Appendix C, Part 2
Chemical Properties Data

Chemical Summary for . . .

- ETHYLENE GLYCOL
- ETHYLENEDIAMINE TETRAACETIC ACID (EDTA)
- FLUOROBORIC ACID (FLUORIDE)
- FORMALDEHYDE
- FORMIC ACID
- GRAPHITE
- HYDROCHLORIC ACID
- HYDROGEN PEROXIDE
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- ISOPHORONE
- ISOPROPANOL
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- m-NITROBENZENE SULFONIC ACID, SODIUM SALT
- MAGNESIUM CARBONATE
- METHANOL

CHEMICAL SUMMARY FOR ETHYLENE GLYCOL

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper and carbon processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of ethylene glycol are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF ETHYLENE GLYCOL

Characteristic/Property	Data	Reference
CAS No.	107-21-1	
Common Synonyms	1,2-ethanediol, 1,2-dihydroxyethane	CHEMFATE 1995
Molecular Formula	$C_2H_6O_2$	CHEMFATE 1995
Chemical Structure	$HOCH_2CH_2OH$	Budavari et al. 1989
Physical State	slightly viscous liquid	Budavari et al. 1989
Molecular Weight	62.07	Budavari et al. 1989
Melting Point	-13°C	Budavari et al. 1989
Boiling Point	197.6°C at 760 mm Hg	Budavari et al. 1989
Water Solubility	miscible	CHEMFATE 1995
	absorbs twice its weight of water at 100% relative humidity	Budavari et al. 1989
Density	$d^{20/4}$, 1.114	Budavari et al. 1989
Vapor Density (air = 1)	2.14	Verschueren 1983
K_{OC}	4 (calculated)	CHEMFATE 1995
Log K_{OW}	-1.36	CHEMFATE 1995
Vapor Pressure	0.092 mm Hg at 25°C	CHEMFATE 1995
Reactivity	reacts violently with chlorosulfonic acid, sulfuric acid, and oleum	Keith and Walters 1985
Flammability	combustible	Keith and Walters 1985
Flash Point	115°C (open cup)	Budavari et al. 1989
Dissociation Constant	15.1	CHEMFATE 1995
Molecular Diffusivity Constant	no data	
Air Diffusivity Constant	no data	
Henry's Law Constant	6.0×10^{-8} atm-m^3/mole	CHEMFATE 1995
Fish Bioconcentration Factor	10 (*Leucisius idus melanotus*, golden ide)	CHEMFATE 1995
Odor Threshold	odorless	ATSDR 1993a
Conversion Factors	1 ppm = 2.58 mg/m^3 1 mg/m^3 = 0.39 ppm	Verschueren 1983

II. ENVIRONMENTAL FATE

A. Environmental Release

In 1992 as reported to the TRI by certain types of U.S. industries, a total of 17.2 million pounds of ethylene glycol was released to the environment. The total consisted of 10.25 million pounds released to the atmosphere, 6.25 million pounds to ground and surface waters, and 0.7 million pounds to land (TRI92 1994). The major source of ethylene glycol in the environment is the disposal of used antifreeze. The chemical was found in concentrations of <0.05-0.33 mg/m^3 as aerosol and <0.05-10.4 mg/m^3 as vapor in ambient air samples collected above bridges following spray application of a deicing fluid containing 50% ethylene glycol (ATSDR 1993a).

B. Transport

The low Henry's Law Constant and high water solubility indicate that ethylene glycol will not volatilize from surface waters. Based on the calculated K_{OC} the chemical is expected to be highly mobile in soils and can leach into ground waters; however, ethylene glycol is readily biodegraded (ATSDR 1993a; U.S. Air Force 1989a). Removal from the atmosphere in rainfall is possible (ATSDR 1993a).

C. Transformation/Persistence

1. Air — The half-life for reaction of ethylene glycol with hydroxy radicals in the atmosphere is 2.1 days (CHEMFATE 1995). Estimated half-lives for photochemical oxidation range from 24 to 50 hours (ATSDR 1993a).
2. Soil — Several genera of soil microbes have been shown to completely degrade concentrations of 1-3% ethylene glycol within 3 days (ATSDR 1993a). *Clostridium glycolicum*, isolated from mud, degraded the chemical under anaerobic conditions (concentration and time not given) (CHEMFATE 1995).
3. Water — Biodegradation of ethylene glycol has been demonstrated by acclimated and unacclimated microorganisms from a variety of aqueous media (ATSDR 1993; U.S. Air Force 1989a). Complete degradation occurred with activated sewage sludge in approximately 80 hours (CHEMFATE 1995). Several *Mycobacterium* sp. and *Alcaligenes* sp. are capable of utilizing ethylene glycol as a sole carbon source (CHEMFATE 1995). In contrast, the half-life for reaction with hydroxy radicals in aqueous solution has been calculated as 2.84 years (CHEMFATE 1995).
4. Biota — The high water solubility, rapid microbial degradation, and low to moderate bioconcentration factor indicate that ethylene glycol would not be expected to bioaccumulate in aquatic organisms.

CHEMICAL SUMMARY FOR ETHYLENEDIAMINE TETRAACETIC ACID (EDTA)

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of EDTA are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF EDTA

Characteristic/Property	Data	Reference
CAS No.	60-00-4	
Common Synonyms	acetic acid, (ethylenedinitrilo)-tetra-; edetic acid; EDTA; EDTA acid; Trilon BW; Versene	HSDB 1995
Molecular Formula	$C_{10}H_{16}N_{2}0_{8}$	
Chemical Structure		
Physical State	colorless crystals	HSDB 1995
Molecular Weight	292.28	HSDB 1995
Melting Point	decomposes @ 240°C	HSDB 1995
Boiling Point	not found	
Water Solubility	0.5 g/L @ 25°C	Budavari et al. 1989
Density	not found	
Vapor Density (air = 1)	not found	
K_{OC}	not found	
Log K_{OW}	not found	
Vapor Pressure	not found	
Reactivity	chelates di- and tri-valent metals	HSDB 1995
Flammability	may burn, but does not ignite readily	HSDB 1995
Flash Point	not found	
Dissociation Constant	0.26 (measured)	CHEMFATE 1995
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	<2 (bluegill, measured) 19 (@25°C, calculated)	HSDB 1995
Odor Threshold	not found	
Conversion Factors	1 ppm = 11.9 mg/m^3 1 mg/m^3 = 0.084 ppm	Calculated using: mg/m^3 x 24.45/m.w.

II. ENVIRONMENTAL FATE

A. Environmental Release

EDTA does not occur naturally in the environment (HSDB 1995). The main sources of EDTA released to the environment are probably domestic sewage and industrial effluents, resulting from the chelating applications of the chemical (HSDB 1995). Other sources of release of the chemical include the use of herbicides and the land disposal of products that contain EDTA (HSDB 1995).

In 1974 in England, concentrations of EDTA ranging from 0 to 1120 ppb were detected in the Lea River and concentrations ranging from 200 to 1200 ppb were detected in the effluent from the Rye Meads sewage treatment plant (HSDB 1995). In other studies, EDTA concentrations of 100 to 550 ppb were detected in sewage effluents (no other details were available) (Verschueren 1983). Other monitoring data were not found in the secondary sources searched.

B. Transport

Under environmental conditions (pH 5-10), EDTA completely dissociates, as is indicated by pKa_1 = 0.26, pKa_2 = 0.96, pKa_3 = 2.60 and pKa_4 = 2.76 (HSDB 1995). This suggests that volatilization from water or soil would not be significant for EDTA. A study of EDTA degradation in soils detected no volatilization (HSDB 1995).

EDTA and complexes of EDTA with alkaline earth metals and trace metals demonstrate negligible adsorption to silica, humic acid, kaolin, kaolinite (EDTA only), river sediments, and humus solids (HSDB 1995). According to at least one report, EDTA leaches readily in soil (HSDB 1995).

