ from a study where aldrin was adsorbed onto silica gel and irradiated at wavelengths >290 nm. 53% of the initial compound remained after 6 days irradiation (Korte et al., 1978). Low $t_{1/2}$ was from a study where a thin film of aldrin was exposed to sunlight for 30 days. 2.6% remained as aldrin, 9.6% as photoaldrin, 4.1% as dieldrin, 24.1% photodieldrin (Rosen, 1971).

✎ **Other:**

Comment: The photolysis of aldrin in acetone (1 to 3 hours) at wavelengths >290 nm results in the rapid formation of photoaldrin (Mansour and Parlar, 1978).

<u>Photooxidation half-life:</u>

✎ **Air:** High: 10 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with aldrin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with aldrin in air is given above (Kwok and Atkinson, 1995). This compound is also expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 1.2×10^{-4} mm Hg (Grayson and Fosbraey, 1982).

✎ **Air:** 5.4 hours

Comment: Aldrin was irradiated in the presence of glyoxal, methylglyoxal, biacetyl, phenylglyoxal, 1-phenyl-1,2-propanedione and benzil (first 3 found in smog chamber experiments) at wavelengths >290 nm. Aldrin was converted in the presence of these "-diketones to dieldrin (Nojima and Isogami, 1993). 32% loss was reported in 3 hours for the reaction of aldrin with nitrogen dioxides in air; dieldrin was reported as the reaction product (Nojima et al., 1982).

✎ **Air:** High: 2 hours
Low: 19 minutes

Comment: No experimental data currently exist concerning the gas-phase reactions of ozone with aldrin. However, reaction with ozone is expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of ozone with aldrin in air is given (Atkinson and Carter, 1984).

✎ **Water:** 0.6 days

Comment: Half-life given for the photodegradation of aldrin in a 5 FM solution of hydrogen peroxide following 12 hours irradiation at wavelengths >285 nm. Corrected for dark control (Draper and Crosby, 1984). No degradation was seen over the same time period in distilled water only. Photoaldrin and dieldrin were formed as reaction products.

• **Water:** 3.6 days
Comment: Aldrin was added to sterilized paddy water and irradiated for 36 hours at wavelengths >300 nm. 25% of the initial aldrin was lost with the formation of dieldrin (Ross and Crosby, 1975).

Hydrolysis:

• **First-order half-life:** 760 days
Comment: Based upon a first order rate constant ($3.8x10^{-5}$ hr^{-1}) at pH 7 and 25 EC (Ellington et al., 1987). Extrapolated from data measured at 75 EC.

• **Acid rate constant:**
Comment:

• **Base rate constant:**
Comment:

References:

Atkinson, R. and Carter, W.P.L. Kinetics and mechanisms of gas-phase ozone with organic compounds under atmospheric conditions. Chem. Rev. 84: 437-470. 1984.

Draper, W.M. and Crosby, D.G. Solar photooxidation of pesticides in dilute hydrogen peroxide. J. Agric. Food Chem. 32: 231-237. 1984.

Eichelberger, J.W. and Lichtenberg, J.J. Persistence of pesticides in river water. Environ. Sci. Technol. 5: 541-544. 1971.

Ellington, J.J., Stancil, F.E. and Payne, W.D. Measurement of hydrolysis rate constants for evaluation of hazardous waste land disposal. Volume 1. Data on 32 chemicals. U.S. EPA-600/3-86-043. NTIS PB87-140 349/GAR. 1987.

Grayson, B.T. and Fosbraey, L.A. Determination of the vapour pressure of pesticides. Pestic. Sci. 13: 269-278. 1982.

Korte, F., Freitag, D., Geyer, H., Klein, W., Kraus, A.G. and Lahaniatis, E. Ecotoxicologic profile analysis: A concept for establishing ecotoxicologic priority lists for chemicals. Chemosphere. 1: 79-102. 1978.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lichtenstein, E.P. and Schulz, K.R. Persistence of some chlorinated hydrocarbon insecticides influenced by soil types, rates of application and temperature. J. Econ. Entomol. 52: 124-131. 1959.

Lichtenstein, E.P., Fuhremann, T.W. and Schulz, K.R. Persistence and vertical distribution of DDT, lindane and aldrin residues, ten and fifteen years after a single soil application. J. Agric. Food Chem. 19: 718-721. 1971.

Mansour, M. and Parlar, H. Gas chromatographic determination of several cyclodiene insecticides in the presence of polychlorinated biphenyls by photoisomerization reactions. J. Agric. Food Chem. 26: 483-485. 1978.

Maule, A., Plyte, S. and Quirk, A.V. Dehalogenation of organochlorine insecticides by mixed anaerobic microbial populations. Pestic. Biochem. Physiol. 277: 229-236. 1987.

McLean, J.E., Sims, R.C., Doucette, W.J., Caupp, C.R. and Grenney, W.J. Evaluation of mobility of pesticides in soil using US EPA methodology. J. Environ. Engineer. 114: 689-703. 1988.

Nash, R.G. and Woolson, E.A. Persistence of chlorinated hydrocarbon insecticides in soils. Science. 157: 924-927. 1967.

Nojima,K., Ohya, T., Kanno, S. and Hirobe, M. Studies on photochemical reactions of air pollutants. VIII. Photochemical epoxidation of olefins with NO_2 in a solid-gas phase system. Chem. Pharm. Bull. 30: 4500-4506. 1982.

Nojima, K. and Isogami, C. Studies on photochemical reactions of air pollutants. Photochemical epoxidation of aldrin with various "-diketones in air. Chemosphere 26: 921-928. 1993.

Rosen, J.D. Photodecomposition of organic pesticides. In: Organic Compounds in Aquatic Environments. Faust, S. (Ed.). New York, NY: Dekker Publ. Chp. 18. 1971.

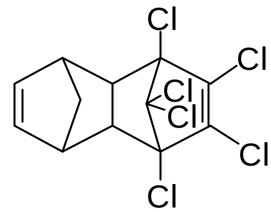
Ross, R.D. and Crosby, D.G. The photooxidation of aldrin in water. Chemosphere. 5: 277-282. 1975.

Wiese, I.H. and Basson, N.C.J. The degradation of some persistent chlorinated hydrocarbon insecticides applied to different soil types. S. Afr. J. Agric. Sci. 9: 945-969. 1966.

Isodrin

CAS Registry Number: 465-73-6

Structure:



Half-lives:

Air: High: 10 hours
Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of isodrin with hydroxyl radicals in the vapor phase (Kwok and Atkinson, 1995). This compound is expected to exist partially in the particulate form in the atmosphere, which may result in longer half-lives.

Surface Water:

Comment: Based on soil biodegradation data, this compound appears to be resistant to biodegradation (Nash and Woolson, 1967; Adams, 1967).

Soil: High: 5 years
Low: 24 days

Comment: The high $t_{1/2}$ is based upon a field study performed over a 14-year period in a Congaree sandy loam soil (Nash and Woolson, 1967) while the low $t_{1/2}$ was reported in a soil die-away test (Williams et al., 1989).

Biodegradation half-life:

Aerobic soil: 5 years

Comment: Based upon a field study performed over a 14-year period in a Congaree sandy loam soil (Nash and Woolson, 1967). There was no distinction between amount of isodrin remaining from the original application and that formed through the degradation of originally applied endrin.

Aerobic soil: High: 32 days
Low: 24 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ are calculated from mineralization data in uncontaminated and contaminated Rocky Mountain Arsenal soils, respectively (Williams et al., 1989).

Aerobic soil: High: 1 year
Low: 6 months

Comment: Half-lives were 1 year, 6 months, and 6 months for two Beltsville, Mississippi and 1 New Jersey soils, respectively (Adams, 1967). There was no differentiation between loss processes. Other study details were not published.

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 10 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with isodrin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with isodrin in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 4.4×10^{-5} mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: 46 years
Comment: Calculated half-life at 25 °C and pH 7 (Ellington, 1989).

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Adams, R.S. Jr. The fate of pesticide residues in soil. J. Minn. Acad. Sci. 34: 44-48. 1967.

Ellington, J.J. Hydrolysis rate constants for enhancing property-reactivity relationships. Report 1989, EPA/600/3-89/063: Order No. PB89-220479, 59 pp. 1989.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Nash, R.G. and Woolson, E.A. Persistence of chlorinated hydrocarbon insecticides in soils. Science. 157: 924-927. 1967.

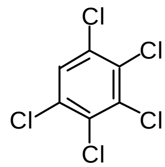
Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, Fla: CRC Press. 245pp. 1985.

Williams, R.T., Ziegenfuss, P.S. and Marks, P.J. Installation restoration program environmental technology development. Biodegradation of DIMP, dieldrin, isodrin, DBCP, and PCPMSO in Rocky Mountain Arsenal soils. Weston, Roy F., West Chester, PA. Contract DAAK11-85-D-007. NTIS/AD-A245852/9, 92 pp. 1989.

Pentachlorobenzene

CAS Registry Number: 608-93-5

Structure:



Half-lives:

- **Air:** High: 460 days
  Low: 46 days

Comment: Based upon an estimated rate constant for the reaction of pentachlorobenzene with hydroxyl radicals in air (Kwok and Atkinson, 1995). This compound is expected to exist completely in the vapor phase in the atmosphere.

- **Surface Water:**

Comment: Pentachlorobenzene is expected to be resistant to biodegradation based on a soil die-away study (Beck and Hansen, 1974) and a 49-year field study in soil (Wang et al., 1995). Photooxidation may occur on water surfaces based on laboratory results in water plus either humic acid or phenolic compounds (Van Noort et al., 1988; Choudhry et al., 1983); however, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

- **Soil:** High: >22 years
  Low: 194 days

Comment: 21% of the added pentachlorobenzene applied to field soil (sandy loam, pH 6.5) in a sludge mixture over a period of 19 years was still present 30 years following the last sludge application (high $t_{1/2}$; Wang et al., 1995). Low $t_{1/2}$ based upon the low value from aerobic soil grab sample data (Beck and Hansen, 1974).

Biodegradation half-life:

- **Aerobic soil:** High: 345 days
  Low: 194 days

Comment: Based upon non-acclimated aerobic soil grab sample data (Beck and Hansen, 1974).

- **Aerobic soil:** >22 years

Comment: 21% of the added pentachlorobenzene applied to field soil (sandy loam, pH 6.5) in a sludge mixture over a period of 19 years was still present 30 years following the last sludge application. Concentrations remaining in 1960 and 1991 were 27% and 21%, respectively, of the applied amount. Loss may be due to volatilization, photodegradation, erosion, and biodegradation (Wang et al., 1995). Half-life based on a 49-year period with a 79% loss.

Aerobic water: High:
Low:
Comment:

Anaerobic: High:
Low:
Comment:

Photolysis half-life:

Air: High:
Low:
Comment:

Water: High: >25 hours
Low: 1.3 days
Comment: No degradation was seen during the 25 hour irradiation of pentachlorobenzene in purified deionized water in a photochemical reactor equipped with 350 nm lamps (high $t_{1/2}$) (van Noort et al., 1988). Pentachlorobenzene in an acetonitrile:water mixture (3:2), irradiated for 24 hours, showed a loss of 41.2%. Reductive dechlorination was reported as the degradative pathway (Choudhry and Webster, 1986).

Water: >7 days
Comment: No degradation of pentachlorobenzene in either hexane or methanol was reported following exposure to sunlight for 7 days (Crosby and Hamadmad, 1971).

Soil: High:
Low:
Comment:

Other: >7 days
Comment: Pentachlorobenzene as a solid was irradiated at wavelengths >290 nm in an oxygen stream for 7 days. Initial weight and final weight was 64 and 62 mg, respectively, indicating that significant degradation did not occur. No mineralization products were detected (Gab et al., 1975).

Photooxidation half-life:

✎ **Air:** High: 460 days
Low: 46 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with pentachlorobenzene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with pentachlorobenzene in air is given above (Kwok and Atkinson, 1995). This compound is expected to exist completely in the vapor phase in the atmosphere based on a vapor pressure of 2.19×10^{-3} mm Hg (Mackay and Shiu, 1981).

✎ **Water:** 5 hours

Comment: Half-life given for the irradiation of pentachlorobenzene in deionized water plus humic acid (DOC=10 mg/L) in a photochemical reactor equipped with 350 nm lamps (Van Noort et al., 1988).

✎ **Water:** High: 1.1 days
Low: 22 hours

Comment: High $t_{1/2}$ is from a study in which pentachlorobenzene, in a 4:6 water:acetonitrile solution containing phenols (5 mM), was irradiated for 24 hours at wavelengths >285 nm. 46.5% disappearance was reported. Reaction products included dichlorodibenzofuran and trichlorodibenzofuran (Choudhry et al., 1983). Low $t_{1/2}$ is from a study where pentachlorobenzene was irradiated in an acetonitrile:water mixture with benzoic acid for 16.5 hours at wavelengths >290 nm. 40.3% disappearance was reported with the formation of a small quantity of polychlorinated biphenyl (Choudhry et al., 1986).

Hydrolysis:

✎ **First-order half-life:** >879 years

Comment: Based upon rate constant ($<0.9\ M^{-1}\ hr^{-1}$) extrapolated to pH 7 at 25 EC from 1% disappearance after 16 days at 85 EC and pH 9.7 (Ellington et al., 1988).

✎ **Acid rate constant:**

Comment:

✎ **Base rate constant:** $<0.9\ M^{-1}\ hr^{-1}$

Comment: Based upon 1% disappearance after 16 days at 85 EC and pH 9.7 (Ellington et al., 1988).

References:

Beck, J. and Hansen, K.E. The degradation of quintozene, pentachlorobenzene, hexachlorobenzene, and pentachloroaniline in soil. Pestic. Sci. 5: 41-48. 1974.

Choudhry, G.G., van den Broecke, J.A. and Hutzinger, O. Formation of polychlorodibenzofurans (PCDFs) by the photolyses of polychlorobenzenes (PCBzs) in aqueous acetonitrile containing phenols. 12: 487-492. 1983.

Choudhry, G.G. and Webster, G.R.B. Environmentally significant photochemistry of chlorinated benzenes and their derivatives in aquatic systems. Toxicol. Environ.Chem. 13: 27-83. 1986.

Choudhry, G.G., van den Broecke, J.A., Webster, G.R.B. and Hutzinger, O. Photochemistry of halogenated benzene derivatives: Part VII. Photoincorporations of polychlorobenzenes with humic model monomers in aqueous acetonitrile solutions. Environ. Toxicol. Chem. 5: 625-635. 1986.

Crosby, D.G. and Hamadmad, N. The photoreduction of pentachlorobenzenes. J. Agric. Food Chem. 19: 1171-1174. 1971.

Ellington, J.J., Stancil, F.E., Payne, W.D. and Trusty, C.D. Measurement of hydrolysis rate constants for evaluation of hazardous waste land disposal: Volume 3. Data on 70 chemicals (preprint). EPA/600/S3-88/028. NTIS PB88-234042/AS. 1988.

Gab, S., Nitz, S., Parlar, H. and Korte, F. Photomineralisation of certain aromatic xenobiotica. Chemosphere 4: 251-256. 1975.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29:1685-1695. 1995.

Mackay, D. and Shiu, W.Y. A critical review of Henry's law constants for chemicals of environmental interest. J. Phys. Chem. Ref. Data. 19: 1175-1799. 1981.

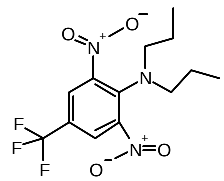
Van Noort, R., Smit, R., Zwaan, E. and Zijlstra, J. Pitfalls in the aquatic photochemistry testing of chlorinated aromatic compounds. Chemosphere 17: 395-398. 1988.

Wang, M-J., McGrath, S.P. and Jones, K.C. Chlorobenzenes in field soil with a history of multiple sewage sludge applications. Environ. Sci. Technol. 29: 356-362. 1995.

Trifluralin

CAS Registry Number: 1582-09-8

Structure:



Half-lives:

- **Air:** High: 193 minutes (3.2 hours)
  Low: 25 minutes

Comment: Range of half-lives determined in outdoor air experiments using trifluralin in the vapor phase under midday sunlight conditions in Nevada during July (low $t_{1/2}$) and October (high $t_{1/2}$) (Mongar and Miller, 1988 as reported by Grover et al., 1997). This compound is expected to partially exist in the particulate phase in the atmosphere, which may result in longer half-lives. Trifluralin may be susceptible to direct photolysis based on laboratory study results (Grover et al., 1997).

- **Surface Water:** High: 36.5 days
  Low: 4.5 days

Comment: Half-life range reported for estuarine sediment:water (high $t_{1/2}$) and estuarine water (low $t_{1/2}$) die-away studies (Walker et al., 1988). Photodegradation in surface waters may be important. However, trifluralin is expected to adsorb to sediment and particulate material in water and may be removed from the surface.

- **Soil:** High: 394 days
  Low: 99 to >190 days

Comment: Low half-life range reported in a review for the dissipation of trifluralin under field conditions in Canada using several different application rates and different soils (Grover et al., 1997). Some loss believed due to volatilization. High half-life reported in a soil die-away test (Kearney et al., 1976).

Biodegradation half-life:

- **Aerobic soil:** High: 201 days
  Low: 116 days

Comment: Half-life range given for 3 soils (a sandy loam, a loam, and a clay loam) in a 364 day die-away experiment at 22 EC and 1/3 bar moisture (as reviewed by Grover et al., 1997). Original paper (cited as Graper and Rainey, 1989a,b) not in XREF.

- **Aerobic soil:** 394 days

Comment: Parent trifluralin was the major product identified in Matapeake sandy loam soil after 7 months (69% remaining) (Kearney et al, 1976).

Aerobic soil: 182 days

Comment: Half-life determined for a 3-year field study. After 3 years, the 0-15 cm soil layer contained 43.5% of the applied radioactivity, 1.5% trifluralin, 4% extractable degradation products, and 38% soil-bound radioactive residues (Golab et al., 1979).

Aerobic soil: High: >190 days
Low: 99 days

Comment: Half-life range reported in a review for the dissipation of trifluralin under field conditions in Canada using several different application rates and different soils (Grover et al., 1997). Some loss believed due to volatilization.

Aerobic water: High: 36.5 days
Low: 8.4 days

Comment: Range of half-lives given for estuarine water:sediment die-away tests (Walker et al., 1988).

Aerobic water: High: 25 days
Low: 4.5 days

Comment: Range of half-lives given for estuarine water die-away tests (Walker et al., 1988).

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High: 193 minutes (3.2 hours)
Low: 25 minutes

Comment: Range of half-lives determined in outdoor air experiments using trifluralin in the vapor phase under midday sunlight conditions in Nevada during July (low $t_{1/2}$) and October (high $t_{1/2}$) (Mongar and Miller, 1988 as reported by Grover et al., 1997).

Water: High: 8 hours
Low: <1 hour

Comment: The low $t_{1/2}$ is given for trifluralin in distilled water exposed to sunlight (Zepp and Cline, 1977) while the high $t_{1/2}$ is from a study where trifluralin in methanol was exposed to sunlight (Plimmer and Klingebiel, 1974). Under alkaline conditions, benzimidazole was the major reaction product. Under acidic conditions, reduction of the nitro groups occurred during photolysis (Grover et al., 1997).

Water: 0.39 days

Comment: Photolysis half-life reported in water from a manufacturer study (Wauchope et al., 1991).

Soil: High: 41 days
Low: 24 days

Comment: Soil-coated TLC plates, exposed to sunlight over 7 days, reported 18.5% photodegradation of trifluralin (low $t_{1/2}$) (Parochetti and Dec, 1978) while soil treated with surface-applied trifluralin and irradiated using a xenon lamp reported 72.4% degradation over 30 days (high $t_{1/2}$) (Carpenter and Fennessey, 1988a, as reported by Grover et al., 1997).

Soil: 66 days

Comment: Photolysis half-life reported in soil from a manufacturer study (Wauchope et al., 1991).

Photooxidation half-life:

Air: High: 27 hours
Low: 3 hours

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with trifluralin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with trifluralin in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 4.85×10^{-5} mm Hg (Spencer and Cliath, 1974).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: Stable

Comment: No readily hydrolyzable functional groups. Hydrolysis studies carried out at pH 3, 6, and 9, at temperatures of 25E, 37 E, and 52 EC and at two different trifluralin concentrations showed that trifluralin was stable over 32 days. No significant loss of the parent compound was reported (Mosier and Saunders, 1978, as reported by Grover et al., 1997).

Acid rate constant:

Comment:

Base rate constant:
Comment:

References:

Golab, T., Althaus, W.A. and Wooten, H.L. Fate of [^{14}C]trifluralin in soil. J. Agric. Food Chem. 27: 163-179. 1979.

Grover, R., Wolt, J.D., Cessna, A.J. and Schiefer, H.B. Environmental fate of trifluralin. Rev. Environ. Contam. Toxicol. 153: 1-64. 1997.

Kearney, P.C., Plimmer, J.R., Wheeler, W.B. and Kontson, A. Persistence and metabolism of di-nitro aniline herbicides in soils. Pest. Biochem. Physiol. 6: 229-238. 1976.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Parochetti, J.V. and Dec. G.W. Jr. Photodecomposition of eleven dinitroanilines. Weed Sci. 26: 153-156. 1978.

Plimmer, J.R. and Klingebiel, U.I. Photochemistry of N-sec-butyl-4-tert-butyl-2,6-dinitroaniline. J. Agric. Food Chem. 22: 689-693. 1974.

Spencer, W.F. and Cliath, M.M. Factors affecting vapor loss of trifluralin from soil. J. Agric. Food Chem. 22: 987-991. 1974.

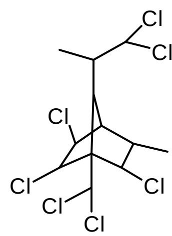
Wauchope, R.D., Butler, T.M., Hornsby, A.G., Augustijn-Beckers, P.W. and Burt, J.P. CES pesticide properties database: Soil Conservation Service/Agricultural Research Service. U.S. Department of Agriculture, South East Watershed Research Lab., Tifton, GA (http://ncsr.arsusda.gov/ppdb3//). 1991.

Walker, W.W., Cripe, C.R., Pritchard, P.H. and Bourquin, A.W. Biological abiotic degradation of xenobiotic compounds in *in vitro* estuarine water and sediment/water systems. Chemosphere. 17: 2255-2270. 1988.

Toxaphene

<u>CAS Registry Number:</u> 8001-35-2

<u>Structure:</u>



Representative structure given for T2, a toxaphene component commonly found in environmental samples.

<u>Half-lives:</u>

Air:	High:	16 days	
	Low:	19 hours	

Comment: Based upon estimated rate constants for the reaction of a hexachlorobornane and a nonachlorobornane (as representative compounds found in the toxaphene mixture) with hydroxyl radicals in air (Kwok and Atkinson, 1995). This compound is also expected to exist in the particulate phase in the atmosphere, which may result in longer half-lives. Photolysis has not been shown to be a major fate process for this mixture.

Surface Water:	High:	5 years	
	Low:	1 year	

Comment: Low $t_{1/2}$ was reported for a shallow eutrophic lake; high $t_{1/2}$ was reported for a deep, oligotrophic lake using reduction in toxicity to fish as a measurement of toxaphene loss (Terriere et al., 1966).

Soil:	High:	4015 days	(11 years)
	Low:	365 days	(1 year)

Comment: High $t_{1/2}$ given for a long-term field study (Nash and Woolson, 1967) while the low $t_{1/2}$ is reported in a review from an original study by Randolph et al., 1960 completed in Texas soils (Sanborn et al., 1977)

<u>Biodegradation half-life:</u>

Aerobic soil:	High:	4015 days	(11 years)
	Low:	365 days	(1 year)

Comment: High $t_{1/2}$ given for a long-term field study (Nash and Woolson, 1967) while the low $t_{1/2}$ is reported in a review from an original study by Randolph et al., 1960 completed in Texas soils (Sanborn et al., 1977). Persistence was measured chemically; however it has been noted that if measured by bioassay that detoxification occurs more rapidly (Hughes, 1970).

• Aerobic water: High: 5 years
Low: 1 year

Comment: Low $t_{1/2}$ was reported for a shallow eutrophic lake; high $t_{1/2}$ was reported for a deep, oligotrophic lake using reduction in toxicity to fish as a measurement of toxaphene loss (Terriere et al., 1966). It is likely that the reduction in toxicity is due to differential sorption of some compounds in the toxaphene mixture to suspended material and particulates in the water followed by sedimentation rather than biodegradation (Johnson et al., 1966). Values are not half-lives, but were reported as time required before restocking of fish could occur.

• Anaerobic: High:
Low:

Comment:

Photolysis half-life:

• Air: High:
Low:

Comment:

• Water: >833 days (>2.3 years)

Comment: Aqueous solutions were photolyzed in Pyrex cells using a mercury lamp. The rate was calculated for a light intensity of $3x10^{+13}$ photons cm^{-2} sec^{-1} from 280 to 300 nm (Wolfe et al., 1976). No change was noted in the liquid chromatographic profile during exposure.

• Soil: High:
Low:

Comment:

Photooxidation half-life:

• Air: High: 1.6 to 16 days
Low: 19 hours to 8 days

Comment: Toxaphene is a mixture of 176 to over 500 related compounds. No experimental data currently exist concerning the gas-phase reactions of the OH radical with either the mixture or the individual compounds. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with a representive hexachloro- (low $t_{1/2}$) and nonachloro- (high $t_{1/2}$) bornane in air is given above (Kwok and Atkinson, 1995). The compounds in this mixture are generally expected to exist partially in the particulate phase based on an average vapor pressure of $6.69x10^{-6}$ mm Hg (Murphy et al., 1987).

• Water:

Comment: Not readily oxidized by photochemically-generated singlet oxygen ($>37.5 in water) (Wolfe et al., 1976).

Water: High: 18.3 years
Low: 2.7 years

Comment: A rate constant of 1.2 to 8.1x10^{+8} $M^{-1}s^{-1}$ was measured for the reaction of toxaphene with hydroxyl radicals in aqueous solution (Haag and Yao, 1992). Based on an average concentration of hydroxyl radicals found in natural water (1x10^{-17} M hydroxyl radicals), the measured half-lives were determined.

Hydrolysis:

First-order half-life: >10 years

Comment: Toxaphene was stable in air-saturated dilute acidic (pH 3.7) and alkaline (pH 10.0) aqueous solutions at 65 EC for 2 days (Wolfe et al., 1976). This result was extrapolated to give the reported half-life for 25 EC and pH values from 5 to 8 (Callahan et al., 1979). These results suggest that under environmental conditions the degradation of toxaphene by oxygen, acid or alkali would not be significant (Wolfe et al., 1976).

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Callahan, M.A., Slimak, M.W., Gabel, N.W., May, I.P., Folwer, C.R., Freed, J.R., Jennings, P., Durfee, R.L., Whitmore, F.C., Maestri, B. et al. Water-related environmental fate of 129 priority pollutants - Volume 1. USEPA-440/4-79-029a. Washington, DC. U.S. EPA. 1979.

Haag, W.R. and Yao, C.C.D. Rate constants for reaction of hydroxyl radicals with several drinking water contaminants. Environ. Sci. Technol. 26: 1005-1013. 1992.

Hughes, R.A. Studies on the persistence of toxaphene in treated lakes. PhD thesis. Ann Arbor, MI: University Microfilms. 1980

Johnson, W.D., Lee, G.F. and Spyrioakis, D. Persistence of toxaphene in treated lakes. Air Water Pollut. 10: 555-560. 1966.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Murphy, T.J., Mullin, M.D. and Meyer, J.A. Equilibration of polychlorinated biphenyls and toxaphene with air and water. Environ. Sci. Technol. 21: 155-162. 1987.

Nash, R.G. and Woolson, E.A. Distribution of chlorinated insecticides in cultivated soil. Soil Sci. Soc. Amer. Proc. 32: 525-527. 1968.

Randolph, N.M., Chisholm, R.D., Koblitsky, L. and Gaines, J.C. Insecticide residues in certain Texas soils. Texas Agric. Expt. Sta. MP-477, 11 pp. (Chem. ABstr. 55: 4868a, 1961). 1960.

Sanborn, J.R., Francis, B.M. and Metcalf, R.L. The degradation of selected pesticides in soil: a review of published literature. EPA-600/9-77-022. Cincinnati, OH: U.S. EPA. 1977.

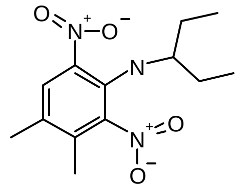
Terriere, L.C., Kiigemagi, U., Gerlach, A.R. and Borovicka, R.L. The persistence of toxaphene in lake water and its uptake by aquatic plants and animals. J. Agric. Food Chem. 14: 66-69. 1966.

Wolfe, N.L., Zepp, R.G., Baughman, G.L., Fincher, R.C. and Gordon, J.A. Chemical and photochemical transformation of selected pesticides in aquatic systems. EPA-600/3-76-067. Athens, GA: U.S. EPA. 1976.

Pendimethalin

CAS Registry Number: 40487-42-1

Structure:



Half-lives:

- **Air:** High: 21 hours; Low: 2 hours

Comment: Based upon an estimated rate constant for the reaction of pendimethalin with hydroxyl radicals (Kwok and Atkinson, 1995). However, this compound is expected to also exist partially in the particulate phase in the atmosphere, which may result in longer half-lives. Pendimethalin may be susceptible to direct photolysis based on laboratory study results (Bossan et al., 1995).

- **Surface Water:**

Comment: Based on soil data (Wauchope et al., 1991; Zimdahl et al., 1984), this compound may be resistant to biodegradation in water. Photolysis of pendimethalin may occur based on laboratory studies in water and organic solvents (Halder et al., 1989; Pal et al., 1991). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

- **Soil:** High: 1300 days (3.6 years); Low: 54 days

Comment: The half-life range was determined from the available aerobic soil biodegradation data (high $t_{1/2}$, Wauchope et al., 1991; low $t_{1/2}$, Zimdahl et al., 1984). Reaction products include N-(1-ethylpropyl)-3,4-dimethyl-2-nitrobenzene-1,6-diamine and 3,4-dimethyl-2,6-dinitroaniline (Kulshrestha and Singh, 1992). Photolysis on soil surfaces may occur based on laboratory data in soil (Halder et al., 1989).

Biodegradation half-life:

- **Aerobic soil:** 1300 days (3.6 years)

Comment: Recommended half-life value reported in the USDA Pesticide Properties database. Source listed as manufacturing data from the American Cyanamid Corporation (1990) for pendimethalin in a sand loam soil (Wauchope et al., 1991).

- **Aerobic soil:** High: 74 days; Low: 69 days

Comment: High $t_{1/2}$ (0.5 ppm) and the low $t_{1/2}$ (2 ppm) from a soil die-away study using three concentrations of pendimethalin (Barrett and Lavy, 1983; paper not currently available in XREF).

- **Aerobic soil:** 666 days (1.8 years)

Comment: Half-life value reported for a soil die-away study measuring radiolabeled CO_2 production (mineralization) (Nelson et al., 1983).

- **Aerobic soil:** High: 77 days
  Low: 54 days

Comment: Half-lives given for soil die-away tests measured at 10 EC (high $t_{1/2}$) and 30 EC (low $t_{1/2}$) and a moisture content 75% of field capacity (Zimdahl et al., 1984).

- **Aerobic soil:** High: 40.4 days
  Low: 30.8 days

Comment: Range of half-lives given for soil die-away tests conducted in 6 different soils at 25 EC (Zheng and Cooper, 1996).

- **Aerobic soil:** High: 261 days
  Low: 157 days

Comment: Half-lives reported for 479-day field studies where pendimethalin was applied at two different locations (Smith et al., 1995).

- **Aerobic water:** High:
  Low:

Comment:

- **Anaerobic:** High:
  Low:

Comment:

<u>Photolysis half-life:</u>

- **Air:**

Comment: Pendimethalin was adsorbed onto fly ash (simulating anthropogenic aerosols) and kaolin (simulating terrigenic aerosol) and irradiated with a sunlamp at wavelengths >290 nm as a model for photodegradation of this compound on particulates in the atmosphere. 70% was degraded following 30 minutes irradiation on fly ash; however, on kaolin no significant degradation was reported over 80 minutes (Bossan et al., 1995).

- **Water:**

Comment: Pendimethalin was photodegraded in both n-hexane and water following exposure to sunlight for 80 hours. Two major photoproducts were reported, one was unidentified and the other was N-propyl-3,4-dimethyl-2,6-dinitroaniline. Insufficient information was available to determine a half-life (Halder et al., 1989).

Soil:

Comment: Pendimethalin applied to a thin layer of soil and then exposed to sunlight for 30 days was photodegraded. Two major photoproducts were reported, one was unidentified and the other was N-propyl-3,4-dimethyl-2,6-dinitroaniline. Insufficient information was available to determine a half-life (Halder et al., 1989).

Other: High: 21 hours
Low: 16 hours

Comment: Half-life values given for pendimethalin in methanol exposed to wavelengths >290 nm over 6 hours at pH 5 (low $t_{1/2}$), 7 (high $t_{1/2}$), and 9 (Pal et al., 1991). At acidic pH, N-dealkylation occurs while at alkaline pH one of the NO_2 groups is replaced with an OH group.

Photooxidation half-life:

Air: High: 21 hours
Low: 2 hours

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with pendimethalin. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with pendimethalin in air is given above (Kwok and Atkinson, 1995). This compound is also expected to exist partially in the particulate phase based on a vapor pressure of $3x10^{-5}$ mm Hg (Wauchope et al., 1991).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: Stable

Comment: Based on manufacturing data from American Cyanamid Corporation (1990) (Wauchope et al., 1991).

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Barrett, M.R. and Lavy, T.L. Effects of soil water content on pendimethalin dissipation. J. Environ. Qual. 12: 504-508. 1983.

Bossan, D., Wortham, H. and Masclet, P. Atmospheric transport of pesticides adsorbed on aerosols. Chemosphere. 30: 21-29. 1995.

Halder, P., Barua, A.S., Raha, P., Biswas, B., Pal, S., Bhattacharya, A., Bedi, S. and Chowdhury, A. Studies on the photodegradation of pendimethalin in solvents and in Kalyani soil. Chemosphere. 18: 1611-1619. 1989.

Kulshrestha, G. and Singh, S.B. Influence of soil moisture and microbial activity on pendimethalin degradation. Bull. Environ. Contam. Toxicol. 48: 269-274. 1992.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Nelson, J.E., Meggitt, W.F. and Penner, D. Fractionation of residues of pendimethalin, trifluralin and oryzalin during degradation in soil. Weed Sci. 31: 68-75. 1983.

Pal, S., Moza, P.N. and Kettrup, A. Photochemistry of pendimethalin. J. Agric. Food Chem. 39: 797-800. 1991.

Smith, A.E., Aubin, A.J. and McIntosh, T.C. Field persistence studies with emulsifiable concentrate and granular formations of the herbicide pendimethalin in Saskatchewan. J. Agric. Food Chem. 43: 2988-91. 1995.

Wauchope, R.D., Butler, T.M., Hornsby, A.G., Augustijn-Beckers, P.W. and Burt, J.P. CES pesticide properties database. Soil Conservation Service/Agricultural Research Service; U.S. Dept. Agric. South East Watershed Research Lab., Tifton, GA. (URL site- http://ncsr.arsusda.gov/ppdb3//). 1991.

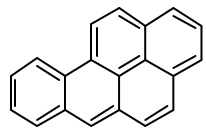
Zheng, S.Q. and Cooper, J.F. Adsorption, desorption, and degradation of three pesticides in different soils. Arch. Environ. Contam. Toxicol. 30: 15-20. 1996.

Zimdahl, R.L., Catizone, P. and Bucher, A.C. Degradation of pendimethalin in soil. Weed Sci. 32: 408-413. 1984.

Benzo(a)pyrene

<u>CAS Registry Number:</u> 50-32-8

<u>Structure:</u>



<u>Half-lives:</u>

- **Air:** 2.4 hours

  Comment: Emissions from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996).

- **Surface Water:** High: 17.3 years; Low: 5.4 years

  Comment: Based upon data from estuarine and marine waters (Readman et al., 1982). Photolysis of benzo(a)pyrene may occur based on laboratory studies in water (Zepp and Schlotzhauer, 1979; Mill et al., 1981). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

- **Soil:** High: 14.6 years; Low: 151 days

  Comment: High $t_{1/2}$ from a long-term field study (Wild et al., 1991) and low $t_{1/2}$ from a soil die-away study (Keck et al., 1989). Photolysis of this compound may occur on soil surfaces based on laboratory results in aqueous solution (Zepp and Schlotzhauer, 1979; Mill et al., 1981).

<u>Biodegradation half-life:</u>

- **Aerobic soil:** High: 1.4 years; Low: 220 days

  Comment: Based upon aerobic soil die-away test data at 10-30 EC (Coover and Sims, 1987).

- **Aerobic soil:** High: 14.6 years; Low: 11 years

  Comment: Half-lives reported for a long-term field experiment (Wild et al., 1991).

- **Aerobic soil:** $100 days

Comment: Half-life reported for field study performed in the surface sediment of an intertidal sandflat (Wilcock et al., 1996). The relative abundance of benzo(a)pyrene increased over the 256-day test period.

- **Aerobic soil:** High: 309 days
Low: 151 days

Comment: Half-lives are reported for soil-die away studies using benzo(a)pyrene only (high $t_{1/2}$) and 1.0% creosote (low $t_{1/2}$) (Keck et al., 1989).

- **Aerobic soil:** 4 years

Comment: Half-life reported for a sludge-amended soil study which ran for 1280 days (Bossert et al., 1984). It was noted that any losses should be viewed as resulting from a combination of biodegradation and undefined abiotic mechanisms.

- **Aerobic soil:** High: 309 days
Low: 229 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined in soil die-away test performed in Kidman sandy loam and McLaurin sandy loam soils at 20 °C, with durations of 196 and 105 days, respectively (Park et al., 1990). Correction was made for loss due to unspecified abiotic degradation.

- **Aerobic soil:** 3.9 years

Comment: Half-life for a 16-month soil grab study (Bossert and Bartha, 1986).

- **Aerobic water:** High: 17.3 years
Low: 5.4 years

Comment: Half-lives are for dockyard (low $t_{1/2}$) and Plymouth Sound (high $t_{1/2}$) waters, respectively (Readman et al., 1982).

- **Aerobic water:** High: >300 weeks
Low: >200 weeks

Comment: Mineralization half-lives from sediment-water microcosm studies (Heitkamp and Cerniglia, 1987).

- **Anaerobic half-life:** High:
Low:

Comment:

<u>Photolysis half-life:</u>

- **Air:** 2.4 hours

Comment: Emissions from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996).

Air: High: 3.7 hours
Low: 47 minutes

Comment: Wood smoke emissions were exposed to midday sunlight in outdoor Teflon-film chambers (Kamens et al., 1986). Half-lives at temperatures of 20.1 °C, 11.7 °C and -7.0 °C were 47 minutes, 1.1 hours and 3.7 hours, respectively.

Air: High: 1.1 hours
Low: 0.37 hours

Comment: Scientific judgement based upon a measured photolysis rate constant for midday winter sunlight at 35 EN latitude in 20% aqueous acetonitrile (high $t_{½}$) (Smith et al., 1978) and adjusted for approximate summer sunlight intensity (low $t_{½}$) (Lyman et al. (1982).

Water: High: 1.1 hours
Low: 41 minutes

Comment: Based upon a measured sunlight photolysis rate constant in a water:1% acetonitrile mixture adjusted for mid December (high $t_{1/2}$) and late January (low $t_{1/2}$) sunlight at 40 °N latitude. (Mill et al., 1981).

Soil: High:
Low:

Comment:

Other: 14 hours

Comment: Half-life for a mixture of benzo(a)pyrene in n-hexane exposed to sunlight for 4 days (October) (Muel and Saguem, 1985). No benzo(a)pyrene was recovered after exposure to sunlight for one month (November).

Other: High: 11.6 hours
Low: 3.9 hours

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were obtained from benzo(a)pyrene absorbed onto airborne particulates collected either by filtration or on filters and fired at 400° C, respectively (Valerio and Lazzarotto, 1985). Samples were exposed to sunlight for 3 hours.

Other: High: 33.5 days
Low: 1.0 hours

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were obtained from benzo(a)pyrene absorbed onto fly ash and alumina, respectively. Samples were exposed to a mercury vapor lamp in a Pyrex reactor (Behymer and Hites, 1988).

Other: High: 37 minutes
Low: 18 minutes

Comment: Half-lives determined for benzo(a)pyrene in n-hexane on thin petri dishes exposed to wavelengths between 290 and 400 nm (Lane and Katz, 1977).

Photooxidation half-life:

Air: High: 13 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with benzo(a)pyrene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with benzo(a)pyrene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 5.4×10^{-9} mm Hg (Murray et al., 1974).

Water: High: 431 days
Low: 8.6 days

Comment: Based upon a measured rate constant for reaction with alkylperoxyl radical in water (Smith et al., 1978).

Water: 32.4 minutes

Comment: Based upon a measured photolysis rate constant at wavelengths >290 nm in natural water adjusted for midsummer sunlight at 40 °N latitude. (Zepp and Schlotzhauer, 1979).

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Behymer, T.D. and Hites, R.A. Photolysis of polycyclic aromatic hydrocarbons adsorbed on fly ash. Environ. Sci. Technol. 22: 1311-1319. 1988.

Bossert, I.D. and Bartha, R. Structure-biodegradability relationships of polycyclic aromatic hydrocarbons in soil. Bull. Environ. Contam. Toxicol. 37: 490-495. 1986.

Bossert, I., Kachel, W.M. and Bartha, R. Fate of hydrocarbons during oily sludge disposal in soil. Appl. Environ. Microbiol. 47: 763-7. 1984.

Coover, M.P. and Sims, R.C.C. The effects of temperature on polycyclic aromatic hydrocarbon persistence in an unacclimated agricultural soil. Haz. Waste Haz. Mat. 4: 69-82. 1987.

Heitkamp, M.A. and Cerniglia, C.E. Effects of chemical structure and exposure on the microbial degradation of polycyclic aromatic hydrocarbons in freshwater and estuarine ecosystems. Environ. Toxicol. Chem. 6: 535-546. 1987.

Kamens, R.M., Fulcher, J.N. and Zhishi, G. Effects of temperatures on wood soot PAH decay in atmospheres with sunlight and low NO_2. Atmos. Environ. 20: 1579-1587. 1986.

Keck, J., Sims, R.C., Coover, M., Park, K., and Symons, B. Evidence for cooxidation of polynuclear aromatic hydrocarbons in soil. Wat. Res. 21: 1467-1476. 1989.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lane, D.A. and Katz, M. The photomodification of benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoroanthene under simulated atmospheric conditions. Adv. Environ. Sci. Technol. 8: 137-54. 1977.

Lyman, W.J., Reele, W.F. and Rosenblatt, D.H. Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds. McGraw-Hill. New York, NY. pp. 960. 1982.

Mill, T., Mabey, W.R., Lan, B.Y. and Baraze, A. Photolysis of polycyclic aromatic hydrocarbons in water. Chemosphere. 10: 1281-1290. 1981.

Muel, B. and Saguem, S. Determination of 23 polycyclic aromatic hydrocarbons in atmospheric particulate matter of the Paris area and photolysis by sunlight. Inter. J. Environ. Anal. Chem. 19: 111-131. 1985.

Murray, J.J., Pottie, R.F. and Pupp, C. Vapor pressures and enthalpies of sublimation of five polycyclic aromatic hydrocarbons. Can. J. Chem. 52: 557-63. 1974.

Park, K.S., Sims, R.C., Dupont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: Influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Readman, J.W., Mantoura, R.F.C., Rhead, M.M. and Brown, L. Aquatic distribution and heterotrophic degradation of polycyclic aromatic hydrocarbons (PAH) in the Tamar Estuary. Estuarine, Coastal Shelf Sci. 14: 369-389. 1982.

Smith, J.H., Mabey, W.R., Bohonos, N., Holt, B.R., Lee, S.S., Chou, T.W., Venberger, D.C. and Mill, T. Environmental pathways of selected chemicals in freshwater systems. Part II. Laboratory studies. EPA-600/7-78-074. U.S. EPA, Athens, GA. 1978.

Valerio, F and Lazzarotto, A. Photochemical degradation of polycyclic aromatic hydrocarbons (PAH) in real and laboratory conditions. Intern. J. Environ. Anal. Chem. 23: 135-151. 1985.

Wilcock, R.J., Corban, G.A., Northcott, G.L., Wilkins, A.L. and Langdon, A.G. Persistence of polycyclic aromatic compounds of different molecular size and water solubility in surficial sediment of an intertidal sandflat. Environ. Toxicol. Chem. 15: 670-676. 1996.

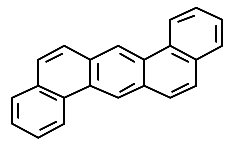
Wild, S.R., Obbard, J.P., Munn, C.I., Berrow, M.L. and Jones, K.C. The long-term persistence of polynuclear aromatic hydrocarbons (PAHs) in an agricultural soil amended with metal-contaminated sewage sludges. Sci. Total Environ. 101: 235-253. 1991.

Zepp, R.G. and Schlotzhauer, P.F. Photoreactivity of selected aromatic hydrocarbons in water. In: Polynuclear Aromatic Hydrocarbons. Jones, P.W. & Leber, P. Eds. Ann Arbor, MI: Ann Arbor Sci. Pub., Inc. pp.141-58. 1979.

Dibenzo(a,h)anthracene

CAS Registry Number: 53-70-3

Structure:



Half-lives:

- **Air:** High: 13 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of dibenzo(a,h)anthracene with hydroxyl radicals (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. Dibenzo(a,h)anthracene may be susceptible to direct photolysis based on laboratory study results (Pennise and Kamens, 1996).

- **Surface Water:** $\geq$100 days

Comment: Based on a long-term field experiment (Wilcock et al., 1996). Photolysis of dibenzo(a,h)anthracene may occur based on laboratory studies in n-hexane (Muel and Saguem, 1985). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

- **Soil:** High: 2 years
  Low: 240 days

Comment: Range taken from several soil die-away studies (low $t_{1/2}$, Coover and Sims, 1987; high $t_{1/2}$, Keck et al., 1989). Photolysis on soil surfaces may occur based on laboratory studies in n-hexane (Muel and Saguem, 1985).

Biodegradation half-life:

- **Aerobic soil:** High: 1.9 years
  Low: 240 days

Comment: Based upon aerobic soil die-away test data at 10-30 EC (Coover and Sims, 1987).

- **Aerobic soil:** High: 2 years
  Low: 361 days

Comment: Half-lives are reported for soil-die away studies using a mixture of PAHs (high $t_{1/2}$) and dibenzo(a,h)anthracene only (low $t_{1/2}$) (Keck et al., 1989).

- **Aerobic soil:** >16 months

Comment: No biodegradation was reported over 16-month soil study (Bossert and Bartha, 1986).

Aerobic soil: High: 420 days
Low: 361 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined in soil die-away test performed in Kidman sandy loam and McLaurin sandy loam soils at 20 °C, with durations of 196 and 105 days, respectively (Park et al., 1990). Correction was made for loss due to unspecified abiotic degradation.

Aerobic water: $100 days

Comment: Half-life reported for field study performed in the surface sediment of an intertidal sandflat (Wilcock et al., 1996). The relative abundance of dibenzo(a,h)anthracene increased over the 256-day test period.

Aerobic water: High: 256 days
Low: 17 days

Comment: Half-lives for polluted creek water die-away studies using napthalene (high $t_{1/2}$) and phenanthrene (low $t_{1/2}$) growth substrates (McKenna and Heath, 1976). Culture was prepared with non-sterile creek water.

Anaerobic: High:
Low:

Comment:

<u>Photolysis half-life:</u>

Air: High: 6 hours
Low: 21 minutes

Comment: Emissions from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Other: 34 days

Comment: 46% loss was reported for a mixture of dibenzo(a,h)anthracene in n-hexane exposed to sunlight for one month (November) (Muel and Saguem, 1985).

Other: 4.7 hours

Comment: Half-life for dibenzo(a,h)anthracene absorbed on aluminum oxide (Konig et al., 1985). Sample was exposed to a mercury high pressure lamp with a heat absorbing filter that cut off all irradiation below 290 nm.

Photooxidation half-life:

Air: High: 13 hours

Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with dibenzo(a,h)anthracene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with dibenzo(a,h)anthracene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of $1x10^{-10}$ mm Hg (Callahan et al., 1979).

Water: High:

Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Bossert, I.D. and Bartha, R. Structure-biodegradability relationships of polycyclic aromatic hydrocarbons in soil. Bull. Environ. Contam. Toxicol. 37: 490-495. 1986.

Callahan, M.A., Slimak, M.W., Gabel, N.W., et al. Water-related environmental fate of 129 priority pollutants -Volume II. EPA-440/4-79-029B. Washington, DC: U.S. EPA. 1979.

Coover, M.P. and Sims, R.C.C. The effects of temperature on polycyclic aromatic hydrocarbon persistence in an unacclimated agricultural soil. Haz. Waste Haz. Mat. 4: 69-82. 1987.

Keck, J., Sims, R.C., Coover, M., Park, K., and Symons, B. Evidence for cooxidation of polynuclear aromatic hydrocarbons in soil. Wat. Res. 21: 1467-1476. 1989.

Konig, J., Balfanz, E., Funcke, W. and Romanowski, T. Structure-reactivity relationships for the photooxidation of anthracene and its anellated homologues. In: Polynuclear Aromatic Hydrocarbons: Mechanisms, Methods and Metabolism. Cooke, M & Dennis, AJ eds. Columbus, OH: Battelle Press. pp.739-749. 1985.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

McKenna, E.J. and Heath, R.D. Biodegradation of polynuclear aromatic hydrocarbon pollutants by soil and water microorganisms. Res. Rep.-Univ. IL. Urbana-Champaign, Water Resour. Cent. 113, 25 pp. 1976.

Muel, B. and Saguem, S. Determination of 23 polycyclic aromatic hydrocarbons in atmospheric particulate matter of the Paris area and photolysis by sunlight. Inter. J. Environ. Anal. Chem. 19: 111-131. 1985.

Park, K.S., Sims, R.C., Dupont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: Influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

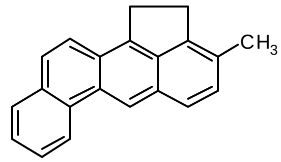
Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Wilcock, R.J., Corban, G.A., Northcott, G.L., Wilkins, A.L. and Langdon, A.G. Persistence of polycyclic aromatic compounds of different molecular size and water solubility in surficial sediment of an intertidal sandflat. Environ. Toxicol. Chem. 15: 670-676. 1996.

3-Methylcholanthrene

CAS Registry Number: 56-49-5

Structure:



Half-lives:

- **Air:** High: 3 hours; Low: 0.3 hours

Comment: Based upon an estimated rate constant for the reaction of hydroxyl radicals with 3-methylcholanthrene in air (Kwok and Atkinson, 1995). This compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:** High: 1400 days (3.8 years); Low: 609 days (1.7 years)

Comment: Scientific judgement based upon mineralization half-life in freshwater and estuarine ecosystems (Heitkamp, 1988).

- **Soil:**

Comment: Based on data for aquatic systems (Heitkamp, 1988), this compound is expected to be resistant to biodegradation.

Biodegradation half-life:

- **Aerobic soil:** High: ; Low:

Comment:

- **Aerobic water:** High: 1400 days (3.8 years); Low: 609 days (1.7 years)

Comment: Based upon mineralization half-lives in freshwater and estuarine ecosystems (Heitkamp, 1988).

- **Anaerobic:** High: ; Low:

Comment:

Photolysis half-life:

- **Air:** High: ; Low:

Comment:

● **Water:** High:
Low:

Comment:

● **Soil:** High:
Low:

Comment:

Photooxidation half-life:

● **Air:** High: 3 hours
Low: 0.3 hours

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 3-methylcholanthrene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 3-methylcholanthrene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based upon an estimated vapor pressure of 3.3×10^{-8} mm Hg at 25 EC (Neely and Blau, 1985).

● **Water:** High:
Low:

Comment:

Hydrolysis:

● **First-order half-life:** No hydrolyzable groups

Comment:

● **Acid rate constant:**

Comment:

● **Base rate constant:**

Comment:

References:

Heitkamp, M.A. Environmental and microbiological factors affecting the biodegradation and detoxification of polycyclic aromatic hydrocarbons. Diss. Abstr. Int. B. 48: 1926. 1988.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase

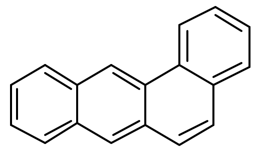
organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Neely, W.B. and Blau, G.E. Environmental exposure from chemicals. Volume 1. Boca Raton, FL: CRC Press. 245 pp. 1985.

Benzo(a)anthracene

CAS Registry Number: 56-55-3

Structure:



Half-lives:

- **Air:** High: 13 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of benzo(a)anthracene with hydroxyl radicals (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. Benzo(a)anthracene may be susceptible to direct photolysis based on laboratory study results (Pennise and Kamens, 1996).

- **Surface Water:** High: 3 years
  Low: 1.2 years

Comment: Based upon data from an enclosed marine ecosystem (Hinga et al., 1980). Neither benzo(a)anthracene or its degradation products appear to further degrade after approximately 2 months in the sediment of a marine ecosystem (Hinga and Pilson, 1987). Photolysis of benzo(a)anthracene may occur based on laboratory studies in water (Zepp and Schlotzhauer, 1979; Mill et al., 1981). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

- **Soil:** High: 2.0 years
  Low: 240 days

Comment: Based upon aerobic soil die-away test data (low $t_{1/2}$) (Coover and Sims, 1987) and a 16-month soil grab study (high $t_{1/2}$) (Bossert and Bartha, 1986). This compound may photolyze on soil surfaces based on laboratory results in water (Mill et al., 1981; Zepp and Schlotzhauer, 1979).

Biodegradation half-life:

- **Aerobic soil:** High: 1.9 years
  Low: 240 days

Comment: Based upon aerobic soil die-away test data at 10-30 °C (Coover and Sims, 1987).

- **Aerobic soil:** 2 years

Comment: Half-life for 16-month soil grab study (Bossert and Bartha, 1986).

Aerobic soil: High: 261 days
Low: 162 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined in soil die-away test performed in Kidman sandy loam and McLaurin sandy loam soils at 20 °C, with durations of 196 and 105 days, respectively (Park et al., 1990). Correction was made for loss due to unspecified abiotic degradation.

Aerobic soil: 211 days

Comment: Half-life reported for a sludge-amended soil study which ran for 1280 days (Bossert et al., 1984). It was noted that any losses should be viewed as resulting from a combination of biodegradation and undefined abiotic mechanisms.

Aerobic soil: High: 1.2 years
Low: 77 days

Comment: Half-lives are reported for soil-die away studies using a mixture of PAHs (high $t_{1/2}$) and oil refinery waste (low $t_{1/2}$) (Keck et al., 1989).

Aerobic water: High: 36 days
Low: 18 days

Comment: Half-lives for water die-away studies using napthalene (high $t_{1/2}$) and phenanthrene (low $t_{1/2}$) growth substrates (McKenna and Heath, 1976). Culture was prepared with unsterile creek water.

Aerobic water: $100 days

Comment: Half-life reported for field study performed in the surface sediment of an intertidal sandflat (Wilcock et al., 1996). The relative abundance of benzo(a)anthracene decreased over the 256 day test period.

Aerobic water:

Comment: 44% of the added radiolabeled benzo(a)anthracene was found as CO_2 by day 163 in an enclosed marine ecosystem experiment (Hinga and Pilson, 1987). However, neither benzo(a)anthracene or its degradation products appear to further degrade after approximately 2 months in the sediment.

Aerobic water: High: 3 years
Low: 1.2 years

Comment: Based on data for benzo(a)anthracene mineralization in a 230-day enclosed marine ecosystem experiment (Hinga et al., 1980). 29% of the radiolabel was measured as CO_2 by day 216. Half-lives determined assuming that the rate of the final 100 days of the experiment remained constant.

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High: 12.4 hours
Low: 48 minutes

Comment: Emissions from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Benzo(a)anthracene was not separated from chrysene. The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Air: High: 2.9 hours
Low: 37 minutes

Comment: Wood smoke emissions were exposed to midday sunlight in outdoor Teflon-film chambers (Kamens et al., 1986). Half-lives at temperatures of 20.1 °C, 11.7 °C and -7.0 °C were 37 minutes, 54 minutes and 2.9 hours, respectively.

Air: High: 3 hours
Low: 1 hour

Comment: Based upon measured photolysis rate constant for midday March sunlight on a cloudy day (Smith et al., 1978) and adjusted for approximate summer and winter sunlight intensity (Lyman et al., 1982).

Water: 5 hours

Comment: Based upon a measured sunlight photolysis rate constant in a water:1% acetronitrile mixture adjusted for early March sunlight at 40 °N latitude. (Mill et al., 1981).

Water: 35 minutes

Comment: Based upon a measured photolysis rate constant at wavelengths > 290 nm in natural water adjusted for midsummer sunlight at 40 °N latitude. (Zepp and Schlotzhauer, 1979).

Water: High: 11.5 hours
Low: 9.6 hours

Comment: Half-lives for benzo(a)anthracene absorbed on silica ICN in water (David and Boule, 1993). Samples were irradiated at 300-350 nm in Pyrex glass vessels.

Soil: High:
Low:

Comment:

Other: High: 8.6 days
Low: 5.9 days

Comment: Half-lives, assuming 2 replicates (high $t_{1/2}$, 91% loss; low $t_{1/2}$, 97% loss), for a mixture of benzo(a)anthracene in n-hexane exposed to sunlight for one month (November) (Muel and Saguem, 1985).

Other: High: 8.4 hours
Low: 1.8 hours

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were obtained from benzo(a)anthracene absorbed onto glass filter fiber and airborne particulates collected on a filter and fired at 400 °C, respectively (Valerio and Lazzarotto, 1985). Samples were exposed to sunlight for 3 hours.

Other: High: 41.7 days
Low: 1.6 hours

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were obtained from benzo(a)anthracene absorbed onto fly ash and alumina, respectively. Samples were exposed to a mercury vapor lamp in a Pyrex reactor. (Behymer and Hites, 1988).

Photooxidation half-life:

Air: High: 13 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with benzo(a)anthracene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with benzo(a)anthracene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 3.05×10^{-8} mm Hg (Pupp et al., 1974).

Water: High: 160 days
Low: 3.2 days

Comment: Based upon a measured rate constant for reaction with alkylperoxyl radical in water (Radding et al., 1976).

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Behymer, T.D. and Hites, R.A. Photolysis of polycyclic aromatic hydrocarbons adsorbed on fly ash. Environ. Sci. Technol. 22: 1311-1319. 1988.

Bossert, I.D. and Bartha, R. Structure-biodegradability relationships of polycyclic aromatic hydrocarbons in soil. Bull. Environ. Contam. Toxicol. 37: 490-495. 1986.

Bossert, I., Kachel, W.M. and Bartha, R. Fate of hydrocarbons during oily sludge disposal in soil. Appl. Environ. Microbiol. 47: 763-7. 1984.

Coover, M.P. and Sims, R.C.C. The effects of temperature on polycyclic aromatic hydrocarbon persistence in an unacclimated agricultural soil. Haz. Waste Haz. Mat. 4: 69-82. 1987.

David, B. and Boule, P. Phototransformation of hydrophobic pollutants in aqueous medium. I. PAHs adsorbed on silica. Chemosphere. 9: 1617-1630. 1993.

Hinga, K.R . and Pilson, M.E.Q. Persistence of benz[a]anthracene degradation products in an enclosed marine ecosystem. Environ. Sci. Technol. 21: 648-653. 1987.

Hinga, K. R., Pilson, M.E.Q, Le, R.F., Farrington, J.W., Tjessem, K. and Davis, A.C. Biogeochemistry of benzanthracene in an enclosed marine ecosystem. Environ. Sci. Technol. 14: 1136-1143. 1980.

Kamens, R.M., Fulcher, J.N. and Zhishi, G. Effects of temperatures on wood soot PAH decay in atmospheres with sunlight and low NO_2. Atmos. Environ. 20: 1579-1587. 1986.

Keck, J., Sims, R.C., Coover, M., Park, K., and Symons, B. Evidence for cooxidation of polynuclear aromatic hydrocarbons in soil. Wat. Res. 21: 1467-1476. 1989.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lyman, W.J., Reele, W.F. and Rosenblatt, D.H. Handbook of Chemical Property Estimation Methods.

Environmental Behavior of Organic Compounds. McGraw-Hill. New York, NY. pp. 960. 1982.

McKenna, E.J. and Heath, R.D. Biodegradation of polynuclear aromatic hydrocarbon pollutants by soil and water microorganisms. Res. Rep.-Univ. IL. Urbana-Champaign, Water Resour. Cent. 113, 25 pp. 1976.

Mill, T., Mabey, W.R., Lan, B.Y. and Baraze, A. Photolysis of polycyclic aromatic hydrocarbons in water. Chemosphere. 10: 1281-1290. 1981.

Muel, B. and Saguem, S. Determination of 23 polycyclic aromatic hydrocarbons in atmospheric particulate matter of the Paris area and photolysis by sunlight. Inter. J. Environ. Anal. Chem. 19: 111-131. 1985.

Park, K.S., Sims, R.C., Dupont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: Influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Pupp, C., Lao, R.C., Murray, J.J. and Pottie, R.F. Equilibrium vapor concentrations of some polycyclic aromatic hydrocarbons, AS4O6 and SEO2 and the collection efficiencies of these air pollutants. Atmos. Environ. 8: 915-25. 1974.

Radding, S.B., Mill, T., Gould, C.W., Liu, D.H. and Johnson, H.L. The environmental fate of selected polynuclear aromatic hydrocarbons. EPA-560/5-75-009. Menlo Park, CA: Stanford Research Institute. pp. 131. 1976.

Smith, J.H., Mabey, W.R., Bohonos, N., Holt, B.R., Lee, S.S., Chou, T.W., Venberger, D.C. and Mill, T. Environmental pathways of selected chemicals in freshwater systems. Part II. Laboratory studies. EPA-600/7-78-074. U.S. EPA, Athens, GA. 1978.

Valerio, F and Lazzarotto, A. Photochemical degradation of polycyclic aromatic hydrocarbons (PAH) in real and laboratory conditions. Intern. J. Environ. Anal. Chem. 23: 135-151. 1985.

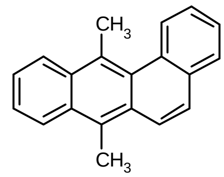
Wilcock, R.J., Corban, G.A., Northcott, G.L., Wilkins, A.L. and Langdon, A.G. Persistence of polycyclic aromatic compounds of different molecular size and water solubility in surficial sediment of an intertidal sandflat. Environ. Toxicol. Chem. 15: 670-676. 1996.

Zepp, R.G. and Schlotzhauer, P.F. Photoreactivity of selected aromatic hydrocarbons in water. In: Polynuclear aromatic hydrocarbons. Jones, P.W. & Leber, P. (Eds.). Ann Arbor, MI: Ann Arbor Science Publishers, Inc. pp. 141-158. 1979.

7,12-Dimethylbenz(a)anthracene

CAS Registry Number: 57-97-6

Structure:



Half-lives:

- **Air:** High: 4 hours
  Low: 24 minutes

Comment: Based upon an estimated rate constant for the reaction of 7,12-dimethylbenz(a)anthracene with hydroxyl radicals in air (Kwok and Atkinson, 1995). However, this compound is expected to mainly exist in the particulate form in the atmosphere, which may result in longer half-lives. 7,12-Dimethylbenz(a)anthracene may be susceptible to direct photolysis based on laboratory results showing photolysis in an aqueous solution (Lee and Ryan, 1983).

- **Surface Water:** High: 6 years
  Low: 1 year

Comment: Half-life based upon aerobic water data measuring mineralization (Hinga et al., 1986). Based on laboratory studies, dimethylbenz(a)anthracene is also susceptible to photodegradation in aqueous solution (Lee and Ryan, 1983). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** High: 28 days
  Low: 20 days

Comment: Based upon aerobic soil die-away test data (Park et al., 1990). Mineralization studies in water report a much greater half-life (1 to 6 years; Hinga et al., 1986), however, suggesting that this compound is resistant to degradation.

Biodegradation half-life:

- **Aerobic soil:** High: 28 days
  Low: 20 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined in soil die-away tests performed in McLaurin sandy loam and Kidman sandy loam soils at 20 °C, for 196 and 105 days, respectively (Park et al., 1990). Correction was made for loss due to unspecified abiotic degradation.

Aerobic water: High: 6 years
Low: 1 year

Comment: Production of labeled CO_2 during the first 10 days of the experiment could have been due to biological mineralization of either one or more of the photoproducts (Hinga et al., 1986). If the labeled CO_2 production rate from the last 25 days of the experiment continued without change, it would take 1-6 years for the remaining label to be completely mineralized.

Anaerobic half-life: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: 173 days

Comment: 0.3% was mineralized in 18 hours of the added 7,12-dimethylbenzanthracene in a quartz flask suspended in estuarine water in an outside tank (Lee and Ryan, 1983).

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 4 hours
Low: 24 minutes (0.4 hours)

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 7,12-dimethylbenz(a)anthracene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 7,12-dimethylbenz(a)anthracene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 5.63×10^{-9} mm Hg (Murray et al., 1974).

Water: High: 157 years
Low: 1.57 years

Comment: Based upon a measured rate constant for reaction with singlet oxygen in benzene (Stevens et al., 1974).

Hydrolysis:

- **First-order half-life:** No hydrolyzable groups

  Comment:

- **Acid rate constant:**

  Comment:

- **Base rate constant:**

  Comment:

References:

Hinga, K.R., Pilson, M.E.Q. and Almquist, G. The degradation of 7,12-dimethylbenz(a)anthracene in an enclosed marine ecosystem. Mar. Environ. Res. 18: 79-91. 1986.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lee, R.F. and Ryan, C. Microbial and photochemical degradation of polycyclic aromatic hydrocarbons in estuarine waters and sediments. Can. J. Fish. Aquat. Sci. 40(Suppl 2): 86-94. 1983.

Murray, J.J., Pottie, R.F. and Pupp, C. Vapor pressures and enthalpies of sublimation of five polycyclic aromatic hydrocarbons. Can. J. Chem. 52: 557-63. 1974.

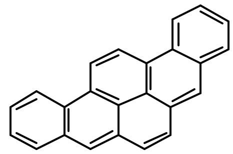
Park, K.S., Sims, R.C., Dupont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: Influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

Stevens, B., Perez, S.R. and Ors, J.A. Photoperoxidation of unsaturated organic molecules of O2'Delta G acceptor properties and reactivity. J. Amer. Chem. Soc. 96: 6846-50. 1974.

Benzo(r,s,t)pentaphene

CAS Registry Number: 189-55-9

Structure:



Half-lives:

Air: High: 13 hours
Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of benzo(r,s,t)pentaphene with hydroxyl radicals in air (Kwok and Atkinson, 1994). This compound is also expected to exist in the particulate phase in the atmosphere, which may result in longer half-lives.

Surface Water:

Comment: No data were located reporting the degradation of benzo(r,s,t)pentaphene in water. Based on soil studies, this compound is moderately biodegradable (Stevens et al., 1989; Park et al., 1990).

Soil: High: 371 days
Low: 232 days

Comment: Based upon aerobic soil test data (Stevens et al., 1989).

Biodegradation:

Aerobic soil: High: 361 days
Low: 289 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined in soil die-away tests performed in Kidman sandy loam and McLaurin sandy loam soils at 20 °C, respectively (Park et al., 1990). Correction was made for loss due to unspecified abiotic degradation.

Aerobic soil: High: 371 days
Low: 232 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined in soil die-away tests performed in Kidman sandy loam and McLaurin sandy loam soils at 20 °C, respectively (Stevens et al., 1989). Correction was made for loss due to volatilization.

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 13 days
Low: 1.3 days

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with benzo(r,s,t)pentaphene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with benzo(r,s,t)pentaphene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 1.15×10^{-10} mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Neely,W.B. and Blau,G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, Fla: CRC Press. 245pp. 1985.

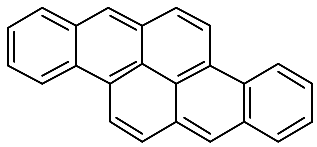
Park, K.S., Sims, R.C., Dupont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: Influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

Stevens, D.K. Grenny, W.J. Yan, Z. and Sims, R.C. Sensitive parameter evaluation for vadose zone fate and transport model. Project summary. EPA/600/S3-89/058. Robert S. Kerr. Environ. Res. Lab., Ada, OK. pp. 8. 1989.

Dibenzo(a,h)pyrene

CAS Registry Number: 189-64-0

Structure:



Half-lives:

- **Air:** High: 13 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of dibenzo(a,h)pyrene with hydroxyl radicals in air (Kwok and Atkinson, 1995). This compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:**

Comment: No data were located reporting the degradation of dibenzo(a,h)pyrene in water. Based on soil studies for an analogous compound, dibenzo(a,i)pyrene, this compound is resistant to biodegradation (Stevens et al., 1989; Park et al., 1990).

- **Soil:** High: 371 days
  Low: 232 days

Comment: No data were located reporting the degradation of dibenzo(a,h)pyrene in soil. Based on soil studies for an analogous compound, dibenzo(a,i)pyrene, this compound is resistant to biodegradation (Stevens et al., 1989; Park et al., 1990).

Biodegradation half-life:

- **Aerobic soil:** High: 371 days
  Low: 232 days

Comment: The half lives in soil are based on analogy to the experimental data obtained on dibenzo(a,i)pyrene by Stevens et al., 1989.

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- **Aerobic soil:** High: 361 days
  Low: 289 days

Comment: The half lives in soil are based on analogy to the experimental data obtained on dibenzo(a,i)pyrene by Park et al., 1990.

- **Aerobic water:** High:
  Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 13 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with dibenzo(a,h)pyrene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with dibenzo(a,h)pyrene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 7.87×10^{-12} mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-95. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1; Boca Raton, FL: CRC Press. 1985.

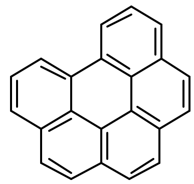
Park, K.S., Sims, R.C., Dupont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: Influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

Stevens, D.K. Grenny, W.J. Yan, Z. and Sims, R.C. Sensitive parameter evaluation for vadose zone fate and transport model. Project summary. EPA/600/S3-89/058. Robert S. Kerr. Environ. Res. Lab., Ada, OK. pp. 8. 1989.

Benzo(g,h,i)perylene

CAS Registry Number: 191-24-2

Structure:



Half-lives:

- **Air:** High: 10.0 hours; Low: 0.31 hours

Comment: Emissions containing benzo(g,h,i)perylene from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996).

- **Surface Water:** $\geq$100 days

Comment: Based on a long-term field experiment (Wilcock et al., 1996).

- **Soil:** High: 1.8 years; Low: 173 days

Comment: Based upon aerobic soil die-away test data at 10-30 EC (high $t_{1/2}$, Coover and Sims, 1987) and a soil grab sample experiment (low $t_{1/2}$, Symons et al., 1988).

Biodegradation half-life:

- **Aerobic soil:** High: 1.8 years; Low: 1.6 years

Comment: Based upon soil die-away test data in Kidman sandy loam soil for 240 days at 10-30 °C (Coover and Sims, 1987).