C. Transformation/Persistence

1. Air — EDTA released to the atmosphere may undergo direct photolysis or may react with photochemically-generated hydroxyl radicals (HSDB 1995). The estimated half-life for the reaction of EDTA vapor with photochemically generated hydroxyl radicals in the atmosphere is 3.01 days (HSDB 1995).
2. Soil — EDTA released to the soil is expected to complex with trace metals and alkaline earth metals that occur in the soil, increasing their total solubility (HSDB 1995). Eventually, EDTA may exist predominantly as the Fe(III) chelate in acidic soils and as the Ca chelate in alkaline soils (HSDB 1995).

   Biodegradation is the predominant removal mechanism for EDTA in aerobic soils, whereas biodegradation of the chemical is negligible in anaerobic soils (HSDB 1995). Mineralization values for 2-4 ppm EDTA in various soils range from 13 to 45% after 15 weeks and from 65 to 70% after 45 weeks (HSDB 1995).
3. Water — EDTA released to water is expected to complex with trace metals and alkaline earth metals (HSDB 1995). In water under aerobic conditions, EDTA undergoes biodegradation relatively slowly. As in soil, the anaerobic biodegration of EDTA in water is negligible (HSDB 1995). Possible biodegradation products of the ammonium ferric chelate of EDTA include the following: ethylenediamine triacetic acid (ED3A), iminodiacetic acid (IDA), N,N-ethylenediamine diacetic acid (N,N-EDDA), N,N'-EDDA, ethylenediamine monoacetic acid (EDMA), nitrilotriacetic acid (NTA) and glycine (HSDB 1995).

   In water, EDTA may react with photochemically-generated hydroxyl radicals (half-life, 229 days) or undergo photodegradation. In an aqueous solution, the Fe(III) complex of EDTA degraded with a half-life of 11.3 minutes when exposed to artificial sunlight (HSDB 1995). The following were photodegradation products of Fe(III)-EDTA: carbon monoxide, formaldehyde, ED3A, N,N-EDDA, N,N'-EDDA, IDA, EDMA and glycine (HSDB 1995).
4. Biota — The fish bioconcentration factors for EDTA (<2 and 19) suggest that the chemical will not bioaccumulate in aquatic organisms (HSDB 1995). It is not expected to adsorb to suspended solids or sediments (HSDB 1995).

CHEMICAL SUMMARY FOR FLUOROBORIC ACID (FLUORIDE)

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources. Very little information on the environmental fate and toxicity of fluoroboric acid or fluoroborates was found in the available secondary sources. Supplemental information is provided for fluoride which may be a degradation product and for sodium bifluoride.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of fluoroboric acid are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF FLUOROBORIC ACID

Characteristic/Property	Data	Reference
CAS No.	16872-11-0	HSDB 1995
Common Synonyms	hydrogen tetrafluoroborate fluoboric acid hydrofluoroboric acid	HSDB 1995
Molecular Formula	HBF_4	HSDB 1995
Chemical Structure	$B\text{-}F_4\text{-}H$	Fisher Scientific 1993
Physical State	colorless liquid	HSDB 1995
Molecular Weight	87.82	HSDB 1995
Melting Point	-90°C	Fisher Scientific 1993
Boiling Point	130°C (decomposes)	HSDB 1995
Water Solubility	miscible; sol. in hot water	HSDB 1995
Density	~1.84 g/mL	HSDB 1995
K_{OC}	NA	
Log K_{OW}	NA	
Vapor Pressure	5.1 mm Hg at 20°C	Fisher Scientific 1993
Vapor Density	3.0	Fisher Scientific 1993
Reactivity	strong acid; corrosive	HSDB 1995
Flammability	NA	
Flash Point	NA	
Dissociation Constant (-pK)	-4.9	HSDB 1995
Henry's Law Constant	NA	
Molecular Diffusivity Coefficient	NA	
Air Diffusivity Coefficient	NA	
Fish Bioconcentration Factor	NA	
Odor Threshold	NA	
Conversion Factors	NA	

The chemical identity and physical/chemical properties of sodium tetrafluoroborate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM TETRAFLUOROBORATE

Characteristic/Property	Data	Reference
CAS No.	013755-29-8	Lockheed Martin 1994a
Common Synonyms	sodium fluoroborate STB sodium borfluoride sodium boron tetrafluoride	Lockheed Martin 1994a
Molecular Formula	$NaNF_4$	
Chemical Structure	$Na\text{-}F_4\text{-}B$	
Physical State	white crystalline powder	Sigma-Aldrich 1992
Molecular Weight	109.82	Budavari et al. 1989
Melting Point	384°C	Budavari et al. 1989
Boiling Point		
Water Solubility	108 g/100 mL at 26°C 210 g/100 mL at 100°C	Budavari et al. 1989
Density	2.470	Sigma-Aldrich 1992
K_{OC}	NA	
Log K_{OW}	NA	
Vapor Pressure	NA	
Reactivity	reacts with strong oxidizing agents; sensitive to moisture	Sigma-Aldrich 1992
Flammability	noncombustible	Lockheed Martin 1994a
Flash Point	NA	
Dissociation Constant (-pK)	NA	
Henry's Law Constant	NA	
Molecular Diffusivity Coefficient	NA	
Air Diffusivity Coefficient	NA	
Fish Bioconcentration Factor	NA	
Odor Threshold	NA	
Conversion Factors	NA	

The chemical identity and physical/chemical properties of sodium fluoride are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM FLUORIDE

Characteristic/Property	Data	Reference
CAS No.	7681-49-4	
Common Synonyms	sodium hydrofluoride sodium monfluoride floridine	
Molecular Formula	NaF	
Chemical Structure	Na-F	
Physical State	crystals	Budavari et al. 1989
Molecular Weight	42.00	Budavari et al. 1989
Melting Point	993°C	Budavari et al. 1989
Boiling Point	1704°C	Budavari et al. 1989
Water Solubility	4.0 g/100 mL at 15°C 4.3 g/100 mL at 25°C	Budavari et al. 1989
Density	2.78	Budavari et al. 1989
K_{OC}	NA	
Log K_{OW}	NA	
Vapor Pressure	1 mm Hg at 1077°C	Keith and Walters 1985
Reactivity	stable under normal conditions	Keith and Walters 1985
Flammability	nonflammable	Keith and Walters 1985
Flash Point	NA	
Dissociation Constant (-pK)	NA	
Henry's Law Constant	NA	
Molecular Diffusivity Coefficient	NA	
Air Diffusivity Coefficient	NA	
Fish Bioconcentration Factor	NA	
Odor Threshold	NA	
Conversion Factors	NA	

The chemical identity and physical/chemical properties of sodium bifluoride are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM BIFLUORIDE

Characteristic/Property	Data	Reference
CAS No.	1333-83-1	HSDB 1995
Common Synonyms	sodium hydrogen difluoride sodium hydrogen fluoride sodium acid fluoride	HSDB 1995
Molecular Formula	$NaHF_2$	Lewis 1993
Chemical Structure	F_2-H-Na	HSDB 1995
Physical State	white, crystalline powder	Budavari et al. 1989
Molecular Weight	62.01	Budavari et al. 1989
Melting Point	decomposes on heating	Lewis 1993
Boiling Point	NA	
Water Solubility	soluble in cold and hot water	Lide 1991
Density	2.08	Lewis 1993
K_{OC}	NA	
Log K_{OW}	NA	
Vapor Pressure	NA	
Vapor Density	NA	
Reactivity	aqueous solution corrodes glass	Budavari et al. 1989
Flammability	slightly combustible	Lockheed Martin 1990
Flash Point	NA	
Dissociation Constant (-pK)	NA	
Henry's Law Constant	NA	
Molecular Diffusivity Coefficient	NA	
Air Diffusivity Coefficient	NA	
Fish Bioconcentration Factor	NA	
Odor Threshold	NA	
Conversion Factors	NA	

II. ENVIRONMENTAL FATE

A. Environmental Release

Fluoroboric acid may be released into the environment in emissions and effluents from facilities involved in its manufacture or use. It is used primarily in industrial metal plating solutions (60%), in the synthesis of diazo salts (20%), and in metal finishing (20%) (HSDB 1995). It is used in bright dipping solutions for Sn-Pb alloys in printed circuits and other electrical components (HSDB 1995).

B. Transport

No information was found in the available secondary sources on the environmental transport of fluoroboric acid. Its miscibility with water indicates that transport in aqueous systems is very likely.

C. Transformation/Persistence

FLUOROBORIC ACID:

1. Air — No information was found in the available secondary sources on the transformation and persistence of fluoroboric acid or fluoroborates in the atmosphere.
2. Soil — No information was found in the available secondary sources on the transformation and persistence of fluoroboric acid or fluoroborates in soil. Fluoroboric acid may undergo limited hydrolysis in moist soils (Budavari et al. 1989).
3. Water — Fluoroboric acid undergoes limited hydrolysis in water to form hydroxyfluoroborate ions, the major product is BF_3OH^- (Budavari et al. 1989).
4. Biota — No information was found in the available secondary sources on the biotransformation or bioconcentration of fluoroboric acid or fluoroborates. Rapid urinary excretion of tetrafluoroborates suggests that these salts would not bioaccumulate.

FLUORIDES:

1. Air — Gaseous inorganic fluorides undergo hydrolysis in the atmosphere; however, particulate forms are relatively stable and do not hydrolyze readily (ATSDR 1993b).
2. Soil — Fluorides tend to persist in soils as fluorosilicate complexes under acidic conditions and as calcium fluoride under alkaline conditions. Sandy acidic soils favor the formation of soluble forms (ATSDR 1993b).
3. Water — In dilute solutions and at neutral pH, fluoride is generally present as dissolved fluoride ion. High calcium carbonate levels may lead to precipitation as calcium fluoride (ATSDR 1993b).
4. Biota — Fluorides have been shown to accumulate in some aquatic organisms (ATSDR 1993b). Soluble forms of fluoride are taken up by terrestrial plants and converted into fluoro-organic compounds (ATSDR 1993b).

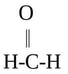
CHEMICAL SUMMARY FOR FORMALDEHYDE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information from these databases or secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of formaldehyde are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF FORMALDEHYDE

Characteristic/Property	Data	Reference
CAS No.	50-00-0	
Common Synonyms	methanal; oxymethane; methyl aldehyde; formalin (solution)	U.S. EPA 1985b
Molecular Formula	CH_2O	
Chemical Structure	 $H-\overset{\overset{O}{\|}}{C}-H$	
Physical State	gas	U.S. EPA 1985b
Molecular Weight	30.03	U.S. EPA 1985b
Melting Point	-118°C	U.S. EPA 1985b
Boiling Point	-19°C @ 1 atm	U.S. EPA 1985b
Water Solubility	$\geq$100 mg/mL @ 20°C	Keith and Walters 1985
Specific Gravity	0.815 @ -20/4°C	Verschueren 1983
Vapor Density (air = 1)	1.03	Verschueren 1983
K_{OC}	$\approx$5 (calculated)	U.S. EPA 1985b
Log K_{OW}	0.00 (calculated)	Verschueren 1983
Vapor Pressure	10 mm Hg @ -88°C 3883 mm Hg @ 25°C	Verschueren 1983 Howard 1989
Reactivity	flammable gas; in solution reacts with acids, bases, metal salts, and NO_2; reducing agent especially in alkali; oxidizes in air to formic acid. Reacts explosively with peroxides and performic acid.	Keith and Walters 1985 Budavari et al. 1989 IARC 1995
Dissociation Constant	No data	
Air Diffusivity Coefficient	No data	
Molecular Diffusivity Coefficient	No data	
Flash Point	50-60°C	Keith and Walters 1985
Henry's Law Constant	1.43×10^{-7} atm-m^3/mole @ 25°C 3.27×10^{-7} atm-m^3/mole @ 25°C	U.S. EPA 1985b Howard 1989
Fish Bioconcentration Factor	0.2 (calculated)	U.S. EPA 1985b
Odor Threshold	perception, 0.07 mg/m^3	Verschueren 1983
Conversion Factors	1 ppm = 1.248 mg/m^3; 1 mg/m^3 = 0.815 ppm	Verschueren 1983

II. ENVIRONMENTAL FATE

A. Environmental Release

Formaldehyde is a colorless gas at room temperature with a characteristic pungent, straw-like odor that becomes suffocating and intolerable at increasing concentrations (U.S. EPA 1985b; Budavari et al. 1989; Verschueren 1983). It is released into the environment from natural and man-made sources. It is a product of combustion and is found in smoke from wood, wood products, and tobacco; gasoline and diesel engine exhaust; and in the effluent from power plants, incinerators, and refineries (Howard 1989). It can also be made indirectly in the atmosphere by the photochemical oxidation of other organic molecules, many of which are also products of combustion (U.S. EPA 1985b; Howard 1989). The contribution of formaldehyde to the atmosphere from this indirect source has been estimated to be twice that from automobiles (U.S. EPA 1985b). Formaldehyde is found in some fruits and vegetables including apples (17.3-22.3 µg/g), green onions (13.3-26.3 µg/g), carrots (6.7-10.0 µg/g), and tomatoes (5.7-7.3 µg/g). It has also been measured in commercial shrimp at 0.39-2.15 mg/kg (U.S. EPA 1985b). Solutions of the gas in water (typically, 37% formaldehyde) are known as formalin and are commonly used as biological preserving agents (U.S. EPA 1985b). Atmospheric levels of formaldehyde have been extensively monitored around the world. Air concentrations range from 0-1 parts-per-billion (ppb) measured off the West coast of Ireland to 24-59 ppb in Los Angeles during a photochemical smog episode (U.S. EPA 1985b). Only 25% of 749 air samples taken from suburban/urban sites across the U.S. were found to contain over 2.7 ppb formaldehyde (U.S. EPA 1985b). Concentrations increase with automobile traffic and during photochemical smog episodes (Howard 1989; U.S. EPA 1985b), and decrease markedly with altitude (U.S. EPA 1985b). Formaldehyde concentrations in indoor air vary with activities involving combustion and materials used in construction. Levels of 33-380 ppb were measured in a test kitchen with a gas stove, concentrations of 0.06-1.83 ppb were measured in homes using urea-formaldehyde particle board, and levels of <0.41-8.2 parts-per-million (ppm) were measured in homes with urea-formaldehyde foam insulation (U.S. EPA 1985b). Higher levels are also measured in areas where formaldehyde solutions (formalin) are used, such as funeral homes (0.35-1.39 ppm), anatomy laboratories (1 ppm, mean), and academic laboratories (1.33-2.48 ppm) (U.S. EPA 1985b). Drinking water supplies were found to be free from formaldehyde contamination in a national survey of suspected carcinogens in drinking water. Formaldehyde was also not found in seawater, and was found in only 1/204 samples at 12 ppb from heavily industrialized river basins in the U.S. It was found in the effluent streams from two chemical plants and one sewage treatment plant (Howard 1989).

In 1992, releases of formaldehyde to environmental media, as reported to the TRI by certain types of U.S. industries, totaled about 16,435,148 pounds. Of this amount, 10,903,227 pounds (66.34%) were released to the atmosphere, 4,916,248 pounds (29.91%) were released in underground injection sites, 441,244 pounds (2.68%) were released to surface water, and 174,429 pounds (1.06%) were released to land (TRI92 1994).

B. Transport

Formaldehyde in solution reacts with water to become hydrated. In this form, it becomes less volatile than water; thus, volatilization from the aquatic environment is not expected to be significant (U.S. EPA 1985b). Formaldehyde is known to leach into the soil, and its high water solubility and calculated soil sorption coefficient (Koc $\approx$5) indicate relatively high mobility, but the actual fate of formaldehyde in the soil is largely unknown (Howard 1989; U.S. EPA 1985b). In the atmosphere, formaldehyde will transfer into rainwater and also adsorb to aerosol particulates (U.S. EPA 1985b). Half-lives of 50 and 19 hours were predicted from a model system for wet and dry deposition, respectively (Howard 1989).