- **Aerobic soil:** High: >180 days; Low: 173 days

Comment: Half-life of 173 days was reported for Kidman sandy loam soil, while in Nunn clay loam, no degradation was seen over the 6 month test period (Symons et al., 1988)

- **Aerobic water:** $100 days

Comment: Half-life reported for field study performed in the surface sediment of an intertidal sandflat (Wilcock et al., 1996). The relative abundance of benzo(g,h,i)perylene increased over the 256 day test period.

Aerobic water: High:
Low:
Comment:

Anaerobic: High:
Low:
Comment:

Photolysis half-life:

Air: High: 10.0 hours
Low: 0.31 hours
Comment: Emissions from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Air: High: 6 hours
Low: 69 minutes
Comment: The high $t_{1/2}$ and low $t_{1/2}$ were obtained from wood smoke emissions into a smog chamber facility at -7.0 °C and 20.1 °C, respectively. Samples were exposed to midday sunlight in outdoor Teflon-film chambers (Kamens et al., 1986). Half-lives at temperatures of 20.1 °C, 11.7 °C and -7.0 °C were 69 minutes, 1.8 hours and 6 hours, respectively.

Water: High:
Low:
Comment:

Soil: High:
Low:
Comment:

Other: 8 days
Comment: Half-life determined for the reaction of benzo(g,h,i)perylene absorbed on carbon with 10 ppm NO_2 for up to 50 days (National Research Council, 1983).

Other: High: >1000 hours
Low: 7 hours
Comment: The high $t_{1/2}$ and low $t_{1/2}$ were obtained from benzo(g,h,i)perylene absorbed on carbon black and silica gel, respectively. Samples were exposed to a mercury vapor lamp in a Pyrex reactor (Behymer and Hites, 1985). Half-lives of benzo(g,h,i)perylene on silica gel,

alumina, fly ash and carbon black were 7, 22, 29 and >1000 hours, respectively.

Photooxidation half-life:

Air: High: 7 hours
Low: 44 minutes (0.7 hours)

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with benzo(g,h,i)perylene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with benzo(g,h,i)perylene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 1.01×10^{-10} mm Hg (Murray et al., 1974).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Behymer, T.D. and Hites, R.A. Photolysis of polycyclic aromatic hydrocarbons adsorbed on simulated atmospheric particulates. Environ. Sci. Technol. 19: 1004-1006. 1985.

Coover, M.P. and Sims, R.C.C. The effects of temperature on polycyclic aromatic hydrocarbon persistence in an unacclimated agricultural soil. Haz. Waste Haz. Mat. 4: 69-82. 1987.

Kamens, R.M., Fulcher, J.N. and Zhishi, G. Effects of temperatures on wood soot PAH decay in atmospheres with sunlight and low NO_2. Atmos. Environ. 20: 1579-1587. 1986.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-activity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Murray, J.J., Pottie, R.F. and Pupp, C. Vapor pressures and enthalpies of sublimation of five polycyclic aromatic hydrocarbons. Can. J. Chem. 52: 557-563. 1974.

National Research Council. Polycyclic Aromatic Hydrocarbons: Evaluation of Sources and Effects. Natl. Acad. Press. Washington, D.C.:Natl. Res. Council. 1983.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

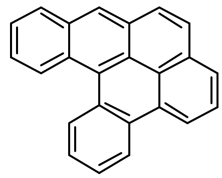
Symons, B.D., Sims, R.C. and Grenney, W.J. Fate and transport of organics in soil: model predictions and experimental results. JWPCF. 60: 1684-1693. 1988.

Wilcock, R.J., Corban, G.A., Northcott, G.L., Wilkins, A.L. and Langdon, A.G. Persistence of polycyclic aromatic compounds of different molecular size and water solubility in surficial sediment of an intertidal sandflat. Environ. Toxicol. Chem. 15: 670-676. 1996.

Dibenzo(a,l)pyrene

CAS Registry Number: 191-30-0

Structure:



Half-lives:

- **Air:** High: 13 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of dibenzo(a,l)pyrene with hydroxyl radicals in air (Kwok and Atkinson, 1995). This compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:**

Comment: No data were located reporting the degradation of dibenzo(a,l)pyrene in water. Based on soil studies for an analogous compound, dibenzo(a,i)pyrene, this compound is resistant to biodegradation (Stevens et al., 1989; Park et al., 1990).

- **Soil:** High: 371 days
  Low: 232 days

Comment: No data were located reporting the degradation of dibenzo(a,l)pyrene in soil. Based on soil studies for an analogous compound, dibenzo(a,i)pyrene (half-lives above), this compound is resistant to biodegradation (Stevens et al., 1989; Park et al., 1990).

Biodegradation half-life:

- **Aerobic soil:** High: 371 days
  Low: 232 days

Comment: The half lives in soil are based on analogy to the experimental data obtained on dibenzo(a,i)pyrene by Stevens et al., 1989.

- **Aerobic soil:** High: 361 days
  Low: 289 days

Comment: The half lives in soil are based on analogy to the experimental data obtained on dibenzo(a,i)pyrene by Park et al., 1990.

- **Aerobic water:** High:
  Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 13 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with dibenzo(a,l)pyrene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with dibenzo(a,l)pyrene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 4.8×10^{-10} mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1; Boca Raton, FL: CRC Press. 1985.

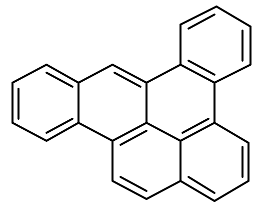
Park, K.S., Sims, R.C., Dupont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: Influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

Stevens, D.K. Grenny, W.J. Yan, Z. and Sims, R.C. Sensitive parameter evaluation for vadose zone fate and transport model. Project summary. EPA/600/S3-89/058. Robert S. Kerr. Environ. Res. Lab., Ada, OK. pp. 8. 1989.

Dibenzo(a,e)pyrene

CAS Registry Number: 192-65-4

Structure:



Half-lives:

- **Air:** High: 13 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of dibenzo(a,e)pyrene with hydroxyl radicals in air. (Kwok and Atkinson, 1995). This compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:**

Comment: No data were located reporting the degradation of dibenzo(a,e)pyrene in water. Based on soil studies for an analogous compound, dibenzo(a,i)pyrene, this compound is resistant to biodegradation (Stevens et al., 1989; Park et al., 1990).

- **Soil:** High: 371 days
  Low: 232 days

Comment: No data were located reporting the degradation of dibenzo(a,e)pyrene in soil. Based on soil studies for an analogous compound, dibenzo(a,i)pyrene, this compound is resistant to biodegradation (Stevens et al., 1989; Park et al., 1990).

Biodegradation half-life:

- **Aerobic soil:** High: 371 days
  Low: 232 days

Comment: The half lives in soil are based by analogy to the experimental data obtained on dibenzo(a,i)pyrene by Stevens et al., 1989.

- **Aerobic soil:** High: 361 days
  Low: 289 days

Comment: The half lives in soil are based on analogy to the experimental data obtained on dibenzo(a,i)pyrene by Park et al., 1990.

- **Aerobic water:** High:
  Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 13 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with dibenzo(a,e)pyrene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with dibenzo(a,e)pyrene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 7.03×10^{-11} mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1; Boca Raton, FL: CRC Press. 1985.

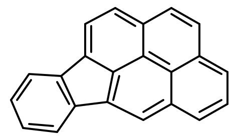
Park, K.S., Sims, R.C., Dupont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: Influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

Stevens, D.K. Grenny, W.J. Yan, Z. and Sims, R.C. Sensitive parameter evaluation for vadose zone fate and transport model. Project summary. EPA/600/S3-89/058. Robert S. Kerr. Environ. Res. Lab., Ada, OK. pp. 8. 1989.

Indeno(1,2,3-cd)pyrene

CAS Registry Number: 193-39-5

Structure:



Half-lives:

- **Air:** High: 7.6 hours; Low: 20.4 minutes

Comment: Emissions from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996).

- **Surface Water:**

Comment: No data were located reporting the degradation of indeno(1,2,3-cd)pyrene. Based on soil studies, this compound is expected to be resistant to biodegradation (Coover and Sims, 1987; Keck et al., 1989). Photolysis of indeno(1,2,3-cd)pyrene may occur based on laboratory studies in n-heptane (Muel and Saguem, 1985). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

- **Soil:** High: 730 days; Low: 58 days

Comment: Based upon aerobic soil die-away tests (Coover and Sims, 1987; Symons et al., 1988). Photolysis on soil surfaces may occur based on laboratory studies in n-hexane (Muel and Saguem, 1985).

Biodegradation half-life:

- **Aerobic soil:** High: 730 days; Low: 600 days

Comment: Based upon aerobic soil die-away test data at 10 to 30 °C (Coover and Sims, 1987).

- **Aerobic soil:** High: 730 days; Low: 139 days

Comment: Half-lives are reported for soil-die away studies using a mixture of PAHs (high $t_{1/2}$) and oil refinery waste (low $t_{1/2}$) (Keck et al., 1989).

Aerobic soil: High: 289 days
Low: 288 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined in soil die-away tests performed in McLaurin sandy loam and Kidman sandy loam soils at 20 °C, with durations of 196 and 105 days, respectively (Park et al., 1990). Correction was made for loss due to unspecified abiotic degradation.

Aerobic soil: High: 139 days
Low: 58 days

Comment: Based on data from soil die-away test in Nunn clay loam soil (low $t_{1/2}$) and in Kidman sandy loam (high $t_{1/2}$) (Symons et al., 1988).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

<u>Photolysis half-life:</u>

Air: High: 7.6 hours
Low: 20.4 minutes

Comment: Emissions from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively.

Air: High: 16 hours
Low: 48 minutes

Comment: Wood smoke emissions were exposed to midday sunlight in outdoor Teflon-film chambers (Kamens et al., 1986). Half-lives at temperatures of 20.1 °C, 11.7 °C, and -7.0 °C were 48 minutes, 1.8 hours, and 16 hours, respectively.

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Other: 336 days

Comment: 6% loss was reported for a mixture of indeno(1,2,3-cd)pyrene in n-hexane exposed to sunlight for one month (November) (Muel and Saguem, 1985).

Other: High: 4.2 days
Low: 1.6 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were obtained from indeno(1,2,3-cd)pyrene absorbed on carbon black and alumina, respectively. Samples were exposed to a mercury vapor lamp in a Pyrex reactor (Behymer and Hites, 1988).

Photooxidation half-life:

Air: High: 10 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with indeno(1,2,3-cd)pyrene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with indeno(1,2,3-cd)pyrene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of $1x10^{-10}$ mm Hg (Coover and Sims, 1987).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Behymer, T.D. and Hites, R.A. Photolysis of polycyclic aromatic hydrocarbons adsorbed on fly ash. Environ. Sci. Technol. 22: 1311-1319. 1988.

Coover, M.P. and Sims, R.C.C. The effects of temperature on polycyclic aromatic hydrocarbon persistence in an unacclimated agricultural soil. Haz. Waste Haz. Mat. 4: 69-82. 1987.

Kamens, R.M., Fulcher, J.N. and Zhishi, G. Effects of temperatures on wood soot PAH decay in atmospheres with sunlight and low NO_2. Atmos. Environ. 20: 1579-1587. 1986.

Keck, J., Sims, R.C., Coover, M., Park, K., and Symons, B. Evidence for cooxidation of polynuclear aromatic hydrocarbons in soil. Wat. Res. 21: 1467-1476. 1989.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lyman, W.J., Reele, W.F. and Rosenblatt, D.H. Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds. McGraw-Hill. New York, NY. pp. 960. 1982.

Muel, B. and Saguem, S. Determination of 23 polycyclic aromatic hydrocarbons in atmospheric particulate matter of the Paris area and photolysis by sunlight. Inter. J. Environ. Anal. Chem. 19: 111-131. 1985.

Park, K.S., Sims, R.C., Dupont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: Influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

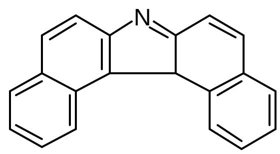
Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Symons, B.D., Sims, R.C. and Grenney, W.J. Fate and transport of organics in soil: model predictions and experimental results. JWPCF. 60: 1684-1693. 1988.

7H-Dibenzo(c,g)carbazole

CAS Registry Number: 194-59-2

Structure:



Half-lives:

- **Air:** High: 23 hours
  Low: 2 hours

Comment: Based upon an estimated rate constant for the reaction of 7H-dibenzo(c,g)carbazole with hydroxyl radicals in air (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. 7H-dibenzo(c,g)carbazole may be susceptible to direct photolysis based on laboratory study results in water (Smith et al., 1978).

- **Surface Water:**

Comment: 7H-Dibenzo(c,g)carbazole is expected to be resistant to biodegradation in water based on a soil study reporting a half-life >160 days (Grosser et al., 1995). Photolysis of 7H-dibenzo(c,g)carbazole is expected to occur based on laboratory studies in natural waters (Smith et al., 1978). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

- **Soil:** >160 days

Comment: No mineralization was noted in a 160-day grab sample study of 5 different soils obtained at and around a coal tar refining plant (Grosser et al., 1995). This compound may photolyze on soil surfaces based on laboratory results in water (Smith et al., 1978).

Biodegradation half-life:

- **Aerobic soil:** >160 days

Comment: No mineralization (as compared to heat-treated control soils) was noted in a 160-day grab sample study of 5 different soils obtained at and around a coal tar refining plant (Grosser et al., 1995).

- **Aerobic water:** High:
  Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High: 24 minutes
Low: 8 minutes

Comment: High half-life was measured in pure water on a clear day in late January; low half-life was measured in pure water irradiated at 366 nm (Smith et al., 1978).

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 23 hours
Low: 2 hours

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 7H-dibenzo(c,g)carbazole. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{½}$ for the reaction of hydroxyl radicals with 7H-dibenzo(c,g)carbazole in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 3.4×10^{-9} mm Hg (Neely and Blau, 1985).

Water: High: 4 hours
Low: 6.4 minutes

Comment: High $t_{1/2}$ was measured in pure water with added humic acid irradiated at 366 nm; low $t_{1/2}$ was measured in pond water, also irradiated at 366 nm (Smith et al., 1978). Two other pond water samples irradiated at 366 nm gave intermediate half-lives.

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:
Comment:

References:

Grosser, R.J., Warshawsky, D. and Vestal, J.R. Mineralization of polycyclic and n-heterocyclic aromatic compounds in hydrocarbon-contaminated soils. Environ. Toxicol. Chem. 14: 375-382. 1995.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

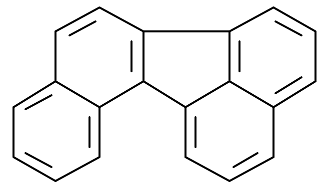
Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1; Boca Raton, FL: CRC Press. 1985.

Smith, J.H., Mabey, W.R., Bohonus, N., Holt, B.R., Lee, S.S., Chou, T.W., Venberger, D.C. and Mill, T. Environmental pathways of selected chemicals in freshwater systems. Part II. Laboratory Studies. EPA-600/7-78-074. U.S. EPA, Athens, GA. 1978.

Benzo(j)fluoranthene

CAS Registry Number: 205-82-3

Structure:



Half-lives:

- **Air:** High: 12 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of benzo(j)fluoranthene with hydroxyl radicals (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. Benzo(j)fluoranthene may be susceptible to direct photolysis based on laboratory study results (Kamens et al., 1986).

- **Surface Water:**

Comment: No data were located reporting the degradation of benzo(j)fluoranthene in water. Based on soil studies, this compound is expected to be resistant to biodegradation (Bossert et al., 1984). Photolysis of benzo(j)fluoranthene may occur, based on laboratory studies in n-hexane (Muel and Saguem, 1985) and laboratory studies in water for an analogous compound, fluoranthene (Zepp and Schlotzhauer, 1979; Lyman et al., 1982). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

- **Soil:** 10.5 years

Comment: Based upon aerobic soil die-away test data (Bossert et al., 1984). Photolysis on soil surfaces may occur based upon laboratory studies in n-hexane (Muel and Saguem 1985) and laboratory studies in water for an analogous compound, fluoranthene (Zepp and Schlotzhauer, 1979; Lyman et al., 1982).

Biodegradation half-life:

- **Aerobic soil:** 10.5 years

Comment: Half-life reported for a sludge-amended soil study which ran for 1280 days (Bossert et al., 1984). It was noted that any losses should be viewed as resulting from a combination of biodegradation and undefined abiotic mechanisms.

- **Aerobic water:** High:
  Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High: 11.6 hours
Low: 1.8 hours

Comment: Wood smoke emissions were exposed to midday sunlight in outdoor Teflon-film chambers. Benzo(k)fluoranthene was not separated from benzo(j)fluoranthene (Kamens et al., 1986). Half-lives at temperatures of 20.1 °C, 11.7 °C, and -7.0 °C were 1.8 hours, 1.8 hours, and 11.6 hours, respectively.

Water: High: 371 days
Low: 232 days

Comment: The half-lives in water are based by analogy to the experimental data obtained on fluoranthene by Zepp and Schlotzhauer, 1979 and Lyman et al., 1982.

Soil: High:
Low:

Comment:

Other: 286 days

Comment: 7% loss was reported for a mixture of benzo(j)fluoranthene in n-hexane exposed to sunlight for one month (November) (Muel and Saguem, 1985).

Photooxidation half-life:

Air: High: 12 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with benzo(j)fluoranthene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with benzo(j)fluoranthene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 2.4×10^{-8} mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups
Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Bossert, I., Kachel, W.M. and Bartha, R. Fate of hydrocarbons during oily sludge disposal in soil. Appl. Environ. Microbiol. 47: 463-467. 1984.

Kamens, R.M., Fulcher, J.N. and Zhishi, G. Effects of temperatures on wood soot PAH decay in atmospheres with sunlight and low NO_2. Atmos. Environ. 20: 1579-1587. 1986.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lyman, W.J., Reele, W.F. and Rosenblatt, D.H. Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds. McGraw-Hill. New York, NY. pp. 960. 1982.

Muel, B. and Saguem, S. Determination of 23 polycyclic aromatic hydrocarbons in atmospheric particulate matter of the Paris area and photolysis by sunlight. Inter. J. Environ. Anal. Chem. 19: 111-131. 1985.

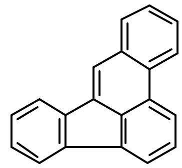
Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, Fla: CRC Press. 245pp. 1985.

Zepp, R.G. and Schlotzhauer, P.F. Photoreactivity of selected aromatic hydrocarbons in water. In: Polynuclear Aromatic Hydrocarbons. Jones, P.W. and Leber, P., Eds. Ann Arbor Sci. Publ. Inc. Ann Arbor, MI. pp. 141-58. 1979.

Benzo(b)fluoranthene

CAS Registry Number: 205-99-2

Structure:



Half-lives:

Air: High: 1.4 days
Low: 3.4 hours

Comment: Based upon an estimated rate constant for the reaction of benzo(b)fluoranthene with hydroxyl radicals (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate phase in the atmosphere, which may result in longer half-lives. Benzo(b)fluoranthene may be susceptible to direct photolysis based on laboratory study results (Pennise and Kamens, 1996; Kamens et al., 1986).

Surface Water: $\geq$100 days

Comment: Based on a long-term field experiment (Wilcock et al., 1996). Photolysis of benzo(b)fluoranthene may occur, based on laboratory studies in n-hexane (Lane and Katz, 1977; Muel and Saguem, 1985) and laboratory studies in water for an analogous compound, fluoranthene (Zepp and Schlotzhauer, 1979; Lyman et al., 1982). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

Soil: High: 14.2 years
Low: 87 days

Comment: High $t_{1/2}$ from a long-term field study (Wild et al., 1991) and the low $t_{1/2}$ from a soil die-away study (Keck et al., 1989).

Biodegradation half-life:

Aerobic soil: High: 1.7 years
Low: 360 days

Comment: Based upon aerobic soil die-away test data at 10 to 30 °C (Coover and Sims, 1987).

Aerobic soil: High: 14.2 years
Low: 12 years

Comment: Half-lives reported for a long-term field experiment (Wild et al., 1991).

Aerobic soil: 10.5 years

Comment: Half-life reported for a sludge-amended soil study which ran for 1280 days (Bossert et al., 1984). It was noted that any losses should be viewed as resulting from a combination of biodegradation and undefined abiotic mechanisms.

Aerobic soil: High: 1.7 years
Low: 87 days

Comment: Half-lives are reported for soil-die away studies using a mixture of PAHs (high $t_{1/2}$) and 1.0% creosote (low $t_{1/2}$) (Keck et al., 1989).

Aerobic soil: High: 294 days
Low: 211 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined in soil die-away tests performed in Kidman sandy loam and McLaurin sandy loam soils at 20 °C, with durations of 196 and 105 days, respectively (Park et al., 1990). Correction was made for loss due to unspecified abiotic degradation.

Aerobic water: $100 days

Comment: Half-life reported for field study performed in the surface sediment of an intertidal sandflat (Wilcock et al., 1996). The relative abundance of benzo(b)fluoranthene increased over the 256 day test period.

Anaerobic: High:
Low:

Comment:

<u>Photolysis half-life:</u>

Air: High: 7 hours
Low: 39.6 minutes

Comment: Emissions containing benzo(b)fluoranthene from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). Benzo(b)fluoranthene was not separated from benzo(k)fluoranthene.

Air: High: 7.2 hours
Low: 2.7 hours

Comment: Wood smoke emissions were exposed to midday sunlight in outdoor Teflon-film chambers. Half-lives at temperatures of 20.1 °C, 11.7 °C and -7.0 °C were 1.8 hours, 1.8 hours and 11.6 hours, respectively (Kamens et al., 1986).

Water: High: 371 days
Low: 232 days

Comment: The half lives in water are based by analogy to the experimental data obtained on fluoranthene by Zepp and Schlotzhauer, 1979 and Lyman et al., 1982.

Soil: High:
Low:

Comment:

Other: High: 8.7 hours
Low: 1.9 hours

Comment: Half-lives determined for benzo(b)fluoranthene in n-hexane on thin petri dishes exposed to wavelengths between 290 and 400 nm (Lane and Katz, 1977).

Other: 93 days

Comment: 20% loss was reported for a mixture of benzo(b)fluoranthene in n-hexane exposed to sunlight for one month (November) (Muel and Saguem, 1985).

Photooxidation half-life:

Air: High: 1.4 days
Low: 3.4 hours

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with benzo(b)fluoranthene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with benzo(b)fluoranthene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of $5x10^{-7}$ mm Hg (Perwak et al., 1982).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Bossert, I., Kachel, W.M. and Bartha, R. Fate of hydrocarbons during oily sludge disposal in soil. Appl. Environ. Microbiol. 47: 763-767. 1984.

Coover, M.P. and Sims, R.C.C. The effects of temperature on polycyclic aromatic hydrocarbon persistence in an unacclimated agricultural soil. Haz. Waste Haz. Mat. 4: 69-82. 1987.

Kamens, R.M., Fulcher, J.N. and Zhishi, G. Effects of temperatures on wood soot PAH decay in atmospheres with sunlight and low NO_2. Atmos. Environ. 20: 1579-1587. 1986.

Keck, J., Sims, R.C., Coover, M., Park, K., and Symons, B. Evidence for cooxidation of polynuclear aromatic hydrocarbons in soil. Wat. Res. 21: 1467-1476. 1989.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lane, D.A. and Katz, M. The photomodification of benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoroanthene under simulated atmospheric conditions. Adv. Environ. Sci. Technol. 8: 137-154. 1977.

Lyman, W.J., Reele, W.F. and Rosenblatt, D.H. Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds. McGraw-Hill. New York, NY. pp. 960. 1982.

Muel, B. and Saguem, S. Determination of 23 polycyclic aromatic hydrocarbons in atmospheric particulate matter of the Paris area and photolysis by sunlight. Inter. J. Environ. Anal. Chem. 19: 111-131. 1985.

Park, K.S., Sims, R.C., Dupont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: Influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Perwak, J., Byrne, M., Coons, S., Goyer, M., Harris, J., Cruse, P., Derosier, R., Moss, K. and Wendt, S. Exposure and risk assessment for benzo(a)pyrene and other polycyclic aromatic hydrocarbons. Vol 4. EPA-440/4-85-020-V4. (NTIS PB 85 222-586). Washington, DC: USEPA. 215 pp. 1982.

Wilcock, R.J., Corban, G.A., Northcott, G.L., Wilkins, A.L. and Langdon, A.G. Persistence of polycyclic aromatic compounds of different molecular size and water solubility in surficial sediment of an intertidal sandflat. Environ. Toxicol. Chem. 15: 670-676. 1996.

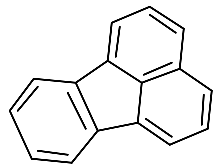
Wild, S.R., Obbard, J.P., Munn, C.I., Berrow, M.L. and Jones, K.C. The long-term persistence of polynuclear aromatic hydrocarbons (PAHs) in an agricultural soil amended with metal-contaminated sewage sludges. Sci. Total Environ. 101: 235-253. 1991.

Zepp, R.G. and Schlotzhauer, P.F. Photoreactivity of selected aromatic hydrocarbons in water. In: Polynuclear Aromatic Hydrocarbons. Jones, P.W. and Leber, P., Eds. Ann Arbor Sci. Publ. Inc. Ann Arbor, MI. pp. 141-158. 1979.

Fluoranthene

CAS Registry Number: 206-44-0

Structure:



Half-lives:

- **Air:** High: 20 hours
  Low: 2 hours

Comment: Based upon an estimated rate constant for the reaction of fluoranthene with hydroxyl radicals (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. Fluoranthene may be susceptible to direct photolysis based on results showing photolysis in aqueous solution (Zepp and Schlotzhauer, 1979; Lyman et al., 1982).

- **Surface Water:**

Comment: This compound is expected to be resistant to biodegradation in water based upon soil data (Coover and Sims, 1987; Wild et al., 1991). Fluoranthene may photolyze in surface waters (Zepp and Schlotzhauer, 1979; Lyman et al., 1982). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis will occur.

- **Soil:** High: 13 years
  Low: 110 days

Comment: Based upon aerobic soil die-away test data (low $t_{1/2}$) (Wild and Jones, 1993) and a long term-field experiment (high $t_{1/2}$) (Wild et al., 1991).

Biodegradation half-life:

- **Aerobic soil:** High: 440 days
  Low: 140 days

Comment: Based upon an aerobic soil die-away test data at 10 to 30 EC (Coover and Sims, 1987).

- **Aerobic soil:** High: 184 days
  Low: 110 days

Comment: Range reported for aerobic soil die-away tests using 4 different soils (Wild and Jones, 1993).

- **Aerobic soil:** Low: 290 days

Comment: Half-life reported for a sludge-amended soil study which ran for 1280 days (Bossert et al., 1984).

Aerobic soil: High: 440 days
Low: 377 days

Comment: Half-lives are reported for soil die-away studies using a mixture of PAHs (high $t_{1/2}$) and fluoranthene only (low $t_{1/2}$) (Keck et al., 1989).

Aerobic soil: High: 377 days
Low: 268 days

Comment: Half-lives determined for a Kidman sandy loam (high $t_{1/2}$) and for a McLaurin sandy loam (low $t_{1/2}$) (Park et al., 1990).

Aerobic soil: High: 4745 days (13 years)
Low: 4088 days (11.2 years)

Comment: Half-lives reported for a long-term sludge-amended soil field experiment (Wild et al., 1991).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High: 63 hours (2.6 days)
Low: 21 hours

Comment: Based upon a measured sunlight photolysis rate constant in water adjusted for midday summer sunlight at 40 EN latitude (low $t_{½}$) (Zepp and Schlotzhauer, 1979) and adjusted for approximate winter sunlight intensity (high $t_{½}$) (Lyman et al., 1982).

Soil: High:
Low:

Comment:

Other: 120 days

Comment: Fluoranthene was added to DMSO and exposed to an artificial light source. Only light above 310 nm was transmitted. 98% of the initial material was present following 3.5 days of exposure (Holloway et al., 1987).

Other: ~110 days

Comment: 10% loss was reported for a mixture of fluoranthene in n-hexane exposed to sunlight for one month (November). Half-life reported in paper (Muel and Saguem, 1985).

Photooxidation half-life:

Air: High: 13 hours
Low: 1.3 hours

Comment: A measured $t_{1/2}$ for the reaction of hydroxyl radicals with fluoranthene in air is given above (Masclet and Mouvier, 1988). However, this compound is expected to exist mainly in the particulate phase based on a vapor pressure of $1.23x10^{-8}$ mm Hg (Boyd et al., 1965). Reaction products of this reaction when NO_x is present include 2-nitrofluoranthene, 7-nitrofluoranthene, and 8-nitrofluoranthene (Atkinson and Arey, 1994).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Atkinson,R. and Arey, J. Atmospheric chemistry of gas-phase polycyclic aromatic hydrocarbons: formation of atmospheric mutagens. Environ. Health Perspect. 4:117-126. 1994.

Bossert, I., Kachel, W.M. and Bartha, R. Fate of hydrocarbons during oily sludge disposal in soil. Appl. Environ. Microbiol. 47: 763-767. 1984.

Boyd, R.H., Christensen, R.L. and Pua, R. The heats of combustion of acenaphthene, acenaphthylene, and fluoranthene. Strain and delocalization in bridged naphthalenes. J. Amer. Chem. Soc. 87: 3554-3559. 1965.

Coover, M.P. and Sims, R.C.C. The effects of temperature on polycyclic aromatic hydrocarbon persistence in an unacclimated agricultural soil. Haz. Waste Haz. Mat. 4: 69-82. 1987.

Holloway, M.P., Biaglow, M.C., McCoy, E.C., Anders, M., Rosenkranz, H.S. and Howard, P.C. Photochemical instability of 1-nitropyrene, 3-nitrofluoranthene, 1,8-dinitropyrene and their parent polycyclic aromatic hydrocarbons. Mutation Res. 187: 199-207. 1987.

Keck, J., Sims, R.C., Coover, M., Park, K. and Symons, B. Evidence for cooxidation of polynuclear aromatic hydrocarbons in soil. Wat. Res. 21: 1467-1476. 1989.

Lyman, W.J., Reele, W.F. and Rosenblatt, D.H. Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds. McGraw-Hill. New York, NY. pp. 960. 1982.

Masclet, P. and Mouvier, G. Atmospheric chemistry of polycyclic aromatic hydrocarbons. Pollut. Atmos. 117: 25-31. 1988.

Muel, B. and Saguem, S. Determination of 23 polycyclic aromatic hydrocarbons in atmospheric particulate matter of the Paris area and photolysis by sunlight. Intern. J. Environ. Anal. Chem. 19: 111-131. 1985.

Park, K.S., Sims, R.C., DuPont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

Wild, S.R., Obbard, J.P., Munn, C.I., Berrow, M.L. and Jones, K.C. The long-term persistence of polynuclear aromatic hydrocarbons (PAHs) in an agricultural soil amended with metal-contaminated sewage sludges. Sci. Total Environ. 101: 235-253. 1991.

Wild, S.R. and Jones, K.C. Biological and abiotic losses of polynuclear aromatic hydrocarbons (PAHs) from soils freshly amended with sewage sludge. Environ. Toxicol. Chem. 12: 5-12. 1993.

Zepp, R.G. and Schlotzhauer, P.F. Photoreactivity of selected aromatic hydrocarbons in water. In: Polynuclear Aromatic Hydrocarbons. Jones, P.W. and Leber, P., Eds. Ann Arbor Sci. Publ. Inc. Ann Arbor, MI. pp. 141-158. 1979.

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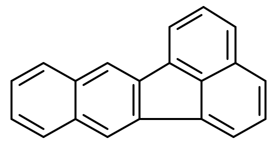
Benzo(k)fluoranthene

CAS Registry Number: 207-08-9

Structure:



Half-lives:

- **Air:** High: 12 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of benzo(k)fluoranthene with hydroxyl radicals (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. Benzo(k)fluoranthene may be susceptible to direct photolysis based on laboratory study results (Pennise and Kamens, 1996; Kamens et al., 1986).

- **Surface Water:**

Comment: No data were located reporting the degradation of benzo(k)fluoranthene in water. Based on a long term field study, this compound is resistant to biodegradation in soil (Wild et al., 1991). Photolysis of benzo(k)fluoranthene may occur, based on laboratory studies in n-hexane (Lane and Katz, 1977; Muel and Saguem, 1985) and laboratory studies in water for an analogous compound, fluoranthene (Zepp and Schlotzhauer, 1979; Lyman et al., 1982). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

- **Soil:** High: 11 years
  Low: 139 days

Comment: The high $t_{1/2}$ was reported in a long-term field experiment (Wild et al., 1991) and the low $t_{1/2}$ was reported in a soil die-away study (Symons et al., 1988).

Biodegradation half-life:

- **Aerobic soil:** High: 3.84 years
  Low: 2.49 years

Comment: Based upon aerobic soil die-away test data at 10 to 30 °C (Coover and Sims, 1987).

- **Aerobic soil:** High: 11 years
  Low: 8.1 years

Comment: Half-lives reported for a long-term field experiment (Wild et al., 1991).

Aerobic soil: High: >180 days
Low: 139 days

Comment: Half-life of 139 days was reported for Nunn clay loam soil, while in Kidman sandy loam, no degradation was seen over the 6 month test period (Symons et al., 1988)

Aerobic soil: 2 years

Comment: Half-life reported for a sludge-amended soil study which ran for 1280 days (Bossert et al., 1984). It was noted that any losses should be viewed as resulting from a combination of biodegradation and undefined abiotic mechanisms.

Aerobic soil: High: 3.84 years
Low: 231 days

Comment: Half-lives are reported for soil-die away studies using a mixture of PAHs (high $t_{1/2}$) and oil refinery waste (low $t_{1/2}$) (Keck et al., 1989).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

<u>Photolysis half-life:</u>

Air: High: 7 hours
Low: 39.6 minutes

Comment: Emissions containing benzo(k)fluoranthene from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively. Benzo(k)fluoranthene was not separated from benzo(b)fluoranthene.

Air: High: 11.6 hours
Low: 1.8 hours

Comment: Wood smoke emissions were exposed to midday sunlight in outdoor Teflon-film chambers. Benzo(k)fluoranthene was not separated from benzo(j)fluoranthene (Kamens et al., 1986). Half-lives at temperatures of 20.1 °C, 11.7 °C, and -7.0 °C were 1.8 hours, 1.8 hours, and 11.6 hours, respectively.

Water: High: 371 days
Low: 232 days

Comment: The half-lives in water are based by analogy to the experimental data obtained on fluoranthene by Zepp and Schlotzhauer, 1979 and Lyman et al., 1982.

Soil: High:
Low:

Comment:

Other: High: 14.1 hours
Low: 54 minutes

Comment: Half-lives determined for benzo(k)fluoranthene in n-hexane on thin petri dish exposed to wavelengths between 290 and 400 nm (Lane and Katz, 1977).

Other: 16.3 days

Comment: 72% loss was reported for a mixture of benzo(k)fluoranthene in n-hexane exposed to sunlight for one month (November) (Muel and Saguem, 1985).

Photooxidation half-life:

Air: High: 12 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with benzo(k)fluoranthene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with benzo(k)fluoranthene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 9.65×10^{-10} mm Hg (Murray et al., 1974).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Bossert, I., Kachel, W.M. and Bartha, R. Fate of hydrocarbons during oily sludge disposal in soil. Appl. Environ. Microbiol. 47: 763-767. 1984.

Coover, M.P. and Sims, R.C.C. The effects of temperature on polycyclic aromatic hydrocarbon persistence in an unacclimated agricultural soil. Haz. Waste Haz. Mat. 4: 69-82. 1987.

Kamens, R.M., Fulcher, J.N. and Zhishi, G. Effects of temperatures on wood soot PAH decay in atmospheres with sunlight and low NO_2. Atmos. Environ. 20: 1579-1587. 1986.

Keck, J., Sims, R.C., Coover, M., Park, K., and Symons, B. Evidence for cooxidation of polynuclear aromatic hydrocarbons in soil. Wat. Res. 21: 1467-1476. 1989.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lane, D.A. and Katz, M. The photomodification of benzo[a]pyrene, benzo[b]fluoranthene, and benzo[k]fluoranthene under simulated atmospheric conditions. Adv. Environ. Sci. Technol. 8: 137-154. 1977.

Lyman, W.J., Reele, W.F. and Rosenblatt, D.H. Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds. McGraw-Hill. New York, NY. pp. 960. 1982.

Muel, B. and Saguem, S. Determination of 23 polycyclic aromatic hydrocarbons in atmospheric particulate matter of the Paris area and photolysis by sunlight. Inter. J. Environ. Anal. Chem. 19: 111-131. 1985.

Murray, J.J., Pottie, R.F. and Pupp, C. Vapor pressures and enthalpies of sublimation of five polycyclic aromatic hydrocarbons. Can. J. Chem. 52: 557-563. 1974.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Symons, B.D., Sims, R.C. and Grenney, W.J. Fate and transport of organics in soil: model predictions and experimental results. JWPCF. 60: 1684-1693. 1988.

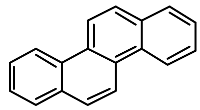
Wild, S.R., Obbard, J.P., Munn, C.I., Berrow, M.L. and Jones, K.C. The long-term persistence of polynuclear aromatic hydrocarbons (PAHs) in an agricultural soil amended with metal-contaminated sewage sludges. Sci. Total Environ. 101: 235-253. 1991.

Zepp, R.G. and Schlotzhauer, P.F. Photoreactivity of selected aromatic hydrocarbons in water. In: Polynuclear Aromatic Hydrocarbons. Jones, P.W. and Leber, P., Eds. Ann Arbor Sci. Publ. Inc. Ann Arbor, MI. pp. 141-158. 1979.

Benzo(a)phenanthrene

<u>CAS Registry Number:</u> 218-01-9

<u>Structure:</u>



<u>Half-lives:</u>

- **Air:** High: 13 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of benzo(a)phenanthrene with hydroxyl radicals (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. Benzo(a)phenanthrene may be susceptible to direct photolysis based on laboratory study results (Pennise and Kamens, 1996; Kamens et al., 1986).

- **Surface Water:** High: 3.8 years
  Low: 79 days

Comment: Half-lives based on sediment grab sample experiment (Lee and Ryan, 1983). Photolysis of benzo(a)phenanthrene may occur based on laboratory studies in water (Zepp and Schlotzhauer, 1979; Lyman et al., 1982). However, this compound should absorb to sediment and particulate material in water and may be removed from the surface where photolysis occurs.

- **Soil:** High: 2.7 years
  Low: 255 days

Comment: Comment: Based upon aerobic soil die-away test data at 10-30 EC (high $t_{1/2}$, Coover and Sims, 1987) and a sludge-amended soil study (low $t_{1/2}$, Bossert et al., 1984). Photolysis on soil surfaces may occur based on laboratory studies in water (Zepp and Schlotzhauer, 1979; Lyman et al., 1982).

<u>Biodegradation half-life:</u>

- **Aerobic soil:** High: 2.7 years
  Low: 2 years

Comment: Based upon aerobic soil die-away test data at 10 to 30°C (Coover and Sims, 1987).

Aerobic soil: High: 2.7 years
Low: 77 days

Comment: Half-lives are reported for soil-die away studies using a mixture of PAHs (high $t_{1/2}$) and oil refinery waste (low $t_{1/2}$) (Keck et al., 1989).

Aerobic soil: 255 days

Comment: Half-life reported for a sludge-amended soil study which ran for 1280 days (Bossert et al., 1984). It was noted that any losses should be viewed as resulting from a combination of biodegradation and undefined abiotic mechanisms.

Aerobic soil: High: 116 days
Low: 41 days

Comment: Based on data from soil die-away test in Nunn clay loam soil (high $t_{1/2}$) and in Kidman sandy loam (low $t_{1/2}$) (Symons et al., 1988).

Aerobic soil: High: 387 days
Low: 371 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined in soil die-away tests performed in McLaurin sandy loam and Kidman sandy loam soils at 20 °C, with durations of 196 and 105 days, respectively (Park et al., 1990). Correction was made for loss due to unspecified abiotic degradation.

Aerobic water: High: 3.8 years
Low: 79 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined in sediments from Savannah, GA and Charleston, SC, respectively (Lee and Ryan, 1983).

Aerobic water: \$100 days

Comment: Half-life reported for field study performed in the surface sediment of an intertidal sandflat (Wilcock et al., 1996). The relative abundance of benzo(a)phenanthrene decreased over the 256 day test period.

Aerobic water: High: 189 days
Low: 153 days

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were determined in Gulf of Thailand sediment slurry and Chao Phraya sediment slurry, respectively (Hungspreugs et al., 1984).

Anaerobic half-life: High:
Low:

Comment:

Photolysis half-life:

Air: High: 12.4 hours
Low: 48 minutes

Comment: Emissions from the combustion of a mixture of wood chips treated with pentachlorophenol, PVC pipe shavings, solid pentachlorophenol contaminated with a mix of PCDDs and solid 2,4,6-trichlorophenol were exposed to natural sunlight in outdoor Teflon-film chambers (Pennise and Kamens, 1996). The high $t_{1/2}$ and low $t_{1/2}$ represent two different combustion temperatures, 800 and 355 EC, respectively. Benzo(a)phenanthrene was not separated from benz(a)anthracene.

Air: High: 14.4 hours
Low: 2.3 hours

Comment: Wood smoke emissions were exposed to midday sunlight in outdoor Teflon-film chambers (Kamens et al., 1986). Half-lives at temperatures of 20.1 °C, 11.7 °C and -7.0 °C were 2.3 hours, 4.3 hours and 14.4 hours, respectively. Benzo(a)phenanthrene was not separated from triphenylene.

Water: High: 13 hours
Low: 4.4 hours

Comment: Based upon measured aqueous photolysis quantum yields and calculated for midday summer sunlight at 40 EN latitude (low $t_{½}$) (Zepp and Schlotzhauer, 1979) and adjusted for approximate winter sunlight intensity (high $t_{½}$) (Lyman et al., 1982).

Soil: High:
Low:

Comment:

Other: High: 690 hours
Low: 38 hours

Comment: The high $t_{1/2}$ and low $t_{1/2}$ were obtained from benzo(a)phenanthrene absorbed on carbon black and fly ash, respectively. Samples were exposed to a mercury vapor lamp in a Pyrex reactor. (Behymer and Hites, 1986). Half-lives of benzo(a)phenanthrene on silica gel, alumina, fly ash and carbon black were 100, 78, 38 and 690 hours, respectively.

Other: 69 days

Comment: 26% loss was reported for a mixture of benzo(a)phenanthrene in n-hexane exposed to sunlight for one month (November) (Muel and Saguem, 1985).

Photooxidation half-life:

Air: High: 13 hours

Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with benzo(a)phenanthrene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with benzo(a)phenanthrene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 6.23×10^{-9} mm Hg (Hoyer and Peperle, 1958).

Water: High:

Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Behymer, T.D. and Hites, R.A. Photolysis of polycyclic aromatic hydrocarbons adsorbed on simulated atmospheric particulates. Environ. Sci. Technol. 19: 1004-1006. 1985.

Bossert, I., Kachel, W.M. and Bartha, R. Fate of hydrocarbons during oily sludge disposal in soil. Appl. Environ. Microbiol. 47: 763-767. 1984.

Coover, M.P. and Sims, R.C.C. The effects of temperature on polycyclic aromatic hydrocarbon persistence in an unacclimated agricultural soil. Haz. Waste Haz. Mat. 4: 69-82. 1987.

Hoyer, H. and Peperle, W. Determination of the vapor pressure and heat of sublimation of organic compounds. Z. Elektrochem. 62: 61-66. 1958.

Hungspreugs, M., Silpipat, S., Tonapong, C., Lee, R.F., Windom, H.L. and Tenore, K.R. Heavy metals and polycyclic hydrocarbon compounds in benthic organisms of the upper gulf of Thailand. Mar. Pollut. Bull. 15: 213-218. 1984.

Kamens, R.M., Fulcher, J.N. and Zhishi, G. Effects of temperatures on wood soot PAH decay in atmospheres with sunlight and low NO_2. Atmos. Environ. 20: 1579-1587. 1986.

Keck, J., Sims, R.C., Coover, M., Park, K., and Symons, B. Evidence for cooxidation of polynuclear aromatic hydrocarbons in soil. Wat. Res. 21: 1467-1476. 1989.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lee , R.F. and Ryan, C. Microbial and photochemical degradation of polycyclic aromatic hydrocarbons in estuarine waters and sediments. Can, J. Fish Aquat. Sci. 40(Suppl 2): 86-94. 1983.

Lyman, W.J., Reele, W.F. and Rosenblatt, D.H. Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds. McGraw-Hill. New York, NY. pp. 960. 1982.

Muel, B. and Saguem, S. Determination of 23 polycyclic aromatic hydrocarbons in atmospheric particulate matter of the Paris area and photolysis by sunlight. Inter. J. Environ. Anal. Chem. 19: 111-131. 1985.

Park, K.S., Sims, R.C., Dupont, R.R., Doucette, W.J. and Matthews, J.E. Fate of PAH compounds in two soil types: Influence of volatilization, abiotic loss and biological activity. Environ. Toxicol. Chem. 9: 187-195. 1990.

Pennise, D.M. and Kamens, R.M. Atmospheric behavior of polychlorinated dibenzo-p-dioxins and dibenzofurans and the effect of combustion temperature. Environ. Sci. Technol. 30: 2832-2842. 1996.

Symons, B.D., Sims, R.C. and Grenney, W.J. Fate and transport of organics in soil: model predictions and experimental results. JWPCF. 60: 1684-1693. 1988.

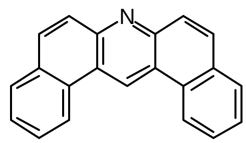
Wilcock, R.J., Corban, G.A., Northcott, G.L., Wilkins, A.L. and Langdon, A.G. Persistence of polycyclic aromatic compounds of different molecular size and water solubility in surficial sediment of an intertidal sandflat. Environ. Toxicol. Chem. 15: 670-676. 1996.

Zepp, R.G. and Schlotzhauer, P.F. Photoreactivity of selected aromatic hydrocarbons in water. In: Polynuclear Aromatic Hydrocarbons. Jones, P.W. and Leber, P., Eds. Ann Arbor Sci. Publ. Inc. Ann Arbor, MI. pp. 141-58. 1979.

Dibenz(a,j)acridine

CAS Registry Number: 224-42-0

Structure:



Half-lives:

- **Air:** High: 23 hours; Low: 2 hours

Comment: Based upon an estimated rate constant for the reaction of dibenz(a,j)acridine with hydroxyl radicals in air (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. This compound may be susceptible to direct photolysis based on its aromatic structure; however, published data were not located.

- **Surface Water:**

Comment: Photolysis of dibenz(a,j)acridine in surface waters may occur based on its aromatic structure; however, this compound is expected to adsorb to particulates and suspended material in the water and may be removed from the surface where photolysis could occur. This compound is expected to be resistant to aerobic biodegradation given its multiple ring structure and data reported in a soil grab sample study.

- **Soil:** >160 days

Comment: If exposed to sunlight at the soil surface, dibenz(a,j)acridine may photodegrade based on its aromatic structure; however data suitable for calculating a half-life for this process were not located. This compound is expected to be resistant to aerobic biodegradation as no mineralization was reported in 5 different soils over a 160 day period (Grosser et al., 1995).

Biodegradation half-life:

- **Aerobic soil:** >160 days

Comment: No mineralization of dibenz(a,j)acridine was noted in a 160-day grab sample study of 5 different soils obtained at and around a coal tar refining plant (Grosser et al., 1995).

- **Aerobic water:** High: ; Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 23 hours
Low: 2 hours

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with dibenz(a,j)acridine. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with dibenz(a,j)acridine in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 1.85×10^{-9} mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Grosser, R.J., Warshawsky, D. and Vestal, J.R. Mineralization of polycyclic and N-heterocyclic aromatic compounds in hydrocarbon-contaminated soils. Environ. Toxicol. Chem. 14: 375-82. 1995.

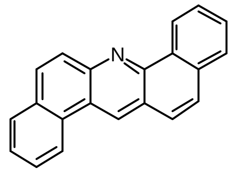
Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-95. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1; Boca Raton, FL: CRC Press. 1985.

Dibenz(a,h)acridine

CAS Registry Number: 226-36-8

Structure:



Half-lives:

- **Air:** High: 13 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of dibenz(a,h)acridine with hydroxyl radicals in air (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. This compound may be susceptible to direct photolysis based on its aromatic structure; however, published data were not located.

- **Surface Water:**

Comment: Photolysis of dibenz(a,h)acridine in surface waters may occur based on its aromatic structure; however, this compound is expected to adsorb to particulates and suspended material in the water and may be removed from the surface where photolysis could occur. This compound is expected to be resistant to aerobic biodegradation given its multiple ring structure. Data suitable for calculating half-lives for these processes were not located.

- **Soil:** >160 days

Comment: If exposed to sunlight at the soil surface, dibenz(a,h)acridine may photodegrade. This compound is expected to be resistant to aerobic biodegradation given its multiple ring structure. Results reported for dibenz(a,j)acridine showed no mineralization of this compound in 5 different soils in a 160-day grab sample study (Grosser et al., 1995).

Biodegradation half-life:

- **Aerobic soil:** >160 days

Comment: No data were located on the rate of biodegradation of dibenz(a,h)acridine in soil. Results reported for a structurally-similar compound, dibenz(a,j)acridine, showed no mineralization of this compound in a 160-day grab sample study of 5 different soils obtained at and around a coal tar refining plant (Grosser et al., 1995).

- **Aerobic water:** High:
  Low:

Comment:

● **Anaerobic:** High:
Low:

Comment:

Photolysis half-life:

● **Air:** High:
Low:

Comment:

● **Water:** High:
Low:

Comment:

● **Soil:** High:
Low:

Comment:

Photooxidation half-life:

● **Air:** High: 13 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with dibenz(a,h)acridine. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with dibenz(a,h)acridine in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 1.85×10^{-9} mm Hg (Neely and Blau, 1985).

● **Water:** High:
Low:

Comment:

Hydrolysis:

● **First-order half-life:** No hydrolyzable groups

Comment:

● **Acid rate constant:**

Comment:

● **Base rate constant:**

Comment:

References:

Grosser, R.J., Warshawsky, D. and Vestal, J.R. Mineralization of polycyclic and N-heterocyclic aromatic compounds in hydrocarbon-contaminated soils. Environ. Toxicol. Chem. 14: 375-82. 1995.

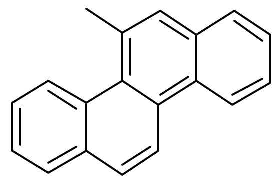
Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-95. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1; Boca Raton, FL: CRC Press. 1985.

5-Methylchrysene

CAS Registry Number: 3697-24-3

Structure:



Half-lives:

- **Air:** High: 5 hours
  Low: 0.5 hour

Comment: Based upon an estimated rate constant for the reaction of 5-methylchrysene with hydroxyl radicals in air (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate phase in the atmosphere, which may result in longer half-lives. 5-Methylchrysene may be susceptible to direct photolysis based on laboratory study results in water for a structurally-similar compound, chrysene (Zepp and Schlotzhauer, 1979; Lyman et al., 1982).

- **Surface Water:**

Comment: No biodegradation data were located for 5-methylchrysene. However, a structurally-similar compound, chrysene, had a low $t_{1/2}$ of 79 days and a high $t_{1/2}$ of 3.8 years based on data from a sediment grab sample experiment (Lee and Ryan, 1983). Photolysis of 5-methylchrysene in surface waters may occur based on laboratory study results for chrysene in water (Zepp and Schlotzhauer, 1979; Lyman et al., 1982); however, 5-methylchrysene is also expected to adsorb to particulates and suspended material in the water and may be removed from the surface where photolysis could occur.

- **Soil:**

Comment: No biodegradation data were located for 5-methylchrysene. However, a structurally-similar compound, chrysene, had a low $t_{1/2}$ of 255 days (Bossert et al., 1984) and a high $t_{1/2}$ of 2.7 years (Coover and Sims, 1987) in laboratory soil studies. Photolysis on soil surfaces may occur based on laboratory studies in water using chrysene (Zepp and Schlotzhauer, 1979; Lyman et al., 1982).

Biodegradation half-life:

- **Aerobic soil:** High: 2.7 years
  Low: 2 years

Comment: No biodegradation data were located for 5-methylchrysene. However, data for a structurally-similar compound, chrysene, were found and used as a representative model for 5-methylchrysene. Based upon aerobic soil die-away test data at 10 to 30 °C (Coover and Sims, 1987).

Aerobic soil: 255 days

Comment: No biodegradation data were located for 5-methylchrysene. However, data for a structurally-similar compound, chrysene, were found and used as a representative model for 5-methylchrysene. Half-life reported for a sludge-amended soil study which ran for 1280 days (Bossert et al., 1984). It was noted that any losses should be viewed as resulting from a combination of biodegradation and undefined abiotic mechanisms.

Aerobic water: High: 3.8 years
Low: 79 days

Comment: No biodegradation data were located for 5-methylchrysene. However, data for a structurally-similar compound, chrysene, were found and used as a representative model for 5-methylchrysene. The high $t_{1/2}$ and low $t_{1/2}$ were determined in sediments from Savannah, GA and Charleston, SC, respectively (Lee and Ryan, 1983).

Aerobic water: High: 189 days
Low: 153 days

Comment: No biodegradation data were located for 5-methylchrysene. However, data for a structurally-similar compound, chrysene, were found and used as a representative model for 5-methylchrysene. The high $t_{1/2}$ and low $t_{1/2}$ were determined in Gulf of Thailand sediment slurry and Chao Phraya sediment slurry, respectively, for chrysene (Hungspreugs et al., 1984).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High: 13 hours
Low: 4.4 hours

Comment: No biodegradation data were located for 5-methylchrysene. However, data for a structurally-similar compound, chrysene, were found and used as a representative model for 5-methylchrysene. Based upon measured aqueous photolysis quantum yields and calculated for midday summer sunlight at 40 EN latitude (low $t_{1/2}$) (Zepp and Schlotzhauer, 1979) and adjusted for approximate winter sunlight intensity (high $t_{1/2}$) (Lyman et al., 1982).

Soil: High:
Low:

Comment:

- Other: High:
Low:

Comment: 26% loss was reported for a mixture of chrysene in n-hexane exposed to sunlight for one month (November) (Muel and Saguem, 1985).

Photooxidation half-life:

Air: High: 5 hours
Low: 0.5 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 5-methylchrysene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with 5-methylchrysene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 2.53×10^{-7} mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Bossert, I., Kachel, W.M. and Bartha, R. Fate of hydrocarbons during oily sludge disposal in soil. Appl. Environ. Microbiol. 47: 763-767. 1984.

Coover, M.P. and Sims, R.C.C. The effects of temperature on polycyclic aromatic hydrocarbon persistence in an unacclimated agricultural soil. Haz. Waste Haz. Mat. 4: 69-82. 1987.

Hungspreugs, M., Silpipat, S., Tonapong, C., Lee, R.F., Windom, H.L. and Tenore, K.R. Heavy metals and polycyclic hydrocarbon compounds in benthic organisms of the upper gulf of Thailand. Mar. Pollut. Bull. 15: 213-218. 1984.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Lyman, W.J., Reele, W.F. and Rosenblatt, D.H. Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds. McGraw-Hill. New York, NY. pp. 960. 1982.

Muel, B. and Saguem, S. Determination of 23 polycyclic aromatic hydrocarbons in atmospheric particulate matter of the Paris area and photolysis by sunlight. Inter. J. Environ. Anal. Chem. 19: 111-131. 1985.

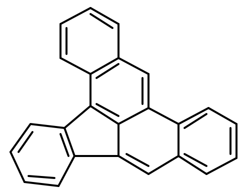
Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1; Boca Raton, FL: CRC Press. 1985.

Zepp, R.G. and Schlotzhauer, P.F. Photoreactivity of selected aromatic hydrocarbons in water. In: Polynuclear Aromatic Hydrocarbons. Jones, P.W. and Leber, P., Eds. Ann Arbor Sci. Publ. Inc. Ann Arbor, MI. pp. 141-158. 1979.

Dibenzo(a,e)fluoranthene

CAS Registry Number: 5385-75-1

Structure:



Half-lives:

- **Air:** High: 10 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of dibenzo(a,e)fluoranthene with hydroxyl radicals in air (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. This compound may be susceptible to direct photolysis based on its aromatic structure; however, published data were not located.

- **Surface Water:**

Comment: Photolysis of dibenzo(a,e)fluoranthene in surface waters may occur based on its aromatic structure; however, this compound is expected to adsorb to particulates and suspended material in the water and may be removed from the surface where photolysis could occur. This compound is expected to be resistant to aerobic biodegradation given its multiple ring structure. Data suitable for calculating half-lives for these processes were not located.

- **Soil:**

Comment: If exposed to sunlight at the soil surface, dibenzo(a,e)fluoranthene may photodegrade. This compound is expected to be resistant to aerobic biodegradation given its multiple ring structure. Data suitable for calculating half-lives for these processes were not located.

Biodegradation half-life:

- **Aerobic soil:** High:
  Low:

Comment:

- **Aerobic water:** High:
  Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 10 hours
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with dibenzo(a,e)fluoranthene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with dibenzo(a,e)fluoranthene in air is given above (Kwok and Atkinson, 1995). However, this compound will exist mainly in the particulate form in the atmosphere based on a vapor pressure of 1.15×10^{-10} mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

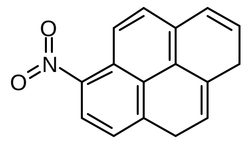
Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1; Boca Raton, FL: CRC Press. 1985.

1-Nitropyrene

CAS Registry Number: 5522-43-0

Structure:



Half-lives:

Air: High: 4 days
Low: 10 hours

Comment: Based upon an estimated rate constant for the reaction of 1-nitropyrene with hydroxyl radicals in the vapor phase (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate phase in the atmosphere, which may result in longer half-lives. This compound is susceptible to direct photolysis as shown by several laboratory studies using organic solvents (Fan et al. 1996; Holder et al., 1994; Koizumi et al., 1994).

Surface Water: High: 44 years (16153 days)
Low: 16 years (5861 days)

Comment: Half-lives given for the mineralization of 1-nitropyrene in two waters, an oil contaminated drainage pond (high $t_{1/2}$) and a bay (low $t_{1/2}$) (Heitkamp et al., 1991). Photolysis of 1-nitropyrene in surface waters may occur based on direct photolysis studies in organic solvents (Greenberg et al., 1987; Holloway et al., 1987; Koizumi et al., 1994); however, this compound is expected to adsorb to particulates and suspended material in the water and may be removed from the surface where photolysis will occur.

Soil:

Comment: No biodegradation studies were located for this compound in soil. 1-Nitropyrene is expected to be resistant to aerobic biodegradation based on results in water. Photolysis on the soil surface may occur based on laboratory results reported for 1-nitropyrene placed on glass surfaces and in organic solvents.

Biodegradation half-life:

Aerobic soil: High:
Low:

Comment:

● **Aerobic water:** High: 44 years (16153 days)
Low: 16 years (5861 days)

Comment: Based on a microcosm study using composite sediment and water samples collected from an oil contaminated drainage pond (high $t_{½}$) and a bay (low $t_{½}$); less than 1% mineralization of 1-nitropyrene occurred over an 8 week period (Heitkamp et al., 1991).

● **Anaerobic:** High:
Low:

Comment:

Photolysis half-life:

● **Air:** High: 2 hours
Low: 1.5 hours

Comment: Half-life is based on study in an outdoor smog chamber containing diesel exhaust and a mixture of deuterated and native nitro-polycyclic aromatic hydrocarbons exposed to natural sunlight for 5 to 7 hours in the presence of ozone and nitrogen oxides; the half-lives in the smog chamber containing the same hydrocarbon mixture with diluted diesel exhaust or wood smoke were 0.8 hours and 0.5 hours, respectively (Fan et al. 1996).

● **Air:** High: 139 days
Low: 28 days

Comment: 1-Nitropyrene was deposited from the vapor phase onto coal fly ash and exposed to artificial light at 300 nm continuously for 3 weeks; 33-41% (low $t_{1/2}$), 10-12% (high $t_{1/2}$), and 20-21% was apparently lost in silica gel, ferromagnetic fraction, and mineral fraction samples, respectively (Holder et al., 1994).

● **Air:** 51 days

Comment: 1-Nitropyrene was adsorbed onto washed diesel engine soot and exposed to sunlight for 40 days; the major degraded compound was 9-hydroxy-1-nitropyrene (Koizumi et al., 1994).

● **Water:** High:
Low:

Comment:

● **Soil:** High:
Low:

Comment:

Other: 6 days

Comment: 1-Nitropyrene was coated onto silica and exposed to artificial light $310 nm for up to 15 days (Holloway et al., 1987).

Other: 15 days

Comment: Half-life is calculated from data in a study using glass plates coated with ^{14}C-labeled 1-nitropyrene exposed to natural sunlight for 12-670 hours (no transformation was noted in control samples left in the dark); photodegradation products included hydroxypyrene (Benson et al., 1985).

Other: 2.8 days

Comment: 1-Nitropyrene was dissolved in methanol and exposed to natural sunlight for 14 days; no significant decrease was noted in control samples kept in the dark for up to 14 days or exposed to artificial light for 5 hours (Greenberg et al., 1987).

Other: 1.2 days

Comment: 1-Nitropyrene was dissolved in DMSO in glass vials and exposed to artificial light $310 nm for up to 4 days (Holloway et al., 1987).

Other: 4 hours

Comment: 1-Nitropyrene was dissolved in benzene and exposed to sunlight in quartz glass flasks for 2 days; the major degraded compound was 9-hydroxy-1-nitropyrene (Koizumi et al., 1994).

Photooxidation half-life:

Air: High: 4 days
Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with 1-nitropyrene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{½}$ for the reaction of hydroxyl radicals with 1-nitropyrene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of $5.52x10^{-8}$ mm Hg (Neely and Blau, 1985).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: No hydrolyzable groups

Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Benson, J.M., Brooks, A.L., Cheng, Y.S., Henderson, T.R. and White, J.E. Environmental transformations of 1-nitropyrene on glass surfaces. Atmos. Environ. 19: 1169-1174. 1985.

Fan, Z., Kamens, R.M., Hu, J., Zhang, J. and McDow, S. Photostability of nitro-polycyclic aromatic hydrocarbons on combustion soot particles in sunlight. Environ. Sci. Technol. 30: 1358-1364. 1996.

Greenberg, A., Darack, F., Wang, Y., Harkov, R., Louis, J. and Atherholt, T. Fate of airborne PAH and nitro-PAH. Proceedings of the 80th Annual Meeting of the APCA. 6: 1-33. 1987.

Heitkamp, M.A., Freeman, J.P., Miller, D.W. and Cerniglia, C.E. Biodegradation of 1-nitropyrene. Arch. Microbiol. 156: 223-230. 1991.

Holder, P.S., Wehry, E.L. and Mamantov, G. Photochemistry transformation of 1-nitropyrene sorbed on coal fly ash fractions. Polycyclic Arom. Comp. 4: 135-139. 1994.

Holloway, M.P., Biaglow, M.C., McCoy, E.C., Anders, M., Rosenkranz, H.S. and Howard, P.C. Photochemical instability of 1-nitropyrene, 3-nitrofluoranthene, 1,8-dinitropyrene and their parent polycyclic aromatic hydrocarbons. Mutat. Res. 187: 199-207. 1987.

Koizumi, A., Satioh, N., Suzuki, T. and Kamiyama, S. A novel compound, 9-hydroxy-1-pyrene, is a major photodegraded compound of 1-nitropyrene in the environment. Arch. Environ. Health. 49: 87-93. 1994.

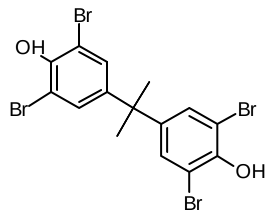
Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Neely, W.B. and Blau, G.E. Environmental exposure from chemicals. Volume 1. Boca Raton, FL: CRC Press. 1985.

Tetrabromobisphenol A

CAS Registry Number: 79-94-7

Structure:



Half-lives:

- **Air:** High: 9 days
  Low: 1 day

Comment: Based upon an estimated rate constant for the reaction of tetrabromobisphenol A with hydroxyl radicals in air (Kwok and Atkinson, 1995). This chemical is expected to also exist in the particulate phase in the air.

- **Surface Water:** High: 84 days
  Low: 48 days

Comment: Half-life range based upon a 56-day grab sample of river sediment and water (Great Lakes Chemical Corporation, 1989).

- **Soil:** High: 179 days
  Low: 44 days

Comment: 37 to 78% of the initial tetrabromobisphenol A was still remaining after 64 days incubation in a soil die-away test using three different soils (Great Lakes Chemical Corporation, 1989).

Biodegradation half-life:

- **Aerobic soil:** High: 179 days
  Low: 44 days

Comment: 37 to 78% of the initial tetrabromobisphenol A was still remaining after 64 days incubation in a soil die-away test using three different soils (Great Lakes Chemical Corporation, 1989).

- **Aerobic water:** High: 84 days
  Low: 48 days

Comment: Based upon a 56-day grab sample of river sediment and water incubated at 25EC at three concentrations from 10 to 1000 Fg/L. High $t_{1/2}$ reported for tetrabromobisphenol A at 1000 Fg/L; low $t_{1/2}$ for tetrabromobisphenol A at 10 Fg/L (Great Lakes Chemical Corporation, 1989).

Photolysis half-life:

- **Air:** High:
  Low:

Comment:

- **Water:** High:
  Low:

Comment:

- **Soil:** High:
  Low:

Comment:

Photooxidation half-life:

- **Air:** High: 9 days
  Low: 1 day

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with tetrabromobisphenol A. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with tetrabromobisphenol A in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist mainly in the particulate form in the atmosphere based on a vapor pressure of 1.76×10^{-11} mm Hg (Neely and Blau, 1985).

- **Water:** High:
  Low:

Comment:

Hydrolysis:

- **First-order half-life:**

Comment:

- **Acid rate const $(M(H+)\text{-}hr)^{-1}$:**

Comment:

- **Base rate const $(M(OH-)\text{-}hr)^{-1}$:**

Comment:

References:

Great Lakes Chemical Corporation. Determination of the biodegradability in a sediment/soil microbial system on tetrabromobisphenol A (draft) with cover letter dated 082389. U.S. EPA/OPTS Public

Files. Fiche #: OTS0525505. Document #: 40-8998115. 1989.

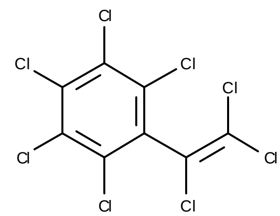
Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-activity relationship: an update. Atmos. Environ. 29: 1685-95. 1995.

Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1; Boca Raton, FL: CRC Press. 245 pp. 1985.

Octachlorostyrene

CAS Registry Number: 29082-74-4

Structure:



Half-lives:

- **Air:** High: 10 hours
  Low: 1 hour

Comment: Based upon an estimated rate constant for the reaction of octachlorostyrene with hydroxyl radicals in air (Kwok and Atkinson, 1995). This compound is also expected to exist partially in the particulate phase in the atmosphere, which may result in longer half-lives. It may be susceptible to direct photolysis based on results showing photolysis in aqueous solution (Hustert et al., 1984).

- **Surface Water:**

Comment: Photolysis occurred very slowly at wavelengths greater than 290 nm using a Pyrex filter (Hustert et al, 1984).

- **Soil:**

Comment: No data were located reporting the degradation of octachlorostyrene in soil.

Biodegradation half-life:

- **Aerobic soil:** High:
  Low:

Comment:

- **Aerobic water:** High:
  Low:

Comment:

- **Anaerobic:** High:
  Low:

Comment:

- **Other:**

Comment: Octachlorostyrene has been detected in water and suspended sediments of the St. Clair River (Chan, 1993) and in soils in Canada (Sanderson and Weis, 1989).

Photolysis half-life:

- **Air:** High:
  Low:

Comment:

- **Water:**

Comment: Photolysis occurred very slowly at wavelengths greater than 290 nm using a Pyrex filter (Hustert et al, 1984).

- **Soil:** High:
  Low:

Comment:

Photooxidation half-life:

- **Air:** High: 10 hours
  Low: 1 hour

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with octachlorostyrene. Hydroxyl radical reactions are expected to be important in the atmospheric degradation of this compound in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with octachlorostyrene in air is given above (Kwok and Atkinson, 1995). However, this compound is expected to exist partially in the particulate form in the atmosphere based on a vapor pressure of 1.32×10^{-5} Hg (Neely and Blau, 1985).

- **Water:** High:
  Low:

Comment:

Hydrolysis:

- **First-order half-life:**

Comment:

- **Acid rate constant:**

Comment:

- **Base rate constant:**

Comment:

References:

Chan, C.H. St. Clair River head and mouth water quality monitoring, 1987-89. Water Poll. Res. J. Canada. 28: 451-471. 1983.

Hustert, K., Kotzias, D. and Korte, F. Beitrag zum verhalten von octachlorostyrol bei UV-bestrahlung. Chemosphere. 13: 845-848. 1984.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

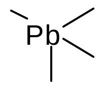
Neely, W.B. and Blau, G.E. Environmental Exposure from Chemicals. Volume 1. Boca Raton, Fla: CRC Press. 245pp. 1985.

Sanderson, M. and Weis, I.M. Concentrations of two organic contaminants in precipitation, soils and plants in the Essex region of Southern Ontario. Environ. Pollut. 59: 41-54. 1989.

Tetramethyl Lead

CAS Registry Number: 75-74-1

Structure:



Half-lives:

- **Air:** High: 10 hours to 4.2 days
  Low: 7 hours to 3 days

Comment: Based upon measured rate constants for the reaction of tetramethyl lead with hydroxyl radicals in the vapor phase (Atkinson, 1989). This compound is also expected to exist partially in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:** High: 43 days
  Low: <5 days

Comment: 59% of the initially added tetramethyl lead in aqueous solution, exposed to sunlight for 22 days, was decomposed (high $t_{1/2}$, Jarvie et al., 1981). In the dark, tetramethyl lead was completely decomposed within 5 days when present in an environmental water (low $t_{1/2}$, Van Cleuvenbergen et al., 1992).

- **Soil:**

Comment: No biodegradation data were located for tetramethyl lead. However, a structurally-similar compound, tetraethyl lead, reported a half-life range in soil of 7 hours (Ou et al., 1994) to 47 days (Teeling and Cypionka, 1997) based on soil die-away studies.

Biodegradation half-life:

- **Aerobic soil:** High: 14 hours
  Low: 7 hours

Comment: No biodegradation data were located for tetramethyl lead. However, a structurally-similar compound, tetraethyl lead, had reported half-lives for soil die-away studies at three different soil depths. The high $t_{1/2}$ is from the 0-15 cm soil layer; the low $t_{1/2}$ is from the 15-30 cm layer (Ou et al., 1994). Sterile controls had half-lives ranging from 12 to 17 hours indicating that significant abiotic degradation is occurring. 4-6% of the applied radiolabel appeared as CO_2, indicating mineralization of the alkyl group.

- **Aerobic soil:** High: 47 days
  Low: 3.6 days

Comment: No biodegradation data were located for tetramethyl lead. However, a structurally-similar compound, tetraethyl lead, reported half-lives for this compound at two different concentrations. High $t_{1/2}$ is for tetraethyl lead added to soil at 10 g Pb/kg dry weight; low $t_{1/2}$ is for tetraethyl lead added to soil at 2 g Pb/kg dry weight (Teeling and Cypionka, 1997).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: 43 days

Comment: 59% of the initially added tetramethyl lead in aqueous solution, exposed to sunlight for 22 days, was decomposed. In the dark, only 16% of the tetramethyl lead was decomposed. The main reaction product was trimethyl lead (Jarvie et al., 1981).