C. Transformation/Persistence

1. Air — Formaldehyde rapidly reacts with free radicals produced by sunlight in the atmosphere. These include primarily hydroxyl radicals and, to a lesser extent, other radicals, especially chlorine and nitrate. A half-life for formaldehyde of about 0.8 days was calculated for the reaction with hydroxyl radicals (U.S. EPA 1985)b. Formaldehyde also undergoes direct photolysis (significant absorption of wavelengths between 290 and 370 nm.). The atmospheric half-life of formaldehyde was calculated to be 0.17 days at sea level with the sun at 30° zenith angle. Calculated for the same conditions, but at an altitude of 10 km, the half-life was reduced to 0.08 days (U.S. EPA 1985b).

2. Soil — No information is available on the fate of formaldehyde in the natural soil environment. However, a number of bacteria and yeasts isolated from soil were able to degrade formaldehyde, suggesting that formaldehyde released to the soil is susceptible to microbial degradation (U.S. EPA 1985b; Howard 1989).
3. Water — Formaldehyde in water is subject to biodegradation. Under aerobic conditions complete degradation was observed in about 30 hours at 20°C utilizing natural water from a lake in Japan and a known amount of formaldehyde. Degradation occurred in about 48 hours under anaerobic conditions. No degradation was seen with sterilized lake water (U.S. EPA 1985b). Activated sludges were shown to be efficient in decomposing formaldehyde in aqueous effluents, and various *Pseudomonas* strains were shown to use formaldehyde as a sole carbon source (U.S. EPA 1985b).
4. Biota — Experiments on fish and shrimp have shown no bioconcentration of formaldehyde. It is a natural metabolic product and not thought to be subject to bioaccumulation (U.S. EPA 1985b).

CHEMICAL SUMMARY FOR FORMIC ACID

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of formic acid are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF FORMIC ACID

Characteristic/Property	Data	Reference
CAS No.	64-18-6	
Common Synonyms	methanoic acid; formylic acid; hydrogen carboxylic acid	HSDB 1995
Molecular Formula	CH_2O_2	Budavari et al. 1989
Chemical Structure	HCOOH	Parmeggiani 1983
Physical State	colorless liquid	Budavari et al. 1989
Molecular Weight	46.02	Budavari et al. 1989
Melting Point	8.4°C	Budavari et al. 1989
Boiling Point	100.5°C	Budavari et al. 1989
Water Solubility	miscible with water	Budavari et al. 1989
Density	1.220 @ 20/4°C	Budavari et al. 1989
Vapor Density (air = 1)	1.59	HSDB 1995
K_{OC}	not estimated due to ionization	CHEMFATE 1995
Log K_{OW}	-0.54	CHEMFATE 1995
Vapor Pressure	42.59 mm Hg at 25°C	CHEMFATE 1995
Reactivity	strong acid in aqueous solution;	ACGIH 1991
	can react as an acid or aldehyde;	NTP 1992
	reacts explosively with strong oxidizing agents	HSDB 1995
Flammability	2 (liquid which must be moderately heated before ignition will occur)	HSDB 1995
Flash Point	68.89°C, open cup	ACGIH 1991
Dissociation Constant	3.7515 @ 25°C	CHEMFATE 1995
Henry's Law Constant	1.67×10^{-7} atm-m^3/mole	CHEMFATE 1995
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	0.22 (calculated)	HSDB 1995
Odor Threshold	10 mg/m^3	Verschueren 1983
Conversion Factors	1 mg/m^3 = 0.52 ppm; 1 ppm = 1.91 mg/m^3	Verschueren 1983

II. ENVIRONMENTAL FATE

A. Environmental Release

Formic acid is a colorless, highly caustic liquid with a pungent odor (Budavari et al. 1989; NTP 1992). It is produced in large quantities (48 million pounds in 1984) and is released to the environment primarily from industrial sources during its production and uses including textile dying and finishing (21% of production); pharmaceuticals (20%); rubber intermediate (16%); leather and tanning treatment (15%); and catalysts (12%). Formic acid is also a component of certain paint strippers and is released in photoprocessing effluents (HSDB 1995). Other sources of formic acid include releases from forest fires, lacquer manufacturing, trash and plastic burning, thermal degradation of polyethylene, and tobacco smoke (NTP 1992). Formic acid also occurs naturally in plants and insects, as a product of microbial degradation of organic matter, and as a product of photooxidation of biogenic and anthropogenic compounds (HSDB 1995). A constituent of ant, wasp, and bee venom, formic acid occurs in mammalian muscle tissue, sweat, and urine (NTP 1992). Formic acid has been measured at concentrations ranging from 4 to 72 ppm in the atmosphere. It has been detected in river and surface water, in unfinished industrial waste water, and in municipal sewage and discharge water at concentrations ranging from 10 to 80,000 μg/L (SRI 1981, as reported in NTP 1992).

B. Transport

Formic acid is soluble in water and would not be expected to adsorb significantly to soil or sediments. Formic acid should leach from some soils into groundwater where it probably would biodegrade. The Henry's Law Constant for formic acid (1.67×10^{-7} atm-m^3/mole) indicates that volatilization from water would not be significant. The potential for bioconcentration is low (HSDB 1995).

C. Transformation/Persistence

1. Air — In the atmosphere, formic acid is rapidly scavenged by rain and dissolved in cloud water and aerosols, reacting with dissolved hydroxyl radicals. In the vapor phase, the acid also reacts with photochemically produced hydroxyl radicals (half-life 34 days) and possibly with alkenes that may be present in urban air (HSDB 1995).
2. Soil — If released on land, formic acid is expected to leach from soils where it would probably biodegrade based on the results of screening studies (HSDB 1995). A field study followed an industrial waste containing 11.4% formic acid that was disposed of by deep well injection as it traveled a distance of 427-823 meters over a 2 to 4-year period. Formic acid was not detected in two observation wells, while a third well contained 0.4%. The disappearance of the acid was attributed to anaerobic degradation or to reaction with mineral material in ground water (HSDB 1995).
3. Water — If released to water, formic acid should biodegrade and not adsorb significantly to sediment (HSDB 1995).
4. Biota — The estimated bioconcentration factor of 0.22 (based on a log/water partition coefficient of -0.54) suggests that formic acid would not bioaccumulate in aquatic organisms (HSDB 1995).

CHEMICAL SUMMARY FOR GRAPHITE

This chemical was identified by one or more suppliers as a bath ingredient for the conductive ink and graphite process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of graphite are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF GRAPHITE

Characteristic/Property	Data	Reference
CAS No.	7782-42-5	
Common Synonyms	plumbago; black lead; mineral carbon	Budavari et al. 1989
Molecular Formula	C	ACGIH 1991
Chemical Structure	C	
Physical State	compact crystalline mass of black or gray color with metallic luster	Pendergrass 1983
Molecular Weight	12	NIOSH 1994
Melting Point	3652-3697°C	Pendergrass 1983
Boiling Point	4200°C	Pendergrass 1983
Water Solubility	insoluble	NIOSH 1994
Density	2.0-2.25	NIOSH 1994
Vapor Density (air = 1)	no data	
K_{OC}	no data	
Log K_{OW}	no data	
Vapor Pressure	0 mm Hg at 68°F	NIOSH 1994
Reactivity	reacts with very strong oxidizers such as fluorine, chlorine trifluoride, and potassium peroxide	NIOSH 1994
Flammability	combustible	NIOSH 1994
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data	
Conversion Factors	not applicable	

II. ENVIRONMENTAL FATE

A. Environmental Release

Graphite exists as a black or gray crystalline mass and occurs naturally in lump, amorphous, and flake forms (Pendergrass 1983). It is found in most parts of the world (Pendergrass 1983) and is usually found with impurities such as quartz, mica, iron oxide, and granite. The crystalline silica content can range from 2% to 25% (ACGIH 1991). Synthetic graphite is produced by heating a mixture of coal or petroleum coke, a binder, and a petroleum-based oil to facilitate extrusion (ACGIH 1991). Although graphite occurs naturally, exposure to graphite is expected to be primarily occupational. No information on the environmental release of graphite was found in the secondary sources searched.

B. Transport

Graphite is insoluble in water (NIOSH 1994) and, therefore, would not be expected to be transported in surface of ground water. No volatilization is expected to occur under natural conditions.

C. Transformation/Persistence

1. Air — Graphite could be present in air as particulate matter which has a settling time of days.
2. Soil — No information on the transformation/persistence of graphite in soil was found in the secondary sources searched.
3. Water — No information on the transformation/persistence of graphite in water was found in the secondary sources searched.
4. Biota — Graphite does not dissociate in water. Although it may be ingested by bottom feeders, it is not expected to accumulate in aquatic organisms..

CHEMICAL SUMMARY FOR HYDROCHLORIC ACID

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, non-formaldehyde electroless copper, organic-palladium, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

Hydrochloric acid is formed when the gaseous and highly soluble hydrogen chloride (HCl) is dissolved in water; hydrochloric acid usually contains 20% HCl (constant boiling acid) or 38% HCl (muriatic acid) (Perry et al. 1994). The chemical identity and physical/chemical properties of hydrochloric acid and/or HCl are summarized below, depending on availability.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF HYDROCHLORIC ACID

Characteristic/Property	Data	Reference
CAS No.	7647-01-0	
Common Synonyms	anhydrous hydrochloric acid; chlorohydric acid; hydrogen chloride; muriatic acid	RTECS 1995
Molecular Formula	HCl	
Chemical Structure	Cl-H	
Physical State	colorless liquid (hydrochloric acid); colorless gas (HCl)	HSDB 1995; WHO 1982
Molecular Weight	36.46	HSDB 1995
Melting Point	—114.8°C @ 1 atm (freezing point, HCl)	WHO 1982
Boiling Point	—84.9 °C @ 1 atm (HCl)	WHO 1982
Water Solubility	56.1 g/100 mL @ 60°C (HCl);	HSDB 1995
	82.3 g/100 mL @ 0°C (HCl)	WHO 1982
pH	0.1 (1.0 N), 1.1 (0.1 N), 2.02 (0.01 N), 3.02 (0.001 N)	HSDB 1995
Density	$1.05^{15/4°C}$ (hydrochloric acid)	HSDB 1995
Vapor Density (air = 1)	1.268 (HCl)	ACGIH 1991
K_{OC}	not found	
Log K_{OW}	not found	
Vapor Pressure	3.54×10^4 mm Hg @ 25°C (hydrochloric acid)	CHEMFATE 1995
Reactivity	hydrochloric acid with formaldehyde may form bis(chloromethyl)ether, a human carcinogen; hydrochloric acid in contact with various metals or metal salts may form flammable gases or may undergo energetic reactions; hydrochloric acid is corrosive to most metals, HCl is not; pressurized container may explode releasing toxic vapors.	HSDB 1995
Flammability	HCl will not burn	HSDB 1995
Flash Point	not found	
Dissociation Constant	not found	
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	0.26-5 ppm; irritating pungent odor	HSDB 1995
Conversion Factors	1 ppm = 1.49 mg/m^3	Calculated using:
	1 mg/m^3 = 0.67 ppm	ppm = mg/m^3 x 24.45/m.w.

II. ENVIRONMENTAL FATE

A. Environmental Release

HCl occurs naturally in gases evolved from many volcanoes. There are apparently no other natural sources of the chemical, but chlorides are present in the minerals halite, sylvite, and carnallite, and in seawater (HSDB 1995).

HCl is released to the environment from its production and various other industrial processes (WHO 1982). Sources of its release include refuse incineration and the secondary metals industry (such as the smelting of scrap, rather than ore) (HSDB 1995). It is also released from the thermodecomposition of gases, as a by-product in the numerous dehydrohalogenation processes in the production of unsaturated compounds from the parent chlorinated hydrocarbon, and from coal-fired power plants (HSDB 1995).

In 1992, environmental releases of hydrochloric acid, as reported to the TRI by certain types of U.S. industries, totaled about 287.3 million pounds, including 207.8 million pounds to underground injection sites, 77.1 million pounds to the atmosphere, 1.9 million pounds to surface water, and 432,770 pounds to land (TRI92 1994). Hydrochloric acid ranks second highest in the TRI for total releases and transfers.

B. Transport

HCl, highly soluble in water, may be removed from the atmospheric environment by wet deposition. This was illustrated by a study in the Netherlands in which the chemical was washed out from the plume of a coal fired power plant (HSDB 1995).

Anhydrous HCl spilled onto the soil undergoes rapid evaporation and is not expected to infiltrate the soil (HSDB 1995). In contrast, hydrochloric acid spilled onto soil will infiltrate and will dissolve some soil materials, particularly those of a carbonate base. A portion of the acid will be neutralized, but significant amounts will remain, available for transport to the ground water table. The presence of water in the soil influences the rate of movement of the chemical (HSDB 1995).

C. Transformation/Persistence

1. Air — No information was found in the secondary sources searched regarding the transformation/persistence of HCl/hydrochloric acid in the atmosphere.
2. Soil — Hydrochloric acid spilled onto soil will infiltrate and will dissolve some soil materials, particularly those of a carbonate base, which will neutralize a portion of the acid (HSDB 1995). Information regarding other potential reactions of hydrochloric acid in the soil was not available in the secondary sources searched.
3. Water — HCl in water dissociates almost completely; the hydrogen ion is captured by the water molecules to form the hydronium ion (HSDB 1995).
4. Biota — No information was found in the secondary sources searched regarding the transformation/persistence of HCl/hydrochloric acid in biota.

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CHEMICAL SUMMARY FOR HYDROGEN PEROXIDE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, non-formaldehyde electroless copper, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of hydrogen peroxide are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF HYDROGEN PEROXIDE

Characteristic/Property	Data	Reference
CAS No.	7722-84-1	
Common Synonyms	hydrogen dioxide; hydroperoxide; albone; hioxyl	Budavari et al. 1989
Molecular Formula	H_2O_2	Budavari et al. 1989
Chemical Structure	H_2O_2	IARC 1985
Physical State	colorless, unstable liquid bitter taste	Budavari et al. 1989
Molecular Weight	34.02	Budavari et al. 1989
Melting Point	–0.43°C	Budavari et al. 1989
Boiling Point	152°C	Budavari et al. 1989
Water Solubility	miscible	Budavari et al. 1989
Density	1.463 @ 0°C	Budavari et al. 1989
Vapor Density (air = 1)	no data	
K_{OC}	no data	
Log K_{OW}	no data	
Vapor Pressure	1.97 mm Hg @ 25° C (measured)	CHEMFATE 1995
Reactivity	strong oxidizer; may decompose violently if traces of impurities are present	Budavari et al. 1989
	molecular additions, substitutions, oxidations, reduction; can form free radicals	IARC 1985
Flammability	not flammable, but can cause spontaneous combustion of flammable materials	HSDB 1995
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	Budavari et al. 1989
Conversion Factors	1 ppm = 1.39 mg/m^3 1 mg/m^3 = 0.72 ppm	IARC 1985
	30% soln 1.1 kg/L anhydrous 1.46 kg/L	Budavari et al. 1989

II. ENVIRONMENTAL FATE

A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of hydrogen peroxide. Solutions of hydrogen peroxide gradually deteriorate (Budavari et al. 1989). Hydrogen peroxide is a naturally occurring substance. Gaseous hydrogen peroxide is recognized to be a key component and product of the earth’s lower atmospheric photochemical reactions, in both clean and polluted atmospheres. Atmospheric hydrogen peroxide is also believed to be generated by gas-phase photochemical reactions in the remote troposphere (IARC 1985)

B. Transport

No information was found in the secondary sources searched regarding the transport of hydrogen peroxide.

C. Transformation/Persistence

1. Air — Hydrogen peroxide may be removed from the atmosphere by photolysis giving rise to hydroxyl radicals, by reaction with hydroxyl radicals, or by heterogenous loss processes such as rain-out (IARC 1985).
2. Soil — No information was found in the secondary sources searched regarding the transformation or persistence of hydrogen peroxide in soil, however, solutions of hydrogen peroxide gradually deteriorate (Budavari et al. 1989).
3. Water — Hydrogen peroxide is a naturally occurring substance. Surface water concentrations of hydrogen peroxide have been found to vary between 51-231 mg/L, increasing both with exposure to sunlight and the presence of dissolved organic matter (IARC 1985).
4. Biota — Hydrogen peroxide is a naturally occurring substance. Endogenous hydrogen peroxide has been found in plant tissues at the following levels (mg/kg frozen weight): potato tubers, 7.6; green tomatoes, 3.5; red tomatoes, 3.5; and castor beans in water, 4.7 (IARC 1985).