Water: <2 days

Comment: Tetramethyl lead was reported to convert rapidly (within 48 hours) to the trimethyl lead in rainwater (Radojevic and Harrison, 1987).

Soil: High:
Low:

Comment:

Other:

Comment: Tetramethyl lead was adsorbed from aqueous solution onto silica and underwent rapid reaction to give trimethyl lead. On days 0, 7, 14, 28, and 49 the respective percent of tetramethyl lead recovered was 66, 35, 29, 15, and 8%; the percent recovered trimethyl lead was 5, -, 18, 25, and 29%, respectively (Jarvie et al., 1981).

Photooxidation half-life:

Air:

Comment: Alkyllead compounds have been measured in both the vapor and particulate phase in the atmosphere although concentrations in the vapor phase are much greater (Radojevic and Harrison, 1987). The predominant atmospheric species are gaseous tetraalkyl lead with lesser quantities of trialkyl lead and aerosol-associated alkyl lead compounds. Based on smog chamber experiments with a high concentration of hydroxyl radicals, tetramethyl lead is expected to react with hydroxyl radicals in the atmosphere, producing both di- and trimethyl lead and inorganic lead (Radojevic and Harrison, 1987).

Air: High: 10 hours to 4.2 days
Low: 7 hours to 3 days

Comment: Rate constants reported for the reaction of tetramethyl lead with hydroxyl radicals in the atmosphere range from 6.3 to 9.0×10^{-12} cm^3/molecule-sec (Atkinson, 1989). High $t_{1/2}$ range is for the lower rate constant; low $t_{1/2}$ range is for the larger rate constant.

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: <5 days

Comment: In the dark, tetramethyl lead was completely decomposed within 5 days when present in an environmental water (Van Cleuvenbergen et al., 1992).

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Atkinson, R. Kinetics and mechanisms of the gas-phase reactions of the hydroxyl radical with organic compounds. J. Phys. Chem. Ref. Data. Monograph No. 1. 1989.

Harrison, R.M., Hewitt, C.N. and Radojevic, M. Environmental pathways of alkyllead compounds. Heavy Met. Environ. Inter. Conf. 1: 82-84. 1985.

Hewitt, C.N. and Harrison, R.M. Formation and decomposition of trialkyllead compounds in the atmosphere. Environ. Sci. Technol. 20: 797-802. 1986.

Jarvie, A.W.P., Markall, R.N. and Potter, H.R. Decomposition of organolead compounds in aqueous systems. Environ. Res. 25: 241-249. 1981.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Ou, L.T., Jing, W. and Thomas, J.E. Biological and chemical degradation of ionic ethyllead compounds in soil. Environ. Toxicol. Chem. 14: 545-551. 1995.

Radojevic, M. and Harrison, R.M. Concentrations, speciation and decomposition of organo lead compounds in rain water. Atmos. Environ. 2: 2403-2411. 1987.

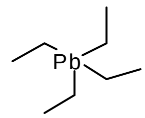
Teeling, H. and Cypionka, H. Microbial degradation of tetraethyl lead in soil monitored by microcalorimetry. Appl. Microbiol. Biotechnol. 48: 275-279. 1997.

Van Cleuvenbergen, R., Dirkx, W., Quevauviller, P. and Adams, F. Preliminary study of degradation of ionic alkyllead species in water. Inter. J. Environ. Anal. Chem. 47: 21-32. 1992.

Tetraethyl Lead

CAS Registry Number: 78-00-2

Structure:



Half-lives:

- **Air:** High: 5.5 hours to 2.3 days
  Low: 0.8 to 8.0 hours

Comment: Based upon measured rate constants for the reaction of tetraethyl lead with hydroxyl radicals in the vapor phase (Atkinson, 1989). This compound is also expected to exist partially in the particulate phase in the atmosphere, which may result in longer half-lives.

- **Surface Water:** High: 2645 days (7.2 years)
  Low: <5 days

Comment: In distilled water, only 2% decomposition of tetraethyl lead to triethyl lead was reported in 77 days when incubated in the dark (Jarvie et al., 1981). The rate of decomposition increases with decreasing water purity. In the dark, tetraethyl lead was completely decomposed within 5 days when present in an environmental water (Van Cleuvenbergen et al., 1992).

- **Soil:** High: 47 days
  Low: 7 hours

Comment: Half-life range given for the degradation of tetraethyl lead in soil. The high $t_{1/2}$ is from a soil die-away study where tetraethyl lead was added to soil at 10 g Pb/kg dry weight (Teeling and Cypionka, 1997). The low $t_{1/2}$ is also from a soil die-away study (Ou et al., 1994). Significant degradation was due in both studies to abiotic processes.

Biodegradation half-life:

- **Aerobic soil:** High: 14 hours
  Low: 7 hours

Comment: Half-life range given for soil die-away studies at three different soil depths. The high $t_{1/2}$ is from the 0-15 cm soil layer; the low $t_{1/2}$ is from the 15-30 cm layer (Ou et al., 1994). Sterile controls had half-lives ranging from 12 to 17 hours indicating that significant abiotic degradation is occurring. 4-6% of the applied radiolabel appeared as CO_2, indicating mineralization of the alkyl group.

Aerobic soil: High: 47 days
Low: 3.6 days

Comment: High $t_{1/2}$ is for tetraethyl lead added to soil at 10 g Pb/kg dry weight; low $t_{1/2}$ is for tetraethyl lead added to soil at 2 g Pb/kg dry weight (Teeling and Cypionka, 1997).

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

Photolysis half-life:

Air: High:
Low:

Comment:

Water: 2.2 days

Comment: In the light, only 1% of the initially added tetraethyl lead in aqueous solution remained after 15 days; triethyl lead was the main reaction product (Jarvie et al., 1981).

Water: <2 days

Comment: Tetraethyl lead was reported to convert rapidly (within 48 hours) to triethyl lead in rainwater (Radojevic and Harrison, 1987).

Soil: High:
Low:

Comment:

Other:

Comment: Tetraethyl lead was adsorbed from aqueous solution onto silica and underwent rapid reaction to give triethyl lead. On days 0, 7, 13, 20, and 29 the respective percent of tetraethyl lead recovered was 78, 54, 19, 19, and 3%; the percent recovered triethyl lead was 0, 33, 63, 56, and 70%, respectively (Jarvie et al., 1981).

Photooxidation half-life:

Air: High: 5.5 hours to 2.3 days
Low: 0.8 to 8.0 hours

Comment: Alkyllead compounds have been measured in both the vapor and particulate phase in the atmosphere although concentrations in the vapor phase are much greater (Radojevic and Harrison, 1987). The predominant atmospheric species are gaseous tetraalkyl lead with lesser quantities of trialkyl lead and aerosol-associated alkyl lead compounds. Rate constants reported for the reaction of tetraethyl lead with hydroxyl radicals in the atmosphere range from 11.6 to $80x10^{-12}$ cm^3/molecule-sec (Atkinson, 1989). High $t_{1/2}$ range is for the smaller rate constant; low $t_{1/2}$ range is for the larger rate constant. Major reaction products include triethyl lead, dialkyl lead and Pb^{2+} (Hewitt and Harrison, 1986).

Water: High:
Low:

Comment:

Hydrolysis:

First-order half-life: 2645 days (7.2 years)

Comment: In distilled water, only 2% decomposition of tetraethyl lead to triethyl lead was reported in 77 days when incubated in the dark (Jarvie et al., 1981). Higher rates of decomposition in the dark which have been reported may be due to loss by adsorption to the glass walls of the reaction vessel (Jarvie et al., 1981).

First-order half-life: <5 days

Comment: In the dark, tetraethyl lead was completely decomposed within 5 days when present in an environmental water (Van Cleuvenbergen et al., 1992).

Acid rate constant:

Comment:

Base rate constant:

Comment:

References:

Atkinson, R. Kinetics and mechanisms of the gas-phase reactions of the hydroxyl radical with organic compounds. J. Phys. Chem. Ref. Data. Monograph No. 1. 1989.

Hewitt, C.N. and Harrison, R.M. Formation and decomposition of trialkyllead compounds in the atmosphere. Environ. Sci. Technol. 20: 797-802. 1986.

Jarvie, A.W.P., Markall, R.N. and Potter, H.R. Decomposition of organolead compounds in aqueous systems. Environ. Res. 25: 241-249. 1981.

Ou, L.T., Thomas, J.E. and Jing, W. Biological and chemical degradation of tetraethyl lead in soil. Bull.

Environ. Contam. Toxicol. 52: 238-245. 1994.

Radojevic, M. and Harrison, R.M. Concentrations, speciation and decomposition of organo lead compounds in rain water. Atmos. Environ. 2: 2403-2411. 1987.

Teeling, H. and Cypionka, H. Microbial degradation of tetraethyl lead in soil monitored by microcalorimetry. Appl. Microbiol. Biotechnol. 48: 275-279. 1997.

Van Cleuvenbergen, R., Dirkx, W., Quevauviller, P. and Adams, F. Preliminary study of degradation of ionic alkyllead species in water. Inter. J. Environ. Anal. Chem. 47: 21-32. 1992.

Mercury

<u>CAS Registry Number:</u> 7439-97-6

<u>General Comments:</u>

Mercury is a metallic element which is able to cycle between various inorganic and organic forms in the environment. The most prevalent forms reported are Hg^0 (elemental), Hg(II) (divalent), methyl and dimethyl mercury. Although biodegradation of mercury does not occur because it is an element, it can be transformed from the divalent form to the highly bioaccumulative and toxic methyl mercury through natural processes. In turn, methyl mercury can be demethylated to form mercury. The relative rates of methylation and demethylation are thought to control the extent of bioaccumulation in aquatic organisms as methyl mercury is, in general, more efficiently bioaccumulated, particularly by fish species. According to a recent hypothesis, the production of both the volatile Hg^0 and the bioavailable methyl mercury through various abiotic and biotic processes is regulated by the concentration of the reactant Hg(II) (Fitzgerald, 1993).

<u>Half-lives:</u>

● **Air:** High: 1 year
Low: 3 days

Comment: Elemental mercury is the predominant form of mercury in the atmosphere (Munthe and McElroy, 1992). Mercury deposition is controlled by the oxidation of Hg^0 to Hg(II) in air followed by dissolution in atmospheric water or adsorption to particulates (Pai et al., 1997). The values given above are the range of residence times estimated for mercury in the atmosphere (ATSDR, 1997)

● **Surface Water:**

Comment: Hg^0, because of its favorable Henry's Law constant and low solubility, is the form of mercury most likely to volatilize from water surfaces. Therefore, the rate of formation of Hg^0 from Hg(II) in the aqueous environment is expected to affect the rate of volatilization. Abiotic reduction in water of Hg(II) to Hg^0, initiated by humic substances has been reported (Allard and Arsenie, 1991). Direct photoreduction of Hg(II) has also been shown to contribute to the formation of dissolved gaseous mercury (mainly Hg^0) in surface waters (Amyot et al., 1997). Oxidation of Hg^0 in the presence of sulfhydryl compounds in water has been shown; up to 250 FM Hg(II) was formed in 10 hours from Hg^0 in the presence of reduced glutathione (Yamamoto, 1995). In addition to the reduction of Hg(II) to Hg^0, abiotic methylation of Hg(II), a process mediated by humic matter (Weber, 1993), as well as the biotic methylation of Hg(II) (Korthals and Winfrey, 1987) may occur forming methyl mercury as the reaction product.

Soil:
Comment: No data were located on the biotransformation of mercury in soil. However, it is expected that in moist soils, Hg(II) will be converted by both biotic and abiotic mechanisms to methylmercury. Reduction to Hg^0 is also expected to occur.

Biotransformation half-life:

Aerobic soil: High:
Low:

Comment:

Aerobic water:
Comment: 367-483 pg methyl mercury were produced after nine days incubation in estuarine water:sediment slurries under aerobic conditions (Weber et al., 1998). 10 ng Hg(II) as HgCl2 was added initially. Control samples which did not receive added Hg(II) produced 168-243 pg methyl mercury.

Aerobic water:
Comment: The rate of biological mercury methylation in lake sediments ranged from 0.003 to 0.220% Hg added/g/hour with the lower rate determined in offshore sediments while the higher rate was measured in sediment from inshore sites (Ramlal et al., (1986).

Aerobic water:
Comment: In aerobic sediment:water systems following incubation with radiolabelled $HgCl_2$, methyl mercury made up 38 and 60% of the extractable radiolabel in the water and sediment, respectively, after 2-3 weeks incubation (Regnell and Tunlid, 1991).

Anaerobic:
Comment: In anaerobic sediment:water systems following incubation with radiolabelled $HgCl_2$, methyl mercury made up 73 and 75% of the extractable radiolabel in the water and sediment, respectively, after 2-3 weeks incubation (Regnell and Tunlid, 1991). The proportion of methylated mercury to total mercury was 12 times higher in the water and 5 times higher in the sediment in the anaerobic systems than in the aerobic systems.

Anaerobic: High: 2.83% methylation/day
Low: 0.51% methylation/day

Comment: Rates of mercury methylation (methyl mercury production from Hg(II)) were greatest in surficial sediments. Methylation also occurred to a lesser extent in aerobic surface waters. The rates given above were determined in surficial sediments from 7 different sites in the lake under anaerobic conditions at *in situ* temperatures (Korthals and Winfrey, 1987). Rates of methylation increased from spring to late summer and decreased in the fall.

Anaerobic:

Comment: 197-2390 pg methyl mercury was produced after nine days incubation in estuarine water:sediment slurries under anaerobic conditions (Weber et al., 1998). 10 ng Hg(II) as $HgCl_2$ was added initially. Control samples which did not receive added Hg(II) produced 197-2390 pg methyl mercury.

<u>Photolysis half-life:</u>

Air: High:
Low:

Comment:

Water:

Comment: Photoreduction of mercury in lake water exposed to sunlight was reported with the formation of dissolved gaseous mercury (mainly Hg^0). A daily photoreduction rate of 263 fM (femtomolar)/day was calculated from this data. Removal of UVB radiation decreased the formation of dissolved gaseous mercury. Studies were completed at two other lakes and at a wetland, also located in the arctic region, with daily photoreduction rates of 0-384 and 672 fM/day reported, respectively (Amyot et al., 1997). Rates of photoreduction to Hg^0 were shown to be substrate limited, most likely due to complexation of Hg(II) in natural waters.

Water:

Comment: Photoreduction of mercury in unfiltered lake water exposed to sunlight was reported with the formation of dissolved gaseous mercury (mainly Hg^0). Photoreduction rates of 17 to 182 fM/hour were calculated from this data. The higher rate was reported in August with the low rate obtained in November (Amyot et al., 1994).

Soil:

Comment: The *in situ* reduction of oxidized mercury to volatile Hg^0 was reported in the uppermost layer of sludge-amended surface soil following exposure to sunlight during a field study (Carpi and Lindberg, 1997). Approximately 1.9 ng/m^2 Hg^0 was applied to the soil while soil Hg^0 emissions ranged from ~20 to >500 ng/m^3/hour. Less than 0.1% of the emitted mercury vapor from the soil was due to the volatilization of methyl mercury.

<u>Photooxidation half-life:</u>

Air:

Comment: The photoreduction of Hg(II) in the presence of oxalate (at 320-800 nm wavelength) was reported to produce a hydroperoxyl radical which reacts with Hg(II) in the atmosphere to form Hg^0. A second-order rate constant of 1.7x10+4/M-sec was measured (Pehkonen and Lin, 1998).

Air:
Comment: Given an ozone concentration of 40 ppb, the rate of oxidation of Hg^0 to Hg(II) is determined to be about 0.01%/hour (Pai et al., 1997).

Water:
Comment:

Hydrolysis:

First-order half-life:
Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Allard, B. and Arsenie, I. Abiotic reduction of mercury by humic substances in aquatic systems-An important process for the mercury cycle. Water Air Soil Pollut. 56: 457-464. 1991.

Amyot, M., Mierle, G., Lean, D.R.S. and McQueen, D.J. Sunlight-induced formation of dissolved gaseous mercury in lake waters. Environ. Sci. Technol. 28: 2366-2371. 1994.

Amyot, M., Lean, D. and Mierle, G. Photochemical formation of volatile mercury in high arctic lakes. Environ. Toxicol. Chem. 16: 2054-2063. 1997.

ATSDR. Agency for Toxic Substances and Disease Registry. Toxicological profile for mercury. United States Department of Health and Human Services. 1997.

Carpi, A. and Lindberg, S.E. Sunlight-mediated emission of elemental mercury from soil amended with municipal sewage sludge. Environ. Sci. Technol. 31: 2085-2091. 1997.

Fitzgerald, W.F. In: Proceedings of the international conference on heavy metals in the environment. Toronto. CEP Consultants Ltd. Edinburgh. Vol. 1: 320-323. 1993.

Korthals, E.T. and Winfrey, W.R. Seasonal and spatial variations in mercury methylation and demethylation in an oligotrophic lake. Appl. Environ. Microbiol. 53: 2397-2404. 1987.

Munthe, J. and McElroy, W.J. Some aqueous reactions of potential importance int he atmospheric chemistry of mercury. Atmos. Environ. 26A: 553-557. 1992.

Pai, P. Kramchandani, P. and Seigneur, C. Simulation of the regional atmospheric transport and fate of mercury using a comprehensive eulerian model. Atmos. Environ. 31: 2717-2732. 1997.

Pehkonen, S.O. and Lin, C-J. Aqueous photochemistry of mercury with organic acids. J. Air & Waste Manage. Assoc. 48: 144-150. 1998.

Ramlal, P.S., Rudd, J.W.M. and Hecky, R.E. Methods for measuring specific rates of mercury methylation and degradation and their use in determining factors controlling net rates of mercury methylation. Appl. Environ. Microbiol. 51: 110-114. 1986.

Regnell, O. and Tunlid, A. Laboratory study of chemical speciation of mercury in lake sediment and water under aerobic and anaerobic conditions. Appl. Environ. Microbiol. 57: 789-795. 1991.

Weber, J.H. Review of possible paths for abiotic methylation of mercury(II) in the aquatic environment. Chemosphere. 26: 2063-2077. 1993.

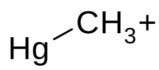
Weber, J.H., Evans, R., Jones, S.H. and Hines, M.E. Conversion of mercury(II) into mercury(0), monomethylmercury cation, and dimethylmercury in saltmarsh sediment slurries. Chemosphere. 36: 1669-1687. 1998.

Yamamoto, M. Possible mechanism of elemental mercury oxidation in the presence of SH compounds in aqueous solution. Chemosphere 31: 2791-2798. 1995.

Methyl Mercury

CAS Registry Number: 22967-92-6 (cation); 16056-34-1

Structure:



Half-lives:

- **Air:** High: 3.3 days
  Low: 8 hours

Comment: Half-life range based upon an estimated rate constant for the reaction of methyl mercury with hydroxyl radicals in air (Kwok and Atkinson, 1995). Methyl mercury is thought to be a product in the atmospheric degradation reactions of dimethyl mercury, a more volatile compound (Sommar et al., 1997).

- **Surface Water:** High: 161 days
  Low: 17 days

Comment: Range of half-lives given for the demethylation of methyl mercury in sediment:water systems (high $t_{1/2}$, freshwater environment; low $t_{1/2}$, saline environment, Oremland et al., 1991). Photolysis of methyl mercury in surface waters may occur (Sellers et al., 1996); however, this compound is expected to adsorb to sediment and particulate matter and may be removed from the surface.

- **Soil:**

Comment: No data on the demethylation of methyl mercury in soils were located. However, based on results reported in water (Oremland et al., 1991), it is possible that this compound would be biotransformed in soil to mercury.

Biodegradation half-life:

- **Aerobic soil:** High:
  Low:

Comment:

- **Aerobic water:** High: 116 days
  Low: 32 days

Comment: Demethylation of methyl mercury was measured in both the water column and in surficial sediments along a lake transect. The half-life range above was determined in surficial sediments from 7 different sites in the lake under aerobic conditions at 23 EC (Korthals and Winfrey, 1987). Rates of demethylation also increased in early summer, were greatest in midsummer and then declined.

Aerobic water:
Comment: Demethylation of methyl mercury in aerobic lake sediments occurred at a rate of 0.017-0.018 % added Hg/g/hour (Ramlal et al., 1986). Demethylation rates determined from sediments from a second lake ranged from 0.023 to 0.267% added Hg/g/hour. Lower rates were from offshore sediments.

Aerobic water: High: 30 days
Low: 17 days
Comment: The half-life range is given for two experiments using estuarine and Mono Lake sediments. After 24 days incubation in aerobic sediments, 63% of the initially added methyl mercury was mineralized (low $t_{1/2}$); after 21 days, 38% of the initially added methyl mercury was mineralized (high $t_{1/2}$) (Oremland et al., 1991). Methane is reported as the major reaction product.

Aerobic water: High: 161 days
Comment: Half-life reported for the demethylation of methyl mercury in aerobic freshwater sediments (Oremland et al., 1991). The major product of this reaction is methane and divalent mercury.

Anaerobic: High: 53 days
Low: 38.5 days
Comment: Demethylation of methyl mercury was reported in anaerobic sediments from estuarine and alkaline-hypersaline environments with the formation of carbon dioxide (Oremland et al., 1991). The half-life range is given for two experiments using estuarine and Mono Lake sediments. After 24 days incubation, 35% of the initially added methyl mercury was mineralized (low $t_{1/2}$); after 21 days, 24% of the initially added methyl mercury was mineralized (high $t_{1/2}$).

Anaerobic: 60 days
Comment: Half-life reported for the demethylation of methyl mercury in anaerobic freshwater sediments (Oremland et al., 1991). Carbon dioxide is reported as the major reaction product. Sulfate-reducing bacteria are believed responsible for the demethylation reaction under anaerobic conditions.

Anaerobic:
Comment: Demethylation of methyl mercury in anaerobic lake sediments occurred at a rate of 0.013-0.014 % added Hg/g/hour (Ramlal et al., 1986).

<u>Photolysis half-life:</u>

Air: High:
Low:

Comment:

Water: 16 days

Comment: Incubation of filtered and unfiltered but sterilized lake water in Teflon bottles in sunlight resulted in the abiotic degradation of methyl mercury. Several comparisons of photodegradation rates in different lakes spanning a range of water chemistry showed no differences in rates due to the water chemistry (Sellers et al., 1996). The half-life was determined for a lake with an average epilimnetic methyl mercury concentration of 0.07 ng/l, an average incident PAR (photosynthetically active radiation between 400 and 700 nm) of 35 E/m^2day, and an average extinction coefficient for PAR of 0.5/m.

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

Photooxidation half-life:

Air: High: 3.3 days
Low: 8 hours

Comment: No experimental data currently exist concerning the gas-phase reactions of the OH radical with methyl mercury. However, rate constants of 18.4 and 19.7×10^{-12} cm^3/mol-sec were reported for the vapor phase reaction of dimethyl mercury with hydroxyl radicals (Atkinson, 1989). Therefore, hydroxyl radical reactions are expected to be important in the atmospheric degradation of methyl mercury in the vapor phase. An estimated $t_{1/2}$ for the reaction of hydroxyl radicals with methyl mercury in air is given above (Kwok and Atkinson, 1995).

Water: 2.1 hours

Comment: Half-life given for the oxidation of methyl mercury in the presence of nitrate following irradiation at wavelengths greater than 290 nm (nitrate photolysis). This reaction took place in a buffered (pH 8.0) solution containing 15 FM octanol. The photolysis of nitrate produced hydroxyl radicals which were responsible for the oxidation of methyl mercury (Zepp et al., 1987).

Hydrolysis:

First-order half-life:

Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

Atkinson, R. Kinetics and mechanisms of the gas-phase reactions of the hydroxyl radical with organic compounds. J. Phys. Chem. Ref. Data. Monograph No. 1. 1989.

Korthals, E.T. and Winfrey, W.R. Seasonal and spatial variations in mercury methylation and demethylation in an oligotrophic lake. Appl. Environ. Microbiol. 53: 2397-2404. 1987.

Kwok, E.S.C. and Atkinson, R. Estimation of hydroxyl radical reaction rate constants for gas-phase organic compounds using a structure-reactivity relationship: an update. Atmos. Environ. 29: 1685-1695. 1995.

Oremland, R.S., Culbertson, C.W. and Winfrey, M.R. Methylmercury decomposition in sediments and bacterial cultures: involvement of methanogens and sulfate reducers in oxidative demethylation. Appl. Environ. Microbiol. 57: 130-137. 1991.

Ramlal, P.S., Rudd, J.W.M. and Hecky, R.E. Methods for measuring specific rates of mercury methylation and degradation and their use in determining factors controlling net rates of mercury methylation. Appl. Environ. Microbiol. 51: 110-114. 1986.

Sellers, P., Kelly, C.A., Rudd, J.W.M. and Machutchon, A.R. Photodegradation of methylmercury in lakes. Nature. 380: 694-697. 1996.

Sommar,J., Hallquist, M., Ljungstrom, E. and Lindqvist,O. On the gas phase reactions between volatile biogenic mercury species and the nitrate radical. J. Atmos. Chem. 27: 233-247. 1997.

Zepp, R.G., Hoigne,J. and Bader, H. Nitrate-induced photooxidation of trace organic chemicals in water. Environ. Sci. Technol. 21: 443-450. 1987.

Cobalt

CAS Registry Number: 7440-48-4

General Comments:

Cobalt is a metallic element. It commonly exists in two oxidation states, the di- and tri- valent forms although other oxidation states have been reported (1^-, 0, 1^+, 4^+, and 5^+) (Schrauzer, 1991). Cobalt is stable to atmospheric oxygen (IARC, 1991). While cobalt is capable of forming complexes with organic material, it is not typically capable of incorporation into organic compounds (an exception is the formation of vitamin B_{12} by microorganisms). Thus, transformation of cobalt occurs mainly between inorganic forms and biotransformation is not expected to be important for this compound in the environment. The environmental chemistry of cobalt and cobalt compounds is mainly ruled by redox potential, pH and complex formation. Half-lives for any transformation process were not found in the literature.

Half-lives:

- **Air:**

Comment: Cobalt is usually released to air as an aerosol as compounds containing cobalt are not typically volatile. Anthropogenic cobalt from combustion exists predominantly as the oxide. The atmospheric half-life associated with deposition will vary considerably depending mainly on the particle size, density and meteorological conditions (ATSDR, 1992).

- **Surface Water:**

Comment: In most fresh waters, <2% of the cobalt species are present in the dissolved state (ATSDR, 1992). In an unpolluted river, 1.6-1.7% was found in the dissolved form, 4.7-8.0% was adsorbed, 27.3-29.2% was precipitated and coprecipitated with mineral oxides (i.e. iron and manganese), 12.9-19.3% formed precipitates such as carbonates and hydroxides, 43.9-51.4% was found in crystalline sediment minerals such as aluminosilicate and goethite. In more polluted waters, the formation of soluble organic complexes may occur to a greater extent. Mobilization of cobalt in water where chelating agents are formed from microbial processes or where chloride is present may occur (ATSDR, 1992). However, a more recent study (Gonsior et al., 1997) reports that EDTA did not significantly solubilize cobalt found in a river sediment. In salt water, cobalt forms ionic complexes with chloride which are then adsorbed onto suspended matter in the water (ATSDR, 1992).

- **Soil:**

Comment: The mobility of cobalt in soil increases as the pH decreases. Higher pH values encourage the formation of the cobalt hydroxide or carbonate forms while a lower pH value will allow some of the precipitated or adsorbed cobalt to form the soluble free ion. Complexes are expected to be formed between cobalt and humic and fulvic acids as well as other organic ligands found in soil (ATSDR, 1992).

Biodegradation half-life:

- **Aerobic soil:** High:
  Low:

Comment:

- **Aerobic water:** High:
  Low:

Comment:

- **Anaerobic:** High:
  Low:

Comment:

Photolysis half-life:

- **Air:** High:
  Low:

Comment:

- **Water:**

Comment: Cobalt in combination with the chelator, EDTA, forms a very stable complex at neutral pH. Less than 1% was decomposed following exposure to sunlight (cited in ATSDR, 1992).

- **Soil:** High:
  Low:

Comment:

Photooxidation half-life:

- **Air:** High:
  Low:

Comment:

- **Water:** High:
  Low:

Comment:

Hydrolysis:

First-order half-life:
Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

ATSDR. Agency for Toxic Substances and Disease Registry. Toxicological profile for cobalt. United States Department of Health and Human Services. 1992.

Gonsior, S.J., Sorci, J.J., Zoellner, M.J. and Landenberger, B.D. The effects of EDTA on metal solubilization in river sediment/water systems. J. Environ. Qual. 26: 957-966. 1997.

IARC. Cobalt and cobalt compounds. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Chlorinated drinking-water; chlorination by-products; some other halogenated compounds; cobalt and cobalt compounds. Vol. 52. pp. 363-472. 1991.

Schrauzer, G.N. Cobalt. In: Metals and Their Compounds in the Environment. Merian, E. (Ed.). VCH Publishers: Weinheim, Federal Republic Germany. pp. 879-892. 1991.

Vanadium

CAS Registry Number: 7440-62-2

General Comments for Metals:

Vanadium is a metallic element; it exists in 6 oxidation states (1^-, 0, 2^+, 3^+, 4^+, and 5^+). The tri-, tetra-, and pentavalent states are the most common. While vanadium is capable of forming complexes with organic material, it is not typically capable of incorporation into organic compounds (e.g., methylated derivatives). Thus, transformation of vanadium occurs mainly between inorganic forms and biotransformation is not important for this compound in the environment (ATSDR, 1992). The environmental chemistry of vanadium is ruled by redox potentials, pH, hydrolysis and complex formation (Byerrum, 1991). Half-lives for any transformation process were not found in the literature.

Half-lives:

- **Air:**

Comment: Vanadium is usually released to air as an aerosol. Man-made sources are generally found as vanadium oxides (ATSDR, 1992). The atmospheric half-life associated with deposition will vary considerably depending mainly on the particle size, density and meteorological conditions.

- **Surface Water:**

Comment: In water, vanadium will exist primarily as the tetravalent and pentavalent forms which are known to bind strongly to mineral or biogenic surfaces by adsorption or complexing. In fresh water, vanadium generally exists as the vanadyl ion (4^+) under reducing conditions and as the vanadate ion (5^+) under oxidizing conditions. The most common vanadyl species are VO^{2+} and $VO(OH)^{1+}$. The most common vanadate species are $H_2VO_4^{1-}$ and HVO_4^{2-} (Byerrum, 1991).

- **Soil:**

Comment: During weathering of soils, the less-soluble trivalent form is usually converted to the more soluble tetra- and pentavalent forms. The ion is usually bound to oxygen (ATSDR, 1992). Precipitation with polyvalent cations such as calcium (2+) and copper (2+), adsorption to clay particles and/or ferric oxide in the soil can reduce mobility of vanadium (ATSDR, 1992). Under unsaturated conditions, some mobility is possible but under reducing, saturated conditions, vanadium is immobile. Metavanadate anions can be converted to immobile vanadyl cations in the presence of humic acids (ATSDR, 1992).

Biodegradation half-life:

- **Aerobic soil:** High:
  Low:

Comment:

Aerobic water: High:
Low:

Comment:

Anaerobic: High:
Low:

Comment:

__**Photolysis half-life:**__

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

Soil: High:
Low:

Comment:

__**Photooxidation half-life:**__

Air: High:
Low:

Comment:

Water: High:
Low:

Comment:

__**Hydrolysis:**__

First-order half-life:
Comment:

Acid rate constant:
Comment:

Base rate constant:
Comment:

References:

ATSDR. Agency for Toxic Substances and Disease Registry. Toxicological profile for vanadium. United States Department of Health and Human Services. 1992.

Byerrum, R.U. Vanadium. In: Metals and Their Compounds in the Environment. Merian, E. (Ed.). VCH Publishers: Weinheim, Federal Republic Germany. pp. 1289-1297. 1991.

APPENDIX 1.