CHEMICAL SUMMARY FOR HYDROXYACETIC ACID

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of hydroxyacetic acid summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF HYDROXYACETIC ACID

Characteristic/Property	Data	Reference
CAS No.	79-14-1	
Common Synonyms	glycolic acid; hydroxyethanoic acid	Budavari et al. 1989
Molecular Formula	$C_2H_4O_3$	Budavari et al. 1989
Chemical Structure	$HOCH_2COOH$	Budavari et al. 1989
Physical State	somewhat hygroscopic crystals	Budavari et al. 1989
Molecular Weight	76.05	Budavari et al. 1989
Melting Point	80°C	Budavari et al. 1989
Boiling Point	100°C (decomposes)	HSDB 1995
Water Solubility	soluble	Budavari et al. 1989
Density	1.49 @ 25°C	HSDB 1995
Vapor Density (air = 1)	no data	
K_{OC}	no data	
Log K_{OW}	-1.11	CHEMFATE 1995
Vapor Pressure	8.1 mm Hg @ 80°C	HSDB 1995
Reactivity	incompatible with bases, oxidizing & reducing agents;	Martin Marietta Energy Systems 1994
	pH of aqueous solution, 2.5 (0.5%), 2.33 (1%), 2.16 (2%) 1.91 (5%), 1.73 (10%)	Budavari et al. 1989
Flammability	capable of creating dust explosion	Eastman Kodak Co. 1989
Flash Point	no data	
Dissociation Constant	3.83 (measured)	CHEMFATE 1995
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	Budavari et al. 1989
Conversion Factors	1 mg/m^3 = 0.32 ppm; 1 ppm = 3.11 mg/m^3	Calculated: mg/m^3 = 1 ppm (MW/24.45)

II. ENVIRONMENTAL FATE

A. Environmental Release

Hydroxyacetic acid is a water soluble solid used in the processing of textiles, leather, and metals, in pH control, and wherever an inexpensive organic acid is needed (Budavari et al. 1989). The chemical can be found in spent sulfite liquor from pulp processing and occurs naturally in sugar cane syrup (HSDB 1995). Hydroxyacetic acid has been detected in the Gulf of Main at concentrations of 0-78 μg/L; in water samples collected at a 3 meter depth in the Belgian zone of the North Sea; in the eastern parts of the English Channel at concentrations ranging from 0.9 to 3.1 μmol/L; and in five Madison, Wisconsin, Lakes and in Falkland Islands waters as a product of algal photosynthesis (CHEMFATE 1995).

B. Transport

No information on the transport of hydroxyacetic acid was found in the secondary sources searched. Hydroxyacetic acid is soluble in water and would be expected to leach through soil. The vapor pressure of 8.1 mm Hg @ 80°C indicates that the chemical is moderately volatile and, therefore, may volatilize to some extent from soils and water. However, a Henry's Law Constant is not available and it is stated that the chemical is water soluble. Hence, even though the vapor pressure is relatively high, volatilization from water may be negligible due to its high water solubility.

C. Transformation/Persistence

1. Air — No information on the transformation/persistence of hydroxyacetic acid in air was found in the secondary sources searched.
2. Soil — The chemical was not biodegraded by 10 strains of *Arthobacter globiformis* and slowly degraded by *Alcalignes* sp. (CHEMFATE 1995).
3. Water — Stream and groundwater bacteria degraded the chemical with half-lives of 73 days and 4.5 days, respectively (CHEMFATE 1995).
4. Biota — The low log octanol-water coefficient (-1.11) suggests that hydroxyacetic acid would not bioaccumulate.

CHEMICAL SUMMARY FOR ISOPHORONE

This chemical was identified by one or more suppliers as a bath ingredient for the conductive ink process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of isophorone are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF ISOPHORONE

Characteristic/Property	Data	Reference
CAS No.	78-59-1	
Common Synonyms	Isoacetophorone	NIOSH 1994
	3,5,5-Trimethyl-2-cyclo-hexenone	
	Isoforon	ATSDR 1989
Molecular Formula	$C_9H_{14}O$	
Chemical Structure		Howard 1990
Physical State	Clear liquid	Budavari et al. 1996
Molecular Weight	138.21	Budavari et al. 1996
Freezing Point	-8.1°C	ATSDR 1989
Boiling Point	215.3°C	ATSDR 1989
Water Solubility	12 g/L (20°C)	Howard 1990
	14.5 g/L (25°C)	ATSDR 1989
Specific Gravity	0.9229 (20/20°C	Keith and Walters 1985
Density	0.923 mg/L (20°C)	Keith and Walters 1985
Vapor Density (air = 1)	4.77	Verschueren 1996
Max vapor Conc.	340 ppm (20°C)	Topping et al. 1994
K_{OC}	25; 384	Howard 1990
Log K_{OW}	1.67 (20°C)	ATSDR 1989
	2.22 (est.)	Howard 1990
Vapor Pressure	0.3 mm Hg (20°C)	Budavari et al. 1996
	0.438 mm Hg (25°C)	CHEMFATE 1996
Reactivity	Incompatible with	HSDB 1996
	strong oxidizers	Keith and Walters 1985
Flammability Limits	0.8-3.5 vol %	ATSDR 1989
Flash Point (open cup)	84°C	Budavari et al. 1996
Henry's Law Constant	5.8×10^{-6} atm-m^3/mol (20°C)	Howard 1990
Molecular Diffusivity Coefficient	No data	
Air Diffusivity Coefficient	No data	
Fish Bioconcentration Factor	7 (bluegill)	Verschueren 1996
Odor Threshold - air	0.20 (v/v)	ATSDR 1989
Conversion Factors	1 ppm = 5.74 mg/m^3	NIOSH 1994
	1 mg/m^3 = 0.17 ppm	

II. ENVIRONMENTAL FATE

A. Environmental Release

Isophorone is not listed on the TRI (TRI93 1995). Information on the amounts released into various environmental media was not found in the available secondary sources.

B. Transport

If released to soil or water, isophorone may be transported to air by volatilization (Howard 1990). Based on a Henrys Law Constant of 5.8×10^{-6} atm-m^3/mol, the half-life from a model river 1 m deep and flowing 1 m/sec was estimated to be about 7.5 days (Howard 1990). Isophorone is not expected to be adsorbed to suspended solids or sediments. K_{oc} values of 25 and 384 have been estimated for isophorone from data on water solubility (12 g/L at 20°C) and K_{ow} (log K_{ow} = 1.67 at 20°C), indicating that leaching through soils to ground water is possible (Howard 1990). Based on its vapor pressure of 0.3 mm Hg, isophorone is expected to exist in the air primarily in the vapor phase (Howard 1990). Isophorone emitted to the atmosphere in particulate form may be removed by wet or dry deposition (Howard 1990).

C. Transformation/Persistence

1. Air — The major degradation pathway for isophorone in air is expected to be by reaction with ozone, with a estimated half-life of 39 min (Howard 1990). Reaction with photochemically generated hydroxyl radicals is not expected to be as significant (half-life 3 hr) (Howard 1990). Overall half-life in air has been estimated to be 32 min (Howard 1990).
2. Soil — The potential exists for transport of isophorone to ground water by leaching through soil (Howard 1990). Biodegradation is a likely degradation pathway in soils.
3. Water — Isophorone is not expected to be adsorbed to suspended solids or sediments, or to be photolyzed, oxidized by reaction with singlet oxygen, oxidized by alkylperoxy radicals or undergo chemical hydrolysis (Howard 1990). Isophorone may undergo biodegradation in water (Howard 1990).
4. Biota — Isophorone is not expected to bioaccumulate (Howard 1990). A bioconcentration factor of 7 was reported for bluegill sunfish (Howard 1990). The half-life of isophorone in fish tissue was estimated to be 1 day, indicating a low potential for bioaccumulation (Howard 1990)

CHEMICAL SUMMARY FOR ISOPROPANOL

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, non-formaldehyde electroless copper, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of isopropanol are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF ISOPROPANOL

Characteristic/Property	Data	Reference
CAS No.	67-63-0	
Common Synonyms	isopropyl alcohol; 2-propanol; dimethyl carbinol	U.S. EPA 1989
Molecular Formula	C_3H_8O	IARC 1977
Chemical Structure	CH_3-CHOH-CH_3	IARC 1977
Physical State	colorless liquid	IARC 1977
Molecular Weight	60.09	Budavari et al. 1989
Melting Point	-88.5°C	Budavari et al. 1989
Boiling Point	82.5°C at 760 mm Hg	Budavari et al. 1989
Water Solubility	> 10%	Weast 1985
Density	0.78505 g/mL	Budavari et al. 1989
Vapor Density (air = 1)	2.08	HSDB 1995
K_{OC}	25	CHEMFATE 1995
Log K_{OW}	0.05	CHEMFATE 1995
Vapor Pressure	32.4 mm Hg at 20°C 44 mm Hg at 25°C	IARC 1977 Rowe and McCollister 1982
Reactivity	attacks some forms of plastic, rubber, and coatings.	HSDB 1995
Flammability	flammable/combustible	HSDB 1995
UV Absorption Coefficient	2.79 (mole-cm)$^{-1}$ at 181 nm	CHEMFATE 1995
Flash Point	11.7°C (closed cup) 18.3°C (open cup)	ACGIH 1991
Dissociation Constant	17.1 (pK_a)	CHEMFATE 1995
Henry's Law Constant	7.89×10^{-6} atm m^3/mole	CHEMFATE 1995
Molecular Diffusivity Coefficient	NA	
Air Diffusivity Coefficient	NA	
Fish Bioconcentration Factor	-0.19	CHEMFATE 1995
Odor Threshold	22 and 40 ppm	Lington and Bevan 1994
Conversion Factors	1 ppm = 2.50 mg/m^3 1 mg/m^3 = 0.4 ppm	NIOSH 1994

II. ENVIRONMENTAL FATE

A. Environmental Release

Isopropanol is released into the environment in emissions from chemical manufacturing plants and as a result of its use in consumer products such as a rubbing alcohol, cosmetics, and antifreezes (HSDB 1995). The chemical is also released as a natural volatile from vegetation, nuts, and milk products, and as a result of microbial degradation of animal wastes (HSDB 1995).

Of the total 1,357,992 pounds of isopropanol released to the environment in 1993, as reported to the TRI by certain types of U.S. industries, 1,357,242 pounds were released to the atmosphere and 750 pounds were released onto land; no releases were reported for surface waters or underground injection sites (TRI93 1995).

B. Transport

Following releases onto land, isopropanol is likely to volatilize into the atmosphere due to its high vapor pressure (32.4 mm Hg at 20°C). Transport through soil to groundwater is also possible considering the chemical's water solubility (>10%) and low K_{oc} value (25). When released into water, isopropanol will slowly volatilize into the atmosphere (Henry's law constant 7.89×10^{-6} atm m^3/mole); the estimated half-life for volatilization from water 1 m deep with a 1 m/sec current and a 3 m/sec wind speed is 3.6 days (Mackay et al. 1992). Because of its miscibility with water and its low potential for adsorption to sediments, downstream transport is also possible (HSDB 1995). Transport through the atmosphere may be limited by photodegradation and removal in precipitation (HSDB 1995).

C. Transformation/Persistence

1. Air — Isopropanol exhibited a low level of reactivity when tested in a smog chamber; a 20% decrease in concentration occurred in 5 hr and 250-255 min was required for maximum NO_x production (CHEMFATE 1995). The rate constant for its reaction with OH radicals is 0.547E-11, and that for reaction with O(3P) radicals is 0.22E-12 (CHEMFATE 1995). Photo-oxidation half-lives of 6.2-72 hr (based on rate of disappearance of the hydrocarbon) and 6.2-72 hr (based on the OH reaction rate constant) have been reported (Mackay et al. 1992).
2. Soil — A half-life of 24-168 hr was calculated from an estimate of the biodegradation half-life under unacclimated aerobic aqueous conditions (Mackay et al. 1992).
3. Water — Reaction of isopropanol with hydroxyl radicals in water is slow; half-lives of 1.09 yr (CHEMFATE 1995) and 197 days to 22 yr (Mackay et al. 1992) have been estimated. Based on an estimate of the unacclimated aerobic aqueous biodegradation rate, the half-lives of isopropanol in surface and groundwater were estimated to be 26-168 hr and 48-336 hr, respectively (Mackay et al. 1992).
4. Biota — Isopropanol is subject to biodegradation in activated sludge systems (CHEMFATE 1995). Microbial species including Arthrobacter sp., Achromobacter sp., and Alcaligenes faecalis have been shown to be capable of degrading isopropanol (CHEMFATE 1995). The low log K_{ow} value of 0.05 for isopropanol indicates that bioconcentration and bioaccumulation are not likely to be important environmental fate processes (HSDB 1995).

CHEMICAL SUMMARY FOR LITHIUM HYDROXIDE

This chemical was identified by one or more suppliers as a bath ingredient for the tin-palladium process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of lithium hydroxide are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF LITHIUM HYDROXIDE

Characteristic/Property	Data	Reference
CAS No.	1310-66-3	
Common Synonyms	lithium hydroxide hydrate lithium hydroxide, monohydrate	Sigma 1992
Molecular Formula	$LiOH \cdot H_2O$	
Chemical Structure	$LiOH \cdot H_2O$	
Physical State	white crystals	Sigma 1992
Molecular Weight	41.96	Beliles 1994a
Melting Point	470°C	Lewis 1993
Boiling Point	924°C (decomposes)	Lewis 1993
Water Solubility	223 g/L at 10°C	Beliles 1994a
Density	1.51	Beliles 1994a
Vapor Density (air = 1)	no data	
K_{OC}	no data	
Log K_{OW}	no data	
Vapor Pressure	no data	
Reactivity	incompatible with strong oxidizing agents and strong acids; binds CO_2	Sigma 1992
Flammability	no data; emits toxic fumes under fire conditions	Sigma 1992
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data	
Conversion Factors	not applicable	

II. ENVIRONMENTAL FATE

A. Environmental Release

For the production of lithium hydroxide, lithium ore is heated with limestone to about 1000°C; water leaching of the kiln product yields lithium hydroxide. Lithium hydroxide is used as a CO_2 absorbent in space vehicles and submarines, as a storage battery electrolyte, in lubricating greases, and in ceramics (Beliles 1994a).

Releases of lithium to the environment are most likely in the form of inorganic salts or oxides (Beliles 1994a). Lithium hydroxide is not listed on the EPA's TRI, requiring certain U.S. industries to report on chemical releases to the environment (TRI93 1995).

B. Transport

No information was found in the secondary sources searched regarding the transport of lithium hydroxide through the environment. Lithium occurs naturally in certain minerals and lithium compounds are found in natural waters and some foods (Beliles 1994a).

C. Transformation/Persistence

No information was found in the secondary sources searched regarding the transformation/persistence of lithium hydroxide in air, water, soil, or biota.

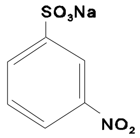
CHEMICAL SUMMARY FOR m-NITROBENZENE SULFONIC ACID, SODIUM SALT

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of m-nitrobenzene sulfonic acid, sodium salt, are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF m-NITROBENZENE SULFONIC ACID, SODIUM SALT

Characteristic/Property	Data	Reference
CAS No.	127-68-4	
Common Synonyms	sodium 3-nitrobenzenesulfonate; ludigol; nacan	HSDB 1995
Molecular Formula	$C_6H_5NO_5S.Na$	HSDB 1995
	Chemical Structure 	
Physical State	white to light	
yellow solid	Sigma-Aldrich 1993	
Molecular Weight	225.16	HSDB 1995
Melting Point	no data	
Boiling Point	no data	
Water Solubility	no data	
Density	no data	
Vapor Density (air = 1)	no data	
K_{OC}	no data	
Log K_{OW}	–2.61	Greim et al. 1994
Vapor Pressure	no data	
Reactivity	incompatible with strong oxidizers, brass, cadmium, copper, nickel	Sigma-Aldrich 1993
Flammability	no data	
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data	
Conversion Factors	no data	

II. ENVIRONMENTAL FATE

A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of nitrobenzene sulfonic acid, sodium salt.