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	003268-87-9
Chemical Name:	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;30;43;51;46
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	3700 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 2600, 2100, 1800, AND 2600 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 003268-87-9
Chemical Name: 1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0;30;0
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: GC-MS
Incubation Time (days): 64;128;260
Test Chemical Concn (ppm): 230 NG/KG DRY WEIGHT
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C): 13-26
pH: 7.4
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCS ON DAY 64, 128 AND 260 WERE 310, 160, AND 280 NG/KG DRY WGT, RESPECTIVELY.
Authors: WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 003268-87-9
Chemical Name: 1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 74;83;83
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: GC-MS
Incubation Time (days): 64;128;260
Test Chemical Concn (ppm): 510 NG/KG DRY WEIGHT
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C): 13-26
pH: 7.4
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PASTURE PLOT. CONCS ON DAY 64, 128 AND 260 WERE 130, 88, AND 87 NG/KG DRY WGT, RESPECTIVELY.
Authors: WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	035822-46-9
Chemical Name:	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;24;45;48;45
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	290 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 220, 160, 150, AND 160 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	035822-46-9
Chemical Name:	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	26 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCENTRATIONS ON DAY 64, 128, AND 260 WERE 37, 33, AND 27 NG/KG DRY WEIGHT, RESPECTIVELY.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	035822-46-9
Chemical Name:	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	69;80;75
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	71 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PASTURE PLOT. CONCENTRATIONS ON DAY 64, 128, AND 260 WERE 22, 14, AND 18 NG/KG DRY WEIGHT, RESPECTIVELY.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 067562-39-4
Chemical Name: 1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0;25;42;44;50
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: HRGC/HRMS
Incubation Time (days): 0;1460;3285;4745;6570
Test Chemical Concn (ppm): 52 NG/KG DRY WEIGHT
Appl Rt (kg/ha):
DOC/Org Content/Add C: 1.8% ORGANIC MATTER
Microbial Population:
Temperature (deg C):
pH: 5.8
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 39, 30, 29, AND 26 NG/KG DRY WEIGHT.
Authors: MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	067562-39-4
Chemical Name:	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	27 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCS ON DAY 64, 128 AND 260 WERE 44, 59, AND 45 NG/KG DRY WGT, RESPECTIVELY.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	067562-39-4
Chemical Name:	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	3;21;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	29 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PASTURE PLOT. CONCS ON DAY 64, 128 AND 260 WERE 28, 23, AND 50 NG/KG DRY WGT, RESPECTIVELY.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 055673-89-7
Chemical Name: 1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0;33;44;44;48
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: HRGC/HRMS
Incubation Time (days): 0;1460;3285;4745;6570
Test Chemical Concn (ppm): 4.8 NG/KG DRY WEIGHT
Appl Rt (kg/ha):
DOC/Org Content/Add C: 1.8% ORGANIC MATTER
Microbial Population:
Temperature (deg C):
pH: 5.8
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 3.2, 2.7, 2.7, AND 2.5 NG/KG DRY WEIGHT.
Authors: MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	055673-89-7
Chemical Name:	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	-;-;-
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	NONDETECTABLE
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PASTURE PLOT. CONCS ON DAY 64, 128 AND 260 WERE NONDETECTABLE.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 055673-89-7
Chemical Name: 1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: -;-;-
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: GC-MS
Incubation Time (days): 64;128;260
Test Chemical Concn (ppm): NONDETECTABLE
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C): 13-26
pH: 7.4
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCS ON DAY 64, 128 AND 260 WERE NONDETECTABLE.
Authors: WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	039227-28-6
Chemical Name:	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;26;39;57;43
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	2.3 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 1.7, 1.4, 1.0, AND 1.3 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	070648-26-9
Chemical Name:	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;25;40;45;35
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	4.0 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 3.0, 2.4, 2.2, AND 2.6 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 070648-26-9
Chemical Name: 1,2,3,4,7,8-HEXACHLORODIBENZOFURAN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0;0;0
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: GC-MS
Incubation Time (days): 64;128;260
Test Chemical Concn (ppm): 3.6 NG/KG DRY WEIGHT
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C): 13-26
pH: 7.4
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCS ON DAY 64, 128 AND 260 WERE 5.6, 5.2, AND 5.2 NG/KG DRY WGT, RESPECTIVELY. UNABLE TO RESOLVE FROM 1,2,3,4,7,9-HXDF.
Authors: WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 070648-26-9
Chemical Name: 1,2,3,4,7,8-HEXACHLORODIBENZOFURAN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0;83;18
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: GC-MS
Incubation Time (days): 64;128;260
Test Chemical Concn (ppm): 6 NG/KG DRY WEIGHT
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C): 13-26
pH: 7.4
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PASTURE PLOT. CONCS ON DAY 64, 128 AND 260 WERE 6.2, 1.0, AND 4.9 NG/KG DRY WGT, RESPECTIVELY. UNABLE TO RESOLVE FROM 123479-HXDF.
Authors: WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	057653-85-7
Chemical Name:	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;29;41;54;45
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	8.6 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 6.1, 5.1, 4.0, AND 4.7 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 057653-85-7
Chemical Name: 1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: -;0;0
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: GC-MS
Incubation Time (days): 64;128;260
Test Chemical Concn (ppm): 3.9 NG/KG DRY WEIGHT
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C): 13-26
pH: 7.4
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCS ON DAY 64, 128 AND 260 WERE NONDETECTABLE, 4.3, AND 4.2 NG/KG DRY WGT, RESPECTIVELY.
Authors: WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 057653-85-7
Chemical Name: 1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 54;69;80
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: GC-MS
Incubation Time (days): 64;128;260
Test Chemical Concn (ppm): 10 NG/KG DRY WEIGHT
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C): 13-26
pH: 7.4
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PASTURE PLOT. CONCS ON DAY 64, 128 AND 260 WERE 4.6, 3.1, AND 2.0 NG/KG DRY WGT, RESPECTIVELY.
Authors: WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	057117-44-9
Chemical Name:	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;29;41;54;45
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	1.8 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 1.5, 1.1, 1.1, AND 1.3 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	057117-44-9
Chemical Name:	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	3.6 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCS ON DAY 64, 128 AND 260 WERE 8.3, 4.6, AND 5.5 NG/KG DRY WGT, RESPECTIVELY.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	057117-44-9
Chemical Name:	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	3;21;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	29 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PASTURE PLOT. CONCS ON DAY 64, 128 AND 260 WERE 28, 23, AND 50 NG/KG DRY WGT, RESPECTIVELY.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	019408-74-3
Chemical Name:	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;27;37;49;44
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	4.1 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 3.0, 2.6, 2.1, AND 2.3 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	019408-74-3
Chemical Name:	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	-;0;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	4.2 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCS ON DAY 64, 128 AND 260 WERE NONDETECTABLE, 4.3, AND 4.9 NG/KG DRY WGT, RESPECTIVELY.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 019408-74-3
Chemical Name: 1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 7;25;30
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: GC-MS
Incubation Time (days): 64;128;260
Test Chemical Concn (ppm): 5.6 NG/KG DRY WEIGHT
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C): 13-26
pH: 7.4
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PASTURE PLOT. CONCS ON DAY 64, 128 AND 260 WERE 5.2, 4.2, AND 3.9 NG/KG DRY WGT, RESPECTIVELY.
Authors: WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	072918-21-9
Chemical Name:	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	-;-;-
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	NONDETECTABLE
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCS ON DAY 64, 128 AND 260 WERE ALL NONDETECTABLE AT 5 NG/KG DRY WGT.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	072918-21-9
Chemical Name:	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	-;-;-
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	NONDETECTABLE
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCS ON DAY 64, 128 AND 260 WERE ALL NONDETECTABLE AT 5 NG/KG DRY WGT.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 040321-76-4
Chemical Name: 1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0;27;44;49;45
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: HRGC/HRMS
Incubation Time (days): 0;1460;3285;4745;6570
Test Chemical Concn (ppm): 1.5 NG/KG DRY WEIGHT
Appl Rt (kg/ha):
DOC/Org Content/Add C: 1.8% ORGANIC MATTER
Microbial Population:
Temperature (deg C):
pH: 5.8
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 1.1, 0.84, 0.76, AND 0.82 NG/KG DRY WEIGHT.
Authors: MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	057117-41-6
Chemical Name:	1,2,3,7,8-PENTACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;12;35;35;29
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	1.7 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 1.5, 1.1, 1.1, AND 1.2 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	052663-65-7
Chemical Name:	2,2',3,3',4,5',6-HEPTACHLOROBIPHENYL
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	50
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	1410
Oxygen Condition:	AE/AN
Environ Sample Type:	PLANO SILT/LOAM SOIL
Location of Study:	
Analysis Method:	GC
Incubation Time (days):	1825
Test Chemical Concn (ppm):	25/75
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	5-YEAR FIELD STUDY IN SLUDGE AMENDED FARMLAND; OTHER HEPTACHOROBIPHENYLS DID NOT SHOW ANY DEGRADATION OVER 5 YEARS.
Authors:	GAN,DR & BERTHOUEX,PM (1994)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 055215-18-4
Chemical Name: 2,2',3,3',4,5-HEXACHLOROBIPHENYL
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 50
Rate Units: % LOSS
Lag Period:
Half-life (days): 1230
Oxygen Condition: AE/AN
Environ Sample Type: PLANO SILT/LOAM SOIL
Location of Study:
Analysis Method: GC
Incubation Time (days): 1825
Test Chemical Concn (ppm): 25/75
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: 5-YEAR FIELD STUDY IN SLUDGE AMENDED FARMLAND; OTHER HEXACHLOROBIPHENYLS DID NOT SHOW ANY DEGRADATION OVER 5 YEARS.
Authors: GAN,DR & BERTHOUEX,PM (1994)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 038379-99-6
Chemical Name: 2,2',3,5',6-PENTACHLOROBIPHENYL
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 50
Rate Units: % LOSS
Lag Period:
Half-life (days): 2610
Oxygen Condition: AE/AN
Environ Sample Type: PLANO SILT/LOAM SOIL
Location of Study:
Analysis Method: GC
Incubation Time (days): 1825
Test Chemical Concn (ppm): 25/75
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: 5-YEAR FIELD STUDY IN SLUDGE AMENDED FARMLAND IN MADISON, WI.
Authors: GAN,DR & BERTHOUEX,PM (1994)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	039585-83-1
Chemical Name:	2,2',4,4',6-PENTACHLOROBIPHENYL
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	50
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	330
Oxygen Condition:	AE/AN
Environ Sample Type:	PLANO SILT/LOAM SOIL
Location of Study:	
Analysis Method:	GC
Incubation Time (days):	1825
Test Chemical Concn (ppm):	25/75
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	5-YEAR FIELD STUDY IN SLUDGE AMENDED FARMLAND IN MADISON, WI.
Authors:	GAN,DR & BERTHOUEX,PM (1994)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	039485-83-1
Chemical Name:	2,2',4,4',6-PENTACHLOROBIPHENYL
Purity:	99.6
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	41.5
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GLC-MS
Incubation Time (days):	
Test Chemical Concn (ppm):	
Appl Rt (kg/ha):	1.12
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	8-31
pH:	6.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	TOT. 14-C RESIDUE SIMILAR (.486/.457 PPM) IN 2 GROWING SEASONS (CARROTS, 1ST YEAR; BEETS, 2ND YEAR WITH NO RETREATMENT; EXACT DAYS NOT NOTED). TOT. RECOVERY=58.5%; 41.5% LOST TO VOL.; 1.4% CROP UPTAKE
Authors:	MOZA,P ET AL. (1979)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	041464-40-8
Chemical Name:	2,2',4,5'-TETRACHLOROBIPHENYL
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	50
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	1740
Oxygen Condition:	AE/AN
Environ Sample Type:	PLANO SILT/LOAM SOIL
Location of Study:	
Analysis Method:	GC
Incubation Time (days):	1825
Test Chemical Concn (ppm):	25/75
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	5-YEAR FIELD STUDY IN SLUDGE AMENDED FARMLAND IN MADISON, WI.
Authors:	GAN,DR & BERTHOUEX,PM (1994)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 035693-99-3
Chemical Name: 2,2',5,5'-TETRACHLOROBIPHENYL
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 50
Rate Units: % LOSS
Lag Period:
Half-life (days): 1740
Oxygen Condition: AE/AN
Environ Sample Type: PLANO SILT/LOAM SOIL
Location of Study:
Analysis Method: GC
Incubation Time (days): 1825
Test Chemical Concn (ppm): 25/75
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: 5-YEAR FIELD STUDY IN SLUDGE AMENDED FARMLAND IN MADISON, WI.
Authors: GAN,DR & BERTHOUEX,PM (1994)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	060851-34-5
Chemical Name:	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;16;37;37;26
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	1.9 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 1.6, 1.2, 1.2, AND 1.4 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	060851-34-5
Chemical Name:	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	-;-;-
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	NONDETECTABLE
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PASTURE PLOT. CONCS ON DAY 64, 128 AND 260 WERE ALL NONDETECTABLE AT 5 NG/KG DRY WGT.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	060851-34-5
Chemical Name:	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	-;-;-
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	NONDETECTABLE
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCS ON DAY 64, 128 AND 260 WERE ALL NONDETECTABLE AT 5 NG/KG DRY WGT.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	057117-31-4
Chemical Name:	2,3,4,7,8-PENTACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;20;44;48;40
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	2.5 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 2.0, 1.4, 1.3, AND 1.5 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	001746-01-6
Chemical Name:	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;24;39;52;41
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	0.87 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDDS APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 0.66, 0.53, 0.42, AND 0.51 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	001746-01-6
Chemical Name:	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	72;51;52;63;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	EGLIN AFB, FLORIDA
Analysis Method:	
Incubation Time (days):	1215
Test Chemical Concn (ppm):	1500;610;1200;270;400
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	0.17% ORGANIC MATTER CONTENT
Microbial Population:	
Temperature (deg C):	17.9
pH:	5.6
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	92% SAND, 3.8% SILT, 4.2% CLAY. FIVE SUBSAMPLES COLLECTED FROM EACH OF 5 PLOTS. FINAL CONCENTRATION=420;300;580;100;400 FOR PLOT 1;2;3;4;5. SAMPLED AUG 1974 (T=0) AND JAN 1978.
Authors:	YOUNG,AL ET AL. (1981)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	051207-31-9
Chemical Name:	2,3,7,8-TETRACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;19;41;50;38
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	3.2 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 2.6, 1.9, 1.6, AND 2.0 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 032690-93-0
Chemical Name: 2,4,4',5-TETRACHLOROBIPHENYL
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 50
Rate Units: % LOSS
Lag Period:
Half-life (days): 330
Oxygen Condition: AE/AN
Environ Sample Type: PLANO SILT/LOAM SOIL
Location of Study:
Analysis Method: GC
Incubation Time (days): 1825
Test Chemical Concn (ppm): 25/75
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: 5-YEAR FIELD STUDY IN SLUDGE AMENDED FARMLAND IN MADISON, WI.
Authors: GAN,DR & BERTHOUEX,PM (1994)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	032774-16-6
Chemical Name:	3,3',4,4',5,5'-HEXACHLOROBIPHENYL
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	73;67;56
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	48 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PASTURE PLOT. CONCS ON DAY 0, 64, 128 AND 260 WERE 48, 13, 16, AND 21 NG/KG DRY WGT, RESPECTIVELY.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	000309-00-2
Chemical Name:	ALDRIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	390;291
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	WISCONSIN
Analysis Method:	PHENYLAZIDE METHOD
Incubation Time (days):	1260
Test Chemical Concn (ppm):	
Appl Rt (kg/ha):	20 LBS/ACRE
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	NO
Remarks:	MUCK SOIL;SILT LOAM SOIL. HALF-LIVES FOR 1ST HALF YEAR IN MUCK AND SILT LOAM SOILS ARE 113 AND 72 DAYS, RESPECTIVELY.
Authors:	LICHTENSTEIN,EP & SCHULZ,KR (1959)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 000309-00-2
Chemical Name: ALDRIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 28;40
Rate Units: % REMAINING
Lag Period:
Half-life (days): 1825;3285
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study: BELTSVILLE, MARYLAND
Analysis Method: GC/ECD
Incubation Time (days): 5840
Test Chemical Concn (ppm): 25;100
Appl Rt (kg/ha): 56;224
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out: NO
Remarks: CONGAREE SANDY LOAM. THE HALF-LIFE FOR PURIFIED ALDRIN IS 5 YEARS WHILE THE HALF-LIFE FOR TECHNICAL ALDRIN IS 9 YEARS. TWO HALF-LIVES AND RATES GIVEN FOR PURIFIED;TECHNICAL ALDRIN.
Authors: NASH,RG & WOOLSON,EA (1967)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 000056-55-3
Chemical Name: BENZO(A)ANTHRACENE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate:
Rate Units:
Lag Period:
Half-life (days): >=100
Oxygen Condition: AE
Environ Sample Type: INTERTIDAL SANDFLAT
Location of Study: MANUKAU HARBOUR, NEW ZEALAND
Analysis Method: GC/MS
Incubation Time (days): 256
Test Chemical Concn (ppm): 0.1 G
Appl Rt (kg/ha):
DOC/Org Content/Add C: 0.34%
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: RELATIVE ABUNDANCE OF BENZO(A)ANTHRACENE DECREASED OVER THE 256 DAY PERIOD.
Authors: WILCOCK,RJ ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	000218-01-9
Chemical Name:	BENZO(A)PHENANTHRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	>=100
Oxygen Condition:	AE
Environ Sample Type:	INTERTIDAL SANDFLAT
Location of Study:	MANUKAU HARBOUR, NEW ZEALAND
Analysis Method:	GC/MS
Incubation Time (days):	256
Test Chemical Concn (ppm):	0.1 G
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	0.34%
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	RELATIVE ABUNDANCE OF BENZO(A)PHENANTHRENE DECREASED OVER THE 256 DAY PERIOD.
Authors:	WILCOCK,RJ ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	000050-32-8
Chemical Name:	BENZO(A)PYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	>=100
Oxygen Condition:	AE
Environ Sample Type:	INTERTIDAL SANDFLAT
Location of Study:	MANUKAU HARBOUR, NEW ZEALAND
Analysis Method:	GC/MS
Incubation Time (days):	256
Test Chemical Concn (ppm):	0.1 G
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	0.34%
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	RELATIVE ABUNDANCE OF BENZO(A)PYRENE INCREASED OVER THE 256 DAY PERIOD.
Authors:	WILCOCK,RJ ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	000050-32-8
Chemical Name:	BENZO(A)PYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	5329;4015
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	LUDDINGTON, UK
Analysis Method:	HPLC
Incubation Time (days):	7300
Test Chemical Concn (ppm):	0.7
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	TWO HALF-LIVES REPORTED DETERMINED BY 1) MASS BALANCE METHOD AND 2) LINE OF BEST FIT WAS DRAWN THROUGH DATA AND USED TO DETERMINE T1/2. SLUDGE APPLIED IN 1968 ONLY.
Authors:	WILD,SR ET AL. (1991)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	000205-99-2
Chemical Name:	BENZO(B)FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	>=100
Oxygen Condition:	AE
Environ Sample Type:	INTERTIDAL SANDFLAT
Location of Study:	MANUKAU HARBOUR, NEW ZEALAND
Analysis Method:	GC/MS
Incubation Time (days):	256
Test Chemical Concn (ppm):	0.1 G
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	0.34%
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	RELATIVE ABUNDANCE OF BENZO(B)FLUORANTHENE INCREASED OVER THE 256 DAY PERIOD.
Authors:	WILCOCK,RJ ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 000205-99-2
Chemical Name: BENZO(B)FLUORANTHENE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate:
Rate Units:
Lag Period:
Half-life (days): 5183;4380
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study: LUDDINGTON, UK
Analysis Method: HPLC
Incubation Time (days): 7300
Test Chemical Concn (ppm): 1.4
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: TWO HALF-LIVES REPORTED DETERMINED BY 1) MASS BALANCE METHOD AND 2) LINE OF BEST FIT WAS DRAWN THROUGH DATA AND USED TO DETERMINE T1/2. SLUDGE APPLIED IN 1968 ONLY.
Authors: WILD,SR ET AL. (1991)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	000191-24-2
Chemical Name:	BENZO(GHI)PERYLENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	MANUKAU HARBOUR, NEW ZEALAND
Analysis Method:	GC-MS
Incubation Time (days):	1;2;3;7;21;49;256
Test Chemical Concn (ppm):	0.1 G
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	0.34% TOC
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	BENZO(GHI)PERYLENE APPLIED TO SURFACE OF INTERTIDAL SAND FLAT HAD A HALF-LIFE OF >=100 DAYS. RELATIVE ABUNDANCE OVER 256 DAY PERIOD INCREASED.
Authors:	WILCOCK,RJ ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	000207-08-9
Chemical Name:	BENZO(K)FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	2956.5;4015
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	LUDDINGTON, UK
Analysis Method:	HPLC
Incubation Time (days):	7300
Test Chemical Concn (ppm):	0.5
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	TWO HALF-LIVES REPORTED DETERMINED BY 1) MASS BALANCE METHOD AND 2) LINE OF BEST FIT WAS DRAWN THROUGH DATA AND USED TO DETERMINE T1/2. SLUDGE APPLIED IN 1968 ONLY.
Authors:	WILD,SR ET AL. (1991)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	000057-74-9
Chemical Name:	CHLORDANE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	85
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC/ECD
Incubation Time (days):	7665
Test Chemical Concn (ppm):	2% CHLORDANE EMULSION
Appl Rt (kg/ha):	4 GAL/5 LINEAR FEET
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	LEACHING
Remarks:	GAMMA ISOMER USED TO MONITOR CHLORDANE CONCENTRATIONS. AFTER 21 YEARS, 15% REMAINED, MAINLY IN THE IMMEDIATE TREATMENT AREA. APPLIED TO OUTER FOUNDATION OF HOME.
Authors:	BENNETT,GW ET AL. (1974)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 000057-74-9
Chemical Name: CHLORDANE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 85
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study: OHIO
Analysis Method:
Incubation Time (days): 4380
Test Chemical Concn (ppm):
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out: NO
Remarks: AFTER 12 YEARS, 15% OF THE CHLORDANE APPLIED TO TURF PLOTS REMAINED.
Authors: LICHTENSTEIN,EP (1959)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 000057-74-9
Chemical Name: CHLORDANE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 60
Rate Units: % REMAINING
Lag Period:
Half-life (days): 2920
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study: BELTSVILLE, MARYLAND
Analysis Method: GC/ECD
Incubation Time (days): 5840
Test Chemical Concn (ppm): 50;100
Appl Rt (kg/ha): 112;224
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out: NO
Remarks: CONGAREE SANDY LOAM.
Authors: NASH,RG & WOOLSON,EA (1967)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 000057-74-9
Chemical Name: CHLORDANE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 84
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study: NOVA SCOTIA, CANADA
Analysis Method: GC/ECD
Incubation Time (days): 5475
Test Chemical Concn (ppm): 15
Appl Rt (kg/ha): 14 KG/HA/YR
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out: NO
Remarks: AFTER 15 YEARS, ALPHA- AND GAMMA-CHLORDANE WERE THE MAIN SOIL RESIDUES. HEPTACHLOR EPOXIDE WAS A MINOR COMPONENT; NO HEPTACHLOR WAS FOUND. PLOTS WERE CULTIVATED AND CROPS WERE GROWN EACH YEAR.
Authors: STEWART,DKR & CHISHOLM,D (1971)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 000053-70-3
Chemical Name: DIBENZO(A,H)ANTHRACENE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate:
Rate Units:
Lag Period:
Half-life (days): >=100
Oxygen Condition: AE
Environ Sample Type: INTERTIDAL SANDFLAT
Location of Study: MANUKAU HARBOUR, NEW ZEALAND
Analysis Method: GC/MS
Incubation Time (days): 256
Test Chemical Concn (ppm): 0.1 G
Appl Rt (kg/ha):
DOC/Org Content/Add C: 0.34%
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: RELATIVE ABUNDANCE OF DIBENZO(A,H)ANTHRACENE INCREASED OVER THE 256 DAY PERIOD.
Authors: WILCOCK,RJ ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 000072-20-8
Chemical Name: ENDRIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 59;59
Rate Units: % LOSS
Lag Period:
Half-life (days): 3972;3972
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study: BELTSVILLE, MARYLAND
Analysis Method: GC/ECD
Incubation Time (days): 5110
Test Chemical Concn (ppm): 25;100
Appl Rt (kg/ha): 56;224
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: ENDRIN WAS MIXED UNIFORMLY THROUGHOUT THE SOIL PROFILE. SOIL WAS A CONGAREE SANDY LOAM. OTHER PROCESSES WERE NOT RULED OUT.
Authors: NASH,RG & WOOLSON,EA (1967)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	000206-44-0
Chemical Name:	FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	4088;4745
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	LUDDINGTON, U.K.
Analysis Method:	HPLC
Incubation Time (days):	7300
Test Chemical Concn (ppm):	3
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	TWO HALF-LIVES REPORTED DETERMINED BY 1) MASS BALANCE METHOD AND 2) LINE OF BEST FIT WAS DRAWN THROUGH DATA AND USED TO DETERMINE T1/2. SLUDGE APPLIED IN 1968 ONLY.
Authors:	WILD,SR ET AL. (1991)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 000076-44-8
Chemical Name: HEPTACHLOR
Purity: TECHNICAL
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 84
Rate Units: % LOSS
Lag Period:
Half-life (days): 730 TO 1460
Oxygen Condition: AE
Environ Sample Type: CONGAREE SANDY LOAM
Location of Study: PLANT INDUSTRY STATION, BELTSVILLE, MD
Analysis Method: GC
Incubation Time (days): 5110
Test Chemical Concn (ppm): 0, 25, 50, OR 100
Appl Rt (kg/ha): 0, 56, 112, OR 224
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: 14-YEAR FIELD STUDY WITH HALF-LIFE OF 2-4 YEARS; LOSSES FROM VOLATILIZATION, CHEMICAL DECOMPOSITION, PHOTODECOMPOSITION, CROP ABSORPTION AND BIODEGRADATION.
Authors: NASH,RG AND WOOLSON,EA (1967)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	000456-73-6
Chemical Name:	ISODRIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	365;182;182
Oxygen Condition:	
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	
Incubation Time (days):	
Test Chemical Concn (ppm):	
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	
pH:	
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	HALF-LIVES WERE 365, 182 AND 182 DAYS IN BELTSVILLE, MISSISSIPPI AND NEW JERSEY SOILS, RESPECTIVELY. INFORMATION FROM A REVIEW AND ORIGINAL PAPERS NOT IN XREF.
Authors:	ADAMS,RSJR (1967)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 000456-73-6
Chemical Name: ISODRIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 15
Rate Units: % REMAINING
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: CONGAREE SANDY LOAM SOIL
Location of Study: PLANT INDUSTRY STATION, BELTSVILLE, MD
Analysis Method: GC
Incubation Time (days): 5110
Test Chemical Concn (ppm):
Appl Rt (kg/ha): 0;56;112;224
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: AFTER 14 YEARS IN A CONGAREE SANDY LOAM SOIL, AMT OF ISODRIN REMAINING WAS 15%. NO DETERMINATION WAS MADE BETWEEN AMT REMAINING FROM ORIGINAL APPLICATION AND THAT PRODUCED BY ENDRIN DEGRADATION.
Authors: NASH,RG & WOOLSON,EA (1967)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	039001-02-0
Chemical Name:	OCTACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;29;45;48;44
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	HRGC/HRMS
Incubation Time (days):	0;1460;3285;4745;6570
Test Chemical Concn (ppm):	140 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	1.8% ORGANIC MATTER
Microbial Population:	
Temperature (deg C):	
pH:	5.8
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDD APPLIED TO SOIL. CONCENTRATIONS AT 4, 9, 13, AND 18 YEARS WERE 100, 77, 73, AND 79 NG/KG DRY WEIGHT.
Authors:	MCLACHLAN,MS ET AL. (1996)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	039001-02-0
Chemical Name:	OCTACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	
Analysis Method:	GC-MS
Incubation Time (days):	64;128;260
Test Chemical Concn (ppm):	42 NG/KG DRY WEIGHT
Appl Rt (kg/ha):	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	13-26
pH:	7.4
Suspended Solids:	
Other Fate Processes Ruled Out:	
Remarks:	SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PLOWED PLOT. CONCS ON DAY 64, 128 AND 260 WERE 60, 43, AND 61 NG/KG DRY WGT, RESPECTIVELY.
Authors:	WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 039001-02-0
Chemical Name: OCTACHLORODIBENZOFURAN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 49;68;58
Rate Units: % LOSS
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study:
Analysis Method: GC-MS
Incubation Time (days): 64;128;260
Test Chemical Concn (ppm): 59 NG/KG DRY WEIGHT
Appl Rt (kg/ha):
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C): 13-26
pH: 7.4
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: SLUDGE CONTAINING PCDF/PCDD, PCBS, AND VOCS APPLIED TO SURFACE OF PASTURE PLOT. CONCS ON DAY 64, 128 AND 260 WERE 30, 19, AND 25 NG/KG DRY WGT, RESPECTIVELY.
Authors: WILSON,SC ET AL. (1997)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 040487-42-1
Chemical Name: PENDIMETHALIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 41;28;31;12
Rate Units: % REMAINING
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study: SASKATOON, SASKATCHEWAN, CANADA
Analysis Method: GC/ECD
Incubation Time (days): 120;479;120;479
Test Chemical Concn (ppm):
Appl Rt (kg/ha): 1.21;1.21;1.11;1.11
DOC/Org Content/Add C: 3.9;3.4;3.4;3.3
Microbial Population:
Temperature (deg C):
pH: 6.7;6.9;7.3;7.3
Suspended Solids:
Other Fate Processes Ruled Out:
Remarks: EC FORMULATION APPLIED IN MAY 1993 AND MEASURED SEPTEMBER 1993 AND 1994 AT TWO LOCATIONS, THE ESTLIN SITE AND THE REGINA SITE.
Authors: SMITH ET AL. (1995)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type:	FIELD
CAS Registry No:	000608-93-5
Chemical Name:	PENTACHLOROBENZENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	6
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Oxygen Condition:	AE
Environ Sample Type:	SOIL
Location of Study:	WOBURN, UK
Analysis Method:	GC/ECD
Incubation Time (days):	11315
Test Chemical Concn (ppm):	0.69 UG/KG
Appl Rt (kg/ha):	0.55 G/HA
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (deg C):	
pH:	6.5
Suspended Solids:	
Other Fate Processes Ruled Out:	NO
Remarks:	SANDY LOAM. 25 SLUDGE APPLICATIONS FROM 1942 TO 1961. APPLICATIONS ENDED IN 1961. PERCENT REMAINING IN 1960=27, PERCENT REMAINING IN 1991=21.
Authors:	WANG,MJ ET AL. (1995)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 008001-35-2
Chemical Name: TOXAPHENE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 55
Rate Units: % REMAINING
Lag Period:
Half-life (days): 4015
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study: BELTSVILLE, MARYLAND
Analysis Method: GC/ECD
Incubation Time (days): 5110
Test Chemical Concn (ppm): 50;100
Appl Rt (kg/ha): 112;224
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out: NO
Remarks: CONGAREE SANDY LOAM.
Authors: NASH,RG & WOOLSON,EA (1967)

Table 1. Biodegradation data for TRI chemicals - Field studies

Parameter Type: FIELD
CAS Registry No: 001582-09-8
Chemical Name: TRIFLURALIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 67;15;4;~0
Rate Units: % 14C-TRIFLURALIN REMAINING
Lag Period:
Half-life (days):
Oxygen Condition: AE
Environ Sample Type: SOIL
Location of Study: GREENFIELD, INDIANA
Analysis Method: 14C-RADIOLABEL
Incubation Time (days): 28;365;728;1095
Test Chemical Concn (ppm):
Appl Rt (kg/ha): 0.84-6.72
DOC/Org Content/Add C:
Microbial Population:
Temperature (deg C):
pH:
Suspended Solids:
Other Fate Processes Ruled Out: LEACHING
Remarks: AFTER 3 YEARS, THE 0-15 CM SOIL LAYER CONTAINED 43.5% OF THE APPLIED RADIOACTIVITY, 1.5% TRIFLURALIN, 4% EXTRACTABLE DEGRDN PRODUCTS AND 38% SOIL BOUND RADIOACTIVE RESIDUES.
Authors: GOLAB,T ET AL. (1979)

APPENDIX 2.