B. Transport

No information was found in the secondary sources searched regarding the transport of nitrobenzene sulfonic acid, sodium salt.

C. Transformation/Persistence

1. Air — No information was found in the secondary sources searched regarding the transformation/persistence of nitrobenzene sulfonic acid, sodium salt, in air.
2. Soil — No information was found in the secondary sources searched regarding the transformation/persistence of nitrobenzene sulfonic acid, sodium salt, in soil.
3. Water — The biodegradability of nitrobenzene sulfonic acid, sodium salt, is greater than 70 % in the Zahn-Wellens or coupled-unit test (Greim et al. 1994).
4. Biota — The Log P_{ow} (equivalent to a log K_{ow}) for nitrobenzene sulfonic acid, sodium salt, is –2.61; therefore, no significant bioaccumulation is expected (Greim et al. 1994).

CHEMICAL SUMMARY FOR MAGNESIUM CARBONATE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of magnesium carbonate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF MAGNESIUM CARBONATE

Characteristic/Property	Data	Reference
CAS No.	546-93-0	
Common Synonyms	magnesite	ACGIH 1991
	carbonic acid, magnesium salt (1:1)	HSDB 1995
Molecular Formula	$MgCO_3$	ACGIH 1991
Chemical Structure	$MgCO_3$	ACGIH 1991
Physical State	white, yellowish, grayish-white, or brown crystalline solid	ACGIH 1991
Molecular Weight	84.33	ACGIH 1991
Melting Point	decomposes @ 350° C	Beliles 1994b
Boiling Point	900° C	ACGIH 1991
Water Solubility	106 mg/L @ 20° C	ACGIH 1991
Density	2.958	ACGIH 1991
Vapor Density (air = 1)	no data	
K_{OC}	no data	
Log K_{OW}	no data	
Vapor Pressure	no data	
Reactivity	readily reacts with acids	HSDB 1995
	liberates CO_2	Beliles 1994b
Flammability	no data	
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless, but readily absorbs odors	HSDB 1995
Conversion Factors	not applicable	

II. ENVIRONMENTAL FATE

A. Environmental Release

Magnesium carbonate occurs naturally as magnesite (HSDB 1995). The “cold” operations in the magnesite industry, mining and processing of raw material and clinker, and brick preparation, are characterized by a high dust content in the working environment with only insignificant amounts of solid particles escaping into the atmosphere (Reichrtova and Takac 1992). Magnesium carbonate is not one of the chemicals reported to the TRI by certain types of U.S. industries.

B. Transport

No specific information was found in the secondary sources searched regarding the transport of magnesium carbonate. It is, however, moderately soluble in water and would be expected to move through the environment.

C. Transformation/Persistence

1. Air — No information was found in the secondary sources searched regarding the transformation/persistence of magnesium carbonate in air. It is, however, moderately soluble in water and would be expected to deposited in rainwater.
2. Soil — No information was found in the secondary sources searched regarding the transformation/persistence of magnesium carbonate in soil.
3. Water — Magnesite occurs in seawater, seawater bitterns, and well brines. In fresh water, dissolved magnesium salts (along with calcium salts) are responsible for the hardness of water (Beliles 1994b). Magnesium carbonates comprise a significant fraction of the sediments of selected lakes and streams studied in the upper Qu'Appelle River basin in southern Saskatchewan, Canada (Oscarson et al. 1981).
4. Biota — No specific information was found in the secondary sources searched regarding the transformation/persistence of magnesium carbonate in biota.

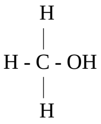
CHEMICAL SUMMARY FOR METHANOL

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper and conductive ink processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical and chemical properties of methanol are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF METHANOL

Characteristic/Property	Data	Reference
CAS No.	67-56-1	
Common Synonyms	methyl alcohol, carbinol, wood spirit, wood alcohol	Budavari et al. 1989
Molecular Formula	CH_4O	Budavari et al. 1989
Chemical Structure	 $H-\overset{H}{\underset{H}{C}}-OH$	
Physical State	colorless liquid	Verschueren 1983
Molecular Weight	32.04	Budavari et al. 1989
Melting Point	-97.8°C	Budavari et al. 1989
Boiling Point	64.7°C at 760 mm Hg	Budavari et al. 1989
Water Solubility	miscible	Budavari et al. 1989
Density	$d^{20/4}$, 0.7915 g/mL	Budavari et al. 1989
Vapor Density (air = 1)	1.11	Budavari et al. 1989
K_{OC}	9	CHEMFATE 1995
Log K_{OW}	-0.77	CHEMFATE 1995
Vapor Pressure	126 mm Hg at 25°C	CHEMFATE 1995
Flammability	flammable	Budavari et al. 1989
Reactivity	may explode when exposed to flame	HSDB 1995
Dissociation Constant	15.3	CHEMFATE 1995
Flash Point	12°C	Budavari et al. 1989
Henry's Law Constant	4.55×10^{-6} atm·m^3/mol	CHEMFATE 1995
Bioconcentration Factor	0.2 (estimated)	HSDB 1995
Molecular diffusivity coefficient	no data	
Air diffusivity coefficient	no data	
Odor Threshold	100 ppm	Lington and Bevan 1994
Conversion Factors	1 ppm = 1.33 mg/m^3 1 mg/m^3 = 0.764 ppm	Verschueren 1983

II. ENVIRONMENTAL FATE

A. Environmental Release

Methanol ranked third in the U.S. among all chemicals for total releases into the environment in 1992. Of the total released, 195 million pounds were into the atmosphere, 43.5 million pounds were into surface and ground waters, and 3.3 million pounds were onto land (TRI92 1994). Methanol detected in the air from Point Barrow, Alaska averaged 0.77 ppb (CHEMFATE 1995). Ambient concentrations from Stockholm, Sweden, ranged from 3.83 to 26.7 ppb while concentrations from two remote locations in Arizona were 7.9 and 2.6 ppb (HSDB 1995). In one survey, methanol was detected in drinking waters from 6 of 10 U.S. cities (HSDB 1995) but levels were not included. The chemical has also been detected at a level of 22 ppb in rainwater collected from Santa Rita, Arizona (HSDB 1995).

B. Transport

The miscibility of methanol in water and a low K_{OC} of 9 indicate that the chemical will be highly mobile in soil (HSDB 1995). Volatilization half-lives from a model river and an environmental pond were estimated at 4.8 days and 51.7 days, respectively (HSDB 1995). Methanol can be removed from the atmosphere in rain water (HSDB 1995).

C. Transformation/Persistence

1. Air — Once in the atmosphere, methanol exists in the vapor phase with a half life of 17.8 days (HSDB 1995). The chemical reacts with photochemically produced hydroxyl radicals to produce formaldehyde (HSDB 1995). Methanol can also react with nitrogen dioxide in polluted air to form methyl nitrite (HSDB 1995).
2. Soil — Biodegradation is the major route of removal of methanol from soils. Several species of Methylobacterium and Methylomonas isolated from soils are capable of utilizing methanol as a sole carbon source (CHEMFATE 1995).
3. Water — Most methanol is removed from water by biodegradation. The anaerobic degradation products methane and carbon dioxide were detected from aqueous cultures of mixed bacteria isolated from sewage sludge (CHEMFATE 1995). Aerobic, gram-negative bacteria (65 strains) isolated from seawater, sand, mud, and weeds of marine origin utilized methanol as a sole carbon source (CHEMFATE 1995). Aquatic hydrolysis, oxidation, and photolysis are not significant fate processes for methanol (HSDB 1995).
4. Biota — Bioaccumulation of methanol in aquatic organisms is not expected to be significant based on an estimated bioconcentration factor of 0.2 (HSDB 1995).