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	003268-87-9
Chemical Name:	1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/MS
Incubation Time (days):	60;270;450
Test Chemical Concn (ppm):	6.0
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL
DOC/Org Content/Add C:	1.7% ORGANIC MATTER
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	8.1
Suspended Solids:	
Remarks:	NO BIODEGRADATION OF 1,2,3,4,6,7,8,9-OCTACHLORODIBENZO-P-DIOXIN WAS SEEN OVER 15 MONTHS IN THIS WATER SATURATED SOIL COLUMN STUDY.
Authors:	ORAZIO,CE ET AL. (1992)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	040321-76-4
Chemical Name:	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/MS
Incubation Time (days):	60;270;450
Test Chemical Concn (ppm):	2.4
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL
DOC/Org Content/Add C:	1.7% ORGANIC MATTER
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	8.1
Suspended Solids:	
Remarks:	NO BIODEGRADATION OF 1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN WAS SEEN OVER 15 MONTHS IN THIS WATER SATURATED SOIL COLUMN STUDY.
Authors:	ORAZIO,CE ET AL. (1992)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 005522-43-0
Chemical Name: 1-NITROPYRENE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0;0.01;0.03;0.06;0.08;0.11;0.17;0.24
Rate Units: % MINERALIZATION
Lag Period:
Half-life (days): 16153
Test Method:
Oxygen Condition: AE
Analysis Method:
Incubation Time (days): 56
Test Chemical Concn (ppm):
Environ Sample Type: WATER
Source of Sample: OIL CONTAMINATED DRAINAGE POND, TEXAS
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 22
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: COMPOSITE SEDIMENT/WATER AEROBIC MICROCOSM; MINERALIZATION OF 1-NITROPYRENE WAS LESS THAN 1% AFTER 8 WEEKS OF INCUBATION.
Authors: HEITKAMP,MA ET AL. (1991)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	005522-43-0
Chemical Name:	1-NITROPYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0.04;0.07;0.13;0.23;0.34;0.47;0.61
Rate Units:	% MINERALIZATION
Lag Period:	
Half-life (days):	6343
Test Method:	
Oxygen Condition:	AE
Analysis Method:	
Incubation Time (days):	56
Test Chemical Concn (ppm):	
Environ Sample Type:	WATER
Source of Sample:	SALT WATER POND, TEXAS
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	22
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	COMPOSITE SEDIMENT/WATER AEROBIC MICROCOSM; MINERALIZATION OF 1-NITROPYRENE WAS LESS THAN 1% AFTER 8 WEEKS OF INCUBATION.
Authors:	HEITKAMP,MA ET AL. (1991)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 005522-43-0
Chemical Name: 1-NITROPYRENE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0;0.04;0.11;0.24;0.37;0.51;0.62;0.76
Rate Units: % MINERALIZATION
Lag Period:
Half-life (days): 5861
Test Method:
Oxygen Condition: AE
Analysis Method:
Incubation Time (days): 56
Test Chemical Concn (ppm):
Environ Sample Type: WATER
Source of Sample: REDFISH BAY, TEXAS
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 22
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: COMPOSITE SEDIMENT/WATER AEROBIC MICROCOSM; MINERALIZATION OF 1-NITROPYRENE WAS LESS THAN 1% AFTER 8 WEEKS OF INCUBATION.
Authors: HEITKAMP,MA ET AL. (1991)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	035694-04-3
Chemical Name:	2,2',3,3',5,5'-HEXACHLOROBIPHENYL
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	13.2
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	480
Test Method:	
Oxygen Condition:	AE
Analysis Method:	TLC
Incubation Time (days):	98
Test Chemical Concn (ppm):	0.68 UG/G
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	FLANAGAN SILT LOAM
DOC/Org Content/Add C:	3% ORGANIC MATTER
Microbial Population:	
Temperature (incub) deg C:	28
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	HALF-LIFE CALCULATED FROM PERCENT OF 14C-LABELLED COMPOUND RECOVERED AFTER 98 DAYS.
Authors:	FRIES,GF & MARROW,GS (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	035065-27-1
Chemical Name:	2,2',4,4',5,5'-HEXACHLOROBIPHENYL
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	5.7
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	1157
Test Method:	
Oxygen Condition:	AE
Analysis Method:	TLC
Incubation Time (days):	98
Test Chemical Concn (ppm):	0.51 UG/G
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	FLANAGAN SILT LOAM
DOC/Org Content/Add C:	3% ORGANIC MATTER
Microbial Population:	
Temperature (incub) deg C:	28
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	HALF-LIFE CALCULATED FROM PERCENT OF 14C-LABELLED COMPOUND RECOVERED AFTER 98 DAYS.
Authors:	FRIES,GF & MARROW,GS (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	002437-79-8
Chemical Name:	2,2',4,4'-TETRACHLOROBIPHENYL
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	>98
Test Method:	
Oxygen Condition:	AE-W
Analysis Method:	HPLC
Incubation Time (days):	98
Test Chemical Concn (ppm):	1 OR 10 UG/L
Environ Sample Type:	WATER
Source of Sample:	TITTABAWSSEE RIVER, MIDLAND, MI
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	NO PRIMARY DEGRADATION OF 14C-LABELLED COMPOUND WAS OBSERVED OVER 98 DAYS IN RIVER DIE-AWAY TEST.
Authors:	BAILEY,RE ET AL. (1983)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	002437-79-8
Chemical Name:	2,2',4,4'-TETRACHLOROBIPHENYL
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	10
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	631
Test Method:	
Oxygen Condition:	AE
Analysis Method:	TLC
Incubation Time (days):	98
Test Chemical Concn (ppm):	0.51 UG/G
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	FLANAGAN SILT LOAM
DOC/Org Content/Add C:	3% ORGANIC MATTER
Microbial Population:	
Temperature (incub) deg C:	28
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	HALF-LIFE CALCULATED FROM PERCENT OF 14C-LABELLED COMPOUND RECOVERED AFTER 98 DAYS.
Authors:	FRIES,GF & MARROW,GS (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	035693-99-3
Chemical Name:	2,2',5,5'-TETRACHLOROBIPHENYL
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	12
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	531
Test Method:	
Oxygen Condition:	AE
Analysis Method:	TLC
Incubation Time (days):	98
Test Chemical Concn (ppm):	0.93 UG/G
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	FLANAGAN SILT LOAM
DOC/Org Content/Add C:	3% ORGANIC MATTER
Microbial Population:	
Temperature (incub) deg C:	28
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	HALF-LIFE CALCULATED FROM PERCENT OF 14C-LABELLED COMPOUND RECOVERED AFTER 98 DAYS.
Authors:	FRIES,GF & MARROW,GS (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	052663-72-6
Chemical Name:	2,3',4,4',5,5'-HEXACHLOROBIPHENYL
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	85.08
Test Method:	
Oxygen Condition:	AN-W
Analysis Method:	GC/ECD
Incubation Time (days):	141
Test Chemical Concn (ppm):	
Environ Sample Type:	RIVER SEDIMENT
Source of Sample:	HOUSATONIC RIVER
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	23-25
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	PRIMED WITH 23456-CB; T0=0.41 MOL % OF TOTAL PCBS; T141=0.13 MOL % OF TOTAL PCBS SHOWING A 68% DECREASE IN CONCENTRATION
Authors:	VANDORT,HM ET AL. (1997)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	031508-00-6
Chemical Name:	2,3',4,4',5-PENTACHLOROBIPHENYL
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	68
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	85.45
Test Method:	
Oxygen Condition:	AN-W
Analysis Method:	GC/ECD
Incubation Time (days):	141
Test Chemical Concn (ppm):	
Environ Sample Type:	RIVER SEDIMENT
Source of Sample:	HOUSATONIC RIVER
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	23-25
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	PRIMED WITH 23456-CB; T0=1.57 MOL % OF TOTAL PCBS; T141=0.5 MOL % OF TOTAL PCBS SHOWING A 68% DECREASE IN CONCENTRATION
Authors:	VANDORT,HM ET AL. (1997)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 039635-31-9
Chemical Name: 2,3,3',4,4',5,5'-HEPTACHLOROBIPHENYL
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate:
Rate Units:
Lag Period:
Half-life (days): 174.63
Test Method:
Oxygen Condition: AN-W
Analysis Method: GC/ECD
Incubation Time (days): 141
Test Chemical Concn (ppm):
Environ Sample Type: RIVER SEDIMENT
Source of Sample: HOUSATONIC RIVER
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 23-25
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: PRIMED WITH 23456-CB; T0=0.07 MOL % OF TOTAL PCBS; T141=0.04 MOL % OF TOTAL PCBS SHOWING A 39% DECREASE IN CONCENTRATION
Authors: VANDORT,HM ET AL. (1997)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	038380-08-4
Chemical Name:	2,3,3',4,4',5-HEXACHLOROBIPHENYL
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	103.48
Test Method:	
Oxygen Condition:	AN-W
Analysis Method:	GC/ECD
Incubation Time (days):	141
Test Chemical Concn (ppm):	
Environ Sample Type:	RIVER SEDIMENT
Source of Sample:	HOUSATONIC RIVER
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	23-25
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	PRIMED WITH 23456-CB; T0=0.36 MOL % OF TOTAL PCBS; T141=0.14 MOL % OF TOTAL PCBS SHOWING A 62% DECREASE IN CONCENTRATION
Authors:	VANDORT,HM ET AL. (1997)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	032598-14-4
Chemical Name:	2,3,3',4,4'-PENTACHLOROBIPHENYL
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	38.69
Test Method:	
Oxygen Condition:	AN-W
Analysis Method:	GC/ECD
Incubation Time (days):	141
Test Chemical Concn (ppm):	
Environ Sample Type:	RIVER SEDIMENT
Source of Sample:	HOUSATONIC RIVER
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	23-25
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	PRIMED WITH 23456-CB; T0=0.25 MOL % OF TOTAL PCBS; T141=0.02 MOL % OF TOTAL PCBS SHOWING A 92% DECREASE IN CONCENTRATION
Authors:	VANDORT,HM ET AL. (1997)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 001746-01-6
Chemical Name: 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0;0;0
Rate Units: % DEGRADATION
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: CGC/MS
Incubation Time (days): 1460
Test Chemical Concn (ppm): 70-84;118-148;149-176
Environ Sample Type: SOIL
Source of Sample: TIMES BEACH, MO
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C:
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: RESULTS ARE GIVEN FOR THREE PLOTS WITH MULTIPLE SAMPLES FOR EACH. SOIL ADDED TO BINS LEFT OUTSIDE UNDER CONDITIONS OF NATURAL SUNLIGHT AND PRECIPITATION. NO LOSS OF COMPOUND SEEN OVER 4 YEARS.
Authors: YANDERS,AF ET AL. (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000056-49-5
Chemical Name:	3-METHYLCHOLANTHRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	609;1400
Test Method:	
Oxygen Condition:	AE
Analysis Method:	CO2 PRODUCTION
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	FRESHWATER AND ESTURINE WATER/SEDIMENT SYSTEMS
Source of Sample:	
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	HALF-LIFE RANGE REPORTED. OTHER STUDY DETAILS NOT AVAILABLE. PAH RESIDUES PERSISTED 2 TO 4 TIMES LONGER IN A PRISTINE ECOSYSTEM.
Authors:	HEITKAMP,MA (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000057-97-6
Chemical Name:	7,12-DIMETHYLBENZ(A)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	20
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	42;84;140;196
Test Chemical Concn (ppm):	18
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIFE WAS 20 DAYS AND WAS CORRECTED FOR LOSS DUE TO UNSPECIFIED ABIOTIC MECHANISMS OF 13.3%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000057-97-6
Chemical Name:	7,12-DIMETHYLBENZ(A)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	28
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	35;70;105
Test Chemical Concn (ppm):	13
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (MCLAURIN)
DOC/Org Content/Add C:	1.1% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	4.8
Suspended Solids:	
Remarks:	IN MCLAURIN SANDY LOAM, HALF-LIFE WAS 28 DAYS AND WAS CORRECTED FOR LOSS DUE TO UNSPECIFIED ABIOTIC MECHANISMS OF 12.0%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000057-97-6
Chemical Name:	7,12-DIMETHYLBENZ(A)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0.3;2;6;7;12
Rate Units:	14C MINERALIZED TO CO2
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	TLC
Incubation Time (days):	1;3;11;30;62
Test Chemical Concn (ppm):	
Environ Sample Type:	WATER/SEDIMENTS
Source of Sample:	NARRAGANSETT BAY, RI
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	IF THE LABELED C02 PRODUCTION RATE FROM THE LAST 25 DAYS OF THE EXPERIMENT CONTINUED WITHOUT CHANGE, IT WOULD TAKE 1-6 YEARS FOR THE REMAINING LABEL TO BE COMPLETELY MINERALIZED.
Authors:	HINGA,KR ET AL. (1986)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000194-59-2
Chemical Name:	7H-DIBENZO(C,G)CARBAZOLE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	22.12;45.01;14.36;4.24;23
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC
Incubation Time (days):	160
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	DOVER, OHIO
Soil Type:	
DOC/Org Content/Add C:	17.7;24.8;11.8;14.4;26.9
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	8;7.4;5.9;8;6.4
Suspended Solids:	
Remarks:	NO MINERALIZATION AS COMPARED TO HEAT-TREATED CONTROL SOILS WAS NOTED IN 5 SOIL SAMPLES OBTAINED AT AND AROUND A COAL TAR REFINING PLANT.
Authors:	GROSSER,RJ ET AL. (1995)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000309-00-2
Chemical Name:	ALDRIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;20;60;80
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/ECD
Incubation Time (days):	0;7;14;28;56
Test Chemical Concn (ppm):	0.01
Environ Sample Type:	WATER
Source of Sample:	LITTLE MIAMI RIVER
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	7.3
Suspended Solids:	
Remarks:	CLOSED GLASS CONTAINERS WERE EXPOSED TO BOTH ARTIFICIAL AND NATURAL SUNLIGHT.
Authors:	EICHELBERGER,JW & LICHTENBERG,JJ (1971)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	011097-69-1
Chemical Name:	AROCLOR 1254
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	>56
Test Method:	
Oxygen Condition:	AE-W
Analysis Method:	GC
Incubation Time (days):	56
Test Chemical Concn (ppm):	10 UG/L
Environ Sample Type:	WATER
Source of Sample:	CENTER HILL RESERVOIR, TENNESSEE
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	25
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	NO APPARENT BIODEGRADATION WAS NOTED AFTER 8 WEEKS, COMPARED TO CONTROL SAMPLES.
Authors:	SHIARIS,MP ET AL. (1980)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 011097-69-1
Chemical Name: AROCLOR 1254
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0
Rate Units: % DEGRADATION
Lag Period:
Half-life (days): >57
Test Method:
Oxygen Condition: AE-W
Analysis Method: LC
Incubation Time (days): 57
Test Chemical Concn (ppm): 38 UG/L
Environ Sample Type: LAKE SURFACE SEDIMENT
Source of Sample: FREJEN LAKE; FIOLEN LAKE, SWEDEN
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C:
Temperature (collect) deg C:
pH: 5.4/6.3
Suspended Solids:
Remarks: 14C-RADIOLABELLED COMPOUND ADDED TO MODEL ECOSYSTEM OF WATER/SEDIMENT FROM HIGH (FREJEN) AND LOW (FIOLEN) HUMIC CONTENT LAKES; NO SIGNIFICANT AEROBIC MICROBIAL MINERALIZATION OCCURRED IN 57 DAYS.
Authors: LARSSON,P & LEMKEMEIER,K (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000056-55-3
Chemical Name:	BENZO(A)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	162
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	35;70;105
Test Chemical Concn (ppm):	12
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (MCLAURIN)
DOC/Org Content/Add C:	1.1% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	4.8
Suspended Solids:	
Remarks:	IN MCLAURIN SANDY LOAM, HALF-LIFE WAS 162 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 1.6%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000056-55-3
Chemical Name:	BENZO(A)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	261
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	42;84;140;196
Test Chemical Concn (ppm):	18
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIFE WAS 261 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 2.5%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000056-55-3
Chemical Name:	BENZO(A)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	1.7%
Rate Units:	LOSS PER DAY
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	14C-RADIOLABEL
Incubation Time (days):	
Test Chemical Concn (ppm):	0.270 UG/L
Environ Sample Type:	WATER/SEDIMENTS
Source of Sample:	NARRAGANSETT BAY, RHODE ISLAND
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	ENCLOSED MARINE ECOSYSTEM. BIODEGRADATION OCCURRED AT A RATE OF 1.7% IN SEDIMENTS BETWEEN DAY 38 AND 68. 44% OF RADIOLABEL FOUND AS CO2 BY DAY 163. INITIAL DEGRADATION PROBABLY PHOTOLYSIS.
Authors:	HINGA,KR & PILSON,MEQ (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000056-55-3
Chemical Name:	BENZO(A)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	1;26;28;29
Rate Units:	% MINERALIZATION
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	14C-RADIOLABEL
Incubation Time (days):	1;86;126;216
Test Chemical Concn (ppm):	
Environ Sample Type:	WATER/SEDIMENTS
Source of Sample:	NARRAGANSETT BAY, RHODE ISLAND
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	ENCLOSED MARINE ECOSYSTEM. 29% OF THE ORIGINAL BENZ(A)ANTHRACENE WAS MINERALIZED TO CO2. IF RATE STAYED THE SAME THEN A HALF-LIFE FROM 1.2 TO 3 YEARS CAN BE CALCULATED.
Authors:	HINGA,KR ET AL., (1980)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000056-55-3
Chemical Name:	BENZO(A)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	2.2;0;0;2.0;4.0;5.4;2.6;3.9;8.4
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC-UV
Incubation Time (days):	75;156;280;419;612;751;920;1092;1280
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	SANDY LOAM
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.5
Suspended Solids:	
Remarks:	AT THE END OF THE 1280 DAY PERIOD, 1.5% OF THE ORIGINAL BENZO(A)ANTHRACENE REMAINED.
Authors:	BOSSERT,I ET AL. (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000056-55-3
Chemical Name: BENZO(A)ANTHRACENE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 41.7
Rate Units: % LOSS
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: TLC
Incubation Time (days): 28
Test Chemical Concn (ppm):
Environ Sample Type: WATER
Source of Sample: URBANA, IL
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C:
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: LOSS OF BENZO(A)ANTHRACENE IN POLLUTED CREEK WATER WITH NAPTHALENE AS A GROWTH SUBSTRATE WAS 41.7%.
Authors: MCKENNA,EJ AND HEATH,RD (1976)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000056-55-3
Chemical Name:	BENZO(A)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	66.2
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	TLC
Incubation Time (days):	28
Test Chemical Concn (ppm):	
Environ Sample Type:	WATER
Source of Sample:	URBANA, IL
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	LOSS OF BENZO(A)ANTHRACENE IN POLLUTED CREEK WATER WITH PHENANTHRENE AS A GROWTH SUBSTRATE WAS 66.2%.
Authors:	MCKENNA,EJ AND HEATH,RD (1976)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000056-55-3
Chemical Name:	BENZO(A)ANTHRACENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	430;261;77;82
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.0
Suspended Solids:	
Remarks:	HALF-LIVES OF 430, 261, 77 AND 82 FOR SYNTHETIC MIXTURE, AS A SINGLE CONSTITUENT, OIL REFINERY WASTE AND 1.0% CREOSOTE, RESPECTIVELY.
Authors:	KECK,J ET AL., (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000056-55-3
Chemical Name:	BENZO(A)ANTHRACENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	18;29;50
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	680;430;240
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	10;20;30
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	HALF-LIVES FOR BENZO(A)ANTHRACENE AT 10, 20 AND 30 DEG C WERE 680, 430 AND 240 DAYS, RESPECTIVELY.
Authors:	COOVER,MP & SIMS,RC (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000056-55-3
Chemical Name:	BENZO(A)ANTHRACENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	2;26;36
Rate Units:	%LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC
Incubation Time (days):	120;330;480
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	NIXON SANDY LOAM
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	LOSSES FOR BENZO(A)ANTHRACENE WERE 2, 26 AND 36% AT 4, 11 AND 16 MONTHS, RESPECTIVELY. CONTROL LOSS WAS 18%.
Authors:	BOSSERT,ID & BARTHA,R (1986)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000218-01-9
Chemical Name: BENZO(A)PHENANTHRENE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate:
Rate Units:
Lag Period:
Half-life (days): 153
Test Method:
Oxygen Condition: AE
Analysis Method:
Incubation Time (days): 72
Test Chemical Concn (ppm): 2.5 UG/G
Environ Sample Type: SEDIMENT
Source of Sample: CHAO PHRAYA RIVER
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C:
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: HALF-LIFE CALCULATED FROM EXPERIMENTAL RESULTS IN CHAO PHRAYA RIVER SEDIMENT WAS 153 DAYS.
Authors: HUNGSPREUGS,M ET AL. (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000218-01-9
Chemical Name:	BENZO(A)PHENANTHRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	189
Test Method:	
Oxygen Condition:	AE
Analysis Method:	
Incubation Time (days):	72
Test Chemical Concn (ppm):	2.5 UG/G
Environ Sample Type:	SEDIMENT
Source of Sample:	GULF OF THAILAND
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	HALF-LIFE CALCULATED FROM EXPERIMENTAL RESULTS IN GULF OF THAILAND SEDIMENT WAS 189 DAYS.
Authors:	HUNGSPREUGS,M ET AL. (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000218-01-9
Chemical Name:	BENZO(A)PHENANTHRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	371
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	42;84;140;196
Test Chemical Concn (ppm):	18
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIFE WAS 371 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 5.9%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000218-01-9
Chemical Name:	BENZO(A)PHENANTHRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	387
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	35;70;105
Test Chemical Concn (ppm):	12
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (MCLAURIN)
DOC/Org Content/Add C:	1.1% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	4.8
Suspended Solids:	
Remarks:	IN MCLAURIN SANDY LOAM, HALF-LIFE WAS 387 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 3.2%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000218-01-9
Chemical Name:	BENZO(A)PHENANTHRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	41;58;77
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	2;4;8 (% BY OIL AND GREASE CONTENT)
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.1
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIVES FOR BENZO(A)PHENATHRENE AT 2, 4 AND 8% BY OIL AND GREASE CONTENT WERE 41, 58 AND 77 DAYS, RESPECTIVELY.
Authors:	SYMONS,BD ET AL. (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000218-01-9
Chemical Name: BENZO(A)PHENANTHRENE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate:
Rate Units:
Lag Period:
Half-life (days): 77;99;116
Test Method:
Oxygen Condition: AE
Analysis Method: HPLC
Incubation Time (days): 240
Test Chemical Concn (ppm): 2;4;8 (% BY OIL AND GREASE CONTENT)
Environ Sample Type: SOIL
Source of Sample:
Soil Type: CLAY LOAM SOIL (NUNN)
DOC/Org Content/Add C: 1.1% ORGANIC CARBON
Microbial Population:
Temperature (incub) deg C: 20
Temperature (collect) deg C:
pH: 8.1
Suspended Solids:
Remarks: IN NUNN CLAY LOAM, HALF-LIVES FOR BENZO(A)PHENATHRENE AT 2, 4 AND 8% BY OIL AND GREASE CONTENT WERE 77, 99 AND 116 DAYS, RESPECTIVELY.
Authors: SYMONS,BD ET AL. (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000218-01-9
Chemical Name:	BENZO(A)PHENANTHRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	.9;.9;.7;.6;1.5
Rate Units:	UG/ML LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	
Incubation Time (days):	14
Test Chemical Concn (ppm):	
Environ Sample Type:	GROUNDWATER
Source of Sample:	PENSACOLA, FL
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	30
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	BENZO(A)PHENATHRENE LOSS OVER THE 14 DAY TEST PERIOD RANGED FROM 0.6 TO 1.5 WITH THE STERILE CONTROL HAVING A LOSS OF 0.3 AFTER 14 DAYS.
Authors:	MUELLER,JG ET AL. (1991)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000218-01-9
Chemical Name:	BENZO(A)PHENANTHRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	.9;0;0;0;1.1;2.9;2.1;2.3;8.2
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC-UV
Incubation Time (days):	75;156;280;419;612;751;920;1092;1280
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	SANDY LOAM
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.5
Suspended Solids:	
Remarks:	AT THE END OF THE 1280 DAY PERIOD, 3.1% OF THE ORIGINAL BENZO(A)PHENANTHRENE REMAINED.
Authors:	BOSSERT,I ET AL. (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000218-01-9
Chemical Name:	BENZO(A)PHENANTHRENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	1000;371;77;148
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.0
Suspended Solids:	
Remarks:	HALF-LIVES OF 1000, 371, 77 AND 148 FOR SYNTHETIC MIXTURE, AS A SINGLE CONSTITUENT, OIL REFINERY WASTE AND 1.0% CREOSOTE, RESPECTIVELY.
Authors:	KECK,J ET AL., (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000218-01-9
Chemical Name: BENZO(A)PHENATHRENE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate:
Rate Units:
Lag Period:
Half-life (days): 1400;246
Test Method:
Oxygen Condition: AE
Analysis Method:
Incubation Time (days):
Test Chemical Concn (ppm):
Environ Sample Type: SEDIMENT
Source of Sample: SAVANNAH, GA
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 8;28
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: HALF-LIVES FOR BENZO(A)PHENANTHRENE AT 8 AND 28 DEG C WERE 1400 AND 246 DAYS, RESPECTIVELY.
Authors: LEE,RF AND RYAN,C (1983)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000218-01-9
Chemical Name:	BENZO(A)PHENATHRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	79
Test Method:	
Oxygen Condition:	AE
Analysis Method:	
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	SEDIMENT
Source of Sample:	CHARLESTON, SC
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	27
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	HALF-LIFE FOR BENZO(A)PHENATHRENE AT 27 DEG C WAS 79 DAYS.
Authors:	LEE,RF AND RYAN,C (1983)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000218-01-9
Chemical Name:	BENZO(A)PHENATHRENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	15;12;14
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	980;1000;730
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	10;20;30
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	HALF-LIVES FOR BENZO(A)PHENANTHRENE AT 10, 20 AND 30 DEG C WERE 980, 1000 AND 730 DAYS, RESPECTIVELY.
Authors:	COOVER,MP & SIMS,RC (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000050-32-8
Chemical Name:	BENZO(A)PYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	-;>300;>200
Test Method:	
Oxygen Condition:	AE
Analysis Method:	TLC;GC/MS
Incubation Time (days):	56
Test Chemical Concn (ppm):	500 NG/G
Environ Sample Type:	WATER/SEDIMENTS
Source of Sample:	DEGRAY RESERVOIR,AK;LAKE CHICOT,AK;REDFISH BAY,TX
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	22
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	SEDIMENT-WATER MICROCOSM STUDY. NO MINERALIZATION WAS DETECTED IN THE DEGRAY RESERVOIR MICROCOSM.
Authors:	HEITKAMP, MA & CERNIGLIA,CE (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000050-32-8
Chemical Name:	BENZO(A)PYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	229
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	35;70;105
Test Chemical Concn (ppm):	12
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (MCLAURIN)
DOC/Org Content/Add C:	1.1% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	4.8
Suspended Solids:	
Remarks:	IN MCLAURIN SANDY LOAM, HALF-LIFE WAS 229 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 8.3%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000050-32-8
Chemical Name:	BENZO(A)PYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	309
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	42;84;140;196
Test Chemical Concn (ppm):	18
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIFE WAS 309 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 7.3%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000050-32-8
Chemical Name:	BENZO(A)PYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0.035;0.011
Rate Units:	% LOSS PER DAY
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	LIQUID SCINTILLATION COUNTER
Incubation Time (days):	6.9
Test Chemical Concn (ppm):	20 UG/L
Environ Sample Type:	WATER
Source of Sample:	DOCKYARD;PLYMOUTH SOUND
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	10
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	DEGRADATION RATES IN ESTUARY WERE HIGHER THAN IN MARINE WATER, WITH DEGRADATION RATES FOR BENZO(A)PYRENE IN DOCKLAND AND PLYMOUTH SOUND WATERS OF 0.035% PER DAY AND 0.011% PER DAY, RESPECTIVELY.
Authors:	READMAN,JW ET AL. (1982)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000050-32-8
Chemical Name:	BENZO(A)PYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	2.1;0;0;0;0;0;0;0;0;
Rate Units:	UG/G LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC-UV
Incubation Time (days):	75;156;280;419;612;751;920;1092;1280
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	SANDY LOAM
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	AT THE END OF THE 1280 DAY PERIOD, 55.6% OF THE ORIGINAL BENZO(A)PYRENE REMAINED.
Authors:	BOSSERT,I ET AL. (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000050-32-8
Chemical Name:	BENZO(A)PYRENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	290;309;ND;151
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.0
Suspended Solids:	
Remarks:	HALF-LIVES OF 290, 309, ND AND 151 FOR SYNTHETIC MIXTURE, AS A SINGLE CONSTITUENT, OIL REFINERY WASTE AND 1.0% CREOSOTE, RESPECTIVELY.
Authors:	KECK,J ET AL., (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000050-32-8
Chemical Name:	BENZO(A)PYRENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;10;19
Rate Units:	%LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC
Incubation Time (days):	120;330;480
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	NIXON SANDY LOAM
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	LOSSES FOR BENZO(A)PYRENE WERE 0, 10 AND 19% AT 4, 11 AND 16 MONTHS, RESPECTIVELY. CONTROL LOSS WAS 2%.
Authors:	BOSSERT,ID & BARTHA,R (1986)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000050-32-8
Chemical Name:	BENZO(A)PYRENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	26;46;47
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	530;290;220
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	10;20;30
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	HALF-LIVES FOR BENZO(A)PYRENE AT 10, 20 AND 30 DEG C WERE 530, 290 AND 220 DAYS, RESPECTIVELY.
Authors:	COOVER,MP & SIMS,RC (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000205-99-2
Chemical Name:	BENZO(B)FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	211
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	35;70;105
Test Chemical Concn (ppm):	12
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (MCLAURIN)
DOC/Org Content/Add C:	1.1% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	4.8
Suspended Solids:	
Remarks:	IN MCLAURIN SANDY LOAM, HALF-LIFE WAS 211 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 8.4%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000205-99-2
Chemical Name:	BENZO(B)FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	294
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	42;84;140;196
Test Chemical Concn (ppm):	18
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIFE WAS 294 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 8.0%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000205-99-2
Chemical Name:	BENZO(B)FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;0;0;0;0;0;0;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC-UV
Incubation Time (days):	75;156;280;419;612;751;920;1092;1280
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	SANDY LOAM
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.5
Suspended Solids:	
Remarks:	AT THE END OF THE 1280 DAY PERIOD, 79.4% OF THE ORIGINAL BENZO(B)FLUORANTHENE REMAINED.
Authors:	BOSSERT,I ET AL. (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000205-99-2
Chemical Name:	BENZO(B)FLUORANTHENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	610;294;-;87
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.0
Suspended Solids:	
Remarks:	HALF-LIVES OF 610, 294, ND AND 87 FOR SYNTHETIC MIXTURE, AS A SINGLE CONSTITUENT, OIL REFINERY WASTE AND 1.0% CREOSOTE, RESPECTIVELY.
Authors:	KECK,J ET AL., (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000205-99-2
Chemical Name:	BENZO(B)FLUORANTHENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	23;25;38
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	580;610;360
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	10;20;30
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	HALF-LIVES FOR BENZO(B)FLUORANTHENE AT 10, 20 AND 30 DEG C WERE 580, 610 AND 360 DAYS, RESPECTIVELY.
Authors:	COOVER,MP & SIMS,RC (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000191-24-2
Chemical Name:	BENZO(GHI)PERYLENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	173;231;O
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	2;4;8 (% BY OIL AND GREASE CONTENT)
Environ Sample Type:	
Source of Sample:	
Soil Type:	CLAY LOAM SOIL (NUNN)
DOC/Org Content/Add C:	1.1% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.1
Suspended Solids:	
Remarks:	IN NUNN CLAY LOAM, HALF-LIVES FOR BENZO(GHI)PERYLENE AT 2,4 AND 8% BY OIL AND GREASE CONTENT WERE 173, 231 AND 0, RESPECTIVELY.
Authors:	SYMONS,BD ET AL. (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000191-24-2
Chemical Name:	BENZO(GHI)PERYLENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	231;138;173
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	2;4;8 (% BY OIL AND GREASE CONTENT)
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.1
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIVES FOR BENZO(GHI)PERYLENE AT 2,4 AND 8% BY OIL AND GREASE CONTENT WERE 231, 138 AND 173, RESPECTIVELY.
Authors:	SYMONS,BD ET AL. (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000191-24-2
Chemical Name:	BENZO(GHI)PERYLENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	19;24;25
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	650;750;940
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	10;20;30
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIVES AT 10, 20 AND 30 DEGREES C WERE 650, 600 AND 590, RESPECTIVELY.
Authors:	COOVER,MP & SIMS,RC (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000205-82-3
Chemical Name:	BENZO(J)FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;0;0;0;0;0;0;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC-UV
Incubation Time (days):	75;156;280;419;612;751;920;1092;1280
Test Chemical Concn (ppm):	0.9
Environ Sample Type:	
Source of Sample:	
Soil Type:	SOIL
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.5
Suspended Solids:	
Remarks:	AFTER 1280 DAYS IN SOIL TREATED WITH OIL SLUDGE, 79% OF THE ORIGINAL BENZO(B)FLUORANTHENE REMAINED.
Authors:	BOSSERT,I ET AL. (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000207-08-9
Chemical Name:	BENZO(K)FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	138;138;231
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	2;4;8 (% BY OIL AND GREASE CONTENT)
Environ Sample Type:	
Source of Sample:	
Soil Type:	CLAY LOAM SOIL (NUNN)
DOC/Org Content/Add C:	1.1% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.1
Suspended Solids:	
Remarks:	IN NUNN CLAY LOAM, HALF-LIVES FOR BENZO(K)FLUORANTHENE AT 2,4 AND 8% BY OIL AND GREASE CONTENT WERE 138, 231 AND 231, RESPECTIVELY.
Authors:	SYMONS,BD ET AL. (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000207-08-9
Chemical Name:	BENZO(K)FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	231;0;0
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	2;4;8 (% BY OIL AND GREASE CONTENT)
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.1
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIVES FOR BENZO(K)FLUORANTHENE AT 2,4 AND 8% BY OIL AND GREASE CONTENT WERE 231, 0 AND 0, RESPECTIVELY.
Authors:	SYMONS,BD ET AL. (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000207-08-9
Chemical Name:	BENZO(K)FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;0;0;0;0;0;0;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC-UV
Incubation Time (days):	75;156;280;419;612;751;920;1092;1280
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	SANDY LOAM
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.5
Suspended Solids:	
Remarks:	AT THE END OF THE 1280 DAY PERIOD, 29.9% OF THE ORIGINAL BENZO(K)FLUORANTHENE REMAINED.
Authors:	BOSSERT,I ET AL. (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000207-08-9
Chemical Name:	BENZO(K)FLUORANTHENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	1400;-;231;-
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.0
Suspended Solids:	
Remarks:	HALF-LIVES OF 1400, ND, 231 AND ND FOR SYNTHETIC MIXTURE, AS A SINGLE CONSTITUENT, OIL REFINERY WASTE AND 1.0% CREOSOTE, RESPECTIVELY.
Authors:	KECK,J ET AL., (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000207-08-9
Chemical Name:	BENZO(K)FLUORANTHENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	7;5;11
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	910;1400;910
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	10;20;30
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	HALF-LIVES FOR BENZO(K)FLUORANTHENE AT 10, 20 AND 30 DEG C WERE 910, 1400 AND 910 DAYS, RESPECTIVELY.
Authors:	COOVER,MP & SIMS,RC (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000189-55-9
Chemical Name:	BENZO(R,S,T)PENTAPHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	232
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (MCLAURIN)
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	IN MCLAURIN SANDY LOAM, HALF-LIFE WAS 232 DAYS AND WAS CORRECTED FOR VOLATILITY LOSSES.
Authors:	STEVENS,DK ET AL. (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000189-55-9
Chemical Name:	BENZO(R,S,T)PENTAPHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	289
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	35;70;105
Test Chemical Concn (ppm):	12
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (MCLAURIN)
DOC/Org Content/Add C:	1.1% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	4.8
Suspended Solids:	
Remarks:	IN MCLAURIN SANDY LOAM, HALF-LIFE WAS 289 DAYS AND WAS CORRECTED FOR LOSS DUE TO UNSPECIFIED ABIOTIC MECHANISMS OF 9.3%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000189-55-9
Chemical Name:	BENZO(R,S,T)PENTAPHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	361
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	42:84:140:196
Test Chemical Concn (ppm):	11
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIFE WAS 361 DAYS AND WAS CORRECTED FOR LOSS DUE TO UNSPECIFIED ABIOTIC MECHANISMS OF 10.3%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000189-55-9
Chemical Name:	BENZO(R,S,T)PENTAPHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	371
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIFE WAS 371 DAYS AND WAS CORRECTED FOR VOLATILITY LOSSES.
Authors:	STEVENS,DK ET AL. (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000057-74-9
Chemical Name:	CHLORDANE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;10;15;15;15
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/ECD
Incubation Time (days):	0;7;14;28;56
Test Chemical Concn (ppm):	0.01
Environ Sample Type:	WATER
Source of Sample:	LITTLE MIAMI RIVER
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	7.3
Suspended Solids:	
Remarks:	OF THE MAJOR COMPONENTS OF TECHNICAL CHLORDANE, ONLY ALPHA AND GAMMA-CHLORDANE WERE COMPLETELY STABLE OVER THE 8 WEEK PERIOD. NO FURTHER DEGRADATION WAS REPORTED AFTER THE SECOND WEEK.
Authors:	EICHELBERGER,JW & LICHTENBERG,JJ (1971)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000224-42-0
Chemical Name: DIBENZ(A,J)ACRIDINE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 8.69;39.85;8.88;0;0.38
Rate Units: % DEGRADATION
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: GC
Incubation Time (days): 160
Test Chemical Concn (ppm):
Environ Sample Type: SOIL
Source of Sample: DOVER, OHIO
Soil Type:
DOC/Org Content/Add C: 17.7;24.8;11.8;14.4;26.9
Microbial Population:
Temperature (incub) deg C:
Temperature (collect) deg C:
pH: 8;7.4;5.9;8;6.4
Suspended Solids:
Remarks: NO MINERALIZATION AS COMPARED TO HEAT-TREATED CONTROL SOILS WAS NOTED IN 5 SOIL SAMPLES OBTAINED AT AND AROUND A COAL TAR REFINING PLANT.
Authors: GROSSER,RJ ET AL. (1995)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000053-70-3
Chemical Name:	DIBENZO(A,H)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	361
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	42;84;140;196
Test Chemical Concn (ppm):	18
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIFE WAS 361 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 13.8%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000053-70-3
Chemical Name:	DIBENZO(A,H)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	420
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	35;70;105
Test Chemical Concn (ppm):	12
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (MCLAURIN)
DOC/Org Content/Add C:	1.1% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	4.8
Suspended Solids:	
Remarks:	IN MCLAURIN SANDY LOAM, HALF-LIFE WAS 420 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 6.4%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000053-70-3
Chemical Name:	DIBENZO(A,H)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	67.1
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	TLC
Incubation Time (days):	28
Test Chemical Concn (ppm):	
Environ Sample Type:	WATER
Source of Sample:	URBANA, IL
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	LOSS OF DIBENZO(A,H)ANTHRACENE IN POLLUTED CREEK WATER WITH PHENANTHRENE AS A GROWTH SUBSTRATE WAS 67.1%.
Authors:	MCKENNA,EJ AND HEATH,RD (1976)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000053-70-3
Chemical Name:	DIBENZO(A,H)ANTHRACENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	7.3
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	TLC
Incubation Time (days):	28
Test Chemical Concn (ppm):	
Environ Sample Type:	WATER
Source of Sample:	URBANA, IL
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	LOSS OF DIBENZO(A,H)ANTHRACENE IN POLLUTED CREEK WATER WITH NAPTHALENE AS A GROWTH SUBSTRATE WAS 7.3%.
Authors:	MCKENNA,EJ AND HEATH,RD (1976)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000053-70-3
Chemical Name:	DIBENZO(A,H)ANTHRACENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	750;361;ND;ND
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.0
Suspended Solids:	
Remarks:	HALF-LIVES OF 750, 361, ND AND ND FOR SYNTHETIC MIXTURE, AS A SINGLE CONSTITUENT, OIL REFINERY WASTE AND 1.0% CREOSOTE, RESPECTIVELY.
Authors:	KECK,J ET AL., (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000053-70-3
Chemical Name:	DIBENZO(A,H)ANTHRACENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	12;13;17
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	820;750;940
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	10;20;30
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	HALF-LIVES FOR DIBENZO(A,H)ANTHRACENE AT 10, 20 AND 30 DEG C WERE 820, 750 AND 940 DAYS, RESPECTIVELY.
Authors:	COOVER,MP & SIMS,RC (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000053-70-3
Chemical Name:	DIBENZO(A,H)ANTHRACENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	18;8;0
Rate Units:	%LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC
Incubation Time (days):	120;330;480
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	NIXON SANDY LOAM
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	NO BIODEGRADATION OF DIBENZO(A,H)ANTHRACENE OCCURRED OVER THE 16 MONTH TEST PERIOD. 7% LOSS WAS NOTED IN CONTROL.
Authors:	BOSSERT,ID & BARTHA,R (1986)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000115-32-2
Chemical Name:	DICOFOL
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	2;1.8;1.6;1.4;1.2;1.0(MIXED)/2;1.8;1.5;1.5;1.2;1.1(SURFACE)
Rate Units:	PPM REMAINING PER DAY
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	
Incubation Time (days):	50;100;150;200;250;300 (FOR MIXED AND SURFACE)
Test Chemical Concn (ppm):	2.0 PPM
Environ Sample Type:	
Source of Sample:	KODAIRA, TOKYO
Soil Type:	VOLCANIC ASH
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	DICOFOL WAS MIXED WITH SOIL OR ADDED ON THE SURFACE OF THE SOIL IN GLASS BOTTLES. BOTTLES WERE LEFT OPEN AND STORED OUTDOORS OR IN A ROOM. ORIGINAL PAPER IN JAPANESE.
Authors:	MATSUI,M ET AL. (1977)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000060-57-1
Chemical Name: DIELDRIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0
Rate Units: % DEGRADATION
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: GC/ECD
Incubation Time (days): 56
Test Chemical Concn (ppm): 0.01
Environ Sample Type: WATER
Source of Sample: LITTLE MIAMI RIVER
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C:
Temperature (collect) deg C:
pH: 7.3
Suspended Solids:
Remarks: NO TRANSFORMATION OF DIELDRIN WAS SEEN. CLOSED GLASS CONTAINERS WERE EXPOSED TO BOTH ARTIFICIAL AND NATURAL SUNLIGHT.
Authors: EICHELBERGER,JW & LICHTENBERG,JJ (1971)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000060-57-1
Chemical Name:	DIELDRIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	1.86
Rate Units:	% 14C LABEL AS 14CO2
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	14C RADIOLABEL
Incubation Time (days):	49
Test Chemical Concn (ppm):	10
Environ Sample Type:	SOIL
Source of Sample:	GERMANY
Soil Type:	LIGHT SILTY LOAM TOPSOIL, PARABRAUNERDE
DOC/Org Content/Add C:	1.48% CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	6.4
Suspended Solids:	
Remarks:	STERILE SOIL RELEASED 0.3% OF THE 14C-DIELDRIN AS 14CO2; 1.86% OF THE 14C-DIELDRIN WAS RELEASED AS 14CO2 IN NON-STERILE SOILS. THE STERILIZED SOIL DID NOT REMAIN STERILE.
Authors:	JAGNOW,G & HAIDER,K (1972)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000060-57-1
Chemical Name:	DIELDRIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	11.9
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	296
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GLC/FID
Incubation Time (days):	42
Test Chemical Concn (ppm):	125
Environ Sample Type:	SOIL
Source of Sample:	GEZIRA, SUDAN
Soil Type:	LOAM
DOC/Org Content/Add C:	4.6% ORGANIC CARBON CONTENT
Microbial Population:	
Temperature (incub) deg C:	37
Temperature (collect) deg C:	
pH:	8.3
Suspended Solids:	
Remarks:	88.1 AND 94.6% DIELDRIN WAS REMAINING IN UNAUTOCLAVED AND AUTOCLAVED SOILS, RESPECTIVELY.
Authors:	EL BIET,IOD ET AL. (1981)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000060-57-1
Chemical Name: DIELDRIN
Purity: 95%
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0
Rate Units: % DEGRADATION
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method:
Incubation Time (days): 336
Test Chemical Concn (ppm): 2
Environ Sample Type: SOIL
Source of Sample:
Soil Type: BEVERLY FINE SANDY LOAM
DOC/Org Content/Add C: 1.5% ORGANIC MATTER
Microbial Population:
Temperature (incub) deg C: 27
Temperature (collect) deg C:
pH: 7.2
Suspended Solids:
Remarks: 76.6% SAND, 21.1% SILT, 2.3% CLAY. NO DEGRADATION SEEN OVER 48 WEEKS.
Authors: HARRIS,CR (1969)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000072-20-8
Chemical Name:	ENDRIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/ECD
Incubation Time (days):	56
Test Chemical Concn (ppm):	0.01
Environ Sample Type:	WATER
Source of Sample:	LITTLE MIAMI RIVER
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	7.3
Suspended Solids:	
Remarks:	NO TRANSFORMATION OF ENDRIN WAS SEEN IN 56 DAYS. CLOSED GLASS CONTAINERS WERE EXPOSED TO BOTH ARTIFICIAL AND NATURAL SUNLIGHT.
Authors:	EICHELBERGER,JW & LICHTENBERG,JJ (1971)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000072-20-8
Chemical Name: ENDRIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 11.76;0;0;0
Rate Units: % DEGRADATION
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: GC/ECD
Incubation Time (days): 60
Test Chemical Concn (ppm): 15
Environ Sample Type: SOIL
Source of Sample:
Soil Type: MAAHAS CLAY;LUISIANA CLAY;PILA CLAY LOAM;CASIGURAN SANDY LOAM
DOC/Org Content/Add C: 2.0;3.2;1.5;4.4
Microbial Population:
Temperature (incub) deg C: 30
Temperature (collect) deg C:
pH: 6.6;4.7;7.6;4.8
Suspended Solids:
Remarks: ENDRIN WAS DEGRADED ONLY IN THE CASIGURAN SOIL.
Authors: CASTRO,TF & YOSHIDA,T (1971)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000206-44-0
Chemical Name:	FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	377;268
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC WITH UV DETECTION
Incubation Time (days):	
Test Chemical Concn (ppm):	883;913
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, UTAH; MISSISSIPPI
Soil Type:	KIDMAN SANDY LOAM; MCLAURIN SANDY LOAM
DOC/Org Content/Add C:	0.5;1.1% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	25
Temperature (collect) deg C:	
pH:	7.9;4.8
Suspended Solids:	
Remarks:	ADDED A MIXTURE OF 14 PAHS TO THE SOIL. NO SIGNIFICANT ABIOTIC LOSS WAS SHOWN BY PAH COMPOUNDS WITH MORE THAT 3 AROMATIC RINGS.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000206-44-0
Chemical Name:	FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	440;377
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC WITH UV DETECTION
Incubation Time (days):	
Test Chemical Concn (ppm):	400
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, UTAH
Soil Type:	KIDMAN FINE SANDY LOAM
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.0
Suspended Solids:	
Remarks:	ADDED A MIXTURE OF 13 PAHS TO THE SOIL. ABIOTIC LOSSES WERE MINIMAL.
Authors:	KECK,J ET AL. (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000206-44-0
Chemical Name:	FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	6;29;85
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	0;440;140
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC WITH UV DETECTION
Incubation Time (days):	240
Test Chemical Concn (ppm):	400
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, UTAH
Soil Type:	SANDY LOAM
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	10;20;30
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	NEGLIGIBLE LOSS IS REPORTED FOR FLUORANTHENE AT 10 DEG C OVER 240 DAYS. MIXTURE OF 16 PAHS ADDED TO MICROCOSM.
Authors:	COOVER,MP & SIMS,RC (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000206-44-0
Chemical Name:	FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	78;35;60;73
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	110;184;143;110
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC WITH FLUORESCENCE DETECTION
Incubation Time (days):	205
Test Chemical Concn (ppm):	0.213;0.395;1.132;1.916
Environ Sample Type:	SOIL
Source of Sample:	LANCASTER, PENNSYLVANIA
Soil Type:	SANDY CLAY LOAM;SANDY CLAY LOAM;FOREST SOIL;SANDY LOAM
DOC/Org Content/Add C:	6.04;8.11;58;9.30 % ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20-30
Temperature (collect) deg C:	
pH:	6.6;6.1;2.9;6.4
Suspended Solids:	
Remarks:	SOIL 1=NO PREVIOUS SLUDGE APPLICATION; SOIL 2 =~10 SURFACE APPLICATIONS SEWAGE SLUDGE OVER 10 YRS; SOIL 3=RURAL CONIFEROUS FOREST; SOIL 4=SIDE OF A MAJOR ROAD. SEWAGE SLUDGE APPLIED TO ALL SOILS.
Authors:	WILD,SR & JONES,KC (1993)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000206-44-0
Chemical Name:	FLUORANTHENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	95.2
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/UV
Incubation Time (days):	1280
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	SANDY LOAM
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.5
Suspended Solids:	
Remarks:	DRIED SLUDGE FROM A PETROCHEMICAL PLANT TREATMENT SYSTEM APPLIED 7 TIMES OVER 960 DAYS FOLLOWED BY 360 DAYS INACTIVE PERIOD W/O FURTHER SLUDGE ADDITIONS.
Authors:	BOSSERT,I ET AL. (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000076-44-8
Chemical Name:	HEPTACHLOR
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;75;100
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	3.5
Test Method:	
Oxygen Condition:	AE
Analysis Method:	TLC
Incubation Time (days):	0;7;14
Test Chemical Concn (ppm):	10 UG/L
Environ Sample Type:	WATER
Source of Sample:	LITTLE MIAMI RIVER
Soil Type:	
DOC/Org Content/Add C:	10.7 MG/L (TOTAL); 5 MG/L (DISSOLVED)
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	7.3-8
Suspended Solids:	
Remarks:	75 AND 100% OF INITIAL HEPTACHLOR WAS DEGRADED AFTER 1 AND 2 WEEKS, RESPECTIVELY IN THIS RIVER DIE-AWAY STUDY; DEGRADATION PRODUCTS WERE 1-HYDROXY CHLORDENE AND HEPTACHLOR EPOXIDE.
Authors:	EICHELBERGER,JW & LICHTENBERG,JJ (1971)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000076-44-8
Chemical Name:	HEPTACHLOR
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	50
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	8.3;222;53;96
Test Method:	
Oxygen Condition:	AE
Analysis Method:	
Incubation Time (days):	50
Test Chemical Concn (ppm):	0.2 MG
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	PLIOCENE SAND; ORGANIC-RICH ORCHARD SOIL; AGRICULTURAL SOIL; SOIL FROM VOLCANIC AREA OF MOUNT AMIATA
DOC/Org Content/Add C:	0.07;8.8;3.7;4.1
Microbial Population:	
Temperature (incub) deg C:	23-26
Temperature (collect) deg C:	
pH:	7.7;7.41;7.38;4.86
Suspended Solids:	
Remarks:	HALF-LIVES WERE CORRECTED FOR VOLATILIZATION IN 4 DIFFERENT SOILS INCUBATED IN GLASS VESSELS IN A GREEN HOUSE.
Authors:	DIAZDIAZ,R ET AL. (1995)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000076-44-8
Chemical Name:	HEPTACHLOR
Purity:	74
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	68;68;56;68
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC
Incubation Time (days):	90
Test Chemical Concn (ppm):	15
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	MAAHAS CLAY; LUISIANA CLAY; PILA CLAY LOAM; CASIGURAN SANDY LOAM
DOC/Org Content/Add C:	2;3.2;1.5;4.4
Microbial Population:	
Temperature (incub) deg C:	30
Temperature (collect) deg C:	
pH:	6.6;4.7;7.6;4.8
Suspended Solids:	
Remarks:	HALF-LIVES CALCULATED FROM 4 SOILS UNDER UPLAND CONDITIONS (80% MAXIMUM WATER HOLDING OF SOILS) IN AEROBIC GRAB SAMPLE STUDY.
Authors:	CASTRO,TF & YOSHIDA,T (1971)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000118-74-1
Chemical Name:	HEXACHLOROBENZENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	969;2089
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/ECD
Incubation Time (days):	600
Test Chemical Concn (ppm):	10 KG/HA
Environ Sample Type:	SOIL
Source of Sample:	SJAELLAND, DENMARK
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	18-20
Temperature (collect) deg C:	
pH:	4.9-7.9
Suspended Solids:	
Remarks:	22 DIFFERENT SOILS. TWO HALF-LIVES REPORTED AS DUPLICATE EXPERIMENTS.
Authors:	BECK,J & HANSEN,KE (1974)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000118-74-1
Chemical Name:	HEXACHLOROBENZENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;0;0
Rate Units:	% DEGRADATION
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/ECD
Incubation Time (days):	365
Test Chemical Concn (ppm):	0.1;1;10;100
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	MATAPEAKE SILT LOAM
DOC/Org Content/Add C:	1.5% ORGANIC MATTER CONTENT
Microbial Population:	
Temperature (incub) deg C:	20-30
Temperature (collect) deg C:	
pH:	5.3
Suspended Solids:	
Remarks:	INCUBATED UNDER GREENHOUSE CONDITIONS. ALL BEAKERS WERE COVERED WITH ALUMINUM FOIL TO REDUCE VOLATILIZATION AND MOISTURE LOSSES. VOLATILIZATION SEEN AS MAJOR LOSS PATHWAY FOR THIS COMPOUND IN SOIL.
Authors:	ISENSEE ET AL. (1976)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000193-39-5
Chemical Name:	INDENO(1,2,3-CD)PYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	288
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	42;84;140;196
Test Chemical Concn (ppm):	18
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIFE WAS 288 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 13.5%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000193-39-5
Chemical Name:	INDENO(1,2,3-CD)PYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	289
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	35;70;105
Test Chemical Concn (ppm):	12
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (MCLAURIN)
DOC/Org Content/Add C:	1.1% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	4.8
Suspended Solids:	
Remarks:	IN MCLAURIN SANDY LOAM, HALF-LIFE WAS 289 DAYS AND WAS CORRECTED FOR LOSS BY UNSPECIFIED ABIOTIC MECHANISMS OF 11.5%.
Authors:	PARK,KS ET AL. (1990)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000193-39-5
Chemical Name: INDENO(1,2,3-CD)PYRENE
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate:
Rate Units:
Lag Period:
Half-life (days): 69;63;58
Test Method:
Oxygen Condition: AE
Analysis Method: HPLC
Incubation Time (days): 240
Test Chemical Concn (ppm): 2;4;8 (% BY OIL AND GREASE CONTENT)
Environ Sample Type: SOIL
Source of Sample:
Soil Type: CLAY LOAM SOIL (NUNN)
DOC/Org Content/Add C: 1.1% ORGANIC CARBON
Microbial Population:
Temperature (incub) deg C: 20
Temperature (collect) deg C:
pH: 8.1
Suspended Solids:
Remarks: IN NUNN CLAY LOAM, HALF-LIVES FOR INDENO(1,2,3-CD)PYRENE AT 2, 4 AND 8% BY OIL AND GREASE CONTENT WERE 69, 63 AND 58 DAYS, RESPECTIVELY.
Authors: SYMONS,BD ET AL. (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000193-39-5
Chemical Name:	INDENO(1,2,3-CD)PYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	99;63;139
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	2;4;8 (% BY OIL AND GREASE CONTENT)
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	SANDY LOAM SOIL (KIDMAN)
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.1
Suspended Solids:	
Remarks:	IN KIDMAN SANDY LOAM, HALF-LIVES FOR INDENO(1,2,3-CD)PYRENE AT 2, 4 AND 8% BY OIL AND GREASE CONTENT WERE 99, 63 AND 139 DAYS, RESPECTIVELY.
Authors:	SYMONS,BD ET AL. (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000193-39-5
Chemical Name:	INDENO(1,2,3-CD)PYRENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	.6;.5;.5;.7;1.0
Rate Units:	UG/ML LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	
Incubation Time (days):	14
Test Chemical Concn (ppm):	
Environ Sample Type:	GROUNDWATER
Source of Sample:	PENSACOLA, FL
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	30
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	INDENO(1,2,3-CD)PYRENE LOSS OVER THE 14 DAY TEST PERIOD RANGED FROM 0.5 TO 1.0 WITH THE STERILE CONTROL HAVING A LOSS OF 0.1 AFTER 14 DAYS.
Authors:	MUELLER,JG ET AL. (1991)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000193-39-5
Chemical Name:	INDENO(1,2,3-CD)PYRENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	730;288;139;330
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.51% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	20
Temperature (collect) deg C:	
pH:	8.0
Suspended Solids:	
Remarks:	HALF-LIVES OF 730, 288, 139 AND 330 FOR SYNTHETIC MIXTURE, AS A SINGLE CONSTITUENT, OIL REFINERY WASTE AND 1.0% CREOSOTE, RESPECTIVELY.
Authors:	KECK,J ET AL., (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000193-39-5
Chemical Name:	INDENO(1,2,3-CD)PYRENE
Purity:	98%
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	20;23;30
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	600;730;630
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	240
Test Chemical Concn (ppm):	
Environ Sample Type:	SOIL
Source of Sample:	KAYSVILLE, OH
Soil Type:	SANDY LOAM (KIDMAN)
DOC/Org Content/Add C:	0.5% ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	10;20;30
Temperature (collect) deg C:	
pH:	7.9
Suspended Solids:	
Remarks:	HALF-LIVES FOR INDENO(1,2,3-CD)PYRENE AT 10, 20 AND 30 DEG C WERE 600, 730 AND 630 DAYS, RESPECTIVELY.
Authors:	COOVER,MP & SIMS,RC (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000465-73-6
Chemical Name:	ISODRIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0.4
Rate Units:	% MINERALIZED
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/MSGFPC
Incubation Time (days):	193
Test Chemical Concn (ppm):	
Environ Sample Type:	
Source of Sample:	ROCKY MOUNTAIN ARSENAL SOIL
Soil Type:	
DOC/Org Content/Add C:	0.63% TOC
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	8.1
Suspended Solids:	
Remarks:	IN CONTAMINATED SOIL, 0.4% OF THE RADIOLABELLED ISODRIN WAS MINERALIZED IN 193 DAYS.
Authors:	WILLIAMS,RT ET AL. (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000465-73-6
Chemical Name:	ISODRIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	1.5
Rate Units:	% MINERALIZED
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/MSGFPC
Incubation Time (days):	193
Test Chemical Concn (ppm):	
Environ Sample Type:	
Source of Sample:	ROCKY MOUNTAIN ARSENAL SOIL
Soil Type:	
DOC/Org Content/Add C:	0.12% TOC
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	7.8
Suspended Solids:	
Remarks:	IN UNCONTAMINATED SOIL, 1.5% OF THE RADIOLABELLED ISODRIN WAS MINERALIZED IN 193 DAYS.
Authors:	WILLIAMS,RT ET AL. (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 7439-97-6
Chemical Name: MERCURY
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0.003;0.149;0.020;0.001;0.220;0.025
Rate Units: % HG METHYLATED/G/HOUR
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: 203HG RADIOLABEL
Incubation Time (days): 0.5
Test Chemical Concn (ppm): 0.2
Environ Sample Type: SEDIMENT
Source of Sample: METHYL BAY, SOUTHERN INDIAN LAKE, NW ONTARIO, CANADA
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 10-15
Temperature (collect) deg C: 10-15
pH:
Suspended Solids:
Remarks: FIRST THREE RATES WERE DETERMINED FOR SEDIMENTS COLLECTED ON JULY 19, 1983. THE SECOND THREE RATES WERE FROM SEDIMENTS COLLECTED AUGUST 1, 1983.
Authors: RAMLAL, PS ET AL. (1986)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	7439-97-6
Chemical Name:	MERCURY
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	1.16;1.65;1.27;1.17;2.83;2.46;0.51
Rate Units:	% METHYLATION
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AN-W
Analysis Method:	14C RADIOLABEL
Incubation Time (days):	1
Test Chemical Concn (ppm):	33.3
Environ Sample Type:	SEDIMENT
Source of Sample:	LAKE CLARA, WI
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	23;23;23;23;23;11;5
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	RESULTS REPORTED FOR SURFICIAL SEDIMENTS.
Authors:	KORTHALS,ET & WINFREY,MR (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	7439-97-6
Chemical Name:	MERCURY
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	2390;197;483;367
Rate Units:	PG METHYLMERCURY PRODUCED
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AN;AN;AE;AE
Analysis Method:	
Incubation Time (days):	9
Test Chemical Concn (ppm):	
Environ Sample Type:	SEDIMENT
Source of Sample:	GREAT BAY ESTUARY, CHAPMANS LANDING, NEW HAMPSHIRE
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	28
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	10 NG HG(II) AS HGCL2 WAS ADDED INITIALLY TO SEDIMENT SAMPLES.
Authors:	WEBER,JH ET AL. (1998)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	7439-97-6
Chemical Name:	MERCURY
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	73;75;38;60
Rate Units:	%METHYL MERCURY AS TOTAL EXTRACTABLE MERCURY
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AN;AN;AE;AE
Analysis Method:	203HG RADIOLABEL
Incubation Time (days):	21
Test Chemical Concn (ppm):	0.007
Environ Sample Type:	SEDIMENT
Source of Sample:	LAKE LEVRASJON, SWEDEN
Soil Type:	
DOC/Org Content/Add C:	18% ORGANIC MATTER IN TOP SEDIMENT LAYER
Microbial Population:	
Temperature (incub) deg C:	13.5
Temperature (collect) deg C:	9.5
pH:	8.05-8.30
Suspended Solids:	
Remarks:	EUTROPHIC LAKE.
Authors:	REGNELL,O & TUNLID,A (1991)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000072-43-5
Chemical Name:	METHOXYCHLOR
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0.0019
Rate Units:	PER DAY
Lag Period:	
Half-life (days):	365
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HEXANE + ACETONITRILE EXTRACTION
Incubation Time (days):	29
Test Chemical Concn (ppm):	0.03
Environ Sample Type:	WATER/SEDIMENT
Source of Sample:	
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	25
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	VALUE CORRECTED FOR SORPTION. INITIAL LOSS DUE TO STRONG SORPTION TO SEDIMENT.
Authors:	CRIPE,CR ET AL. (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000072-43-5
Chemical Name: METHOXYCHLOR
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0.00236;0.000139
Rate Units: PER HOUR
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: GC/ECD
Incubation Time (days):
Test Chemical Concn (ppm): 0.2
Environ Sample Type: ESTUARINE WATER;ESTUARINE WATER + SEDIMENT
Source of Sample: SANTA ROSA SOUND, FLORIDA
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 25
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: PH KEPT TO VALUE FOUND IN WATER SAMPLE. RATE CONSTANTS FOR STERILE WATER AND FOR STERILE WATER:SEDIMENT WERE 0.000639/HR AND 0.00000327/HR, RESPECTIVELY.
Authors: WALKER,WW ET AL. (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000072-43-5
Chemical Name:	METHOXYCHLOR
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0.006-0.009;0.008-0.012;0.007-0.011;0.006-0.008
Rate Units:	PER HOUR
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/ECD
Incubation Time (days):	
Test Chemical Concn (ppm):	
Environ Sample Type:	RIVER;POND;POND;POND WATER
Source of Sample:	ATHENS, GA
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	22
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	OCONEE RIVER;HICKORY HILLS POND;MEMORIAL PARK POND;WATER WORKS POND.
Authors:	PARIS,DF & ROGERS,JE (1986)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000072-43-5
Chemical Name:	METHOXYCHLOR
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0.03;0.12;0.60
Rate Units:	% RADIOACTIVE LABEL FOUND AS 14CO2
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	14C RADIOLABEL; GC
Incubation Time (days):	90
Test Chemical Concn (ppm):	10;100;1000
Environ Sample Type:	SOIL
Source of Sample:	
Soil Type:	SANDY LOAM
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	27
Temperature (collect) deg C:	
pH:	6.7
Suspended Solids:	
Remarks:	70% FIELD CAPACITY. RATE IN 100 PPM EXPT PROCEEDED AT A RATE NEARLY 10 TIMES GREATER THAN THE 10 PPM EXPT, WHILE THE 1000 PPM EXPT HAD A RATE ONLY 10-FOLD HIGHER THAN THE 10 PPM EXPT. TOXICITY?
Authors:	FOGEL,S ET AL. (1982)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000072-43-5
Chemical Name: METHOXYCHLOR
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0.09;0.4
Rate Units: % RADIOACTIVE LABEL FOUND AS 14CO2
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: 14C RADIOLABEL; GC
Incubation Time (days): 100;410
Test Chemical Concn (ppm): 1000
Environ Sample Type: SOIL
Source of Sample:
Soil Type: SANDY LOAM
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 27
Temperature (collect) deg C:
pH: 6.7
Suspended Solids:
Remarks: 70% FIELD CAPACITY.
Authors: FOGEL,S ET AL. (1982)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000072-43-5
Chemical Name: METHOXYCHLOR
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 40;37;53;53
Rate Units: % DEGRADATION
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: GC/ECD
Incubation Time (days): 90
Test Chemical Concn (ppm): 30
Environ Sample Type: SOIL
Source of Sample:
Soil Type: MAAHAS CLAY;LUISIANA CLAY;PILA CLAY LOAM;CASIGURAN SANDY LOAM
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 30
Temperature (collect) deg C:
pH: 6.6;4.7;7.6;4.8
Suspended Solids:
Remarks: DEGRADATION MEASURED UNDER UPLAND CONDITIONS.
Authors: CASTRO,TF & YOSHIDA,T (1971)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 016056-34-1
Chemical Name: METHYL MERCURY
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0.014;0.013;0.017;0.018
Rate Units: % HG ADDED/G/HOUR
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AN;AN;AE;AE
Analysis Method: 14C RADIOLABEL
Incubation Time (days): 0.5
Test Chemical Concn (ppm): 0.2
Environ Sample Type: SEDIMENT
Source of Sample: LAKE 239, EXPERIMENTAL LAKES AREA, NW ONTARIO, CANADA
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 10-15
Temperature (collect) deg C: 10-15
pH:
Suspended Solids:
Remarks:
Authors: RAMLAL, PS ET AL. (1986)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 016056-34-1
Chemical Name: METHYL MERCURY
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0.023;0.205;0.124;0.067;0.267;0.184
Rate Units: % HG DEMETHYLATED/G/HOUR
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: 14C RADIOLABEL
Incubation Time (days): 0.5
Test Chemical Concn (ppm): 0.2
Environ Sample Type: SEDIMENT
Source of Sample: METHYL BAY, SOUTHERN INDIAN LAKE, NW ONTARIO, CANADA
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 10-15
Temperature (collect) deg C: 10-15
pH:
Suspended Solids:
Remarks: FIRST THREE RATES WERE DETERMINED FOR SEDIMENTS COLLECTED ON JULY 19, 1983. THE SECOND THREE RATES WERE FROM SEDIMENTS COLLECTED AUGUST 1, 1983.
Authors: RAMLAL, PS ET AL. (1986)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	016056-34-1
Chemical Name:	METHYL MERCURY
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0.43;0.57;1.19;1.57;1.32;0.92;0.73
Rate Units:	% DEMETHYLATION
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	14C RADIOLABEL
Incubation Time (days):	1
Test Chemical Concn (ppm):	33.3
Environ Sample Type:	SEDIMENT
Source of Sample:	LAKE CLARA, WI
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	23;23;23;23;23;11;5
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	RESULTS REPORTED FOR SURFICIAL SEDIMENTS.
Authors:	KORTHALS,ET & WINFREY,MR (1987)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 016056-34-1
Chemical Name: METHYL MERCURY
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 27;11
Rate Units: % MINERALIZATION
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AN;AE
Analysis Method: 14C RADIOLABEL
Incubation Time (days): 27
Test Chemical Concn (ppm):
Environ Sample Type: SEDIMENT
Source of Sample: SEARSVILLE LAKE, CA
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 21
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: SEDIMENT COLLECTED FROM A FRESHWATER LAKE.
Authors: OREMLAND,RS ET AL. (1991)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	016056-34-1
Chemical Name:	METHYL MERCURY
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	35;24;63;38
Rate Units:	% MINERALIZATION
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AN;AN;AE;AE
Analysis Method:	14C RADIOLABEL
Incubation Time (days):	24;21;24;21
Test Chemical Concn (ppm):	
Environ Sample Type:	SEDIMENT
Source of Sample:	SAN FRANCISCO BAY AND MONO LAKE, CA
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	21
Temperature (collect) deg C:	
pH:	
Suspended Solids:	
Remarks:	SEDIMENTS COLLECTED FROM AN ESTUARINE SLAT MARSH AND FROM THE LITTORAL ZONE OF ALKALINE-HYPERSALINE MONO LAKE.
Authors:	OREMLAND,RS ET AL. (1991)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	039001-02-0
Chemical Name:	OCTACHLORODIBENZOFURAN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	0;0;0
Rate Units:	% LOSS
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/MS
Incubation Time (days):	60;270;450
Test Chemical Concn (ppm):	4.8
Environ Sample Type:	
Source of Sample:	
Soil Type:	SANDY LOAM SOIL
DOC/Org Content/Add C:	1.7% ORGANIC MATTER
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	8.1
Suspended Solids:	
Remarks:	NO BIODEGRADATION OF OCTACHLORODIBENZOFURAN WAS SEEN OVER 15 MONTHS IN THIS WATER SATURATED SOIL COLUMN STUDY.
Authors:	ORAZIO,CE ET AL. (1992)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	040487-42-1
Chemical Name:	PENDIMETHALIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	101;77;54;61;73;56
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/ECD
Incubation Time (days):	180
Test Chemical Concn (ppm):	5
Environ Sample Type:	SOIL
Source of Sample:	COLORADO
Soil Type:	CLAY LOAM
DOC/Org Content/Add C:	1.7% ORGANIC MATTER
Microbial Population:	
Temperature (incub) deg C:	10;20;30;35;30;30
Temperature (collect) deg C:	
pH:	8.0
Suspended Solids:	
Remarks:	% FIELD CAPACITY=75;75;75;75;50;100
Authors:	ZIMDAHL,RL ET AL. (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	040487-42-1
Chemical Name:	PENDIMETHALIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	39.3;40.4;33.9;30.8;33.4;34.6
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HPLC
Incubation Time (days):	30
Test Chemical Concn (ppm):	40
Environ Sample Type:	SOIL
Source of Sample:	MARTINIQUE, FRENCH WEST INDIES; MONTPELLIER, FRANCE
Soil Type:	VERTISOL;VERTISOL;FERRALSOL;REGOSOL; ANDOSOL;FLUVISOL
DOC/Org Content/Add C:	2.1;1.3;1.8;2.6;2.4;1.1 % ORGANIC CARBON
Microbial Population:	
Temperature (incub) deg C:	25
Temperature (collect) deg C:	
pH:	5.4;6.95;5.05;6.6;5.0;8.20
Suspended Solids:	
Remarks:	FIVE SOILS FROM MARTINIQUE; ONE SOIL FROM FRANCE.
Authors:	ZHENG,SQ & COOPER,JF (1996)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	040487-42-1
Chemical Name:	PENDIMETHALIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	42;45
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/ECD
Incubation Time (days):	180
Test Chemical Concn (ppm):	5
Environ Sample Type:	SOIL
Source of Sample:	COLORADO
Soil Type:	CLAY;SANDY LOAM
DOC/Org Content/Add C:	1.3;1.3% ORGANIC MATTER
Microbial Population:	
Temperature (incub) deg C:	30;30
Temperature (collect) deg C:	
pH:	7.5;6.4
Suspended Solids:	
Remarks:	% FIELD CAPACITY=75;75
Authors:	ZIMDAHL,RL ET AL. (1984)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	040487-42-1
Chemical Name:	PENDIMETHALIN
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	85;80;61;54;55
Rate Units:	% PENDIMETHALIN REMAINING
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	14C RADIOLABEL
Incubation Time (days):	0;30;60;120;180
Test Chemical Concn (ppm):	25
Environ Sample Type:	SOIL
Source of Sample:	MICHIGAN
Soil Type:	SANDY LOAM
DOC/Org Content/Add C:	3.9% ORGANIC MATTER
Microbial Population:	
Temperature (incub) deg C:	
Temperature (collect) deg C:	
pH:	7.8
Suspended Solids:	
Remarks:	50% FIELD CAPACITY. STERILE SOIL AT 0;1;2;4;6 MONTHS=87;78;73;69;72% PARENT REMAINING.
Authors:	NELSON,JE ET AL. (1983)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000608-93-5
Chemical Name:	PENTACHLOROBENZENE
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	194;345
Test Method:	
Oxygen Condition:	AE
Analysis Method:	GC/ECD
Incubation Time (days):	600
Test Chemical Concn (ppm):	10 KG/HA
Environ Sample Type:	SOIL
Source of Sample:	SJAELLAND, DENMARK
Soil Type:	
DOC/Org Content/Add C:	
Microbial Population:	
Temperature (incub) deg C:	18-20
Temperature (collect) deg C:	
pH:	4.9-7.9
Suspended Solids:	
Remarks:	22 DIFFERENT SOILS. TWO HALF-LIVES REPORTED AS DUPLICATE EXPERIMENTS.
Authors:	BECK,J & HANSEN,KE (1974)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 000079-94-7
Chemical Name: TETRABROMOBISPHENOL A
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 44.7;64.2;60.8
Rate Units: % REMAINING
Lag Period:
Half-life (days): 48;69;84
Test Method:
Oxygen Condition: AE
Analysis Method: 14C RADIOLABEL, HPLC
Incubation Time (days): 56
Test Chemical Concn (ppm): 0.01;0.10;1.0
Environ Sample Type: SEDIMENT
Source of Sample: STROWS FOLLY BROOK
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 25
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks:
Authors: GREAT LAKES CHEMICAL CORPORATION (1989)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000078-00-2
Chemical Name:	TETRAETHYL LEAD
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	
Rate Units:	
Lag Period:	
Half-life (days):	14;7;8 HOURS
Test Method:	
Oxygen Condition:	AE
Analysis Method:	14C RADIOLABEL
Incubation Time (days):	28
Test Chemical Concn (ppm):	25
Environ Sample Type:	SOIL
Source of Sample:	GAINESVILLE, FL
Soil Type:	ARREDONDO FINE SAND
DOC/Org Content/Add C:	11.8;4.7;3.9 G/KG ORGANIC C
Microbial Population:	
Temperature (incub) deg C:	25
Temperature (collect) deg C:	
pH:	5.5;4.6;5.6
Suspended Solids:	
Remarks:	INCUBATED IN DARK. SOIL DEPTH=0-15;15-30;30-45 CM. HALF-LIVES FOR STERILE CONTROLS=12-17 HOURS. HEXANE AND EDTA (FOR IONIC SPECIES) SOIL EXTRACTION.
Authors:	OU,LT ET AL. (1994)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type:	GRAB
CAS Registry No:	000078-00-2
Chemical Name:	TETRAETHYL LEAD
Purity:	
Chemical Characteristics:	
Reliability:	
Study Biodeg Evaluation:	
Rate:	780;600
Rate Units:	UMOL/DAY/KG DRY WEIGHT
Lag Period:	
Half-life (days):	
Test Method:	
Oxygen Condition:	AE
Analysis Method:	HEAT PRODUCTION RATE, MICROCALORIMETRY
Incubation Time (days):	9-10;15
Test Chemical Concn (ppm):	2;10 G LEAD/KG DRY WEIGHT
Environ Sample Type:	SOIL
Source of Sample:	OLDENBURG, GERMANY
Soil Type:	SANDY LOAM
DOC/Org Content/Add C:	2-4% ORGANIC MATTER CONTENT
Microbial Population:	
Temperature (incub) deg C:	25
Temperature (collect) deg C:	
pH:	3.9
Suspended Solids:	
Remarks:	RATE FOR STERILE CONTROLS=50;200 UMOL/DAY/KG DRY WEIGHT (DUE TO CHEMICAL DECOMPOSITION).
Authors:	TEELING,H & CYPIONKA,H (1997)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 001582-09-8
Chemical Name: TRIFLURALIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0.00504;0.00730;0.00621
Rate Units: PER HOUR
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: GC/ECD
Incubation Time (days):
Test Chemical Concn (ppm): 0.2
Environ Sample Type: ESTUARINE WATER + SEDIMENT
Source of Sample: SANTA ROSA SOUND, FL; SANTA ROSA SOUND, FL; DAVIS BAYOU, MS
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 25
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: PH KEPT TO VALUE FOUND IN WATER SAMPLE. RATE CONSTANTS FOR STERILE WATER AND FOR STERILE WATER:SEDIMENT WERE 0.00160;0.00651;0.00476/HR.
Authors: WALKER,WW ET AL. (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 001582-09-8
Chemical Name: TRIFLURALIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 0.0114;0.00827;0.00439
Rate Units: PER HOUR
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: GC/ECD
Incubation Time (days):
Test Chemical Concn (ppm): 0.2
Environ Sample Type: ESTUARINE WATER
Source of Sample: SANTA ROSA SOUND, FL; SANTA ROSA SOUND, FL; DAVIS BAYOU, MS
Soil Type:
DOC/Org Content/Add C:
Microbial Population:
Temperature (incub) deg C: 25
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: PH KEPT TO VALUE FOUND IN WATER SAMPLE. RATE CONSTANTS FOR STERILE WATER AND FOR STERILE WATER WERE 0.00499;0.00712;0.00299/HR.
Authors: WALKER,WW ET AL. (1988)

Table 2. Biodegradation data for TRI chemicals - Grab studies.

Parameter Type: GRAB
CAS Registry No: 001582-09-8
Chemical Name: TRIFLURALIN
Purity:
Chemical Characteristics:
Reliability:
Study Biodeg Evaluation:
Rate: 31
Rate Units: % DEGRADATION
Lag Period:
Half-life (days):
Test Method:
Oxygen Condition: AE
Analysis Method: 14C RADIOLABEL
Incubation Time (days): 210
Test Chemical Concn (ppm):
Environ Sample Type: SOIL
Source of Sample:
Soil Type: MATAPEAKE SANDY LOAM
DOC/Org Content/Add C: 1.5% ORGANIC MATTER
Microbial Population:
Temperature (incub) deg C:
Temperature (collect) deg C:
pH:
Suspended Solids:
Remarks: DEGRADATION PRODUCTS INCLUDE DEALKYLATED AND CYCLIC DERIVATIVES OF TRIFLURALIN.
Authors: KEARNEY,PC ET AL. (1976)